A Survey of the Freshwater Snails of the Prairie Pothole Region of South Dakota

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Table of Contents

Report

Abstract 1
Introduction 2
Materials and Methods 3
Results 4
Discussion 5
Literature Cited 7
Table 1. Species of snail found at each collection site 9
Table 2. Physical and chemical collection site analysis 10
Figure 1. Survey sites within South Dakota 11
Figure 2. Distribution of *Lymnaea stagnalis*. 12
Figure 3. Distribution of *Stagnicola elodes* 13
Figure 4. Distribution of *Stagnicola caperata* 14
Figure 5. Distribution of *Fossaria obrussa* 15
Figure 6. Distribution of *Aplexa elongata* 16
Figure 7. Distribution of *Physa gyrina* 17
Figure 8. Distribution of *Physa acuta* 18
Figure 9. Distribution of *Helisoma trivolvis* 19
Figure 10. Distribution of G*yraulus deflectus* 20
Figure 11. Distribution of *Promenetus exacuous* 21

Appendix A

A short identification guide to snails in this survey 22
Photograph of ten species 30

Appendix B

Specific site location table 31

ABSTRACT

A survey of aquatic snails was performed in the Prairie Pothole (Prairie Coteau) region of Northeastern South Dakota in the spring and fall of 2005. Shallow water areas of 33 aquatic habitats were sampled. Snails were found by visual examination of the bottom substrate, vegetation and shallow water structures. Shoreline waters and structures were then swept with small hand nets and finally with larger dip nets. Live snails were found at 30 of the 33 sites with shells or subfossils providing evidence of snail habitation in the remaining three sites. Ten species of pulmonate snail in three families were discovered and collected for a total of 112 records. Chemical and physical data including Calcium levels, pH, and bottom substrate were recorded for each collection site. This region has not previously been surveyed for aquatic snails and thus this study provides the first look at their diversity in the region.

INTRODUCTION

The freshwater gastropod fauna of South Dakota have not been well studied and thus little is known about the diversity and distribution of these snails. In North America in general freshwater gastropods comprise more than 500 species in 15 families (Burch, 1988; Burch& Tottenham, 1980). At least seven of these families: Viviparidae, Hydrobiidae, Valvatidae, Lymnaeidae, Physidae, Planorbidae and Ancylidae have distributions that encompass South Dakota. The number of individual species present has not been determined. An online resource (Natureserve, 2005) makes an attempt to establish the species present and has 22 species of freshwater snail listed for South Dakota. It should be noted, however, that this online source lacks references for its distribution data.

Snails are an important food source for fishes and are eaten in abundance by waterfowl (Swanson & Duebbert, 1989). Snails act as primary consumers eating diatoms, algae and plants and thus are important aspects of aquatic primary production. Many snails are also non-specific feeders acting as detritivores (Dillon, 2000). Snails host a variety of parasites including the trematode responsible for "duck-ich" (Dillon, 2000). Though snails are important aspects of freshwater ecology reliable up to date data concerning the distribution of freshwater snails is absent for most of North America and South Dakota in particular. Absence of data on freshwater mollusk species is of great conservation concern since world wide non-marine mollusks may be one of the most threatened groups of organisms (Lydeard et al, 2004). The Prairie Pothole region contains good conditions for waterfowl nesting and migration routes and thus faces conservation issues with respect to bird fauna. This area should also provide good habitat for freshwater snails and should house a high diversity of snail species.

The US Environmental Protection Agency has produced a system of ecoregion designations (EPA, 2005) derived from the map by Bailey (1976) and subsequent works (see Omerik, 1987, 1995 and Gallant et al, 1989). The Prairie Pothole region is designated Northern Glaciated Plains at level III and the more specific level IV designation is Prairie Coteau. This region has no network of streams for drainage and a high concentration of lakes and wetlands. Generally the wetlands are alkaline and thus are categorized as fens. Low-lands to the west are drained by the James River and the Big Sioux Basin ecoregion is a well drained depression that divides the southern and central portions of the Prairie Coteau. The geology of the Coteau is glacial till over Cretaceous shale. Mean precipitation is 53 cm a year.

The purpose of this study was to collect information on the distribution of freshwater snails of the South Dakota Prairie Pothole region. The survey actually accomplished several related goals. First was to provide baseline data for the State and the Prairie Pothole region specifically regarding the presence of the freshwater snails species. A second goal was to assess whether the region shows the presence of any invasive (exotic) species of snail, specifically several species known to be in adjacent states such as the New Zealand Mud Snail *Potomopyrgus antipodarum* and the Red-rimmed Melania *Melanoides tuberculata* (Kerns at al, 2005; MSU, 2005))

MATERIALS AND METHODS

This survey consisted of 33 sites throughout the Prairie pothole region. The survey took place during two periods. Early sampling began in May and was done periodically through June until all sites had been chosen and sampled. A second survey was done in September on the same 33 sites. This scheduling was done in order to examine each site during different seasons. Specific latitude and longitude locality was recorded using a Magellan® Meridian® Gold GPS unit.

Shallow water areas of each water body were sampled. Snails were found by visual examination of shorelines, bottom substrate, vegetation, detritus and shallow water structures. Shoreline waters and structures (particularly grasses) were then swept with small hand nets and finally with larger dip nets. Live specimens and shells were collected. Sorting and Identification of specimens was done after returning from the field. Shells were housed in jars while live specimens were preserved in 95% ethanol before storage.

Water Analysis

Some chemical and physical analyses were done for each waterbody sampled, these included Calcium (as $CaCO_3$), pH, water body size, bottom substrate and shallow water vegetation present.

Chemical Analyses

Calcium levels (as $CaCO_3$) were determined using a broad range (50-500ppm) colorimetric titration kit: (Ward's® Snap test Instant Water quality test kit field). The pH level was determined using Extech Instruments Exstik PH100 pH meter.

Visual Examination

Water body size was estimated visually and placed into one of four categories: Very Small (<0.01 ha), Small (<0.5 ha), Medium (0.5-5 ha), Large (>5 ha). Substrate was recorded as organic mud, sand or small stone. Shallow water vegetation; grasses, cattails or none, was also recorded.

Population Estimates

The dominant snail species present was determined by count of collected snails. Overall snail density, not divided by species, was estimated using a single one-meter quadrate.

Statistical Analysis

ANOVA were performed comparing species richness to water body size, water body type, bottom substrate, pH, Calcium levels and shallow water vegetation. Individual snail species distributions were compared via contingency tables to the same parameters. Significance was set at a P value of 0.05. All statistical analyses were performed using Statview 5.01 (SAS, 1998).

RESULTS

Ten species of pulmonate snail in three families were discovered and collected for a total of 112 records. The three families were Lymnaeidae (with 4 species), Physidae (3 species), and Planorbidae (3 species). Table 1 shows the distribution of the ten species among the 33 collection sites.

Figure 1 is a map showing the 33 collection sites. Figures 2-11 are maps showing the distribution of each species collected. A brief summary of identification information on each species found is provided in Appendix A.

Table 2 displays county location, species diversity and density as well as physical and chemical data for each collection site. Appendix B shows more specific locality information including latitude and longitude. Calcium range (as $CaCO_3$) in the wetlands ranged from 65-200 mg/L. The range of pH values was 7.1-9.0. Common shallow water vegetation was cattails and grasses. Water bodies ranges in size from small roadside ditches less than 0.01 ha to large lakes. Six of the wetlands were determined to be temporary (completely dry when visited in the fall).

The most common species was *Stagnicola elodes* found at 26 sites. The next most common species was *Physa gyrina* found at 25 sites. *Stagnicola elodes* was also the most abundant snail found, being the dominant species at 11 sites. The least common species were *Fossaria obrussa* and *Physa acuta* each found at only 3 sites.

The most diverse sites as far as species richness were sites 17 and 26 with 6 species each. Five other sites had 5 species each. In addition there were five sites where only 1 species was found (sites 2, 5, 12, 16, 19). Species richness was significantly greater when the substrate was organic compared to sand or small stone via ANOVA. Wetlands with organic substrate were also the most densely populated. The four sites with greater than 100 snails per square meter (Table 2) all had organic substrate.

Stagnicola caperata and *Aplexa elongata* were more commonly found in temporary wetlands. Contingency tables (chi-square) confirm this to be a significant correlation. The two least common species *P. acuta* and *F. obrussa* were only found in permanent lakes. No other species distribution trends were evident statistically.

Some living specimens were found at 30 sites with subfossils and shells providing evidence for the presence of snails at the remaining sites (8, 29, 24). The planorbid snail *Helisoma trivolvis* was often found only as shells or subfossils. Only 3 out of 16 records of this species are from live snail collections.

No species known to be invasive (exotic) to North America were discovered.

DISCUSSION

Based on this survey the most successful snails species were *Stagnicola elodes* and *Physa gyrina*. These species were found at most sites visited in this study (78% and 75% respectively) and both were present at permanent and temporary wetlands. These two species also were the primary contributors to high overall snail density at sites 1, 4, 17 and 33. The overall density of snails at these sites was over 100 per square meter during the spring.

The wetlands of this region are alkaline and contain high calcium levels. High calcium levels are an important factor in preferred snail habitat (Dillon, 2000). To a lesser extent pH values that are neutral to alkaline seem to be preferred by most snail species as well. Since the wetlands in this study have high calcium levels and slightly alkaline pH values they would appear to be excellent habitat for freshwater snails.

When considering why the abundance and distribution of snails is different between the water bodies in this study several factors may be responsible. Considering the physical factors of the wetlands looked at in this study (Table 2) only bottom substrate and wetland type (permanent or temporary) showed any distinct connection to snail distribution.

Most of the wetlands in this study (22 of 33) had organic matter as bottom substrate. These wetlands in turn showed the highest species richness and the highest density of snails. The same connection has been made in other studies (Jokinen, 1983). The link is likely that of available food. Many freshwater snails are detritivores and thus the wetlands with high concentrations of organic matter provide an abundant food source.

Two species *S. caperata* and *A. elongata* have been shown to prefer temporary wetlands (Kenk, 1948; Jokinen, 1978) and this survey found that to be the case as well. These species, along with *P. gyrina*, are known to estivate (kenk, 1949; Jokinen, 1978) and thus may utilized temporary ponds that may have no aquatic predators and less competition from other snail species. The lack of predators such as fish and competition between snail species may account for the high density of snails is some of the smaller water bodies. The two least common species in this study *Physa acuta* and *Fossaria obrussa* preferred lacustrine habitats as they were only found in larger lakes. These species were not present in all of the larger lakes sampled however and one could speculate on their lack of distribution throughout the region.

Though some of the variation in the distribution of snails between wetlands can be explained by bottom substrate and wetland type these factors do not seem to account for all the differences. The Prairie Pothole water bodies are not interconnected and thus much of the distribution may simply be due to snails not yet finding there way to a particular water body. Temporal factors also limit the extent of this survey. In four instances the number of species found in a particular wetland increased when the second visit in the fall was undertaken. However, the overall abundance of species found in the entire survey did not change.

Biodiversity:

Since only three out of seven families of aquatic snail with a broad distribution that includes South Dakota were discovered, it is unlikely that this survey caught the extent of the diversity of aquatic snails within the region. The Prairie Coteau has thousands of distinct wetlands. In addition many microhabitats that exist within the larger lakes were not fully sampled. Specifically deeper water habitats were not sampled in this study and thus a greater degree of diversity may be discovered within some of the wetlands sampled. The presence of *H. trivolvis* primarily as shells along the shoreline may indicate that this species is found in greater abundance in deeper water. In an attempt to speculate on how many species were

missed the available nationwide data (Burch & Tottenham, 1980), regional data (Natureserve, 2005) and some data from the adjacent states of North Dakota (Cvancara, 1983) and Minnesota (Laursen et al. 1992) are used here. These resource collectively present at least twenty additional species that may be found in South Dakota overall. Several points should be noted however. First, the taxonomy of the Lymnaeidae is unclear and the number of species represented by this family may change. This group makes up seven of the potential additional species. Physidae taxonomy is also somewhat dubious and this family accounts for three of the potential species. In addition several species of the Lymnaeidae may prefer slightly acidic conditions and thus may find the Prairie Pothole region less than ideal (Laursen et al. 1992). Several snails families including the limpet like Ancylidae and the Hydrobiidae are typically very small - some less than 1mm - and so overlooking some of these species seems likely. These groups make up at least six potential additional species. Overlooking some of the smaller species within the Planorbidae also seems likely. One larger planorbid snail, *Helisoma anceps*, seems notably absent. *H. anceps* is a species with a widespread distribution in North America and it was one of the species expected to be found in this survey. In general *H. anceps* prefers larger ponds and lakes (Jokinen, 1983) and as with its congeneric *H. trivolvis,* which may be found in greater abundance by sampling deeper waters, *H. anceps* may be discovered as well.

Though the state of South Dakota may hold up to twenty more species of freshwater snail then were discovered in this survey the Prairie pothole region is a more homogenous environment. Further surveys will to be expected to increase overall species richness in the Prairie Pothole region but the number of additional species will be small.

At least three invasive snails the Quilted melania, *Tarebia granifera* , the New Zealand Mud Snail *Potomopyrgus antipodarum* and the Red-rimmed Melania *Melanoides tuberculata* are expected to be invaders into South Dakota before long (see Kerns at al, 2005 and MSU, 2005). Fortunately none of these invasive species were discovered.

In general the Prairie Coteau region appears to be an attractive area for freshwater snails. By extension the snail abundance likely makes these ponds attractive to waterfowl and other birds that use snails as a food source (Swanson & Duebbert, 1989).

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TABLE 1. Species of freshwater snail found at each of 33 collection sites in the Prairie Pothole region of South Dakota. Presence is indicated by a symbol (X, S, or D). “S” indicates only shells or subfossils were present, “D” indicates the dominant species present.

Site Number	*Lymnaea stagnalis*	*Stagnicola elodes*	*Stagnicola caperata*	*Fossaria obrussa*	*Aplexa elongata*	*Physa gyrina*	*Physa acuta*	*Helisoma trivolvis*	*Gyraulus deflectus*	*Promenetus exacuous*
1	--	D	--	--	X	--	--	--	--	X
2	--	--	--	--	--	D	--	--	--	--
3	--	X	--	--	--	D	--	--	X	--
4	--	X	--	--	--	D	--	S	--	X
5	--	--	--	--	--	--	D	--	--	--
6	--	S	D	--	--	X	--	--	--	--
7	--	--	--	D	--	--	X	--	--	--
8	S	D,S	--	--	--	S	--	S	--	S
9	--	D	--	--	X	X	--	S	--	--
10	X	D	--	--	--	S	--	S	--	--
11	--	X	--	--	--	D	--	S	X	--
12	--	--	--	--	--	D	--	--	--	--
13	--	X	X	--	D	--	--	--	--	--
14	--	D	--	--	--	X	--	S	S	--
15	--	D	X	--	--	X	--	--	--	X
16	--	--	--	--	--	D	--	--	--	--
17	--	X	X	--	D	X	--	--	X	X
18	--	X	--	--	X	X	--	--	--	D
19	--	--	--	--	--	D	--	--	--	--
20	--	D	--	--	--	X	--	X	X	--
21	--	X	--	X	D	--	--		--	--
22	--	X	--	--	--	D	--	--	--	--
23	--	D	--	--	--	X	--	S	X	--
24	--	S	--	--	S	D,S	--	S	--	--
25	--	D	--	--	--	X	--	S	S	S
26	X	X	--	--	X	D	--	S	X	--
27	D	X	--	--	--	X	--	S	--	X
28	X	D	--	X	--	X	--	S	--	--
29	--	S	--	--	--	--	--	D,S	--	--
30	--	D	--	--	--	X	--	--	--	--
31	--	X	X	--	D	--	--	--	X	--
32	--	--	--	--	--	--	D,S	X	--	--
33	--	D	--	--	--	X	--	S	X	--

Σ	**5**	**26**	**5**	**3**	**9**	**25**	**3**	**16**	**10**	**8**

TABLE 2. Descriptions and water chemistry of 33 freshwater snail collection sites in the Prairie Pothole region of South Dakota

Site #	Waterway	County	* # of species	** Snail Density	pH	CaCO3 (mg/L)	*** Waterbody Size	Waterbody Type	Substrate	Shallow water Vegetation
1	Unnamed pond	Lake	3	Med	7.4	75	Medium	Permanent	Organic	Cattails
2	Lake Madison	Lake	1	Low	8.9	65	Large	Permanent	Sand	Grasses
3	Unnamed pond	Lake	3	Med	7.7	70	Small	Permanent	Organic	Cattails
4	Unnamed ditch	Kingsbury	4	High	8.9	200	Very small	Temporary	Organic	Grasses
5	Oakwood Lake	Brookings	1	Low	8.7	75	Large	Permanent	Small Stone	None
6	Unnamed pond	Brookings	3 (1)	Low	8	-	Very small	Temporary	Organic	Cattails
7	Lake Kampeska	Codington	2	Low	8.7	100	Large	Permanent	Sand	Cattails
8	Grass Lake	Codington	5 (5)	Med	8.8	75	Large	Permanent	Sandy	Grasses
9	Unnamed pond	Codington	4 (2)	Med	8	-	Very small	Temporary	Organic	Cattails
10	Horseshoe Lake	Day	4 (1)	Med	8	100	Large	Permanent	Sand	Cattails
11	Unnamed pond	Day	4	High	8.5	75	Medium	Permanent	Organic	Cattails
12	S. Waubay Lake	Day	1	Low	8.5	80	Large	Permanent	Sand	None
13	Unnamed pond	Day	3	Med	8.5	-	Very small	Temporary	Organic	Cattails
14	Unnamed pond	Day	4 (2)	Med	8.3	80	Medium	Permanent	Organic	Cattails
15	Unnamed pond	Day	4	Low	7.1	60	Small	Permanent	Organic	Cattails
16	Unnamed lake	Day	1	Low	8.5	70	Large	Permanent	Small stone	Grasses
17	Unnamed marsh	Marshall	6	High	7.9	70	Medium	Permanent	Organic	Grasses
18	Unnamed pond	Marshall	4	Med	7.5	75	Small	Permanent	Organic	Cattails
19	Unnamed lake	Marshall	1	Low	8.6	80	Large	Permanent	Sand	Cattails
20	Unnamed lake	Marshall	4 (1)	Med	9	125	Large	Permanent	Organic	Cattails
21	WPA east pond	Deuel	3	Med	7.8	-	Very small	Temporary	Organic	Grasses
22	WPA west pond	Deuel	2	Med	7.4	80	Very small	Permanent	Organic	Cattails
23	Unnamed pond	Clark	4 (1)	Med	8	65	Small	Permanent	Organic	Cattails
24	Unnamed lake	Clark	4 (4)	Med	8.8	75	Large	Permanent	Sandy	None
25	Unnamed ditch	Day	5 (3)	Med	7.2	65	Small	Permanent	Organic	Cattails
26	Unnamed lake	Day	6	Med	8.5	70	Large	Permanent	Organic	None
27	Unnamed pond	Roberts	5 (1)	Med	8	90	Medium	Permanent	Organic	Cattails
28	Dry Wood Lake	Roberts	5 (1)	Med	8.9	200	Large	Permanent	Organic	None
29	Lake Marsh	Hamlin	2 (2)	Med	8	60	Large	Permanent	Sandy	Cattails
30	Mickelson GPA	Hamlin	2	Med	8.5	100	Large	Permanent	Organic	Cattails
31	Unnamed ditch	Hamlin	4	Med	8.5	-	Small	Temporary	Organic	Grasses
32	Spirit Lake	Kingsbury	2 (1)	Low	8.4	80	Large	Permanent	Small stone	Grasses
33	Unnamed marsh	Clark	4 (1)	High	7.3	85	Small	Permanent	Organic	Grasses

*The first value listed is the number of total species. The number in parenthesis is the number of species found only as shells or subfossils
** Density estimates are based on a single quadrate: Only High > 100m2 and Low < 1 per m2 and Med (in between) categories are shown.
***Estimated on visual inspection into four categories: Large (> 5ha), Med (approx 5-0.5 ha), small (<0.5 ha) and very small (<0.01 ha).

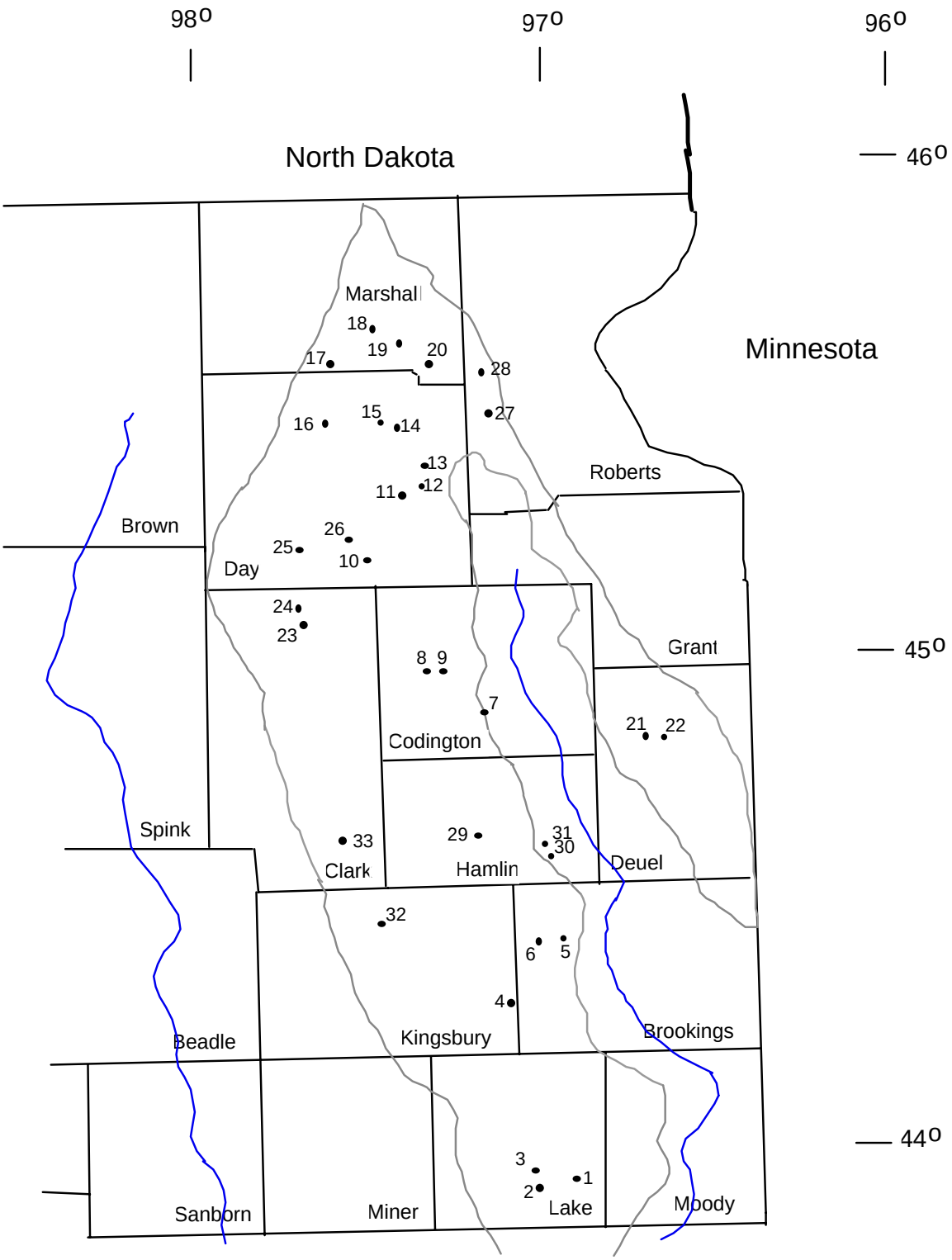


Figure 1. Survey sites within South Dakota. The approximate area of the Prairie Coteau region is outlined in grey. Two dark lines represent the major rivers: James River (on left) and the Big Sioux River (right).

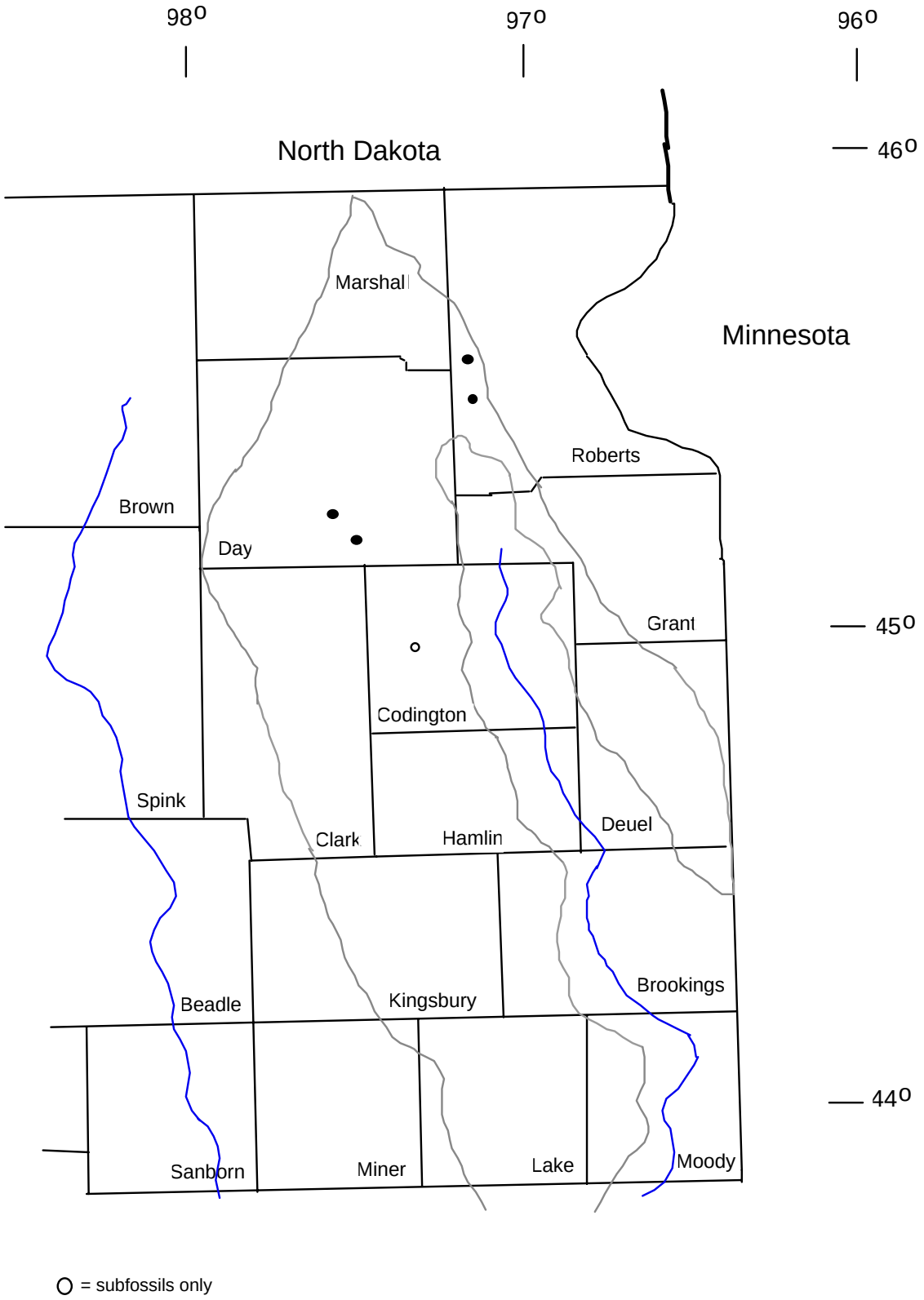


Figure 2. Distribution of *Lymnaea stagnalis* in the Prairie Pothole region of South Dakota.

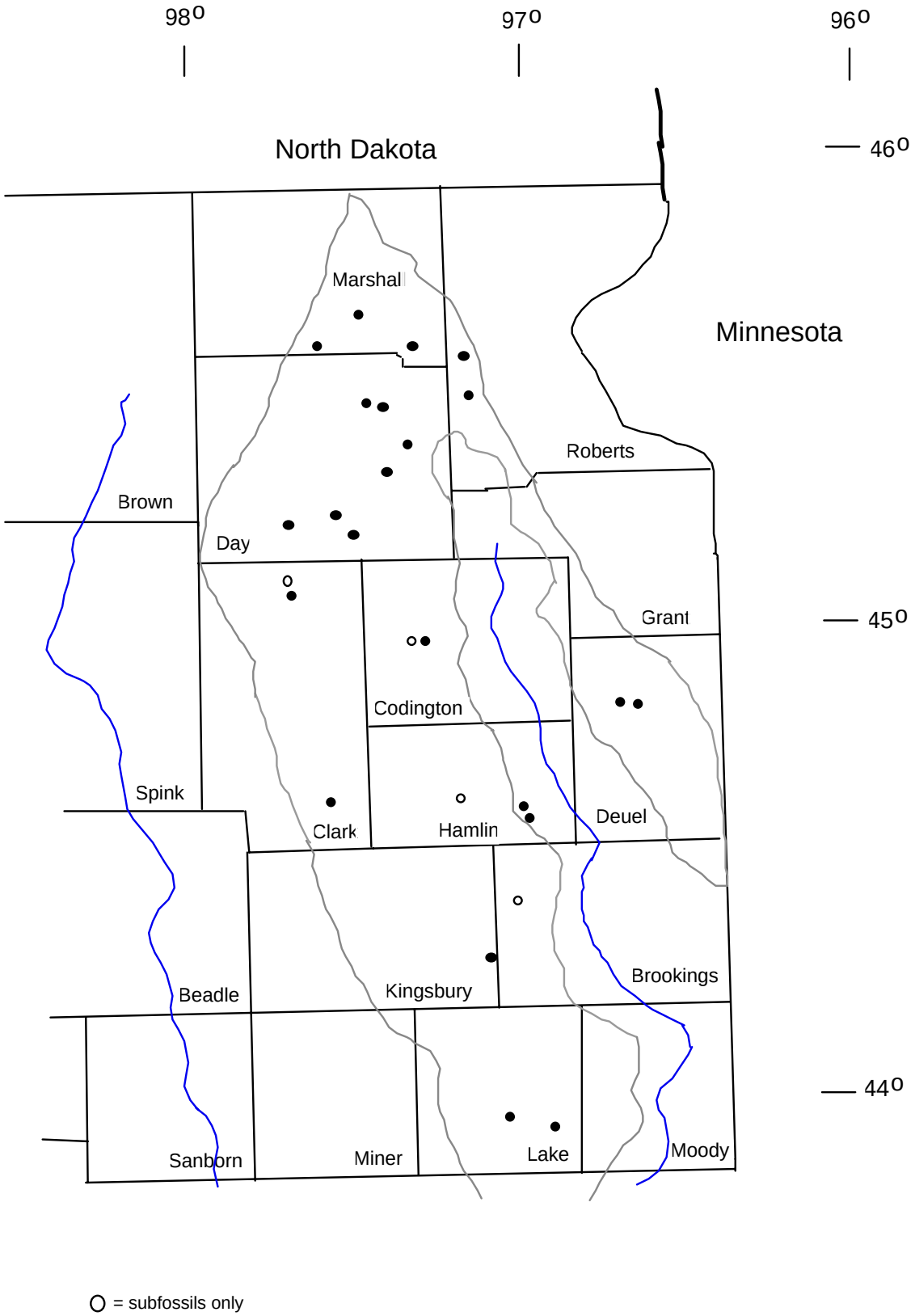
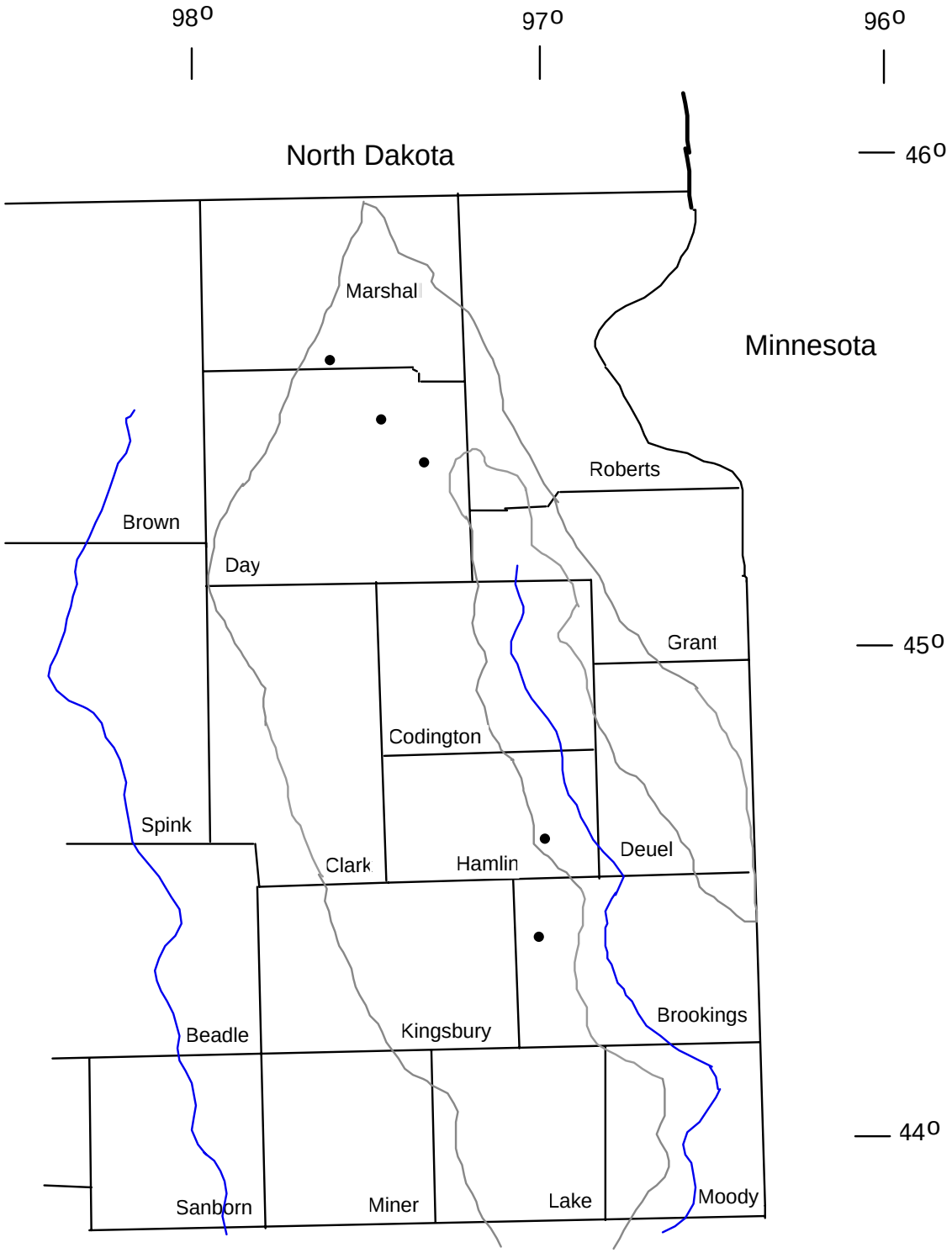
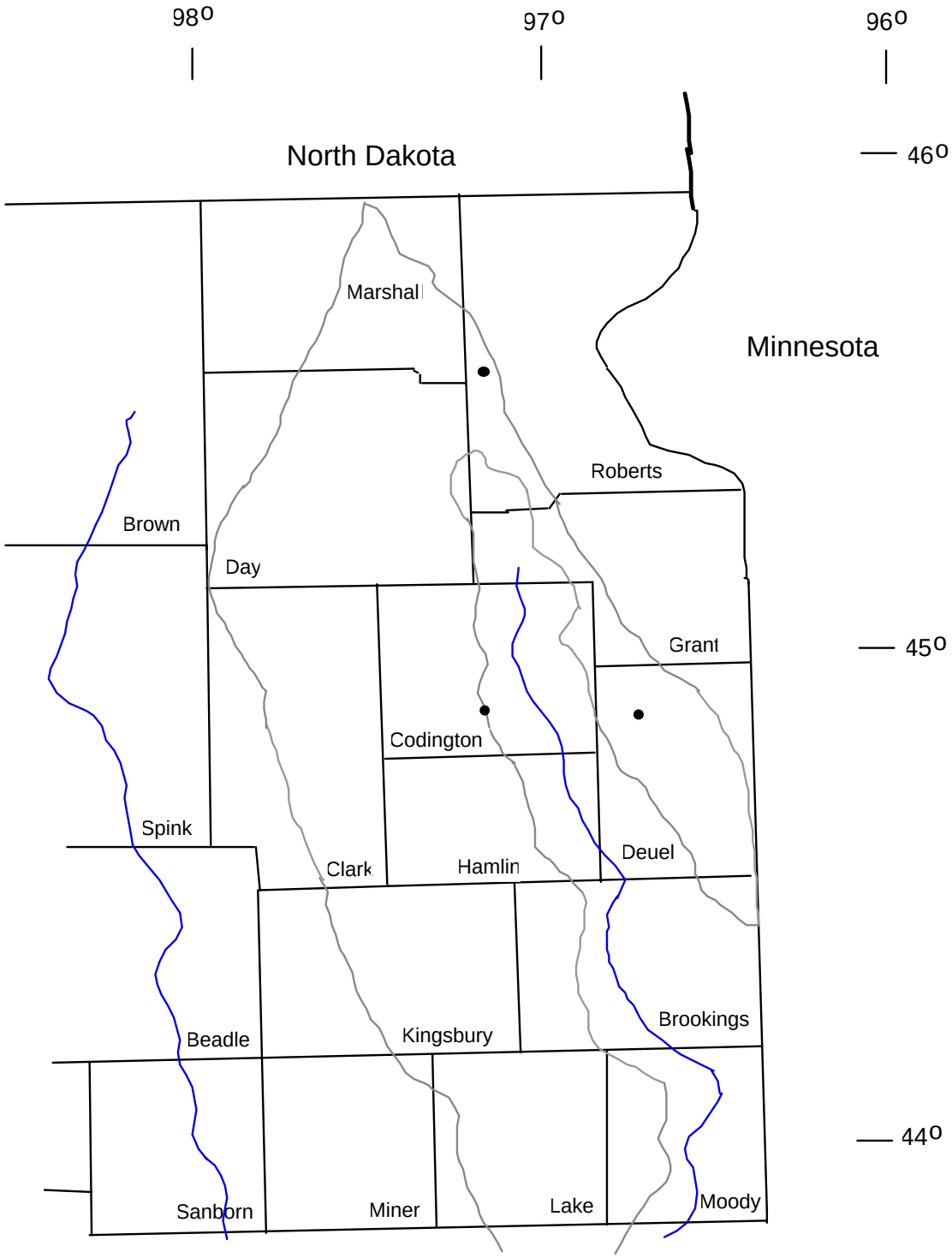


Figure 3. Distribution of *Stagnicola elodes* within the Prairie Pothole region of South Dakota.



○ = subfossils only

Figure 4. Distribution of *Stagnicola caperata* within the Prairie Pothole region of South Dakota.



○ = subfossils only

Figure 5. Distribution of *Fossaria obrussa* within the Prairie Pothole region of South Dakota.

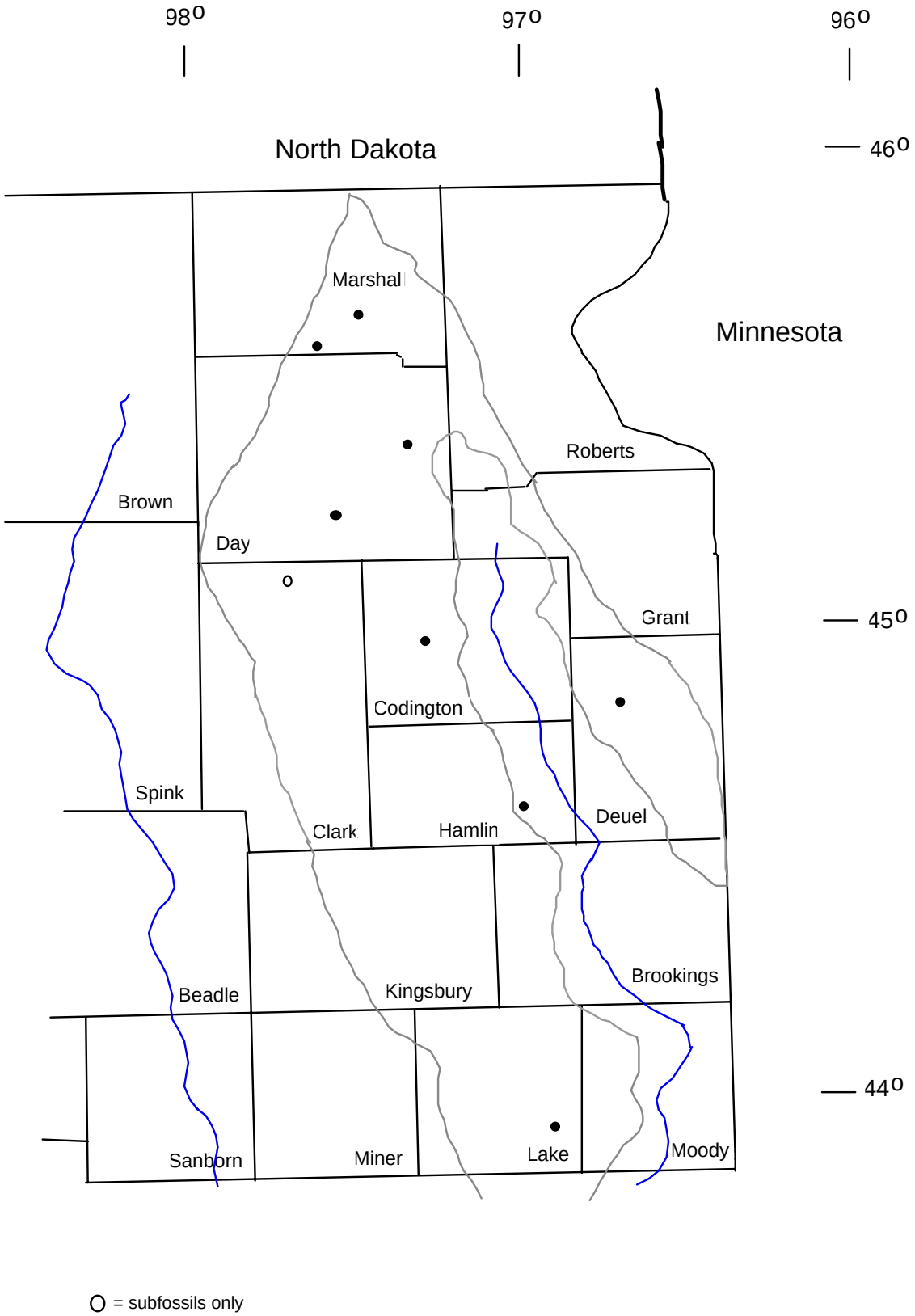


Figure 6. Distribution of *Aplexa elongata* within the Prairie Pothole region of South Dakota.

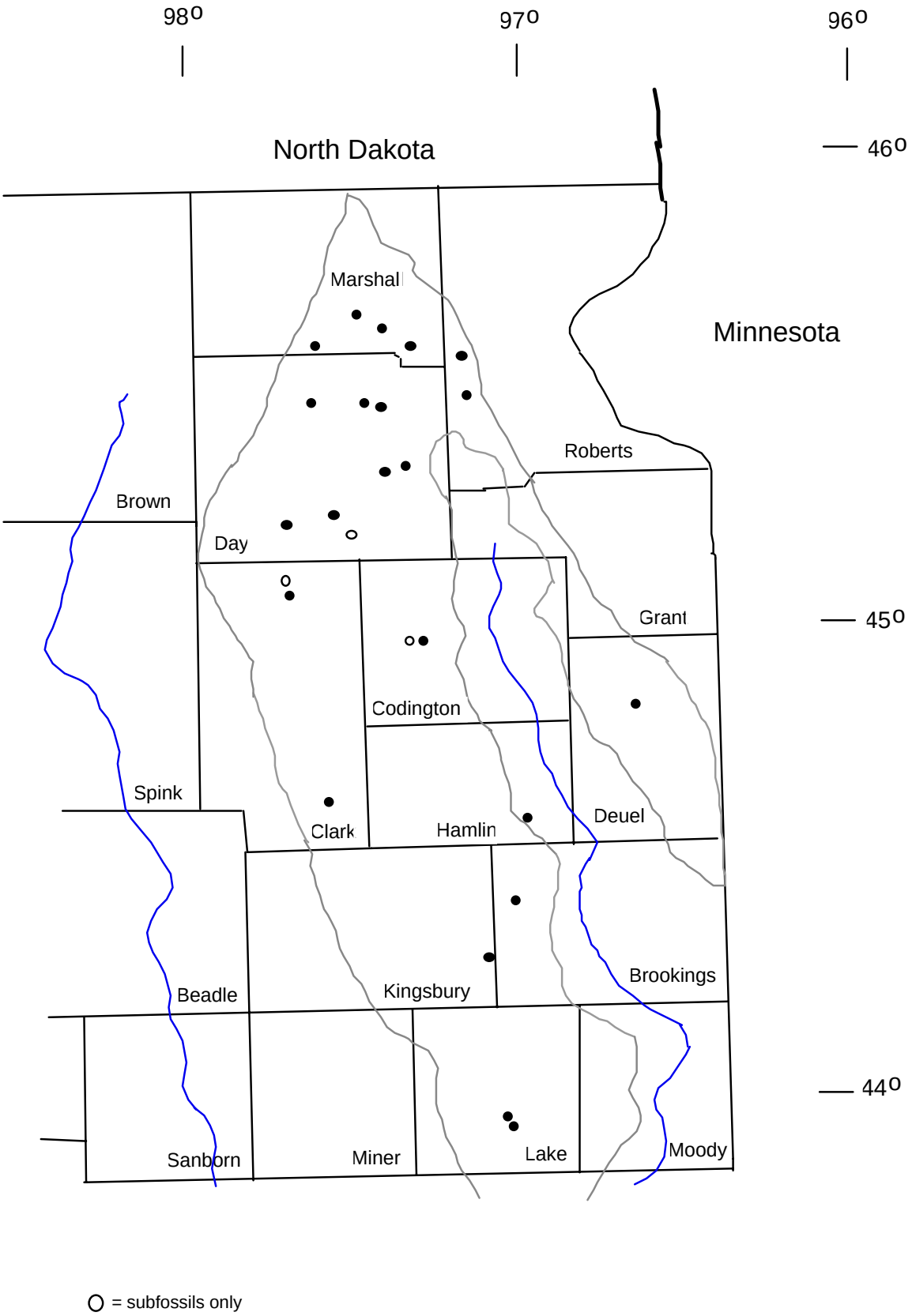


Figure 7. Distribution of *Physa gyrina* within the Prairie Pothole region of South Dakota.

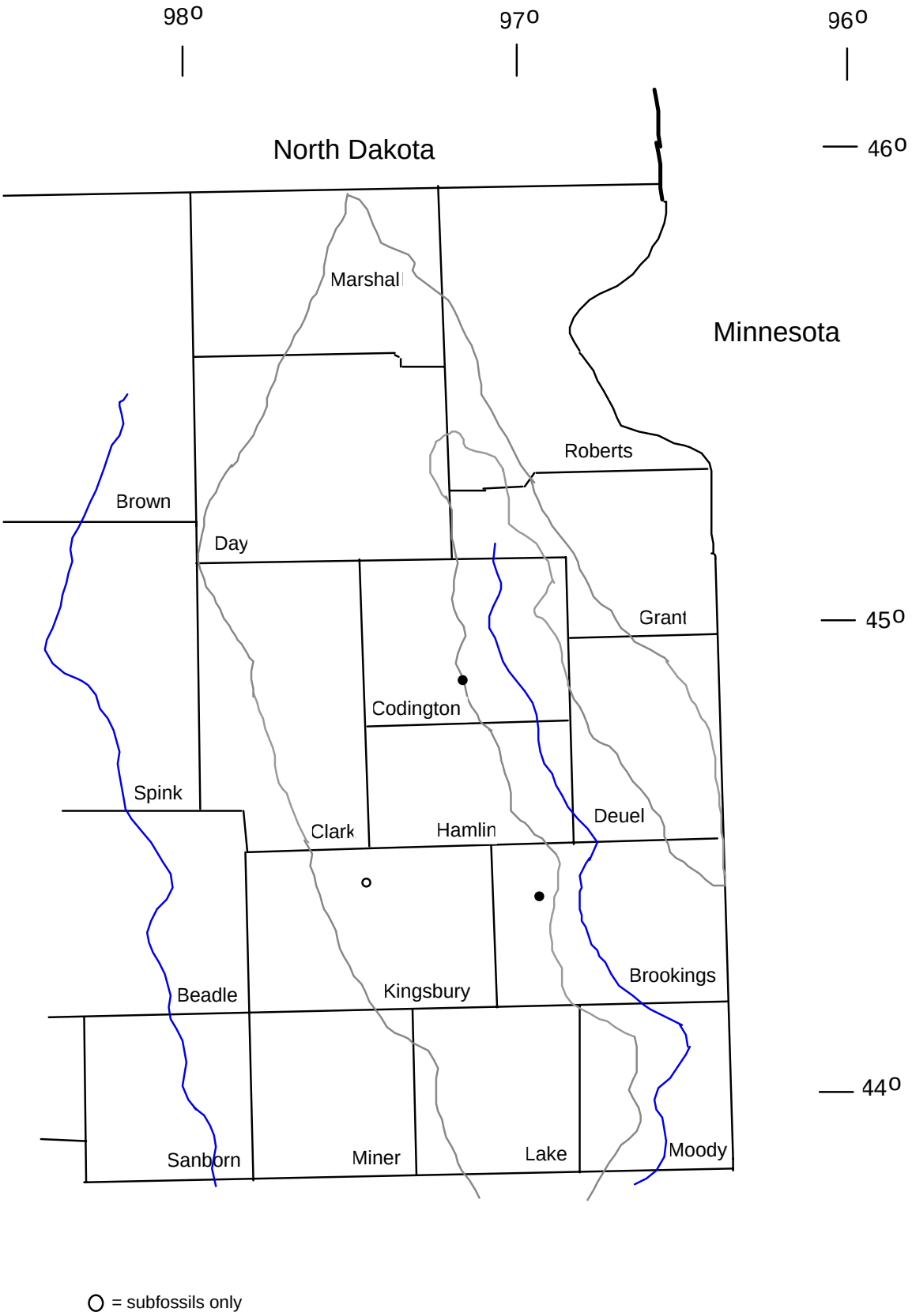


Figure 8. Distribution of *Physa acuta* within the Prairie Pothole region of South Dakota.

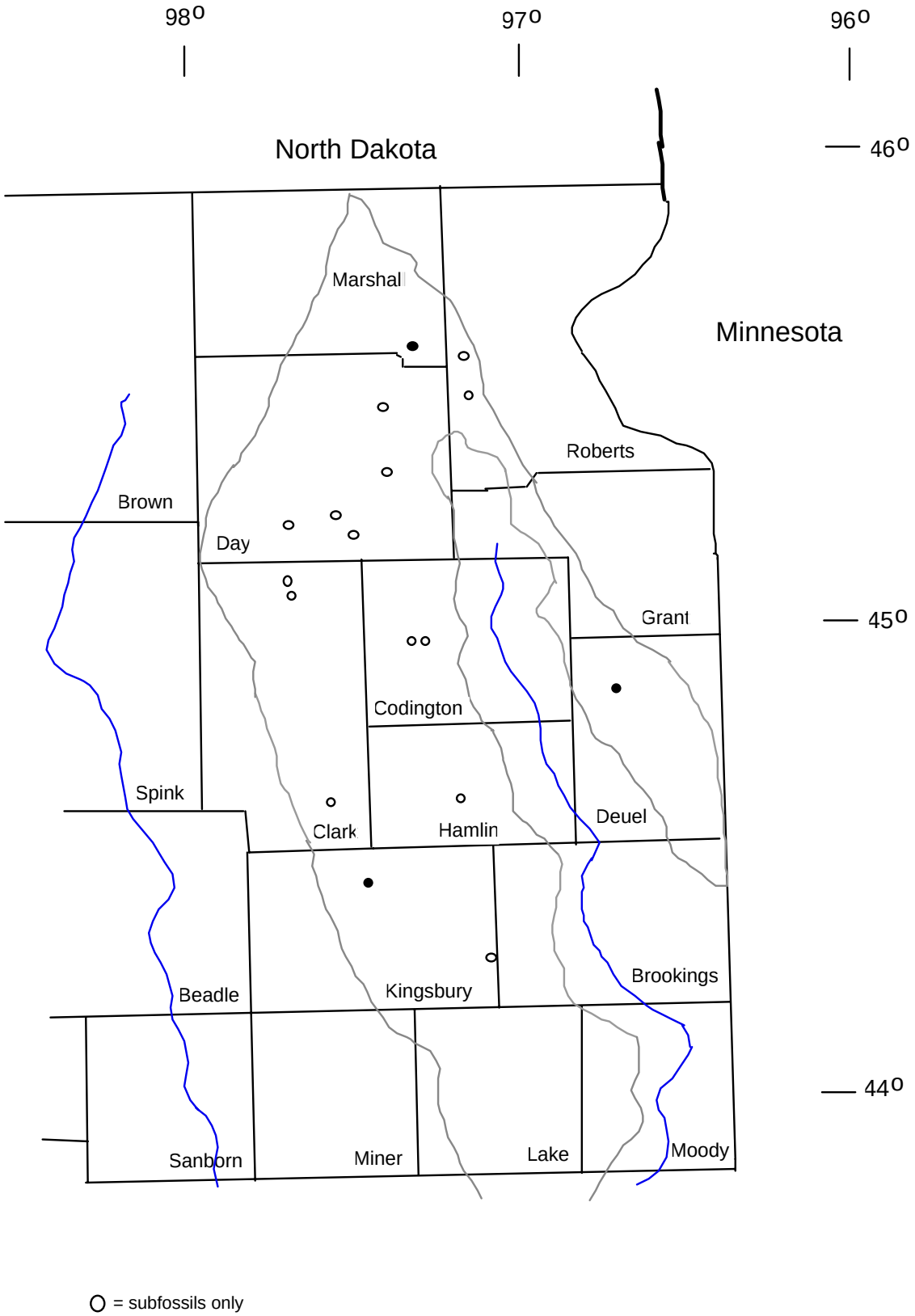
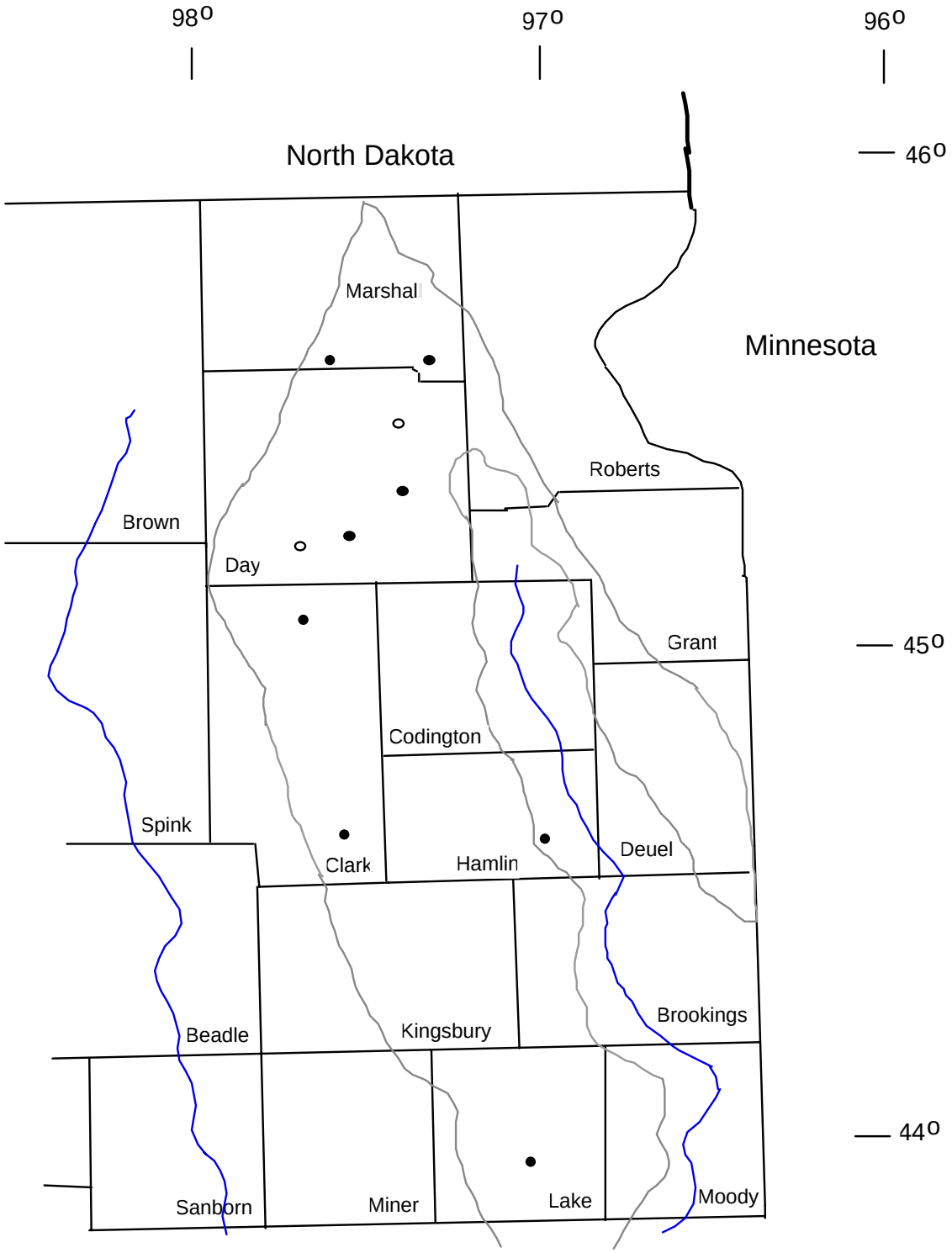


Figure 9. Distribution of *Helisoma trivolvis* within the Prairie Pothole region of South Dakota.



○ = subfossils only

Figure 10. Distribution of G*yraulus deflectus* within the Prairie Pothole region of South Dakota.

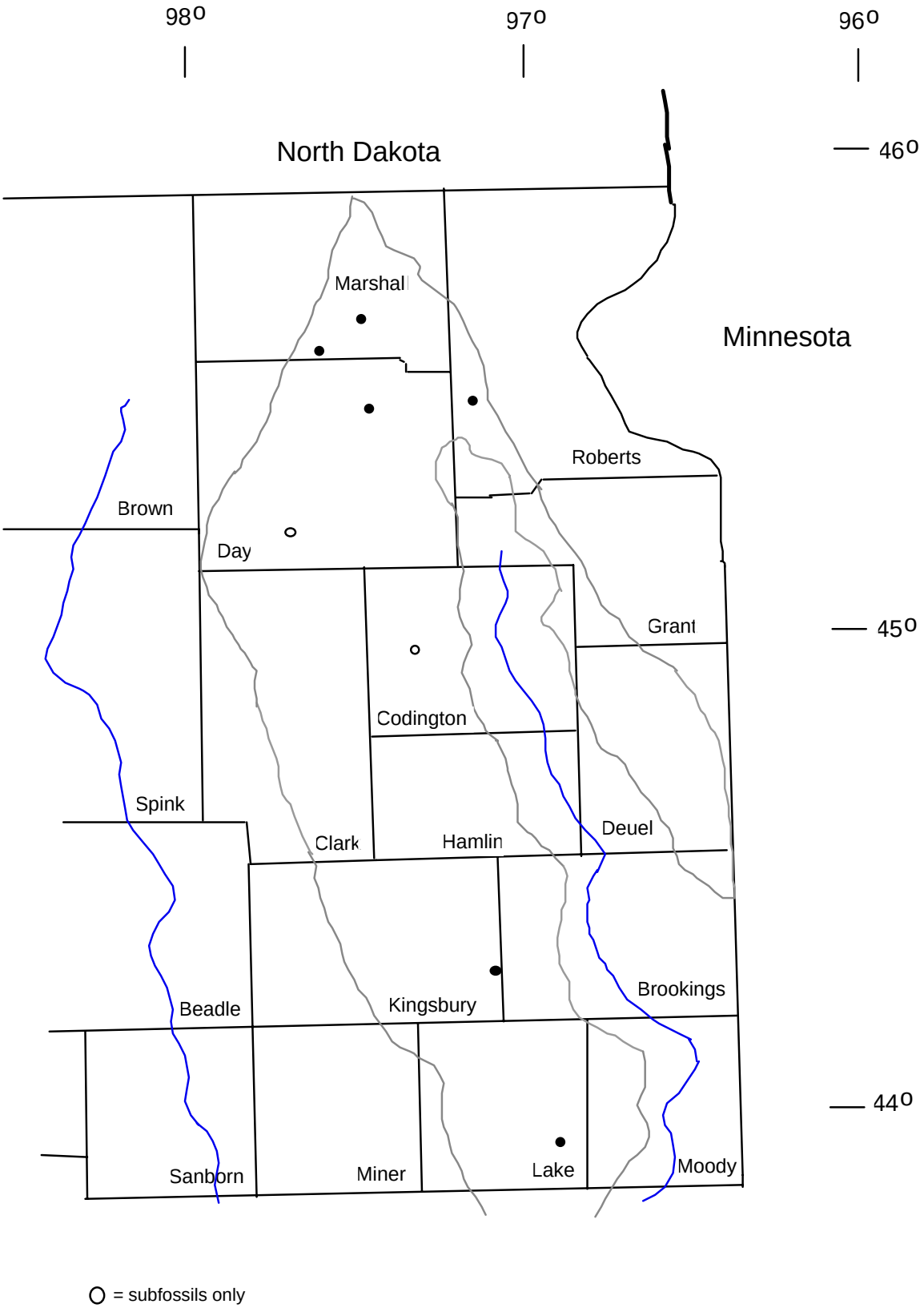


Figure 11. Distribution of *Promenetus exacuous* within the Prairie Pothole region of South Dakota.

Appendix A

This is a brief identification guide to the ten species of freshwater snail collected in this survey of thirty-three sites within the Prairie Pothole region of South Dakota.

The guide includes line drawings (fig 1-10) of each species and one photograph (fig 11) of all ten species.

Subclass: Pulmonata
Order: Basommatophora

Lymnaeidae:
Members of this family are all right-handed and typically high spired. The taxonomy of this group is disputed. Some authors favor placing all species in this family under on genus *Lymnaea* while others split the family into several genera. I follow the taxonomy presented by Burch (1982).

Lymnaea stagnalis (Linnaeus, 1758)
Swamp Lymnaea
Found at five (15%) sites: 8, 10, 26, 27, 28.
Adults 30-60mm. The largest snail found in this survey. This species has a distinct elongated shell and pointed spire. Columella is broad and flat. Shell is thin and typically yellowish brown. This species is a detritivore and a carnivore.

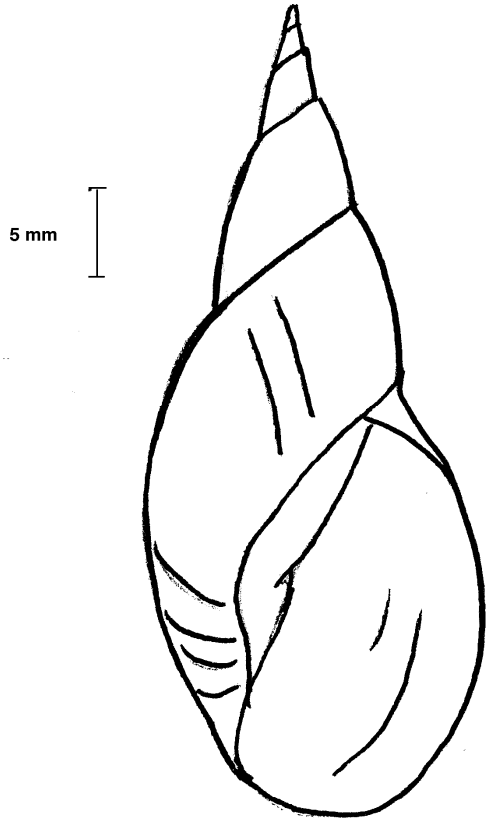


Fig 1. *Lymnaea stagnalis*

Stagnicola elodes (Say 1821)
Marsh pondsnail
Found at twenty-six (78%) sites: 1, 3, 4, 6, 8, 9, 10, 11, 13, 14, 15, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33.
Adults 20-40mm. Shell surface may be malleated. High spire. Twisted columella. Small *S. elodes* may be confused with *S. caperata* the presence of periostracal ridges present in *S. caperata* is the distinguishing feature.
Taxonomic names, AKAs: *Lymnaea palustris*, *Stagnicola palustris*.

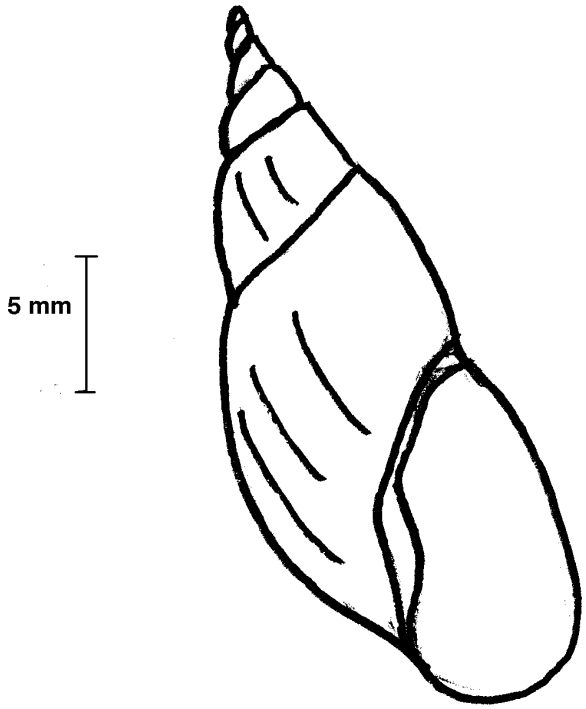


Fig 2. *Stagnicola elodes*

Stagnicola caperata (Say, 1829)
Wrinkled pondsnail
Found at five (15%) sites: 6, 13, 15, 17, 31.
Adults 15-17 mm. Ovately elongate, columella not twisted. Ovate aperture, reddish within. Fine periostracal ridges (see drawing) distinguish this species from small *S. elodes*. This species is typically found in temporary wetlands.

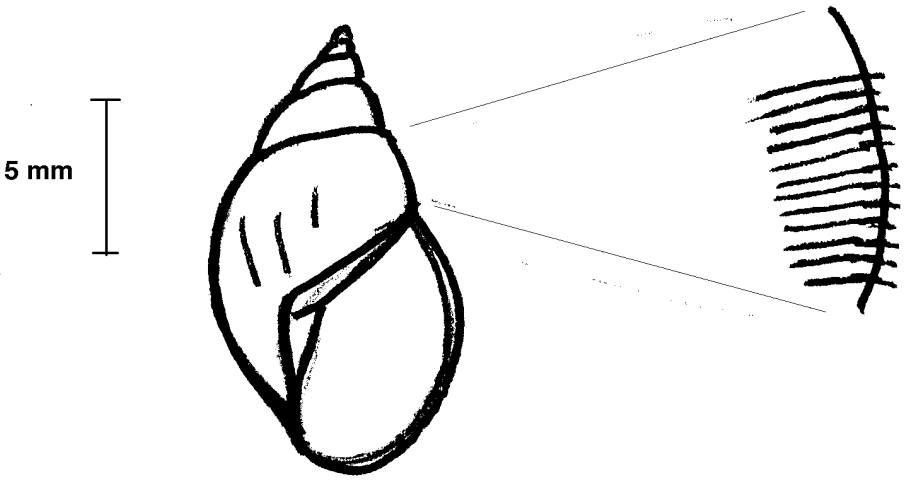


Fig 3. *Stagnicola caperata*

Fossaria obrussa (Say, 1825)
Found at two (9%) sites: 7, 21, 28.
Adults up to 15mm but most smaller (8 mm).
The smallest of the Lymnaeidae species listed here. Whorls 5-6, with prominent shoulder. Acute spire. May be malleated. Taxonomic names, AKAs: *Lymnaea humilis*

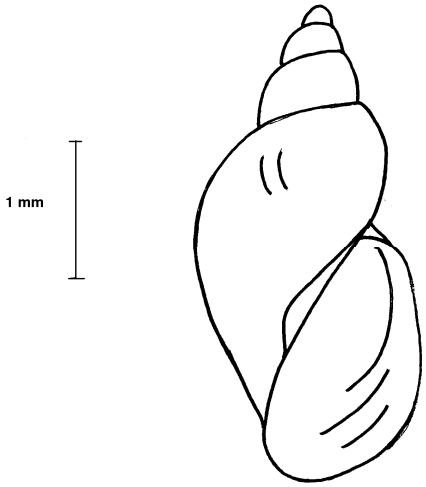


Fig 4. *Fossaria obrussa*

Family: Physidae

Easy to identify to the family level due to the left handed (sinistral) nature of the shell. When the spire is pointed away from the viewer the aperture is located to the left. Snails within this family are generally oval and vary in coloration from light to dark.

As with most families the taxonomy of these snails are disputed. I primarily follow the taxonomy presented by Burch (1982) in this survey but recent authors have reduced this family from a possible multitude of genera and subgenera to only two genera; *Physa* and *Aplexa* (Wethington, 2004) and I follow that scheme here. In South Dakota members of both genera are found in abundance. Species within the genus *Physa* can be difficult to identify do to variable shell morphology. Often identification requires microdissection of soft anatomy.

Aplexa elongata (Say, 1821)
Lance aplexa
Found at nine (27%) sites: 1, 9, 13, 17, 18, 21, 24, 26, 31.
Adult size is generally listed as up to 20mm though several individuals found in this study reached 25mm. Sinistral. This snail has a smooth, shiny shell, oily in appearance. Shell is slender with an elongate spire. Whorls 6, sutures compressed. This species typically inhabits temporary wetlands.
Taxonomic names, AKAs: Sometimes confused with the European species *Aplexa hypnorum*.

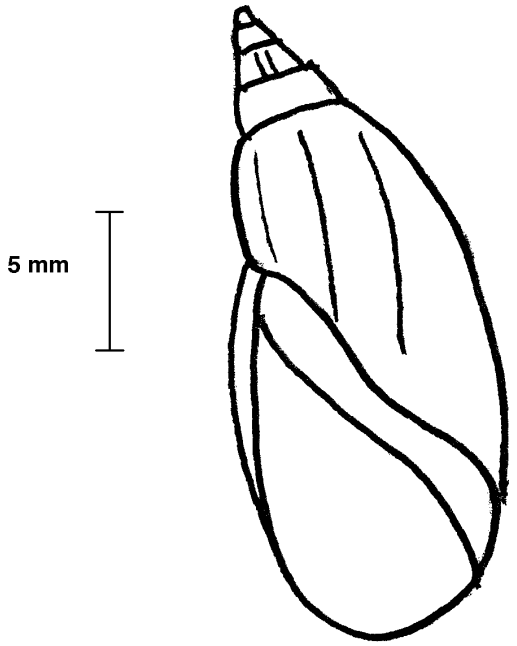


Fig 5. *Aplexa elongata*

Physa gyrina (Say, 1821)
Tadpole physa
Found at twenty-five (75%) sites: 2, 3, 4, 6, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 33.
Length 12-35mm; sinistral. The largest of the physidae found in this study. Shell oval to moderately elongate with substantial variation. Whorls 5-6, body whorl is large and rounded. Whorls do not have shoulder. Inside aperture often bordered by a red band.

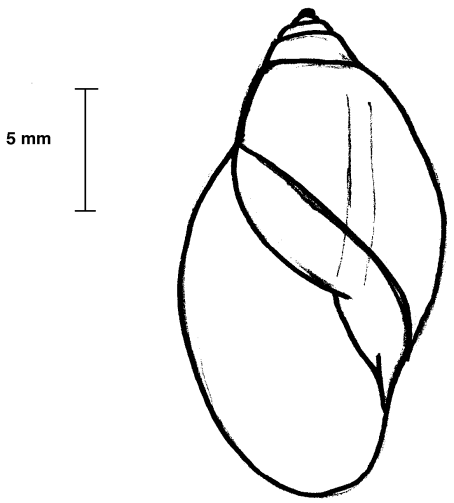


Fig 6. *Physa gyrina*

Physa acuta (Haldeman, 1841)
Ashy physa
Found at three (9%) Sites: 5, 7, 32.
Adult 5-15mm. Oval shell with acute, pointed spire. Whorls 5-6, rounded with large body whorl; distinct shoulder on last whorl. Sutures impressed. This species was found only in large lakes in this study. Dillon et al. (2002) have shown that *P. integra* and *P. heterostropha* are not reproductively isolated from *Physa acuta* and thus should be reduced to one species and referred to as the earliest name *Physa acuta*.

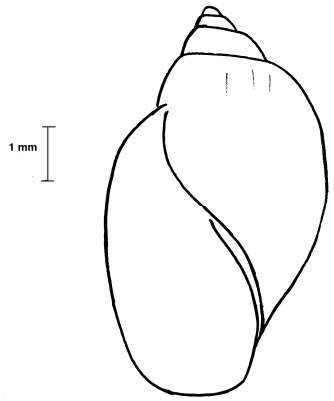


Fig 7. *Physa acuta*

Planorbidae

The planispiral (shell wrapped around on more or less the same plane) structure of the shell makes this family easy to identify. Difficulties can be encountered in establishing the genera of several of these snails. I primarily follow the taxonomy presented by Burch (1982) with the exception of the species *Helisoma trivolvis* (Burch uses the genus *Planorbella*) since most recent authors use the genus *Helisoma*.

Helisoma trivolvis (Say, 1817)
Marsh rams-horm
Found at seventeen (51%) sites: 4, 8, 9, 10, 11, 14, 20, 21, 23, 24, 25, 26, 27, 28, 29, 32, 33.
Adults 20-32mm. The largest planorbid snail. Spire flat, umbilicus narrow and deep. Outer lip thin and rounded outward.
Taxonomic names, AKAs: *Planorbella trivolvis*

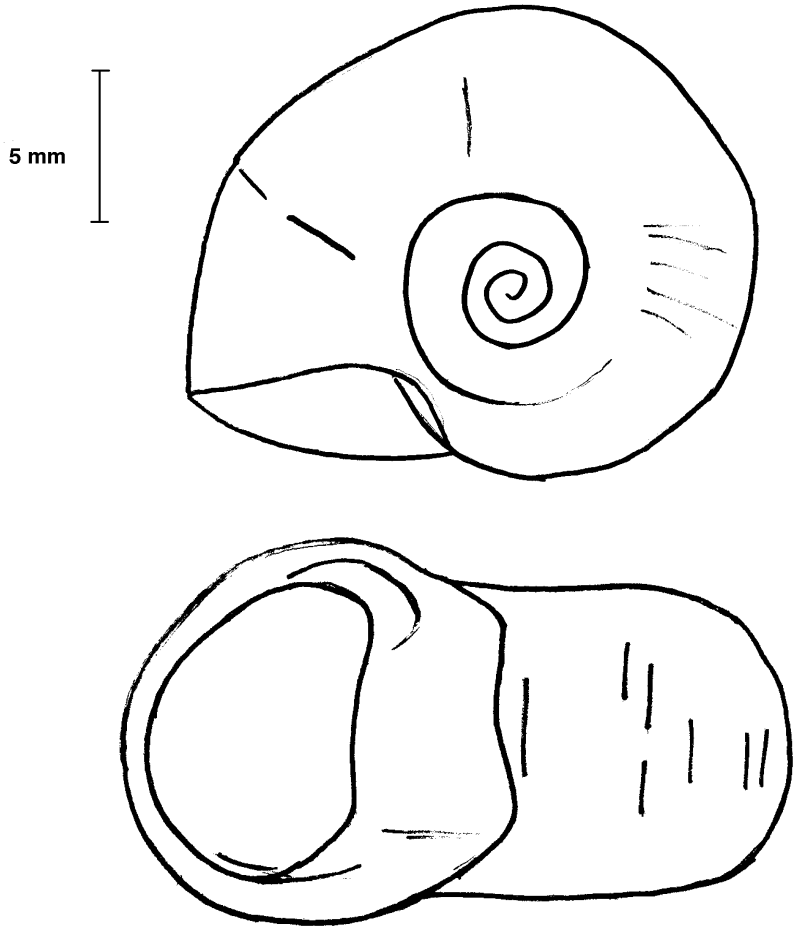


Fig 8. *Helisoma trivolvis*

Gyraulus deflectus (Say, 1824)
Found at ten (30%) sites: 3, 11, 14, 17, 20, 23, 25, 26, 31, 33.
Adults up to 8 mm. Hirsute (hairy) appearance on inner whorls. Shell depressed, apical whorl sunken all other whorls on the same plane.
No acute periphery as with P. exacuous.

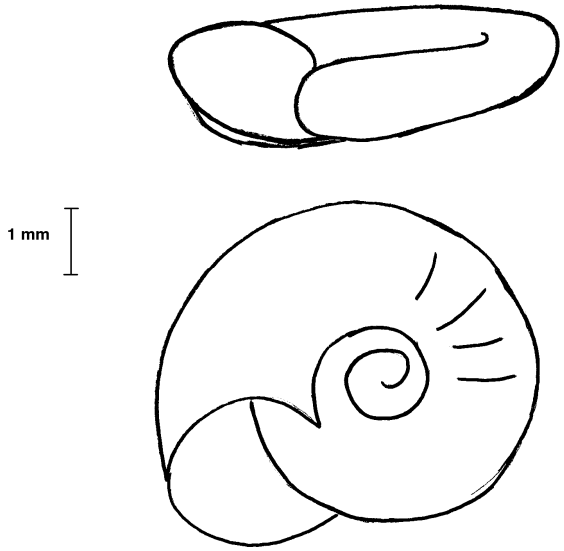


Fig 9. *Gyraulus deflectus*

Promenetus exacuous (Say, 1821)
Found at eight (24%) Sites: 1, 4, 8, 15, 17, 18, 25, 27.
Adults up to 9mm. Shell extremely depressed, acute periphery.

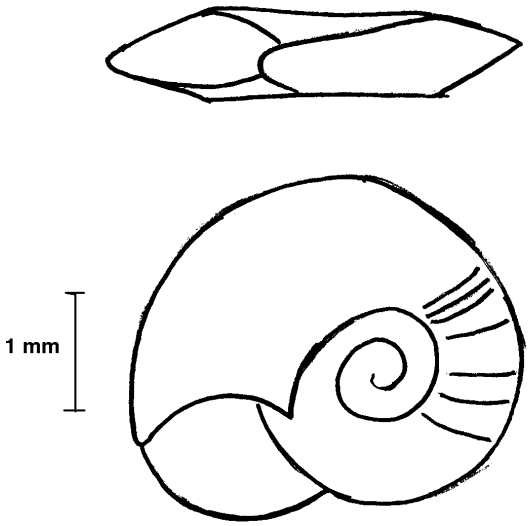


Fig 10. *Promenetus exacuous*

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Appendix Figure 11. Photograph of ten species of freshwater snail collected in this survey of the Prairie Pothole region of South Dakota. Species from left to right beginning in the upper left: *Lymnaea stagnalis* (pair), *Stagnicola elodes* (pair), *Aplexa elongata* (triplet), *Fossaria obrussa* (pair), *Helisome trivolvis* (pair), *Physa gyrina* (pair), Stagnicola caperata (pair), *Gyraulus deflectus* (pair) *Physa acuta* (pair), *Promenetus exacuous* (pair).

Appendix B. Specific location information for each collection site.

Site #	Waterway	County	Specific Location information	N	W
1	Unnamed pond	Lake	Along Rt. 32 between towns of Coleman and Madison	43.97966	-96.96936
2	Lake Madison	Lake	Off Rt. 34, down Johnson Pt. Rd.	43.97276	-97.03773
3	Unnamed pond	Lake	Adj to Johnson pt. N of parking lot	43.97283	-97.03771
4	Unnamed ditch	Kingsbury	Along Rt 81 @ 216st or 215th St	44.26331	-97.12921
5	Oakwood Lake	Brookings	S. end of lake 204th St and 462 ave.	44.42551	-96.96934
6	Unnamed pond	Brookings	S. off 204st just west of site #5. SD special Mgnt area	44.4255	-97.07907
7	Lake Kampeska	Codington	Off Rt 20 NW of Watertown. North side of rd	44.94363	-97.17115
8	Grass Lake	Codington	Off Rt 20 SW of Rd	45.07230	-97.35670
9	Unnamed pond	Codington	Off Rt 20 adj to Grass Lake. Springer WPA	45.07244	-97.35359
10	Horseshoe Lake	Day	Off Rt 25, S of Rd. Lake access Rd and parking lot	45.24787	-97.52290
11	Unnamed pond	Day	N of Webster on Rt 25 & 138th St)	45.38197	-97.51985
12	S. Waubay Lake	Day	Rt 25 & 137 St. Parking area	45.39400	-97.44881
13	Unnamed pond	Day	N from site #12, 436 ave.	45.40303	-97.48916
14	Unnamed pond	Day	130St & 433 av	45.50046	-97.55124
15	Unnamed pond	Day	off 130S. 1 mile W. of site #14	45.50104	-97.59245
16	Unnamed lake	Day	427Av & Rt 25	45.51501	-97.67012
17	Unnamed marsh	Marshall	427Av, Just N of Day county line	45.59411	-97.66989
18	Unnamed pond	Marshall	434Av & 120St, W of 434	45.64552	-97.53226
19	Unnamed lake	Marshall	122St, E of site #18	45.61712	-97.49190
20	Unnamed lake	Marshall	122St & 443Av. N of 122St	45.61771	-97.40162
21	WPA east pond	Deuel	N of 212St between 472&475 Av	44.89092	-96.71258
22	WPA west pond	Deuel	N of 212St between 472&475 Av	44.89095	-96.71778
23	Unnamed pond	Clark	Rt 20 Just E of Crocker	45.10312	-97.77079
24	Unnamed lake	Clark	Rt 20 Just E of Crocker, beach area	45.10422	-97.77089
25	Unnamed ditch	Day	149St and 422Av, E of 422av	45.21712	-97.77901
26	Unnamed lake	Day	462AV&146St	45.26726	-97.57181
27	Unnamed pond	Roberts	127St & Gunderson Rd. (One Lake Rd)	45.54242	-97.16130
28	Dry Wood Lake	Roberts	123St & 451Av, Min Maint Rd.	45.59321	-97.18547
29	Lake Marsh	Hamlin	188St just 0.5 mile W of Hayti	44.66236	-97.21954
30	Mickelson GPA	Hamlin	192St & 462Av (appr) E of Stonebridge	44.60166	-96.96369
31	Unnamed ditch	Hamlin	192St & 462Av (appr) E of Stonebridge	44.60166	-96.96369
32	Spirit Lake	Kingsbury	200St & 430Av	44.48433	-97.61712
33	Unnamed marsh	Clark	193St & 492Av, then West	44.58746	-97.63713