The Distribution of Unionidae (Mollusca: Bivalvia) in the Assiniboine River Drainage in Manitoba

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THE DISTRIBUTION OF UNIONIDAE (MOLLUSCA: BIVALVIA) IN THE ASSINIBOINE RIVER DRAINAGE IN MANITOBA

by

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

Abstract

Watson, E.T., L.C. Graham, and W.G. Franzin. The distribution of Unionidae (Mollusca: Bivalvia) in the Assiniboine River drainage in Manitoba. Can. Tech. Rep. Fish. Aquat. Sci. 2232: iv + 31p.

A survey of the distribution and diversity of freshwater mussels in the Assiniboine River drainage, Manitoba was conducted during the summers of 1995 and 1996. Visual searches and raking the substrate at 63 sites resulted in the collection of 523 live specimens of twelve species. This report presents the locations, physical data collected, and the diversity and abundance of mussel species collected at each site. Previous records from the drainage are collated. Possible avenues of post-glacial dispersal are discussed.

Key Words: Mollusca; Unionidae; freshwater mussels; Assiniboine River; distribution; abundance; habitat; dispersal

Résumé

Watson, E.T., L.C. Graham, and W.G. Franzin. The distribution of Unionidae (Mollusca Bivalvia) in the Assiniboine River drainage in Manitoba. Can. Tech. Rep. Fish. Aquat. Sci. 2232 : iv + 31p.

On a procédé à un relevé sur la distribution et la diversité des mulettes (mollusques d'eau douce) dans le bassin versant de la rivière Assiniboine, au Manitoba, durant l'été, en 1995 et 1996. Des recherches à vue et des opérations de râtelage du substrat de 63 sites ont permis de récolter 523 spécimens vivants de douze espèces. Le présent rapport décrit l'emplacement, les caractéristiques physiques, la diversité et l'abondance des espèces de mulettes récoltées dans chaque site. Il collationne également des données antérieures concernant le bassin versant et présente divers scénarios de dispersion post-glaciaire.

Mots clés : Mollusca; Unionidae; mulettes; rivière Assiniboine; distribution; abondance; habitat; dispersion

INTRODUCTION

Freshwater mussels of the family Unionidae (also known as clams, unionids, or naiades) are a widely distributed fauna with representatives on every continent but Antarctica. Many members of this group have endangered populations. Nearly half of the 293 species of unionids recorded from North America are either extinct, or in peril of becoming extinct, due to anthropogenic activities such as habitat destruction, pollution, commercial over-exploitation, and the introduction of the zebra mussel (Bogan 1993, Williams et al. 1993).

Freshwater mussels are important as consumers of phytoplankton (McMahon 1991), as a food source for small aquatic mammals (Fuller 1974), for sediment mixing in lakes and rivers (McCall et al. 1979), and as a source of Japanese cultured pearl nuclei (Fassler 1991). They are also important biomonitoring tools because they are relatively sedentary, moderately sized, widely distributed, long-lived (many species living for more than 30 years, Heller 1990), somewhat tolerant to pollution, and tend to bioaccumulate many contaminants.

The zoogeography of the mollusc family Unionidae in the Assiniboine River drainage has not been well documented. Clarke (1973) describes the known distribution of unionids within the drainage based on a limited survey and previous collections. Since Clarke's study little work has been conducted on the unionid fauna of the Assiniboine River or its tributaries.

Twelve species of unionid have been recorded from the Assiniboine River drainage. Clarke (1973) reported *Fusconaia flava* Rafinesque, *Amblema plicata* Say, *Quadrula quadrula* Rafinesque, *Lasmigona complanata complanata* Barnes, *Lasmigona compressa* Lea, *Anodontoides ferussacianus* Lea, *Pyganodon grandis* Say, *Strophitus undulatus* Say, *Ligumia recta* Lamarck, *Lampsilis siliquoidea* Barnes, and *Lampsilis ovata* Say. Scaife and Janusz reported *Potamilus alatus* Say from the Assiniboine River in 1992.

This report summarizes the data collected as part of a study conducted during the summers of 1995 and 1996. The primary purpose was to document the distribution and diversity of freshwater mussels in the Assiniboine River drainage in Manitoba.

METHODS

SAMPLING

The Assiniboine River has a drainage area of approximately 153,000 km^2, and can be characterized as a seventh order, low slope, turbid, prairie stream.

In the summer of 1995, a preliminary survey of the mussels in tributaries of the Assiniboine River was conducted. In addition, two trips were made down the lower Assiniboine River from Portage la Prairie, Manitoba, to its confluence with the Red River at Winnipeg. Sampling sites were selected by dividing the river into sixteen 10-km blocks to stratify the sampling, and randomly selecting one 1-km site within each block. A cross-section of the river was sampled at the beginning of each 1-km site. Mussels were collected by raking with a 12 tooth mini-bullrake five times at five equidistant points across the river (i.e. 25 rakes each transect). Depth and substrate type were recorded at each point. Collecting took approximately 30 minutes per site. The approximately 1000 km of Assiniboine River mainstem above Portage la Prairie was not sampled due to the lack of time and resources.

During the summer of 1996, a more rigorous survey of the mussel resources in tributaries of the Assiniboine River was undertaken. Sampling sites were selected according to accessibility at approximately 20 km intervals along Assiniboine River tributaries that were fourth order or larger. Thirty person-minutes were spent searching for mussels at each site by systematically walking back and forth across each site working in an upstream direction. In areas too deep or turbid for a visual search, mussels were collected by raking the

substrate with a 12 tooth mini-bullrake for 30 minutes. All individuals were fixed in 10% formalin, brought to the laboratory, stored in 70% ethanol, and later identified.

RECORDS

Where possible, the following were reported for each site: 1) Location, identified by road crossing or town name; 2) GPS position in latitude and longitude, to the nearest minute; 3) Date of the collection; 4) Stream order (ORD), as determined by Strahler's (1952) stream ordering method; 5) Stream width (W); 6) Substrate types utilized by living mussels, categorized as silt, sand, gravel, cobble and/or clay; 7) Water depth (D); 8) Species collected at each site; 9) Abundance (N) or evidence (EV, indicating the presence of empty valves only) of each species collected at a site.

Previous records from the drainage were taken primarily from Clarke's (1973) survey and the collections that he had re-examined.

Species and common names in this report are those used in Turgeon et al. (1998).

RESULTS AND DISCUSSION

Of the 185 sites visited, 63 yielded 523 live specimens of twelve species. First and second order sites were intermittent and harbored no mussels. Figure 1 shows the names of the major rivers and tributaries sampled. Figure 2 shows the locations of the collection sites. Collection records for this survey are summarized in Appendices 1 and 2 with species distributions shown in Figures 3-14. Previous collections from the Assiniboine River drainage are summarized in Appendix 3.

The distribution maps illustrate the macrohabitat preferences of the individual species. Species such as *Fusconaia flava*, *Amblema plicata*, *Quadrula quadrula*, *Potamilus alatus*, *Ligumia recta* and *Lampsilis ovata*, which are typical of large streams, were found only in the Assiniboine or high order tributaries. Large river species found in the high (5th and 6th) order tributaries could be assumed to occur in suitable habitats in the Assiniboine River mainstem above Portage la Prairie. Species typical of small streams, such as *Anodontoides ferussacianus* and *Lasmigona compressa*, were found primarily at low (3rd and 4th) order sites. Species such as *Lampsilis siliquoidea* and *Pyganodon grandis*, which have broad habitat tolerances, were found throughout the drainage.

The Assiniboine River drainage basin has been re-invaded by unionids following the retreat of the Wisconsin ice sheet which began about 11,500 years ago (Clayton 1983). The 12 unionid species recovered are probably of Mississippian origin, entering via a former confluence between the Minnesota (upper Mississippi) and Red rivers (Johnson 1980). Pro-glacial lakes and drainage courses would have provided initial migration routes for fish hosts (Stewart and Lindsey 1983), allowing the ubiquitous and cold-hardy *Pyganodon grandis* and *Lampsilis siliquoidea* to be the first invaders. Their fossil remains have been found in 11,500-year-old ice-contact deposits in North Dakota (Tuthill 1961, Tuthill et al. 1964). *Lasmigona compressa, Lampsilis siliquoidea* and *Anodontoides ferussacianus* may have invaded the Hudson Bay drainage from the Great Lakes-St. Lawrence River System via a connection with the Rainy River-Winnipeg River System at Saganaga Lake (Clarke 1973, Johnson 1980). The transfer of new biota (fish hosts and mussels) is still possible when the Minnesota and Red Rivers occasionally are joined during periods of high water at Big Stone Lake and Lake Traverse (Clarke 1973).

The fluted shell, *Lasmigona costata* Rafinesque, has been collected in the Red River (Cvancara 1970, Clarke 1973, Dall 1905) and Winnipeg River systems (Clarke 1973, unpublished data), but was not found in our survey. Further collections may eventually expand its range to include the Assiniboine River drainage.

This study provides some of the first baseline data on species occurrences in this drainage basin. Continued collections in the Assiniboine River drainage will be important to monitor changes in species distributions and to discover the occurrence of new freshwater mussel species, particularly the highly invasive zebra and quagga mussels.

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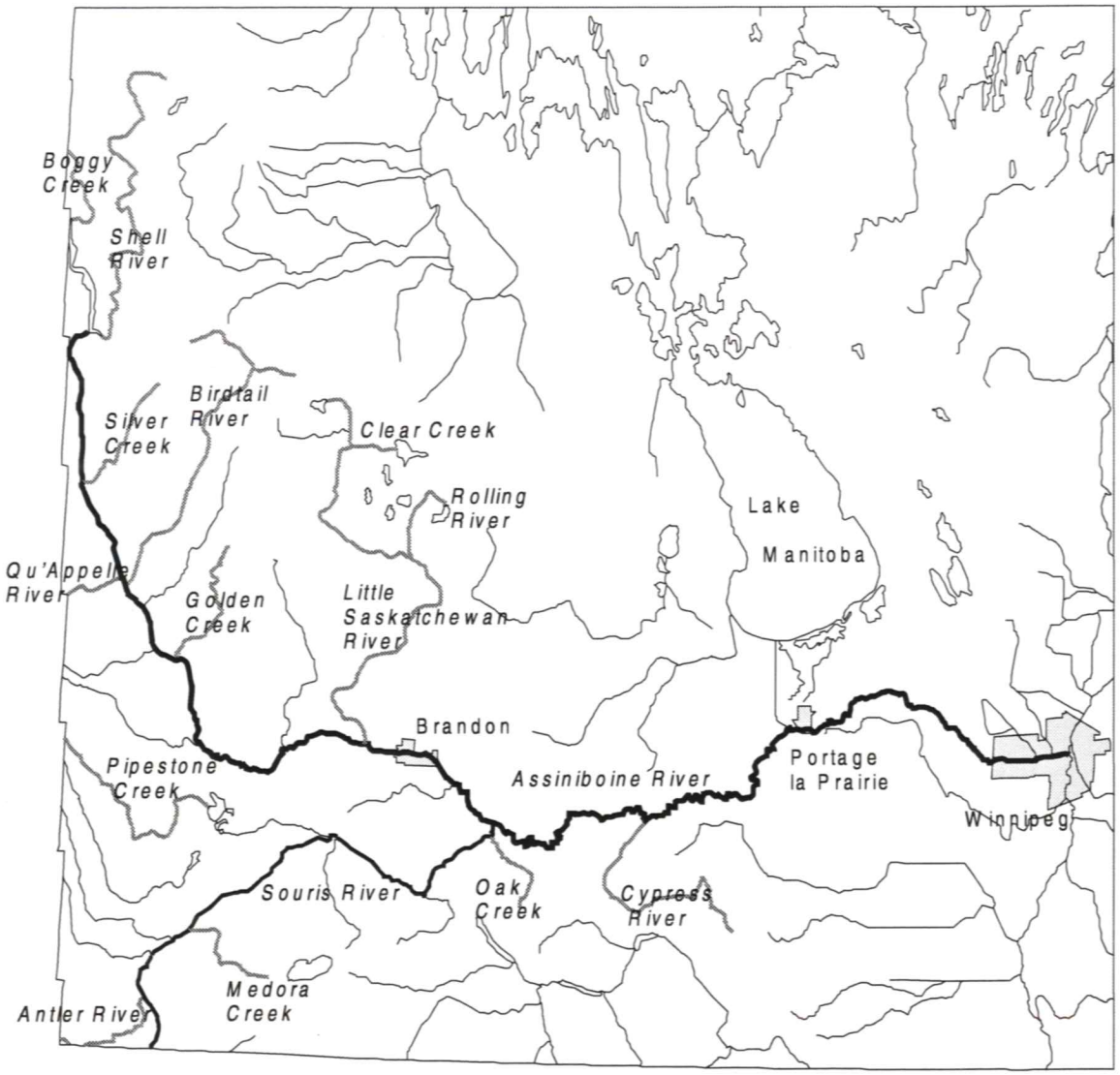

Figure 1. Reference map for the Assinboine River drainage in Manitoba.

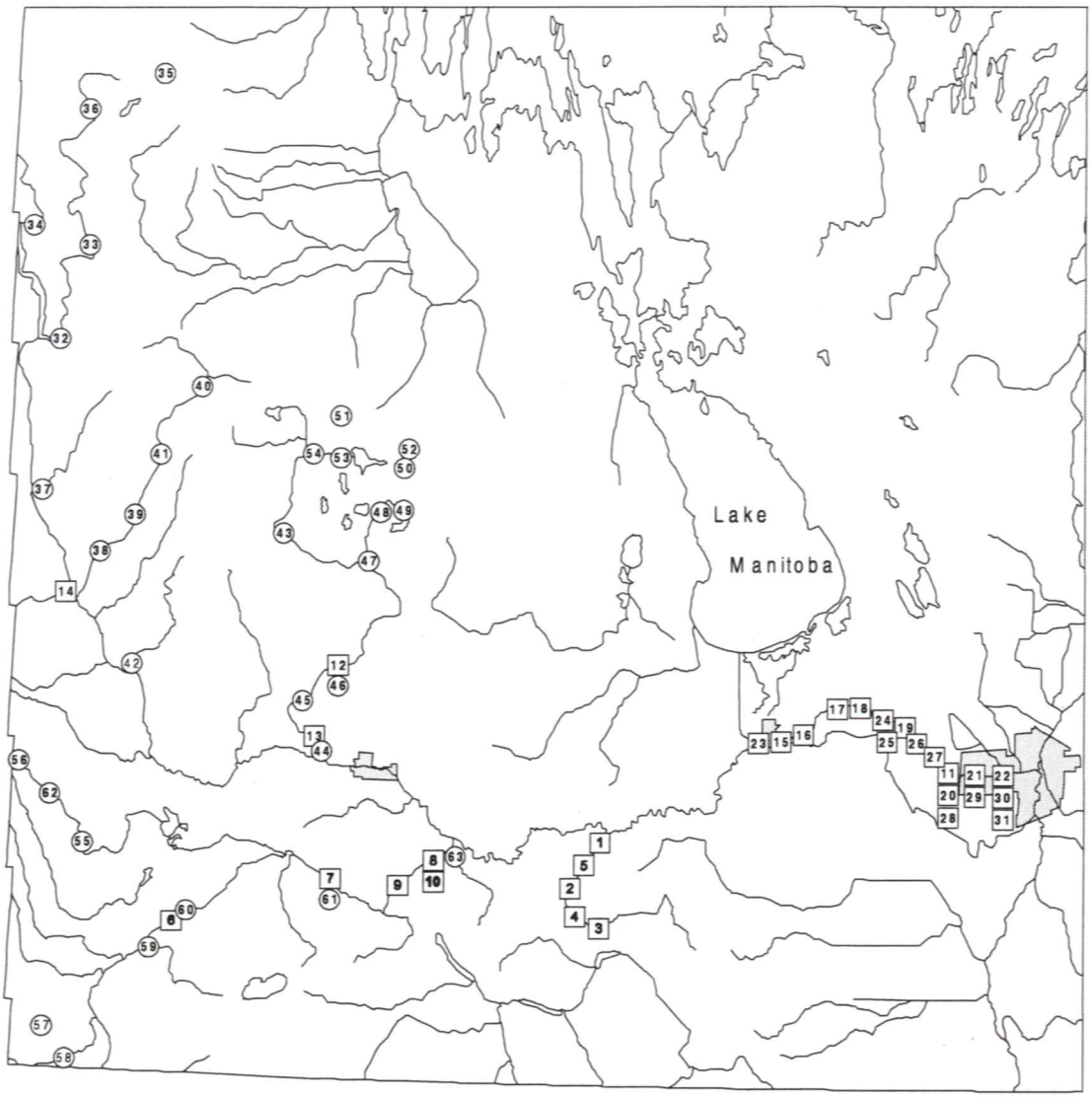

Figure 2. Sites of the 1995 (□) and 1996 (○) collections. Numbers refer to collections described in Appendix 1.

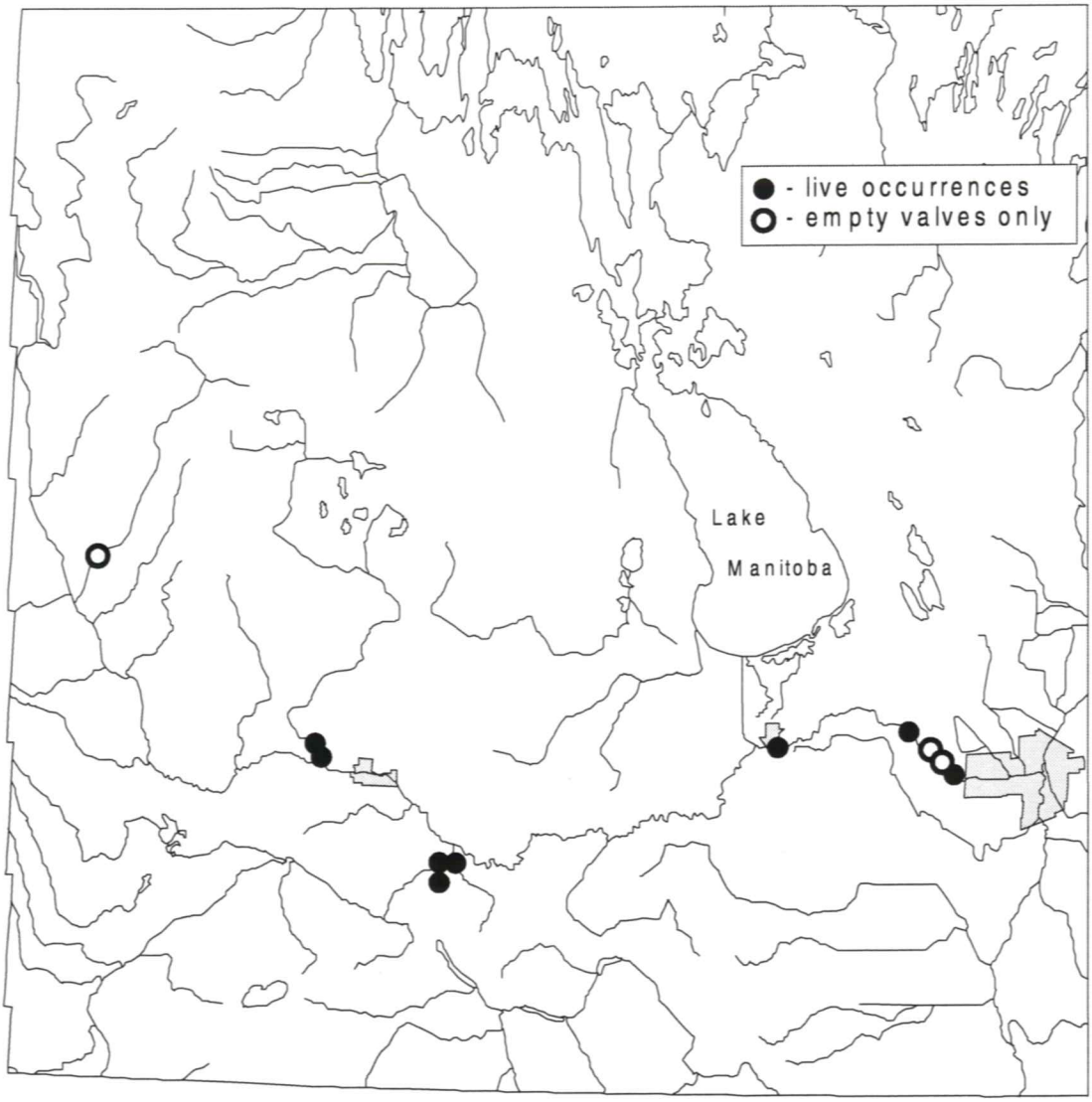

Figure 3. Collection localities for the pigtoe, *Fusconaia flava*.

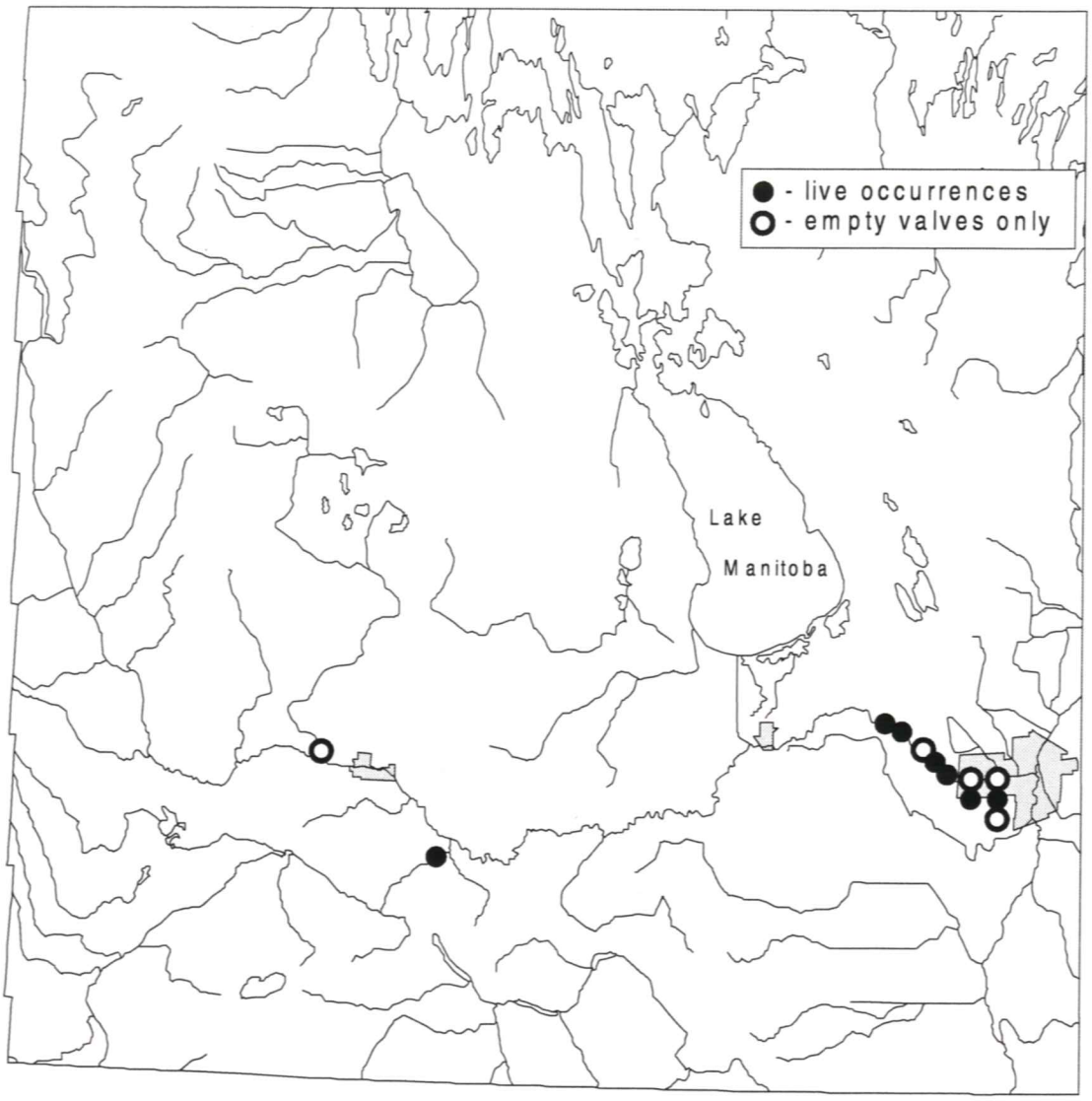

Figure 4. Collection localities for the threeridge, *Amblema plicata*.

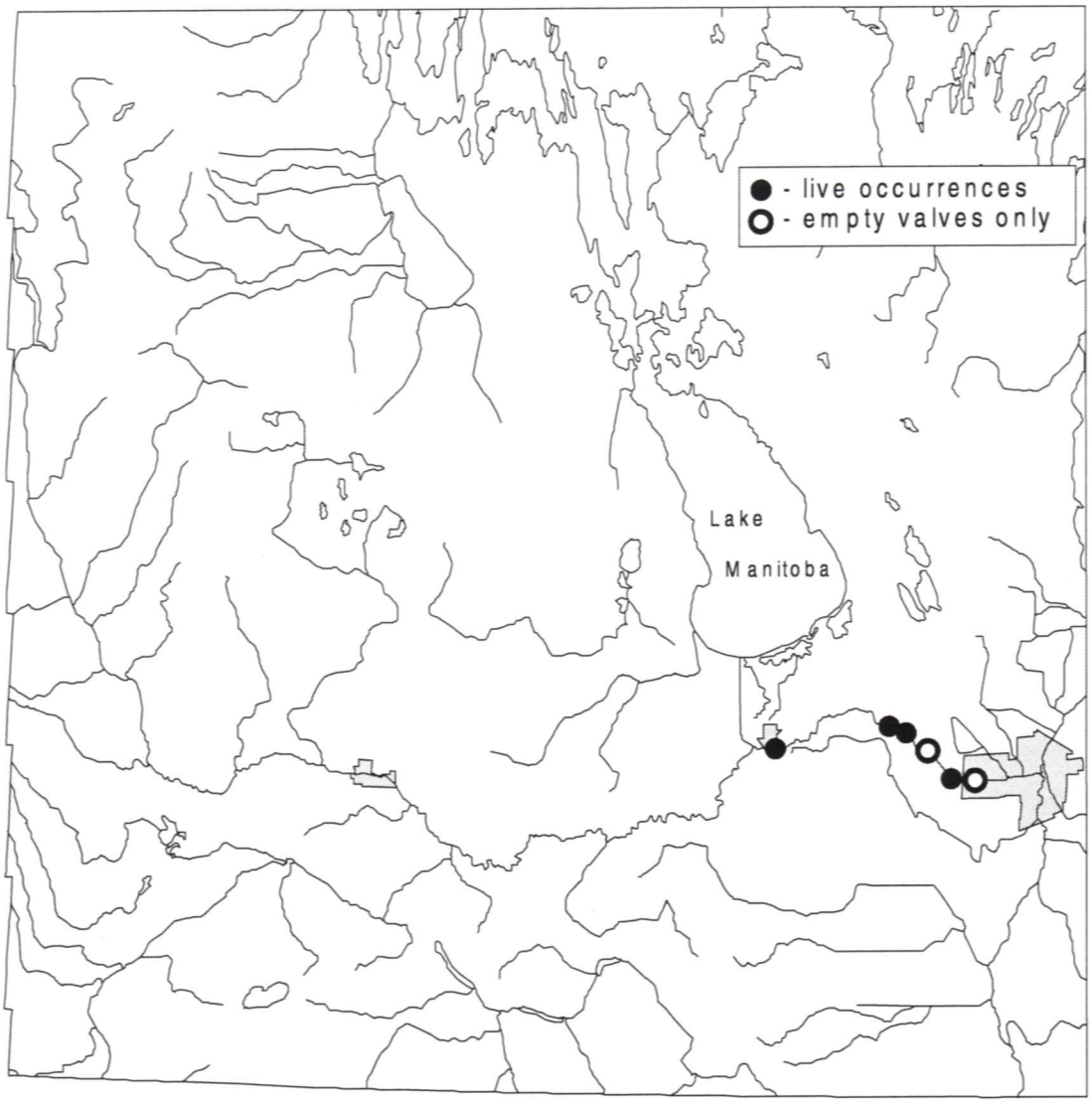

Figure 5. Collection localities for the mapleleaf, *Quadrula quadrula*.

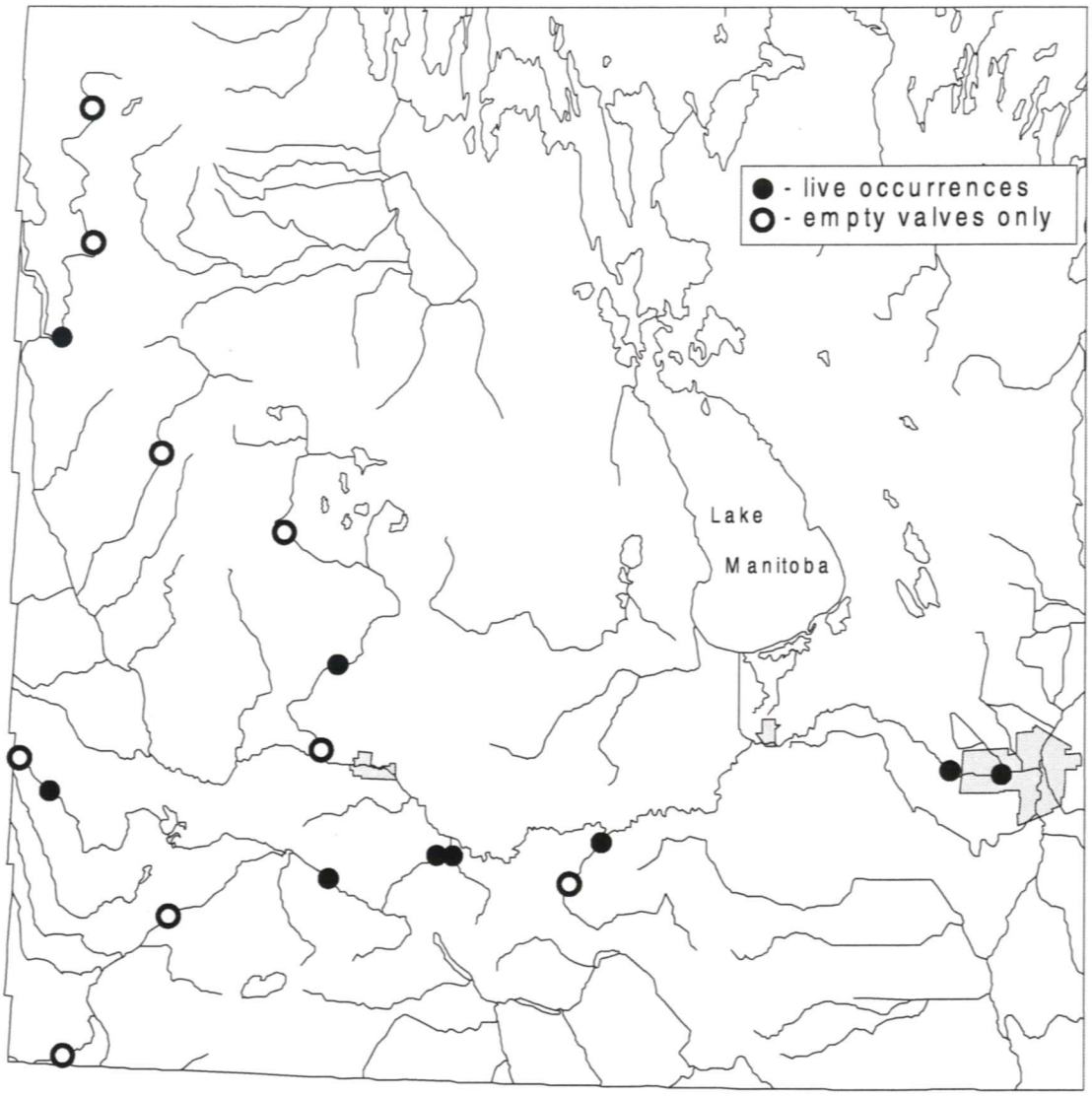

Figure 6. Collection localities for the white heelsplitter, *Lasmigona complanata complanata*.

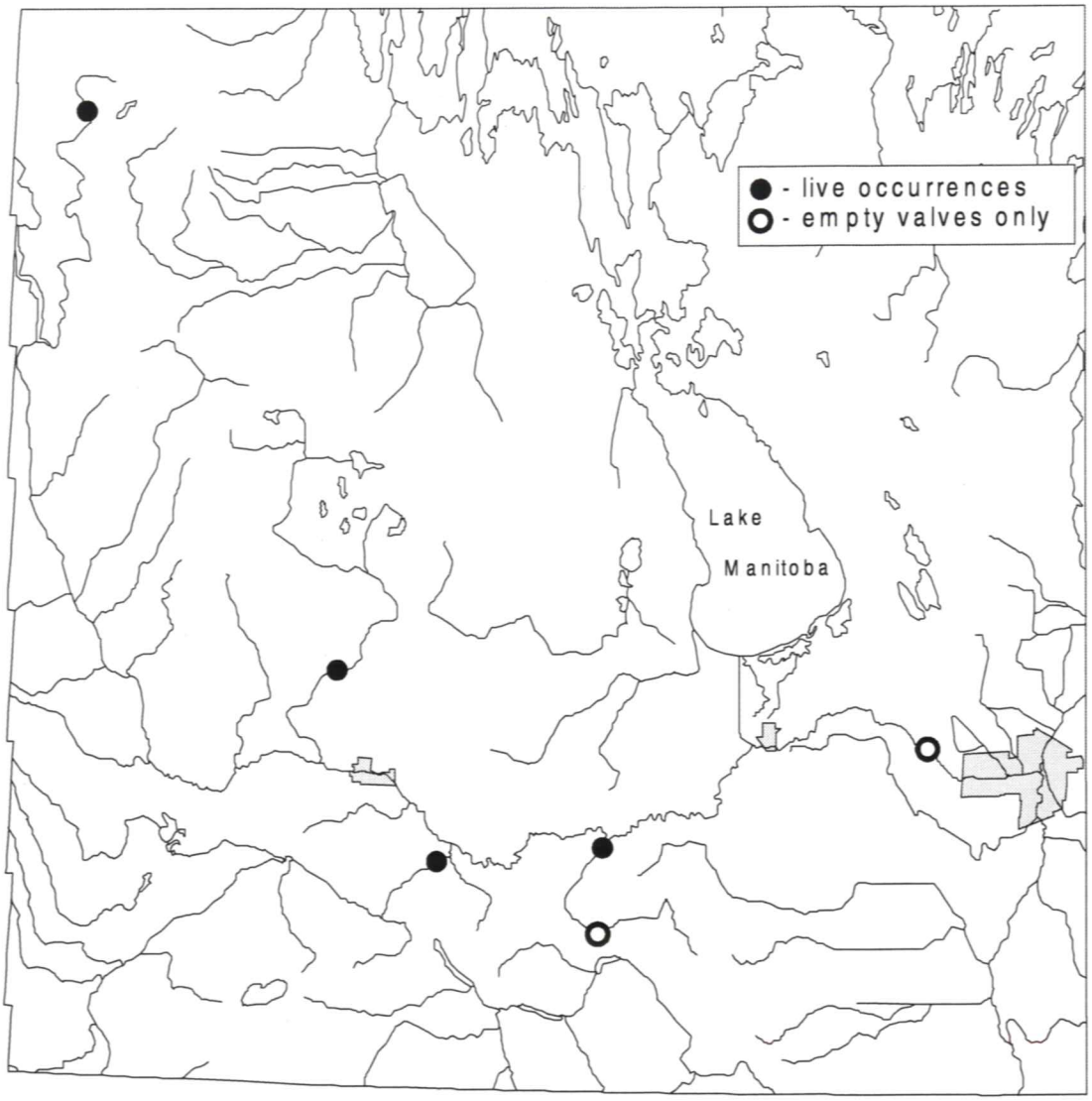

Figure 7. Collection localities for the creek heelsplitter, *Lasmigona compressa*.

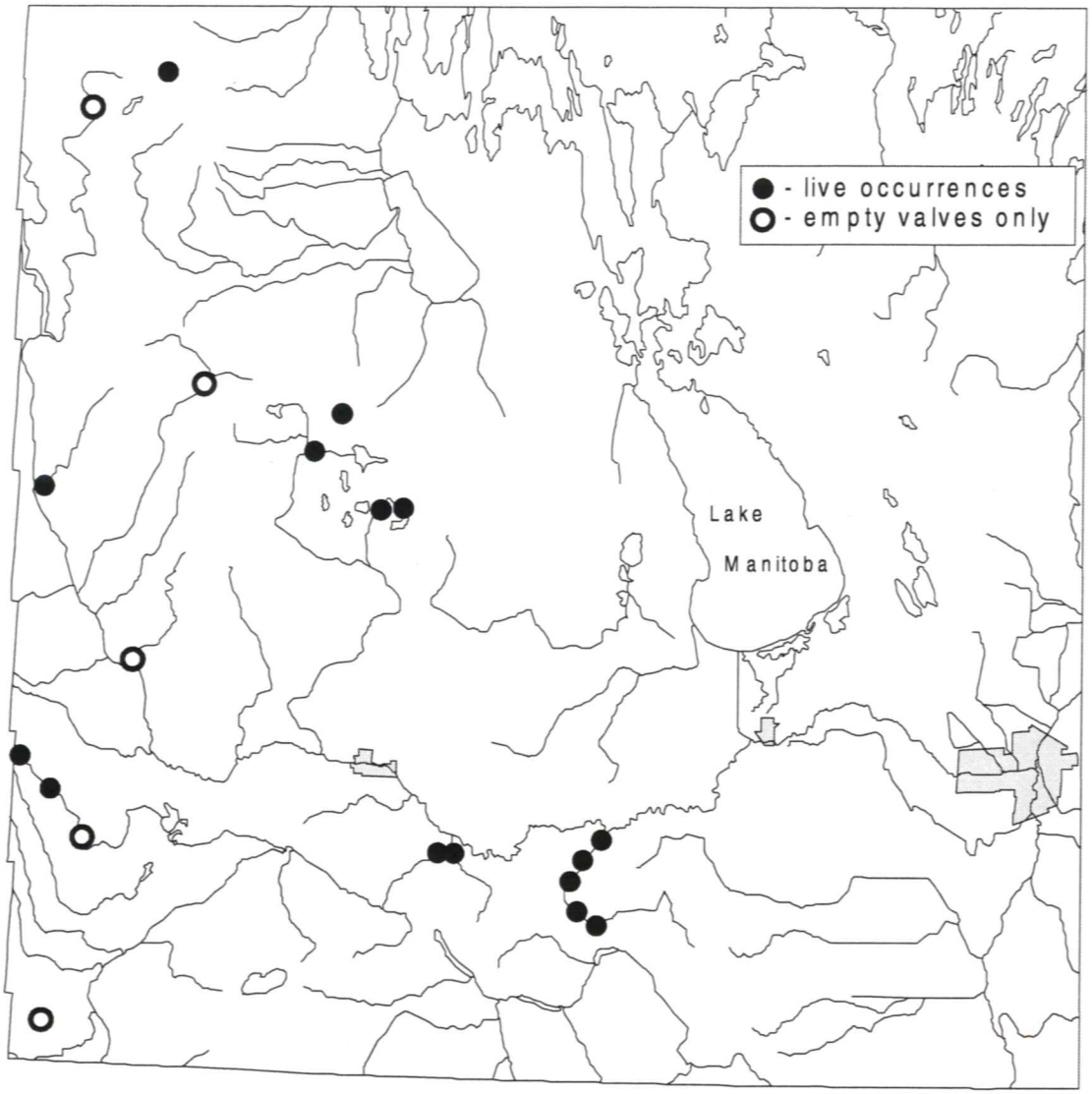

Figure 8. Collection localities for the cylindrical floater, *Anodontoides ferussacianus*.

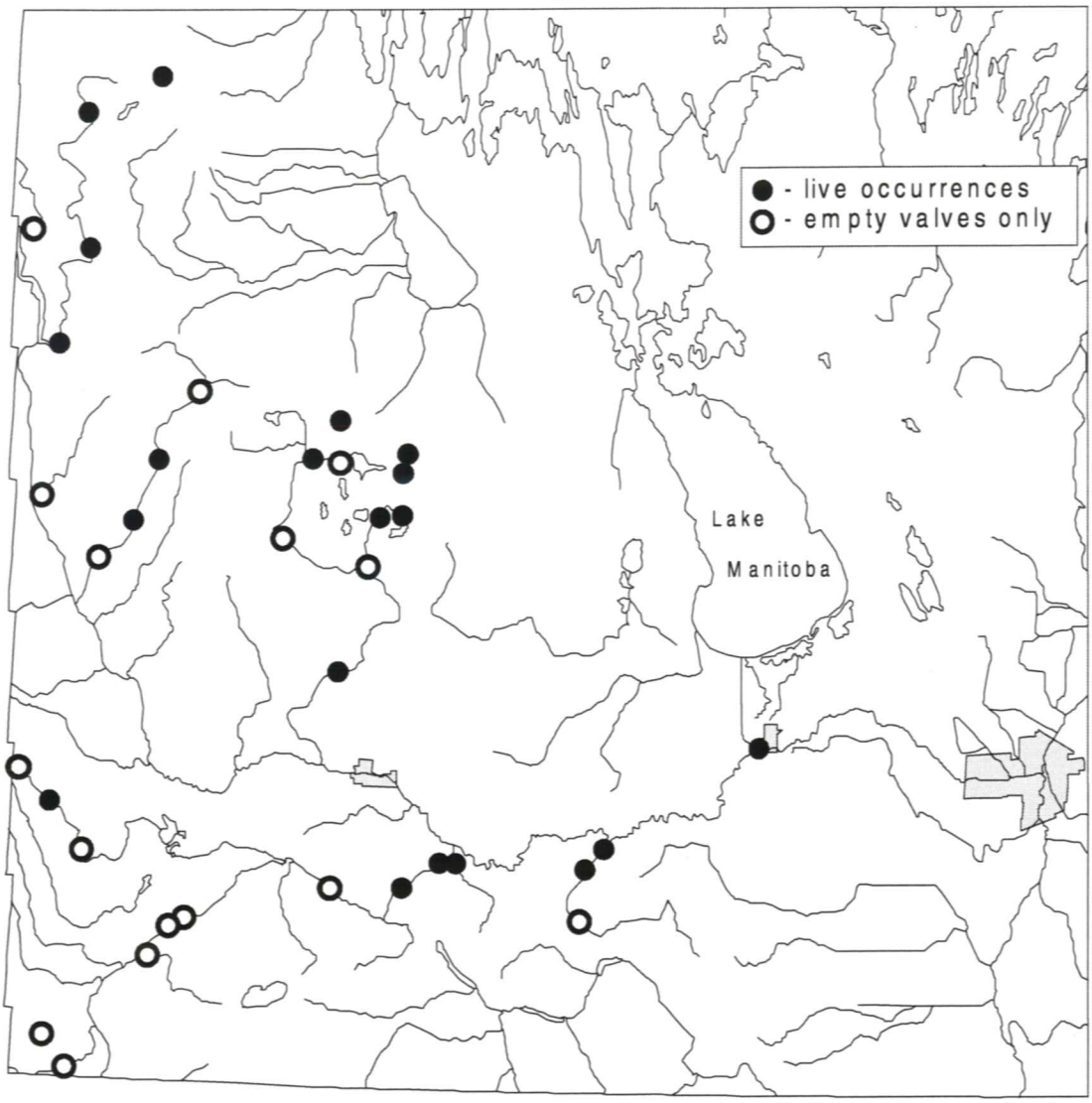

Figure 9. Collection localities for the giant floater, *Pyganodon grandis*.

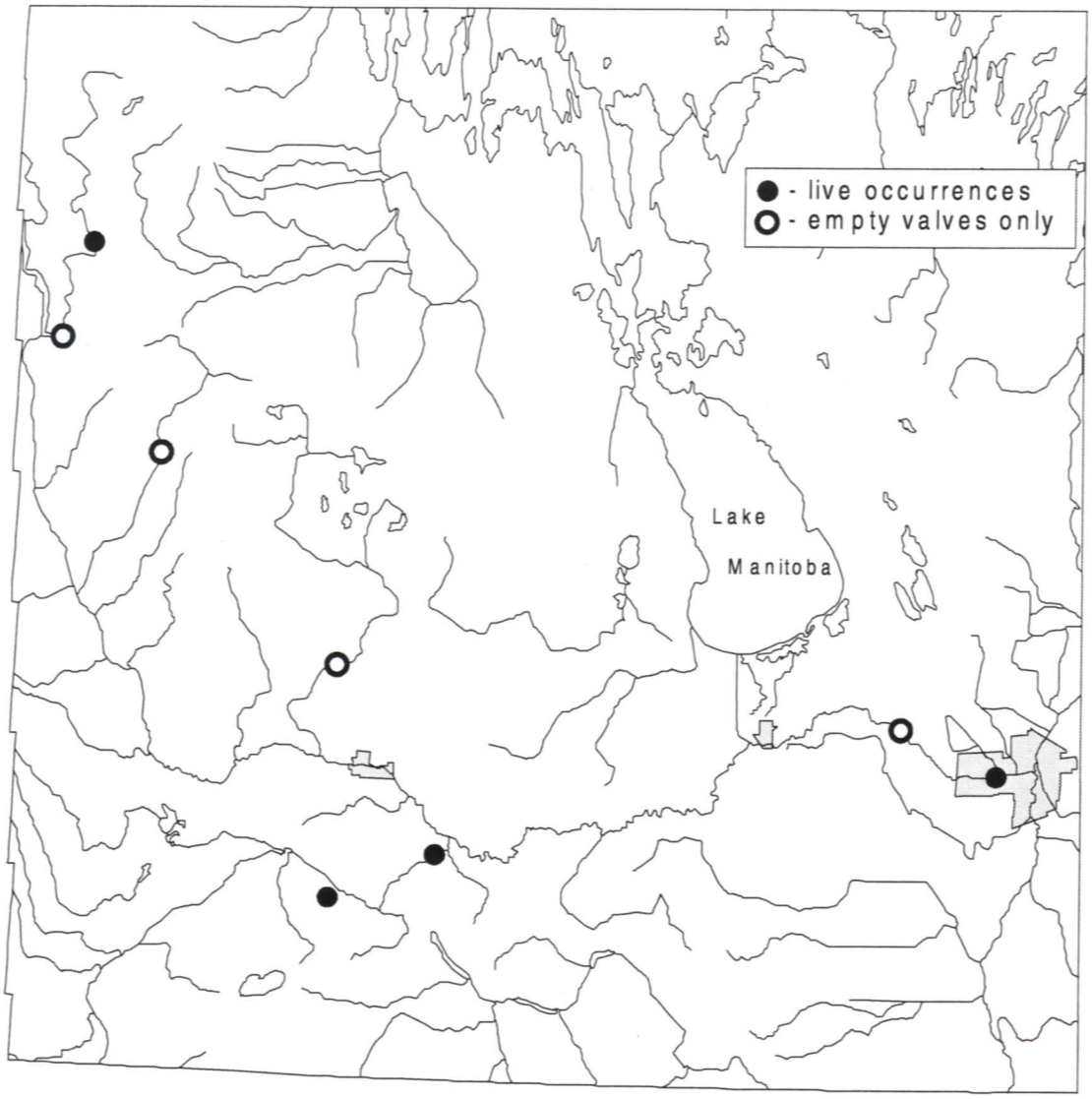

Figure 10. Collection localities for the squawfoot, *Strophitus undulatus*.

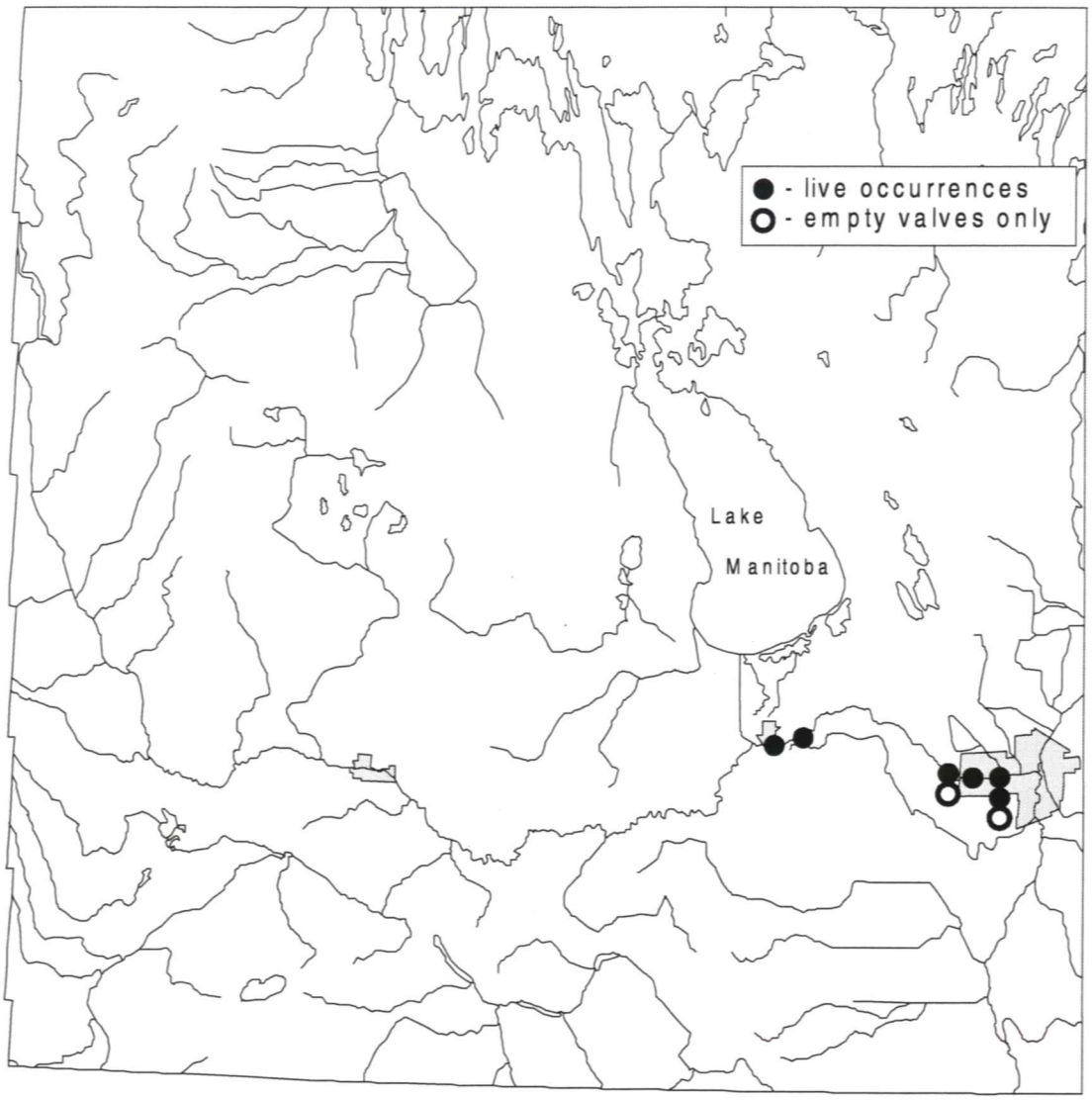

Figure 11. Collection localities for the pink heelsplitter, *Potamilus alatus*.

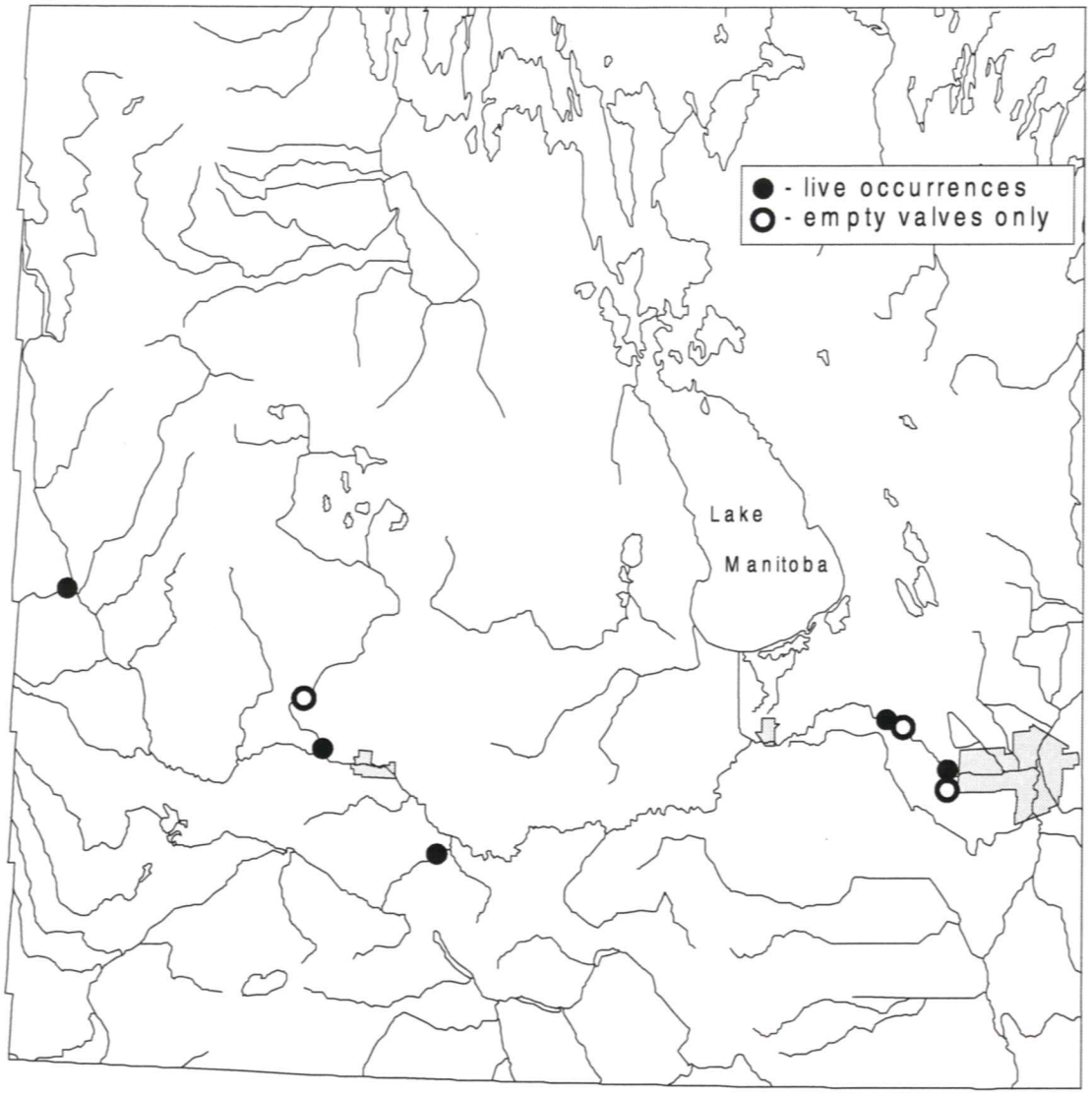

Figure 12. Collection localities for the black sandshell, *Ligumia recta*.

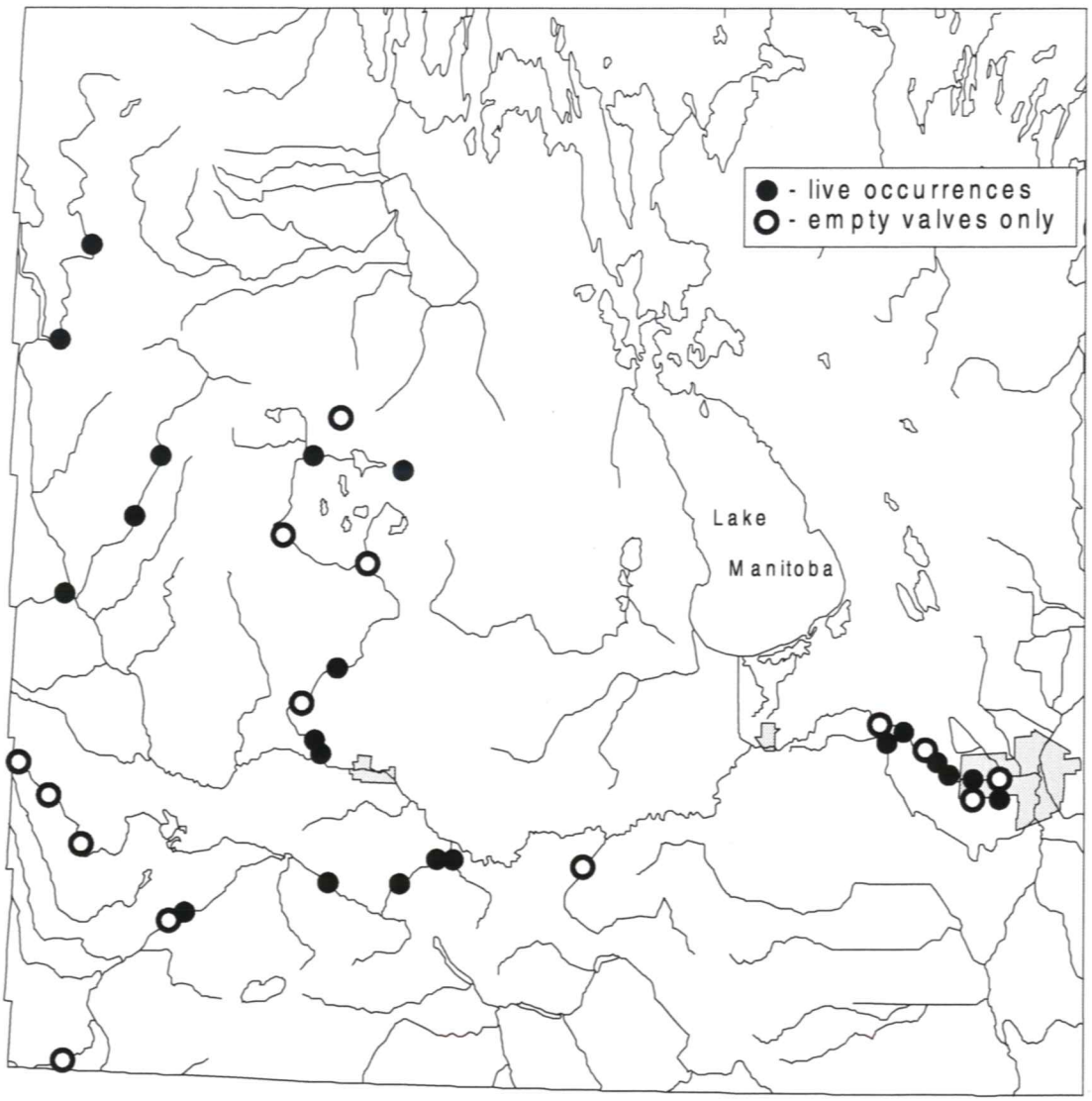

Figure 13. Collection localities for the fatmucket, *Lampsilis siliquoidea*.

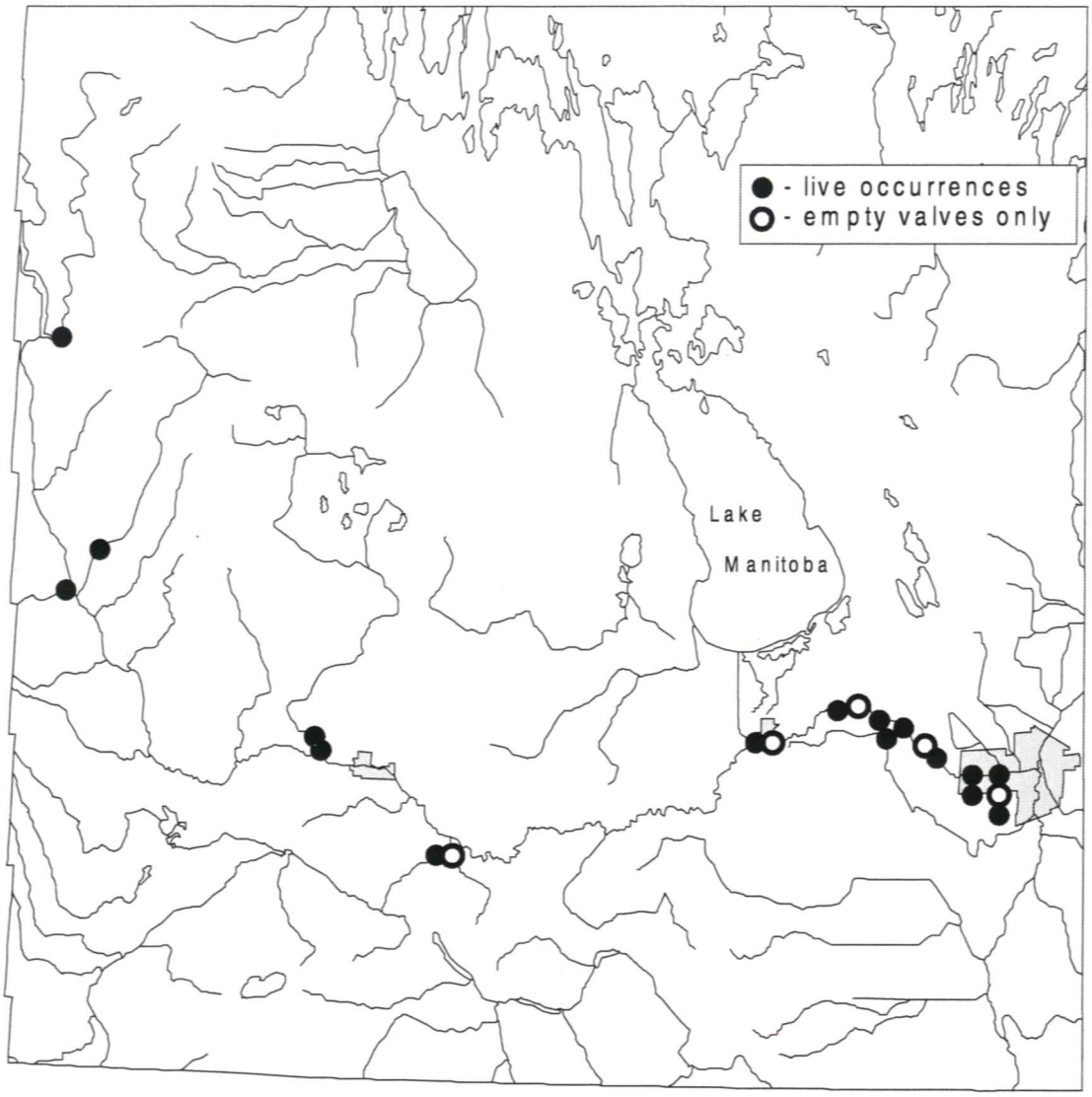

Figure 14. Collection localities for the pocketbook, *Lampsilis ovata*.

APPENDIX 1: SPECIES AND PHYSICAL DATA AT EACH LOCATION

LOCATION	N LAT. W LONG.	DATE	ORD	W(m)	SUBSTRATE	D(cm)	SPECIES	N
1. Cypress River,	49°39'	5/4/96	4		silt/fine shale	75	*Lasmigona complanata*	1
5 mi N of Holland and 3 mi W of PTH 34	98°55'				silt/fine shale	75	*Lasmigona compressa*	1
					silt/fine shale	75	*Anodontoides ferussacianus*	5
					silt/fine shale	75	*Pyganodon grandis*	3
2. Cypress River,	49°32'	5/4/95	3				*Lasmigona complanata*	EV
1 mi E of Cypress River and 1 mi S of PTH 2	99°06'				shale	75	*Anodontoides ferussacianus*	13
3. Cypress River,	49°26'	5/11/95	3				*Lasmigona compressa*	EV
St. Alphonse	98°59'				fine shale	15	*Anodontoides ferussacianus*	12
4. Cypress River,	49°27'	5/11/95	3		silt/sand	50	*Anodontoides ferussacianus*	24
1.5 mi N and 1 mi W of St. Alphonse	98°01'						*Pyganodon grandis*	EV
5. Cypress River,	49°35'	5/11/95	3		mud	75	*Anodontoides ferussacianus*	5
6 mi W of Holland and 6 mi N of PTH 2	99°01'				cobble	75	*Pyganodon grandis*	7
							Lampsilis siliquoidea	EV
6. Souris River,	49°23'	5/18/95	6				*Lasmigona complanata*	EV
PR 345 (9 mi E of Bede)	100°45'						*Pyganodon grandis*	EV
							Lampsilis siliquoidea	EV
7. Souris River,	49°32'	5/18/95	6		shale/cobble	100	*Lasmigona complanata*	1
Bunclody	100°03'				shale/cobble	100	*Lampsilis siliquoidea*	5
8. Souris River,	49°37'	5/18/95	6		cobble/gravel/silt	100	*Fusconaia flava*	25
PR 340 (.5 mi E and .5 mi S of Treesbank)	99°35'				cobble/gravel/silt	100	*Amblema plicata*	3
					cobble/gravel/silt	100	*Lasmigona complanata*	14
					cobble/gravel/silt	100	*Anodontoides ferussacianus*	2
					cobble/gravel/silt	100	*Pyganodon grandis*	4
					cobble/gravel/silt	100	*Strophitus undulatus*	1
					cobble/gravel/silt	100	*Ligumia recta*	2
					cobble/gravel/silt	100	*Lampsilis siliquoidea*	6
					cobble/gravel/silt	100	*Lampsilis ovata*	6

LOCATION	N LAT. W LONG.	DATE	ORD	W(m)	SUBSTRATE	D(cm)	SPECIES	N
9. Souris River,	49°34'	6/28/95	5	20.8	silt	75	*Pyganodon grandis*	9
PTH 2 (1 mi S and 1.5 mi E of Wawanesa)	99°43'				silt	75	*Lampsilis siliquoidea*	8
10. Souris River,	49°37'	6/29/95	6		gravel/sand	50	*Fusconaia flava*	1
PR 340 (.5 mi E and .5 mi S of Treesbank)	99°35'				sand	20	*Lasmigona complanata*	6
					gravel/sand	50	*Lasmigona compressa*	1
					sand	20	*Anodontoides ferussacianus*	4
							Pyganodon grandis	EV
							Strophitus undulatus	EV
					sand	20	*Ligumia recta*	2
					sand	20	*Lampsilis siliquoidea*	8
					sand	20	*Lampsilis ovata*	1
11. Assiniboine River,	49°53'	7/12/95	7		silty sand	150	*Fuconaia flava*	1
Hwy 1	97°30'				silty sand	150	*Amblema plicata*	9
					silty sand	150	*Potamilus alatus*	16
					silty sand	150	*Ligumia recta*	2
					silty sand	150	*Lampsilis siliquoidea*	3
12. Little Saskatchewan River,	50°06'	7/19/95	5		cobble	20	*Lasmigona complanata*	1
1 mi S and 3 mi W of Rapid City	100°07'				sand	52	*Lasmigona compressa*	2
					sand	52	*Pyganodon grandis*	2
					sand	52	*Strophitus undulatus*	1
					cobble	20	*Lampsilis siliquoidea*	22
13. Little Saskatchewan River,	49°54'	7/20/95	5		cobble/sand	50	*Fusconaia flava*	1
4 mi S and 2 mi E of Carnegie	100°08'				cobble/sand	50	*Lampsilis siliquoidea*	2
					cobble/sand	50	*Lampsilis ovata*	1
14. Qu'Appelle River,	50°27'	7/26/95			sand	50	*Ligumia recta*	2
1 mi W of St.Lazare	101°25'					50	*Lampsilis siliquoidea*	11
						50	*Lampsilis ovata*	2
15. Assiniboine River,	49°56'	8/9/95	7		cobble/sand	135	*Fusconaia flava*	1
river km 154	98°17'				cobble/sand	135	*Quadrula quadrula*	1
					gravel/sand/clay	100	*Potamilus alatus*	1
							Lampsilis ovata	EV

LOCATION	N LAT W LONG.	DATE	ORD	W(m)	SUBSTRATE	D(cm)	SPECIES	N
16. Assiniboine River, river km 140	49°57' 98°09'	8/11/95	7		silt/sand	193	*Potamilus alatus*	1
17. Assiniboine River, river km 115	50°01' 97°59'	8/11/95	7		sand	88	*Lampsilis ovata*	1
18. Assiniboine River, river km 109	46°39' 99°06'	8/12/95	7				*Lampsilis ovata*	EV
19. Assiniboine River, river km 73	49°59' 97°41'	8/12/95	7		sand	95	*Fusconaia flava*	1
					gravel/sand	128	*Quadrula quadrula*	1
					sand/cobble	88	*Amblema plicata*	3
							Strophitus undulatus	EV
							Ligumia recta	EV
					gravel/sand	128	*Lampsilis siliquoidea*	1
					sand/gravel	90	*Lampsilis ovata*	1
20. Assiniboine River, river km 47	49°54' 97°32'	8/13/95	7		clay/cobble/sand	160	*Quadrula quadrula*	1
					clay/cobble/sand	160	*Lasmigona complanata*	1
							Ligumia recta	EV
21. Assiniboine River, river km 28	49°52' 97°25'	8/13/95	7				*Amblema plicata*	EV
					cobble/gravel	161	*Potamilus alatus*	1
					cobble/gravel	175	*Lampsilis siliquoidea*	2
					cobble/gravel	193	*Lampsilis ovata*	1
22. Assiniboine River, river km 15	49°51' 97°16'	8/17/95	7				*Amblema plicata*	EV
					clay/cobble	190	*Potamilus alatus*	1
							Lampsilis siliquoidea	EV
					silt/debris	136	*Lampsilis ovata*	1
23. Assiniboine River, river km 157	49°57' 98°19'	9/15/95	7		gravel/sand	145	*Pyganodon grandis*	1
					clay/gravel/sand	115	*Lampsilis ovata*	1
24. Assiniboine River, river km 84	50°00' 97°46'	9/16/95	7				*Lampsilis siliquoidea*	EV
					sand/clay/silt	120	*Lampsilis ovata*	1
25. Assiniboine River, river km 77		9/17/95	7		sand/cobble/clay	140	*Amblema plicata*	1
					sand/cobble/clay	140	*Quadrula quadrula*	1

LOCATION	N LAT W LONG.	DATE	ORD	W(m)	SUBSTRATE	D(cm)	SPECIES	N
					sand/cobble/clay	140	*Ligumia recta*	1
					sand/cobble/clay	140	*Lampsilis siliquoidea*	1
					sand/cobble/clay	140	*Lampsilis ovata*	3
26. Assiniboine River, river km 64	49°57' 97°38'	9/17/95	7				*Fusconaia flava*	EV
							Amblema plicata	EV
							Quadrula quadrula	EV
							Lasmigona compressa	EV
							Lampsilis siliquoidea	EV
							Lampsilis ovata	EV
27. Assiniboine River, river km 57	49°55' 97°35'	9/17/95	7				*Fusconaia flava*	EV
					cobble/clay	93	*Amblema plicata*	3
					cobble/clay	93	*Lampsilis siliquoidea*	2
					cobble/clay	93	*Lampsilis ovata*	1
28. Assiniboine River, river km 45	49°53' 97°30'	9/17/95	7		sand/clay	240	*Potamilus alatus*	EV
29. Assiniboine River, river km 32	49°51' 97°27'	9/18/95	7		sand/clay	105	*Quadrula quadrula*	2
					sand/clay	105	*Amblema plicata*	2
							Lampsilis siliquoidea	EV
					sand/clay	82	*Lampsilis ovata*	1
30. Assiniboine River, river km 23	49°52' 97°22'	9/18/95	7		cobble/sand	99	*Amblema plicata*	1
					gravel/sand	208	*Potamilus alatus*	1
					sand/cobble	108	*Potamilus alatus*	1
					sand/cobble	108	*Lampsilis siliquoidea*	1
							Lampsilis ovata	EV
31. Assiniboine River, river km 18	49°52' 97°19'	9/18/95	7				*Amblema plicata*	EV
					cobble/gravel/sand	148	*Lasmigona complanata*	2
					gravel/cobble	87	*Stophitus undulatus*	1
							Potamilus alatus	EV
					gravel/cobble	87	*Lampsilis ovata*	1
32. Shell River, PTH 83 (1 mi N and 2 mi E of Inglis)	50°57' 101°18'	7/3/96	5	18.4	silt/gravel	51	*Lasmigona complanata*	1
					silt/gravel	51	*Pyganodon grandis*	1

LOCATION	N LAT W LONG.	DATE	ORD	W(m)	SUBSTRATE	D(cm)	SPECIES	N
							Strophitus undulatus	EV
					silt/gravel	51	*Lampsilis siliquoidea*	3
					silt/gravel	51	*Lampsilis ovata*	1
33. Shell River,	51°11'	7/3/96	5	23.3			*Lasmigona complanata*	EV
PTH 5 (1 mi N of Shevlin)	101°15'				sand/silt	68	*Pyganodon grandis*	1
					sand/silt	68	*Strophitus undulatus*	2
					sand/silt	68	*Lampsilis siliquoidea*	2
34. Boggy Creek,	51°16'	7/3/96		8.5			*Pyganodon grandis*	EV
6 mi W and 3 mi N of Roblin	101°29'							
35. East Shell River,	51°41'	7/4/96	3		silt		*Anodontoides ferussacianus*	16
PR 366 (6 mi N of PR 367 and 7 mi S of PR 271)	100°39'				silt		*Pyganodon grandis*	1
36. Shell River,	51°36'	7/4/96	5	9.8			*Lasmigona complanata*	EV
PR 367 (6 mi E and 2.5 mi N of Boggy Creek)	101°15'				gravel/cobble/silt	42	*Lasmigona compressa*	1
							Anodontoides ferussacianus	EV
					gravel/cobble/silt	42	*Pyganodon grandis*	5
37. Silver Creek,	50°33'	7/5/96	4	4.1	gravel/silt/sand	34	*Anodontoides ferussacianus*	4
1.5 mi E and 2.5 S of Gambler	101°22'						*Pyganodon grandis*	EV
38. Birdtail River,	50°22'	7/5/96	4	20.8			*Fusconaia flava*	EV
PR 477 (3 mi S and 4 mi W of Birtle)	101°08'						*Pyganodon grandis*	EV
							Lampsilis ovata	EV
39. Birdtail River,	50°30'	7/5/96	4	13.6	shale/silt	52	*Pyganodon grandis*	5
PTH 16 (1 mi N and 1.5 mi W of Solsgirth)	100°57'				shale/silt	52	*Lampsilis siliquoidea*	2
40. Birdtail River,	50°50'	7/6/96	3				*Anodontoides ferussacianus*	EV
1 mi N and 1 mi E of Mears	100°42'						*Pyganodon grandis*	EV
41. Birdtail River,	50°37'	7/6/96	4	15			*Lasmigona complanata*	EV
PR 359 (7 mi W of Vista)	100°52'				silt/shale/gravel	46	*Pyganodon grandis*	3
							Strophitus undulatus	EV
					silt/shale/gravel	46	*Lampsilis siliquoidea*	4

LOCATION	N LAT. W LONG.	DATE	ORD	W(m)	SUBSTRATE	D(cm)	SPECIES	N
42. Golden Creek, 1 mi S and 1 mi E of Glenlochar	50°05' 100°57'	7/8/96	4	6.5			*Anodontoides ferussacianus*	EV
43. Little Saskatchewan River, PR 354 (3 mi S of Elphinstone)	50°28' 100°19'	7/8/96	4	17.5			*Lasmigona complanata*	EV
							Pyganodon grandis	EV
							Lampsilis siliquoidea	EV
44. Little Saskatchewan River, 1.2 mi NW of Grand Valley Prov. Rec. Park	49°52' 100°06'	7/9/96	5	16.6	sand/gravel	42	*Fusconaia flava*	1
							Amblema plicata	EV
							Lasmigona complanata	EV
					sand/gravel	42	*Ligumia recta*	5
					sand/gravel	42	*Lampsilis siliquoidea*	2
					sand/gravel	42	*Lampsilis ovata*	11
45. Little Saskatchewan River, 1 mi S of Rivers	50°01' 100°14'	7/9/96	5	9.1			*Ligumia recta*	EV
							Lampsilis siliquoidea	EV
46. Little Saskatchewan River, 1 mi S and 3 mi W of Rapid City	50°06' 100°07'	7/9/96	5	22.8			*Lasmigona complanata*	EV
					silt/cobble	31	*Pyganodon grandis*	4
							Strophitus undulatus	EV
					silt/cobble	31	*Lampsilis siliquoidea*	16
47. Rolling River, 7.5 mi S and 2 mi W of Erikson	50°23' 99°57'	7/10/96	5	11			*Pyganodon grandis*	EV
							Lampsilis siliquoidea	EV
48. Rolling River, 3.5 mi N of Erickson	50°32' 99°54'	7/10/96	5	10.5	silt		*Anodontoides ferussacianus*	1
					silt		*Pyganodon grandis*	1
49. Rolling River, PR 263 (1 mi N and .5 mi W of Scandinavia)	50°32' 99°45'	7/10/96	4	10.1	silt		*Anodontoides ferussacianus*	5
					silt		*Pyganodon grandis*	2
50. Whirlpool River, PTH 19	50°43' 99°50'	7/30/96	4	9.1	gravel/silt/sand	55	*Pyganodon grandis*	10
					gravel/silt/sand	55	*Lampsilis siliquoidea*	11
51. Jackfish Creek, 5 mi N and 4 mi E of Lake Audy	50°47' 100°08'	7/31/96	3	9.1	gravel/silt/sand	27	*Anodontoides ferussacianus*	4
					gravel/silt/sand	27	*Pyganodon grandis*	1
52. Whirlpool River, Whirlpool Lake	50°42' 99°48'	7/31/96	3	7.7	gravel/sand	52	*Pyganodon grandis*	21

LOCATION	N LAT. W LONG.	DATE	ORD	W(m)	SUBSTRATE	D(cm)	SPECIES	N
53. Clear Creek, 1 mi E of Crawford Park	50°50' 100°05'	8/1/96	3	16.7			*Pyganodon grandis*	EV
54. Clear Creek, PR 354 (1.5 mi S and 1 mi W of Lake Audy)	50°41' 100°09'	8/1/96	3	6.5	sand/gravel/silt	34	*Anodontoides ferussacianus*	2
					sand/gravel/silt	34	*Pyganodon grandis*	5
					sand/gravel/silt	34	*Lampsilis siliquoidea*	1
55. Pipestone Creek, 4 mi N of Reston	49°37' 101°05'	8/12/96		10.5			*Anodontoides ferussacianus*	EV
							Pyganodon grandis	EV
							Lampsilis siliquoidea	EV
56. Pipestone Creek, 1.5 mi W of Kola	49°50' 101°23'	8/12/96		14.6			*Lasmigona complanata*	EV
					sand	58	*Anodontoides ferussacianus*	2
							Pyganodon grandis	EV
							Lampsilis siliquoidea	EV
57. Gainsborough Creek, 3 mi W and 1.5 mi N of Lyleton	49°04' 101°14'	8/13/96					*Anodontoides ferussacianus*	EV
							Pyganodon grandis	EV
58. Antler River, 2 mi S and 2 mi E of Lyleton	49°01' 101°08'	8/13/96		8.1			*Lasmigona complanata*	EV
							Pyganodon grandis	EV
							Lampsilis siliquoidea	EV
59. Medora Creek, 1 mi E and 1 mi N of Napinka	49°20' 100°49'	8/13/96	3	4.3			*Pyganodon grandis*	EV
60. Souris River, 2 mi N and 1.5 mi W of Lauder		8/13/96	6	36			*Pyganodon grandis*	EV
					silt/sand		*Lampsilis siliquoidea*	10
61. Souris River, Bunclody	49°32' 100°03'	8/14/96	6	48.3	shale		*Lasmigona complanata*	4
							Pyganodon grandis	EV
					shale		*Strophitus undulatus*	1
					shale		*Lampsilis siliquoidea*	5
62. Pipestone Creek, Cromer	49°44' 101°14'	8/15/96		13.6	sand/silt/gravel	55	*Lasmigona complanata*	1
					sand/silt/gravel	55	*Anodontoides ferussacianus*	11
					sand/silt/gravel	55	*Pyganodon grandis*	4
							Lampsilis siliquoidea	EV

LOCATION	N LAT. W LONG.	DATE	ORD	W(m)	SUBSTRATE	D(cm)	SPECIES	N
63. Oak Creek,	49°37'	8/22/96	4	5.5	sand	26	*Fusconaia flava*	2
1 mi S and 2 mi E of Treesbank	99°34'				sand	26	*Lasmigona complanata*	2
					sand	26	*Anodontoides ferussacianus*	2
					sand	26	*Pyganodon grandis*	8
					sand	26	*Lampsilis siliquoidea*	9
							Lampsilis ovata	EV

ORD = stream order; W = stream width; D = depth; N = number of individuals; EV = empty valves

APPENDIX 2: LOCATIONS OF SPECIES

SPECIES	LOCATION
Fusconaia flava	Assiniboine River, Hwy 1 Assiniboine River, river km 57 Assiniboine River, river km 64 Assiniboine River, river km 73 Assiniboine River, river km 154 Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank) Souris River, PTH 2 (1 mi S and 1.5 mi E of Wawanesa) Little Saskatchewan River, 1.2 mi NW of Grand Valley Prov Rec Park Little Saskatchewan River, 4 mi S and 2 mi E of Carnegie Birdtail River, PR 477 (3 mi S and 4 mi W of Birtle) Oak Creek, 1 mi S and 2 mi E of Treesbank
Amblema plicata	Assiniboine River, Hwy 1 Assiniboine River, river km 15 Assiniboine River, river km 18 Assiniboine River, river km 23 Assiniboine River, river km 28 Assiniboine River, river km 32 Assiniboine River, river km 73 Assiniboine River, river km 77 Assiniboine River, river km 57 Assiniboine River, river km 64 Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank) Little Saskatchewan River, 1.2 mi NW of Grand Valley Prov Rec Park
Quadrula quadrula	Assiniboine River, river km 32 Assiniboine River, river km 47 Assiniboine River, river km 73 Assiniboine River, river km 64 Assiniboine River, river km 77 Assiniboine River, river km 154
Lasmigona complanata	Assiniboine River, river km 47 Assiniboine River, river km 18 Souris River, PR 345 (9 mi E of Bede) Souris River, Bunclody Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank) Little Saskatchewan River, 1 mi S and 3 mi W of Rapid City Little Saskatchewan River, PR 354 (3 mi S of Elphinstone) Little Saskatchewan River, 1.2 mi NW of Grand Valley Prov. Rec. Park Shell River, PTH 83 (1 mi N and 2 mi E of Inglis) Shell River, PTH 5 (1 mi N of Shevlin) Shell River, PR 367 (6 mi E and 2.5 mi N of Boggy Creek) Birdtail River, PR 359 (7 mi W of Vista) Pipestone Creek, 1.5 mi W of Kola Pipestone Creek, Cromer Antler River, 2 mi S and 2 mi E of Lyleton Oak Creek, 1 mi S and 2 mi E of Treesbank Cypress River, 5 mi N of Holland and 3 mi W of PTH 34 Cypress River, 1 mi W of Cypress River and 1 mi S of PTH 2
Lasmigona compressa	Assiniboine River, river km 64 Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank) Little Saskatchewan River, 1 mi S and 3 mi W of Rapid City Shell River, PR 367 (6 mi E and 2.5 mi N of Boggy Creek) Cypress River, 5 mi N of Holland and 3 mi W of PTH 34 Cypress River, St. Alphonse
Anodontoides ferussacianus	Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank) Rolling River, 3.5 mi N of Erickson Rolling River, PTH 263 (1 mi N and .5 mi W of Scandinavia) Birdtail River, 1 mi N and 1 mi E of Mears Shell River, PR 367 (6 mi E and 2.5 mi N of Boggy Creek) East Shell River, PR 366 (6 mi N of PR 367 and 7 mi S of PR 271) Golden Creek, 1 mi S and 1 mi E of Glenlochar Silver Creek, 1.5 mi E and 2.5 S of Gambler

SPECIES	LOCATION
	Clear Creek, PR 354 (1.5 mi S and 1 mi W of Lake Audy)
	Jackfish Creek, 5 mi N and 4 mi E of Lake Audy
	Pipestone Creek, 4 mi N of Reston
	Pipestone Creek, 1.5 mi W of Kola
	Pipestone Creek, Cromer
	Gainsborough Creek, 3 mi W and 1.5 mi N of Lyleton
	Oak Creek, 1 mi S and 2 mi E of Treesbank
	Cypress River, 5 mi N of Holland and 3 mi W of PTH 34
	Cypress River, 1 mi W of Cypress River and 1 mi S of PTH 2
	Cypress River, St. Alphonse
	Cypress River, 1.5 mi N and 1 mi W of St. Alphonse
	Cypress River, 6 mi E of Holland and 6 mi N of PTH 2
Pyganodon grandis	Assiniboine River, river km 157
	Souris River, PR 345 (9 mi E of Bede)
	Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank)
	Souris River, PTH 2 (1 mi S and 1.5 mi E of Wawanesa)
	Souris River, 2 mi N and 1.5 mi W of Lauder
	Souris River, Bunclody
	Little Saskatchewan River, 1 mi S and 3 mi W of Rapid City
	Little Saskatchewan River, PR 354 (3 mi S of Elphinstone)
	Shell River, PTH 83 (1 mi N and 2 mi E of Inglis)
	Shell River, PTH 5 (1 mi N of Shevlin)
	Shell River, PR 367 (6 mi E and 2.5 mi N of Boggy Creek)
	East Shell River, PR 366 (6 mi N of PR 367 and 7 mi S of PR 271)
	Birdtail River, PR 477 (3 mi S and 4 mi W of Birtle)
	Birdtail River, PTH 16 (1 mi N and 1.5 mi W of Solsgirth)
	Birdtail River, 1 mi N and 1 mi E of Mears
	Birdtail River, PR 359 (7 mi W of Vista)
	Silver Creek, 1.5 mi E and 2.5 S of Gambler
	Rolling River, 7.5 mi S and 2 mi W of Erikson
	Rolling River, 3.5 mi N of Erickson
	Rolling River, PTH 263 (1 mi N and .5 mi W of Scandinavia)
	Pipestone Creek, 4 mi N of Reston
	Pipestone Creek, 1.5 mi W of Kola
	Pipestone Creek, Cromer
	Gainsborough Creek, 3 mi W and 1.5 mi N of Lyleton
	Antler River, 2 mi S and 2 mi E of Lyleton
	Medora Creek, 1 mi E and 1 mi N of Napinka
	Boggy Creek, 6 mi W and 3 mi N of Roblin
	Whirlpool River, PTH 19
	Whirlpool River, Whirlpool Lake
	Clear Creek, 1 mi E of Crawford Park
	Clear Creek, PR 354 (1.5 mi S and 1 mi W of Lake Audy)
	Jackfish Creek, 5 mi N and 4 mi E of Lake Audy
	Oak Creek, 1 mi S and 2 mi E of Treesbank
	Cypress River, 5 mi N of Holland and 3 mi W of PTH 34
	Cypress River, 1.5 mi N and 1 mi W of St. Alphonse
	Cypress River, 6 mi E of Holland and 6 mi N of PTH 2
Strophitus undulatus	Assiniboine River, river km 18
	Assiniboine River, river km 73
	Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank)
	Souris River, Bunclody
	Little Saskatchewan River, 1 mi S and 3 mi W of Rapid City
	Shell River, PTH 83 (1 mi N and 2 mi E of Inglis)
	Shell River, PTH 5 (1 mi N of Shevlin)
	Birdtail River, PR 359 (7 mi W of Vista)
Potamilus alatus	Assiniboine River, Hwy 1
	Assiniboine River, river km 15
	Assiniboine River, river km 18
	Assiniboine River, river km 23
	Assiniboine River, river km 28
	Assiniboine River, river km 45
	Assiniboine River, river km 140
	Assiniboine River, river km 154

SPECIES	LOCATION
Ligumia recta	Assiniboine River, Hwy 1
	Assiniboine River, river km 47
	Assiniboine River, river km 73
	Assiniboine River, river km 77
	Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank)
	Little Saskatchewan River, 1.2 mi NW of Grand Valley Prov Rec Park
	Little Saskatchewan River, 1 mi S of Rivers
	Qu'Appelle River, 1 mi W of St.Lazare
Lampsilis siliquoidea	Assiniboine River, Hwy 1
	Assiniboine River, river km 15
	Assiniboine River, river km 23
	Assiniboine River, river km 28
	Assiniboine River, river km 32
	Assiniboine River, river km 57
	Assiniboine River, river km 64
	Assiniboine River, river km 77
	Assiniboine River, river km 73
	Assiniboine River, river km 84
	Souris River, PR 345 (9 mi E of Bede)
	Souris River, Bunclody
	Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank)
	Souris River, PTH 2 (1 mi S and 1.5 mi E of Wawanesa)
	Souris River, 2 mi N and 1.5 mi W of Lauder
	Little Saskatchewan River, PR 354 (3 mi S of Elphinstone)
	Little Saskatchewan River, 1.2 mi NW of Grand Valley Prov. Rec. Park
	Little Saskatchewan River, 1 mi S of Rivers
	Little Saskatchewan River, 1 mi S and 3 mi W of Rapid City
	Little Saskatchewan River, 4 mi S and 2 mi E of Carnegie
	Qu'Appelle River, 1 mi W of St.Lazare
	Shell River, PTH 83 (1 mi N and 2 mi E of Inglis)
	Shell River, PTH 5 (1 mi N of Shevlin)
	Birdtail River, PTH 16 (1 mi N and 1.5 mi W of Solsgirth)
	Birdtail River, PR 359 (7 mi W of Vista)
	Rolling River, 7.5 mi S and 2 mi W of Erikson
	Whirlpool River, PTH 19
	Jackfish Creek, 5 mi N and 4 mi E of Lake Audy
	Clear Creek, PR 354 (1.5 mi S and 1 mi W of Lake Audy)
	Antler River, 2 mi S and 2 mi E of Lyleton
	Pipestone Creek, 4 mi N of Reston
	Pipestone Creek, 1.5 mi W of Kola
	Pipestone Creek, Cromer
	Oak Creek, 1 mi S and 2 mi E of Treesbank
	Cypress River, 6 mi E of Holland and 6 mi N of PTH 2
Lampsilis ovata	Assiniboine River, river km 18
	Assiniboine River, river km 15
	Assiniboine River, river km 23
	Assiniboine River, river km 28
	Assiniboine River, river km 32
	Assiniboine River, river km 57
	Assiniboine River, river km 64
	Assiniboine River, river km 73
	Assiniboine River, river km 77
	Assiniboine River, river km 84
	Assiniboine River, river km 109
	Assiniboine River, river km 115
	Assiniboine River, river km 154
	Assiniboine River, river km 157
	Souris River, PR 340 (.5 mi E and .5 mi S of Treesbank)
	Little Saskatchewan River, 1.2 mi NW of Grand Valley Prov Rec Park
	Little Saskatchewan River, 4 mi S and 2 mi E of Carnegie
	Shell River, PTH 83 (1 mi N and 2 mi E of Inglis)
	Birdtail River, PR 477 (3 mi S and 4 mi W of Birtle)
	Qu'Appelle River, 1 mi W of St.Lazare
	Oak Creek, 1 mi S and 2 mi E of Treesbank

APPENDIX 3: OTHER COLLECTIONS

SPECIES	LOCATION	COLLECTION
Fusconaia flava	Assiniboine River west of Winnipeg (Headingley)	Pip 1995
	Assiniboine River from PR 241 upstream to PTH 1	Scaife and Janusz 1992
	Assiniboine River west Winnipeg	Clarke 1973
	Assiniboine River 8 miles west of Winnipeg	Clarke 1973
	Assiniboine River 12 miles northwest of St. Francis Xavier	Clarke 1973
	Souris River	Mozley 1938 (see Clarke 1973)
Amblema plicata	Assiniboine River west of Winnipeg (Headingley)	Pip 1995
	Assiniboine River from PR 241 upstream to PTH 1	Scaife and Janusz 1992
	Assiniboine River west Winnipeg	Clarke 1973
	Assiniboine River 8 miles west of Winnipeg	Clarke 1973
	Assiniboine River 12 miles northwest of St. Francis Xavier	Clarke 1973
	Assiniboine River at Millwood	Tyrell 1889 (see Clarke 1973)
Quadrula quadrula	Assiniboine River west of Winnipeg (Headingley)	Pip 1995
	Assiniboine River from PR 241 upstream to PTH 1	Scaife and Janusz 1992
	Assiniboine River at west Winnipeg	Clarke 1973
	Assiniboine River 8 miles west of Winnipeg	Clarke 1973
Lasmigona complanata	Assiniboine River from PR 241 upstream to PTH 1	Scaife and Janusz 1992
	Assiniboine River west Winnipeg	Clarke 1973
	Assiniboine River 12 miles northwest of St. Francis Xavier	Clarke 1973
	Assiniboine River at Millwood	Tyrell 1889 (see Clarke 1973)
	"Upper" Assiniboine River	Bell 1984 (see Whiteaves 1895)
	Shell River 6 miles east of Roblin	Clarke 1973
	Shell River 8 miles east of Roblin	Clarke 1973
	Shell River 9 miles north-northwest of Roblin	Clarke 1973
	Little Saskatchewan River 11 miles north-northeast of Elphinstone	Clarke 1973
	Little Saskatchewan River 10 miles north-northwest of Minnedosa	Clarke 1973
	Souris River at Souris	Selwyn 1882 (see Clarke 1973)
Lasmigona compressa	Shell River 6 miles east of Roblin	Clarke 1973
	Shell River 8 miles east of Roblin	Clarke 1973
Anodontoides ferussacianus	Souris River .5 miles northeast of Souris	Clarke 1973
Pyganodon grandis	Assiniboine River west of Winnipeg (Headingley)	Pip 1995
	Assiniboine River west Winnipeg	Clarke 1973
	Little Saskatchewan River 11 miles north-northeast of Elphinstone	Clarke 1973
	Little Saskatchewan River 10 miles north-northwest of Minnedosa	Clarke 1973
	Clear Lake 4 miles and 8 miles North of Wasagaming	Clarke 1973
	Shell River 6 miles east-southeast of Roblin	Clarke 1973
	Shell River 8 miles east of Roblin	Clarke 1973
	Shell River 9 miles north-northwest of Roblin	Clarke 1973
Strophitus undulatus	Assiniboine River west Winnipeg	Clarke 1973
	Assiniboine River 12 miles northwest of St. Francis Xavier	Clarke 1973
	Birdtail Creek near Birtle	Mozley 1938 (see Clarke 1973)
	Shell River 6 miles east of Roblin	Clarke 1973
	Shell River 8 miles east of Roblin	Clarke 1973
	Shell River 9 miles north-northwest of Roblin	Clarke 1973
Potamilus alatus	Assiniboine River west of Winnipeg (Headingley)	Pip 1995
	Assiniboine River from PR 241 upstream to PTH 1	Scaife and Janusz 1992
Ligumia recta	Assiniboine River west Winnipeg	Clarke 1973
	Assiniboine River 12 miles northwest of St. Francis Xavier	Clarke 1973

SPECIES	LOCATION	COLLECTION
	Assiniboine at Millwood	Tyrell 1888 (see Clarke 1973)
	Assiniboine River west of Winnipeg (Headingley)	Pip 1995
	Assiniboine River from PR 241 upstream to PTH 1	Scaife and Janusz 1992
Lampsilis siliquoidea	Numerous Records	
Lampsilis ovata	Assiniboine River west of Winnipeg (Headingley)	Pip 1995
	Assiniboine River from PR 241 upstream to PTH 1	Scaife and Janusz 1992
	Assiniboine River west Winnipeg	Clarke 1973
	Assiniboine River 8 miles west of Winnipeg	Clarke 1973
	Assiniboine River 12 miles northwest of St. Francis Xavier	Clarke 1973
	Assiniboine at Millwood	Tyrell 1888 (see Clarke 1973)
	Shell River 6 miles east of Roblin	Clarke 1973
	Shell River 9 miles north-northwest of Roblin	Clarke 1973