Mussel Monitoring of Eau Claire County Streams

By Anna Mares
Beaver Creek Reserve Citizen Science Center
Fall Creek, WI

December 31, 2012

Funded by
Wisconsin Department of Natural Resources, Grant # RP-225-12

Acknowledgements

The Beaver Creek Reserve Citizen Science Center would like to thank Lisie Kitchel and Terry Balding for their expertise and guidance with mussel identification. Thank you to Jeanette Kelly for assisting with mussel monitoring. Thank you to all of the volunteers that attended trainings and assisted with mussel monitoring throughout the field season.

About Beaver Creek Reserve

Beaver Creek Reserve is a nature reserve and environmental education center located in Eau Claire County, Wisconsin. The Beaver Creek Citizen Science Center (BCCSC), established in 2003, has collaborated with scientific professionals on a local, state, and national level while promoting the importance of citizen science with the general public, school groups, and local organizations.

Cover photo: Volunteers posing next to their mussel piles while surveying for mussels in the Chippewa River. Photo taken by Anna Mares.

Contents

List of Tables

List of Figures

Introduction

Native mussels are an overlooked segment of the biological community. Despite this fact, mussels (freshwater bivalves) are an important part of river ecosystems because they remove particulate matter from the water column, are excellent indicators of water quality, and provide food and habitat for other animals.

There are 51 native mussels of the Upper Mississippi River that may be present in the streams and rivers of Wisconsin and of those 51 species, 12 are state endangered, seven are state threatened, 14 are species of special concern, and 18 appear to have healthy populations (see *Appendix B*). Two mussel species are additionally listed as federally endangered and three were proposed for federal listing at the start of the project. That equates to seventy percent (36/51) of the native mussels having questionable or poor population health. The Mussel Monitoring Program of Wisconsin (MMPW) website states that "Over half of Wisconsin's native mussel species (also known as clams) are listed as species of greatest conservation need or we need information on where they currently occur. Threats like habitat alteration (dams, siltation) and the presence of invasive mussels (zebra mussels) pose major threats to the existence of our native mussels. The Mussel Monitoring Program of Wisconsin would like your help in finding out what mussels occur in your area!" (WDNR 2011)

Over 90% (65/72) of the rivers/streams in Eau Claire County had never been surveyed for mussels. Of the seven streams that had been surveyed prior to 2012 (see Table 1.), 28 different species of mussels were found and of those there are 17 apparently healthy population species, seven species of special concern, three threatened species, and one endangered species. Only half of the species thought to be in Wisconsin were known to be present in Eau Claire County.

During the summer of 2012, Beaver Creek Reserve Citizen Science Center (BCCSC) initiated the Mussel Monitoring of Eau Claire County Streams (MMECCS) project to increase the inventory of streams monitored for mussels as requested by the MMPW. Prospective project outcomes included:

1.) **Survey 49 streams for mussels** – 42 more streams than previously done
2.) **Increase public awareness** – host one educational talk about mussels and one training workshop on surveying for mussels (approx. 20 individuals each)
3.) **Create a mussel species list for Eau Claire County**
4.) **Have community involvement** – have citizens assist in surveying for mussels (approx. 20 individuals)

In addition, by conducting surveys of the rivers and streams of Eau Claire County, BCCSC will fulfill natural resource manager's needs for data on WI freshwater bivalves in this area. This data will create a baseline to be used in establishing future monitoring goals.

Methods

Project location

The project area for this grant was the streams and rivers of Eau Claire County (ECC). ECC is situated in the west central region of Wisconsin and is the county in which the CSC is located. ECC hosts 72 streams that either originate in or enter into the county. This does not include the small unnamed tributaries of each of these streams.

Table 1. Streams/rivers that had been monitored for mussel populations prior to 2012, the number of species found in each stream/river and the last year that the stream/river was surveyed. (WNDR 2011)

Name of stream/river	Number of mussel species found in stream/river	Last date that stream/river was surveyed
Black Creek	1	1976
Chippewa River	25	2002
Eau Claire River	18	1995
Hay Creek	2	1976
North Fork of the Eau Claire River	4	1976
South Fork of the Eau Claire River	3	2003
Wolf River	3	1976

Certain stream types are more likely to host mussels than others. Preferred streams to sample are those that have wadeable sections or banks and are non-trout streams. Trout waters tend not to support mussel populations due to limited amounts of algae and diatoms, mussel food sources. Low fish diversity limits potential for host fish and cold temperatures are also factors that are not conducive for mussel reproduction and growth. Therefore, the project area included all the streams in Eau Claire County that were previously sampled for mussels (seven streams), streams not listed as any class (I, II or III) of trout stream (21 streams), all Class III trout streams (11 streams), which are warmer than class I and II, and a small subset of ten class I and II trout streams (five streams from each class = 10 streams) to assure that possible habitats were not being over looked (*Appendix A*). A total of 49 streams were scheduled for mussel monitoring (Figure 13).

Figure 1. Volunteer helping to survey Schoolhouse Creek, a previously unsurveyed stream.

Mussel monitoring

Sampling methods followed those outlined by the MMPW. A similar but modified data sheet was used to allow for the collection of additional parameters (*Appendix C*). Sampling occurred at shallow-water areas, exposed sand and gravel bars, river and lake bottoms during low-water periods (droughts, drawdowns, etc.), and islands and streambanks for middens. The sampling

locations fell into two basic groups: a.) streams that have been surveyed for freshwater mussels at an earlier date and are being reexamined (7/49, 14%) and b.) streams that have never been examined (42/49, 86%). Sampling sites were positioned at easy to access locations such as road crossings or public access points. Sampling was conducted via wading by one of the following methods:

1. Number of mussels per unit of time (number per person-hour - e.g. 2 people searching for one hour = 2 search hours)
2. Number of mussels per unit of distance

Sample sites that were thought to have larger quantities and different types of mussels were given first priority in sampling. These are the 28 streams that are not listed as any class of trout stream or have been previously sampled. Each of these 28 streams had up to eight hours of survey time devoted to them. The class I, II, and III trout streams had up to four hours of survey time devoted to them. Cursory surveys were performed on all trout streams by walking a 100 yard segment, looking for evidence of mussels (live mussel or mussel shell). If no mussel evidence was found during that cursory search, the stream was considered void of mussels. All parameters and information listed below was collected during the surveys. All meters were calibrated prior to use in the field. Data collected at each stream (device used to collect information):

1. Species of native mussels present (live mussels and empty shells)
2. Presence of zebra mussels
3. pH (Oakton pH meter)
4. Dissolved oxygen (YSI meter)
5. Stream flow (approximate using a float and timer)
6. Temperature (YSI meter)
7. Turbidity (transparency tube of 120 cm)
8. Stream bed substrate type
9. Water depth (meter stick)
10. GPS location of each sample site (Garmin GPS unit)

Figure 2. Lead researcher comparing a live specimen to the field identification chart.

Identification

Mussel identification can be very difficult to the untrained eye. Live specimens often vary in appearance to the pictures in identification guides. It was important that the survey crew accompanied experts in the field to gain expertise prior to project survey dates. Still, some shells had questionable IDs. If the specimens were alive they were photographed and the pictures were sent to experts for confirmations. If the shells were empty, the shells were saved for verification. Additional empty shells were saved as voucher specimens for each stream.

Trainings

Along with increasing scientific knowledge through data collection, MMECCS aimed to increase the public's knowledge of native mussels by training citizen science volunteers to be part of this mussel monitoring project. The public was informed of the state's diversity of mussels, the roles

they play in the ecosystem, their interesting life cycle, and their identification. After the classroom portion of the training, volunteers visited a stream that needed to be surveyed and received firsthand experience on mussel surveying.

Access points

Plotted access points were searched for as part of the grant requirements. Searches were made one mile in either direction from survey sites. Online mapping software was used to locate potential access locations and they were then confirmed by using maps from the Eau Claire County Planning and Zoning Department.

Results

Personnel

The lead researcher, Anna Mares, was responsible for project preparation, coordinating volunteers, leading all monitoring days, trainings, data compilation, and report writing spending approximately 400 hours doing so. A dedicated volunteer was able to assist with monitoring two days a week throughout the summer. There were 57 (17 more than projected) volunteers that helped monitor the streams, identify mussel shells, along with one volunteer that worked on assessing plotted access points within the project area. All told, 357.5 volunteer hours were contributed to the project, 137 hours above the anticipated amount.

Plotted access points

Thirty-four plotted and public access sites were found in Eau Claire County. That is 21 more access sites than were previously known. This is not an all-inclusive list for the county, only those found using the previously described methods. Access points are shown in Figures 5-12.

Trainings

Two trainings were held at Beaver Creek Reserve, both in June of 2012. These trainings were a combination of the expected monitoring training and the educational talk described in the grant application. Twenty six people attended the formal trainings. Several of these volunteers signed up to assist with future monitoring dates. Another 28 individuals received “on the job” training before they assisted with mussel monitoring.

Figure 3. Volunteers sorting mussels into collection buckets during a training and mussel surveying session on the Eau Claire River.

Dissemination of survey results

It was important that the information collected during this project was shared with as many interested individuals and groups as possible. This report of the findings was compiled at the end of the project and was shared with the WDNR. It will be posted on the Beaver Creek Reserve Website. All species data was shared with the Mussel Monitoring Program of Wisconsin. The Natural Heritage Inventory was contacted about

species of special concern, threatened and endangered species that were found. Presence/absence data of zebra mussels will be entered into the Surface Water Integrated Monitoring System (SWIMS) under the aquatic invasive species monitoring program. Water quality information will also be added to that site. A display was made for the Beaver Creek Reserve Nature Center to showcase mussels. Additionally, a poster was created to be displayed at the Upper Midwest Invasive Species conference in October 2012 and the Citizen Based Monitoring Conference in April 2012. A presentation of the project will be given at the Wisconsin Lakes Conference in April 2012. BCCSC may offer a yearly clamming day on the Chippewa River as an educational event.

Monitoring data

Out of the 49 streams surveyed in Eau Claire County, 12 were found to contain mussels, five more than previously known to host mussels (Table 3). Seven of those were non-trout streams, two were Class III, two were Class II, and one was a Class I trout stream. Over 1,540 individual mussels were collected, identified and returned to the streams (Figure 38). Twenty-three species were identified, five less than found in the past. Species found included one endangered species (sheepnose – *Plethobasus cyphyus*), one threatened species (pistol grip- *Tritogonia verrucosa*), and five species of special concern (elktoe – *Allasmidonta marginata*, fawnsfoot – *Truncilla donaciformis*, paper pondshell– *Utterbackia imbecilis*, black sandshell – *Ligumia recta*, and the round pigtoe – *Pleurobema sintoxia*). Fifteen of the 23 species found had fewer than 50 individuals collected of each (Figure 39). Several species had not been previously documented in specific streams. For a complete list of the streams that contained mussels and the species inhabiting them see Table 2 and Figures 14-36. No zebra mussels (*Dreissena polymorpha*) were found at any of the survey locations.

Figure 4. Plain pocketbooks piled high for counting in the Chippewa River.

The most frequently occurring species (at mussel populated sites) were the white heelsplitter (83%), plain pockbook (75%), giant floater (75%), wabash pigtoe (67%), and fat mucket (58%)(Figure 37).

The following creeks were determined to be void of mussels after cursory surveys were performed: Bear Grass, Beaver 1, Beaver 2, Brown, Clear, Cold, Coon, Darrow, Diamond Valley, First Trestle, Five Mile, Hay 2, Horse, Kelly, Lowes, Little Niagra, McGaver, Nine Mile South, Otter, Pea, Pesso, Pine 1, Pine 2, Rock, Rush, Seven Mile, Sherman, Taylor, Thompson Valley, West and Willow.

The summer of 2012 was a severe drought year. As a result, the following streams were not surveyed due to a lack of running water or no water at all: Unnamed 1, Alder, South fork of Paint, Kluckman, Session Valley, and Simes.

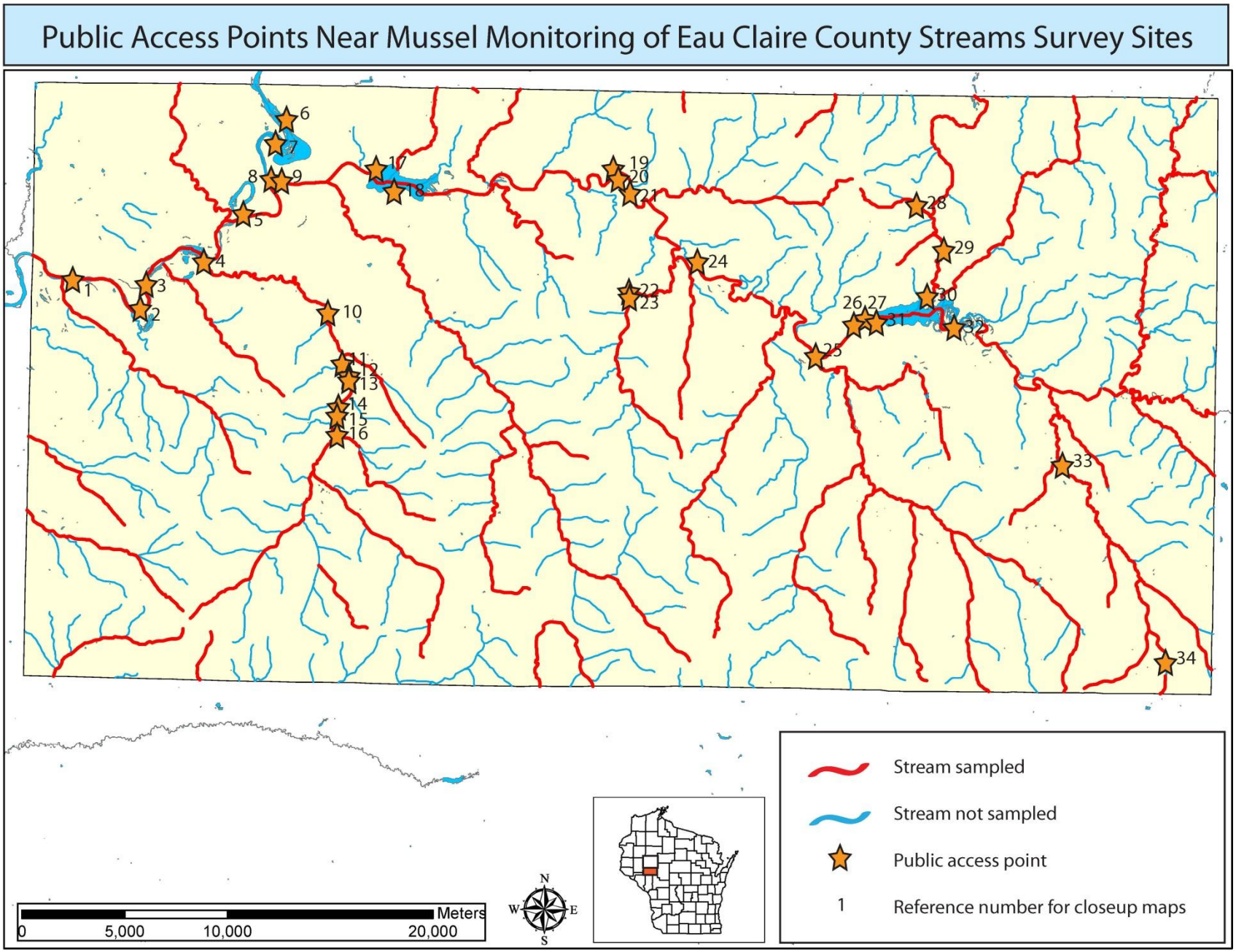

Figure 5. Public access points near Mussel Monitoring of Eau Claire County Streams survey sites in the summer of 2012.

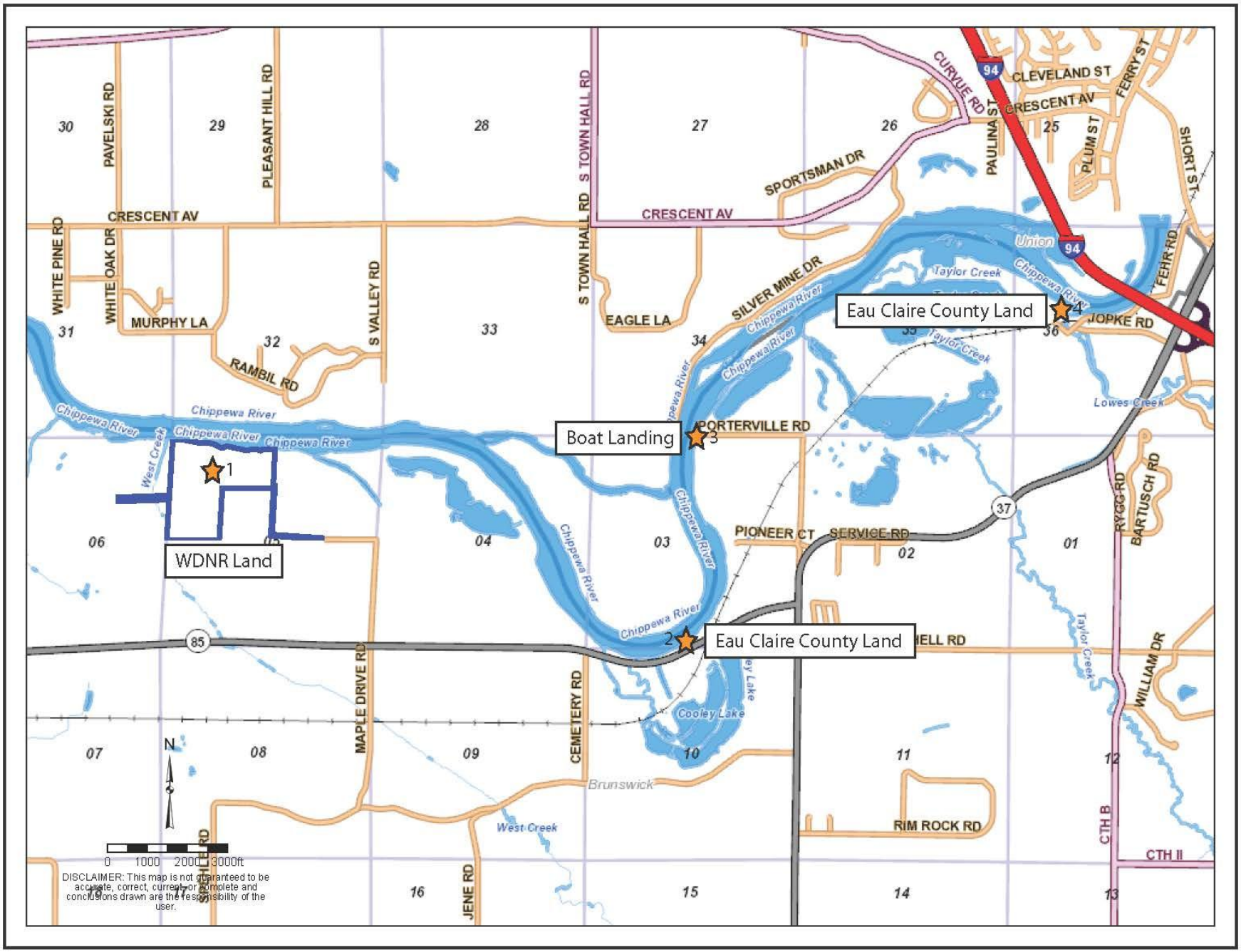

Figure 6. Zoomed in view of access points 1-4 near mussel surveying sites in the summer of 2012.

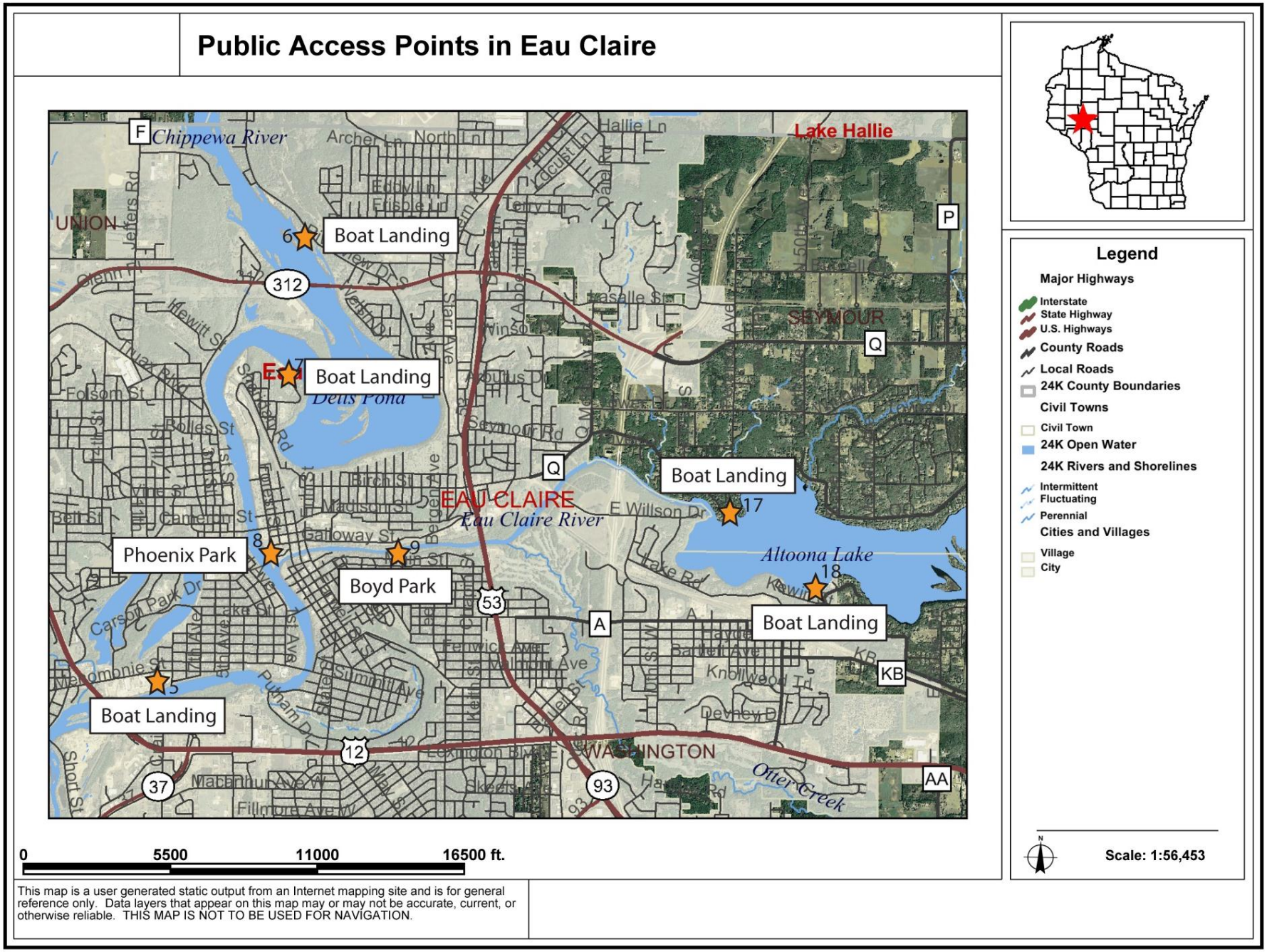

Figure 7. Zoomed in view of access points 5-9, 17, and 18 near mussel surveying sites in the summer of 2012.

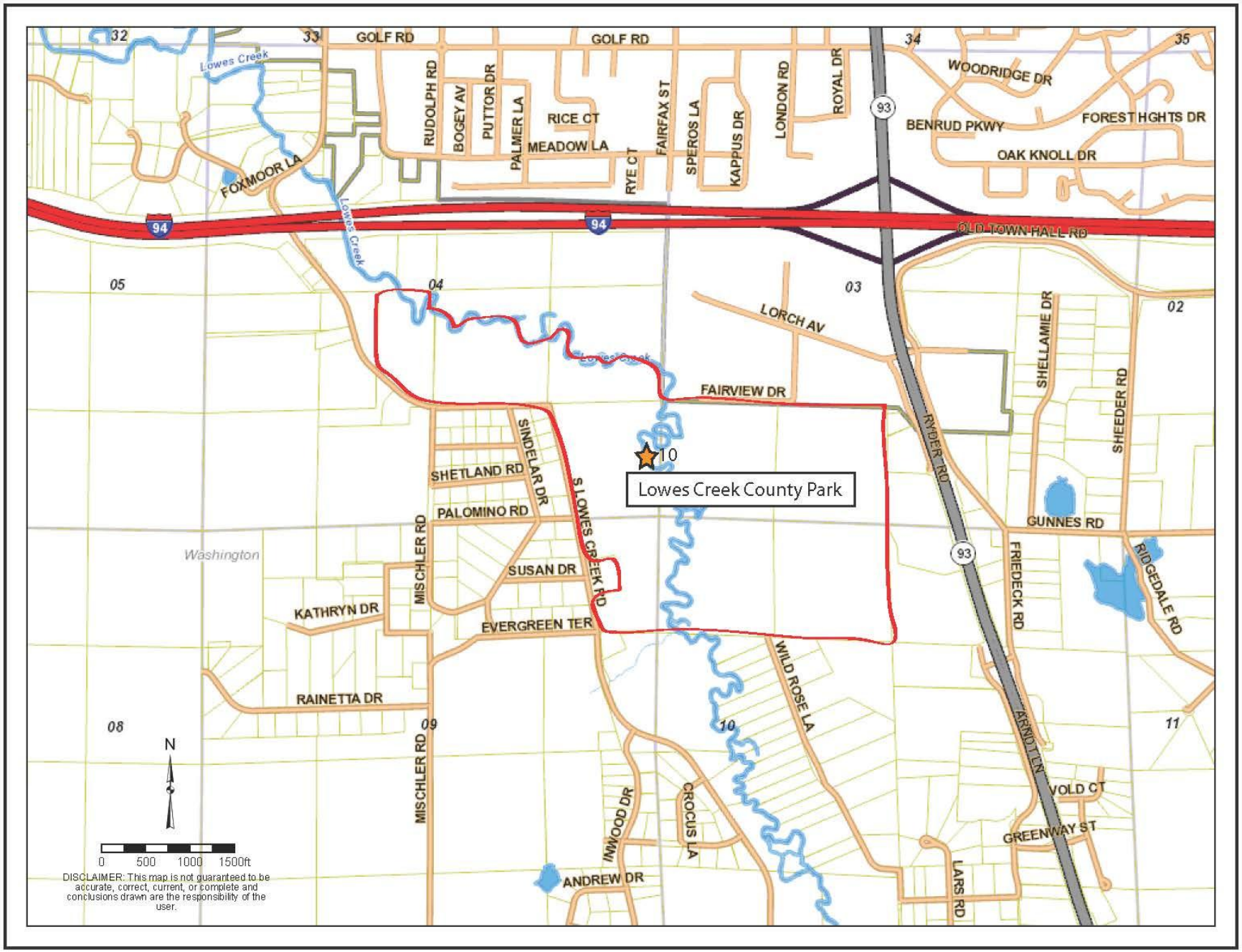

Figure 8. Zoomed in view of access point 10 near mussel surveying sites in the summer of 2012.

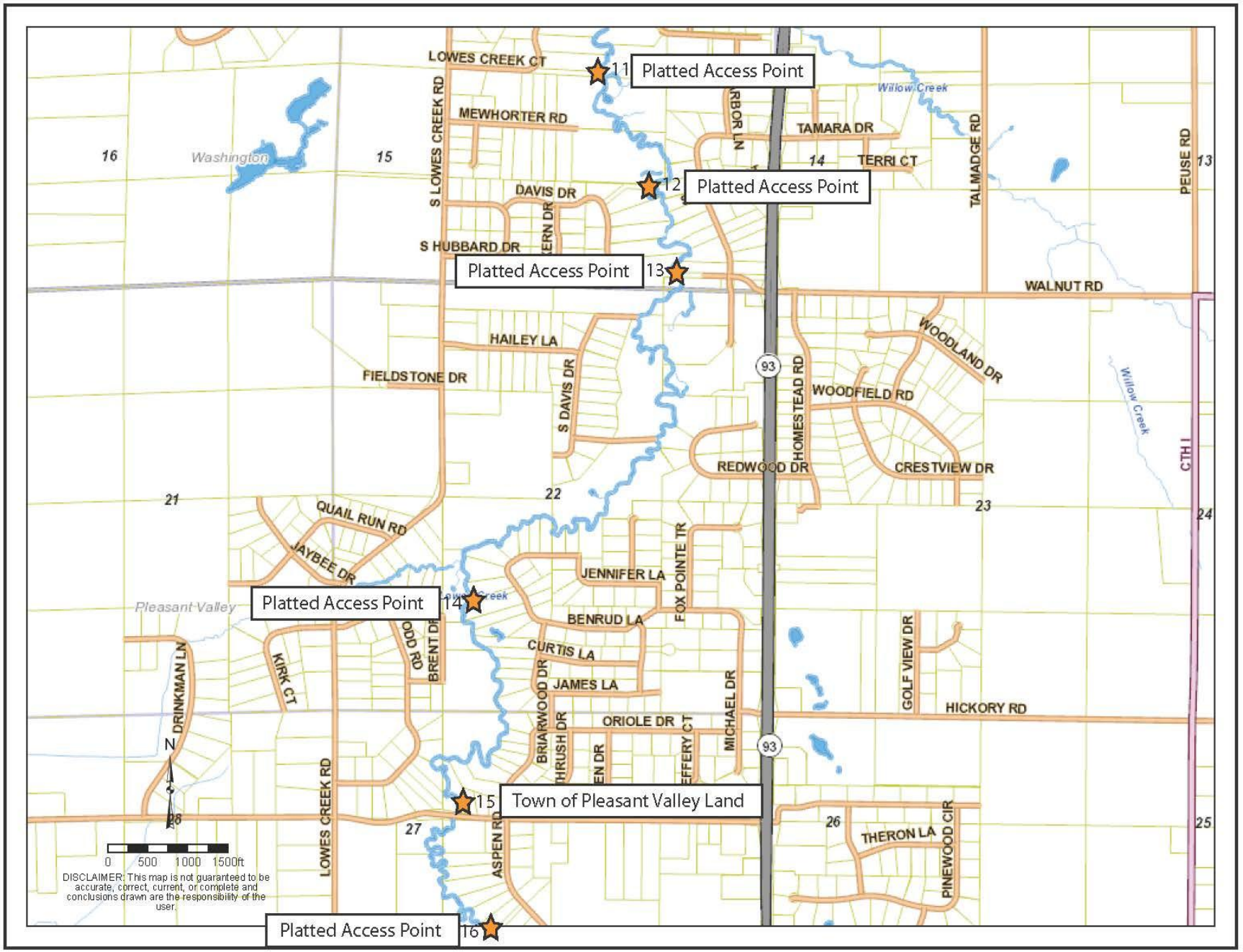

Figure 9. Zoomed in view of access points 11-16 near mussel surveying sites in the summer of 2012.

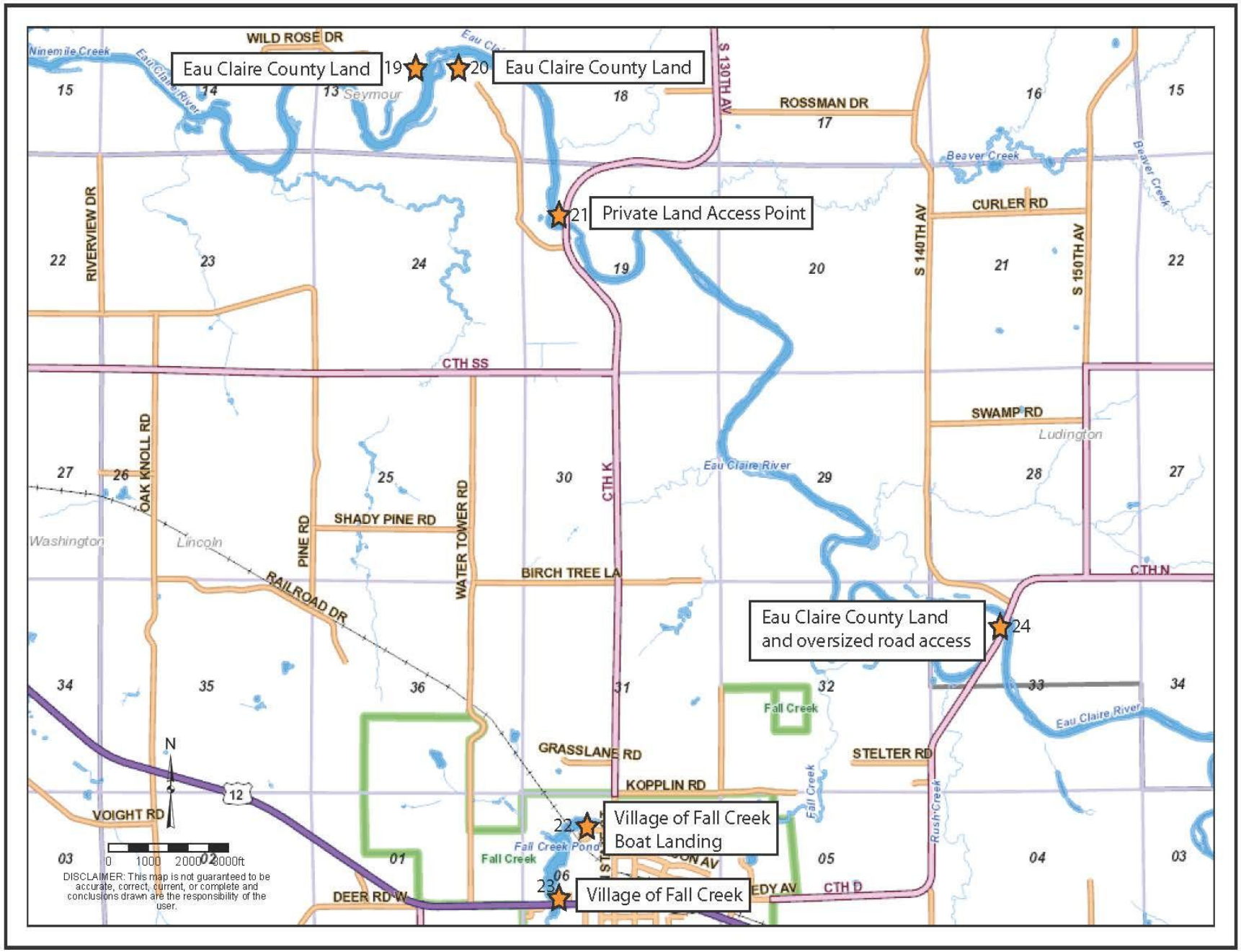

Figure 10. Zoomed in view of access points 19-24 near mussel surveying sites in the summer of 2012.

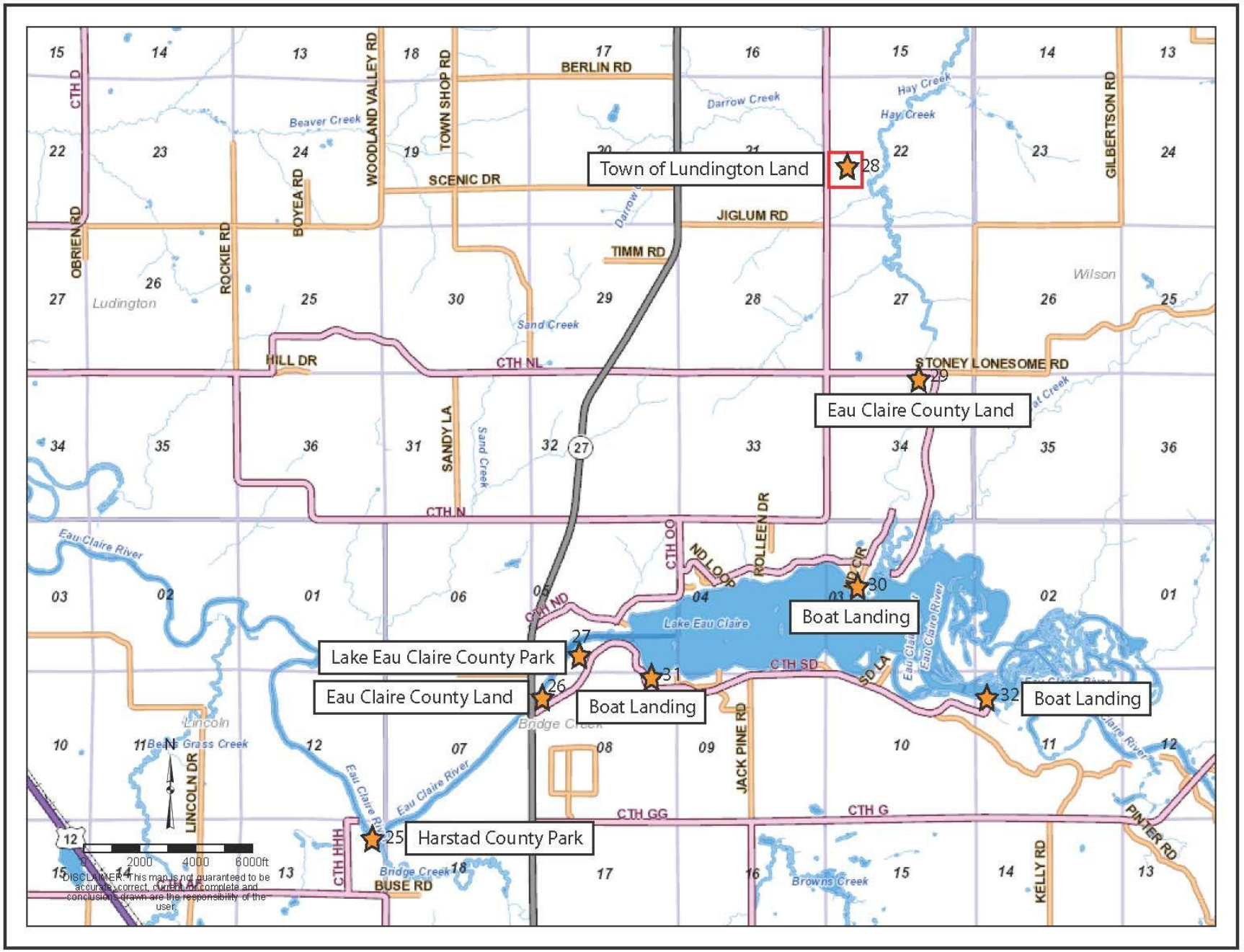

Figure 11. Zoomed in view of access points 25-32 near mussel surveying sites in the summer of 2012.

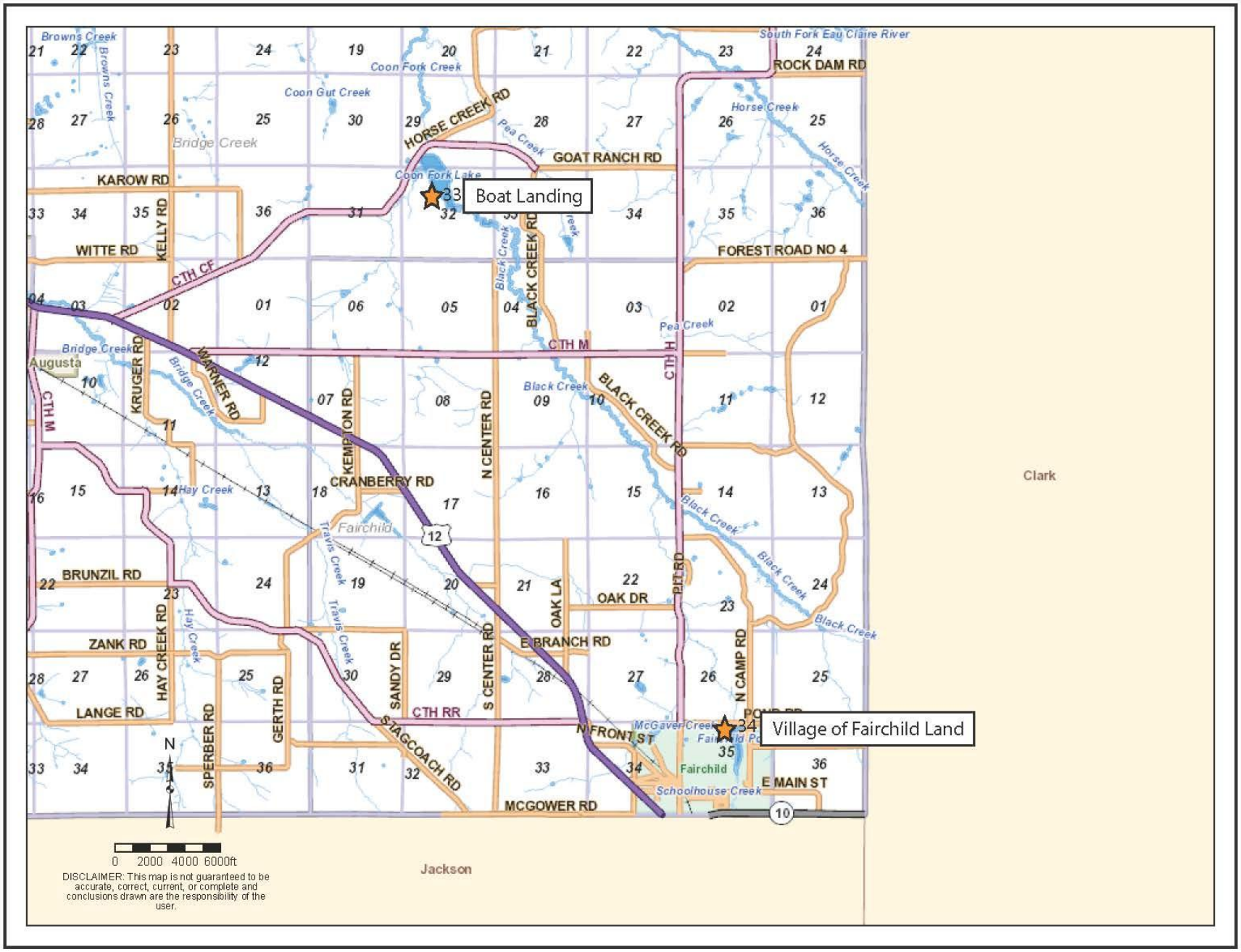

Figure 12. Zoomed in view of access points 33 and 34 near mussel surveying sites in the summer of 2012.

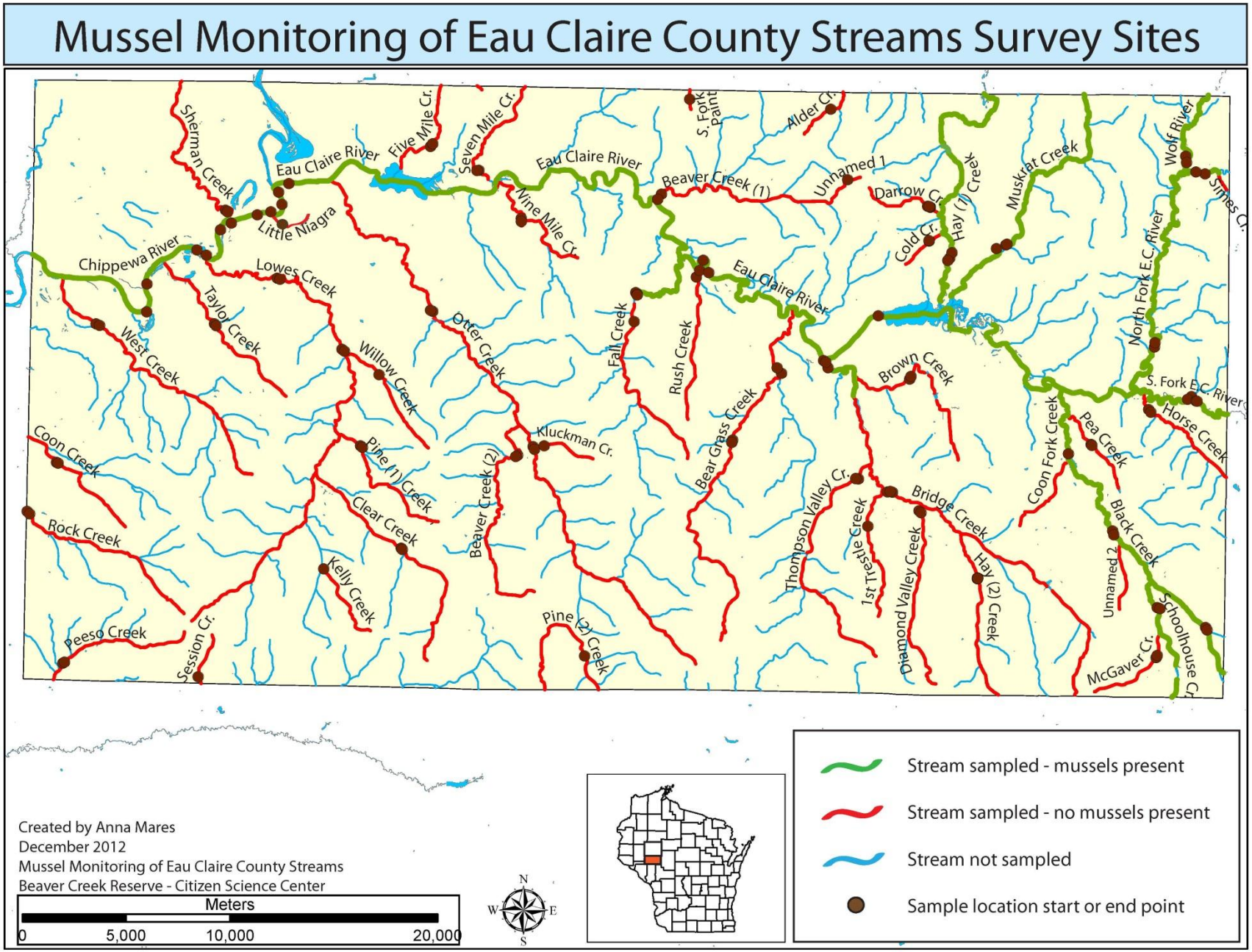

Figure 13. Area covered by the Mussel Monitoring of Eau Claire County Streams Project including streams not sampled, sampled without mussels present, sampled with mussels present and sample site locations on each of those streams during the summer of 2012.

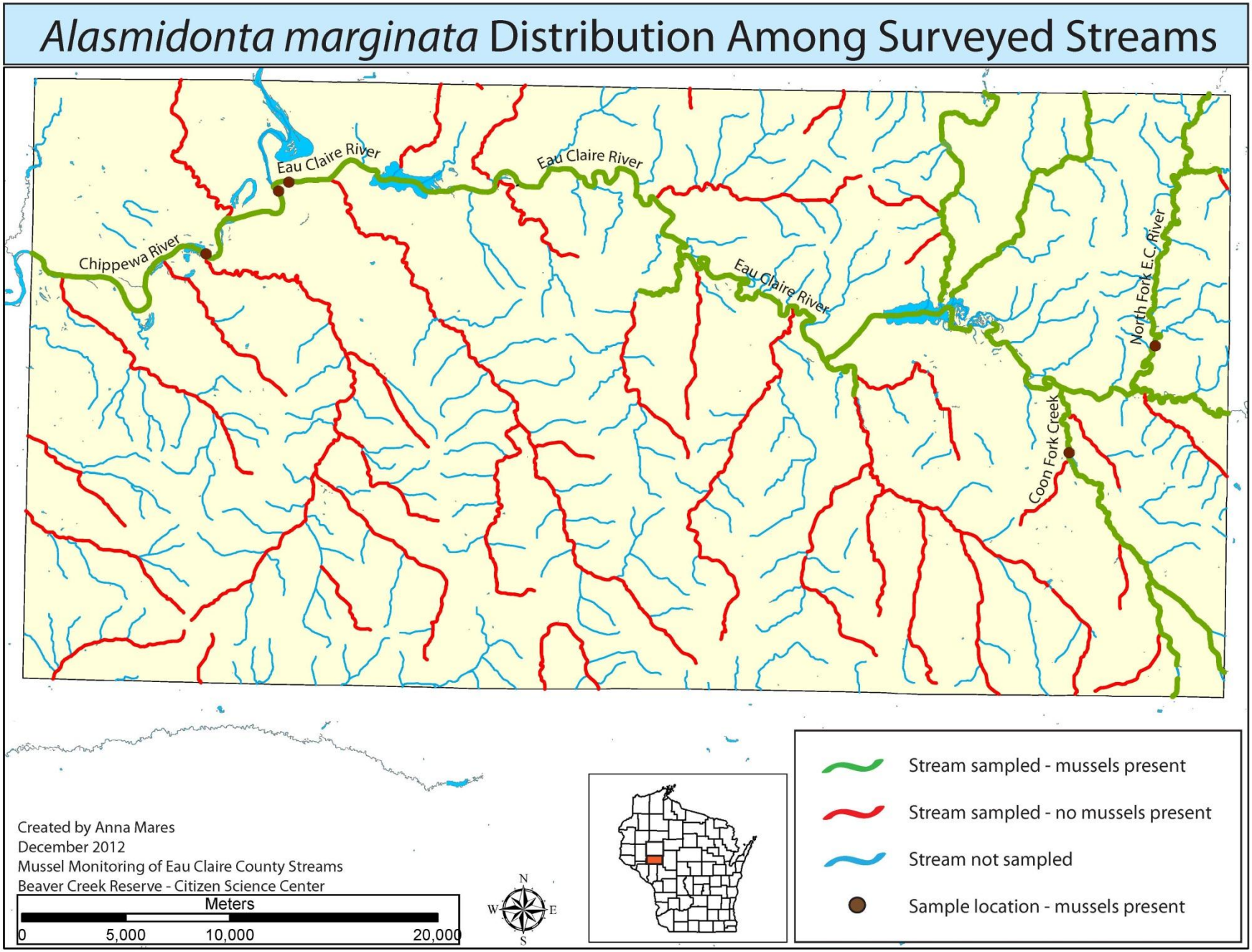

Figure 14. ***Alasmidonta marginata*** **(elk toe) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

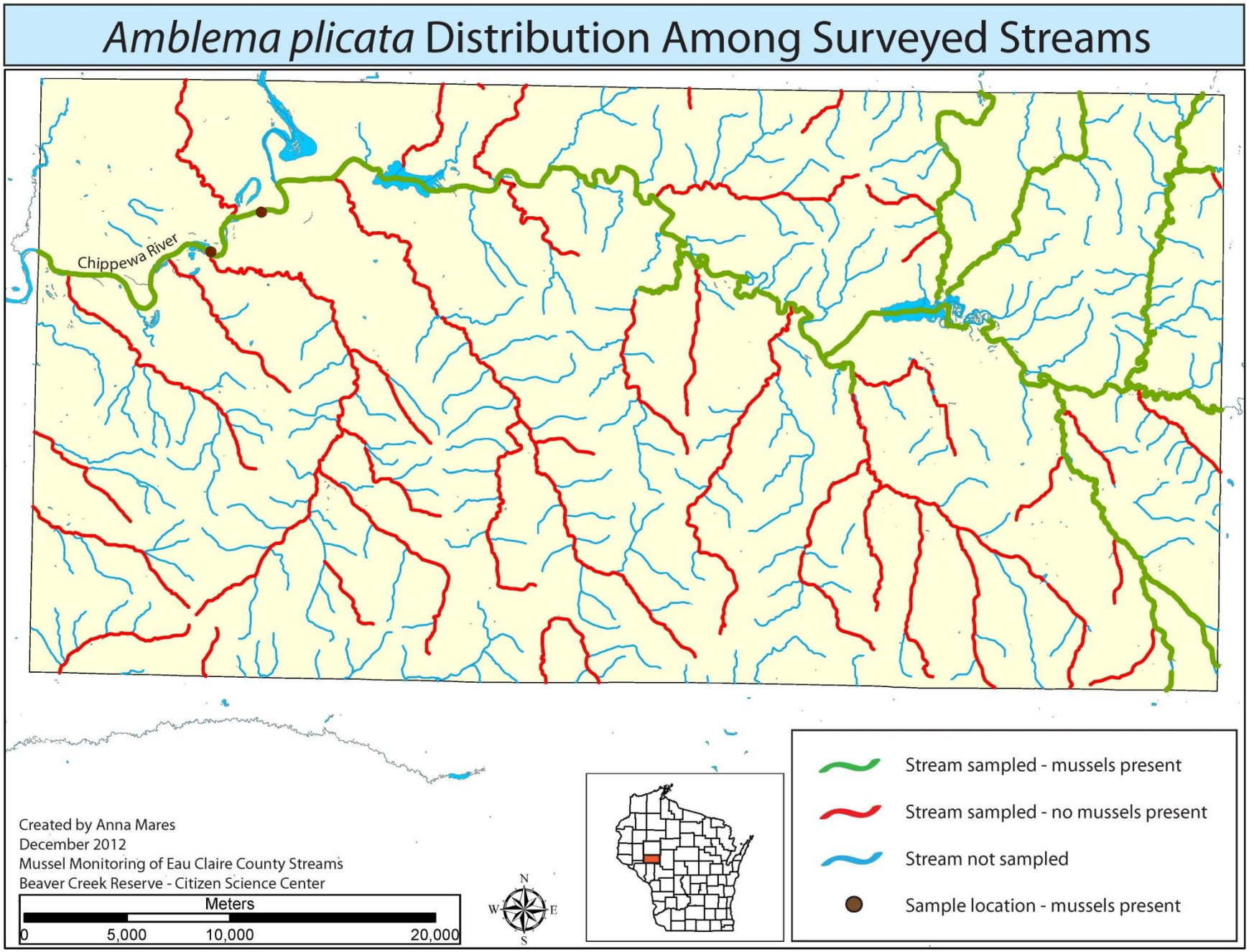

Figure 15. *Amblema plicata* (threeridge) distribution among surveyed streams in Eau Claire County in the summer of 2012.

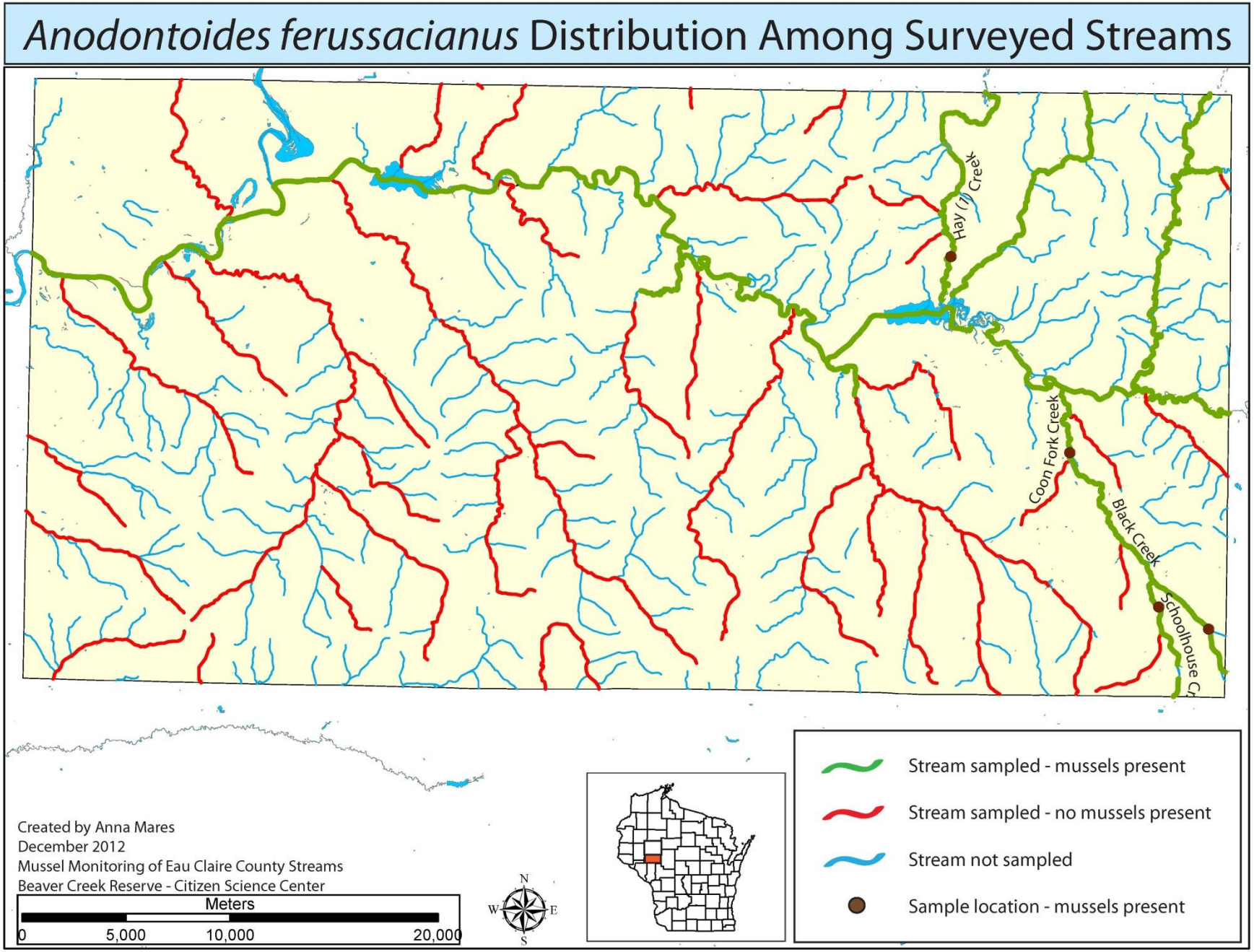

Figure 16. ***Anodontoides ferussacianus*** **(cylindrical papershell) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

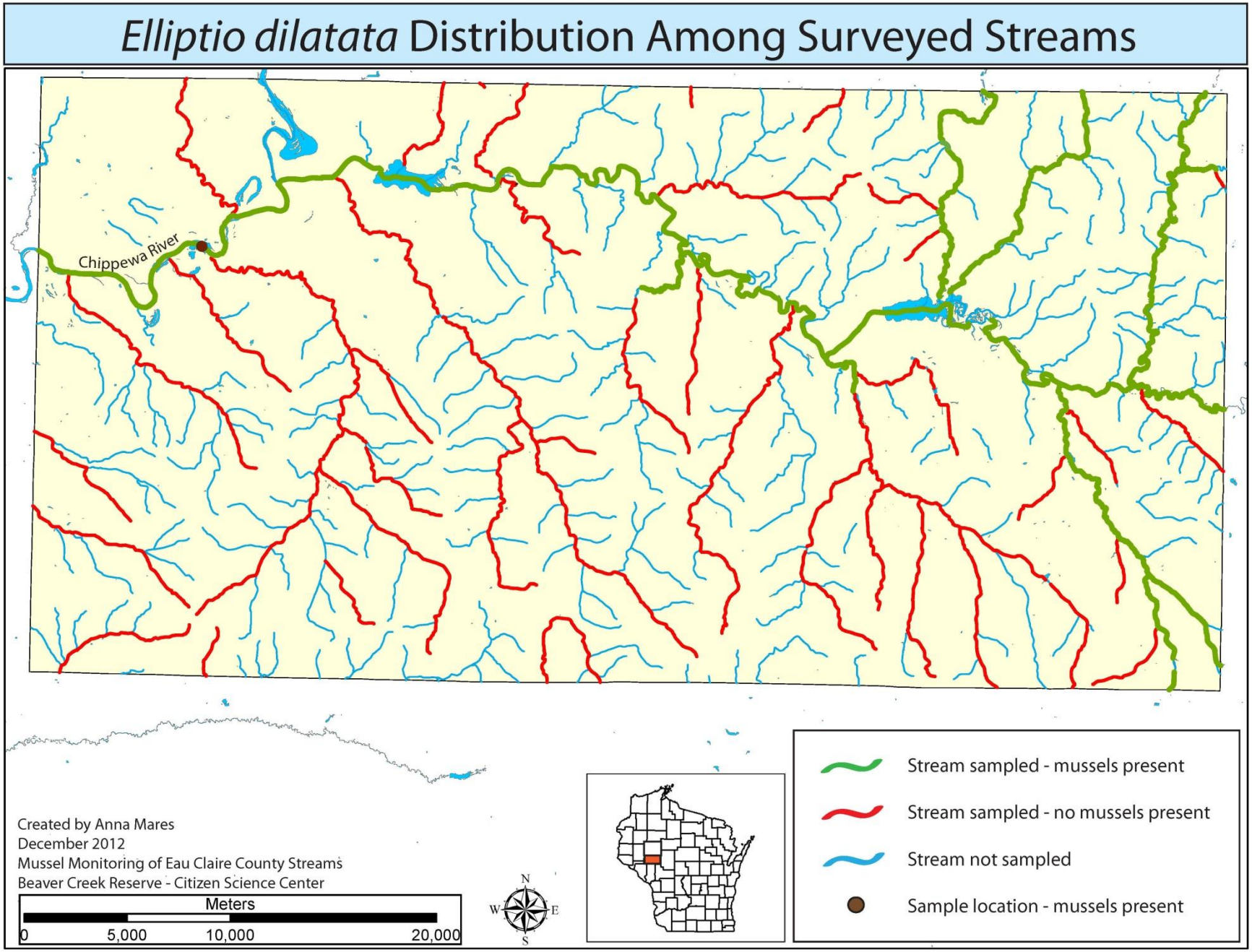

Figure 17. *Elliptio dilatata* (spike) distribution among surveyed streams in Eau Claire County in the summer of 2012.

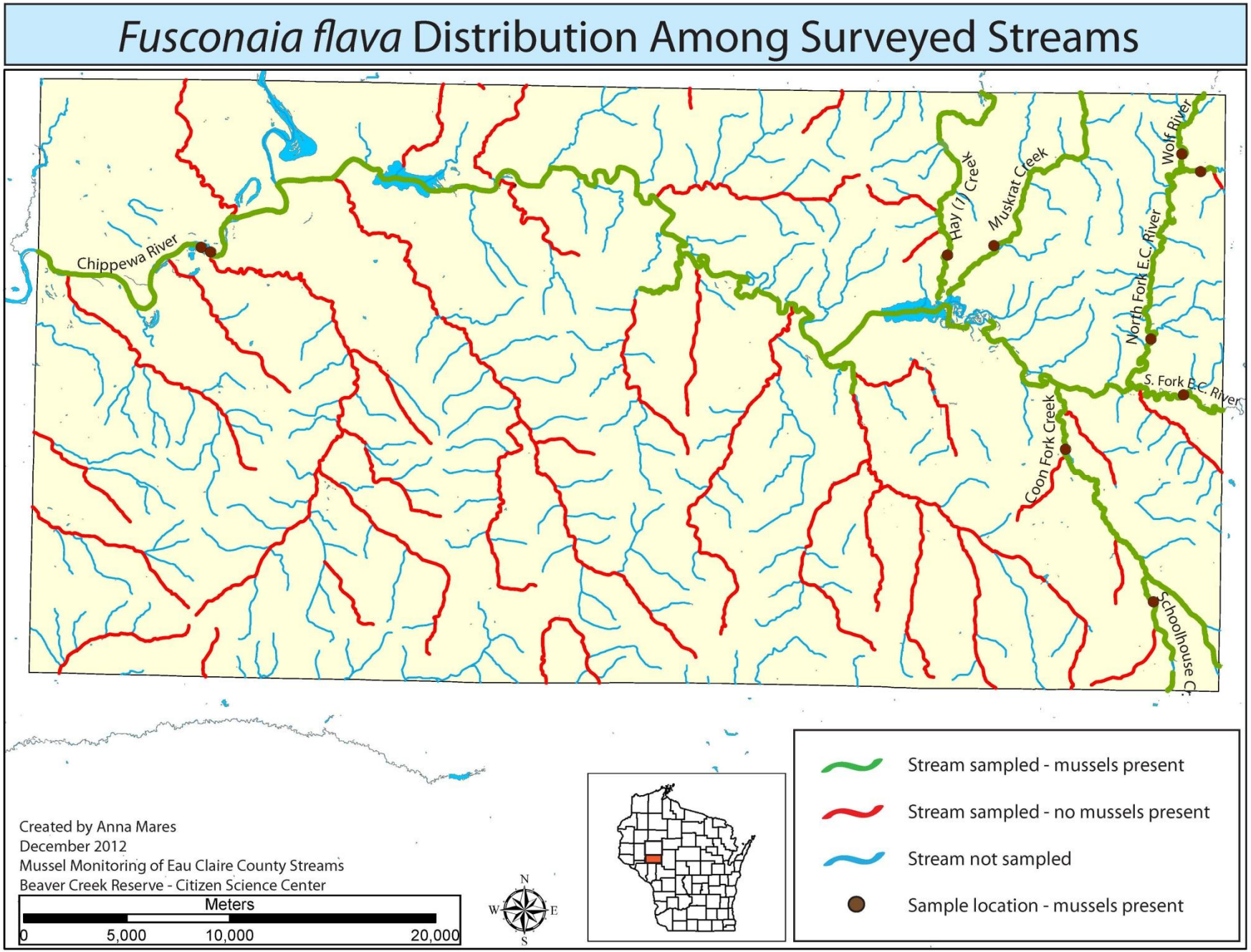

Figure 18. ***Fusconaia flava*** **(Wabash pigtoe) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

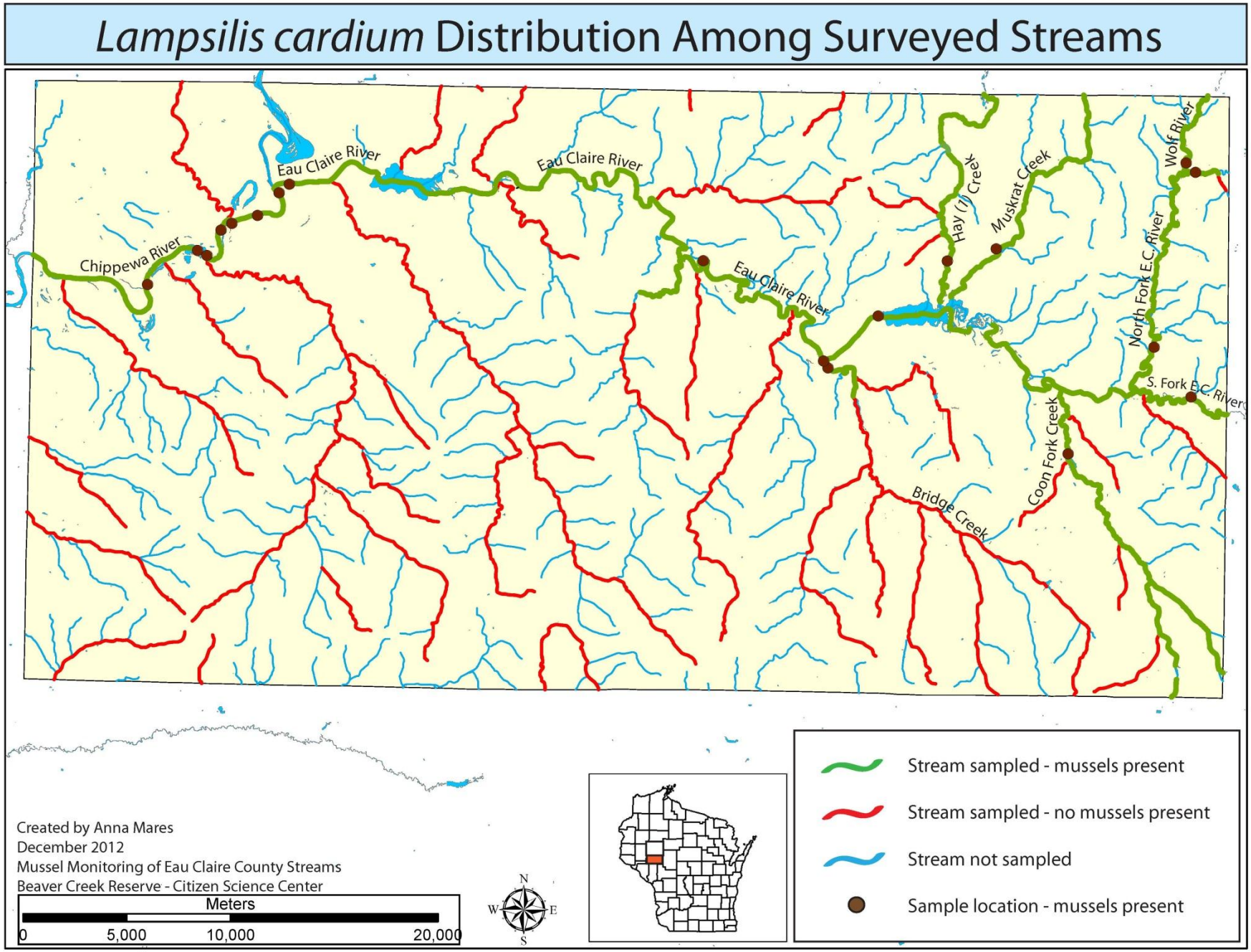

Figure 19. ***Lampsilis cardium*** **(plain pocketbook) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

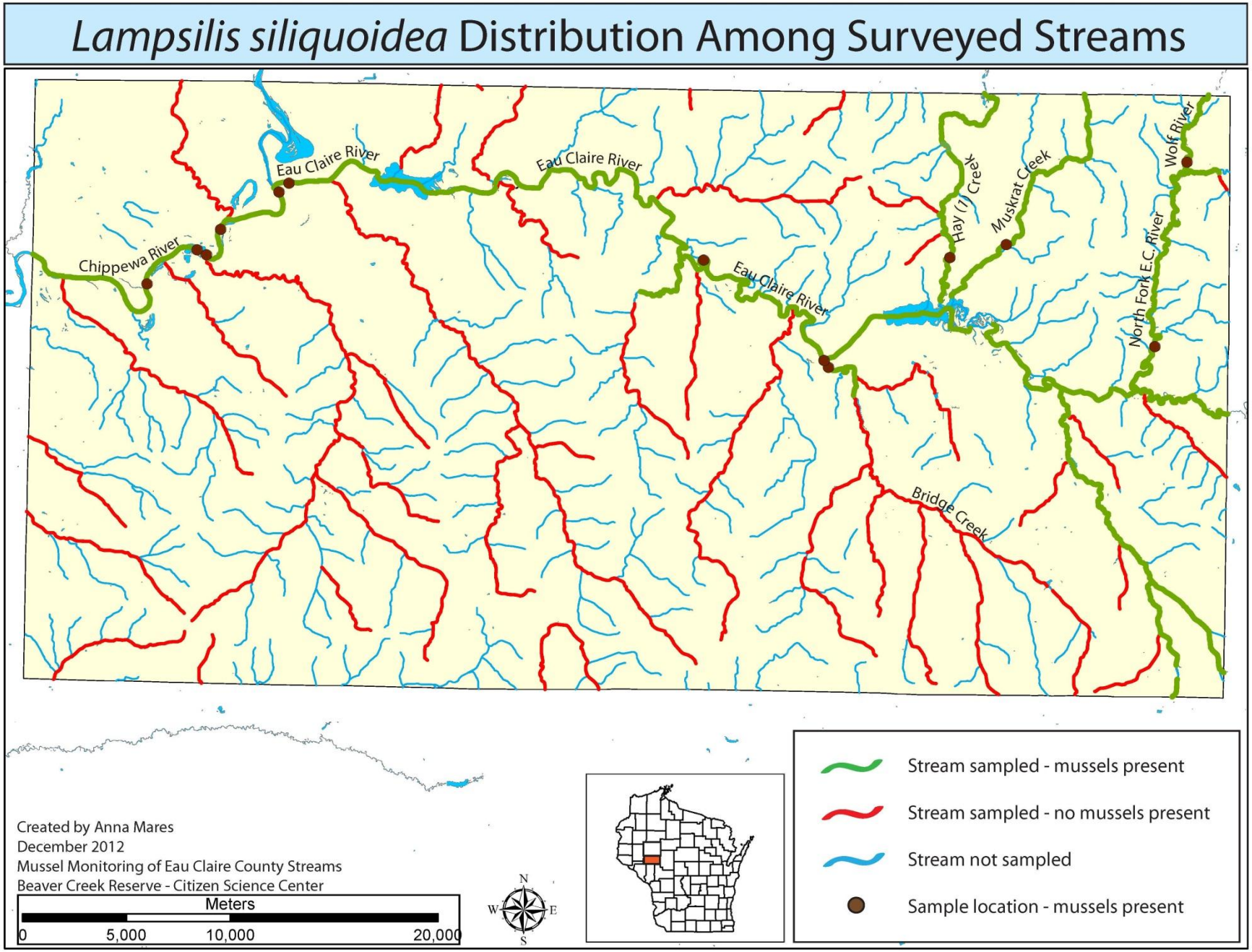

Figure 20. ***Lampsilis siliquoidea*** **(fat mucket) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

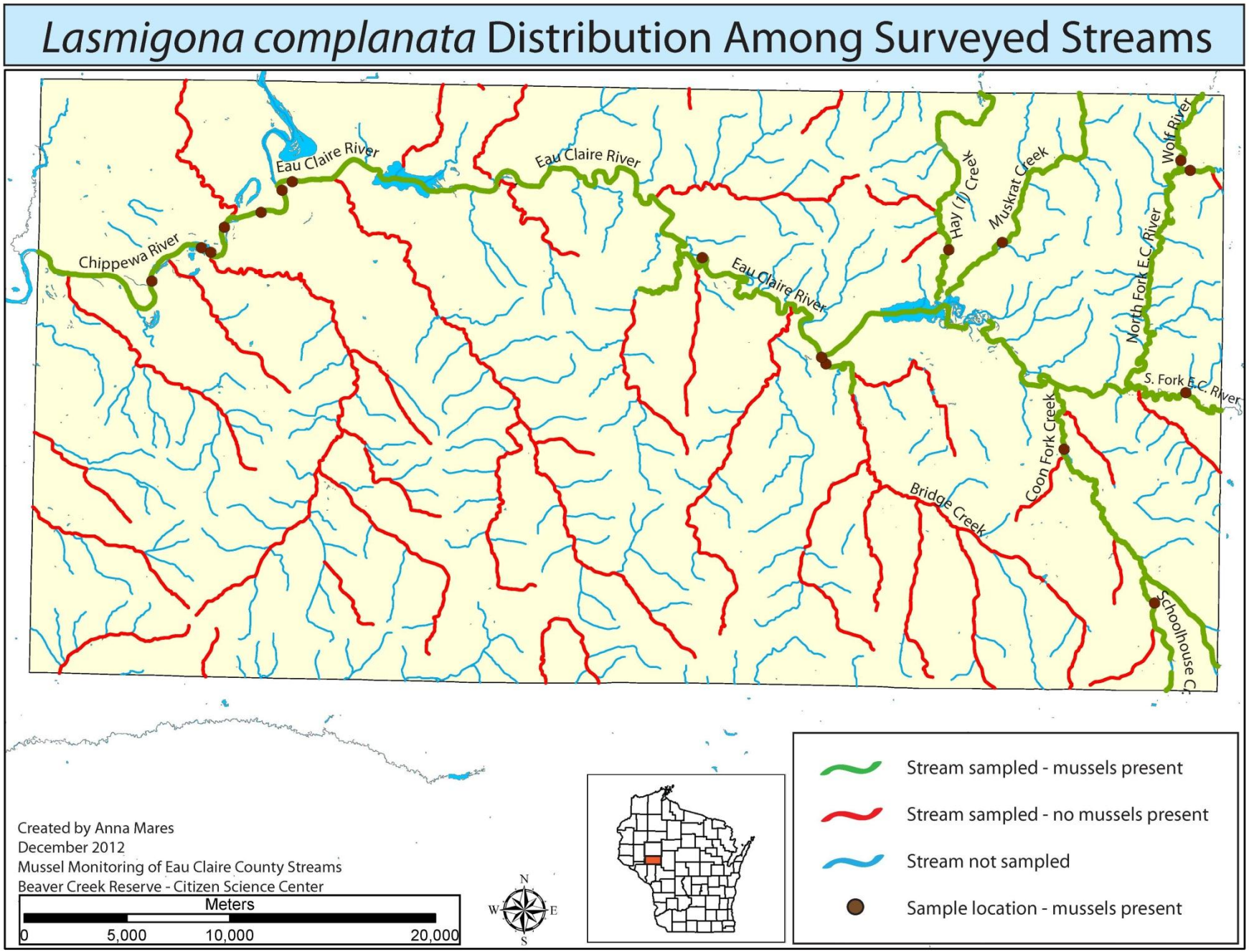

Figure 21. ***Lasmigona complanata*** **(white heelsplitter) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

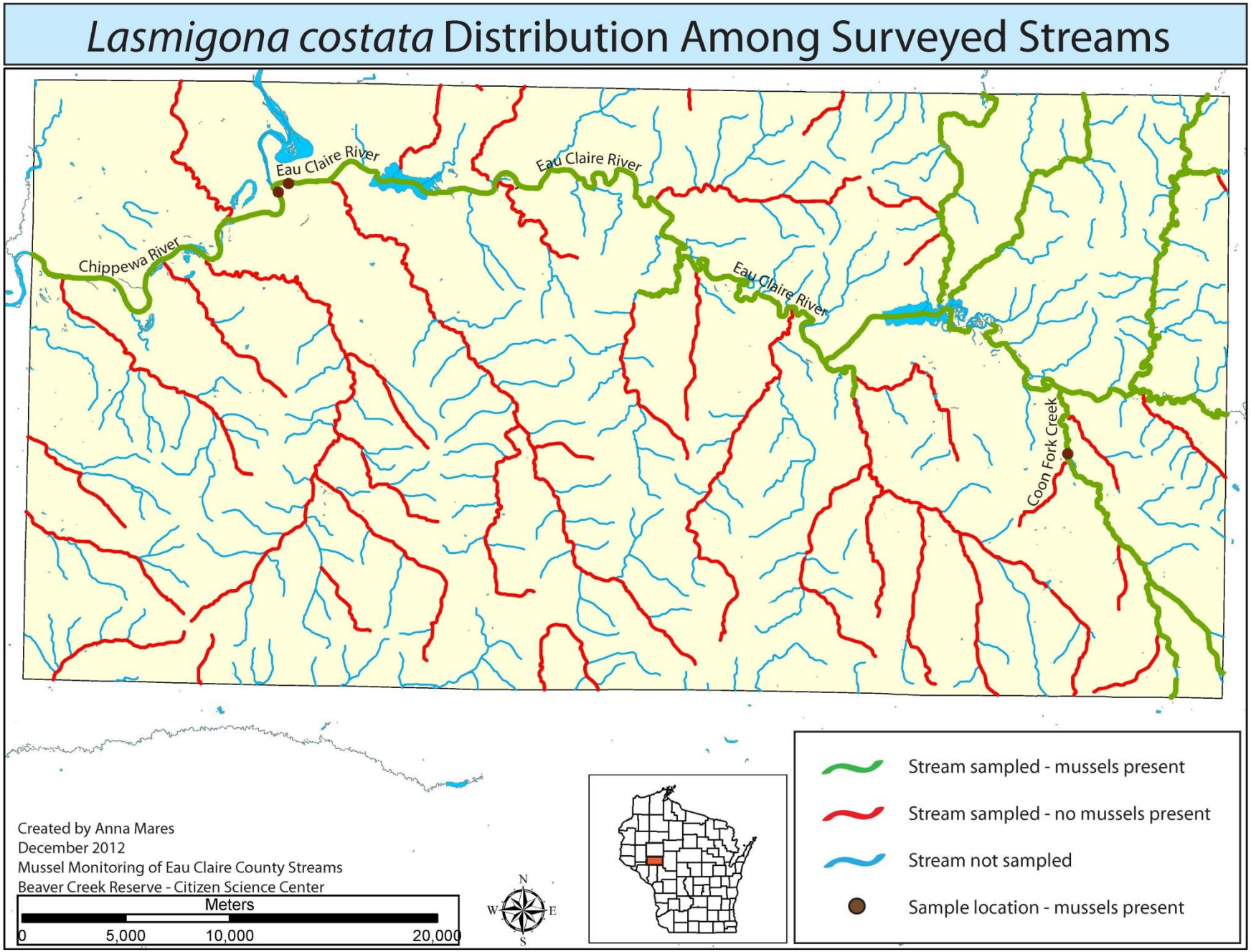

Figure 22. ***Lasmigona costata*** **(fluted shell) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

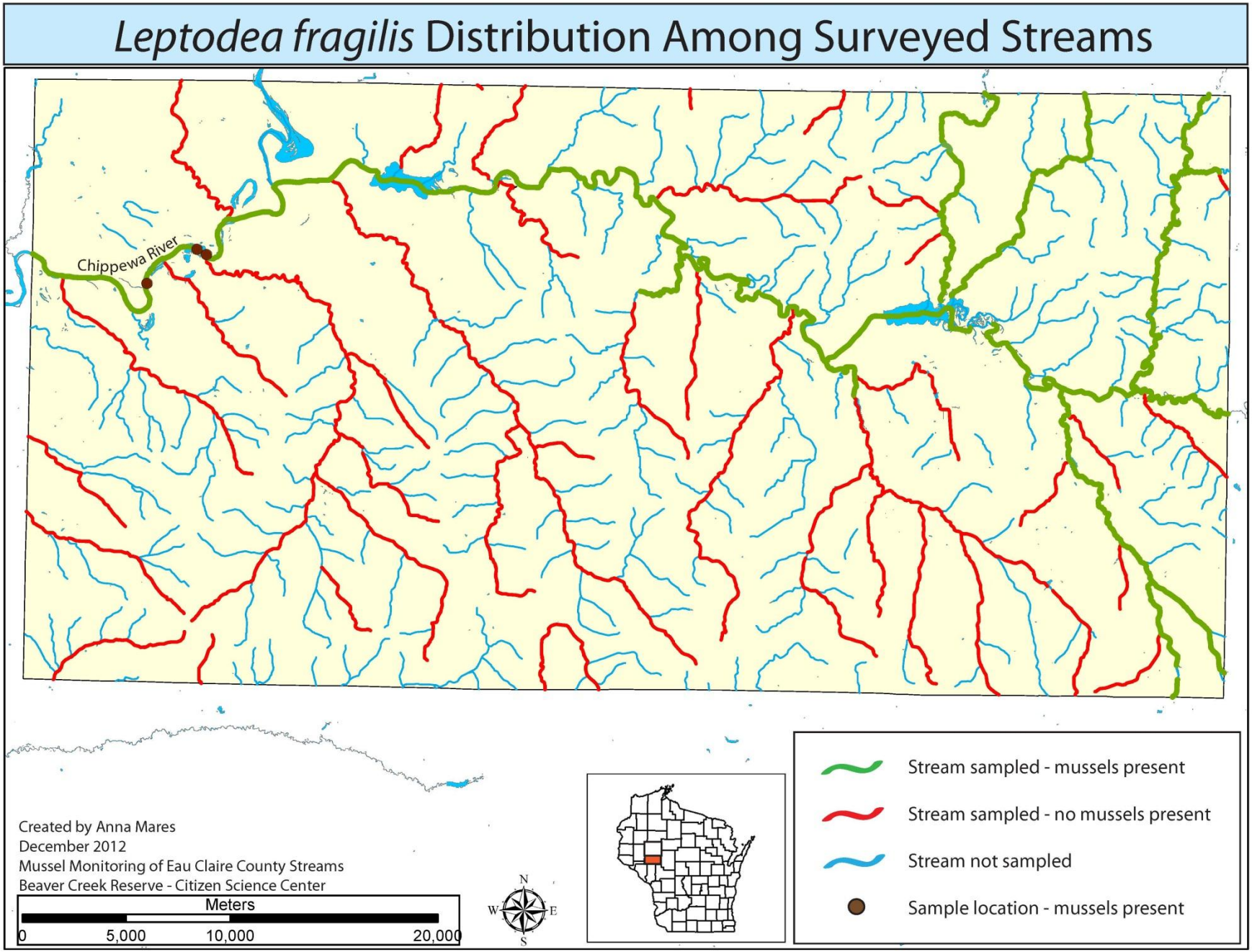

Figure 23. ***Leptodea fragilis*** **(fragile papershell) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

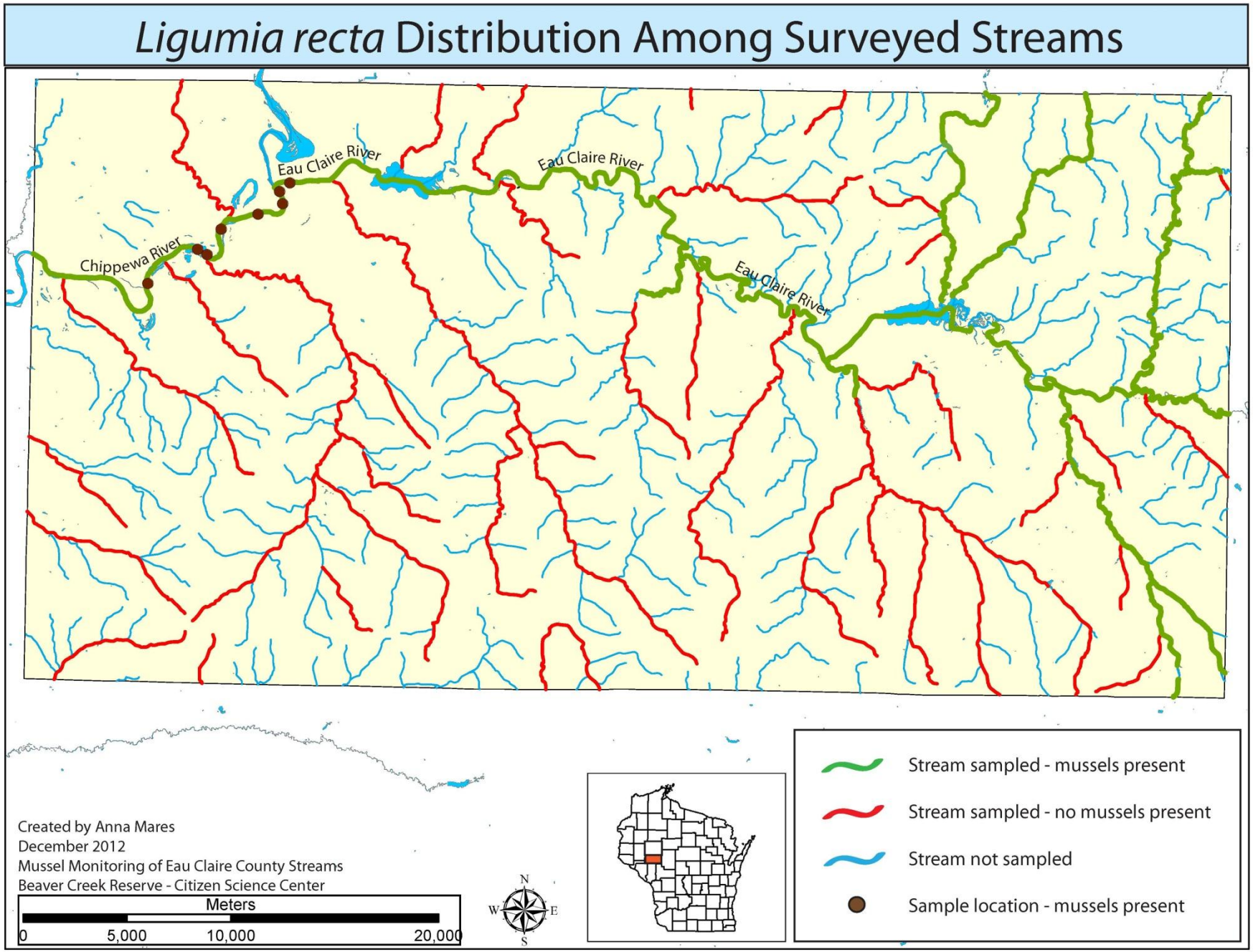

Figure 24. *Ligumia recta* (black sandshell) distribution among surveyed streams in Eau Claire County in the summer of 2012.

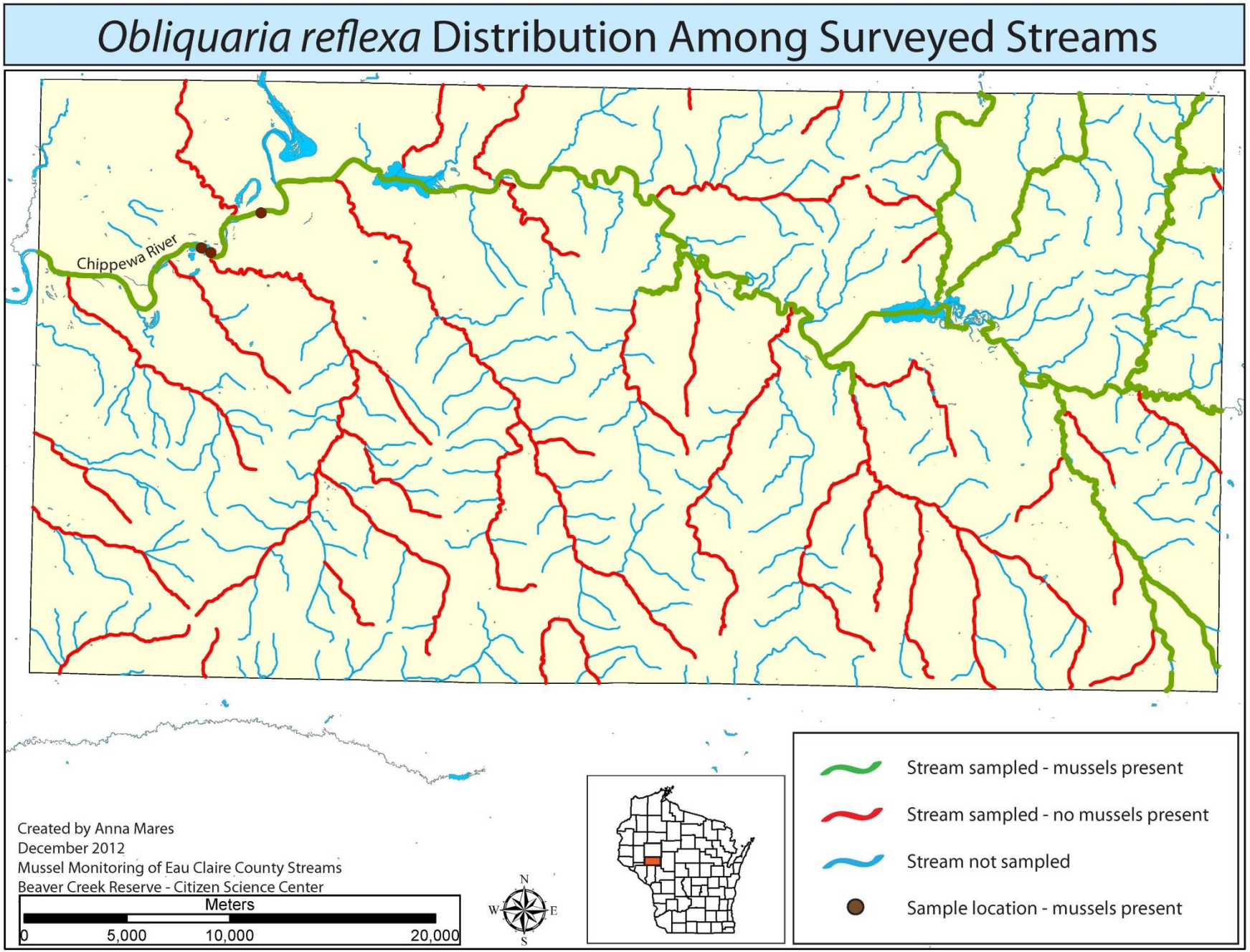

Figure 25. *Obliquaria reflexa* (threehorn wartyback) distribution among surveyed streams in Eau Claire County in the summer of 2012.

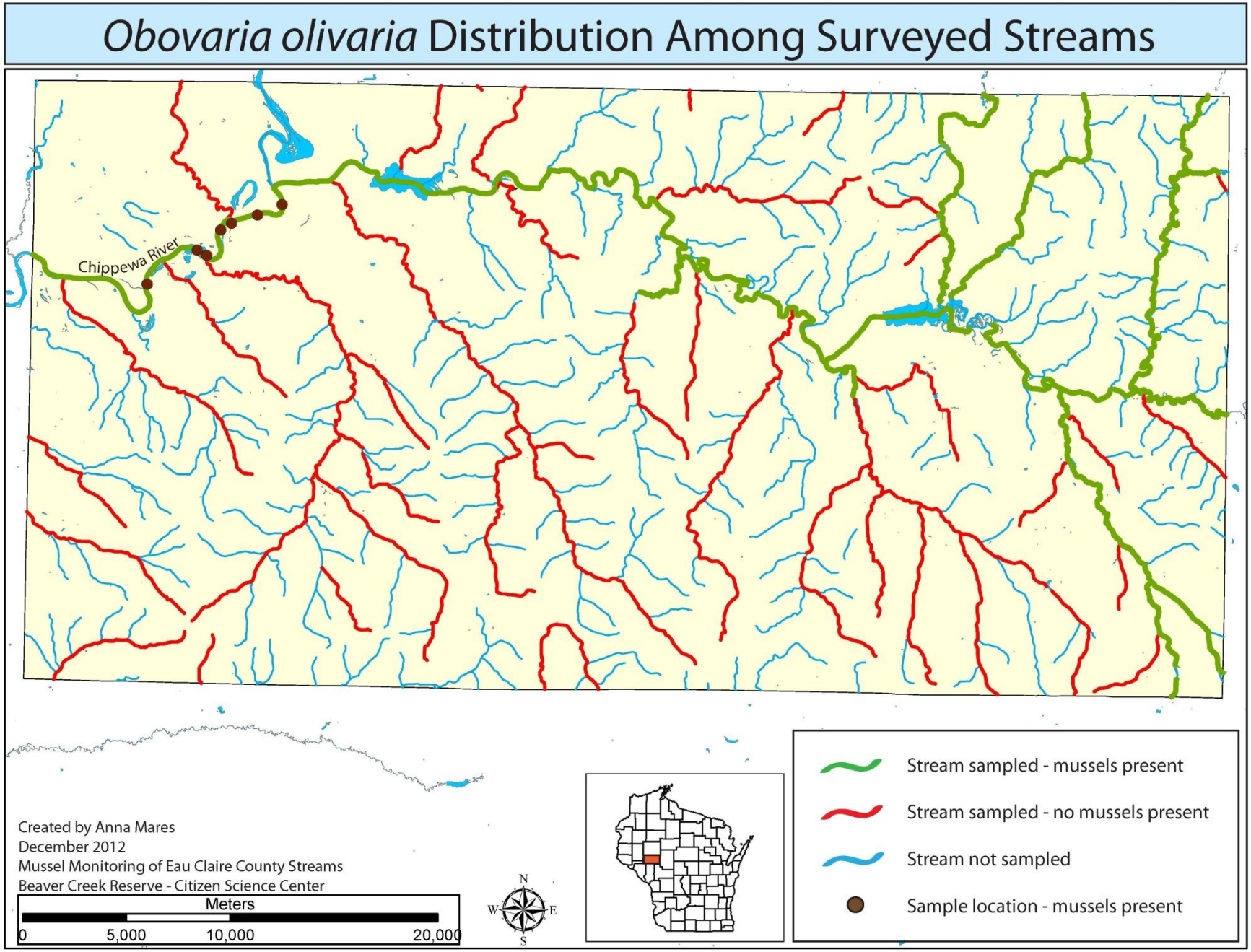

Figure 26. *Obovaria olivaria* (hickory nut) distribution among surveyed streams in Eau Claire County in the summer of 2012.

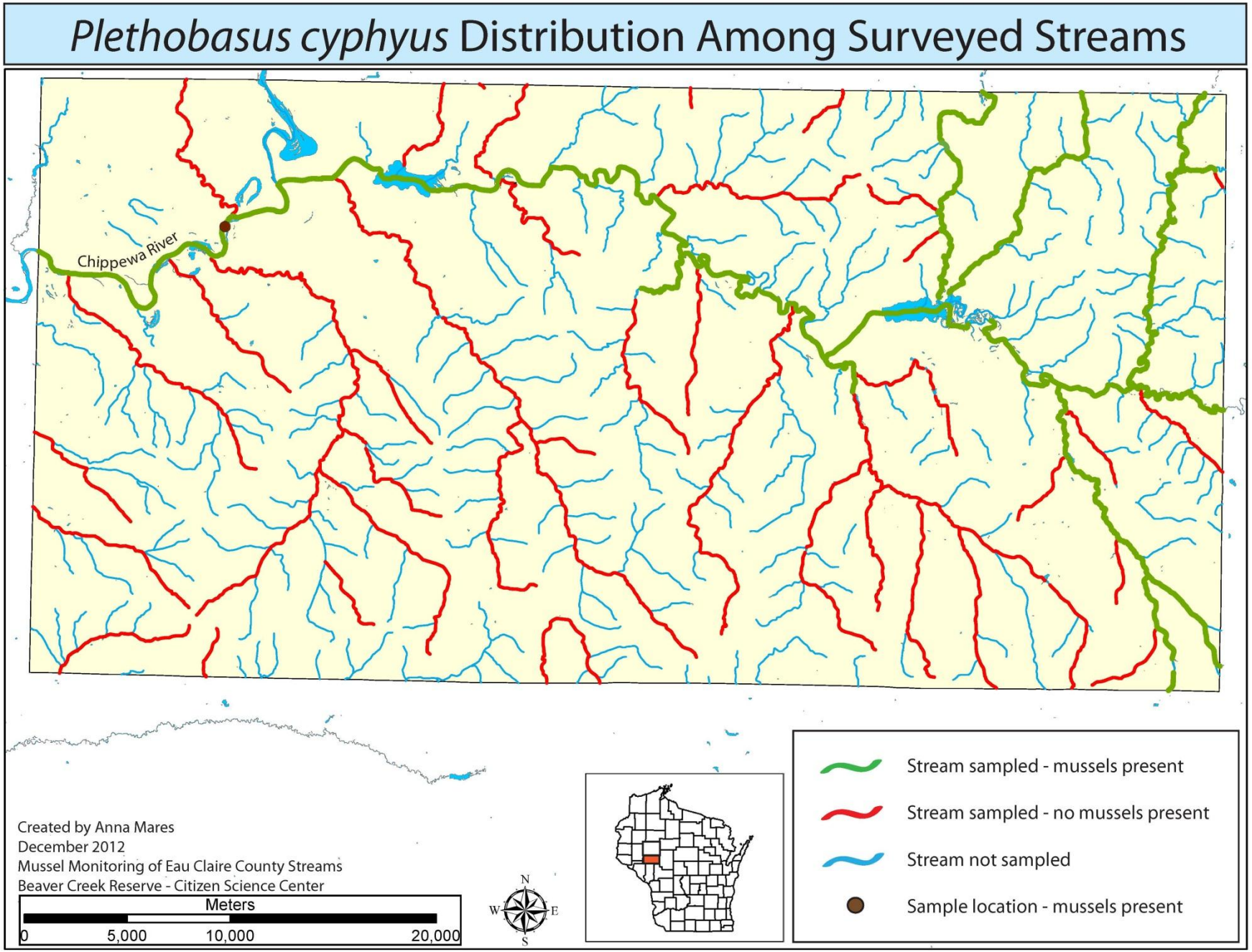

Figure 27. ***Plethobasus cyphyus*** **(sheepnose) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

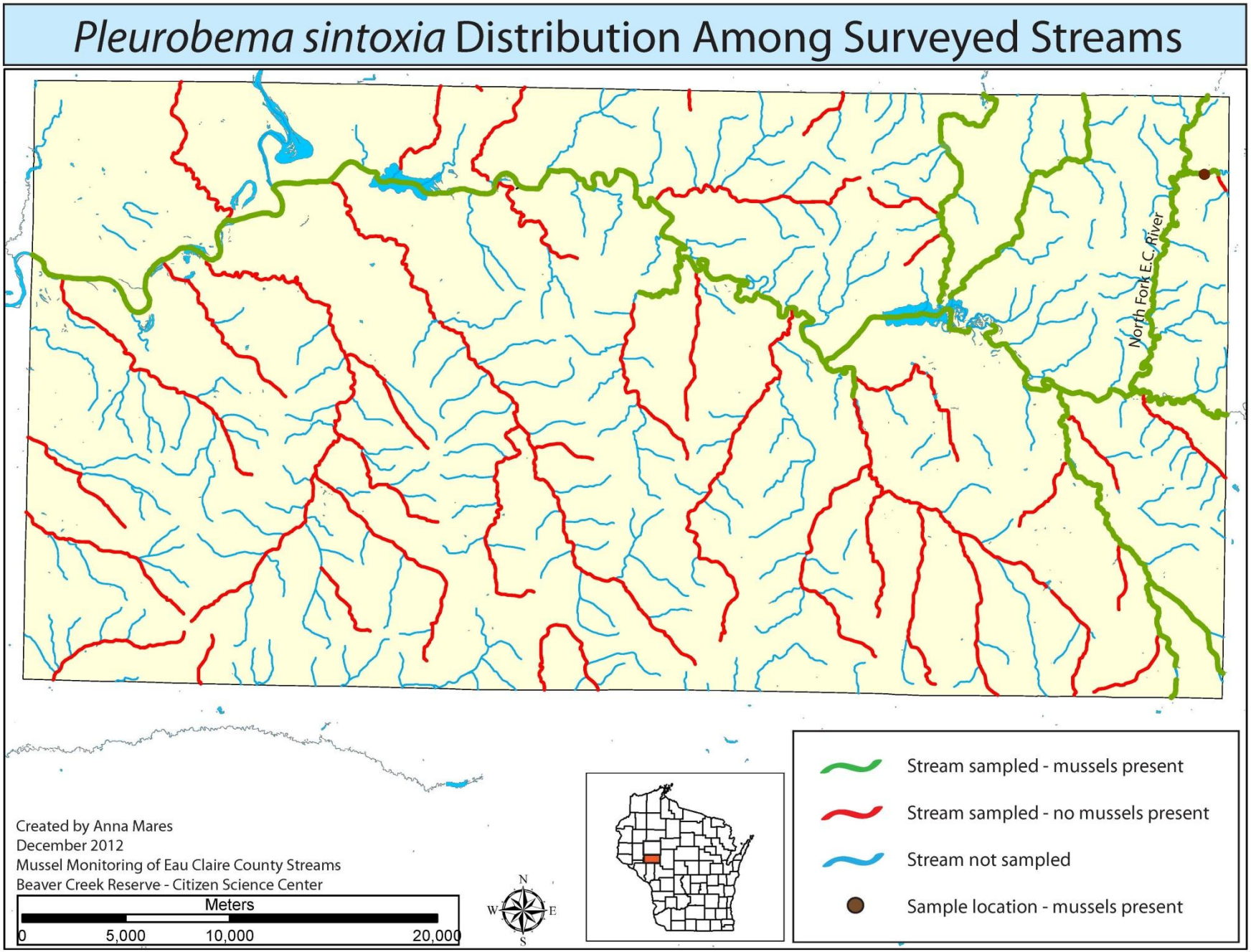

Figure 28. *Pleurobema sintoxia* (round pigtoe) distribution among surveyed streams in Eau Claire County in the summer of 2012.

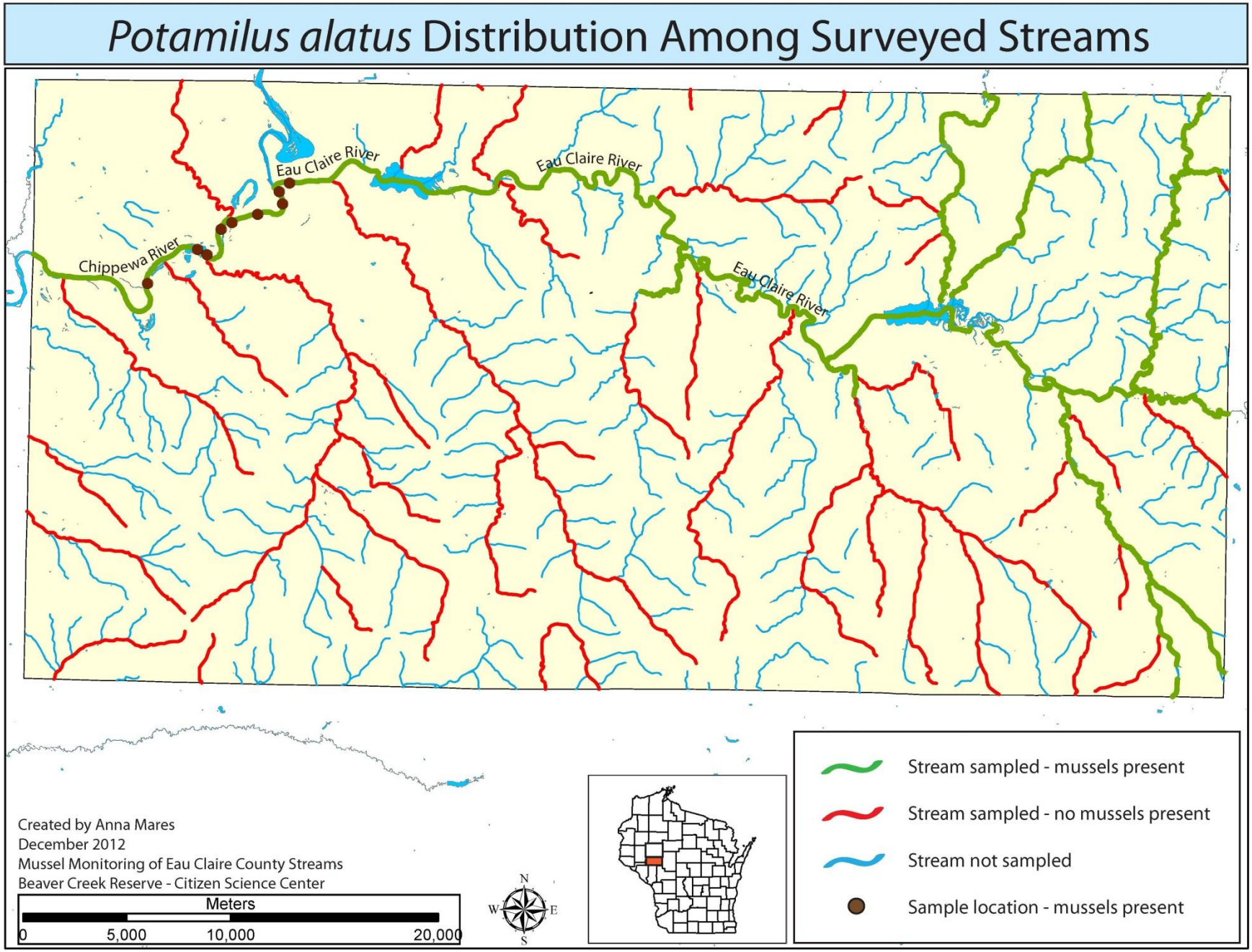

Figure 29. ***Potamilus alatus*** **(pink heelsplitter) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

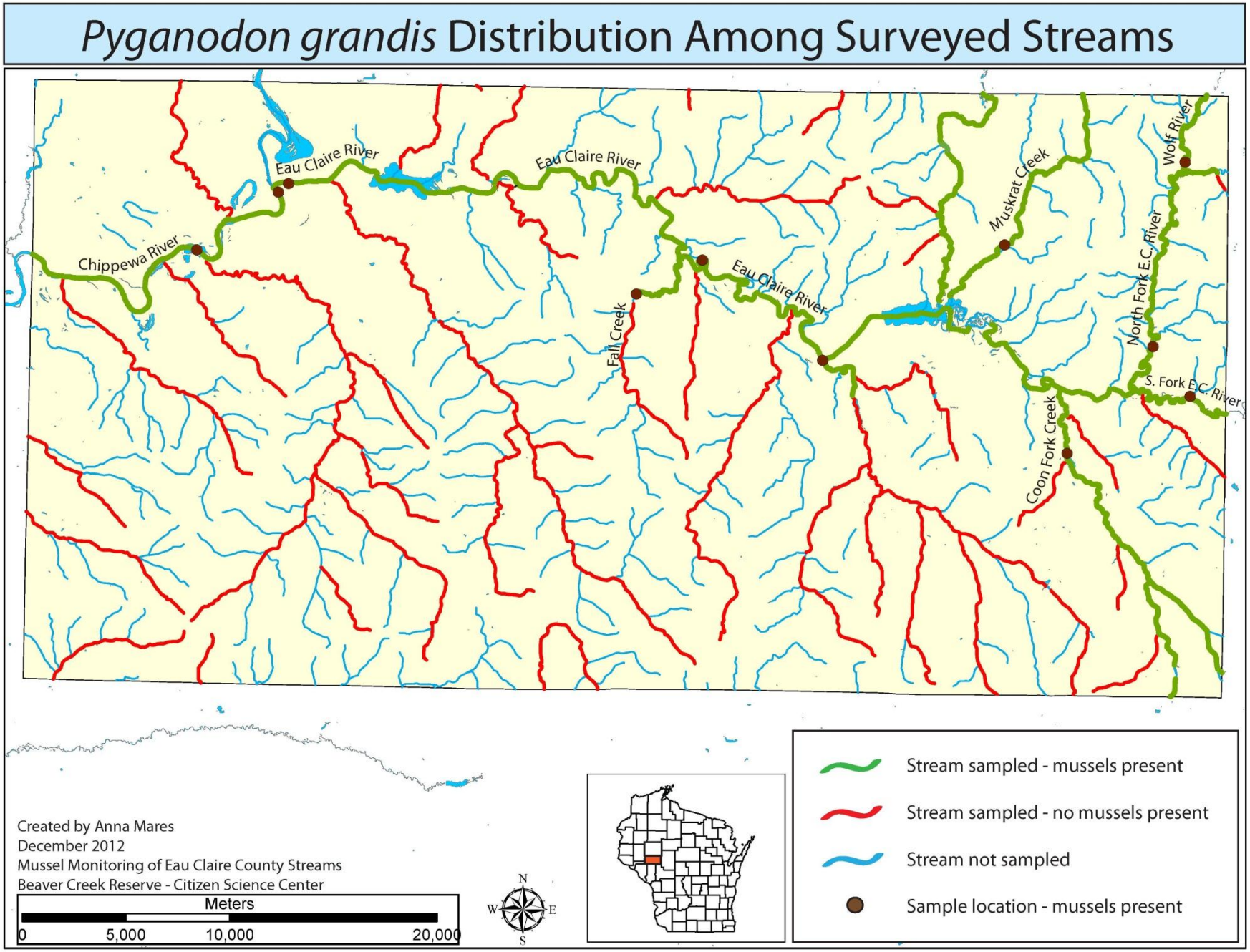

Figure 30. ***Pyganodon grandis*** **(giant floater) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

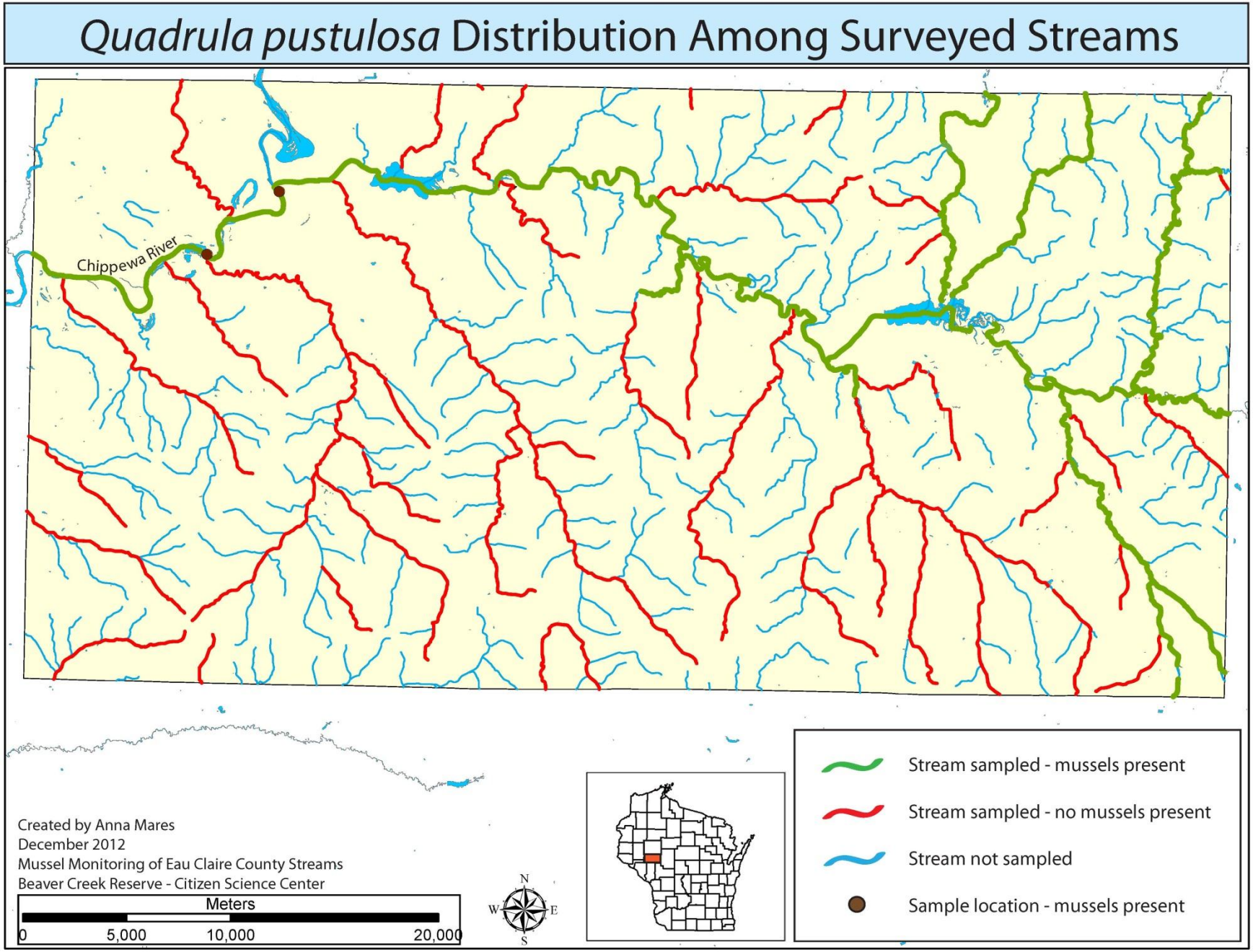

Figure 31. *Quadrula pustulosa* (pimpleback) distribution among surveyed streams in Eau Claire County in the summer of 2012.

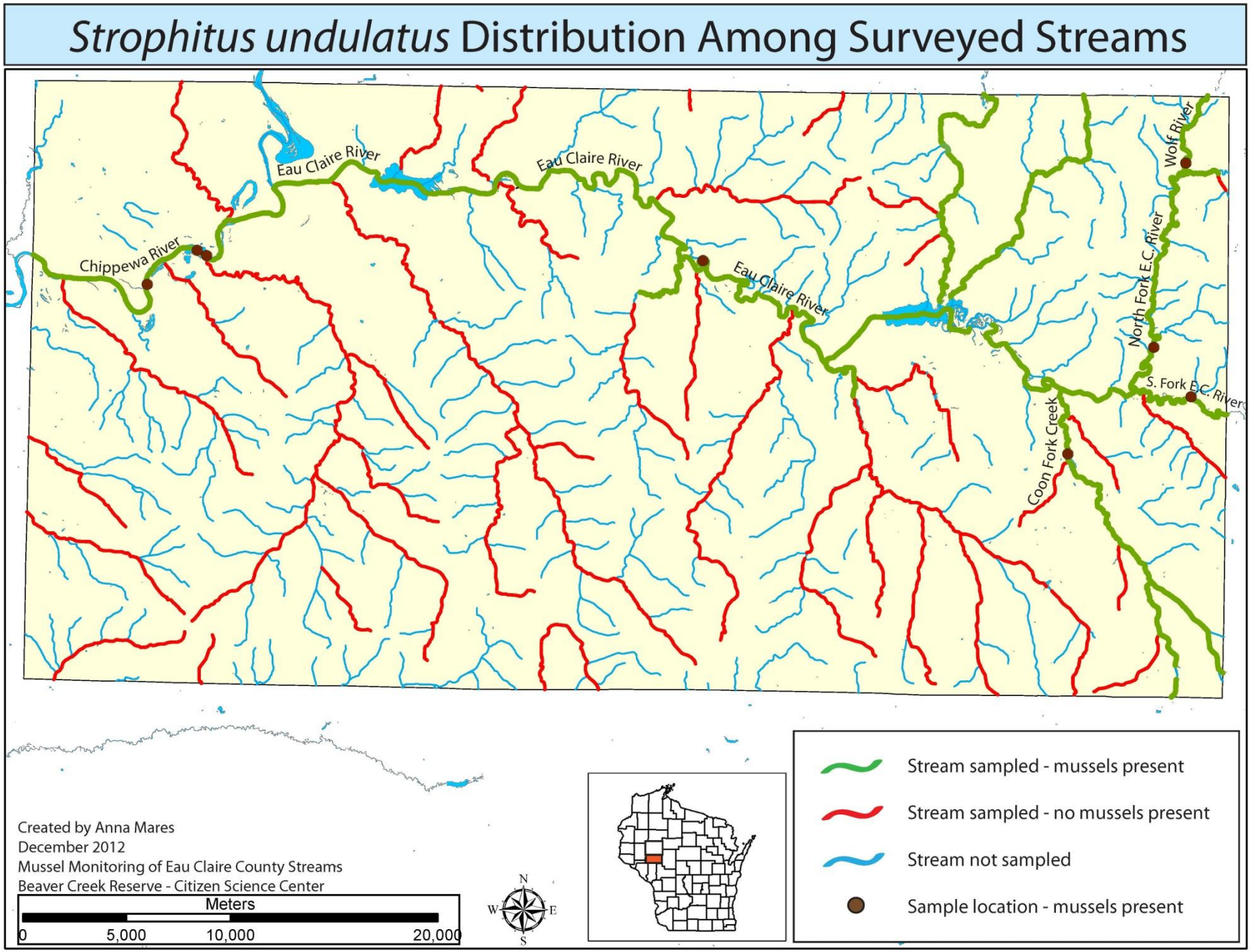

Figure 32. *Strophitus undulatus* (creeper) distribution among surveyed streams in Eau Claire County in the summer of 2012.

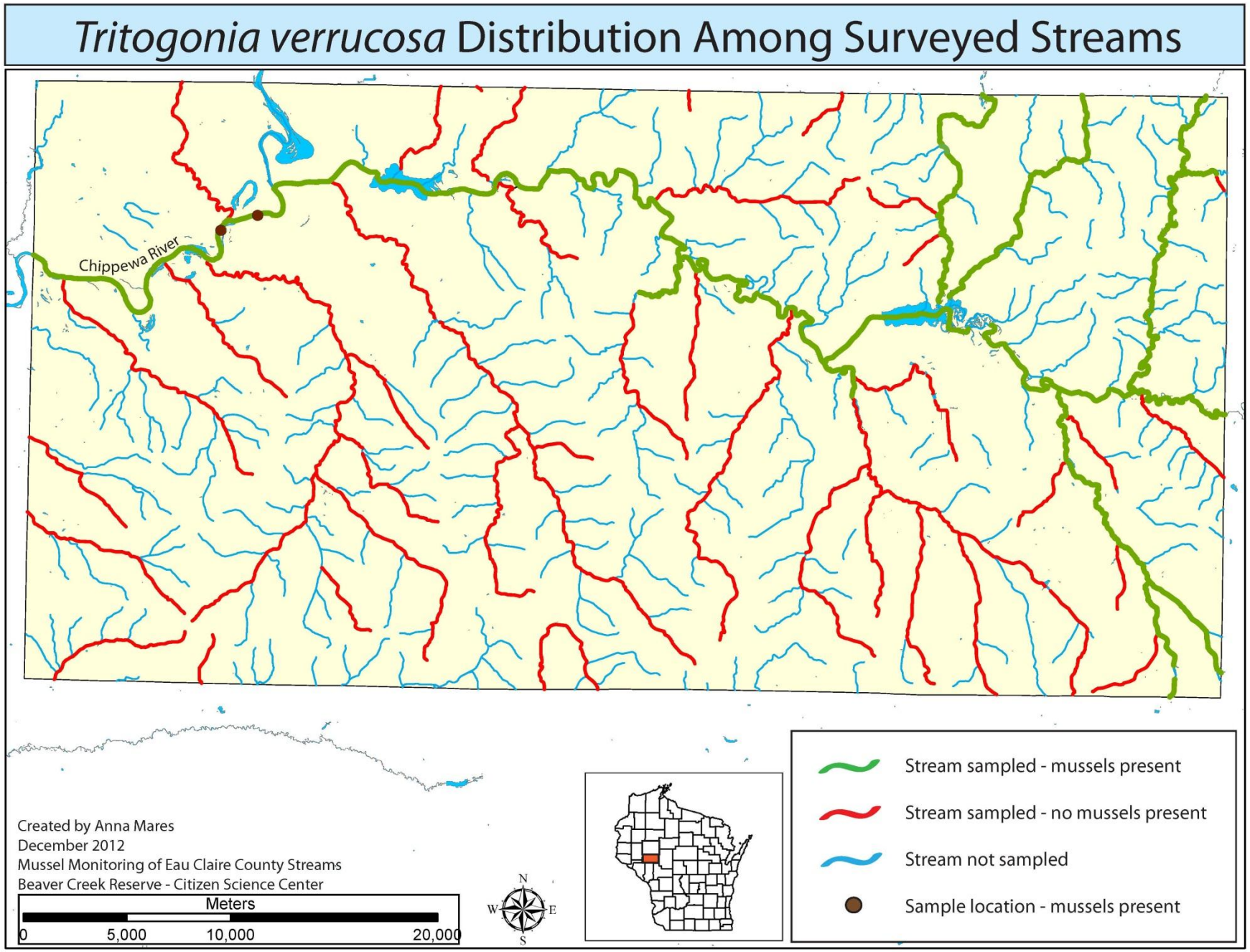

Figure 33. ***Tritogonia verrucosa*** **(pistol grip) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

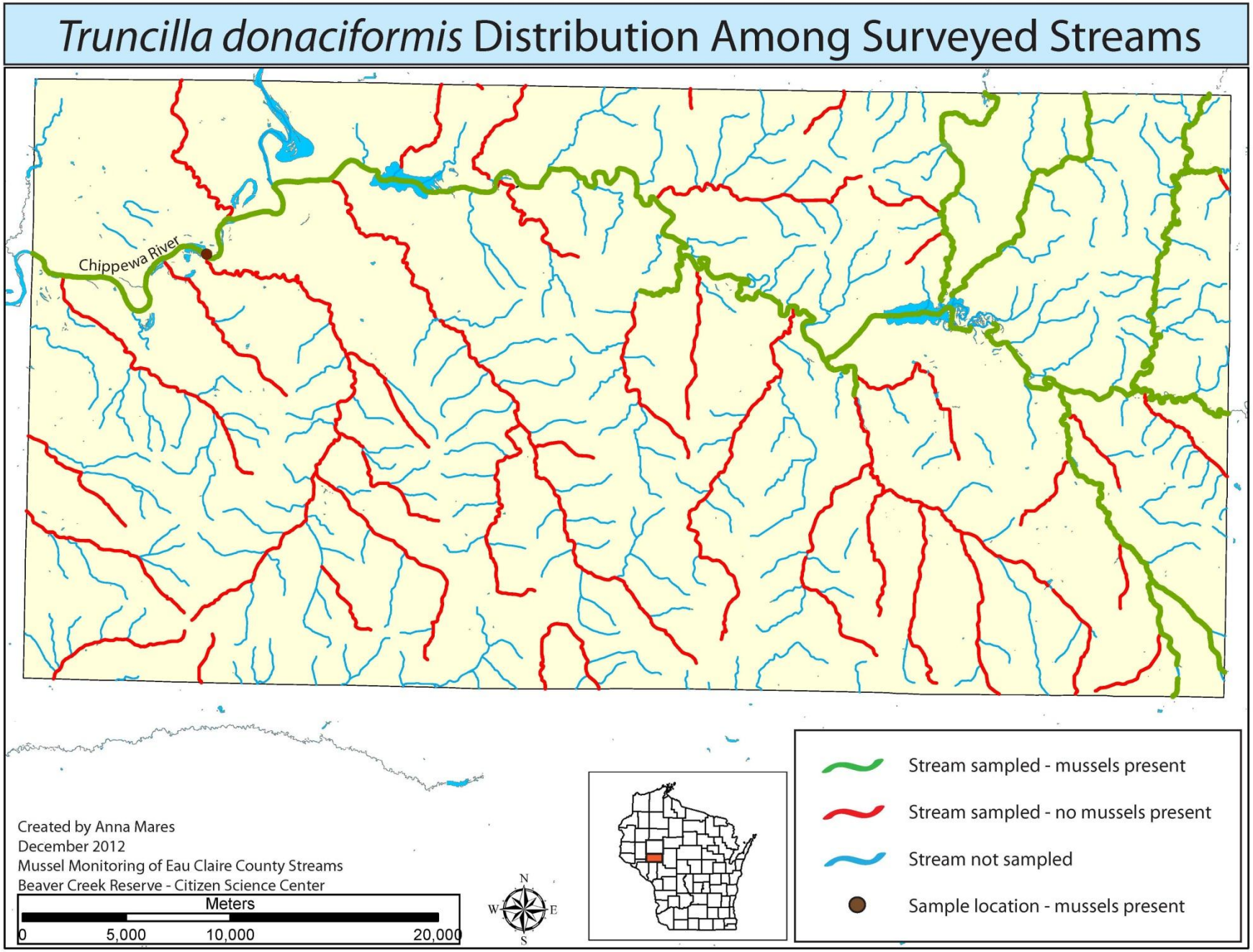

Figure 34. ***Truncilla donaciformis*** **(fawns foot) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

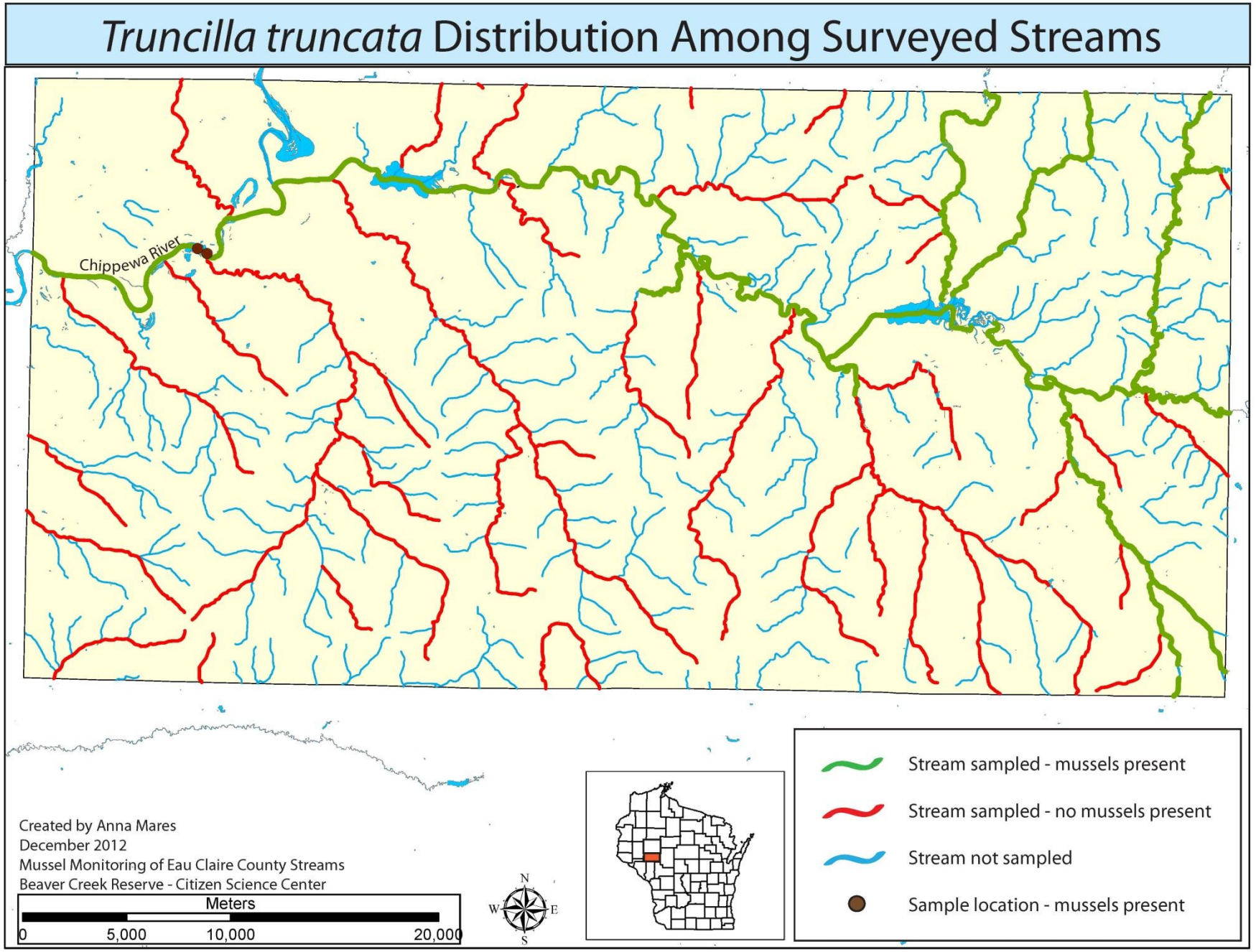

Figure 35. ***Truncilla truncata*** **(deertoe) distribution among surveyed streams in Eau Claire County in the summer of 2012.**

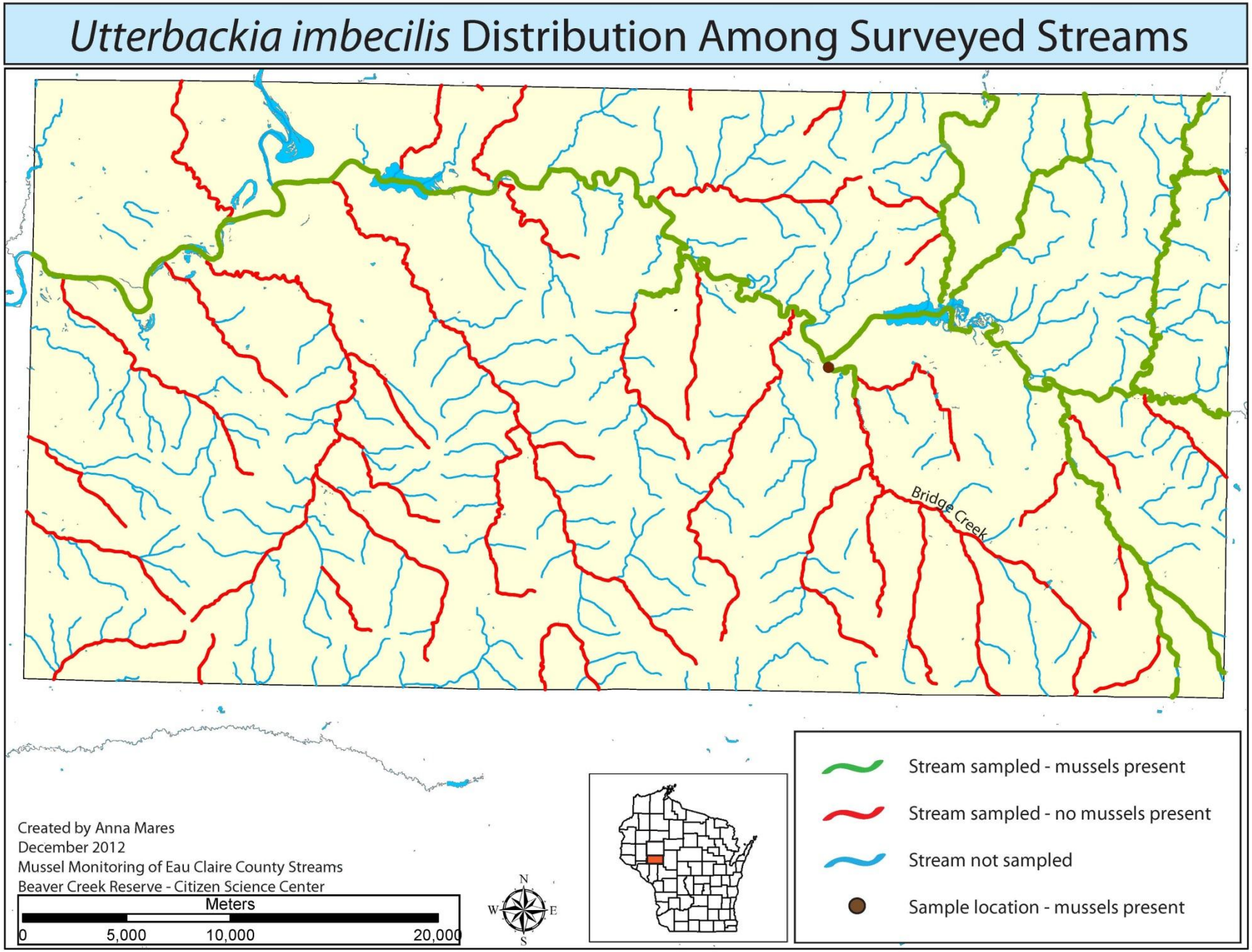

Figure 36. *Utterbackia imbecilis* (paper pondshell) distribution among surveyed streams in Eau Claire County in the summer of 2012.

Table 2. Mussel monitoring survey results for streams with mussels present.

Monitoring Location	Mussel Species	Number of live mussel found	Native Mussel Species: Black sandshell (*Ligumia recta*)	Creeper (*Strophitus undulatus*)	Cylindrical papershell (Anodontoides ferussacianus)	Deertoes (*Truncilla truncata*)	Elk toe (*Alasmidonta marginata*)	Fat mucket (*Lampsilis siliquoidea*)	Fawnsfoot (*Truncilla donaciformis*)	Fluted shell (*Lasmigona costata*)	Fragile papershell (*Leptodea fragilis*)	Giant floater (*Pyganodon grandis*)	Hickory nut (*Obovaria olivaria*)	Paper pondshell (*Utterbackia imbecilis*)	Pimpleback (*Quadrula pustulosa*)	Pink heelsplitter (*Potamilus alatus*)	Pistolgrip (*Tritogonia verrucosa*)	Plain pocketbook (*Lampsilis cardium*)	Round pigtoe (*Pleurobema sintoxia*)	Sheepnose (*Plethobasus cyphyus*)	Spike (*Elliptio dilatata*)	Threehorn wartyback (*Obliquaria reflexa*)	Threeridge (*Amblema plicata*)	Wabash pigtoe (*Fusconaia flava*)	White heelsplitter (*Lasmigona complanata*)
Black Creek	1	6			**6**																				
Bridge Creek	5	17						**3**				**2**		**1**				**1**							**10**
Chippewa River	20	929	233	10		30	7	39	3	1	40	3	135		7	96	2	256		**1**	1	5	2	12	46
Coon Fork	8	49		**1**	**4**		**1**			**1**		**2**						**3**						**3**	**34**
Eau Claire River	9	266	1	3			2	24		2		60				1		72							101
Fall Creek	1	23										**23**													
Hay Creek 1	5	30			12			**4**										**1**						**13**	**shell only**
Muskrat Creek	6	91			**2**			**25**				**4**						**1**						**47**	**12**
North Fork of Eau Claire River	8	21		1			shell only	1				**1**						6	**1**					**9**	**shell only**
Schoolhouse	3	14			**1**																			**11**	**2**
South Fork of Eau Claire River	5	3		**1**								**shell only**						2						**shell only**	shell only
Wolf River	6	122		**9**				39				**39**						**10**						17	**8**

Individual and Summary Statistics

Total number of individuals	23	1569	234	25	25	30	10	135	3	4	40	134	135	1	7	97	2	352	1	1	1	5	2	112	213
Number of sites where species was found			2	6	5	1	4	7	1	3	1	9	1	1	1	2	1	9	1	1	1	1	1	8	10
Relative abundance			15%	1.6%	1.6%	2%	.6%	8.6%	.2%	.3%	2.5%	8.5%	8.6%	.1%	.4%	6.2%	.1%	22%	.1%	.1%	.1%	.3%	.1%	7.1%	14%
Frequency of occurrence within mussel populated streams			17%	50%	42%	8%	33%	58%	8%	25%	8%	75%	8%	8%	8%	17%	8%	75%	8%	8%	8%	8%	8%	67%	83%
Relative frequency of species occurrence			3%	8%	6%	1%	5%	9%	1%	4%	1%	12%	1%	1%	1%	3%	1%	12%	1%	1%	1%	1%	1%	10%	13%

Endangered species	text = species previously found in stream
Threatened species	**text** = new species documentation for stream
Species of special concern	
Healthy species	

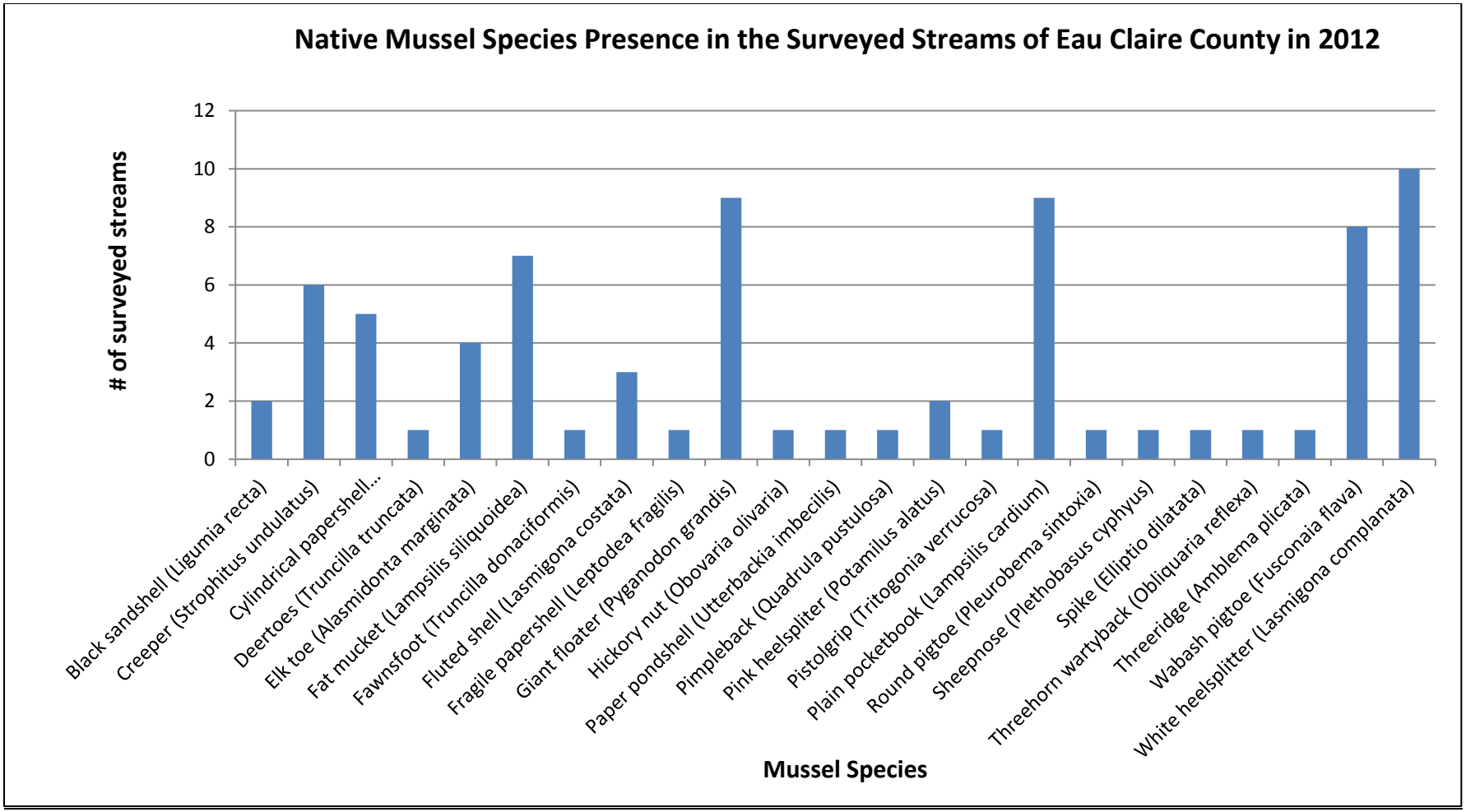

Figure 37. Native mussel species presence in the surveyed streams of Eau Claire County during the summer of 2012.

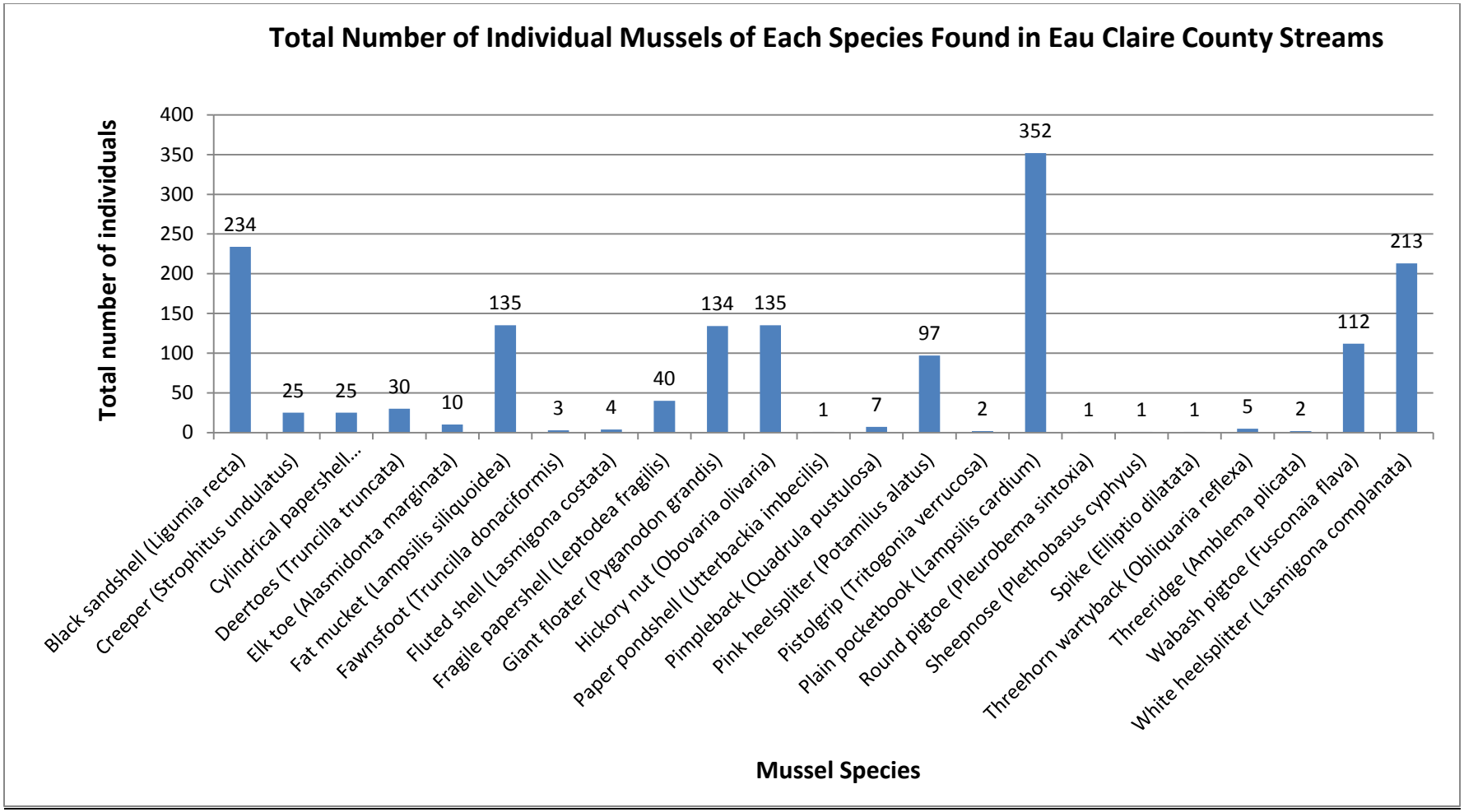

Figure 38. Total number of individual live mussels of each species found in the surveyed streams of Eau Claire County during the summer of 2012.

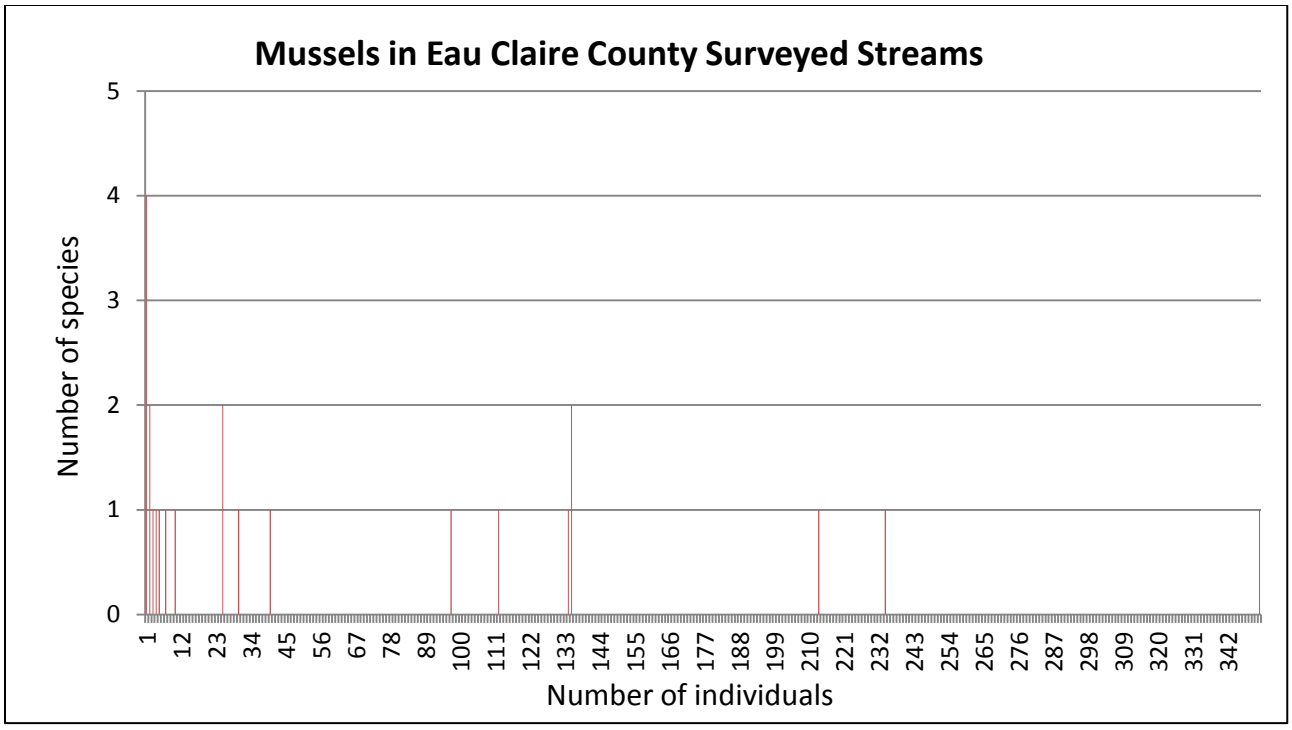

Figure 39. Numbers of individuals and species of mussels found in surveyed Eau Claire County streams during the summer of 2012.

Discussion

Project deliverables

The CSC was able to provide all of the deliverables set out in the original grant application for the project. These included: a species list of native mussels for each of the 49 streams sampled, species distribution maps, water quality and stream data, water access identification, citizen recruitment, and a final report.

Weather conditions

As previously stated, 2012 was a drought year and because of this several streams scheduled for sampling did not have water in them at the time of surveying. Most of those streams appeared to not have the makeup that would support mussels. The one exception was the South Fork of Paint Creek, although dry, showed promise for possibly supporting mussels. The dry stream bed contained numerous fingernail clams and snail shells, as well as having small gravel present.

Even if the stream beds were not totally dry, the drought posed a serious threat to the health of some mussels that were located in shallow water. As the water levels continued to drop over the course of the summer, it left many mussels stranded, causing them to desiccate in the sun. The water either dropped so quickly that the mussels did not have enough time to move to deeper water or they went the wrong way. While surveying areas such as this, the mussel crew would

move any live mussels to deeper water to help them avoid similar fates after they were identified and counted.

Despite the negative aspects of the drought, there were three positives. One was that many sections of the larger rivers were more accessible to wading, allowing for a better survey effort. Secondly, it was exceptionally hot. That meant that the water was a comfortable temperature for wading in when waders were not worn. And lastly, the unusually high number of sunny days proved to be excellent for viewing mussels in the stream. A bright sunny day provided greater visibility into the water, allowing mussels to be seen easier.

Weather plays an important role in the ability of a surveyor to spot a mussel in the stream, especially if wading is the only sampling method. A couple of sample days fell on overcast or rainy days. Cloudy weather made the surveying more difficult but still possible, while rain made it impossible. The rain disrupts the water's surface and decreased the transparency with runoff. Significant effort should be made to align sampling with sunny days, which allow for the best visibility. Polarized sunglasses also increased the ability to spot mussels by reducing the surface glare of the water.

Sampling locations

The original project design stated that a single location for each stream was going to be sampled. Several streams were afforded a second or multiple sampling locations. Also, a different location than originally planned had to occasionally be used. Reasons for this varied from no water or stagnant water, no mussels present, few mussels present, or streambed substrates that did not appear representative of the stream as a whole. Sample locations that lacked water or were stagnant in the upper reaches of stream often had flowing water a few miles lower in the reach. Rivers like the Eau Claire and the Chippewa had multiple sites because if, for example, only five species were found at one site that seemed under representative when 18 and 25 mussel species, respectively, had been previously found.

Volunteers

Volunteers were instrumental to the success of this project. Having an assisting volunteer in the field was a safety factor, should something happen. Volunteers and professionals provided over 350 hours to the project. With these hours, streams could be checked more thoroughly and more than one small stream could be done in one survey day. The volunteers were especially helpful on larger waters like the Eau Claire and Chippewa rivers. Such large expanses needed more than one or two pairs of eyes on them. Several additional survey days per large river would have been necessary without the help of volunteers.

Changes in species listed status

A few of the species found in Wisconsin had status changes in state and federal listings over the course of the project. As of Sept 24, 2012 the fawnsfoot was up for consideration to be listed as state threatened instead of a species of special concern. The sheepnose, spectaclecase, and snuff box were state listed as endangered and federally proposed as endangered. As of March 15, 2012 for the snuff box and April 12, 2012 for the sheepnose and spectaclecase, they were granted federal endangered species status.

Anecdotal observations

When wading a stream, the survey crew began to notice characteristics that coincided with the presence of mussels. These characteristics included:

1. Fish
2. Crustaceans (crayfish, snails, fingernail clams)
3. Some rocky substrate (gravel, cobble, boulders, not bedrock)

When one, two or all three of these were not observed, mussels were most often not found. This makes sense with what is known of native mussels. Fish are needed as hosts for them to complete their life cycles. The presence of crustaceans would indicate that an adequate amount of calcium was in the water to construct mussel shells. And, a few mussels will be found in soft, shifty sand but it appears that most mussels prefer to have a mix of sand, gravel and cobble. This mix is a stable base for them to anchor into, unlike bedrock, which allows no burrowing for the mussels and soft, shifty sand that can bury the mussels.

Comparison to past distributions

There are differences between the results of this study and what has been found in the streams in the past (Table 3.). It should be noted that not all of the species found in 2012 were live mussels (see Table 2.).

Black Creek previously had giant floaters present but this survey found only cylindrical papershells to be present. Young giant floaters can easily be confused with cylindrical papershells.

Findings in the Chippewa River were fairly similar between the past and the present. Three species were not detected: the lilliput, mucket, and stout floater. The only notable difference was the addition of the endangered sheepnose in 2012, which was a new section (Township, Range, Section) record.

The Eau Claire River had a significant drop (50%) in the number of species seen in 2012. Only nine of the previously seen species were found to be present. The Eau Claire River had visibility issues when the survey crew sampled in the end of July downstream from Lake Altoona. This was due to the high algal concentrations in the reservoir. This portion of the Eau Claire River needs to be surveyed earlier in the season before algae becomes an issue. It would be advised to look closer at the Eau Claire River by surveying more segments of the river to see if sampling locations and effort are the reason for such low species richness in this survey of the Eau Claire River.

Hay Creek (1) saw an increase in the number of species found from two to five. Only one of the same species had previously been found, the cylindrical papershell. The creeper was not found during this survey. Mussels in this stream were very sparse and spread out over great distances.

The North Fork of the Eau Claire saw a doubling of species between previous and current efforts. Only six species would have been documented had a second survey location not been added. The second site yielded two additional species, one of which is the round pigtoe. That is the only location that species, and the only live individual, that was found as part of the project. The round pigtoe appears to be rare in Eau Claire County.

The South Fork of the Eau Claire River had an increase in the number of species seen, but this is a bit deceptive. Three of the five species were represented by empty shells (no live specimen found). Only three total live individuals were found of the other two species. The South Fork stream bed is made of very shifty sand with high stream bank erosion. It is also evident that large flood events occur in this area, altering the stream habitat significantly. This proves to be unfavorable mussel habitat.

The Wolf River had a two fold increase with all species being confirmed by live specimens. Four of the species seen were new documentations. The one species lost from last survey efforts was the round pigtoe. The Wolf River is near the section of the North Fork of the Eau Claire River that hosts the round pigtoe. It is possible that the Wolf R. still contains the round pigtoe and that a larger search effort would yield positive results.

Table 3. Comparison between number of species found prior to and during 2012 surveys for native mussels in Eau Claire County streams.

Name of stream/river	Number of mussel species historically known to be in stream/river	Number of mussel species found in stream/river during the 2012 survey
Black Creek	1	1
Chippewa River	23	20
Eau Claire River	18	9
Hay Creek (1)	2	5
North Fork of the Eau Claire River	4	8
South Fork of the Eau Claire River	3	5
Wolf River	3	6

Recommendations

It appears that not all of the species are doing well in Eau Claire County and could be considered rare here due to the low numbers of individuals of each found. These species include: elk toe, fawnsfoot, fluted shell, paper pondshell, pistolgrip, round pigtoe, sheepnose, spike, threehorn wartyback, and three ridge. The streams and rivers in EEC should be surveyed on a more frequent basis to assess whether these species are in decline because of issues or are just naturally low in number. Specifically, the Eau Claire River needs additional surveying effort to determine changes in mussel health.

Several species may have been overlooked in this survey due to the singular wading survey method used. Balding (2003) found that digging surveys yielded a greater number and different species than non-digging surveys and that there is a bias towards finding larger specimen with wading. The survey crew did find many smaller individuals but this could explain why some numbers were low and species like *Simpsonaias ambigua* were not found at all. Perhaps a few digging transects should be added in to the next study design to capture the presence of a few more species. To make sure that other species are not overlooked due to poor visibility, sampling should occur earlier in the season (June) on waters that are affected by algal issues of upstream impoundments.

If similar surveys take place in other counties across the state, it is important that trout streams are not automatically taken off the surveying list. In our study, five other streams that were not known to host mussels were found to have mussels present. These five streams include Class I, Class II, and Class III trout streams which are typically overlooked for surveying.

Conclusion

The BCCSC was able to accomplish all four objectives set forth for this project, 1) **Survey 49 streams for mussels** – 42 more streams than previously done; 2) **Increase public awareness** – host one educational talk about mussels and one training workshop for surveying for mussels (approx. 20 individuals each); 3) **Create a mussel species list for Eau Claire County**; 4) **Have community involvement** – have citizens assist in surveying for mussels (approx. 20 individuals). In addition to meeting the goals of the project the BCCSC mussel crew was able to produce all of the deliverables of the project. A species list of native mussels found was compiled for each of the 49 streams sampled. Species distribution maps were created. Water quality and stream data was collected for each of the 49 streams as well. A total of 57 individuals were educated on mussel ecology, trained on how to sample for mussels and participated in mussel monitoring in Eau Claire County streams.

The MMECCS project showed that it was worthwhile effort. By resurveying streams that had been looked at in the past, additional species were added to presence lists for six of the seven streams. Five new streams were found to host mussels. A variety of species were found including species of special concern, threatened and endangered (both state and federally). Some species were found to be abundant (white heelsplitter, plain pocketbook, giant floater, Wabash pigtoe, and fat mucket) while others were not (fawnsfoot, round pigtoe, sheepnose, threehorn wartyback and others). Consideration should be given to survey the Eau Claire River in greater depth along with more frequent surveying of streams to assess changes in more rare species.

Cited References

Balding, T.A. 2003. Unionidae of the Chippewa River, Wisconsin, and selected tributaries: 1986-2002. Unpublished booklet, University of Wisconsin - Eau Claire, Eau Claire, Wisconsin.

Wisconsin Department of Natural Resources [WDNR]; Wisconsin Water Search - Find Rivers, Streams, Lakes, Bays and Harbors [Internet]. Madison, WI: WDNR; 2012 Dec. Available from http://dnr.wi.gov/water/waterSearch.aspx

Wisconsin Department of Natural Resources [WDNR]. Freshwater Mussels of the Upper Mississippi River. Madison, WI: WDNR; 2003. 60 p. Available from: WDNR, Madison, WI.

Wisconsin Department of Natural Resources [WDNR]; Mussel Monitoring Program of Wisconsin [Internet]. Madison, WI: WDNR; 2011 May 1 [cited 2012 Dec 15]. Available from http://wiatri.net/inventory/mussels/MusselWatersState.cfm and http://wiatri.net/inventory/mussels/index.cfm

Appendix A

Table 4. List of streams that either originate in or cross through Eau Claire County, the length of the stream within the county borders (in miles), the Water Body Identification Code (WBIC) of each stream, the categorization of trout class, and the listing of outstanding resource water (ORW)/exceptional resource water (ERW). Highlighted streams were surveyed. (WDNR 2012)

Official Name	Water Size	WBIC	Trout Class	ORW/ ERW
Alder Creek	3.0 Miles	2154000	No Listing	
Beaver Creek (2)	10.0 Miles	2126800	No Listing	
Beaver Creek (1)	9.4 Miles	2129400	No Listing, Class I	ERW
Browns Creek	7.0 Miles	2130700	No Listing	
Chippewa River	39.5 Miles	2050000	No Listing	
Coon Fork Creek	7.0 Miles	2135100	No Listing	
Eau Claire River	41.0 Miles	2125600	No Listing	
First Trestle Creek	3.0 Miles	2131300	No Listing	
Five Mile Creek	5.0 Miles	2128200	No Listing	
Hay Creek	21.4 Miles	2133300	No Listing	
Kelly Creek	2.0 Miles	2124800	No Listing	
Kluckman Valley Creek	2.0 Miles	2127500	No Listing	
Little Niagara Creek	1.0 Miles	2125500	No Listing	
North Fork Eau Claire River	56.0 Miles	2145400	No Listing	
Pea Creek	4.0 Miles	2135200	No Listing	
Pine Creek	5.0 Miles	2124300	No Listing	
Rush Creek	5.0 Miles	2130200	No Listing	
Session Valley Creek	4.0 Miles	1822600	No Listing	
Sherman Creek	14.0 Miles	2125100	No Listing	
Simes Creek	3.0 Miles	2147800	No Listing	
South Fork Eau Claire River	50.0 Miles	2137000	No Listing	
South Fork Paint Creek	6.0 Miles	2153300	No Listing	
Taylor Creek	7.0 Miles	2123600	No Listing	
Unnamed 1	.1 Miles	5012705	No Listing	ERW
Unnamed 2	6.0 Miles	2135800	No Listing	
West Creek	12.0 Miles	2122500	No Listing	
Willow Creek	4.0 Miles	2124000	No Listing	
Wolf River	6.6 Miles	2146000	No Listing	
Clear Creek	9.1 Miles	2124400	CLASS I	ERW
Darrow Creek	2.6 Miles	2133500	CLASS I	ERW
Hay Creek	7.1 Miles	2131900	CLASS I	ERW
Schoolhouse Creek	4.7 Miles	2135900	CLASS I	
Sevenmile Creek	4.7 Miles	2128700	CLASS I	ERW
Unnamed	.8 Miles	5012788	CLASS I	ERW
Unnamed	1.1 Miles	2129650	CLASS I	ERW
Unnamed	3.0 Miles	2129500	CLASS I	ERW
Adams Creek	4.3 Miles	1823600	CLASS II	
Beeman Creek	3.3 Miles	2145500	CLASS II	

Appendix A Continued

Table 4 continued. List of streams that either originate in or cross through Eau Claire County, the length of the stream within the county borders (in miles), the Water Body Identification Code (WBIC) of each stream, the categorization of trout class, and the listing of outstanding resource water (ORW)/exceptional resource water (ERW). Highlighted streams were surveyed. (WDNR 2012)

Official Name	Water Size	WBIC	Trout Class	ORW/ ERW
Big Creek	5.0 Miles	1823300	CLASS II	
Cold Creek	1.5 Miles	2133400	CLASS II	
Coon Gut Creek	4.0 Miles	2135000	CLASS II	
Deinhammer Creek	3.3 Miles	2129300	CLASS II	
Elk Creek	.3 Miles	2120800	CLASS II	
Fall Creek	10.7 Miles	2129900	CLASS II	
Graham Creek	4.8 Miles	2124700	CLASS II	
Hathaway Creek	4.4 Miles	2134800	CLASS II	
Lindsay Creek	1.8 Miles	1823000	CLASS II	
Loper Creek	3.3 Miles	2145900	CLASS II	
Lowes Creek	24.3 Miles	2123900	CLASS II	ERW
McGaver Creek	3.2 Miles	2136000	CLASS II	
Muskrat Creek	17.8 Miles	2134200	CLASS II	
Ninemile Creek -North	5.6 Miles	2128900	CLASS II	
Ninemile Creek -South	7.5 Miles	2128600	CLASS II	
Pine Creek	4.1 Miles	2129600	CLASS II	
Sand Creek	4.7 Miles	2130500	CLASS II	
Shambaugh Creek	2.3 Miles	2145600	CLASS II	
Sixmile Creek	4.5 Miles	2128500	CLASS II	
Swim Creek	1.4 Miles	2146100	CLASS II	
Travis Creek	5.4 Miles	2132700	CLASS II	
Unnamed	2.6 Miles	2124500	CLASS II	
Whippoorwill Creek	3.9 Miles	2134900	CLASS II	
Bridge Creek	20.6 Miles	2130600	CLASS II, III	
Thompson Valley Creek	9.8 Miles	2131100	CLASS II, III	
Bears Grass Creek	15.9 Miles	2130300	CLASS III	
Black Creek	10.5 Miles	2135700	CLASS III	
Coon Creek	6.0 Miles	2120300	CLASS III	
Diamond Valley Creek	7.1 Miles	2131400	CLASS III	
Horse Creek	8.2 Miles	2137100	CLASS III	
Otter Creek	26.5 Miles	2125700	CLASS III	
Peeso Creek	9.7 Miles	1820700	CLASS III	
Pine Creek	5.7 Miles	1825900	CLASS III	
Rock Creek	11.6 Miles	2119000	CLASS III	

Appendix B

Table 5. Mussel species that can be found in Wisconsin, including scientific name, common name and population health status (WDNR 2003). Highlight species found during the project.

Scientific name	Common name	Status
Actinonaias ligamentina	Mucket	Special Concern
Alasmidonta marginata	Elktoe	Special Concern
Alasmidonta viridis	Slippershell	State Threatened
Amblema plicata	Threeridge	Apparently Healthy
Anodonta suborbiculata	Flat Floater	Special Concern
Anodontoides ferussacianus	Cylindrical Papershell	Apparently Healthy
Arcidens confragosus	Rock Pocketbook	State Threatened
Cumberlandia monodonta	Spectaclecase	State Endangered/Federally Endangered
Cyclonaias tuberculata	Purple Wartyback	State Endangered
Ellipsaria lineolata	Butterfly	State Endangered
Elliptio complanata	Eastern Elliptio	Special Concern
Elliptio crassidens	Elephant-Ear	State Endangered
Elliptio dilatata	Spike	Apparently Healthy
Epioblasma triquetra	Snuffbox	State Endangered/Federally Endangered
Fusconaia ebena	Ebonyshell	State Endangered
Fusconaia flava	Wabash Pigtoe	Apparently Healthy
Lampsilis cardium	Plain Pocketbook	Apparently Healthy
Lampsilis higginsi	Higgins Eye	State Endangered
Lampsilis siliquoidea	Fatmucket	Apparently Healthy
Lampsilis teres (anodontoides)	Yellow Sandshell	State Endangered
Lampsilis teres (teres)	(Slough Sandshell)	State Endangered
Lasmigona complanata	White Heelsplitter	Apparently Healthy
Lasmigona compressa	Creek Heelsplitter	Special Concern
Lasmigona costata	Fluted-Shell	Apparently Healthy
Leptodea fragilis	Fragile Papershell	Apparently Healthy
Leptodea leptodon	Scaleshell	Special Concern/Federally Endangered
Ligumia recta	Black Sandshell	Special concern
Megalonaias nervosa	Washboard	Special Concern
Obliquaria reflexa	Threehorn Wartyback	Apparently Healthy
Obovaria olivaria	Hickorynut	Apparently Healthy
Plethobasus cyphyus	Sheepnose	State Endangered/Federally Endangered
Pleurobema sintoxia	Round Pigtoe	Special Concern
Potamilus alatus	Pink Heelsplitter	Apparently Healthy
Potamilus capax	Fat Pocketbook	Special Concern/Federally Endangered
Potamilus ohiensis	Pink Papershell	Special Concern
Pyganodon cataracta	Eastern Floater	Apparently Healthy
Pyganodon grandis	Giant Floater	Apparently Healthy
Quadrula fragosa	Winged Mapleleaf	State Endangered
Quadrula metanevra	Monkeyface	State Threatened
Quadrula nodulata	Wartyback	State Threatened

Appendix B Continued

Table 5 continued. Mussel species that can be found in Wisconsin, including scientific name, common name and the population health status (WDNR 2003). Highlight species found during the project.

Scientific name	Common name	Status
Quadrula pustulosa	Pimpleback	Apparently Healthy
Quadrula quadrula	Mapleleaf	Special Concern
Simpsonaias ambigua	Salamander Mussel	State Threatened
Strophitus undulatus	Creeper	Apparently Healthy
Toxolasma parvus	Lilliput	Apparently Healthy
Tritogonia verrucosa	Pistolgrip	State Threatened
Truncilla donaciformis	Fawnsfoot	Special Concern
Truncilla truncata	Deertoe	Apparently Healthy
Utterbackia imbecilis	Paper pondshell	Special Concern
Venustaconcha ellipsiformis	Ellipse	State Threatened
Villosa iris	Rainbow	State Endangered

Appendix C

Figure 40. Data sheet used in the field at survey sites.

FIELD OBSERVATIONS

Water Depth_____ (m or ft) **Water Temperature_____ (C or F)**
Water depth range_____

FLOW RATE
If known,
m/sec or ft/sec:
_____ ☐ 1 – no flow 2 – low 3 – normal 4 – flood 5 – high

WATER COLOR ☐ 1 – no color 2 – light green 3 – dark green
4 – tan 5 – red 6 – green/brown 7 – black

WATER CLARITY ☐ 1 – clear 2 – cloudy

WATER SURFACE ☐ 1 – clear 2 – scum 3 – foam 4 – debris 5 – sheen

SUBSTRATE ☐
1 – bedrock _____ **Check all that apply,**
2 – silt _____ - Indicate estimated %
3 – sand _____
4 – gravel _____ **Wentworth scale substrate size**
5 – cobble _____ Boulder: > 25.6 cm
6 – boulder _____ Cobble: 6.4-25.6 cm
7 – other: _____ Gravel: 0.2 – 6.4 cm
(e.g. wood, vegetation) Sand: 0.006 – 0.2 cm
Silt: < 0.006 cm

pH _____
Dissolved 0xygen (mg/L) _____
Turbidity (cm) _____

What land uses are directly adjacent to this site? Check all that apply:

☐ Undisturbed area
☐ Suburban residences
☐ Urban residences
☐ Rural residences
☐ Recreation area (describe)
_____
☐ Cropland_____

☐ Agricultural land (pasture)
_____
_____
☐ Industry/Manufacturing
_____
☐ Other_____

Notes:_____
_____
_____
_____

Appendix C Continued

Mussel Monitoring Program of Wisconsin Survey Data Sheet

Date:_____ Collected By:_____ Identified By:_____

Address:_____City: _____State: WI Zip:_____

Phone Number: _____ Email: _____

Monitoring Location: _____

County: _____State: WI Drainage Basin:_____

GPS Start Lat:_____ Long: _____

GPS End Lat:_____ Long: _____

Collection Method: Hand ☐ Snorkel* ☐ SCUBA*☐
*Volunteers should never use snorkeling or SCUBA to obtain Wisconsin Mussel Program date without WDNR authorization

Random or Timed Search	Area or Transect Search	
□ Random shoreline search	□ Area _____ (m or ft)	□ 6.1-m (20 ft) transect
□ Random shallow water search	□ 0.25-m² (2.7 ft²) quadrat	□ 40-m (131.2 ft) transect
□ Timed search (time_____)	□ 10-m² (107.6 ft²) quadrat	

Total Volunteer Time (Hours Searching X Number of Volunteers): _____
Comments: _____

Asian Clams (Corbicula fluminea)	□ Present	□ Absent
Zebra Mussel (Dreissena polymorpha)	□ Present	□ Absent

Mussel Species	# Alive	# Shells (Whole)	# Shells kept	# Valves (halves)	# Valves kept	Shell Condition (Example: very-recently dead to subfossil- See definition below)

Fresh dead: No soft tissue remains, but otherwise in good condition (looking like a living specimen that had been killed and cleaned); internally nacre is glossy and without evidence of algal staining, calcium deposition, or external erosive effects; internal and external colors are not faded.
Dead: Early signs of internal and external erosion, staining, calcium deposition, or some combination of these; most or all of the internal coloration and glossy nature has faded; epidermis with major sections absent, or if present, clearly aged and flaking.
Subfossil: little or no epidermis; nacre faded white and entire shell often white; sometimes with signs of erosion, staining, or calcium deposition; typically chalky and powdery to the touch; shells often brittle and crumbling.

Appendix D

Figure 41. Scaled down version of "Mussel Monitoring of Eau Claire County Streams" project poster that was displayed at conferences and other community events.