ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

Freshwater mollusks of the middle Mississippi River

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Prepared for Illinois Department of Natural Resources,
Wildlife Preservation Fund
Grant Agreement Number 13-031W
Project duration: 31 July 2012 – 31 December 2013

Illinois Natural History Survey Technical Report 2014 (03)
20 January 2014

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PDF reprint of Tiemann, J.S., W.R. Posey, K.S. Cummings, K.J. Irwin, and B. Turner. 2013. First Occurrences of *Lithasia armigera* and *Lithasia verrucosa* (Gastropoda: Pleuroceridae) in the Mississippi River. Southeastern Naturalist 12(4)N35-N39. 65

CHAPTER 1

Freshwater mollusks of the middle Mississippi River

Abstract – The middle Mississippi River (e.g., the area between its confluence with the Missouri River and its confluence with the Ohio River) was sampled for freshwater mollusks to obtain baseline data on the distribution of the assemblage. Forty sites were sampled in the middle Mississippi River during 2012 and 2013. A total of 28 species of mollusks, including 19 native species of freshwater mussels, four exotic bivalves, and five species of aquatic gastropods, were collected. Seventy-six individuals of six species of native freshwater mussels were collected alive in 80 person-hours of handpicking, and an additional six species were found as fresh-dead shell. Habitat instability (e.g., shifting sand) might explain the lack of freshwater mollusks in the middle Mississippi River.

Introduction

Freshwater mollusks (mussels and snails) are a vital component of stream ecosystems (Williams et al. 1993; Johnson et al. 2013). Their sensitivity to stream habitats allows them to be biological indicators of stream integrity. They also play an important role in aquatic ecosystems by providing a food source for many animals, including muskrats, raccoons and various fishes (e.g., redear sunfish *Lepomis microlophus* and freshwater drum *Aplodinotus grunniens*). Their spent valves provide habitat for algae and aquatic insect larvae and nests and refuges for certain species of fishes, such as madtoms (Ictaluridae: *Noturus*). In addition, freshwater mussels help stabilize stream substrate against the scouring effects of floods.

During the past century, North American freshwater mollusks have undergone drastic decline, and they currently are one of the most imperiled groups of animals (Williams et al. 1993; Lydeard et al., 2004; Johnson et al. 2013). Of the approximate 300 species of freshwater mussels and almost 700 species of freshwater snails native to North America, nearly three-quarters are extinct, federally–listed, or are in need of conservation status. Factors responsible for the decline in freshwater mollusks include anthropogenic disturbances to stream habitats (e.g., habitat destruction and environmental contamination), commercial harvest, and invasion of exotic species (e.g., Zebra Mussel *Dreissena polymorpha*). Monitoring the remaining populations is vital for natural resource agencies, and although many basins have been surveyed in the past two decades, others still lack recent data. One such area is the middle Mississippi

River (e.g., the area between its confluence with the Missouri River and its confluence with the Ohio River – Figure 1). The middle Mississippi River and its floodplain have been substantially modified to accommodate multiple human uses that include urban development, navigation, and agriculture. The freshwater mollusk assemblage of the middle Mississippi River was sampled to collect baseline distribution data.

Methods

Forty sites were sampled in the middle Mississippi River during 2012 and 2013 (Table 1; Figure 1). Selected sites included areas with historical collections (data taken from the following mollusk collections: Field Museum of Natural History, Chicago; Illinois Natural History Survey [INHS], Champaign; Illinois State Museum, Normal; Ohio State University Museum of Biological Diversity, Columbus; University of Michigan Museum of Zoology, Ann Arbor; Smithsonian National Museum of Natural History, Washington D.C.) and areas that looked suitable for freshwater mollusks (e.g., heads of islands and mouths of large streams). Each site was sampled up to four person-hours by handpicking freshwater mollusks while wading through all available habitats. Live individuals were identified before being returned to the site. Areas of the shoreline also were visually searched for the presence of fresh dead and relict shells. Voucher specimens of all species from each site were deposited in the INHS Mollusk Collection.

Results

A total of 28 species of mollusks, including 19 native species of freshwater mussels, four exotic bivalves, and five species of aquatic gastropods, were collected during the summers of 2012 and 2013 (Appendix 1). Seventy-six individuals of six species of native freshwater mussels (*Quadrula quadrula* [N = 2], *Lampsilis teres* [N = 10], *Leptodea fragilis* [N = 50], *Obovaria olivaria* [N = 2], *Potamilus alatus* [N = 1], and *Potamilus ohiensis* [N = 11]) were collected alive in 80 person-hours of handpicking (Appendix 1). An additional six species (*Pyganodon grandis*, *Utterbackia imbecillis*, *Amblema plicata*, *Obliquaria reflexa*, *Truncilla donaciformis,* and *Truncilla truncata*) were found as fresh-dead shell during the 2012-2013 surveys (Appendix 1). Three of the four exotic species and two of the five aquatic gastropod species were found as live or fresh-dead (Table 2). The number of extant (live and fresh-dead) native species varied from 0 to 7 per site, whereas the total number of species, including exotic, varied from 1 to 17 per site (Table 1).

A review of museum records revealed an additional 20 species (all native freshwater mussel species) known from the middle Mississippi River, increasing the total of freshwater mollusk species known from this region to 48 (Table 2; Appendix 1). Of these 20 species, nine species are considered extant in the middle Mississippi River. Eight species (*Arcidens confragosus*, *Lasmigona complanata*, *Fusconaia flava*, *Megalonaias nervosa*, *Quadrula nodulata*, *Quadrula pustulosa*, *Ellipsaria lineolata*, and *Lampsilis cardium*) were collected alive by Ecological Specialists, Inc. (ESI), in 2012 near the confluence with the Missouri River, and another species (*Potamilus purpuratus*) was found as fresh-dead in 2002 near the confluence of the Ohio River in 2002 (INHS Collections database, Champaign).

Discussion

Numerous studies have reported an absence of freshwater mussels in the middle Mississippi River, and most attribute sediment loads as responsible for low diversity and abundance numbers. Bartsch (1916) suggested that "the heavy load of mud" from the Missouri River was responsible for the lack of freshwater mussels. Ellis (1931) concluded that silt was prohibitive for many species in the middle Mississippi River. van der Schalie and van der Schalie (1950) stated this area was depauperate in freshwater mussels because "of the tremendous loads of erosion silt carried into it from the extensive treeless plains drained by the Missouri River." More recently, Hoke (2009) speculated that some freshwater mussels have always occurred in the middle Mississippi River, but that substrate instability and erosion silt limits diversity in this region. Very few patches of stable substrates (e.g., firm sand and gravel) were encountered. The majority of the habitat encountered in the middle Mississippi River during the 2012-2013 surveys was loose, unconsolidated "shifting" sand (Figure 2).

The majority of the extant (live + fresh-dead) species encountered (e.g., *L. fragilis* and *P. ohiensis*) were thin-shelled species that can adapt to the dynamic conditions in large sandy rivers. These adaptions include an abundant fish host fauna (e.g., drum [Sciaenidae], catfishes [Ictaluridae], and gar [Lepisosteidae]), high recruitment, mobility, and rapid burrowing after being dislodged (Haag 2012). This extant species list is similar to the lower Missouri River (Hoke 2009) and the lower Wabash River, which is another large sandy river (INHS Mollusk Collection database, Champaign).

Although studies and records are limited (e.g., Baker 1906; Goodrich 1939; Wu et al. 1997), the same sporadic occurrence pattern reported for freshwater mussels seems to hold true for freshwater snails and exotic mollusks. The gastropods encountered are common species

based on Johnson et al. (2013), and appear to be common in large rivers in Illinois (INHS Mollusk Collection database, Champaign). They are commonly found in stable substrates (sandy mud or rocky bottoms), and do not do well in shifting sand (Baker 1906; Wu et al. 1997; Johnson et al. 2013). Regarding exotic species, *Corbicula* spp. were found throughout the survey area, but few live Zebra Mussels were found, probably due to the dynamics of the river (e.g., lack of structure to attach).

Attempts were made to sample the mouths of tributaries in the region with the hope that these areas might offer refugia (Sietman et al. 2001). However, only the mouth of the Big Muddy River was productive during this survey. Six species of native freshwater mussels were extant in this area (Table 2). The mouths of all other streams were either dry or offered unsuitable habitats (e.g., loosely consolidated silted sand), thus no mollusks were found (Figure 3). It should be noted that we did not sample near the mouth of the Meramec River[1], which offers one of the most of the diverse freshwater mussel faunas in the Midwest (Hinck et al. 2012). Also, attempts were made to sample wing-dams, but little evidence of shell was found in these areas. A subsequent survey done by Ecological Specialists, Inc., which sampled near the confluence of the Missouri River in 2012, found 17 live species in a small area along boulders placed in river for old pilings (H. Dunn, Ecological Specialists, Inc., pers. comm.; INHS Mollusk Collection database, Champaign).

This survey did yield the first documented occurrence of the Armored Rocksnail (*Lithasia armigera*) from the Mississippi River (see Tiemann et al. 2013 and Chapter 2 of this report; Figure 4). The species was thought to have been an Ohio River basin endemic until a population was discovered at five sites in the Mississippi River in the St. Louis metroplex (Tiemann et al. 2013).

van der Schalie and van der Schalie (1950) stated that collecting in the middle Mississippi River "is usually possible only in sloughs and along shore." The summer droughts of 2012 and 2013 resulted in some of the most historically low water levels on record in the middle Mississippi River. Yet, it cannot be ignored that hand-picking while wading has its limitations in a large navigable river. We cannot rule out the possibility of freshwater mussels occupying areas stable substrate in the middle river. However, there was a paucity of shells (both fresh-dead and relict, including exotic species) on exposed sand bars, island heads and

[1] Very few boat ramps were accessible during the extremely low water levels, and the INHS boat used had limited range from the boat ramps that were usable.

tails, dried sloughs, and riverbanks, and there are no reports of permanent mussel beds in this area, suggesting the middle Mississippi River is depauperate in freshwater mollusks.

Acknowledgements

This project was funded in part by a grant from the Illinois Department of Natural Resources' Wildlife Preservation Fund (#13-031W) and the Illinois Department of Transportation, Springfield. K.S. Cummings (INHS), B. Dabney (INHS), S.A. (Bales) Douglass (INHS), S.M. Jaworski (INHS), D.K. Shasteen (INHS), D. Ostendorf (Missouri Department of Conservation), D. Knuth (Missouri Department of Conservation), and B. Turner (St Louis Community College) assisted in collecting. H. Dunn (Ecological Specialists, Inc.), S. McMurray (Missouri Department of Conservation), T. Moore (Missouri Department of Conservation), and J.E. Schwegman (Illinois Department of Natural Resources, retired) provided records from this area. A.C. Haskett (INHS) and M. Grobelny (INHS) assisted in lab preparation. J.L. Sherwood (INHS) assisted in map creation. C.A. Mayer (INHS) assisted in data management.

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Table 1. List of 2012-2013 sampling locations (N = 40) with date collected, effort sampled (in person hour), number of extant native species collected (as live or fresh-dead), and total number of species collected, including relict and introduced (exotic) species.

State	County	Common Location	Latitude / Longitude	Date	Effort	Extant	Total
Illinois	Alexander	2.7 mi ESE Cairo, Fort Defiance State Park, mouth	36.98394, -89.13839	25 September 2013	2	3	6
Illinois	Alexander	2.3 mi NW Cairo, bottom of Boston Bar Slough	37.02734, -89.21153	25 September 2013	2	2	6
Illinois	Alexander	4.6 mi W Cairo, Browns Bar	37.00375, -89.26353	25 September 2013	2	1	4
Illinois	Alexander	4.2 mi ESE Miller City, head of Island 28	37.08582, -89.28687	25 September 2013	2	2	4
Illinois	Alexander	7.8 mi S Olive Branch, Bumgard Island	37.05770, -89.37811	25 September 2012	2	0	5
Missouri	Scott	2.4 mi SSW Miller City, Billings Island	37.08027, -89.37843	25 September 2012	2	0	1
Illinois	Alexander	2.1 mi W Miller City, tail of Goose Island	37.11351, -89.39431	25 September 2012	3	3	6
Missouri	Scott	3.6 mi SSE Thebes, under power lines	37.16990, -89.44711	25 September 2012	4	6	13
Illinois	Alexander	2.4 mi SSE Thebes	37.20061, -89.45881	25 September 2012	2	1	3
Illinois	Alexander	2.4 mi NNW Thebes	37.25440, -89.47421	25 September 2012	2	1	2
Illinois	Union	7.4 mi S Grand Tower, Crawford Towhead slough	37.51987, -89.49892	19 September 2013	3	6	9
Missouri	Cape Girardeau	6.5 mi S Grand Tower, Lovejoy Creek confluence	37.53441, -89.51934	19 September 2013	3	7	10
Illinois	Jackson	3.4 mi SSW Grand Tower, mouth of Big Muddy River	37.57795, -89.51155	19 September 2013	3	6	7
Missouri	Perry	0.9 mi SW Grand Tower, head of Cottonwood Island	37.61671, -89.50862	19 September 2013	2	5	9
Missouri	Perry	2.8 mi N Wittenberg, Gill Point, above Owl Creek	37.69313, -89.52122	19 September 2013	3	2	8
Missouri	Perry	6.7 mi NW Wittenberg, “76” Conservation Area boat ramp	37.72080, -89.61187	19 September 2013	2	1	4
Illinois	Randolph	3.1 mi SE Chester, mouth of Marys River	37.88080, -89.78366	18 September 2013	2	1	4
Illinois	Randolph	Chester, boat ramp	37.89963, -89.82948	18 September 2013	1	0	3
Illinois	Randolph	3.5 mi WNW Chester	37.92558, -89.88084	18 September 2013	1	0	5
Illinois	Randolph	2.6 mi SSW Ellis Grove, mouth of unnamed tributary	37.97546, -89.92610	18 September 2013	1	0	0
Illinois	Randolph	2.9 mi SW Ellis Grove, mouth Kaskaskia River	37.97455, -89.93661	18 September 2013	1	0	5
Illinois	Randolph	5 mi SW Ellis Grove, bottom of Moro Chute	37.96422, -89.97906	26 September 2013	1	0	4
Illinois	Randolph	6.2 mi WSW Ellis Grove, bottom of Moro Island	37.98578, -90.01532	26 September 2013	2	0	1
Missouri	Ste. Genevieve	2.4 mi NW Ste. Genevieve	38.01125, -90.07848	26 September 2013	2	1	4
Illinois	Randolph	2.8 mi WSW Prairie du Rocher, Onemile Race Creek mouth	38.06869, -90.14416	26 September 2013	2	0	1
Illinois	Monroe	3.4 mi SSW Fults, opp. mouth Isle du Bois Creek	38.12524, -90.24487	26 September 2013	2	1	2

Table 1. Cont.

State	County	Common Location	Latitude / Longitude	Date	Effort	Extant	Total
Missouri	Jefferson	3.5 mi ESE Festus, Selma Hollow confluence	38.19259, -90.33887	26 September 2013	2	5	17
Missouri	Jefferson	1.1 mi SSE Herculaneum, near Joachim Creek	38.25375, -90.36998	26 September 2013	2	4	10
Missouri	St. Louis City	1.1 mi SE St. Louis, MacArthur Bridge	38.61505, -90.18496	26 September 2013	1	0	0
Illinois	St. Clair	Brooklyn	38.65093, -90.17642	17 October 2013	1	0	1
Illinois	Madison	Venice, Merchants Railroad Bridge	38.67509, -90.18371	17 October 2013	1	2	5
Illinois	Madison	1.9 mi W Madison, Chain of Rocks Canal confluence	38.68732, -90.19187	27 September 2012	2	0	7
Missouri	St. Louis City	3.5 mi ENE Pine Lawn, opp. Mosenthein Island	38.71239, -90.21687	27 September 2013	1	1	4
Illinois	Madison	3.6 mi NW Granite City, first wingdam downstream of dam	38.74756, -90.17827	26 September 2012	2	2	5
Illinois	Madison	4 mi NNW Granite City, Chain of Rocks dam	38.75596, -90.17205	24 September 2012	4	1	9
Missouri	St. Louis City	Glasgow Village, Chain of Rocks Dam	38.75607, -90.18072	27 September 2013	1	0	3
Illinois	Madison	4.1 mi NNW Granite City, Chain of Rocks bridge	38.75818, -90.17165	24 September 2012	3	2	5
Illinois	Madison	4 mi S Wood River, head of Chain of Rocks Canal	38.79404, -90.11948	26 September 2012	2	2	6
Illinois	Madison	2.4 mi SSW Harford, Lewis & Clark State Memorial Park	38.80259, -90.11574	24 September 2012	2	2	5
Missouri	St. Louis	3.6 mi ESE Cora Island	38.80928, -90.12231	26 September 2012	2	1	6

Table 2. List of species found in the middle Mississippi River. Information about species distribution can be found in the appendix. Species in **bold** are considered extant in the middle Mississippi. Special status includes FE = Federally-endangered, SE = State-endangered, ST = State-threatened, I = Introduced (exotic).

Class Bivalvia
- Order Unionoida
  - Family Margaritiferidae
    - *Cumberlandia monodonta* (Say, 1829) - Spectaclecase SE, FE
  - Family Unionidae
    - Subfamily Anodontinae
      - ***Arcidens confragosus*** **(Say, 1829) - Rock Pocketbook**
      - ***Lasmigona complanata*** **(Barnes, 1823) - White Heelsplitter**
      - ***Pyganodon grandis*** **(Say, 1829) - Giant Floater**
      - ***Utterbackia imbecillis*** **(Say, 1829) - Paper Pondshell**
      - *Utterbackia suborbiculata* Say, 1831 - Flat Floater
    - Subfamily Ambleminae
      - ***Amblema plicata*** **(Say, 1817) - Threeridge**
      - *Cyclonaias tuberculata* (Rafinesque, 1820) - Purple Wartyback ST
      - *Elliptio crassidens* (Lamarck, 1819) - Elephantear ST
      - *Elliptio dilatata* (Rafinesque, 1820) - Spike ST
      - *Fusconaia ebena* (Lea, 1831) - Ebonyshell ST
      - ***Fusconaia flava*** **(Rafinesque, 1820) - Wabash Pigtoe**
      - ***Megalonaias nervosa*** **(Rafinesque, 1820) - Washboard**
      - *Pleurobema rubrum* (Rafinesque, 1820) - Pyramid Pigtoe SE
      - *Pleurobema sintoxia* (Rafinesque, 1820) - Round Pigtoe
      - *Quadrula metanevra* (Rafinesque, 1820) - Monkeyface
      - *Quadrula nobilis* (Conrad, 1854) - Gulf Mapleleaf
      - ***Quadrula nodulata*** **(Rafinesque, 1820) - Wartyback**
      - ***Quadrula pustulosa*** **(Lea, 1831) - Pimpleback**
      - ***Quadrula quadrula*** **(Rafinesque, 1820) - Mapleleaf**
      - *Tritogonia verrucosa* (Rafinesque, 1820) - Pistolgrip
      - *Uniomerus tetralasmus* (Say, 1831) - Pondhorn
    - Subfamily Lampsilinae
      - *Actinonaias ligamentina* (Lamarck, 1819) - Mucket
      - ***Ellipsaria lineolata*** **(Rafinesque, 1820) - Butterfly ST**
      - *Epioblasma triquetra* (Rafinesque, 1820) - Snuffbox SE, FE
      - ***Lampsilis cardium*** **Rafinesque, 1820 - Plain Pocketbook**
      - *Lampsilis higginsii* (Lea, 1857) - Higgin's Eye SE, FE
      - *Lampsilis siliquoidea* (Barnes, 1823) - Fatmucket
      - ***Lampsilis teres*** **(Rafinesque, 1820) - Yellow Sandshell**
      - ***Leptodea fragilis*** **(Rafinesque, 1820) - Fragile Papershell**
      - *Ligumia recta* (Lamarck, 1819) - Black Sandshell ST
      - ***Obliquaria reflexa*** **Rafinesque, 1820 - Threehorn Wartyback**
      - ***Obovaria olivaria*** **(Rafinesque, 1820) - Hickorynut**
      - ***Potamilus alatus*** **(Say, 1817) - Pink Heelsplitter**
      - ***Potamilus ohiensis*** **(Rafinesque, 1820) - Pink Papershell**
      - ***Potamilus purpuratus*** **(Lamarck, 1819) - Bleufer**
      - *Toxolasma parvus* (Barnes, 1823) - Lilliput
      - ***Truncilla donaciformis*** **(Lea, 1828) - Fawnsfoot**
      - ***Truncilla truncata*** **Rafinesque, 1820 - Deertoe**

Table 2. Cont.

Order Veneroida
Family Corbiculidae
***Corbicula fluminea* (Müller, 1774) - Asian Clam I**
***Corbicula largillierti* (Philippi, 1844) - "purple" Asian Clam I**
Family Dreissenidae
***Dreissena polymorpha* (Pallas, 1771) - Zebra Mussel I**
Family Mactridae
Rangia cuneata (Sowerby, 1832) - Atlantic Rangia I
Class Gastropoda
Family Viviparidae
Campeloma decisum (Say, 1816) - Pointed Campeloma
Lioplax sulculosa (Menke, 1827) - Furrowed Lioplax
Viviparus georgianus (Lea, 1834) - Banded Mysteryshell
Family Pleuroceridae
***Lithasia armigera* (Say, 1821) – Armored Rocksnail**
***Pleurocera acuta* Rafinesque, 1831 - Sharp Hornsnail**

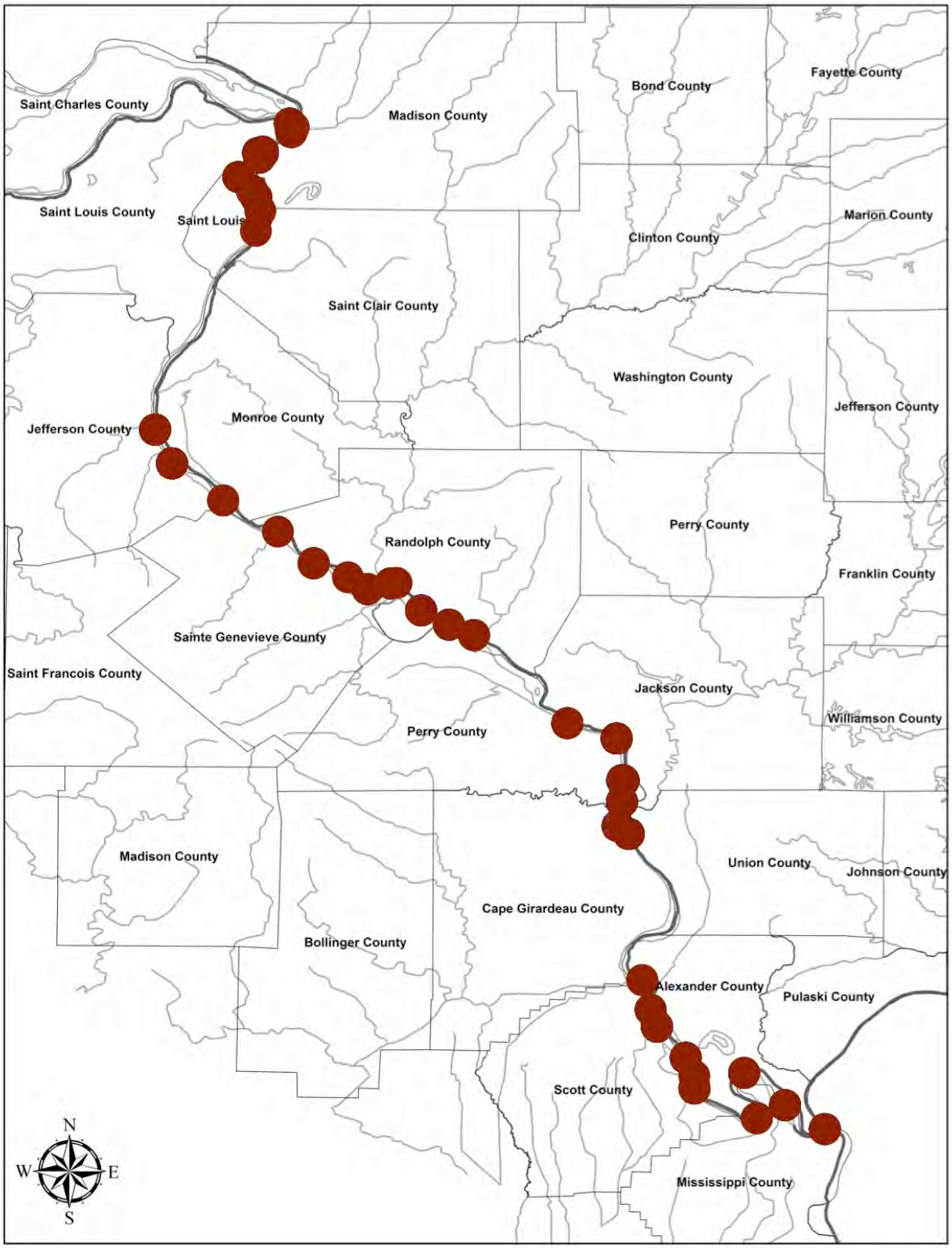


Figure 1. Map of 2012-2013 sample sites (N = 40) in the middle Mississippi River. Reference Table 1 for a list of locations.

a)

b)

Figure 2. The Mississippi at (a) Boston Bar Slough (facing downstream toward I-55), 2.3 mi NW Cairo (37.02734, -89.21153), Alexander County, Illinois, on 25 September 2013; and (b) Cottonwood Island (facing downstream), 0.9 mi SW Grand Tower (37.61671, -89.50862), Perry County Missouri, on 19 September 2013. Photos by K.S. Cummings (INHS).

a)

b)

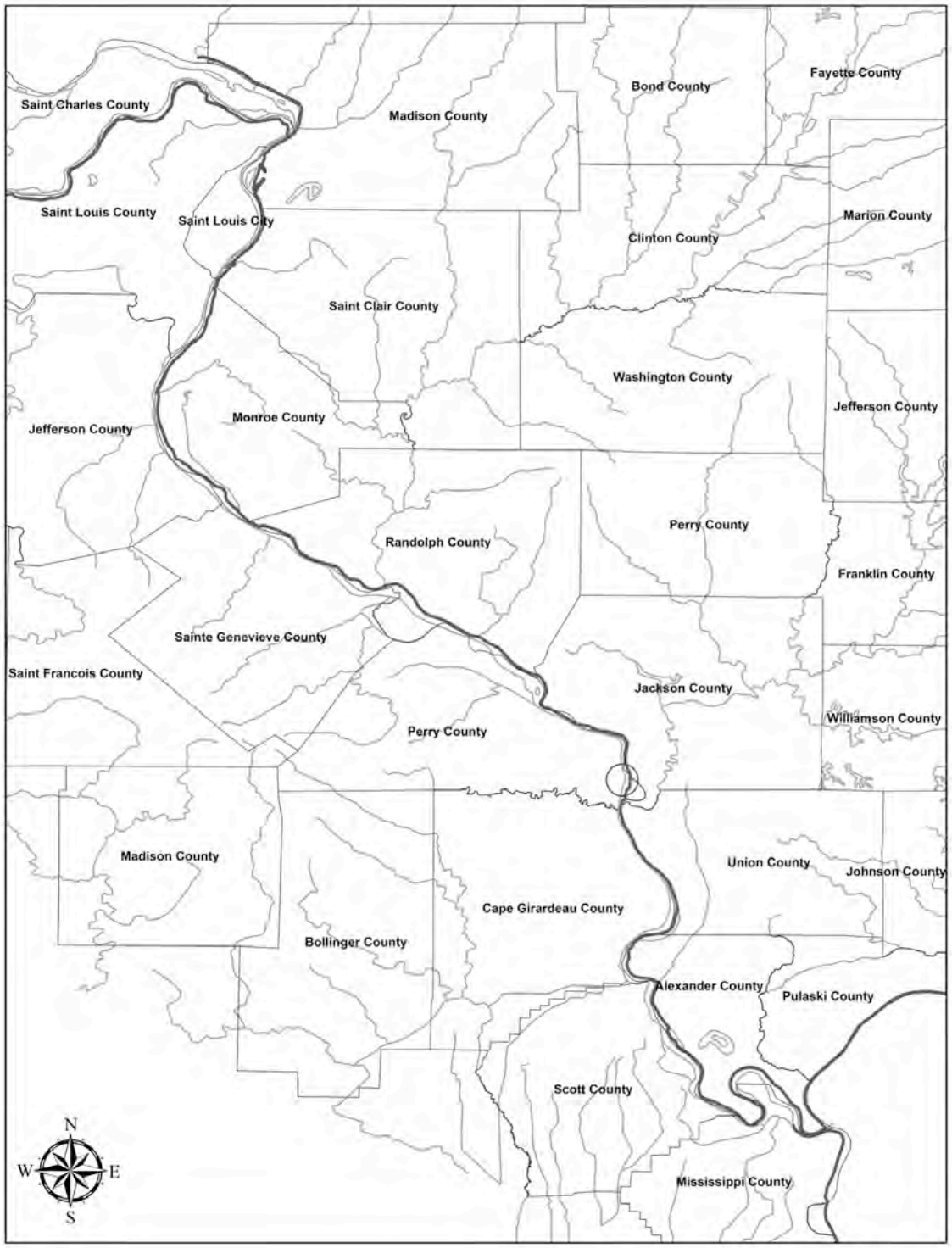
Figure 3. The confluences of two tributaries of the Mississippi at (a) mouth of Marys River, 3.1 mi SE Chester (37.88080, -89.78366), Randolph County, Illinois, on 18 September 2013 (author sunk to knees in loose-consolidated sand); and (b) mouth of unnamed tributary, 2.6 mi SSW Ellis Grove (37.97546, -89.92610), Randolph County, Illinois, on 18 September 2013. Photos by K.S. Cummings (INHS).

Figure 4. The Armored Rocksnail (*Lithasia armigera*) with Zebra Mussels (*Dreissena polymorpha*) attached. Photo by K.S. Cummings (INHS).

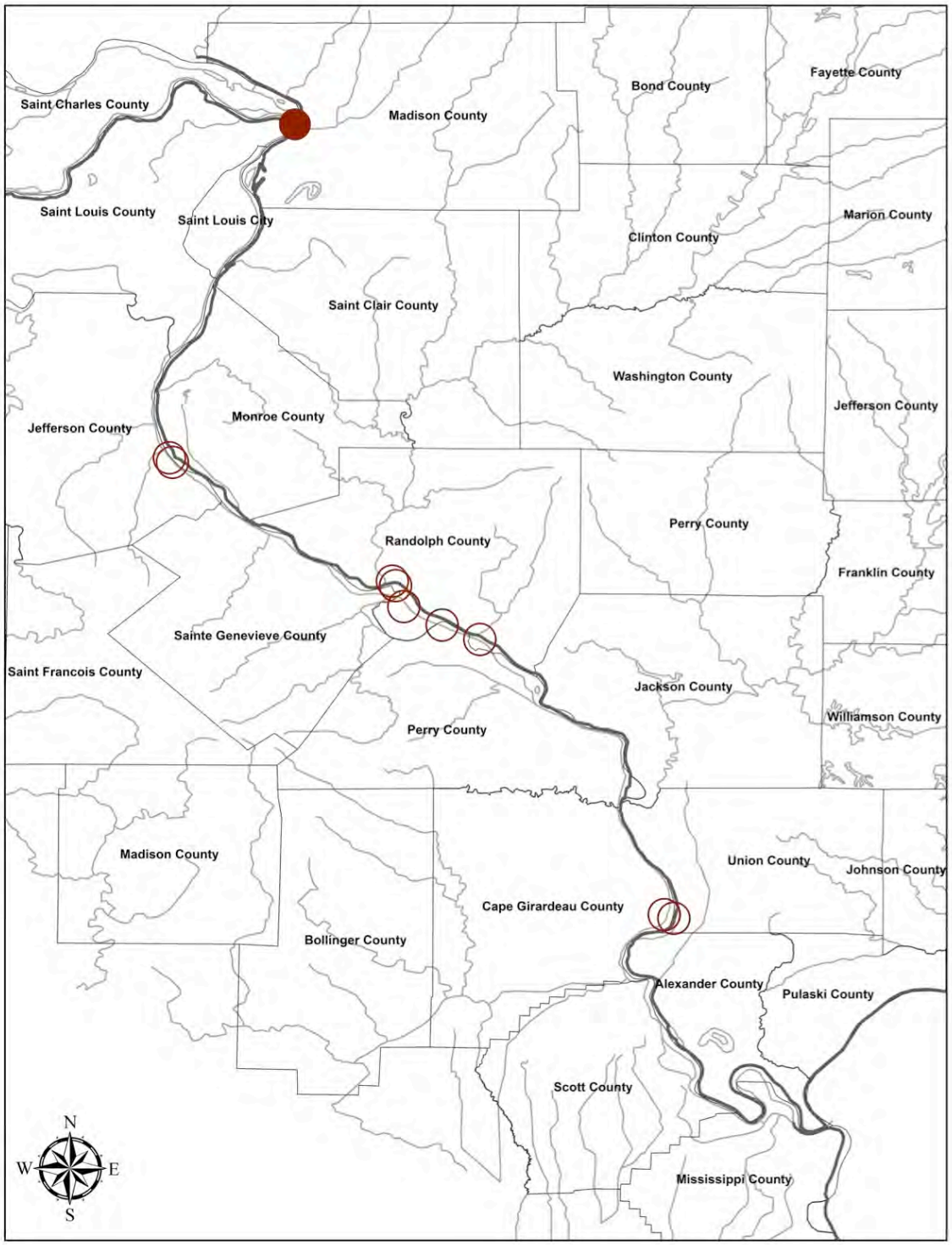
Appendix – Species distribution maps

Species found in the middle Mississippi River. Maps include data from not only the 2012-2013 survey but also from those records that reside in museums list in the methods section, including recent work by Ecological Specialists, Inc. (ESI) and state agencies from Illinois and Missouri. Open circles are sites where the species has been found either as live or fresh-dead since 2000, whereas open circles are sites where historical records exists (e.g., relict shell). Species status includes FE = Federally-endangered, SE = State-endangered, ST = State-threatened, and I = Introduced (exotic).

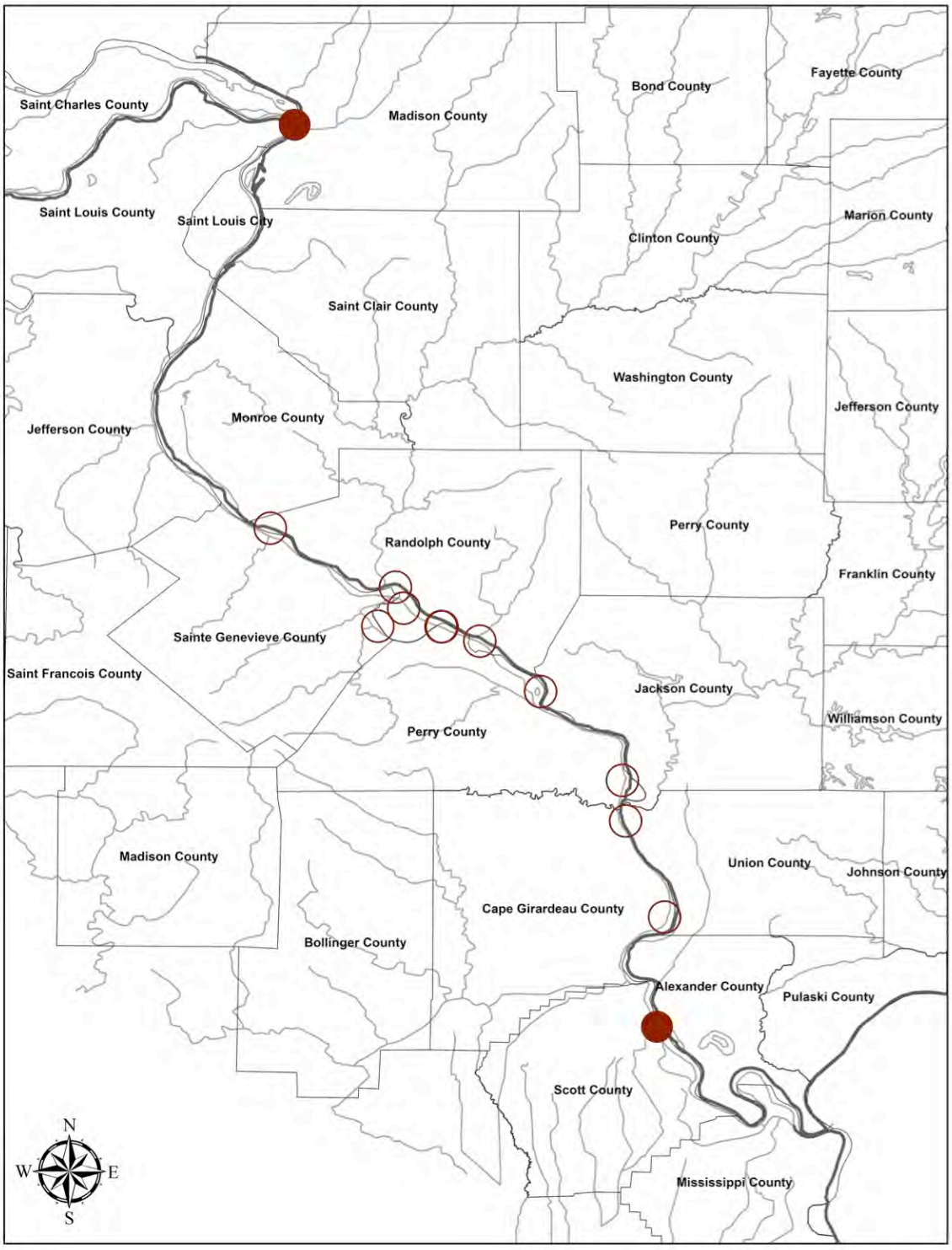
Cumberlandia monodonta (Say, 1829) – Spectaclecase SE, FE – was not encountered during the 2012-2013 survey. Once widely distributed, it is now restricted to the Ohio and Mississippi rivers where it is sporadic and very rare. It prefers areas with swiftly flowing water, but is found among boulders in patches of sand, cobble, or gravel in areas where current is reduced (Cummings and Mayer 1992; Cummings and Mayer 1997).



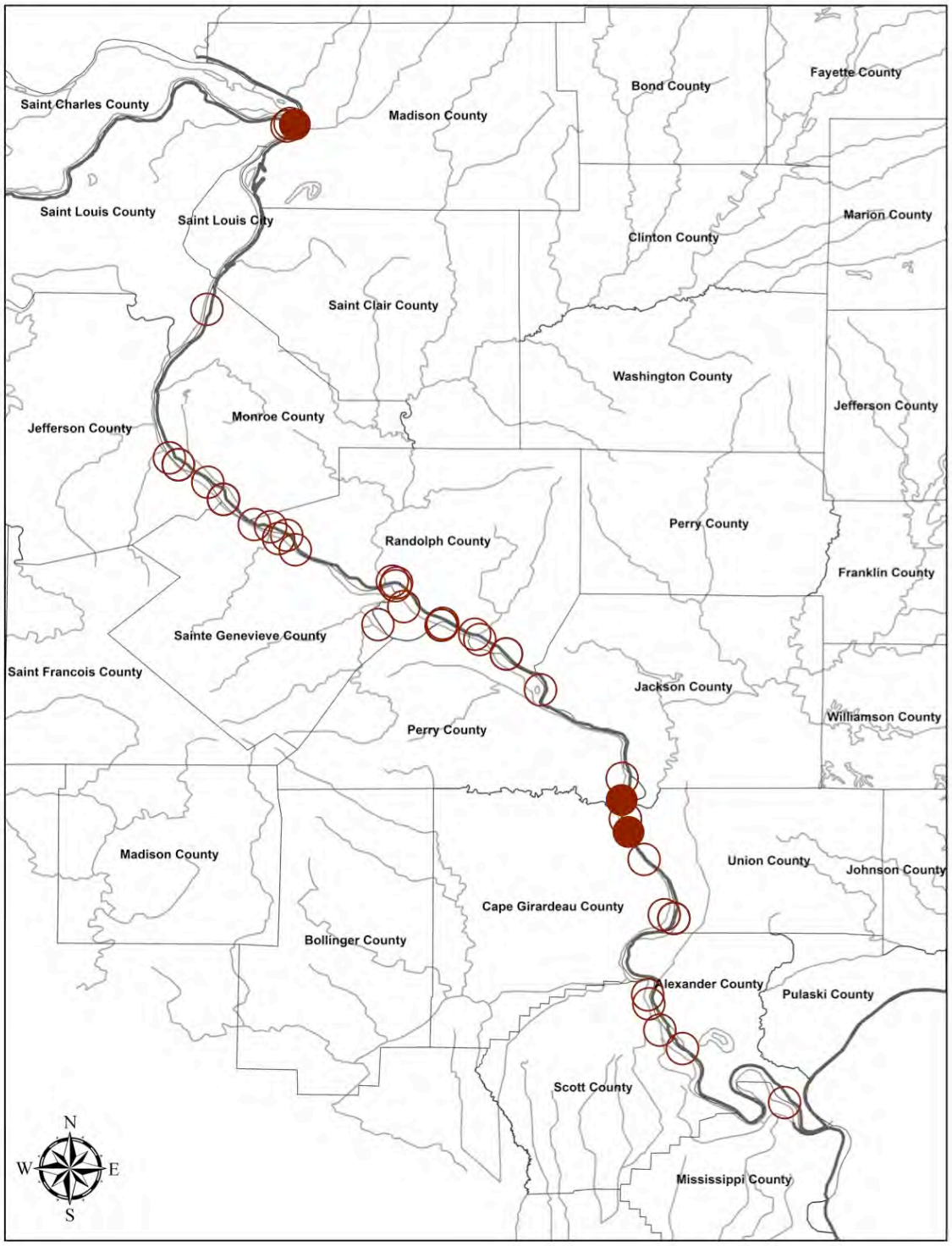
Arcidens confragosus (Say, 1829) – Rock Pocketbook – was found only as relict at 1 site during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. The species is found in pools and areas of reduced flow in mud and sand, and within Illinois, it is generally distributed but uncommon in medium to large rivers in (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



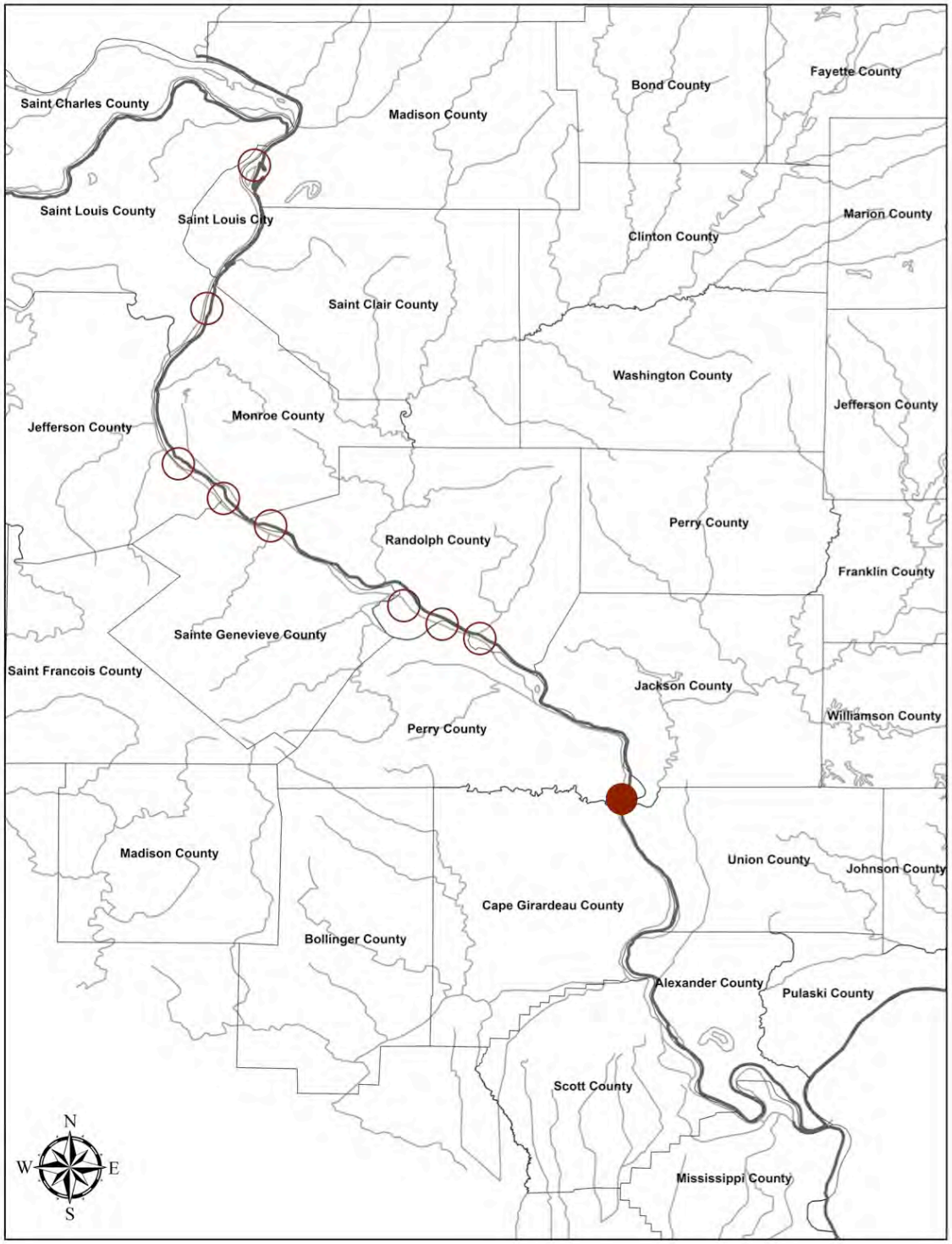
Lasmigona complanata (Barnes, 1823) – White Heelsplitter – was found only as fresh-dead, and was found at only 1 site during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. This ecologically tolerant mussel can inhabit a variety of habitats, including pools or sluggish streams with a mud, sand, or fine gravel bottom (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



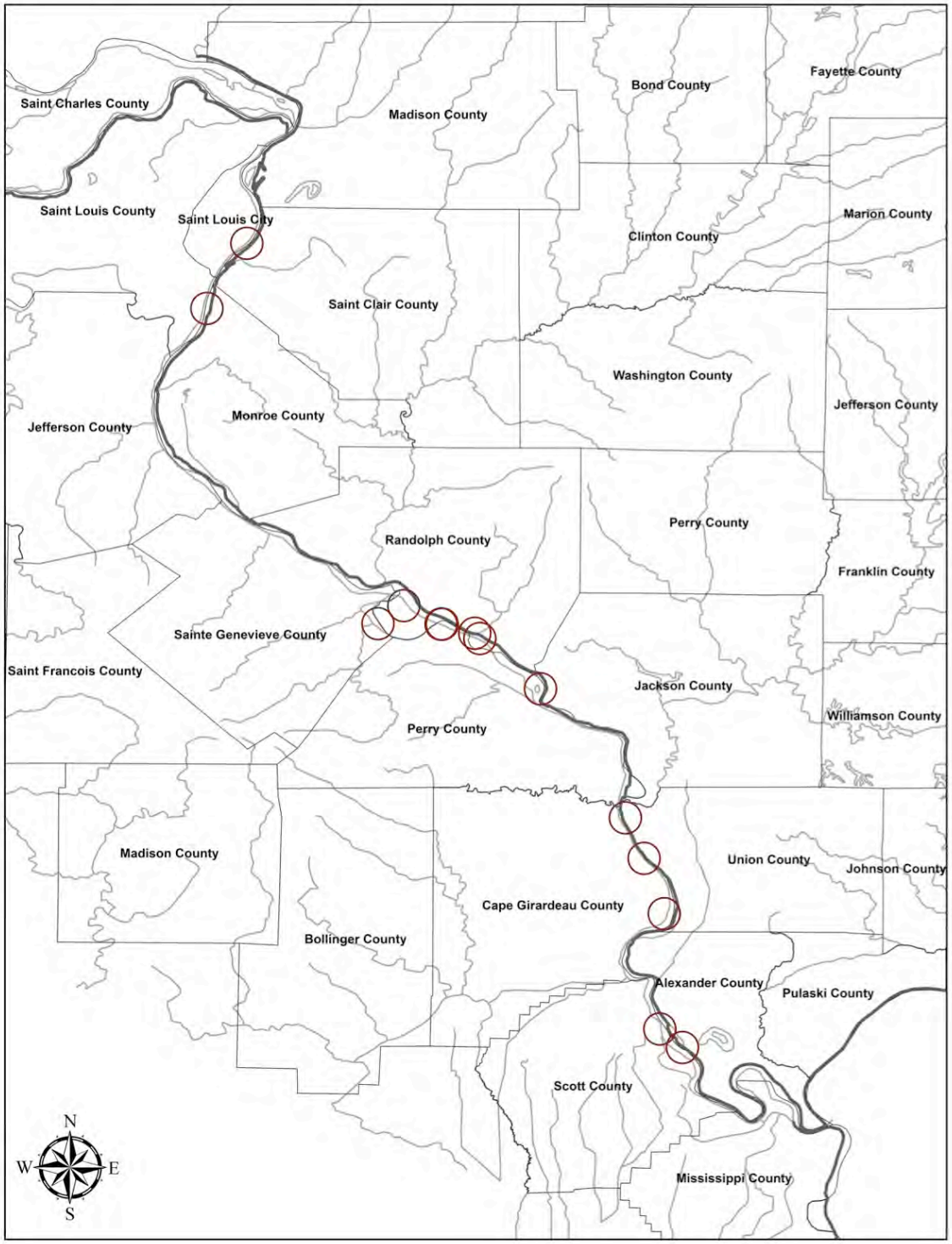
Pyganodon grandis (Say, 1829) – Giant Floater – was found as fresh-dead at 3 sites and relict at 3 sites during the 2012-2013 survey. ESI found it alive in 2012 near the confluence with the Missouri River. This ecologically tolerant mussel can inhabit a variety of habitats, including pools or sluggish streams with a mud, sand, or fine gravel bottom (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



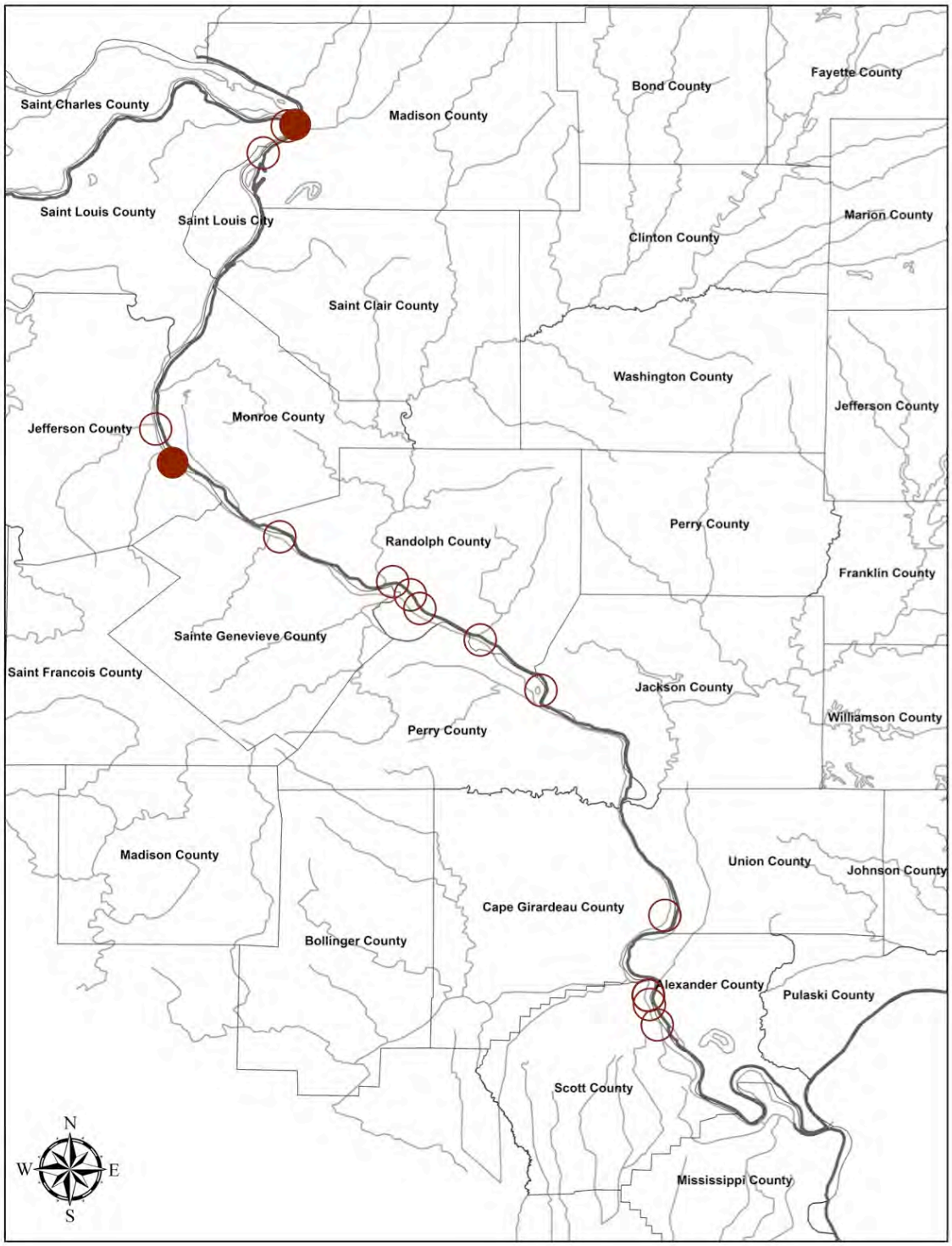
Utterbackia imbecillis (Say, 1829) – Paper Pondshell – was found only as fresh-dead, and was found at only 1 site during the 2012-2013 survey. The species is generally distributed and locally abundant in sluggish mud-bottomed pools of creeks and rivers throughout Illinois (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



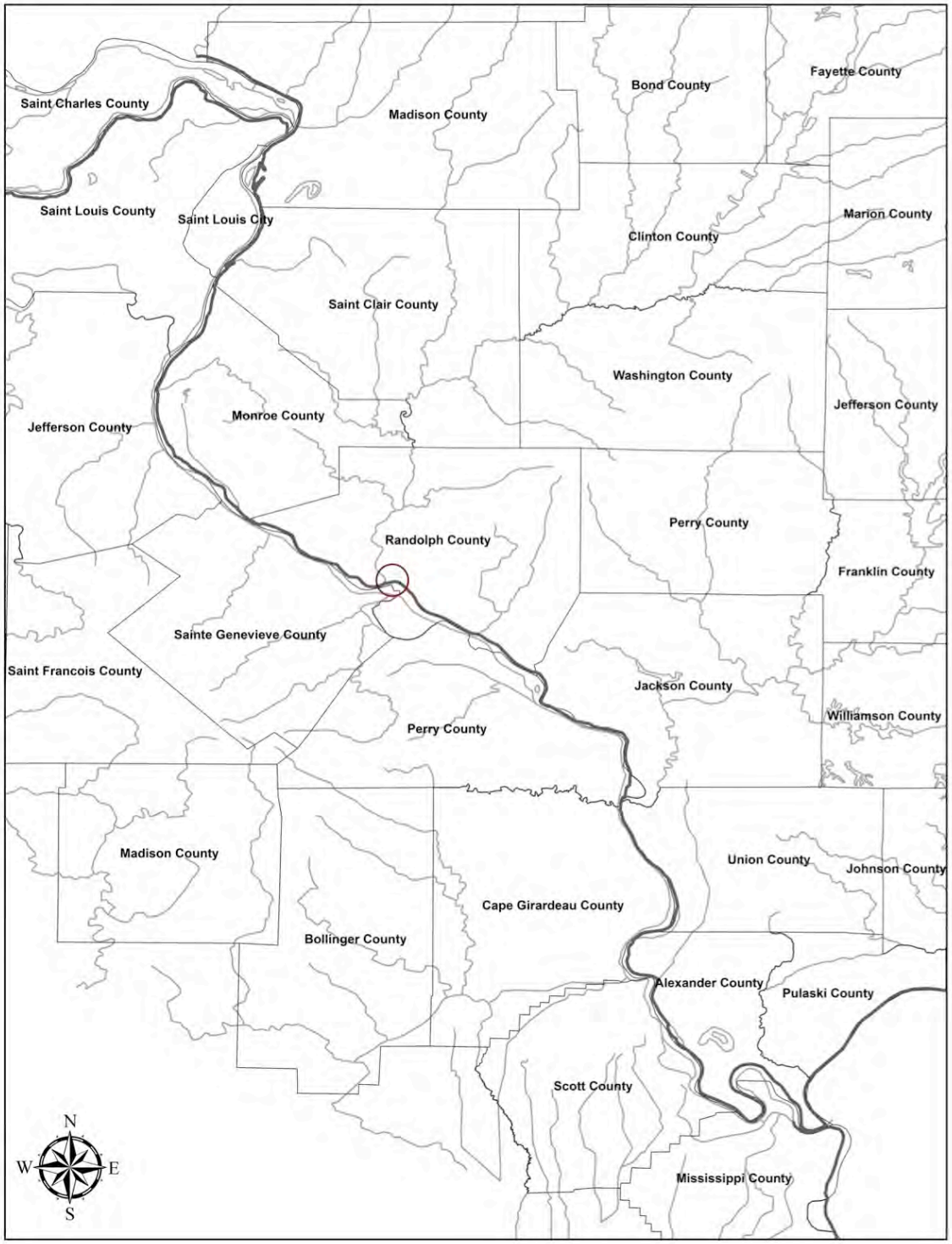
Utterbackia suborbiculata Say, 1831 – Flat Floater – was not encountered during the 2012-2013 survey. Within Illinois, the species is occasionally found in the mud-bottomed substrates of floodplain ponds or quiet backwaters of large rivers (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



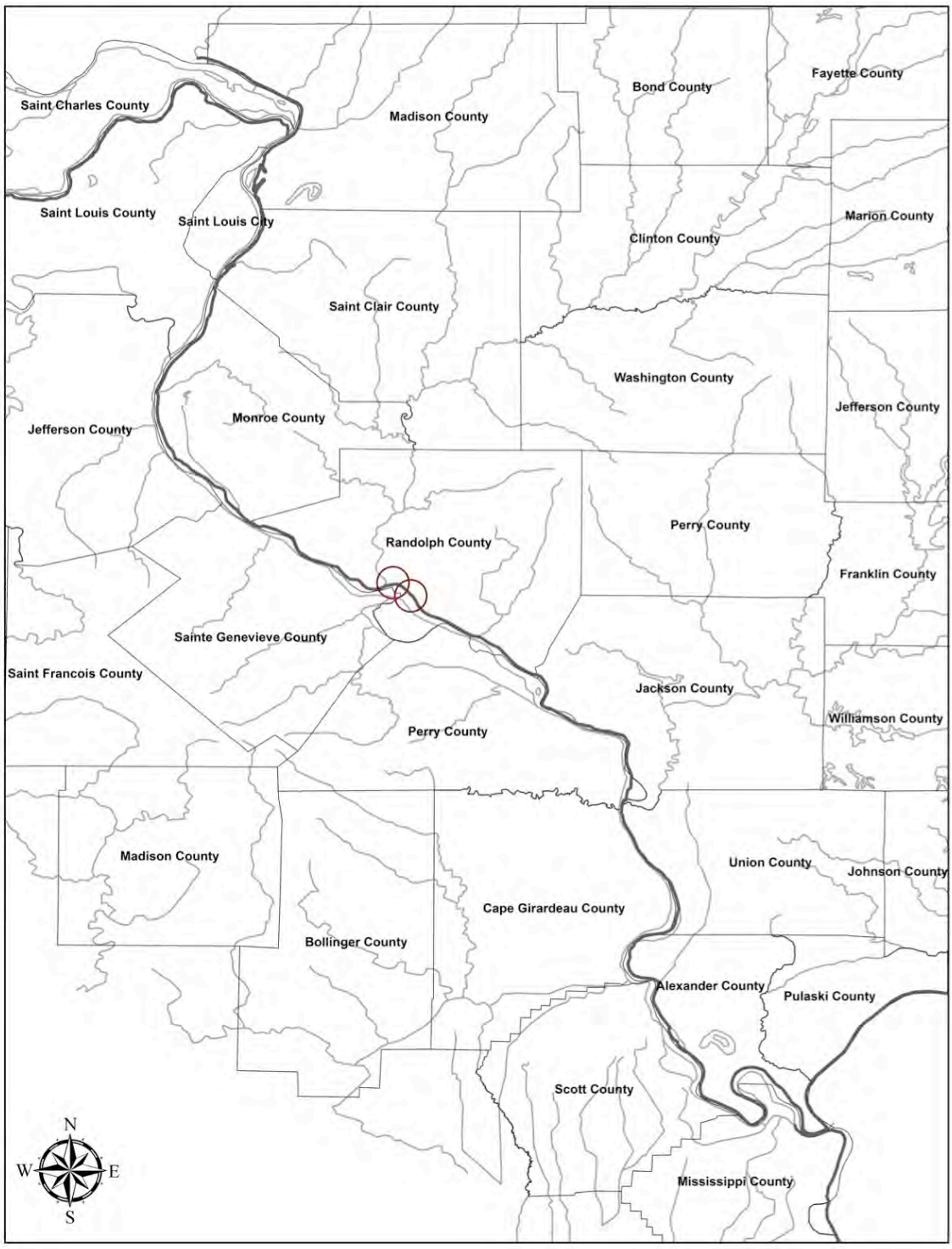
Amblema plicata (Say, 1817) – Threeridge – was found as fresh-dead at 1 site and relict at 3 sites during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. The species is generally distributed throughout Illinois in small to large rivers and impoundments in mud, sand, or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



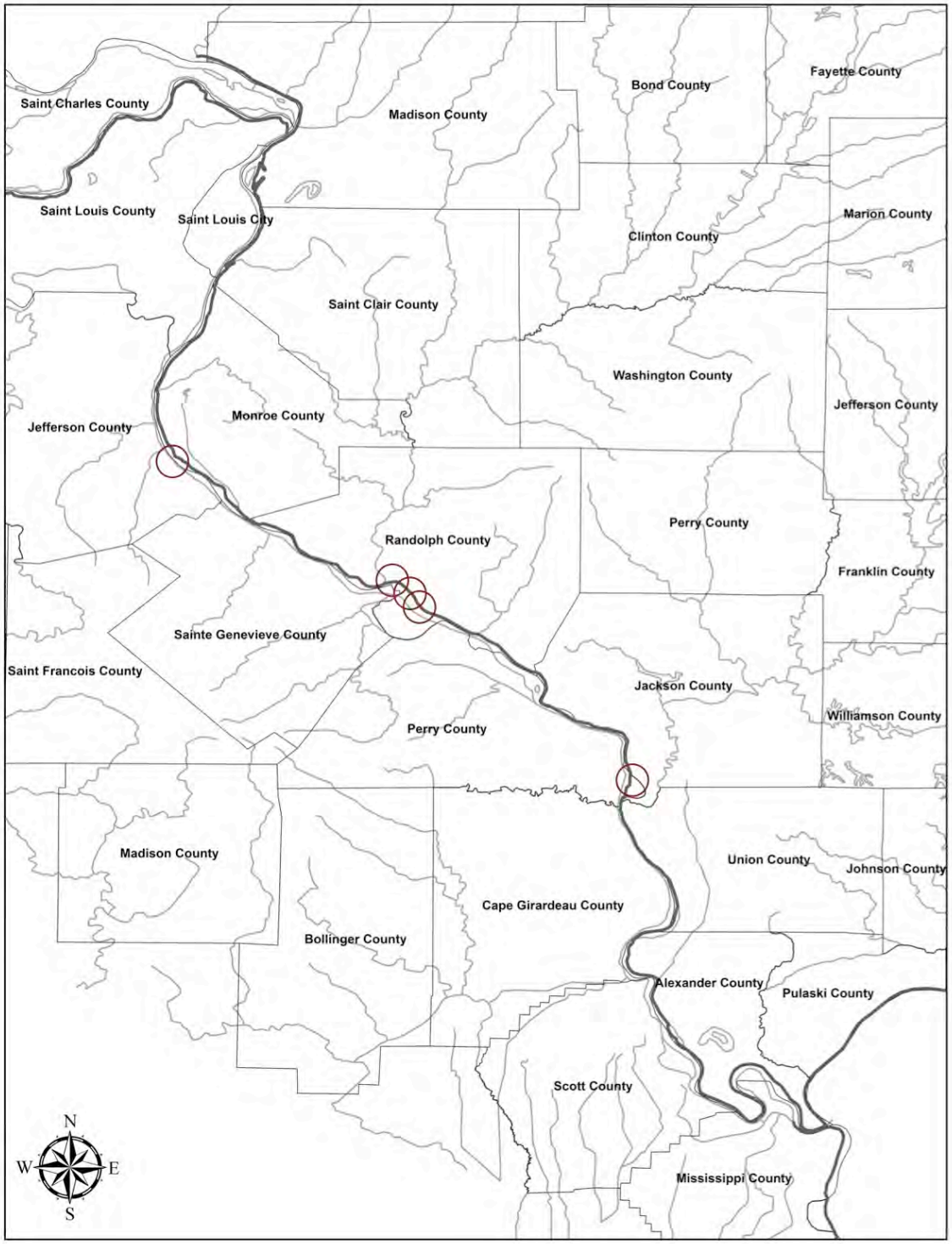
Cyclonaias tuberculata (Rafinesque, 1820) – Purple Wartyback ST – was not encountered during the 2012-2013 survey. Within Illinois, the species is uncommon and sporadically found in medium to large rivers in gravel or mixed sand and gravel (Cummings and Mayer 1992; Cummings and Mayer 1997).



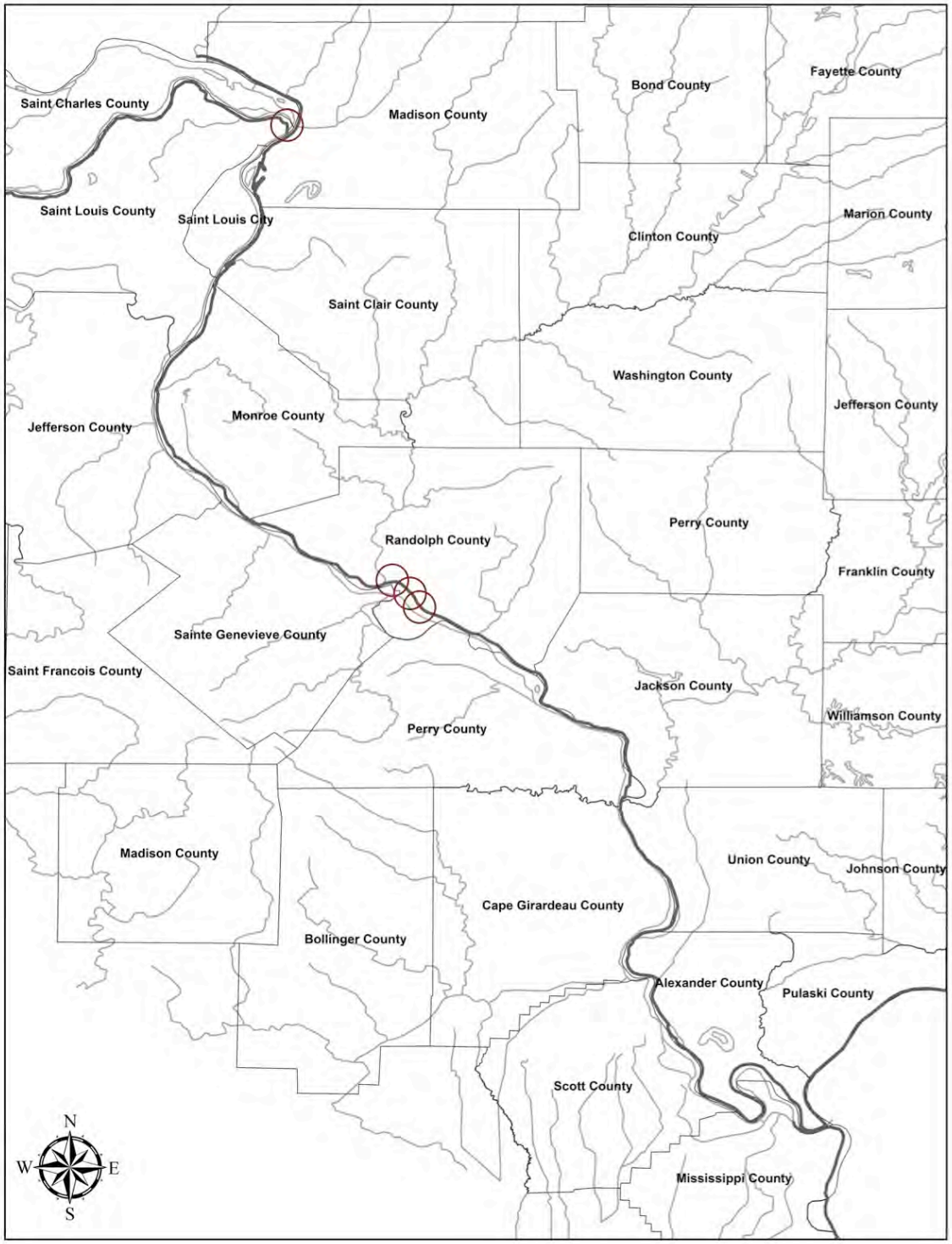
Elliptio crassidens (Lamarck, 1819) – Elephantear ST – was not encountered during the 2012-2013 survey. Within Illinois, the species is uncommon and sporadically found in mud, sand, or fine gravel of large rivers (Cummings and Mayer 1992; Cummings and Mayer 1997).



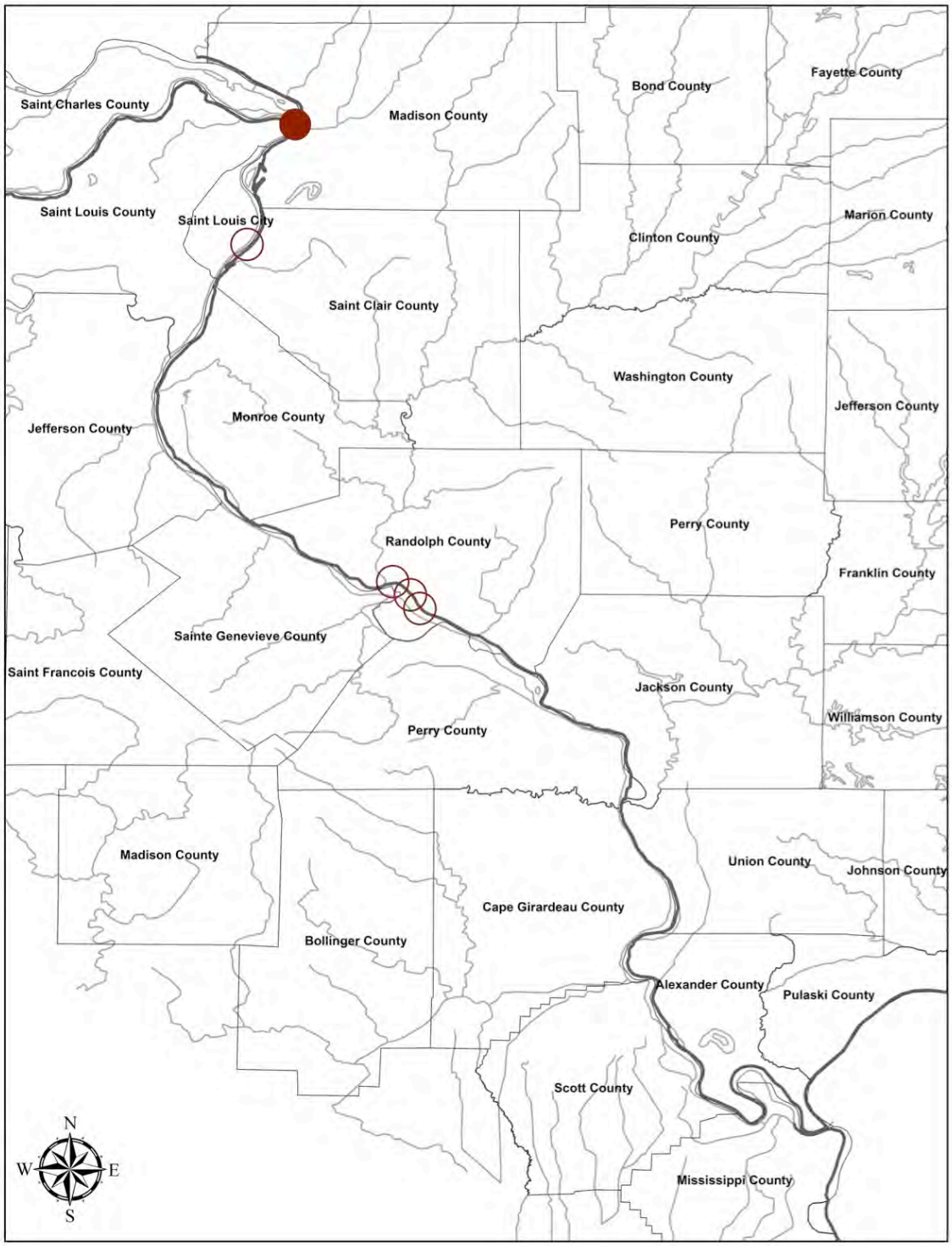
Elliptio dilatata (Rafinesque, 1820) – Spike ST – was found only as relict at 1 site during the 2012-2013 survey. Within Illinois, the species is uncommon and sporadically found in creeks to large rivers in mud, sand, or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



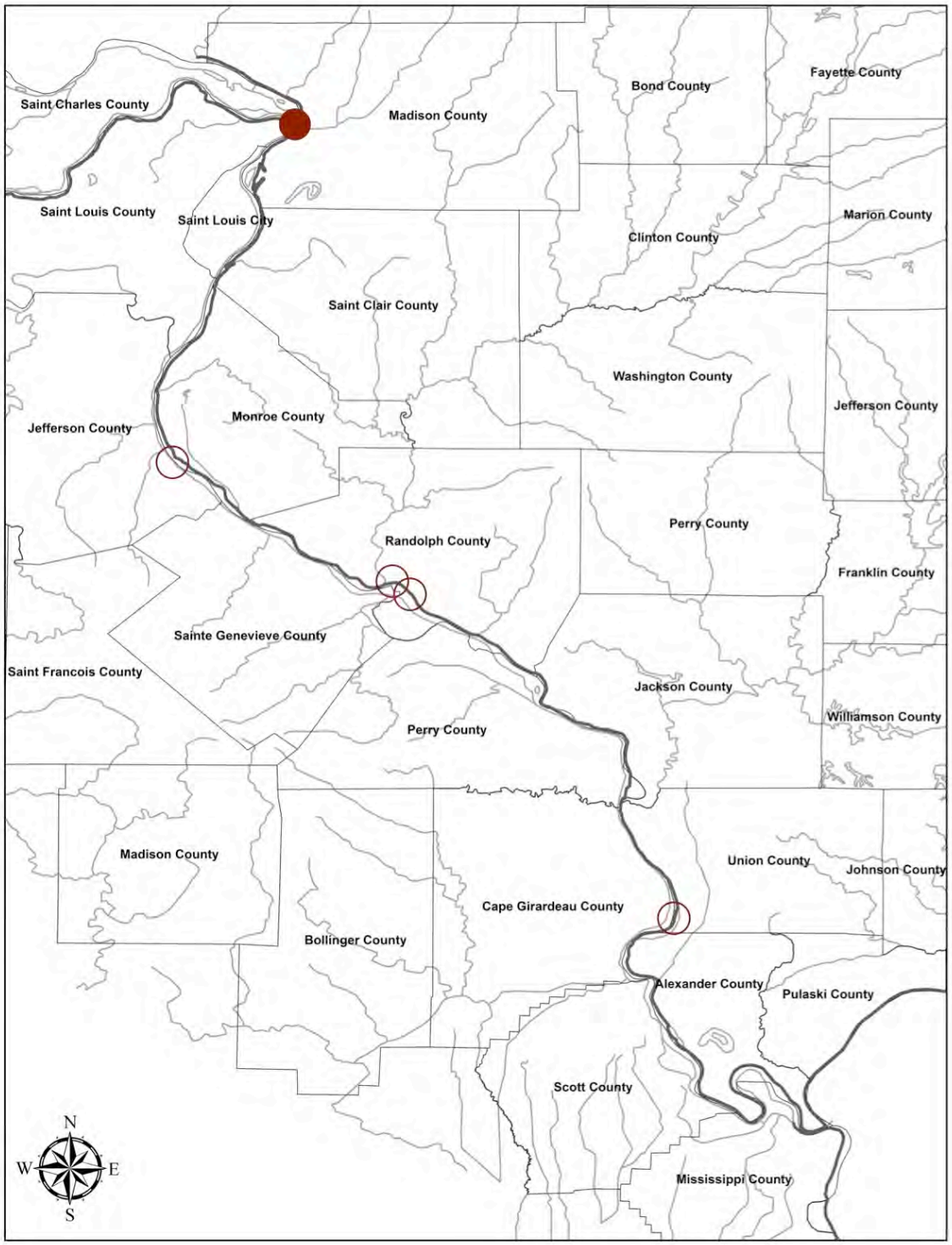
Fusconaia ebena (Lea, 1831) – Ebonyshell ST – was not encountered during the 2012-2013 survey. Within Illinois, the species is uncommon and sporadically found in mud, sand, or fine gravel of large rivers (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



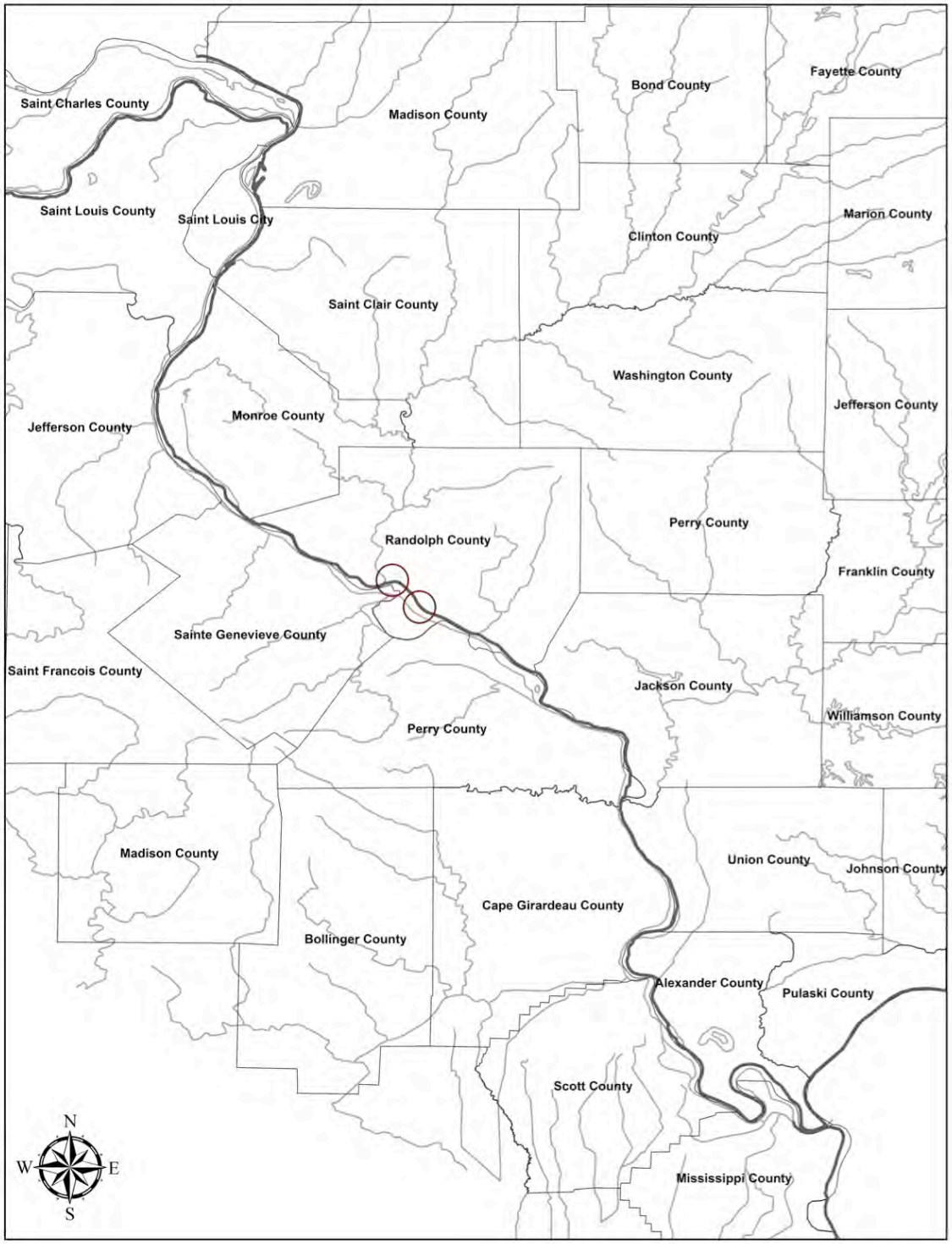
Fusconaia flava (Rafinesque, 1820) – Wabash Pigtoe – was not encountered during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. Within Illinois, the species is generally distributed throughout in Illinois in mud, sand, or gravel of small to large rivers (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



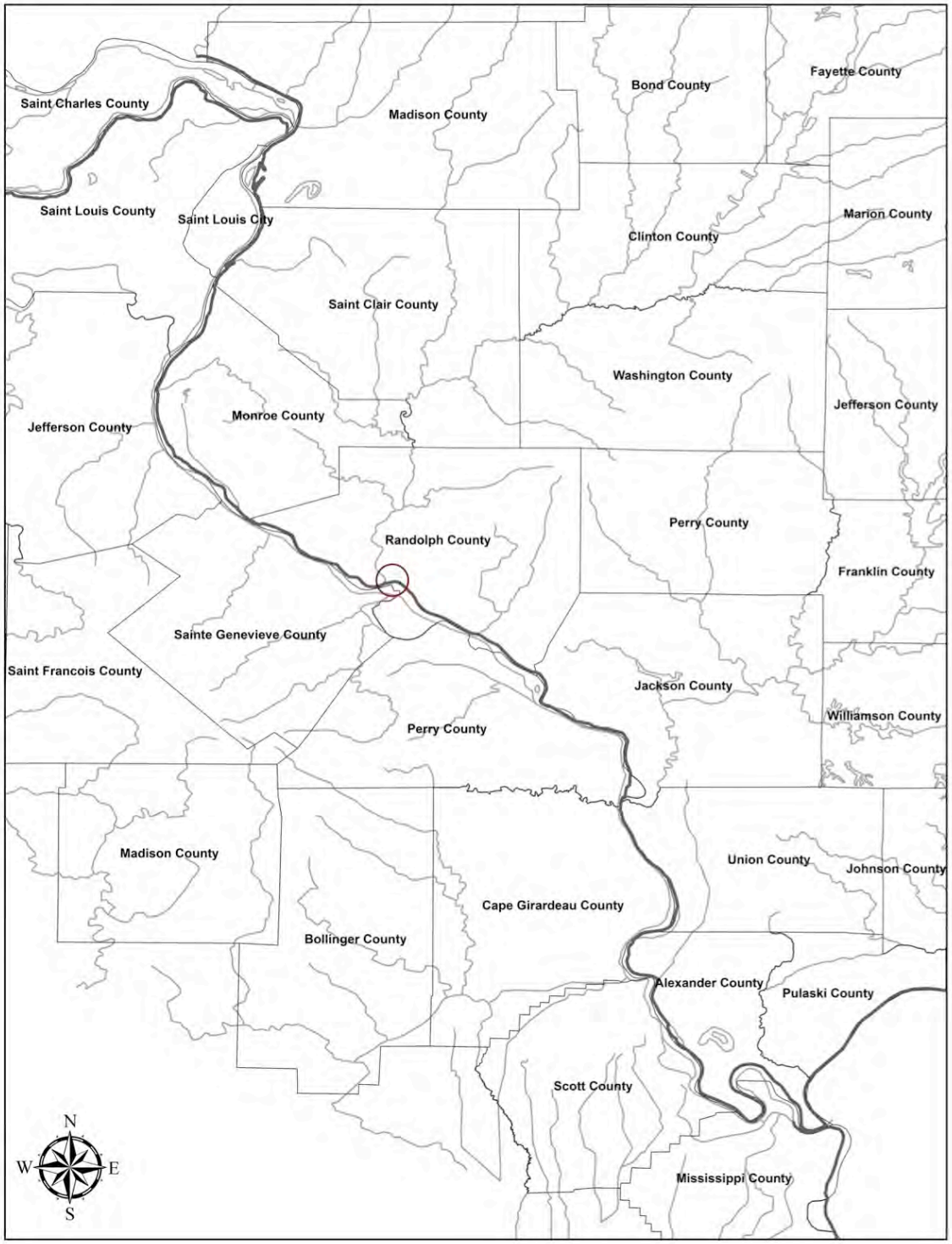
Megalonaias nervosa (Rafinesque, 1820) – Washboard – was found only as relict at 1 site during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. The species is sporadically found throughout the state in mud, sand, or gravel primarily in large rivers with a good current (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



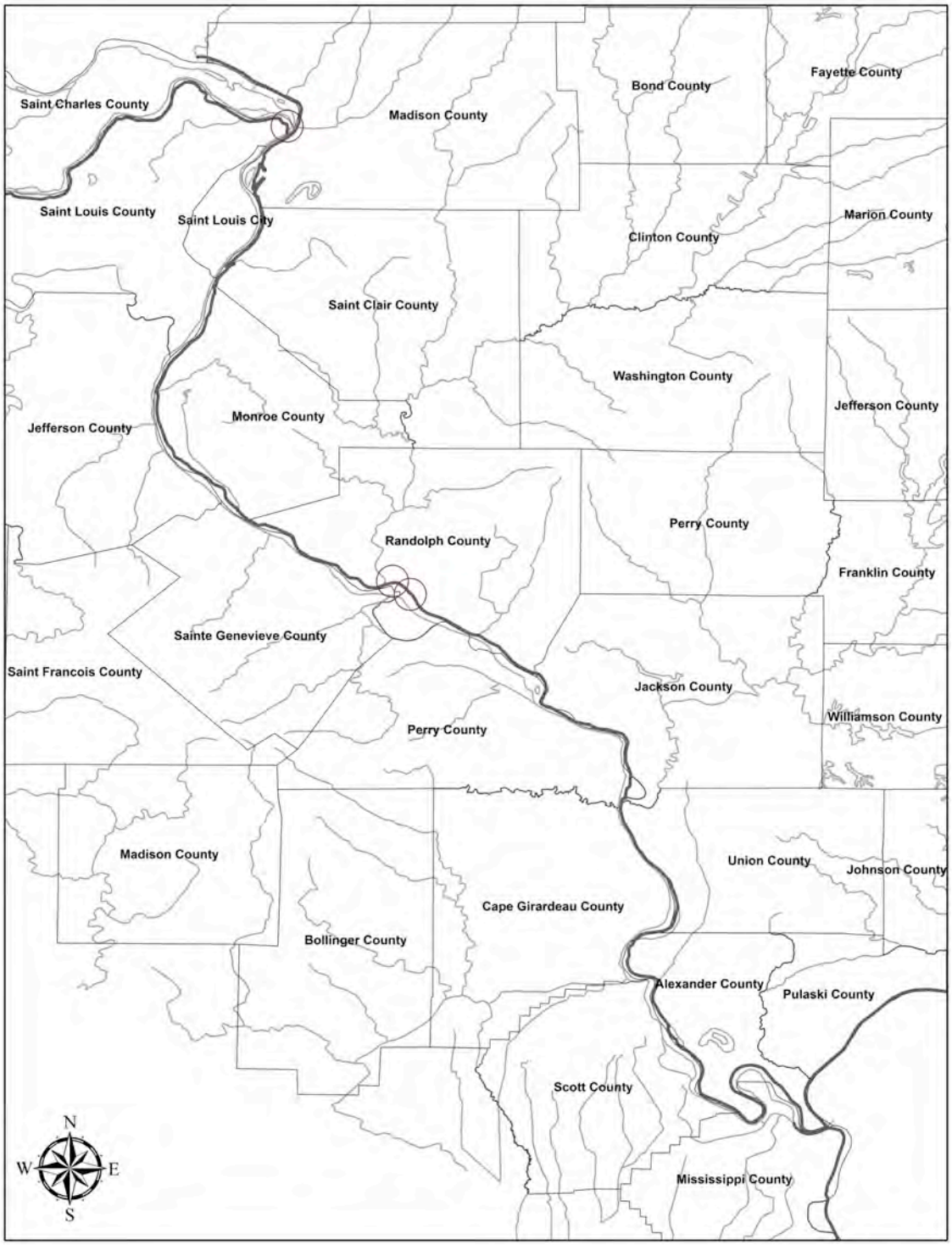
Pleurobema rubrum (Rafinesque, 1820) – Pyramid Pigtoe SE – was not encountered during the 2012-2013 survey. Within Illinois, the species is uncommon and sporadically found in large rivers in sand or gravel in areas with a good current (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



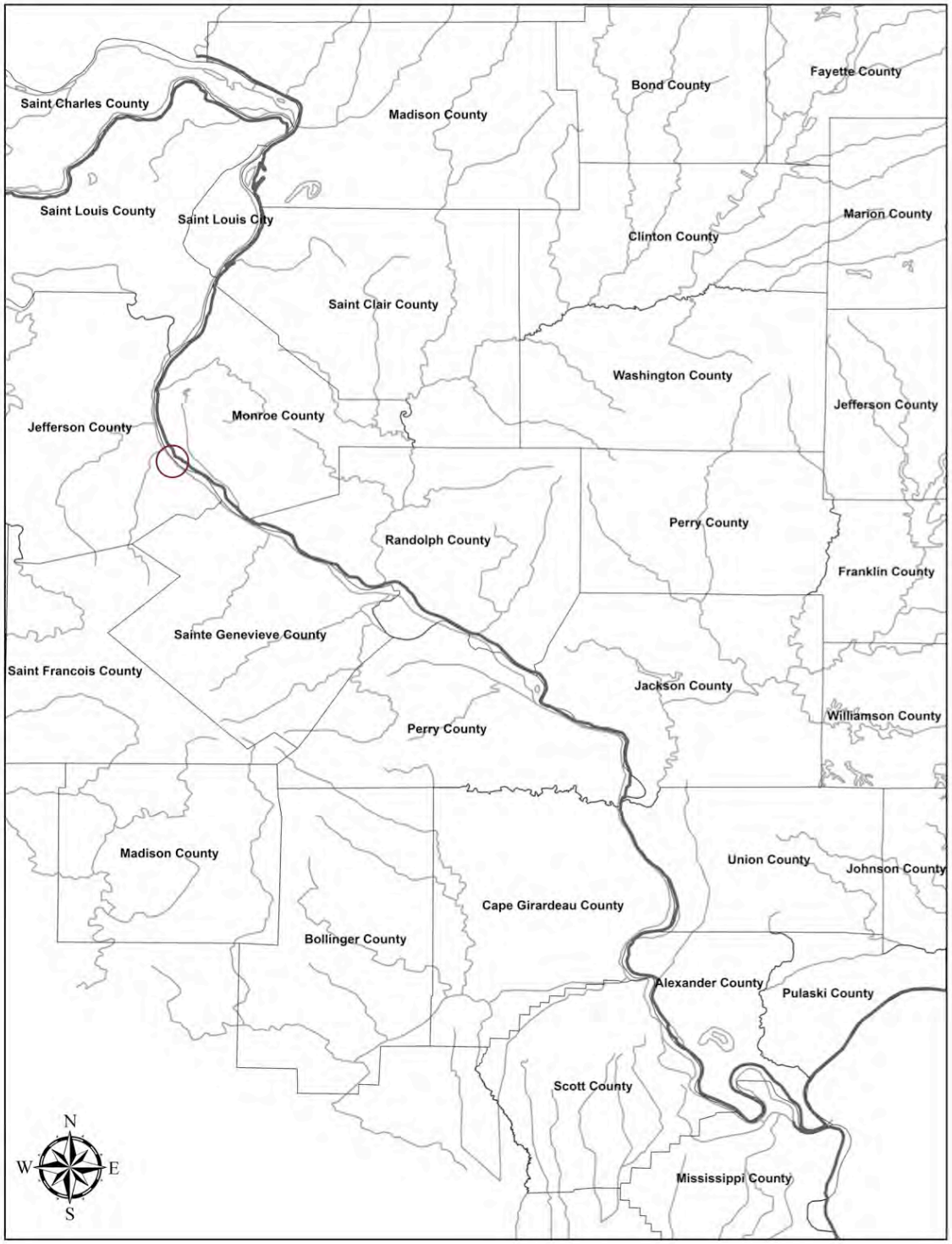
Pleurobema sintoxia (Rafinesque, 1820) – Round Pigtoe – was not encountered during the 2012-2013 survey. Within Illinois, the species is occasionally found in mud, sand, or gravel of medium to large rivers in the northern two-thirds of Illinois (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



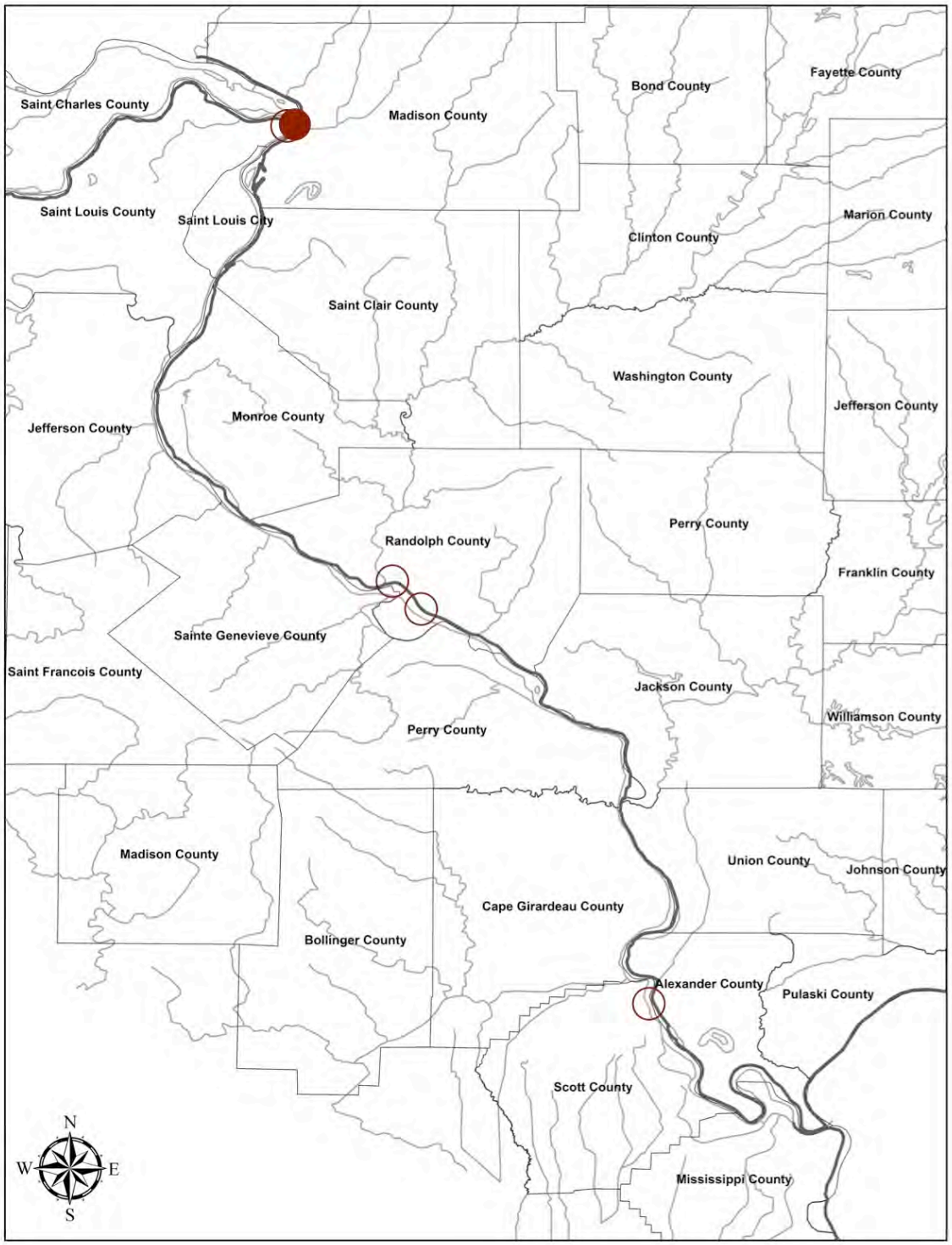
Quadrula metanevra (Rafinesque, 1820) – Monkeyface – was not encountered during the 2012-2013 survey. Historically found in medium to large rivers in sand and gravel throughout Illinois, the species has experienced a considerable decline in range and abundance during the last half century, with populations only occurring in a few rivers including the Mississippi River (Cummings and Mayer 1992; Cummings and Mayer 1997).



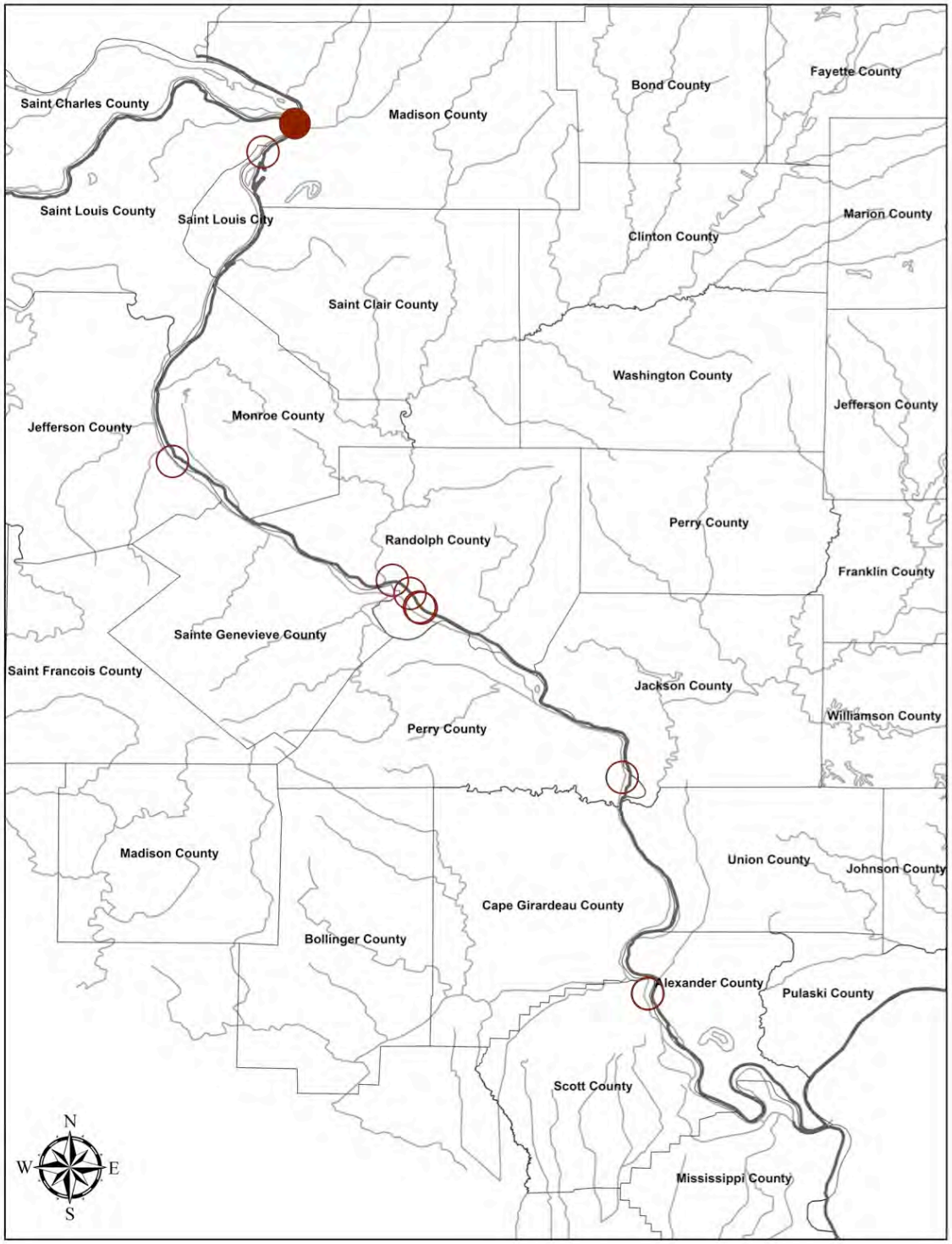
Quadrula nobilis (Conrad, 1854) – Gulf Mapleleaf – was found only as relict at 1 site during the 2012-2013 survey. Not much is known of this species status in Illinois (Cummings and Mayer 1997; Tiemann et al. 2007), but is probably sporadically found in large rivers in mud, sand, or gravel.



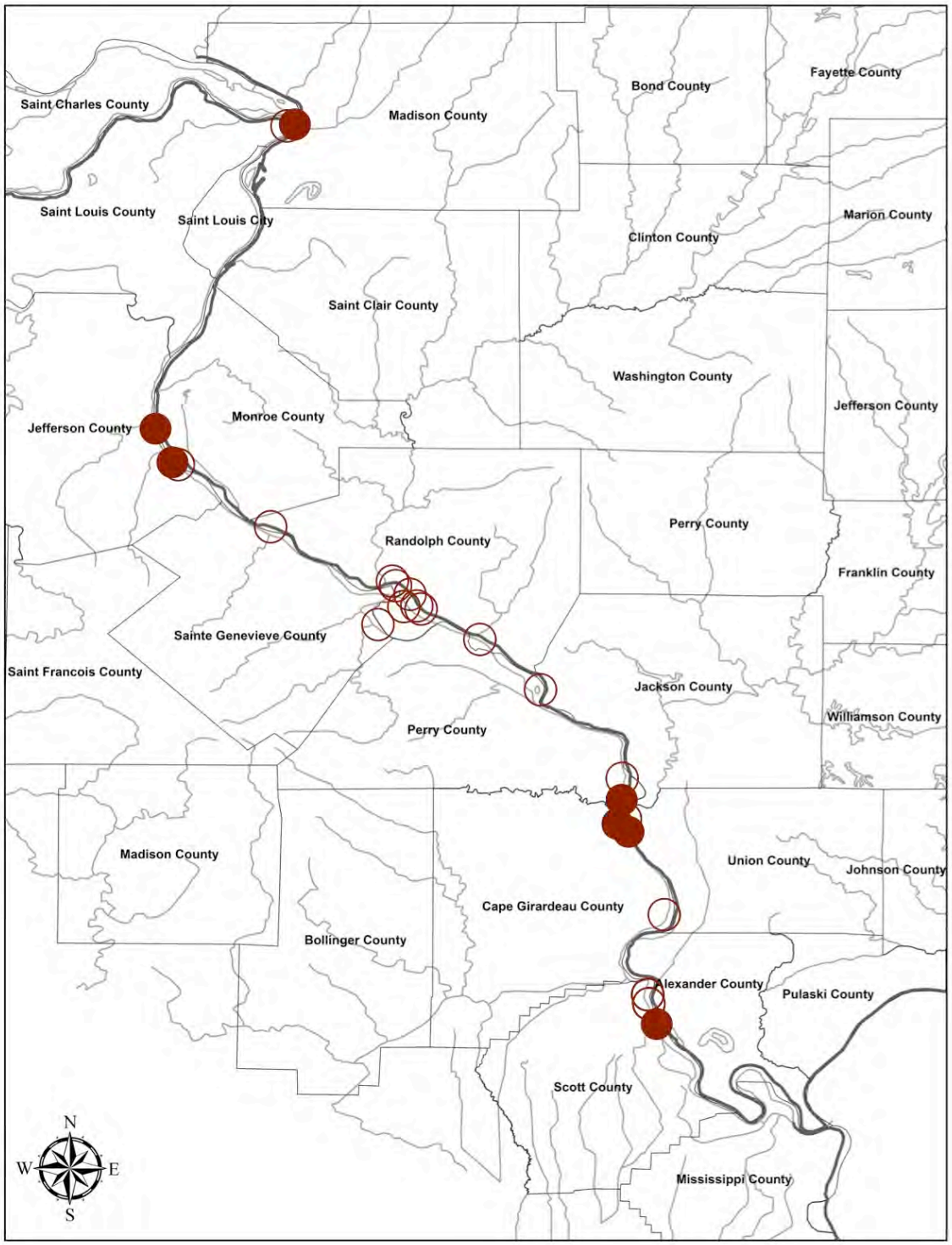
Quadrula nodulata (Rafinesque, 1820) – Wartyback – was found only as relict at 1 site during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. Within Illinois, the species is sporadically found in sand or fine gravel in large rivers or in the lower sections of medium-sized rivers throughout the state (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



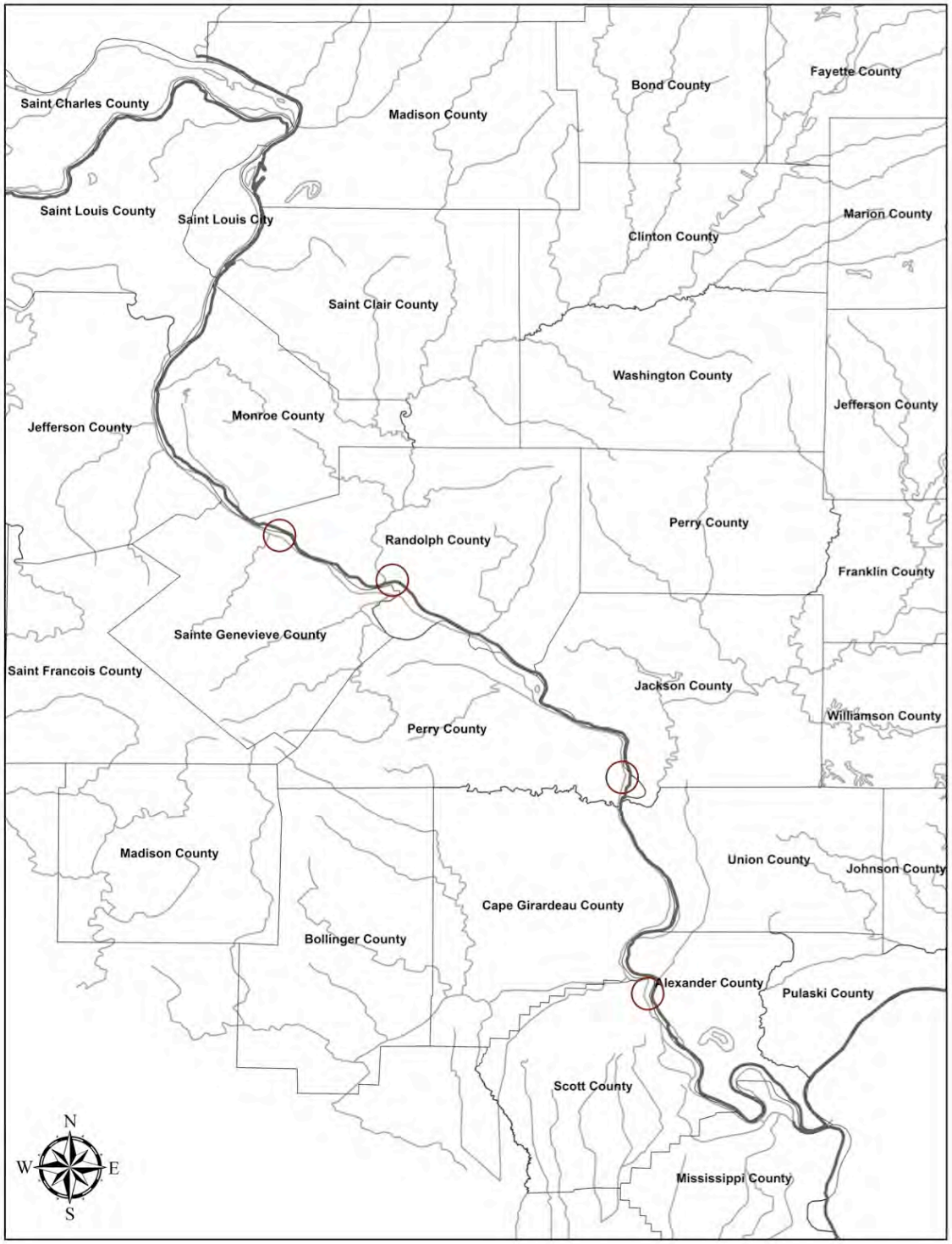
Quadrula pustulosa (Lea, 1831) – Pimpleback – was found only as relict at 3 sites during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. The species is generally distributed throughout Illinois in medium to large rivers in mud, sand, or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



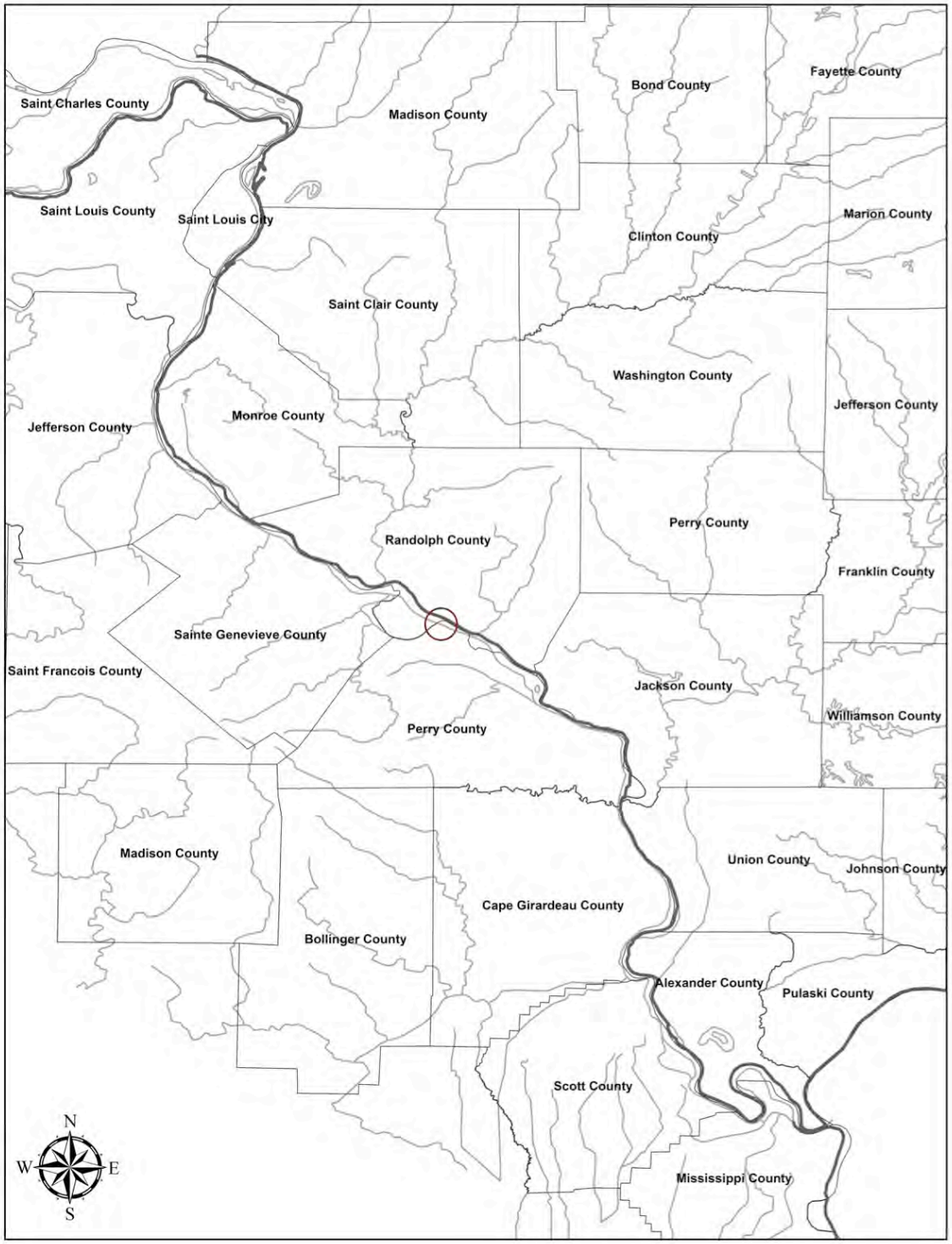
Quadrula quadrula (Rafinesque, 1820) – Mapleleaf – was found at 13 sites (live at 2 sites [N = 2 individuals total], fresh-dead at 5 sites, and relict at 6 sites) during the 2012-2013 survey. ESI found it alive in 2012 near the confluence with the Missouri River. The species is generally distributed throughout Illinois in medium to large rivers and reservoirs in mud, sand, or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



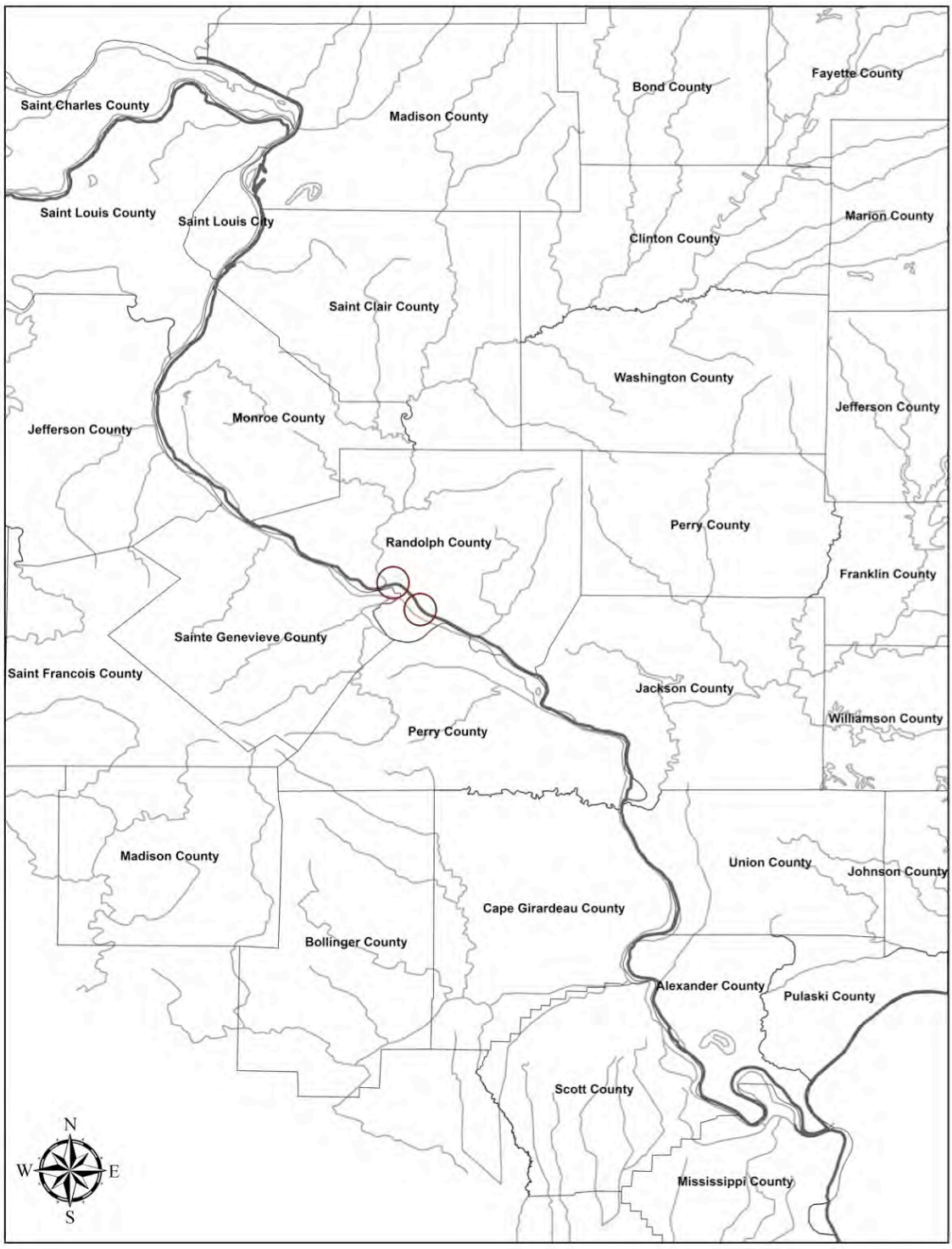
Tritogonia verrucosa (Rafinesque, 1820) – Pistolgrip – was not encountered during the 2012-2013 survey. Formerly distributed throughout Illinois, the species in now sporadically found in medium to large rivers in mud, sand, or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



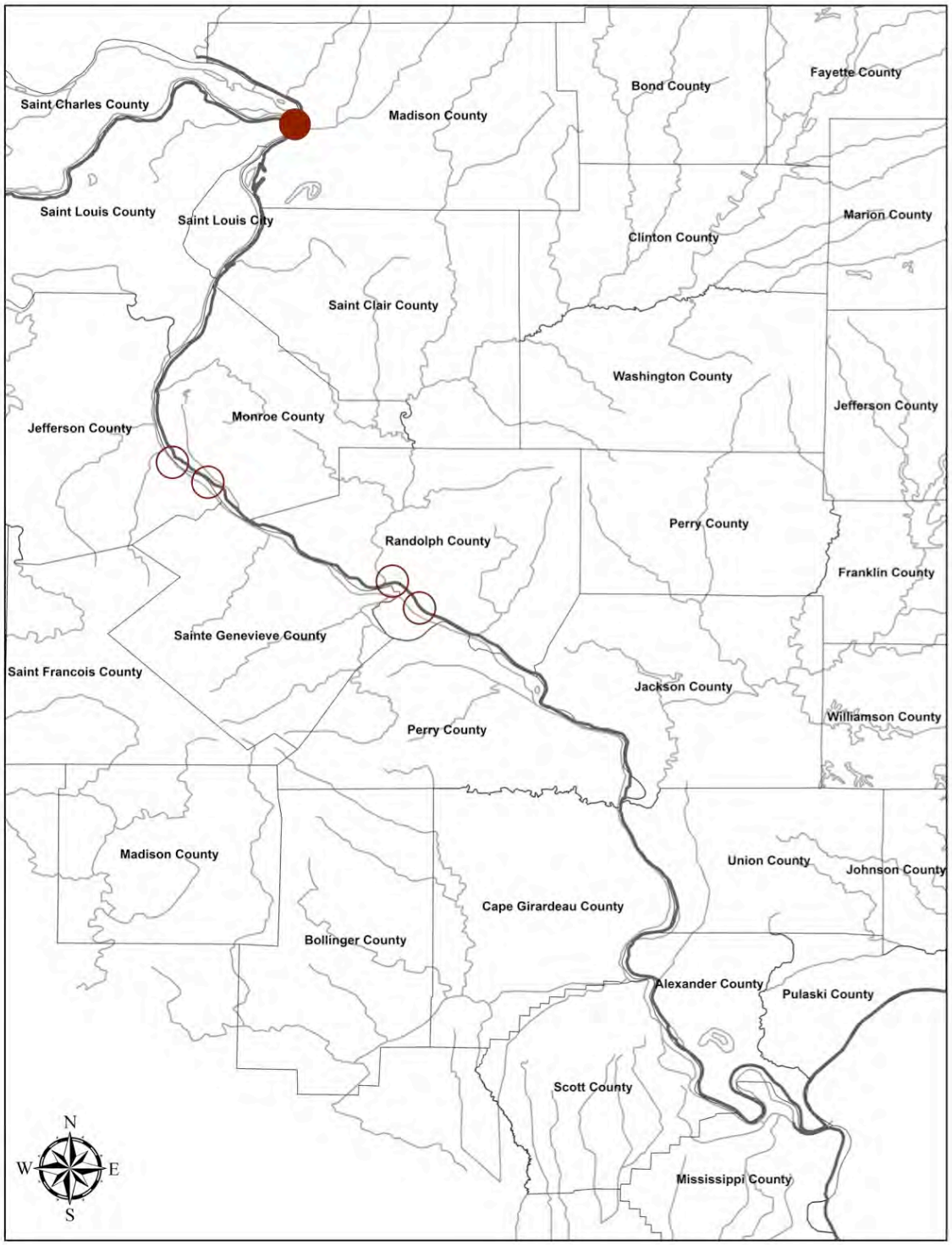
Uniomerus tetralasmus (Say, 1831) – Pondhorn – was not encountered during the 2012-2013 survey. The species is generally distributed throughout Illinois in ponds, small creeks, and the headwaters of larger streams in mud or sand (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



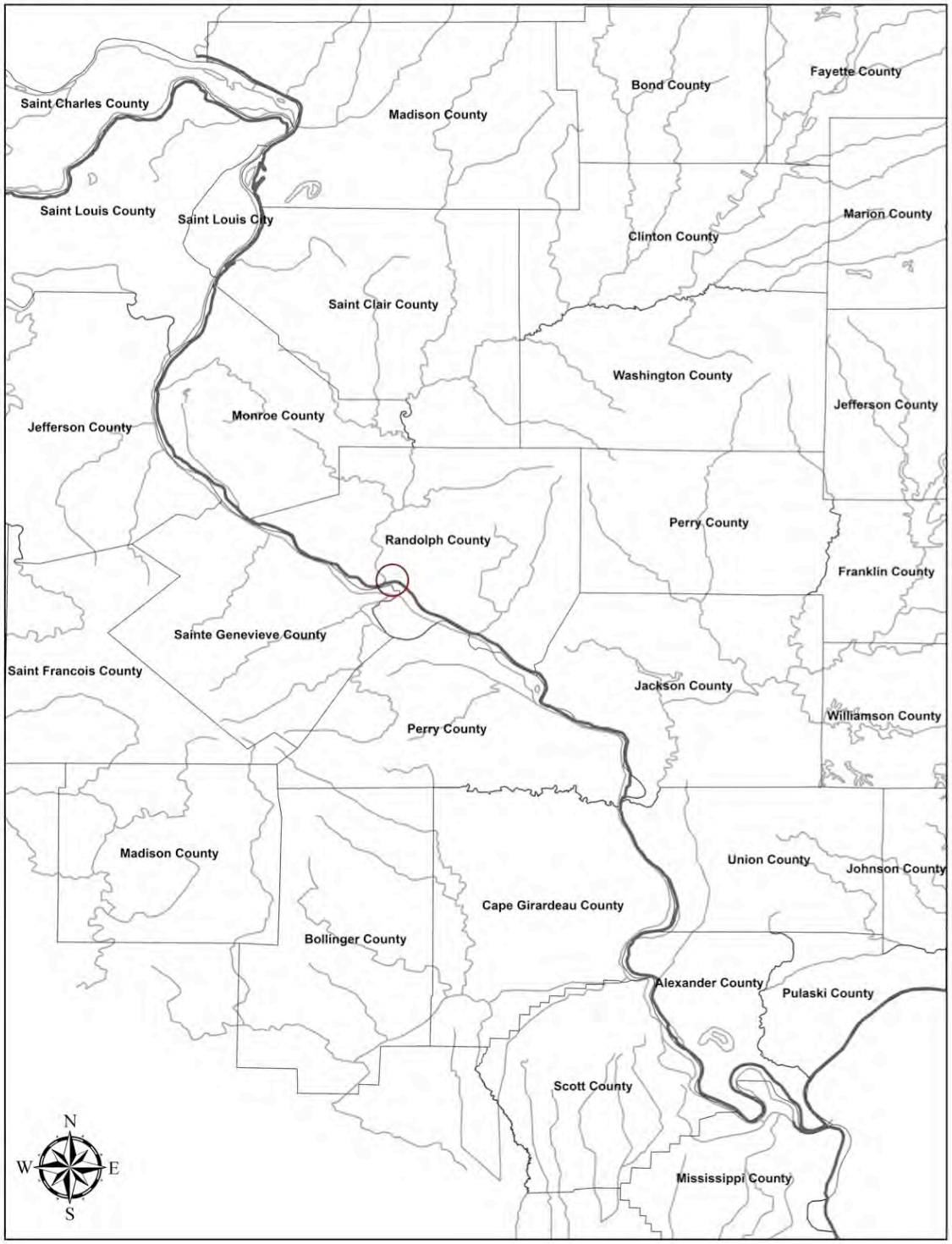
Actinonaias ligamentina (Lamarck, 1819) – Mucket – was not encountered during the 2012-2013 survey. The species is generally distributed throughout Illinois in medium to large rivers in gravel or mixed sand and gravel (Cummings and Mayer 1992; Cummings and Mayer 1997).



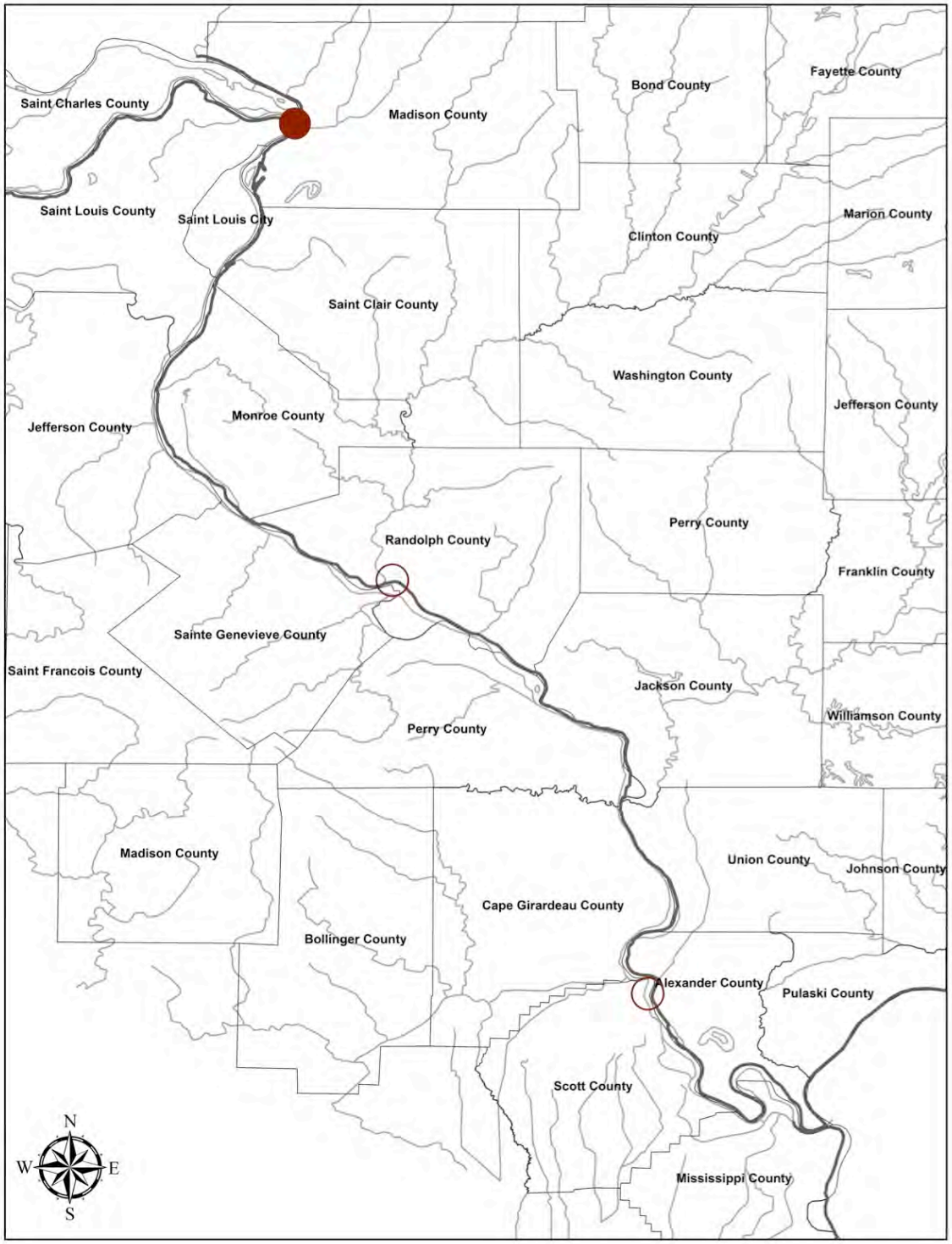
Ellipsaria lineolata (Rafinesque, 1820) – Butterfly ST – was found only as relict at 2 sites during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. Formerly distributed throughout Illinois, the species in now sporadically found in large rivers in sand or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



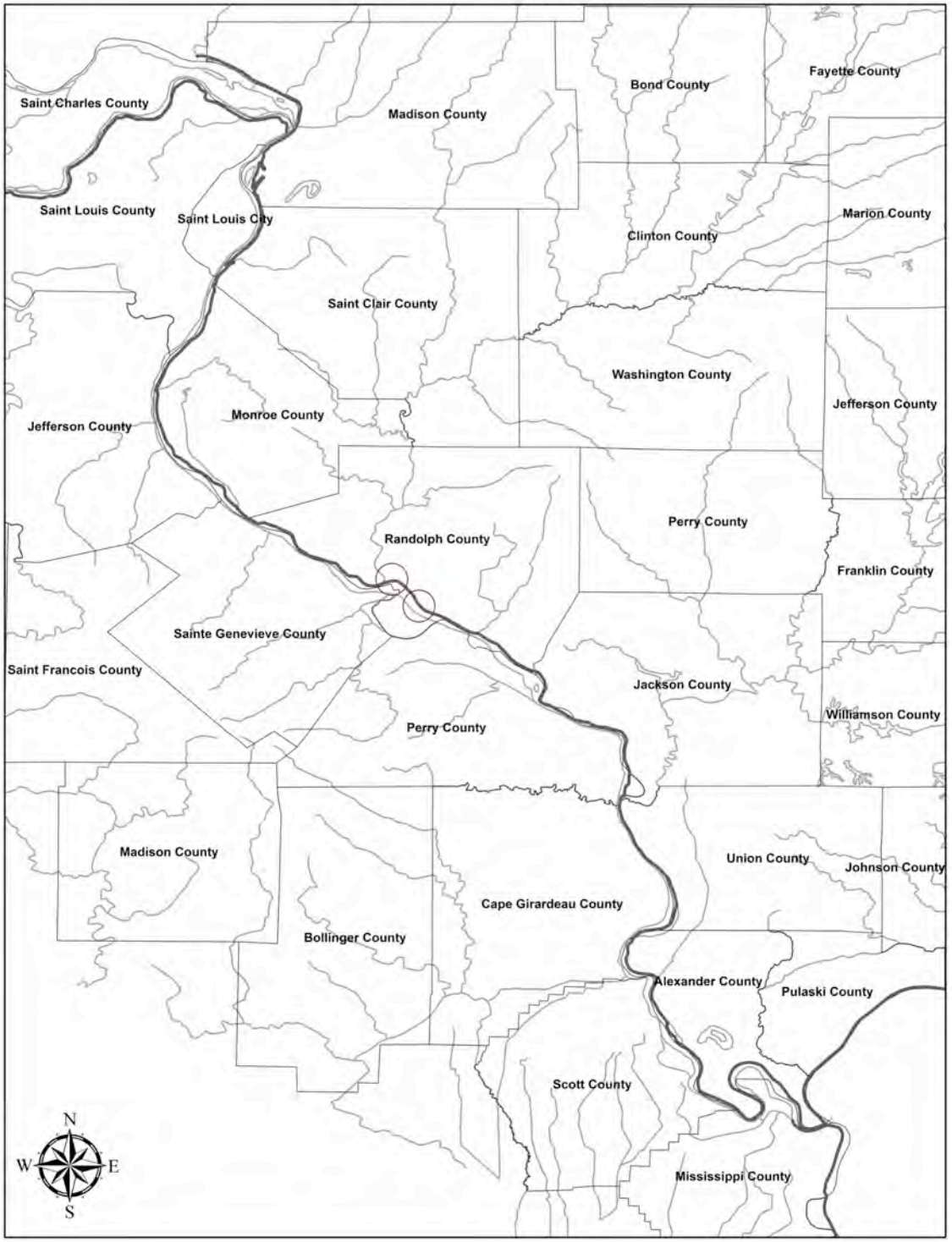
Epioblasma triquetra (Rafinesque, 1820) – Snuffbox SE, FE – was not encountered during the 2012-2013 survey. Historically found throughout Illinois, the species is now found only in a small stretch of the Embarras River clear, gravel riffles (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007; Tiemann 2010).



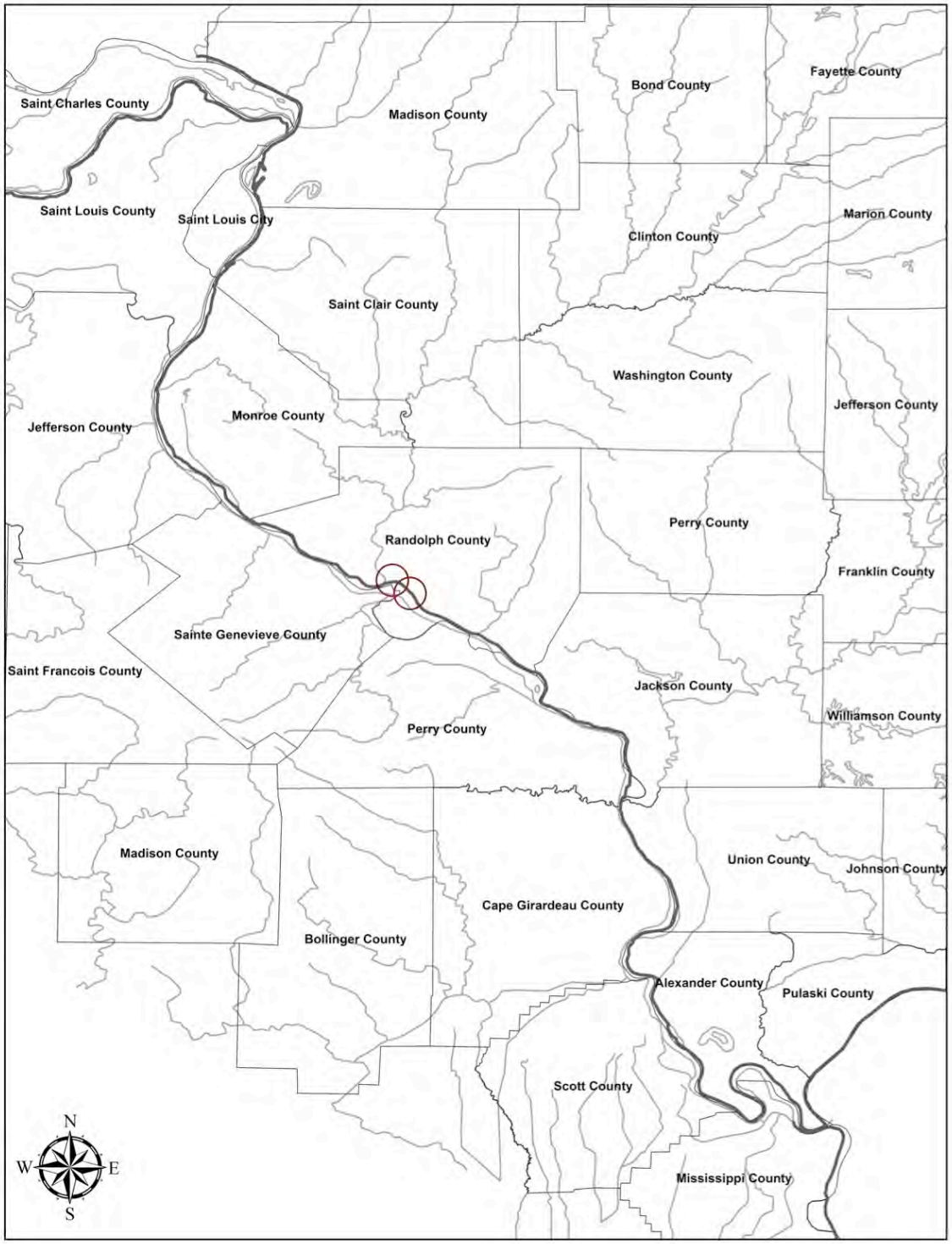
Lampsilis cardium Rafinesque, 1820 – Plain Pocketbook – was not encountered during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. The species is generally distributed throughout Illinois in small streams to large rivers in mud, sand, or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



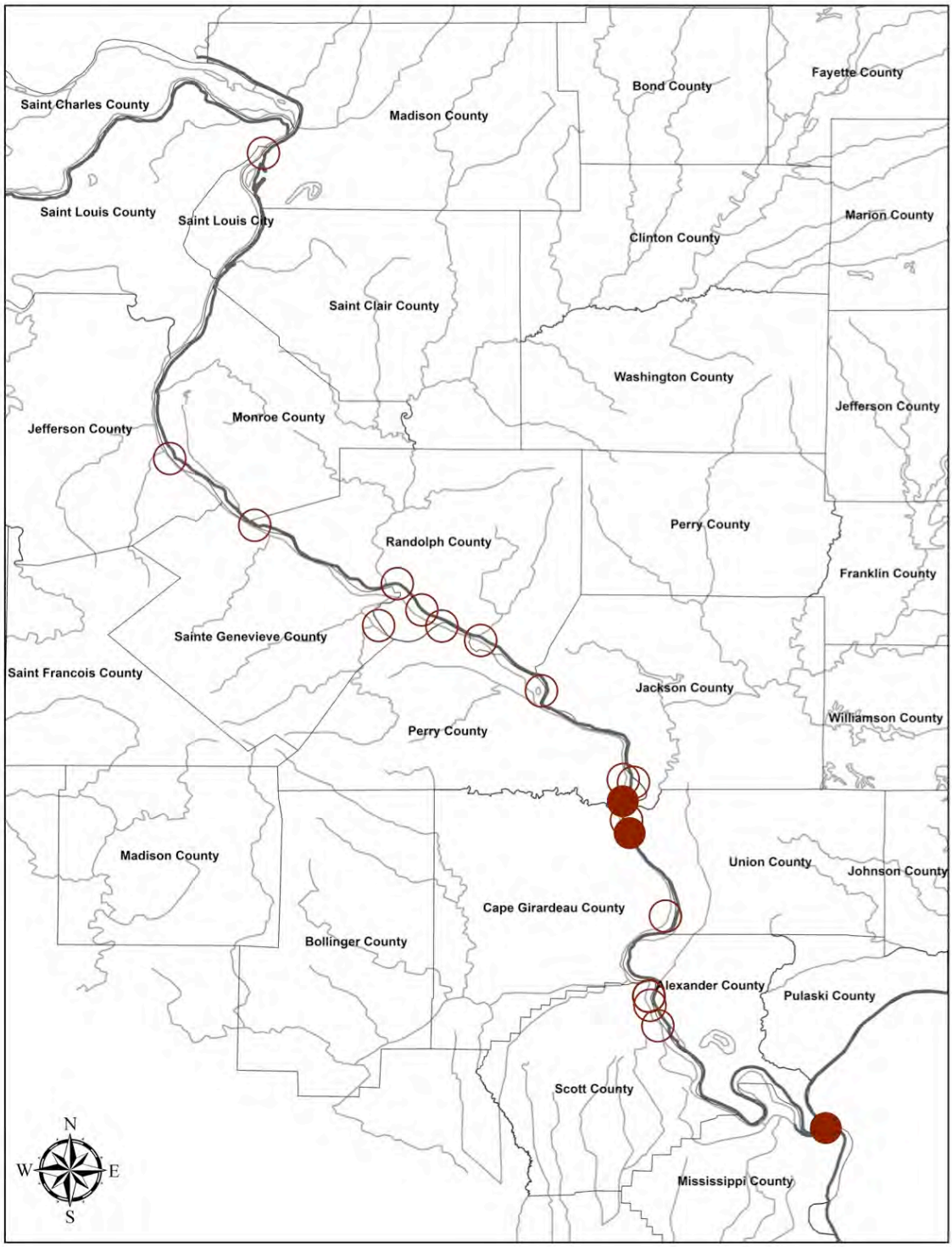
Lampsilis higginsii (Lea, 1857) - Higgin's Eye SE, FE – was not encountered during the 2012-2013 survey. Historically found in the Mississippi River and some of its larger northern tributaries, the species is now only found in the upper Mississppi River in gravel or sand (Cummings and Mayer 1992; Cummings and Mayer 1997).



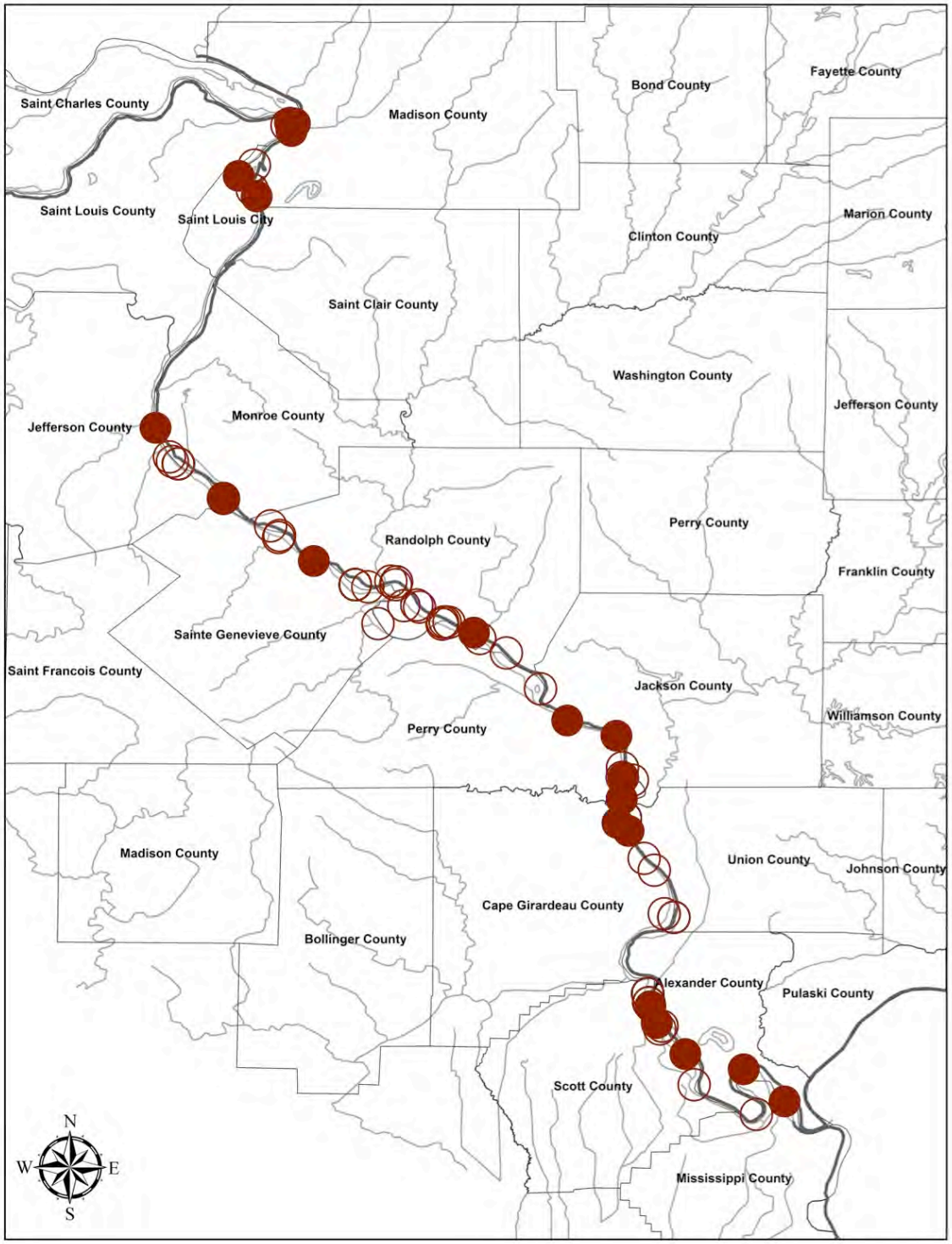
Lampsilis siliquoidea (Barnes, 1823) – Fatmucket – was not encountered during the 2012-2013 survey. The species is generally distributed throughout Illinois in small to medium-sized streams in mud, sand, or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



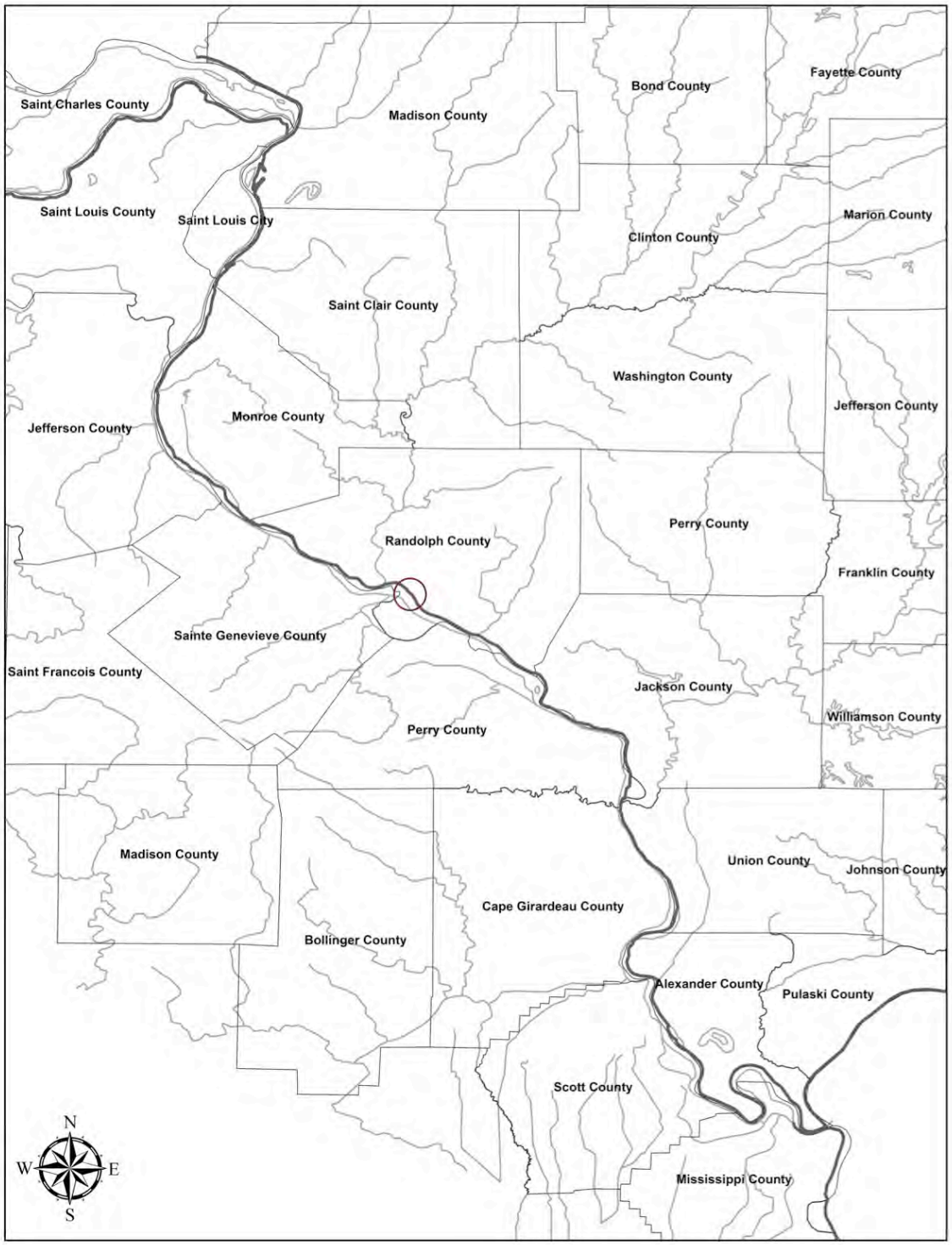
Lampsilis teres (Rafinesque, 1820) – Yellow Sandshell – was found at 7 sites (live at 1 site [N = 10 individuals total], fresh-dead at 2 sites, and relict at 3 sites) during the 2012-2013 survey. Historically found in medium to large rivers in sand or fine gravel throughout Illinois, the species might be declining in its distribution (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



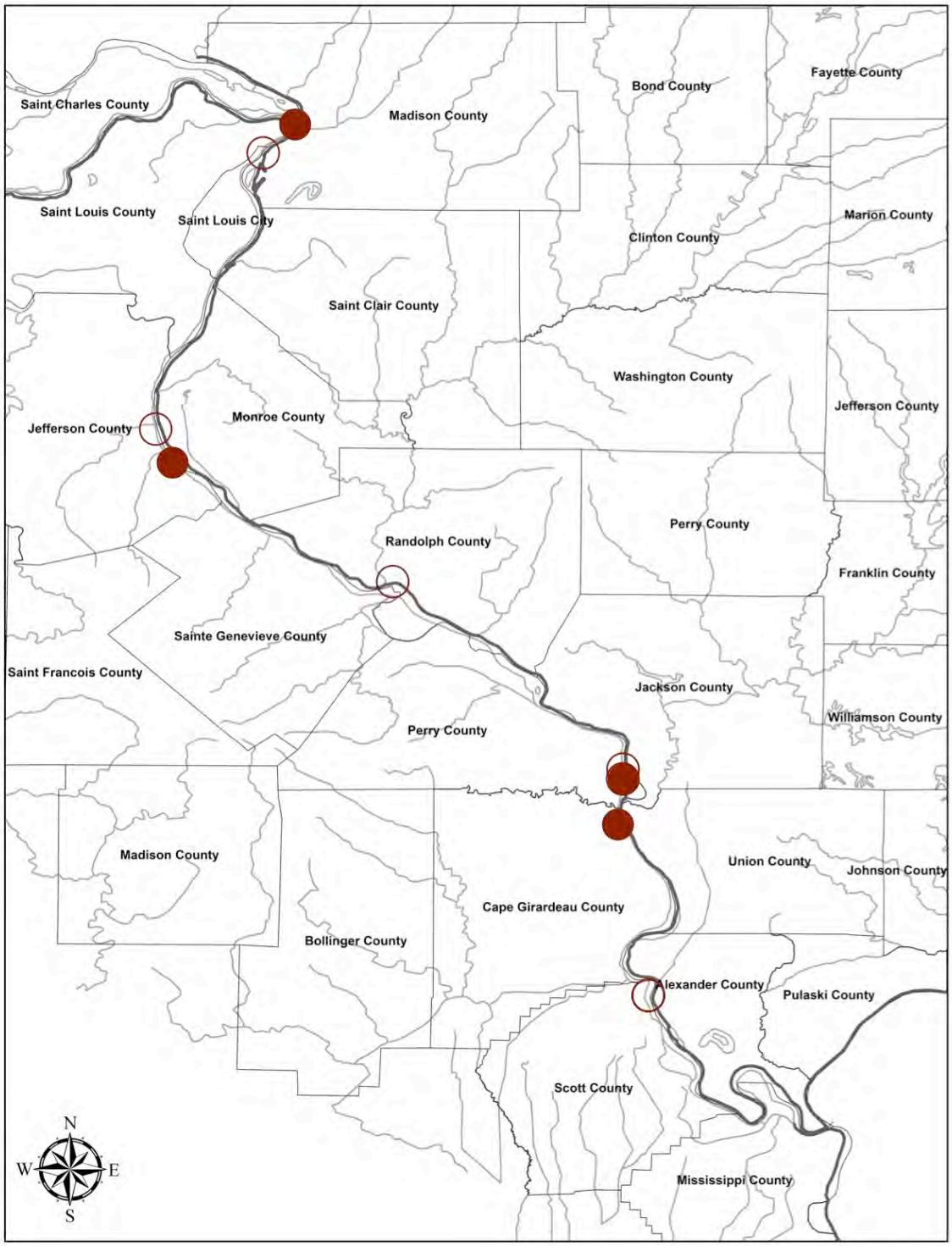
Leptodea fragilis (Rafinesque, 1820) – Fragile Papershell – was found at 27 sites (live at 4 sites [N = 50 individuals total], fresh-dead at 16 sites, and relict at 7 sites) during the 2012-2013 survey. The species is generally distributed throughout Illinois in streams of all sizes in mud, sand, or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



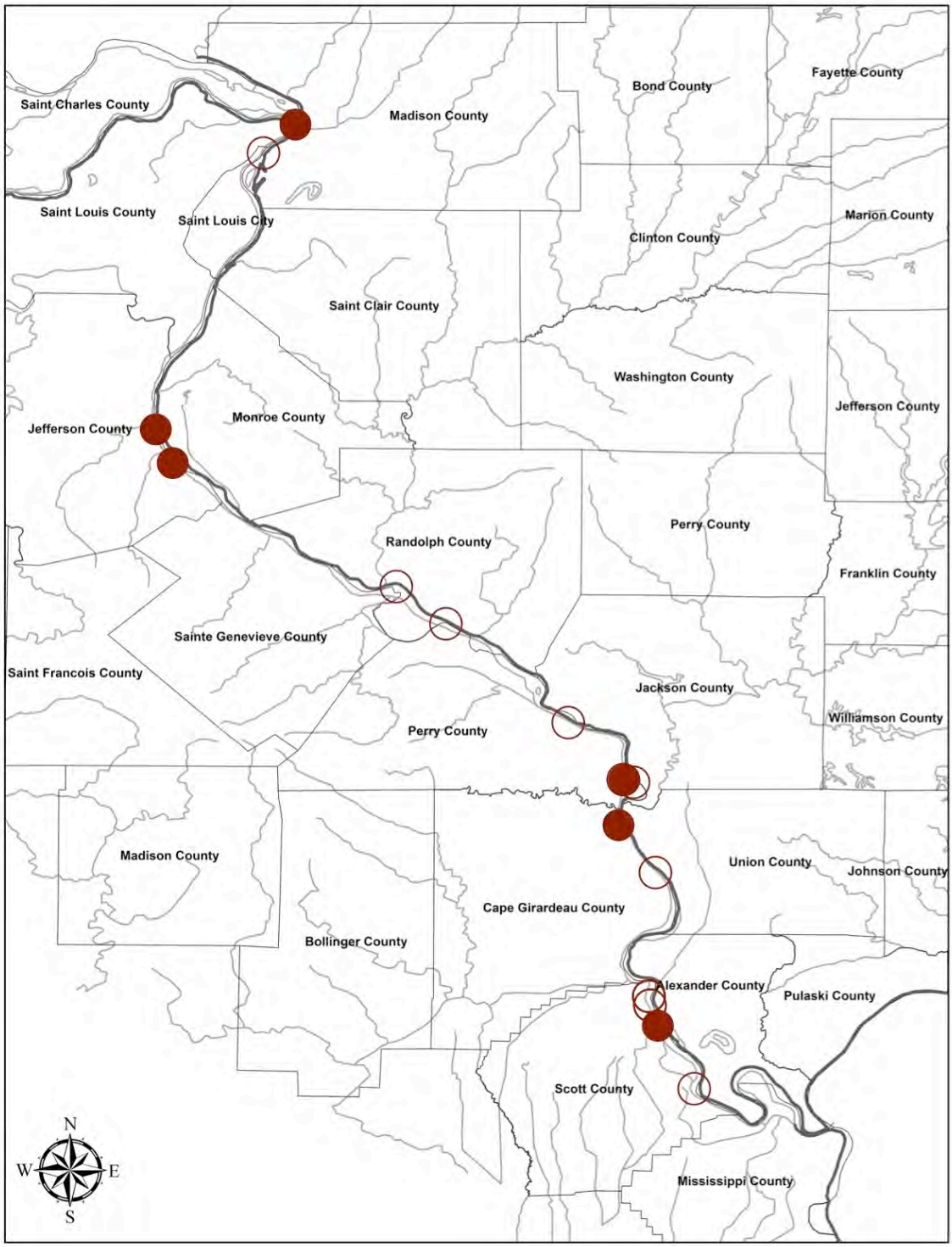
Ligumia recta (Lamarck, 1819) – Black Sandshell ST – was not encountered during the 2012-2013 survey. Historically found throughout Illinois, the species is now extant only in just one-third of the basins it once occupied. Found in medium to large rivers in riffles or raceways in gravel or firm sand (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



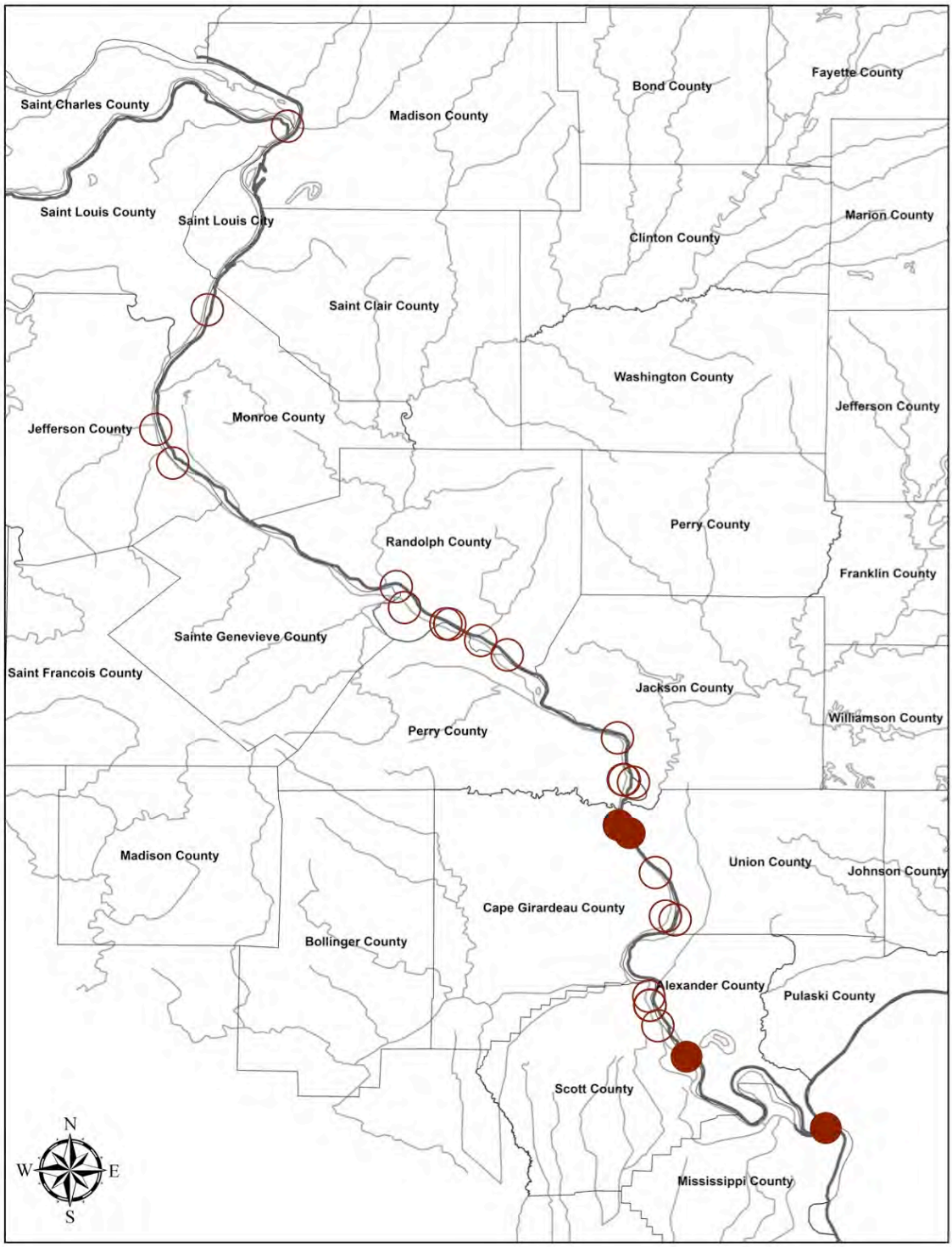
Obliquaria reflexa Rafinesque, 1820 - Threehorn Wartyback – was found as fresh-dead at 3 sites and relict at 2 sites during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. The species is generally distributed throughout Illinois in large rivers in sand or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



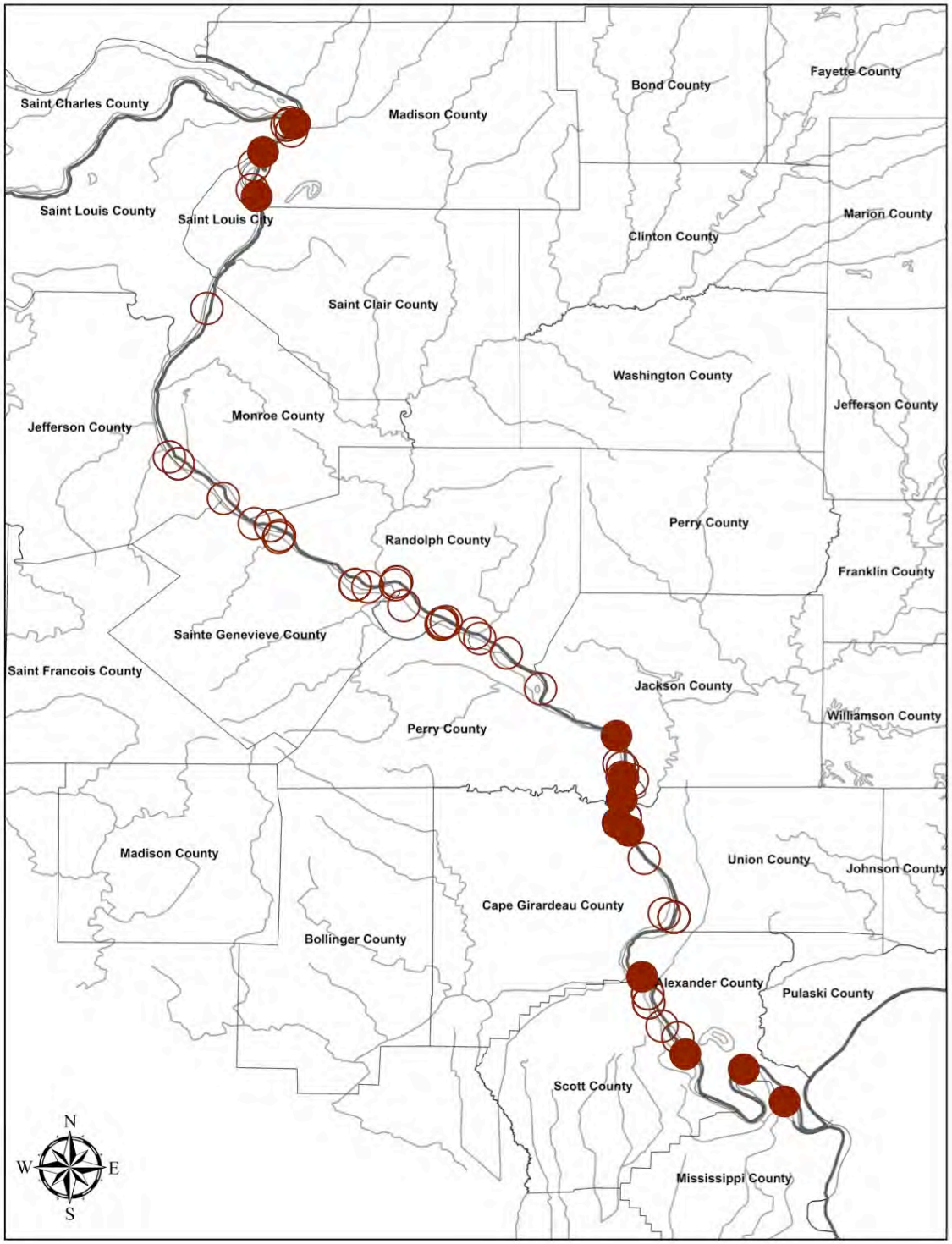
Obovaria olivaria (Rafinesque, 1820) - Hickorynut – was found at 7 sites (live at 2 sites [N = 2 individuals total], fresh-dead at 3 sites, and relict at 2 sites) during the 2012-2013 survey. ESI found it alive in 2012 near the confluence with the Missouri River. The species is generally distributed throughout Illinois in large rivers in sand or mixed sand and gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



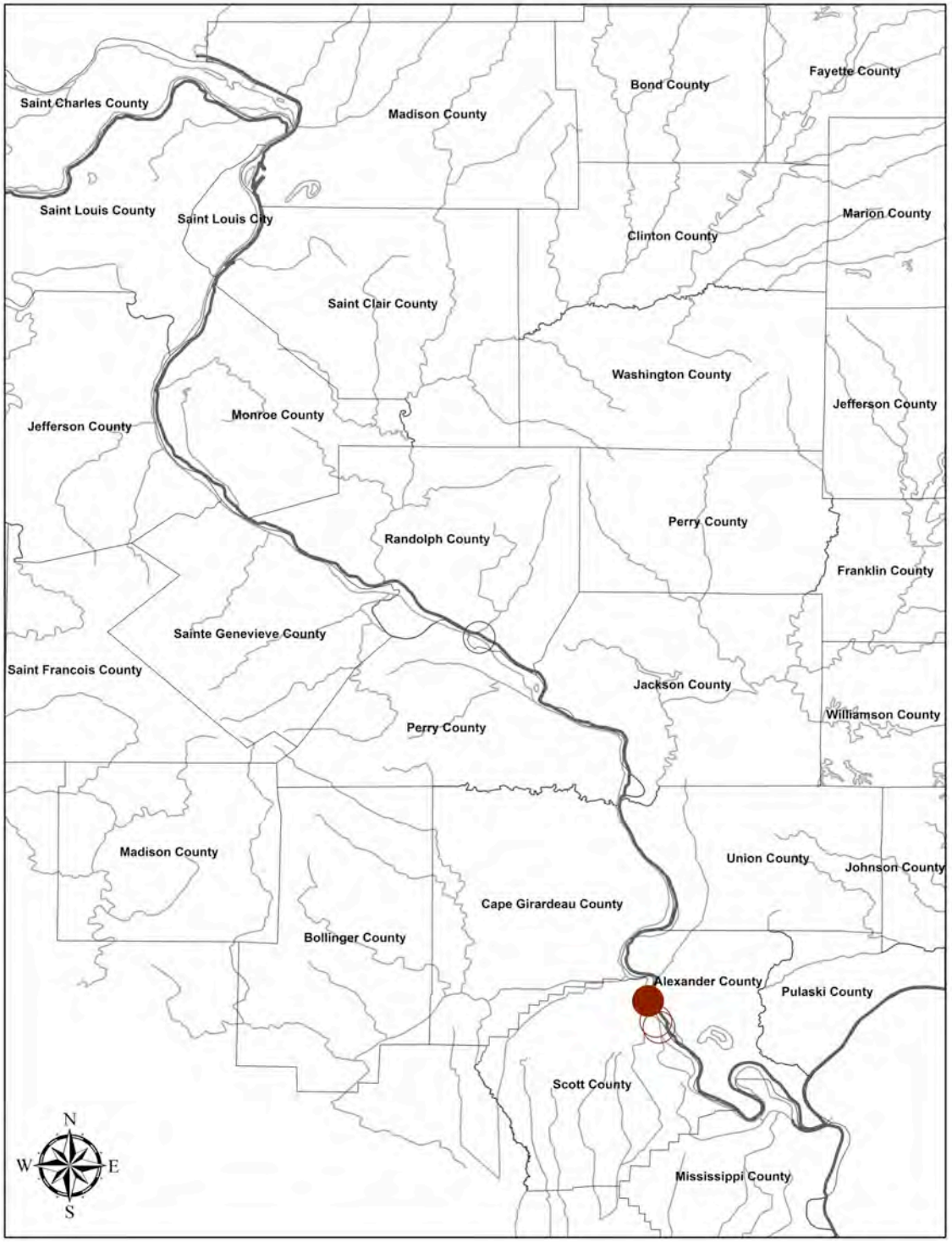
Potamilus alatus (Say, 1817) - Pink Heelsplitter – was found at 10 sites (live at 1 site [N = 1 individual total], fresh-dead at 3 sites, and relict at 6 sites) during the 2012-2013 survey. The species is generally distributed throughout Illinois in medium to large rivers in mud or mixed mud, sand, and gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



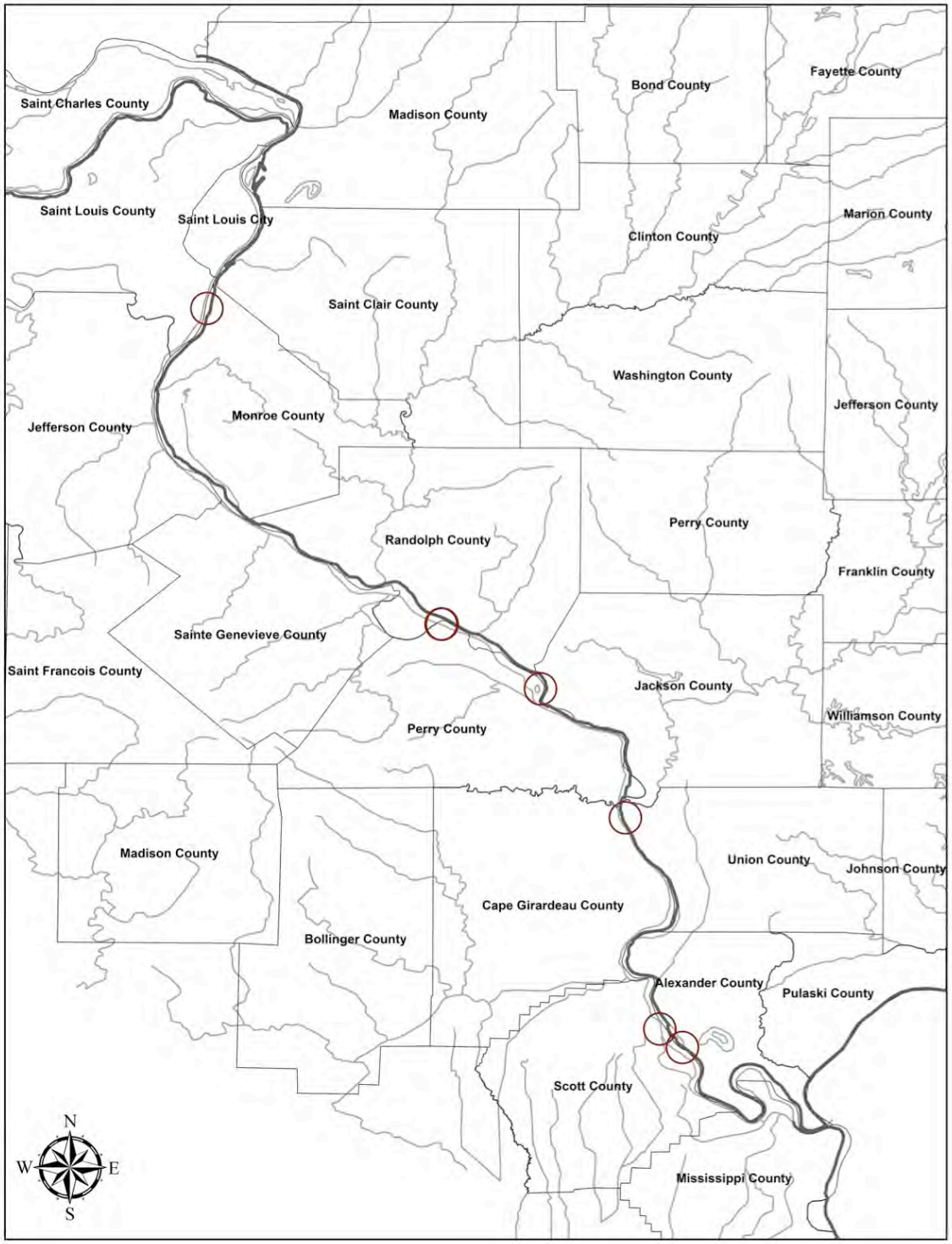
Potamilus ohiensis (Rafinesque, 1820) - Pink Papershell – was found at 16 sites (live at 7 sites [N = 11 individuals total], fresh-dead at 5 sites, and relict at 4 sites) during the 2012-2013 survey. The species is generally distributed throughout Illinois in medium to large rivers in silt, mud, or sand (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



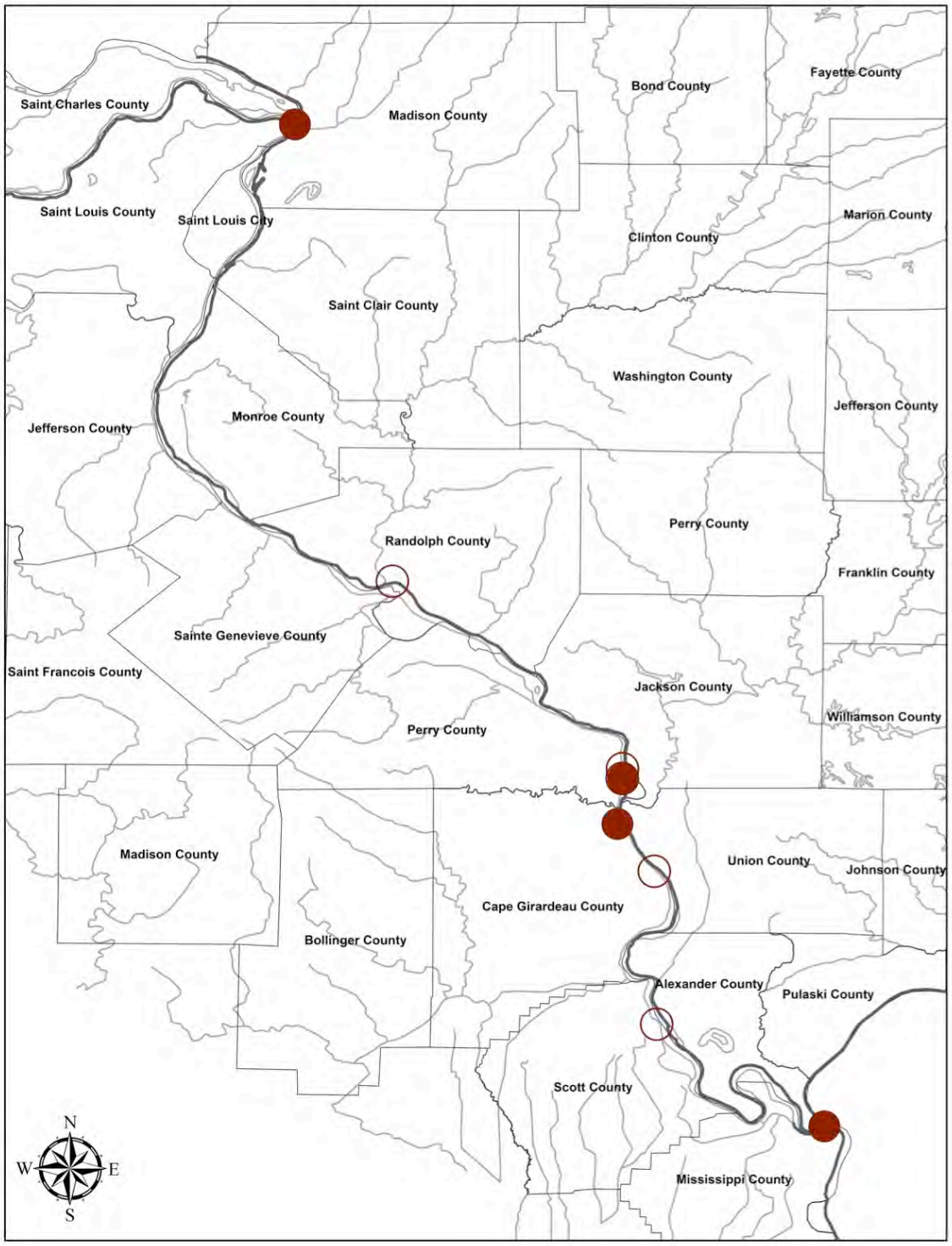
Potamilus purpuratus (Lamarck, 1819) – Bleufer – was found only as relict at 1 site during the 2012-2013 survey. A peripheral species, sporadically found in extreme southern Illinois in large rivers in mud or mixed mud and gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



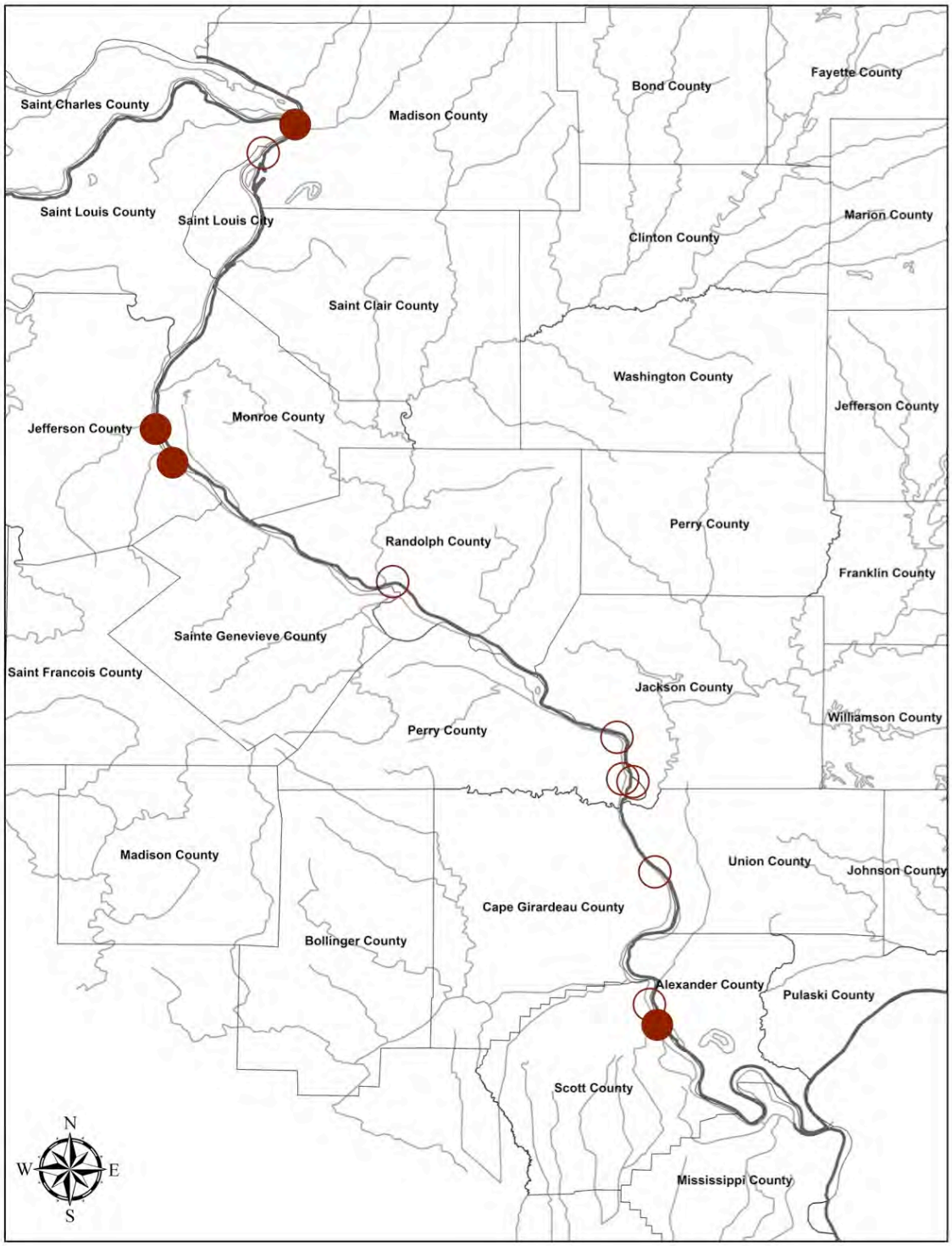
Toxolasma parvus (Barnes, 1823) – Lilliput – was not encountered during the 2012-2013 survey. The species is generally distributed throughout Illinois in ponds, lakes, and creeks to large rivers in mud, sand, or fine gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



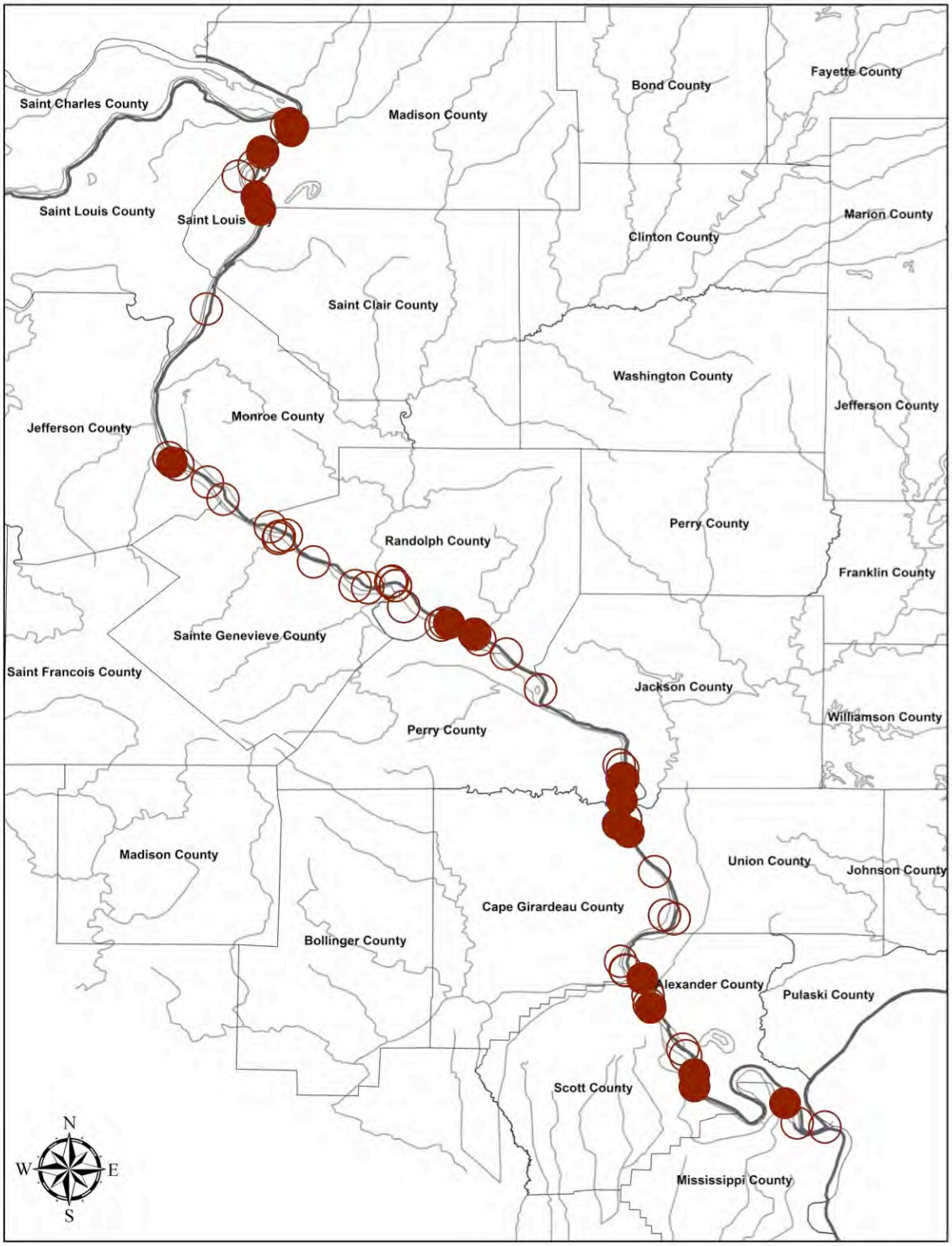
Truncilla donaciformis (Lea, 1828) – Fawnsfoot – was found as fresh-dead at 3 sites and relict at 1 site during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. The species is generally distributed throughout Illinois in large rivers or the lower reaches of medium-sized streams in sand or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



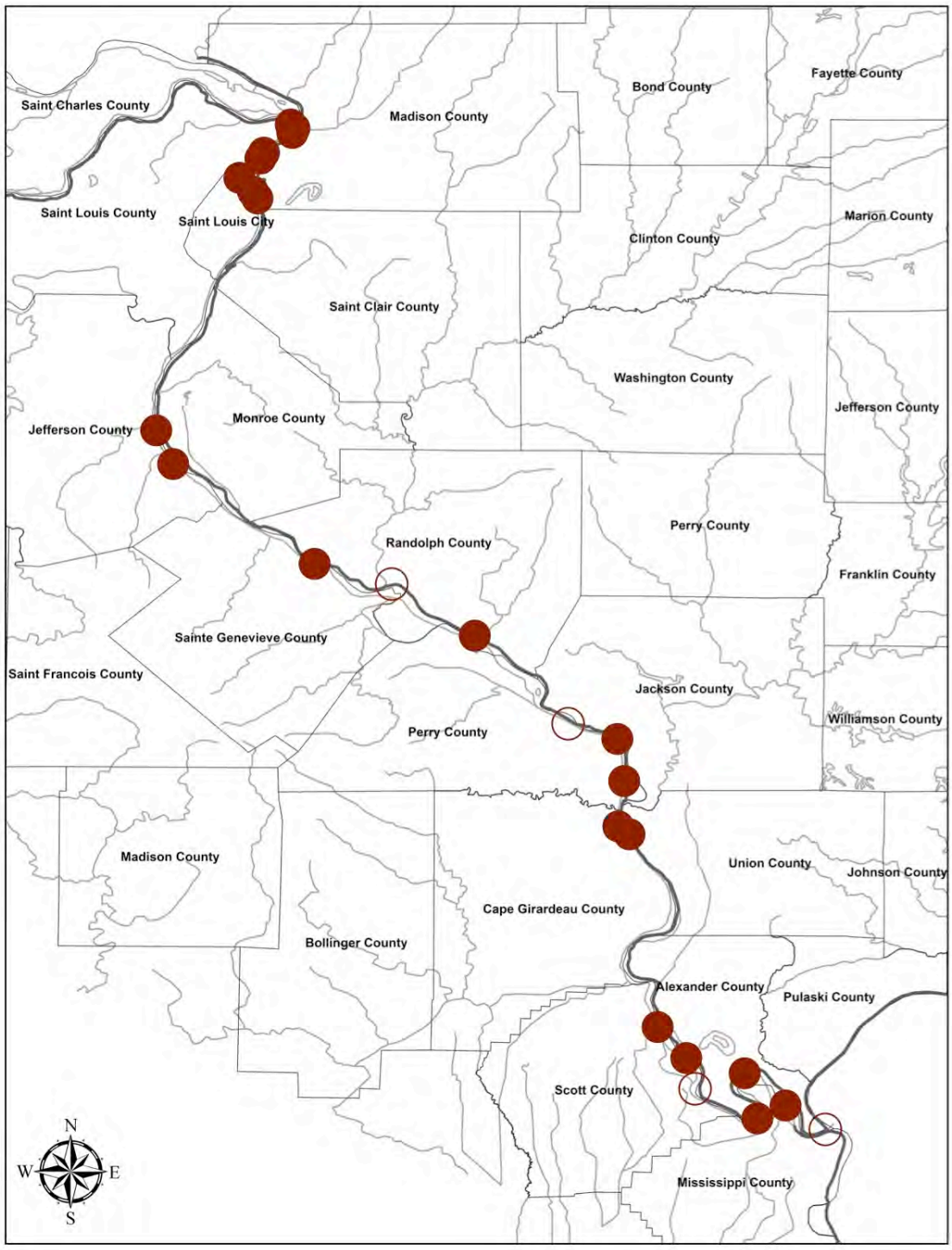
Truncilla truncata Rafinesque, 1820 – Deertoe – was found as fresh-dead at 3 sites and relict at 2 sites during the 2012-2013 survey. However, ESI found it alive in 2012 near the confluence with the Missouri River. The species is generally distributed throughout Illinois in medium to large rivers in mud, sand, or gravel (Cummings and Mayer 1992; Cummings and Mayer 1997; Tiemann et al. 2007).



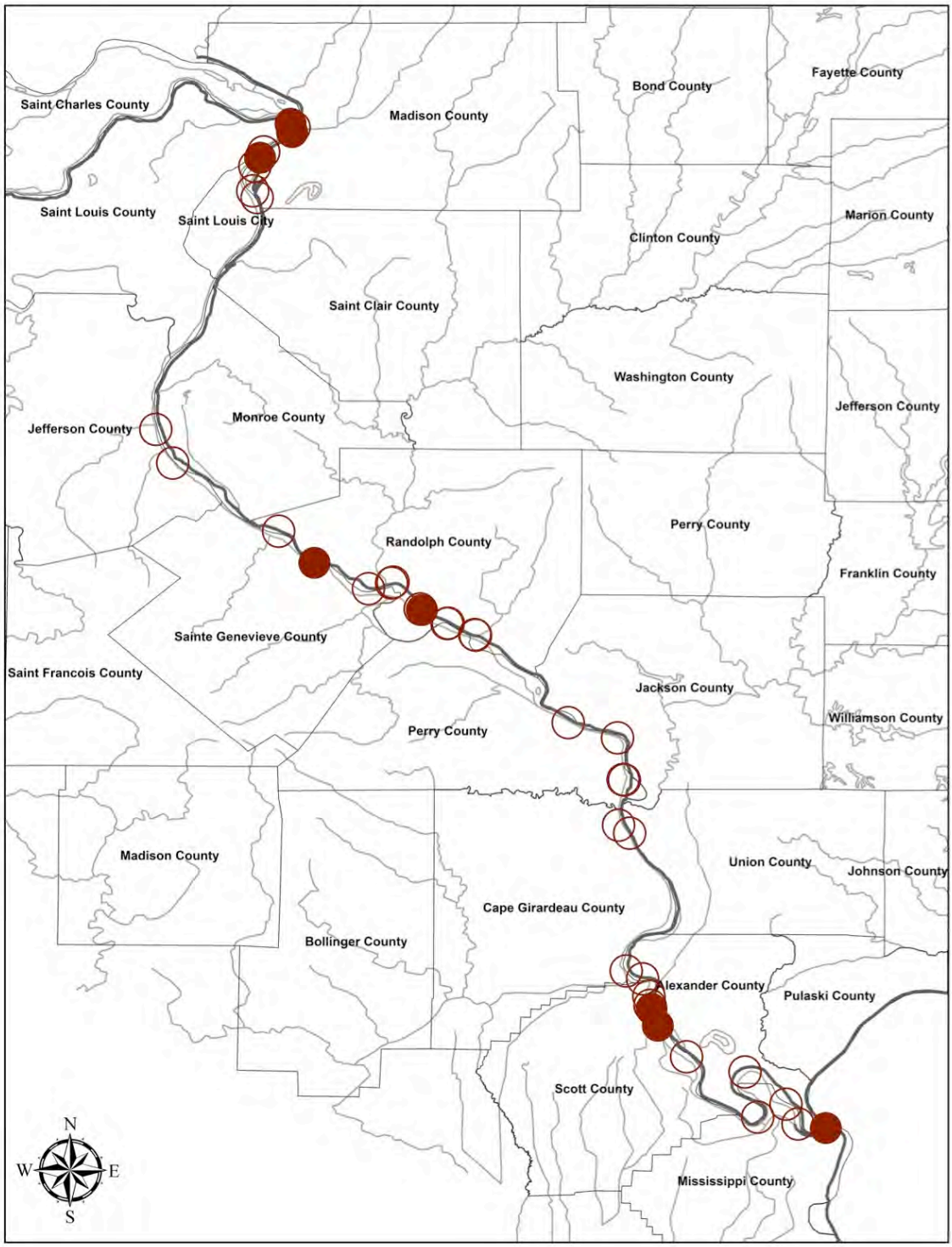
Corbicula fluminea (Müller, 1774) – Asian Clam I – was found at 27 sites (live at 4 sites, fresh-dead at 16 sites, and relict at 7 sites) during the 2012-2013 survey. The species is generally distributed throughout Illinois in lakes and streams of all sizes in silt, mud, sand, or gravel (Cummings and Mayer 1992).



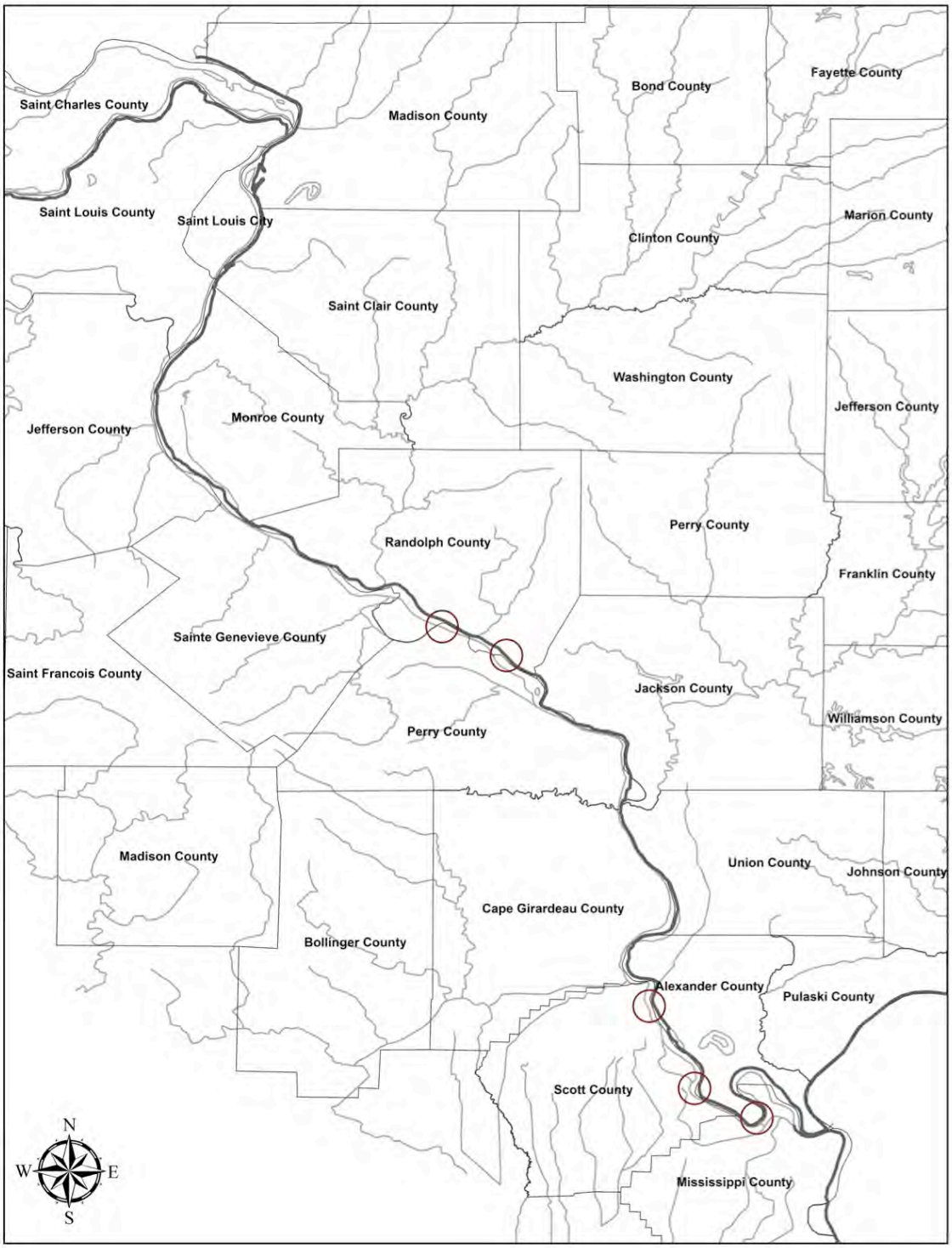
Corbicula largillierti (Philippi, 1844) – "purple" Asian Clam I – was found at 25 sites (live at 2 sites, fresh-dead at 21 sites, and relict at 2 sites) during the 2012-2013 survey. Not much is known of this potential undocumented species, which is more compressed, has finer, tighter ridges, and has a purple nacre. Within Illinois, this species has been found in the Ohio, Mississippi, and Illinois rivers (INHS Mollusk Collection database, Champaign). It syntopically occurs with *C. fluminea* in the navigable rivers in silt, mud, sand, or gravel.



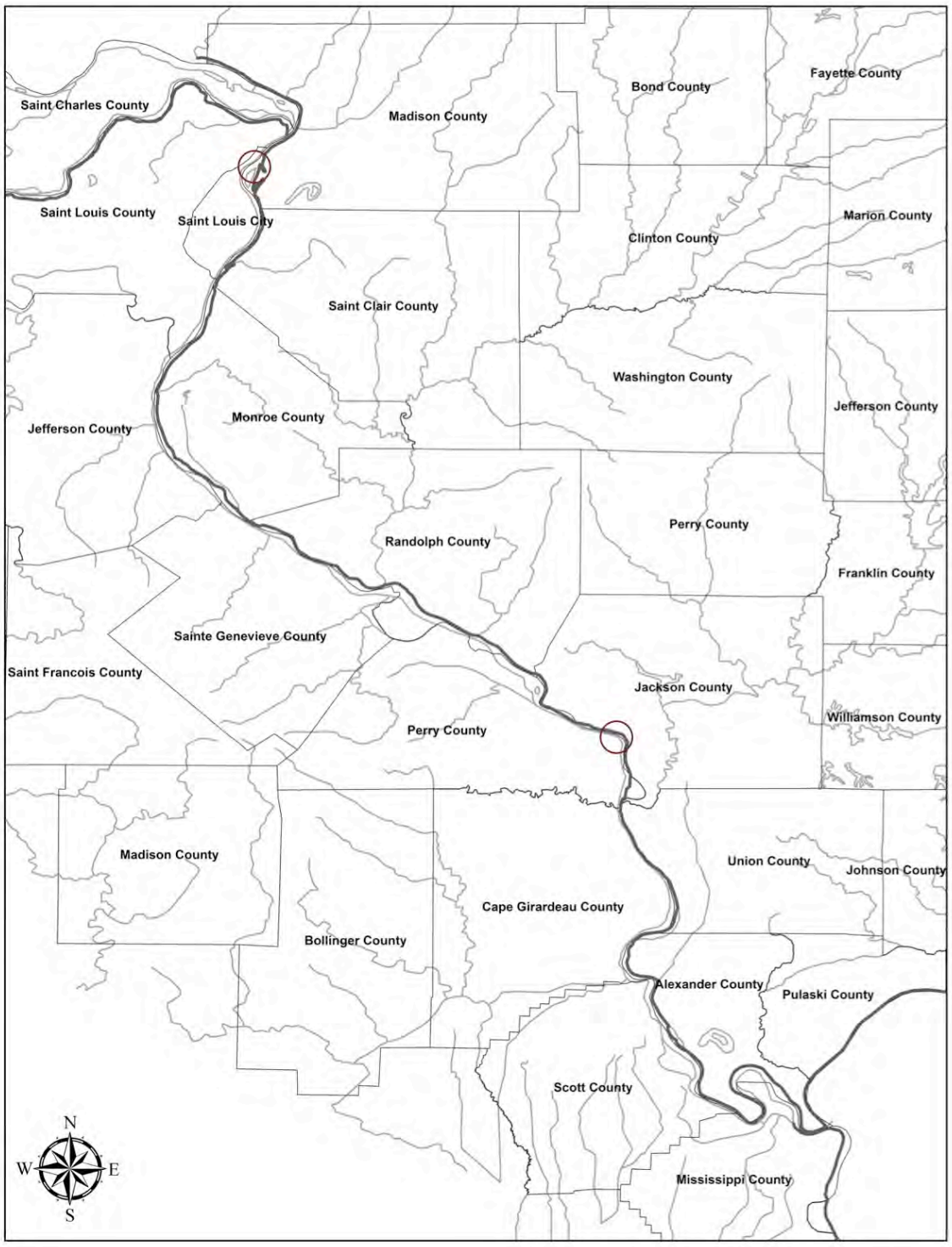
Dreissena polymorpha (Pallas, 1771) – Zebra Mussel I – was found at 28 sites (live at 4 sites, fresh-dead at 4 sites, and relict at 20 sites) during the 2012-2013 survey. The species is generally distributed throughout Illinois in lakes and streams of all sizes; attaches to rocks, freshwater mussels, or almost any hard surface (Cummings and Mayer 1992). We did not notice any Qugga Mussels *Dreissena rostriformis bugensis* during our survey or in museums.



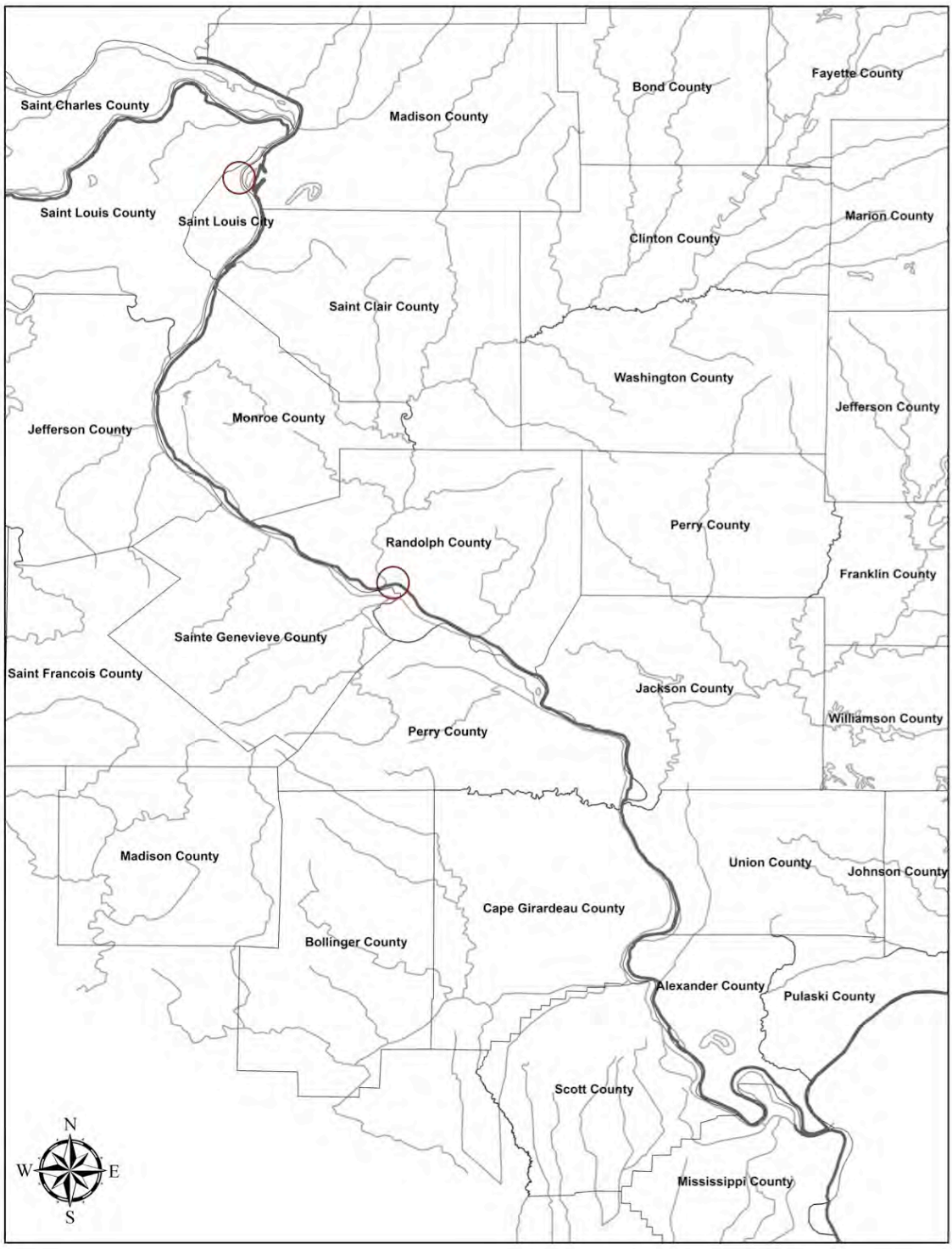
Rangia cuneata (Sowerby, 1832) – Atlantic Rangia or Gulf Wedge Clam – was found only as relict at 2 sites during the 2012-2013 survey. This clam is a brackish species that inhabits low salinity estuarine habitats (Parker 1966). There are several potential reasons for this unusual find, including remnants of a historical population, archeological specimens (e.g., trade at Cahokia), or barge fill.



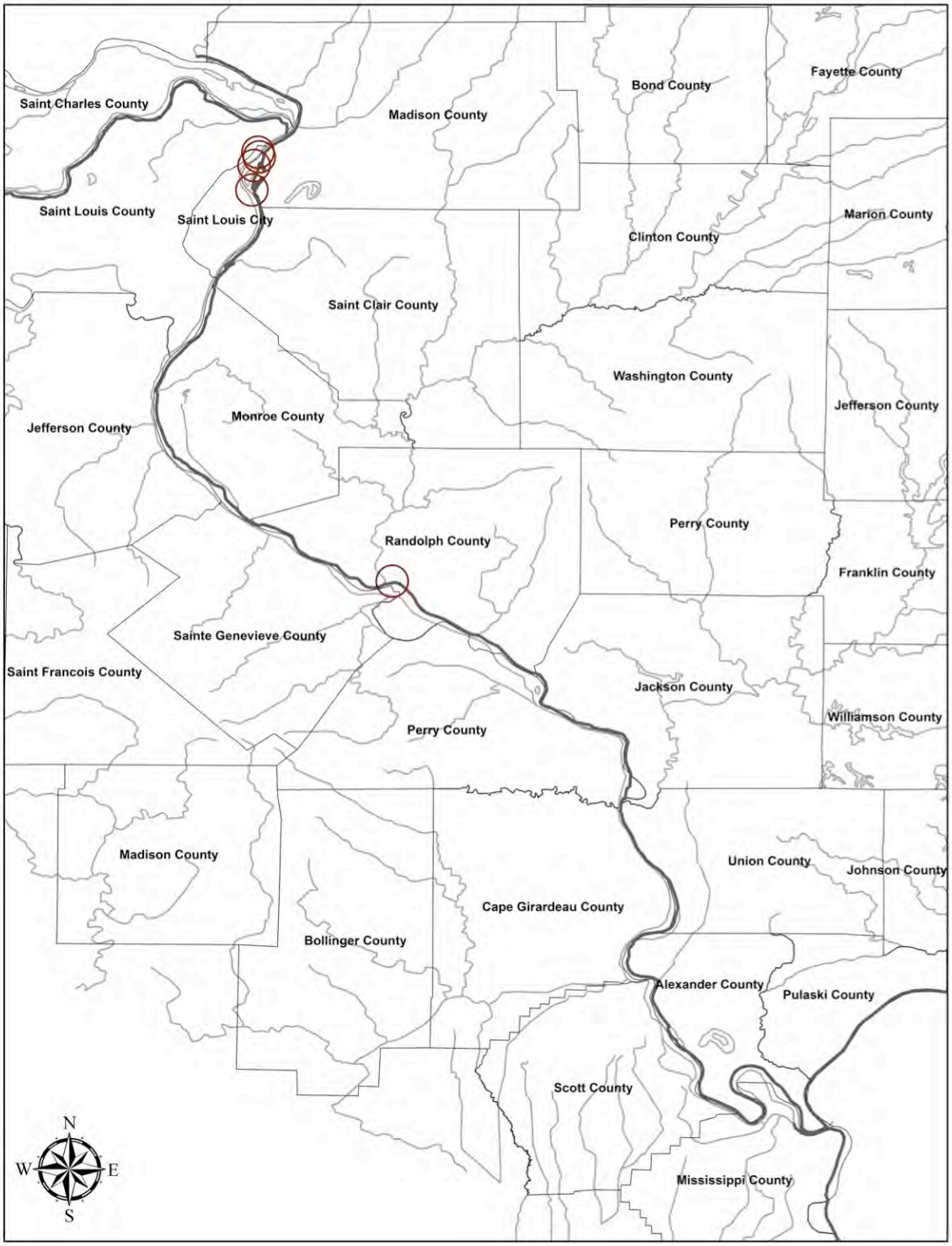
Campeloma decisum (Say, 1816) – Pointed Campeloma – was found only as relict at 1 site during the 2012-2013 survey. The species is generally distributed throughout Illinois, and can be found in lakes and streams of all sizes in silt, mud, and sand (Baker 1906; Wu et al. 1997).



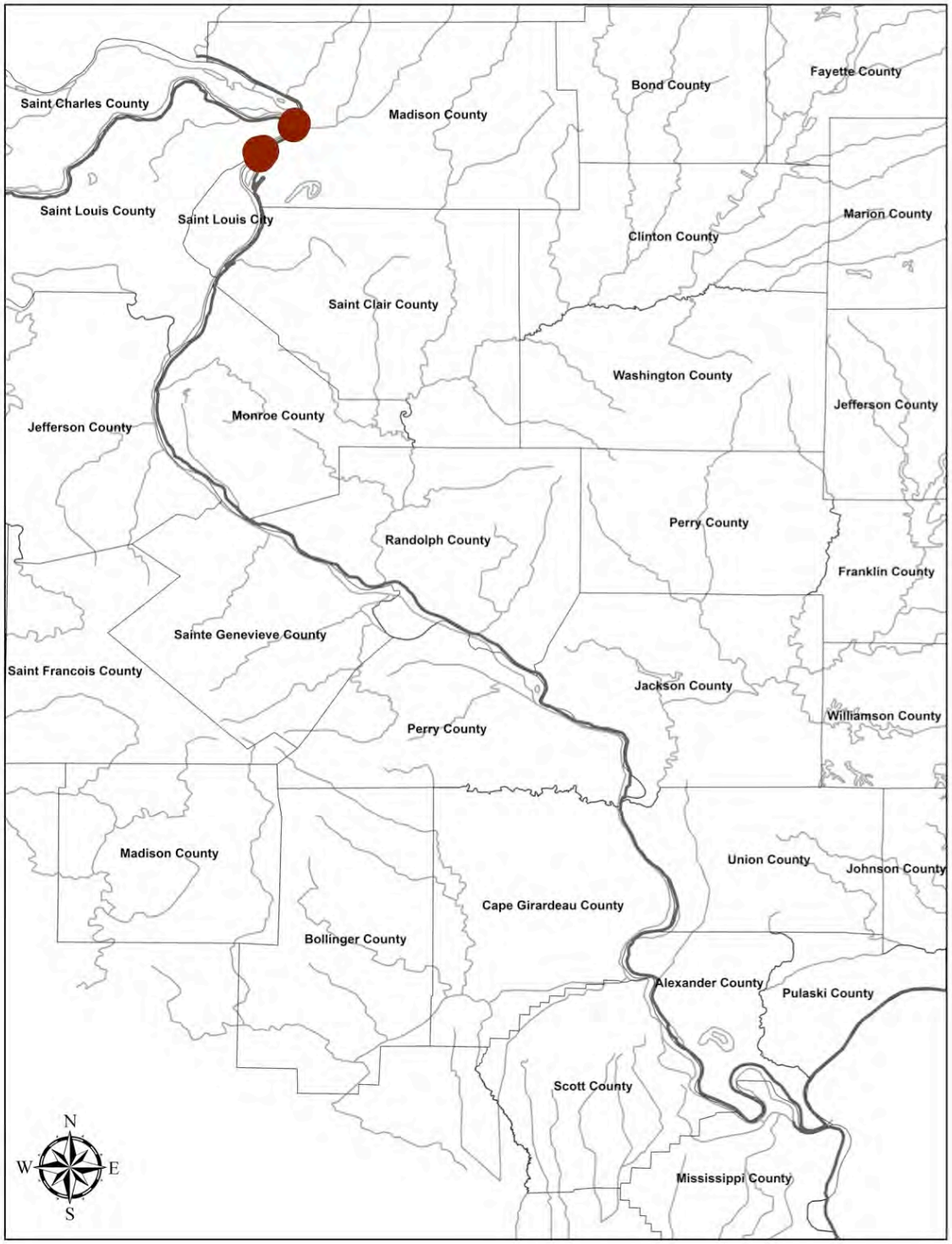
Lioplax sulculosa (Menke, 1827) – Furrowed Lioplax – was found only as relict at 1 site during the 2012-2013 survey. The species is generally distributed throughout Illinois, and can be found in silt, mud, or sand of larger streams (Baker 1906; Wu et al. 1997).



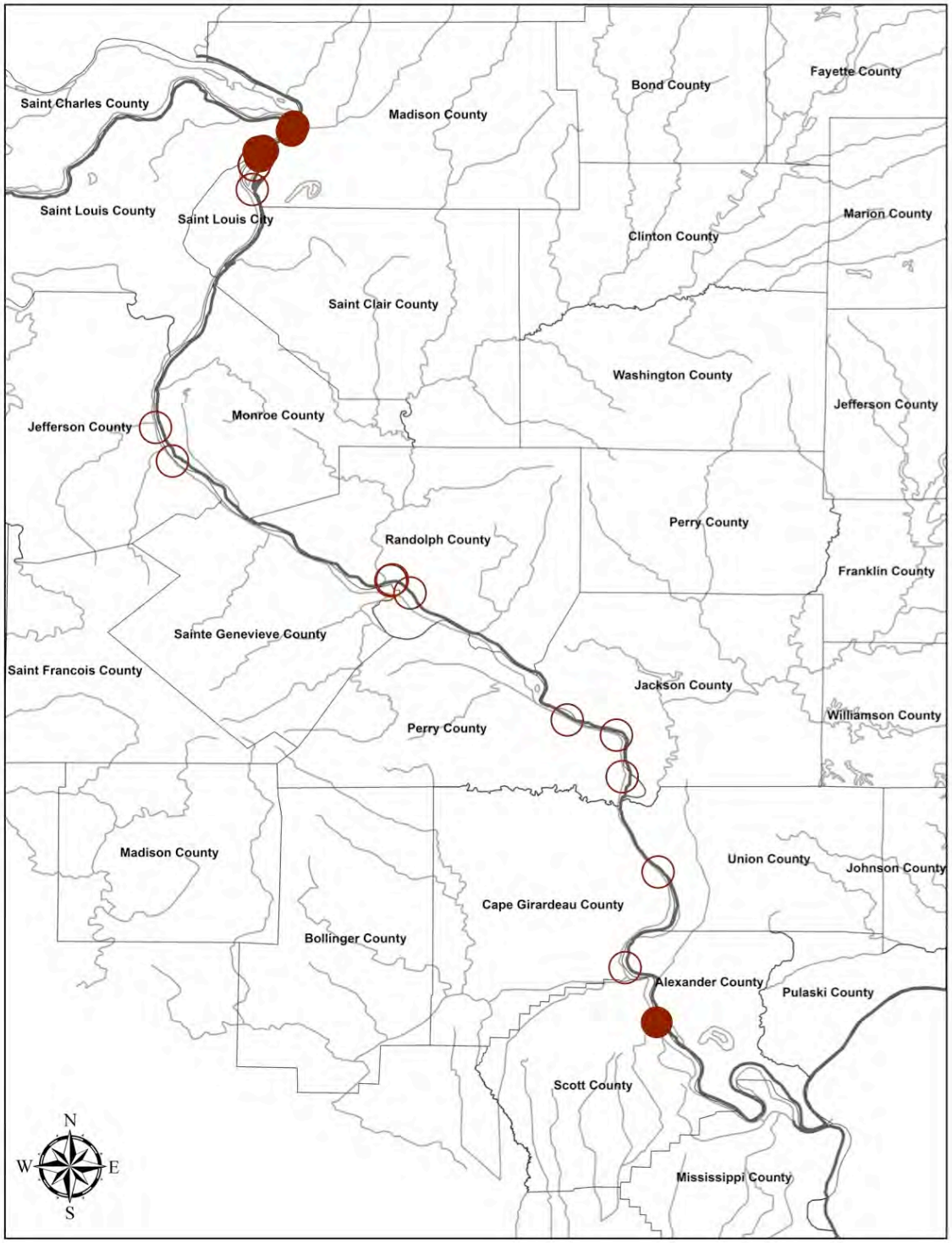
Viviparus georgianus (Lea, 1834) – Banded Mysteryshell – was found only as relict at 3 sites during the 2012-2013 survey. The species is generally distributed throughout Illinois, and can be found in lakes and streams of all sizes in silt, mud, or sand (Baker 1906; Wu et al. 1997).



Lithasia armigera (Say, 1821) – Armored Rocksnail – was found alive at 5 sites during the 2012-2013 survey. An Ohio River basin species, was thought to only be found in the silted sand and gravel of the Wabash and Ohio rivers in Illinois until a population was discovered in the Mississippi River in the St. Louis metroplex (see Chapter 2 of this report).



Pleurocera acuta Rafinesque, 1831 – Sharp Hornsnail – was found at 12 sites (live at 5 sites, fresh-dead at 1 site, and relict at 6 sites) during the 2012-2013 survey. The species is generally distributed throughout Illinois, and can be found in lakes and streams of all sizes in silt, mud, sand, or gravel (Baker 1906; Wu et al. 1997).



CHAPTER 2

First Occurrences of *Lithasia armigera* and *Lithasia verrucosa* (Gastropoda: Pleuroceridae) in the Mississippi River

While conducting the freshwater mussel surveys in the Middle Mississippi River, an undocumented population of Armored Rocksnail (*Lithasia armigera*) was encountered. The snail was historically known from the Cumberland, Ohio, and Tennessee river drainages of eastern North America, but was never documented in the Mississippi River mainstem. I published these data in the Southeastern Naturalist, and the PDF reprint is included in this report with permission from Keith Goldfarb on 7 January 2014. Any distribution or reproduction in part or entirely other than for personal research purposes is prohibited without prior approval of the publisher, the Eagle Hill Institute.

Citation – Tiemann, J.S., W.R. Posey, K.S. Cummings, K.J. Irwin, and B. Turner. 2013. First Occurrences of *Lithasia armigera* and *Lithasia verrucosa* (Gastropoda: Pleuroceridae) in the Mississippi River. Southeastern Naturalist 12(4):N35-N39.

Notes of the *Southeastern Naturalist*, Issue 12/4, 2013

First Occurrences of *Lithasia armigera* and *Lithasia verrucosa* (Gastropoda: Pleuroceridae) in the Mississippi River

Jeremy S. Tiemann[1,*], William R. Posey[2], Kevin S. Cummings[3], Kelly J. Irwin[4], and Bryan Turner[5]

Abstract - *Lithasia armigera* (Armored Rocksnail) historically occurred in the Cumberland, Ohio, and Tennessee river drainages of eastern North America, whereas *Lithasia verrucosa* (Verrucose Rocksnail) is known from the Ohio, Tennessee, and Black river drainages. Prior to our 24–27 September 2012 surveys, neither species had been recorded from the Mississippi River. We discovered Armored Rocksnail near the Mississippi River–Missouri River confluence in the St. Louis metropolitan area, and both Armored Rocksnail and Verrucose Rocksnail 5 linear miles east-northeast of Osceola, AR.

Freshwater snails are an understudied group, and basic information on species distribution is not well documented (Brown et al. 2008, Lynse et al. 2008). In addition, some aquatic gastropods are microhabitat specialists with highly patchy distributions, and populations are scattered among the mosaic of microhabitats created by flow regimes and sediment types (Strong et al. 2008). We began investigating the status of gastropods in Illinois and Arkansas by conducting literature reviews, examining museum collections, and qualitatively collecting snails throughout both states. We conducted independent freshwater mollusk surveys in the Mississippi River on 24–27 September 2012. The historically low water levels in the middle and lower sections the Mississippi River (e.g., between its confluences with the Missouri and Ohio rivers, and downstream of its confluence with the Ohio River, respectively) allowed us to search for aquatic mollusks in many areas of the river that were previously inaccessible. The results of our surveys yielded two rocksnail species (Gastropoda: Pleuroceridae) that had not been previously documented in the Mississippi River mainstem: *Lithasia armigera* (Say) (Armored Rocksnail) and *Lithasia verrucosa* (Rafinesque) (Verrucose Rocksnail). We deposited specimens collected as part of the surveys in the Illinois Natural History Survey (INHS) Mollusk Collection, Champaign, IL.

Armored Rocksnail is historically known from the Cumberland, Ohio, and Tennessee river drainages of eastern North America (Burch 1989, Goodrich 1940, Minton et al. 2005). Specifically, the snail has been recorded from the Ohio River; lower Wabash River; Cumberland River upstream of Burnside, Pulaski County, KY, to streams in Trigg County, KY; and the Tennessee River in the vicinity of Florence, Lauderdale County, AL (Fig. 1). Armored Rocksnail is typically found in sandy gravel areas, on cobble rip-rap, or on woody debris (authors' pers. observ.). Johnson et al. (2013) recently assessed the conservation status of North American freshwater snails and ranked Armored Rocksnail as vulnerable (a species that is imminently likely to become threatened throughout all or a significant portion of its range). We here report Armored Rocksnail at two locations in the Mississippi River: 1) near its confluence with the Missouri River in the St. Louis metropolitan area, and 2) near Osceola, AR. The Illinois population was found on rip-rap throughout a five-mile stretch of the Mississippi River in Madison County, from river mile 195, across from its confluence with the Missouri River at Lewis and Clark State Memorial Park, 1 linear mile

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upstream of the Chain of Rocks Canal entrance (38.80529°N, 90.11574°W; INHS #43832), to river mile 189.5, the first wing-dam downstream of the Chain of Rocks dam (38.74756°N, 90.17827°W; INHS #43861) by J.S. Tiemann, K.S. Cummings, and B. Turner. Snail densities were <5 individuals/m^2, except for on the boulders in Chain of Rocks dam at river mile 190.3 (38.75596°N, 90.17205°W; INHS #43859), where density was about 100 individuals/m^2. We failed to find Armored Rocksnail at 27 sites in the Mississippi River between river mile 184.5, at the end of Gabaret Island, Madison County (38.68976°N, 90.19269°W) to the river's confluence with the Ohio River at Fort Defiance State Park near Cairo, Alexander County (36.98308°N, 89.13912°W). We also failed to find the snail upstream of river mile 195 to Lock and Dam 26 (38.86582°N, 90.14231°W). The Arkansas population of Armored Rocksnail was found in the Mississippi River at river mile 791, along Kate Aubrey Towhead, 5.5 linear miles east-northeast of Osceola, Mississippi County, AR (35.74404°N, 89.87894°W; INHS #43433) by W.R. Posey and K.J. Irwin. Unlike the Illinois specimens, the Arkansas specimens were all empty shells found on a gravel bar in concentrated, wave-swept piles along the water's edge. The nearest documented population of Armored Rocksnail to the newly discovered Illinois and Arkansas sites occurs in the Ohio River at river mile 974, Mound City, Pulaski County, IL (37.07804°N, 89.16529°W; INHS #32727; Tieman et al. 2011), which is a distance of 197 river miles from the Illinois population near St. Louis, and 169 river miles from the Arkansas population (noting that the Mississippi River's mile markers change at its confluence with the Ohio River).

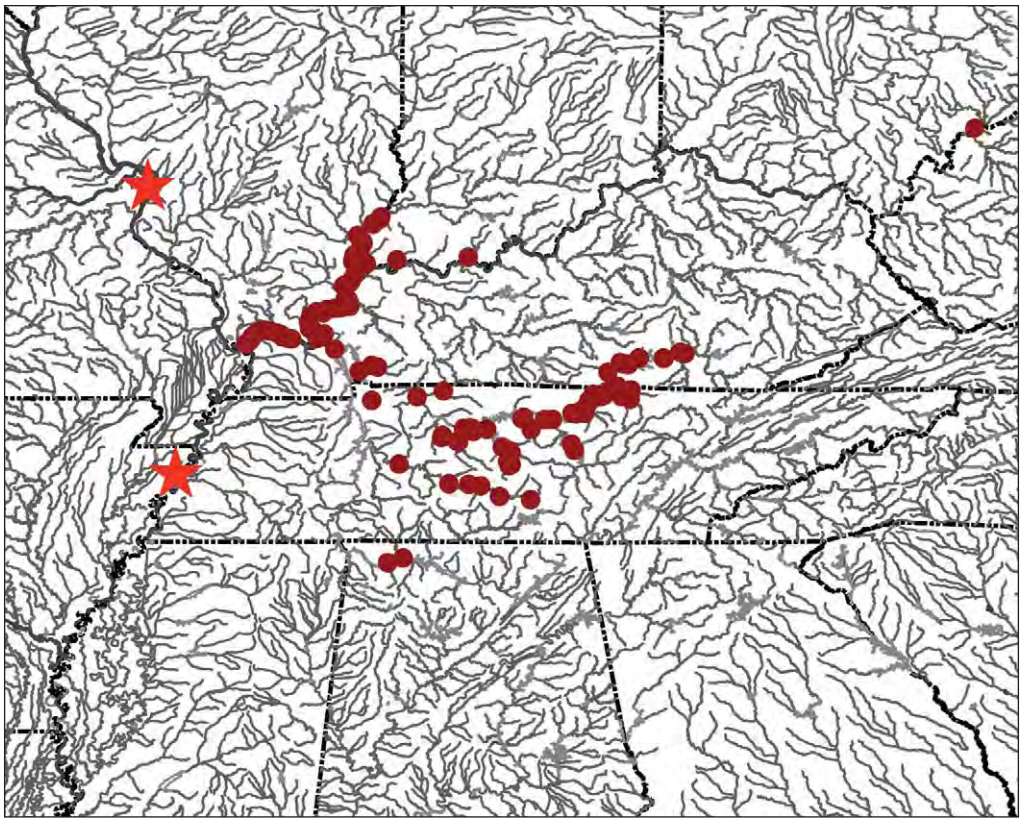

Figure 1. Distribution map of *Lithasia armigera*. Two new locations on Mississippi River are indicated with a star.

Verrucose Rocksnail is historically known from the Ohio, Tennessee, and Black river drainages of North America (Burch 1989, Goodrich 1940, Minton and Lydeard 2003). Specifically, the snail has been recorded from the Ohio River; lower Wabash River; Tennessee River from eastern Tennessee to Marshall County, KY; and Black and Spring rivers, AK (Fig. 2). As with the Armored Rocksnail, the Verrucose Rocksnail is typically found in sandy gravel areas, on cobble rip-rap, or on woody debris (authors' pers. observ.). Johnson et al. (2013) ranked Verrucose Rocksnail as currently stable (species populations not currently at risk). Empty shells of Verrucose Rocksnail were found with Armored Rocksnail in concentrated, wave-swept piles along the water's edge of a gravel bar in the Mississippi River at river mile 791, along Kate Aubrey Towhead, 5.5 linear miles east-northeast of Osceola, Mississippi County, AR (35.74404°N, 89.87894°W; INHS #43434) by W.R. Posey and K.J. Irwin. Although the Black River population is closer in terms of linear distance (approximately 70 miles), in terms of river miles, the nearest documented population of Verrucose Rocksnail occurs in the Ohio River at Mound City (INHS #32728; Tiemann et al. 2011), which is a distance of 169 river miles. Minton and Lydeard (2003) suggested that Verrucose Rocksnails from the Black River drainage, in Arkansas, are genetically distinct from the lower Ohio River populations.

Neither Armored Rocksnail nor Verrucose Rocksnail had been documented in the Mississippi River mainstem prior to our survey (e.g., Baker 1906, 1928; Burch 1989; Dawley 1947; Goodrich 1939; Stewart 2006; Wu et al. 1997). It is beyond the scope of our study

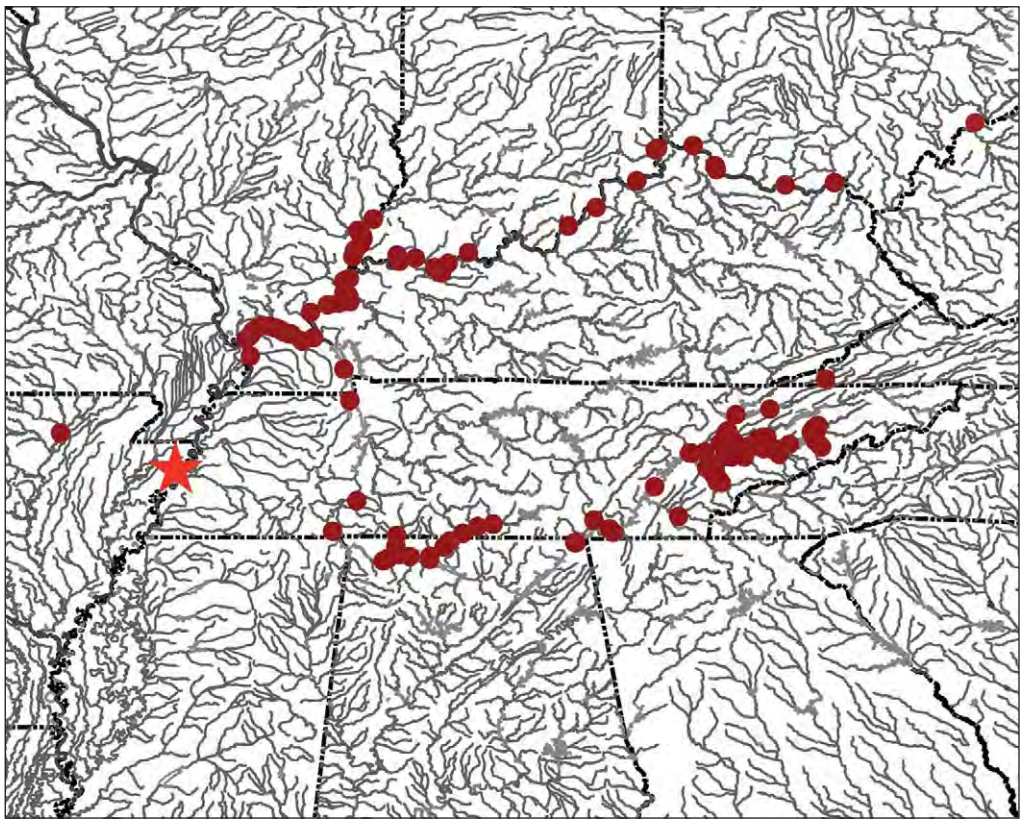

Figure 2. Distribution map of *Lithasia verrucosa*. New location on the Mississippi River is indicated with star.

to determine if these populations are native or introduced. Given the distance to the next known population, these Mississippi River populations could represent unique genetic stocks. Future studies could utilize other methods (e.g., trawling or diving) to assess the snail populations in the middle and lower Mississippi River, and examine genetics to determine the origin of the populations (e.g., Hayes et al. 2007).

Acknowledgments. Funds were provided in part by a grant from the Illinois Department of Natural Resources' Wildlife Preservation Fund (#13-031W) and the Illinois Department of Transportation, Springfield, IL. B. Dabney, H. Dunn, S.M. Jaworski, B. Lubinski, J.E. Petzing, and D. Shasteen assisted in collecting Illinois specimens, and J. Harris assisted in collecting Arkansas specimens. J.L. Sherwood assisted in map creation. A.J. Baldinger, the Museum of Comparative Zoology, Cambridge, MA; P. Callomon, the Academy of Natural Sciences of Drexel University, Philadelphia, PA; D.Ó. Foighil, the University of Michigan Museum of Zoology, Ann Arbor, MI; J. Gerber, Field Museum of Natural History, Chicago, IL; T. Pearce, the Carnegie Museum of Natural History, Pittsburgh, PA; D. Roberts, Chicago Academy of Science, Chicago, IL; J. Slapcinsky, the University of Florida Museum of Natural History, Gainesville, FL; and G.T. Watters, the Ohio State University Museum of Zoology, Columbus, OH, generously provided access to specimens under their care. P. Morrison and J. Clayton provided Ohio River specimens. B. Tiemann offered constructive criticism.

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