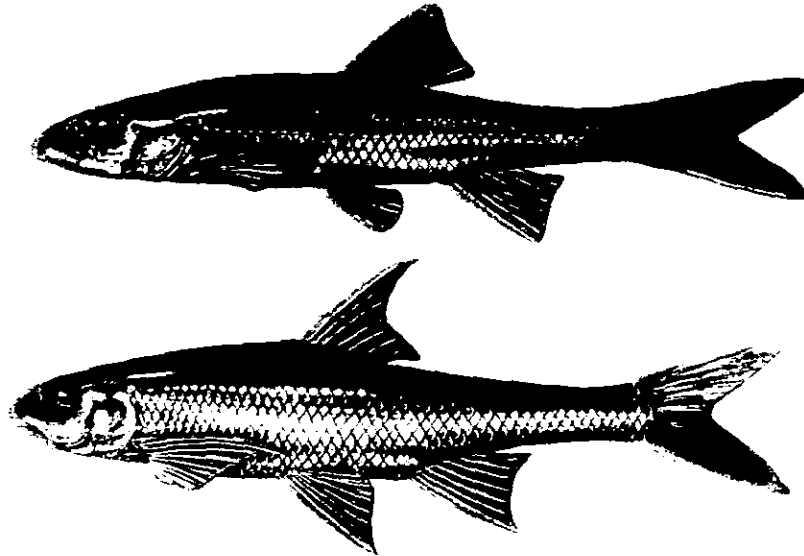


Final Report

Status survey of the sturgeon chub, Macrhybopsis gelida, and the sicklefin chub, M. meeki, in the middle Mississippi River, Illinois



Submitted to:

Division of Natural Heritage  
Illinois Department of Natural Resources  
524 South Second Street  
Springfield, IL 62701-1787

By  
Kyle R. Piller, David J. Eisenhour, and Brooks M. Burr  
Department of Zoology  
Southern Illinois University at Carbondale  
Carbondale, IL 62901-6501

31 July 1996

## INTRODUCTION

The sturgeon chub, Macrhybopsis gelida, and the sicklefin chub, Macrhybopsis meeki, are two small cyprinids that inhabit main channels of large turbid rivers in the Midwest. These species have limited ranges and are presently known from 13 and 14 states, respectively. They are known only from the Missouri River and the lower reaches of a few major tributaries and from the lower Mississippi River. In Illinois, M. gelida and M. meeki are known only from the Mississippi River mainstem below the mouth of the Missouri River (Smith 1979). Both seem to be fairly common in the lower Missouri River mainstem (Pflieger 1975, Pflieger and Grace 1987), but are very rare in the lower Mississippi River (Robison and Buchanan 1988, Etnier and Starnes 1993).

Macrhybopsis gelida, one of the rarest fishes in Illinois, is known from very few specimens (Smith 1979). The species has been reported from Alexander, Union, Randolph, Monroe, and Jackson counties in Illinois (O'Donnell 1935, Smith 1979, Werdon 1993a). The majority of specimens have been collected at Grand Tower, Jackson County, Illinois (Burr et al. 1996a).

Macrhybopsis meeki was first reported in Illinois by Forbes and Richardson (1908) as Platygobio gracilis, but the photograph is M. meeki. In Illinois, M. meeki has been reported to be more common than M. gelida, but still rare (Smith 1979). The majority of Illinois records of M. meeki also are from Grand Tower in Jackson County, with additional records from Monroe, Alexander, and Randolph counties (Smith 1979, Werdon 1993b).

The fish community of the lower Missouri River has undergone a marked change in the last 30-50 years (Pflieger and Grace 1987, Hesse et al. 1993, Cross and Collins 1995). Both M. gelida and M. meeki have experienced declines in relative abundance and distribution in many states (Reigh and Elsen 1979, Rowe 1992, Hesse et al. 1993, Werdon 1993a,b). In addition, other native species specialized for large, turbid rivers, including the federally endangered pallid sturgeon (Scaphirhynchus albus), flathead chub (P. gracilis), and silvery minnows (Hybognathus spp.) have greatly declined in abundance in large rivers of the Midwest (Cross 1967, Cross and Moss 1987, Pflieger and Grace 1987, Hesse et al. 1993, Cross and Collins 1995). Changes in

turbidity, hydrology, and substrate resulting from upstream impoundments, and modifications of the Missouri River for navigation and flood control have been implicated as the primary factors affecting the decline of these species (Hesse et al. 1993, Pflieger and Grace 1987).

Macrhybopsis gelida and M. meeki are candidates for federal protection by the United States Fish and Wildlife Service (Werdon 1993a,b) and have been given Category 1 status (United States Fish and Wildlife Service 1994). Macrhybopsis gelida is state endangered in Illinois (Illinois Endangered Species Protection Board 1994) and M. meeki is on the Illinois state watch list, but receives no protection at federal or state levels (Burr 1991). Because fishes are excellent indicators of environmental quality, documentation of long term shifts in composition or abundance can provide baseline information on the quality of aquatic ecosystems. Habitat requirements and abundance data from both of these unique species may also provide information about the quality of the Mississippi River ecosystem. This study was undertaken to determine the present distribution and abundance of M. gelida and M. meeki in Illinois, to document the historical changes in distribution and abundance, to recognize critical habitat that should be protected to help maintain viable populations, to recommend any additional work that should be completed to aid in the restoration of adequate population numbers, and to assist appropriate agencies in making informed management decisions regarding the conservation of Illinois populations of these species.

## METHODS

Institutional abbreviations follow Leviton et al. (1985). Stream distances are given as river miles (RM). Four museum collections (INHS, KU, SIUC, UMMZ) were accessed to compile a list of known historical localities of M. gelida and M. meeki from the middle Mississippi River, herein defined from the mouth of the Ohio River in Alexander Co., IL (RM 0) to the mouth of the Illinois River in Madison Co., IL (RM 218) (Appendix I). During this survey, 18 total collections were made at 11 sites from 29 September 1995 to 18 July 1996, and included both historical and new localities with potential suitable habitat (Fig. 1, Appendix II). When habitat alteration (e.g., channelization, wing dike construction) prevented sampling at some historical sites, samples were made as close to historical localities as possible. Collections were made in different seasons (Fall,

Spring, Summer) and river levels. Two collections (Grand Tower, Jackson Co., IL, 1 May 1996, 18 July 1996) were made at night. Fifteen additional sites were reconnoitered but not sampled because they were judged to lack habitat suitable for the species (Appendix III). Sites were sampled with a 3.6 X 1.8 m (0.32 mm mesh) seine or a 6 X 1.8 m (0.95 mm mesh) bag seine using downstream hauls (Jenkins and Burkhead 1994).

## RESULTS AND DISCUSSION

**Historical Distribution and Abundance.**--We located 18 historical collections representing six localities of M. gelida and 37 historical collections of M. meeki representing 13 localities (Appendix I) from the middle Mississippi River. The most upstream locality for M. gelida was just above the mouth of the Missouri River, RM 195, St. Charles County, MO, and for M. meeki, 3.5 mi. N Alton, RM 206.5, Madison Co., IL. Both species have a historical range as far downstream in Illinois as 1 mi. S Cairo, RM 0.5, Alexander Co., IL (Figs. 2-3).

Examination of historical collections reveal that M. gelida was always uncommon in the middle Mississippi River, however, recent collections (1978-1995) indicate the species has decreased in distribution and abundance. Although M. gelida was known from six localities from 1936-1963, recent collections (1978-1995) are only available for two geographically proximate localities in Jackson Co., IL. The average number of specimens per collection in that same time period decreased from 6.7 to 1.5.

Macrhybopsis meeki was more common than M. gelida in historical collections, although it also apparently has decreased in distribution and abundance. The range of M. meeki in the middle Mississippi River decreased from 13 known localities in 1906-1963 to four localities in 1978-1994 and the average number of specimens per collection in the same time period decreased from 9.2 to 7.6. Most (98.5%) of the recently collected specimens (1978-1994) are from Grand Tower and Grand Tower Island (Jackson Co., IL).

Neither species was present in any of the 18 collections made during this survey. However, the absence of specimens in the present survey does not necessarily indicate that these species are extirpated from Illinois. Both species were collected at Grand Tower in 1994-1995, just prior to

the present study. The number of specimens deposited in institutions from the middle Mississippi River has greatly varied over the past 90 years (Fig. 4). Although some of this fluctuation is a result of unequal sampling effort, the Mississippi River at Grand Tower (Jackson Co., IL) has been intensively sampled by B. M. Burr and students from the mid-1970s to the present. Both species were present in collections from the early 1980s and mid-1990s following floods, but absent during many intervening years.

**Habitat.**--Previous collections of M. gelida and M. meeki made at Grand Tower by the authors were in strong current at depths of 0.3-1.5 m over a substrate of firm, clean sand. In the western part of the range of M. gelida, the species is strongly associated with coarse substrates of rock and gravel, strong current, and shallow, turbid water (Bailey and Allum 1962, Cross 1967, Reigh and Elsen 1979, Stewart 1980, Rowe 1992, Cross and Collins 1995). In the Mississippi River and lower Missouri River, where gravel substrates are rare, M. gelida has been collected over firm sand (Pflieger 1975, Smith 1979, Klutho 1983, Etnier and Starnes 1993). Young-of-the-year (YOY) M. gelida have been reported to be associated with sand substrates (Reigh and Elsen 1979). Like M. gelida, M. meeki is found in strong currents in turbid water, but is more commonly found over substrates of sand with some gravel (Bailey and Allum 1962, Reigh and Elsen 1979, Smith 1979, Klutho 1983, Etnier and Starnes 1993).

These species were only collected in the lower Kansas River during high water or following floods (Metcalf 1966, Cross 1967, Cross and Collins 1995) and Klutho (1983) reported M. meeki significantly associated with high water in the Mississippi River at Grand Tower (Jackson Co., IL). Several historical collections in the middle Mississippi River note conditions of flooding at the time of collection (UMMZ 147042, 147043, 147049). Low water levels from September 1995 to April 1996 may have contributed to the lack of specimens captured during this survey.

**Life History.**--Specimens in historical collections of M. gelida from the middle Mississippi River are 11.8-44.2 mm SL ( Fig. 5). This species is reported to be mature at 76-81 mm SL and two years of age (Stewart 1981, Werdon 1992). This would make most of the specimens collected from the middle Mississippi River YOY with a few one-year-old subadults.

The most likely source of these YOY is local reproduction in Illinois, although a few individuals may represent waifs that have drifted down from the Missouri River. *Macrhybopsis gelida* has been reported to begin spawning in the Powder River in Montana in early June and continuing throughout the summer (Stewart 1980).

Specimens of *M. meeki* from historical collections from the middle Mississippi River appear to represent at least two age classes. A large group of small (11.7-38.0 mm SL) individuals likely represent YOY and one-year-old subadults and six larger individuals (61.2-72.0 mm SL) may represent adults (Fig. 5). The presence of large numbers of YOY, along with a few adults, indicates *M. meeki* likely has reproduced in Illinois. Reproductive habits are unknown, although Pflieger (1975) has implied a spring spawning season.

**Mississippi River Modifications.**--Early European explorers and settlers described the middle Mississippi River as a much wider river than it is today, with numerous side channels, islands, shifting sand or gravel bars, and rocks (Dobney 1975). Modifications to the middle Mississippi in the early 1800s were mainly by removal of snags and deforestation of the banks (supposedly eliminating potential snags). Later modifications to the river, beginning in the 1830s and continuing to the present, were undertaken in order to control flooding in addition to improvement of the river for navigation. These modifications included construction of wing dikes and levees, straightening of the channel, dredging, stabilization of the banks with rip-rap and mattress revetments, dynamiting of rocks, and construction of locks and dams above St. Louis (Dobney 1975). The result of these modifications was the elimination of shallow, wide areas and most islands and bars, leaving a narrow, deep, swift channel. Turbidity of the middle Mississippi River has been greatly decreased by the construction of upstream reservoirs in the Missouri River (Pflieger and Grace 1987) and a series of locks and dams in the upper Mississippi River.

The extensive modifications to the middle Mississippi River have left little remaining shoreline habitat for *M. gelida* and *M. meeki*. Wing dikes, present throughout the river, direct the current to the middle of the river eliminating flow along the shore. This results in silting in of sand and gravel bars, eliminating critical habitat for these species and other big-river chubs (Etnier and

Starnes 1993). Much of the rest of the shoreline areas of the river have been stabilized by rock rip-rap. Only two of the sites (Grand Tower, Jackson Co., IL and Grays Point, Scott Co., MO), examined in this survey had extensive shoreline areas of sand/gravel substrate with strong current. Other historical sites have been extremely modified by bank stabilization in the form of rip-rap (three sites), construction of wing dikes and channel diversions (seven sites), or impoundment from navigational locks and dams (two sites).

**Possible Sampling Bias.**--Extensive habitat may still be available in the central portion of the channel of the river, where there is strong current, but the deep water prevents sampling by standard collecting methods. Trawling, which has been a successful method for obtaining M. gelida and M. meeki in Montana (Anonymous 1995), might be used to sample deep water habitats in the middle Mississippi River. However, strong currents and numerous bottom obstructions (e.g., embedded logs), would make trawling in the Mississippi River difficult and dangerous.

It has been suggested that seining underestimates populations of M. gelida and M. meeki and should be replaced with trawling (Anonymous 1995). However, one of us (DJE) has had no difficulty in seining large number of individuals (30-100) of these species in good habitat in the lower Missouri River, where both species remain fairly common (Pflieger and Grace 1987). Historical collections were obtained by seining shoreline areas, and we believe our efforts are comparable, indicating that both species have declined in distribution and abundance.

Extant populations of M. gelida and M. meeki in the lower Missouri River (Pflieger and Grace 1987, Werdon 1993b) are a source for recolonization of the middle Mississippi River. Rapid colonization of the middle Mississippi River, particularly after floods, has been documented for Osmerus mordax, Morone americana, and other fishes (Burr et al. 1996b). A single M. meeki collected in the Mississippi River in Lake Co., TN (UT 44.5972) following a large flood event in 1993, perhaps demonstrates the ability of these cyprinids to move long distances with the assistance of floods. Restoration of historical habitat conditions may allow M. gelida and M. meeki to recolonize the middle Mississippi River.

## RECOMMENDATIONS

We recommend that the conservation status of M. gelida remain as endangered on the Illinois state endangered/threatened species list. Although M. meeki is presently more common than M. gelida in Illinois, the decline in the range and abundance of the species indicates some protection is necessary. We recommend that its conservation status be considered threatened on the Illinois state endangered/threatened species list.

Regular monitoring of these species, along with other big-river cyprinids that seem to be declining in the middle Mississippi River (H. argyritus, H. placitus, and P. gracilis), is necessary to document changes in the distribution and abundance of these species. Future surveys should focus on critical habitat (i.e., strong current over sand and gravel) at times of high water or immediately after flood events. Some areas of potentially suitable habitat were observed during this survey, but were not accessible by automobile. We recommend using boats to access islands or other inaccessible areas that have potentially suitable habitat. Management of these species in Illinois should focus on habitat preservation and restoration, rather than culture methods or stocking. In particular, areas that currently provide habitat critical for M. gelida and M. meeki in Illinois (e.g. Grand Tower) need to be protected from additional river modifications, including channelization, construction of wing dikes, and addition of rip-rap.

## SUMMARY

Eighteen historical collections of M. gelida and 37 historical collections of M. meeki were located from the middle Mississippi River. Examination of these collections indicate both M. gelida and M. meeki have declined in distribution and abundance since the early 1960s. These species were absent in all 18 collections conducted during this survey from the middle Mississippi River. An additional fifteen sites were reconnoitered that lacked suitable habitat. Based on previous collections of these species, critical habitat includes sand or gravel bars with strong current in large, turbid streams. The middle Mississippi River has been extremely modified for navigation and flood control and is presently almost entirely devoid of critical habitat for these



species. Although neither species was found in this survey, several recently collected specimens (1994-1995) indicate both species are likely extant, although extremely rare in Illinois. We recommend that M. gelida be considered endangered and M. meeki be considered threatened on the Illinois state endangered/threatened species list.

#### ACKNOWLEDGMENTS

Access to specimens and collection records was made possible by K. Cummings and C. Mayer (INHS), K. Shaw (KU), and D. Nelson (UMMZ). Thanks to B. Atwood (Illinois Department Natural Resources) for providing recent records of M. meeki. We gratefully acknowledge K. M. Cook, W. J. Poly, R. E. Weitzell, and the SIUC ichthyology class for assistance in the field.

The cover illustrations of M. gelida and M. meeki are images photocopied from Cross 1967.

## LITERATURE CITED

- Anonymous. 1995. Montana Chapter says two species may not be rare enough for ESA. Fisheries Action News. Winter 1995:7, *in* Fisheries (Bethesda) 20 (12).
- Bailey, R. M., and M. O. Allum. 1962. Fishes of South Dakota. Misc. Publ. Mus. Zool., Univ. Michigan. 119:1-131.
- Burr, B. M. 1991. The fishes of Illinois: overview of a dynamic fauna, pp 417-427 *in* Our living heritage: the biological resources of Illinois, L. M. Page and M. R. Jeffords (eds). Bull. Illinois Nat. Hist. Surv. 34.
- Burr, B. M., K. M. Cook, D. J. Eisenhour, K. R. Piller, W. J. Poly, R. W. Sauer, C. A. Taylor, E. R. Atwood, and G. L. Seegert. 1996a. Selected Illinois fishes in jeopardy: new records and status evaluations. Trans. Illinois State Acad. Sci. In press.
- Burr, B. M., D. J. Eisenhour, K. M. Cook, C. A. Taylor, G. L. Seegert, R. W. Sauer, and E. R. Atwood. 1996b. Nonnative fishes in Illinois waters: What do the records reveal? Trans. Illinois State Acad. Sci. 89:73-91.
- Cross, F. B. 1967. Handbook of fishes of Kansas. Mus. Nat. Hist., Univ. Kansas, Misc. Publ. 45:1-357.
- Cross, F. B., and J. T. Collins. 1995. Fishes in Kansas, 2nd ed. Univ. Kansas Nat. Hist. Mus. Public Education Series. 14:1-315.
- Cross, F. B., and R. E. Moss. 1987. Historic changes in fish communities and aquatic habitats in Plains streams of Kansas, pp 155-165 *in* Community and evolutionary ecology of North American stream fishes. W. J. Matthews and D. C. Heins (eds.) Univ. Oklahoma Press, Norman.
- Dobney, F. J. 1975. River engineers on the middle Mississippi: A history of the St. Louis District, U.S. Army Corps of Engineers. U.S. Government, Washington, D.C.
- Etnier, D. A., and W. C. Starnes. 1993. The fishes of Tennessee. Univ. Tennessee Press, Knoxville.
- Forbes, S. A., and R. E. Richardson. (1908). The fishes of Illinois. Illinois State Laboratory of Natural History.
- Hesse, L. W., G. E. Mestl, and J. W. Robinson. 1993. Status of selected fishes in the Missouri River in Nebraska with recommendations for their recovery, pp 327-340 *in* Proceedings of the Symposium on Restoration planning for the rivers of the Mississippi River ecosystem. L. W. Hesse, C. B. Stalnaker, N. G. Benson, and J. R. Zuboy (eds). Natl. Biol. Surv. Rept. 19.
- Illinois Endangered Species Protection Board. 1994. Checklist of endangered and threatened animals and plants in Illinois. Illinois Dept. of Conservation, Springfield.
- Jenkins, R. E., and N. M. Burkhead. 1994. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland.

- Klutho, M. A. 1983. Seasonal, daily, and spatial variation of shoreline fishes in the Mississippi River at Grand Tower, Illinois. M.S. Thesis, Southern Illinois Univ., Carbondale.
- Leviton, A. E., R. H. Gibbs, Jr., E. Heal, and C. E. Dawson. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia* 1985:802-832.
- Metcalf, A. L. 1966. Fishes of the Kansas River system in relation to zoogeography of the Great Plains. *Univ. Kansas Publ. Mus. Nat. Hist.* 17:23-189.
- O'Donnell, D. J. 1935. Annotated list of the fishes of Illinois. *Illinois Nat. Hist. Surv., Bull.* 20(5): 473-500.
- Pflieger, W. L. 1975. The fishes of Missouri. Missouri Dept. Conservation.
- Pflieger, W. L., and T. B. Grace. 1987. Changes in the fish fauna of the lower Missouri River, 1940-1983, pp 166-177 in *Community and evolutionary ecology of North American stream fishes*. W. J. Matthews and D. C. Heins (eds). Univ. Oklahoma Press, Norman.
- Reigh, R. C., and D. S. Elsen. 1979. Status of the sturgeon chub (*Hybopsis gelida*) and sicklefin chub (*Hybopsis meeki*) in North Dakota. *Prairie Nat.* 11:49-52.
- Robison, H. W., and T. M. Buchanan. 1988. Fishes of Arkansas. Univ. of Arkansas Press, Fayetteville.
- Rowe, J. W. 1992. The sturgeon chub and the brook silverside in the Platte River of Nebraska. *Prairie Nat.* 24:281-282.
- Smith, P. W. 1979. The fishes of Illinois. Univ. Illinois Press, Urbana.
- Stewart, D. D. 1980. A preliminary study of the biology of the sturgeon chub (*Hybopsis gelida*) in the Powder River in Wyoming. *Amer. Fish. Soc.: Colorado Chapter Proc. of Annual Meeting* 15:38-41.
- Stewart, D. D. 1981. The biology of the sturgeon chub (*Hybopsis gelida* Girard) in Wyoming. M.S. Thesis, The Univ. of Wyoming, Laramie.
- United States Fish and Wildlife Service. 1994. Endangered and threatened wildlife and plants; animal candidate review for listing as endangered or threatened species; proposed rule. *Federal Register.* 59(219): 58982-59028.
- Werdon, S. J. 1992. Population status and characteristics of *Macrhybopsis gelida*, *Platygobio gracilis* and *Rhinichthys cataractae*. M.S. thesis, South Dakota State Univ., Brookings.
- Werdon, S. J. 1993a. Status report on sturgeon chub (*Macrhybopsis gelida*), a candidate endangered or threatened species. U. S. Fish and Wildlife Service, Fish and Wildlife Enhancement, North Dakota State Office, Bismark.
- Werdon, S. J. 1993b. Status report on sicklefin chub (*Macrhybopsis meeki*), a candidate endangered species. U. S. Fish and Wildlife Service, Fish and Wildlife Enhancement, North Dakota State Office, Bismark.

Appendix I. Historical collections of Macrhybopsis gelida and Macrhybopsis meeki in the middle Mississippi River. Collections are listed in alphabetical order by state then county.

Macrhybopsis gelida

Illinois. Alexander County: Mississippi River at Cairo, UMMZ 147043 (2) 18 May 1944. Jackson County: Mississippi River at Grand Tower, UMMZ 105473 (1) 24 August 1938, INHS 26960 (1) 8 April 1978, SIUC 7659 (1) 1 March 1981, SIUC 6222 (1) 2 May 1981, SIUC 6406 (1) 30 June 1981, SIUC 7389 (3) 19 September 1981, SIUC 6266 (1) 12 November 1981, SIUC 8284 (2) 2 March 1982, SIUC 22921 (3) 24 February 1994, SIUC 23887 (1) 1 April 1995; Mississippi River at Grand Tower Island, SIUC 12825 (1) 24 October 1985; Mississippi River at Sandy Island, UMMZ 111576 (24) 13 May 1936, INHS 36540 (10) 13 May 1936. Randolph County: Mississippi River, Bar 76, near Chester, UMMZ 221060 (3) 23 August 1940, UMMZ 164849 (4) 23 August 1940; Mississippi River at Fort Gage, 1 mi. N of Chester, UMMZ 225137 (3) 3 November 1940. Missouri. St. Charles County: Mississippi River above mouth of Missouri River, KU 9687 (2) 24 September 1963.

Macrhybopsis meeki

Illinois. Alexander County: Mississippi River 1 mi. S Cairo, INHS 5793 (7) 11 September 1962. Mississippi River at Fayville, INHS 5868 (6) 11 September 1962. Mississippi River at Cairo, UMMZ 147042 (5) 18 May 1944. Jackson County: Mississippi River at Grand Tower, UMMZ 105475 (2) 24 August 1938, UMMZ 147144 (1) 8 June 1944, INHS 22498 (19) 13 August 1963, INHS 26961 (1) 8 April 1978, SIUC 8289 (3) 21 December 1978, SIUC 7659 (43) 1 March 1981, SIUC 6314 (3) 25 July 1981, SIUC 6500 (2) 10 August 1981, SIUC 6519 (1) 21 August 1981, SIUC 6245 (2) 12 September 1981, SIUC 6267 (4) 12 November 1981, SIUC 8285 (3) 3 March 1982, SIUC 7268 (1) 17 February 1983, SIUC 25367 (1) 9 August 1991, SIUC 22922 (10) 24 February 1994, SIUC 23101 (3) 22 August 1994; Mississippi River at Grand Tower Island, SIUC 15775 (26) 11 April 1987; Mississippi River at Sandy Island, UMMZ 111577 (23) 13 May 1936. Madison County: Mississippi River 3.5 mi. N Alton, INHS 85518 (1) March 1906. Monroe County: Mississippi River 3 mi. W intersection US 50 and IL 3, SIUC 8291 (1) 24 December 1978. Randolph County: Mississippi River, Bar 76, near Chester, UMMZ 221062 (3) 23 August 1940; Mississippi River at Kellogg, INHS 23905 (2) 22 August 1962; Mississippi River at Little Rock Ferry, SIUC 25356 (1) 7 June 1991; Mississippi River at Fort Gage, 1 mi. N Chester, UMMZ 225139 (38) 3 November 1940; Mississippi River at Fort Kaskaskia, INHS 23924 (3) 8 September 1959. Missouri. Cape Girardeau County: Mississippi River at Neely's Landing, KU 24653 (1) 15 October 1963. Jefferson County: Mississippi River in Crystal City, 1 mi. upstream of mouth of Platin Creek, UMMZ 147053 (5) 30 June 1944; Platin Creek at its mouth at Crystal City, UMMZ 147049 (1) 30 June 1944. Mississippi County: Mississippi River at mouth of Ohio River, KU 9664 (5) 15 August 1963. Perry County: Mississippi River at Claryville, KU 10045 (3) 16 October 1963. Scott County: Mississippi River 2 mi. E of Fornfelt, KU 23603 (11) 16 August 1963. St. Charles County: Mississippi River above mouth of Missouri River, KU 9688 (15) 24 September 1963. St. Louis County: Mississippi River at Cliff Cave, UMMZ 147131 (8) 7 July 1944; Mississippi River 0.75 mi. downstream from mouth of Missouri River, UMMZ 147091 (32) 15 July 1944.

Appendix II. Mississippi River localities sampled in 1995-1996 not producing either Macrhybopsis gelida or Macrhybopsis meeki.

- RM 7.5, at I-57 bridge, Alexander Co., IL, 29 September 1995.  
 RM 44, Thebes, Alexander Co., IL, 22 March 1996.  
 RM 45.5, Gale, Alexander Co., IL, 29 September 1995.  
 RM 46.5, Gray's Point, Scott Co., MO, 22 March 1996.  
 RM 70.5, Neely's Landing, Cape Girardeau Co., MO, 22 March 1996.  
 RM 80.5, Devil's Backbone Park at Grand Tower, Jackson Co., IL, 29 September 1995, 22 March 1996, 1 May 1996, 6 July 1996, 18 July 1996.  
 RM 106, 0.5 mi. below mouth of Mary's River, Randolph Co., IL, 13 October 1995, 11 April 1996.  
 RM 125, Little Rock Ferry at IL 12, Randolph Co., IL, 13 October 1995, 11 April 1996.  
 RM 156.5, Sulfur Springs, Jefferson Co., MO, 11 April 1996.  
 RM 190, just below dam no. 27 at Chain of Rocks, Madison Co., IL, 13 October 1995, 11 April 1996.  
 RM 195, Lewis and Clark State Memorial, Madison Co., IL, 13 October 1995.

Appendix III. Mississippi River localities reconnoitered in 1995-1996 lacking suitable habitat for Macrhybopsis gelida or Macrhybopsis meeki.

- RM 0.5, Point Defiance Park, Alexander Co., IL, 29 September 1995 (all rip-rap).  
 RM 13, Mouth of Cache River Diversion Channel, Alexander Co., IL, 29 September 1995 (all rip-rap).  
 RM 39.5, Commerce, Scott Co., MO, 22 March 1996 (wing dikes, mud/silt substrate).  
 RM 42.5, Mouth of Orchard Creek, Alexander Co., IL, 29 September 1995 (rip-rap, wing dikes, mud/silt substrate).  
 RM 44.5, Dority Landing, 2 mi. E of Illmo, Scott Co., MO, 22 March 1996 (mud, bedrock, deep water).  
 RM 52.5, Cape Girardeau, Cape Girardeau Co., MO, 22 March 1996 (rip-rap, developed for shipping).  
 RM 74.5, Hines Landing at CC, Perry Co., MO, 22 March 1996 (bedrock, mud).  
 RM 88.5, Star Landing at Y, Perry Co., MO, 22 March 1996 (all rip-rap).  
 RM 95, McLeans Landing on Wilkinson Island, Jackson Co., IL, 29 September 1995 (all rip-rap).  
 RM 116, Kaskaskia Island at IL 15, Randolph Co., IL, 13 October 1995 (all rip-rap).  
 RM 116.5, Fort Gage/Kaskaskia, Randolph Co., IL, 13 October 1995 (all rip-rap).  
 RM 163, Bluff Springs, 1.5 mi. N of mouth of Meramec River, St. Louis Co., MO, 11 April 1996 (rip-rap, wing dikes, mud/silt substrate).  
 RM 167, Cliff Cave Park, St. Louis Co., MO, 13 October 1995 (all rip-rap).  
 RM 168.5, Jefferson Barracks Bridge, St. Louis Co., MO, 11 April 1996 (mud, bedrock).  
 RM 172.5, Vulcan at IL 6, St. Clair Co., IL, 13 October 1995 (rip-rap, developed for shipping).

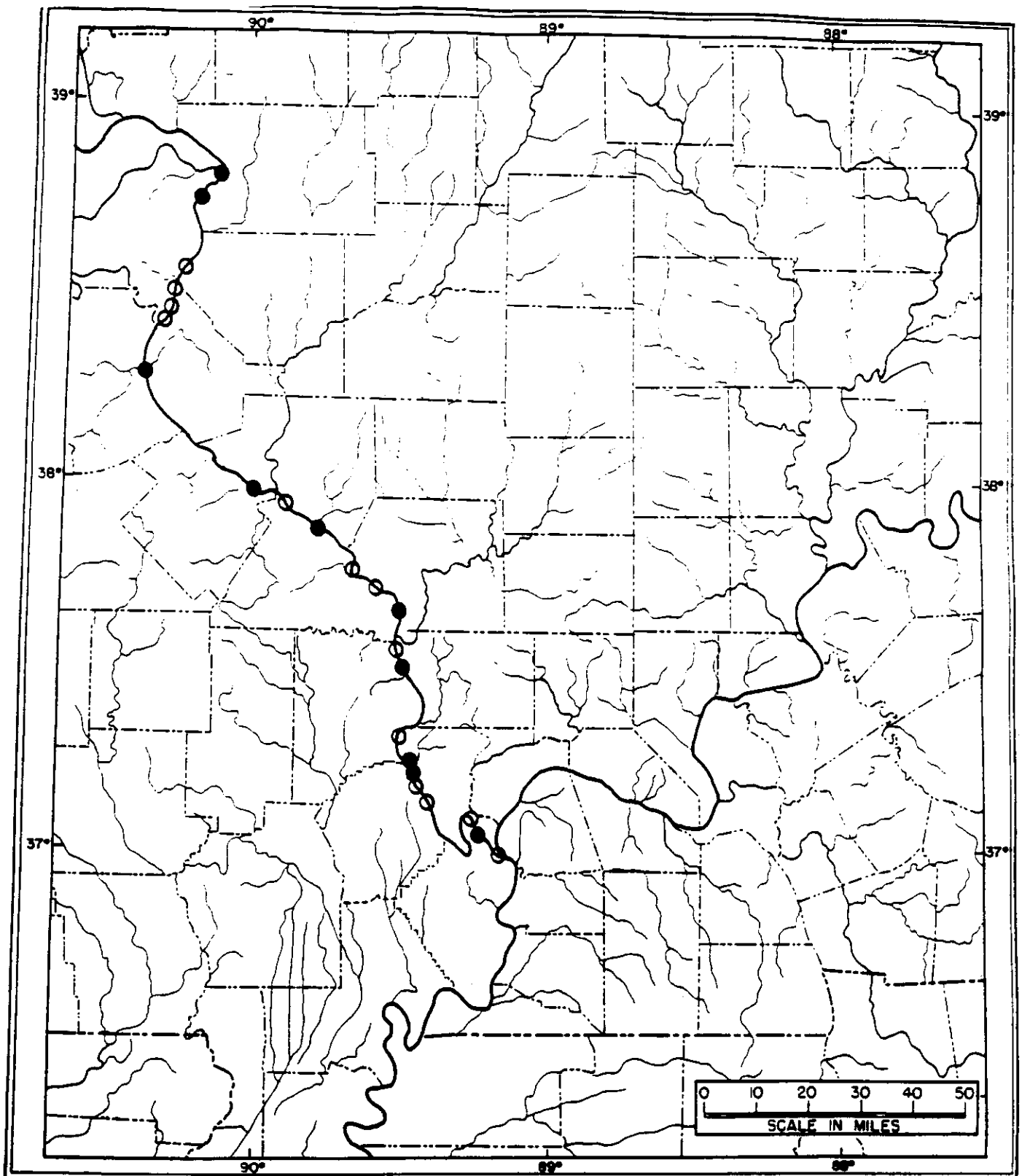


Figure 1. Sites sampled (solid circles) and reconnoitered (open circles) for *Macrhybopsis gelida* and *Macrhybopsis meeki* along the Mississippi River from 29 September 1995 to 18 July 1996.

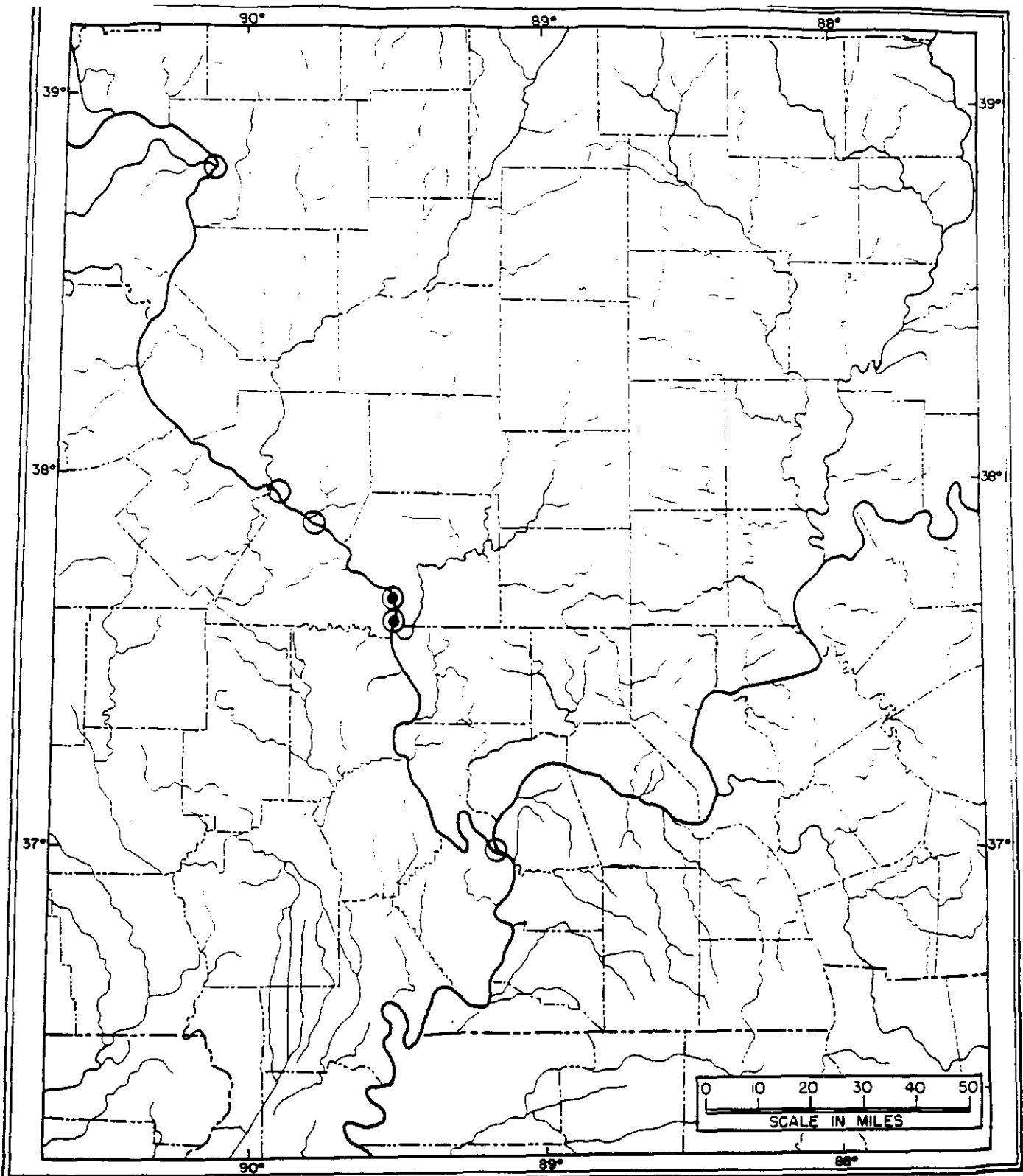


Figure 2. Distribution of *Macrhybopsis gelida* in the middle Mississippi River. Open circles = 1936-1963. Solid circles = 1978-1995.

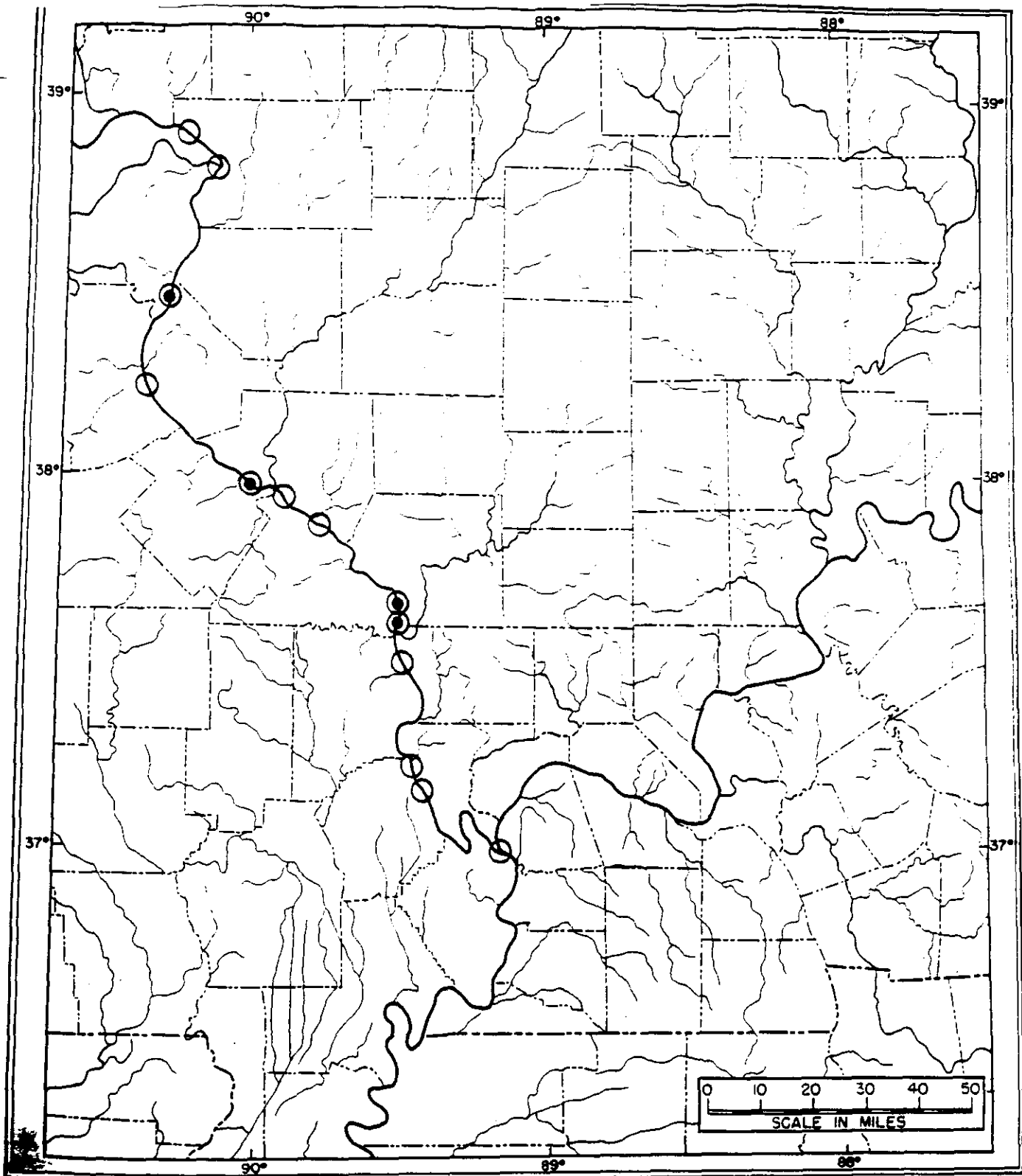


Figure 3. Distribution of *Macrhybopsis meeki* in the middle Mississippi River. Open circles = 1906-1963. Solid circles = 1978-1994.



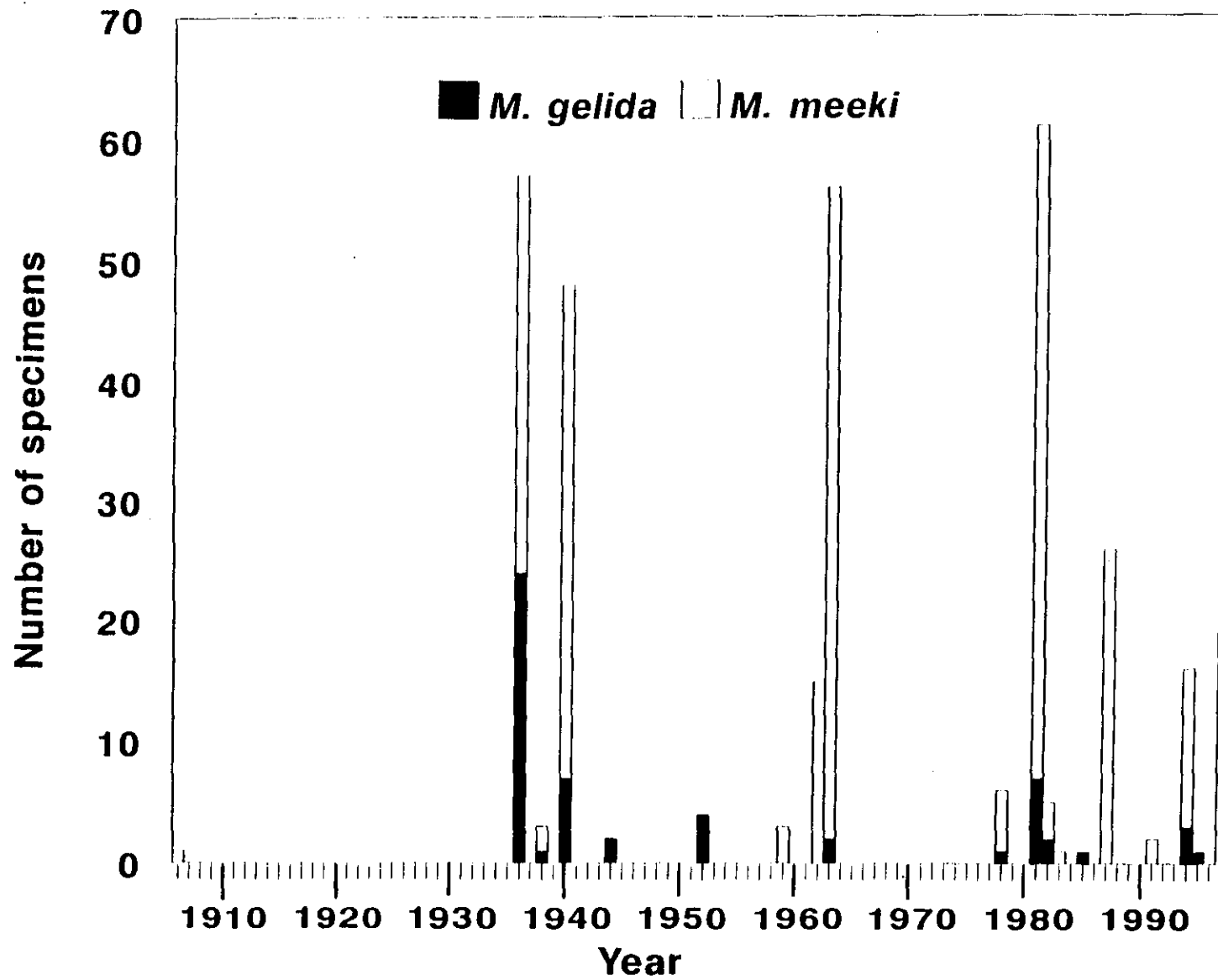


Figure 4. Number of specimens of *Macrhybopsis gelida* and *Macrhybopsis meeki* from the middle Mississippi River vouchered in museum collections.

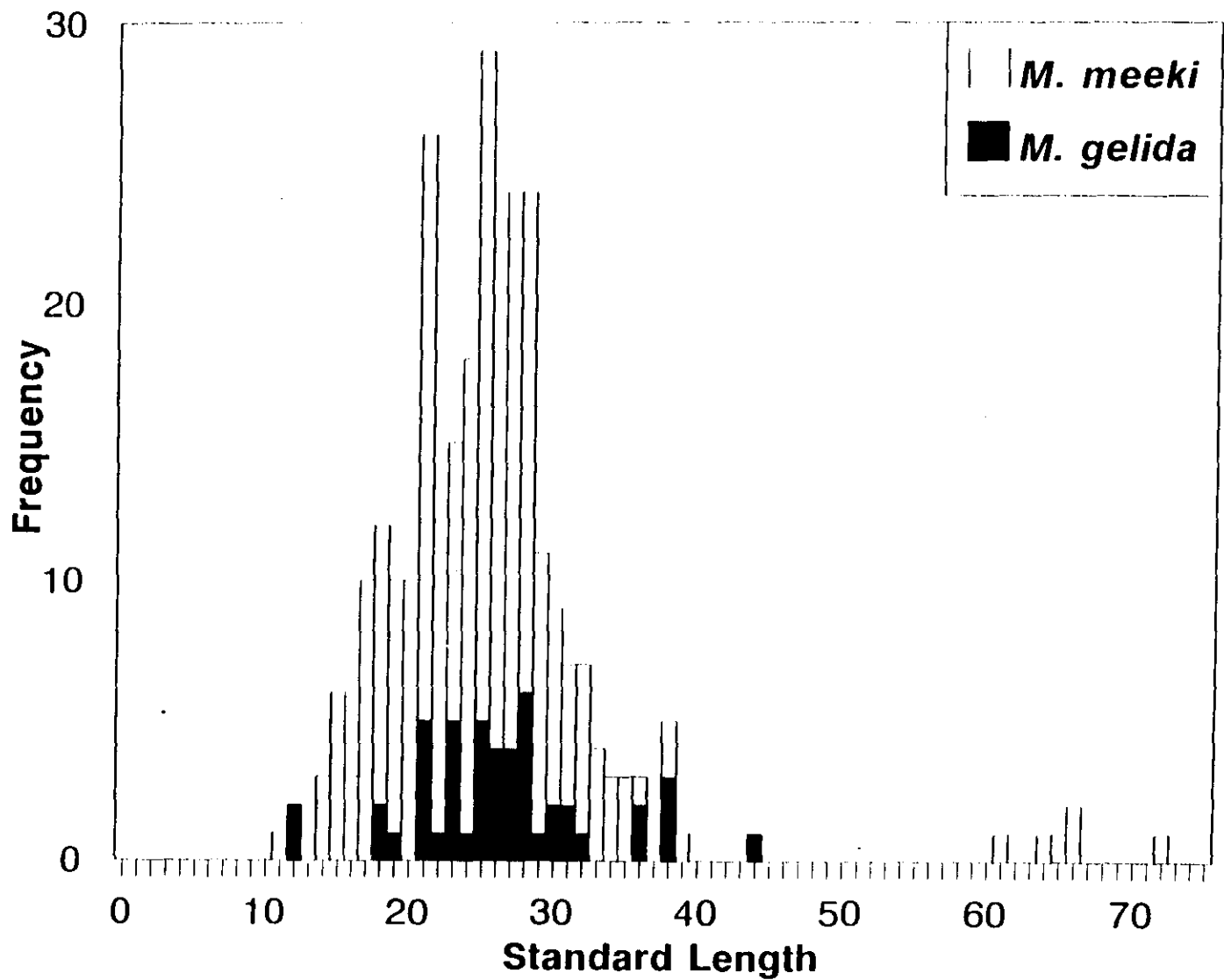


Figure 5. Length-frequency distribution of 48 *Machrybopsis gelida* and 243 *Machrybopsis meeki* collected 1906-1995 from the middle Mississippi River.