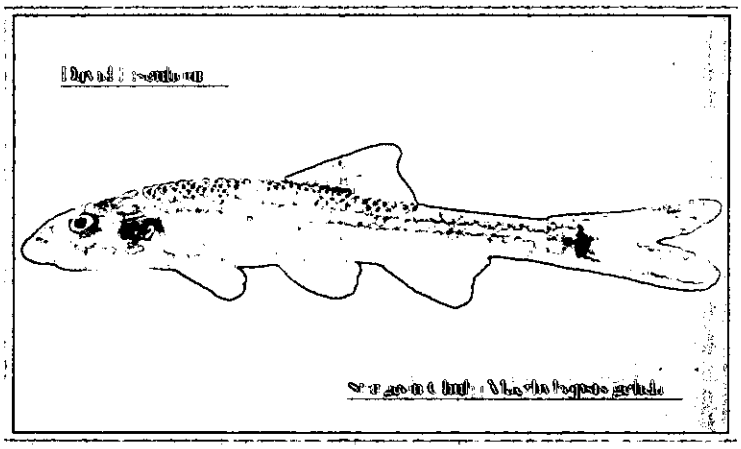
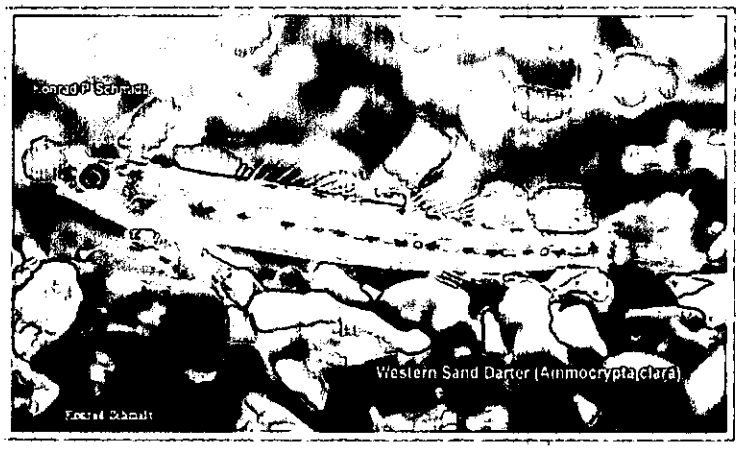
Final Report

Status survey of the Sturgeon Chub, *Macrhybopsis gelida*, the Bigeye Shiner, *Notropis boops,* the Western Sand Darter, *Ammocrypta clara*, and the Crayfish, *Orconectes placidus*, in the Middle Mississippi River, at Grand Tower, Illinois





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Introduction

The four Illinois endangered aquatic species, Bigeye Chub (*Notropis boops*), Sturgeon Chub (*Macrhybopsis gelida*), Western Sand Darter (*Ammocrypta clara*), and Crayfish (*Orconectes placidus*), for this report have varying habitat requirements, yet all have been recorded historically in the Middle Mississippi River at Grand Tower, Jackson County, Illinois.

Two of the species (*M. gelida* and *A. clara*), when relying on standard sampling techniques, are among the rarest and most elusive fishes in the state of Illinois. *Macrhybopsis gelida* has been reported from Alexander, Union, Randolph, Monroe, and Jackson counties in Illinois (O'Donnell 1935, Smith 1979, Werdon 1993a). However, collection of the species in each of these counties (except Jackson) occurred prior to 1944 (Piller et al. 1996). In Jackson County, the species is known from one locality, the Mississippi River at Grand Tower, Illinois.

In 1985, Dimmick (1988) first recorded *Ammocrypta clara* from Grand Tower in the Mississippi River. Extensive collection efforts by Burr et al. (1996) between 1987 and 1996 resulted in no additional records from this locality. Their efforts did, however, document a more continuous range of the species in the Mississippi River in Randolph, Madison, and Calhoun counties. Historically, Smith (1979) reported the Western Sand Darter from the Mississippi River above the mouth of the Missouri River and from the Kaskaskia and Sugar rivers in inland Illinois. Burr et al. (1996) reported a small, localized population in the Kankakee River near Custer Park and Wilmington.

Smith (1979) noted that *Notropis boops* was probably never abundant in Illinois except in the Vermillion and Little Vermillion River systems and occurred sporadically in

its distribution elsewhere. Recent collections have confirmed the species historical abundance in the Little Vermillion River. These collections have documented range expansion in southwestern Illinois in the Clear Creek system where *Notropis boops* is now common in Green, Dutch, and Hutchins creeks (Burr et al. 1996). The Clear Creek system, which drains into the Mississippi River, has the desired small-stream habitat for this species, unlike the big-river habitat of the mainstem Mississippi River.

Orconectes placidus has a restricted distribution in southern Illinois, which is the northern extent of its range, occurring in Big Creek in Hardin County, and along the banks of the mainstems of the Ohio and Mississippi rivers (Page 1985). A recent report on the distribution and taxonomy of the genus *Orconectes* in Illinois raises questions about whether *O. placidus* has ever been an inhabitant of the Middle Mississippi River (Poly and Wetzel 2003). In fact, the records for Grand Tower probably represent the Golden Crayfish, *Orconectes luteus* (see color photographs in Pflieger 1996:92) (pers. comm., E. G. Wetzel)

The ecological integrity of the Mississippi River has been severely compromised by human activity during the past 50 years. The reach of the Mississippi River between St. Louis, Missouri, and the confluence of the Ohio River in Cairo, Illinois, referred to as the Middle Mississippi River, has for years been noted for its turbidity and its distinct native fish fauna adapted to these waters.

Since 1900, an extensive system of dikes, revetments, levees, and upstream reservoirs has changed the Missouri River into a single, narrow, deep channel (Pflieger and Grace 1987). These changes in the Missouri River, along with similar changes in the Mississippi River, have reduced the sediment load and thus the turbidity of both the

Missouri and the Mississippi rivers. These modifications for navigation and flood control and the resulting changes in turbidity, hydrology, and substrate have been implicated as the primary factors affecting the decline of many native species adapted for large, turbid rivers (Hesse et al. 1993, Pflieger and Grace 1987).

Long term shifts in the composition or abundance of fishes, which are excellent indicators of environmental quality, can provide information on the quality of an aquatic ecosystem. Habitat requirements and abundance data from the four endangered species may provide information about the condition of the Mississippi River ecosystem. The objectives of this report were to determine the present distribution and abundance of these four species, observe seasonal fluctuations, quantify habitat occurrence, and recognize critical habitat to be protected to aid in maintaining viable populations in this region.

Study Site

We conducted the study in the Middle Mississippi River near Devil's Backbone Park, Grand Tower, Illinois (Figure 1). We sampled fishes at three locations: 1) site A (river mile 80.5) is a shoreline, backwater area with sand substrate extending into the river; 2) site B (river mile 80) is a shoreline, backwater area near a boat launch and has a mixture of silt and sand substrates, boulders, and emergent vegetation at low water levels; and, 3) site C (river mile 79) is a broad, relatively shallow expanse along a mid-stream island and has moderate to torrential currents that flow over gravel substrate.

Methods

We conducted 18 biweekly sampling sessions between 1 March and 1 December 2003, using methods similar to a graduate research project conducted in 1983 (Klutho

1983). Each diurnal sampling session lasted approximately 90 minutes with 30 minutes of sampling at each site. At each of the three sites, we conducted three 50-meter seine hauls parallel to the shoreline. Study sites A and C were sampled using a 6.2 m x 1.2 m x 3.2 mm mesh bag seine. Site B was sampled using a smaller 3.1 m x 1.2 m x 3.2 mm mesh non-bag seine. To improve our ability to detect nocturnal species, we also sampled during two 24-hour periods. In June, diel sampling included two diurnal and two nocturnal sessions; in September, diel sampling included two diurnal and three nocturnal sessions.

Fishes that could be identified in each seine haul were sorted by species, counted, and released at site of capture. Fishes that could not be identified in the field were fixed and preserved in 10% formalin, identified and counted in the laboratory, cataloged, placed in 70% ethanol, and permanently archived in the SIUC Fluid Vertebrate Collection.

During our study, we also measured and recorded the following data during each sampling period: date, time of day, water discharge, substrate type, gauge height, and water temperature. Water gauge height (feet) and discharge (cubic feet per second) were obtained from the USGS station at Chester, Illinois.

Results and Discussion

Historical Distribution and Abundance: The four endangered species for this report have all previously been collected at Grand Tower, Illinois. Examination of historical collections reveals that these species have all been uncommon in the Middle Mississippi River. *M. gelida* and *A. clara*, threatened/endangered in several states, are known for being rare or uncommon throughout most of their ranges, while *N. boops* is considered

sporadic and rare but more common than other endangered species (Bailey and Allum 1962, Cross 1967, Smith 1979, Burr and Warren 1986, Etnier and Starnes 1993, Cross and Colllins 1995, Burr et al. 1996, Pflieger 1997). *Orconectes placidus* also has been noted as being rare in this area (Page 1985).

Recent Study: Three endangered species were collected during the 2003 collection period. *Macryhobopsis gelida* was collected on 7 March and 22 March 2003 with one individual being collected on each date. Water temperatures for the two dates were 4° C and 10° C, respectively, while gauge height at Chester, Illinois, was 1.4 and 11.6 feet, respectively. While abundances of *M. gelida* seem to be low, a small population has persisted at the Grand Tower locality since at least 1978.

Ammocrypta clara was collected on four different occasions, 19 April, 28 June, 13 September, and 5 October 2003. On the sampling dates, water temperature ranged from 17° to 27° C. Gauge height at Chester was lowest during the October 5th sampling session measuring 0.12 feet and highest on June 28th when readings were at 14.5 feet. *A. clara* was first recorded in the Mississippi River at Grand Tower during 1985.

Notropis boops has not been collected in the Mississippi River at Grand Tower, Illinois, since 1988. Three specimens, probable tributary waifs, were collected during the late 1970s to early 1980s. However, *N. boops* shows no evidence of being a permanent resident in this reach since that time. Its primary habitat is small, clear streams of the Shawnee Hills including the Clear Creek and Miller Creek stream systems in Union and Alexander counties.

Recent collections (1978-2002) at Grand Tower, Illinois, show average number of specimens per collection varied from 1.0 for *N. boops*, 1.75 for *A. clara*, to 2.1 for *M.*

gelida. During the current study the average number of specimens per collection remained the same for *A. clara*, however *M. gelida* and *N. boops* both decreased to 1.0 and 0.0, respectively (Table 1).

The third endangered species collected at Grand Tower was one specimen of *O. placidus* collected on 7 March 2003. Water temperature on the date of collection was 4° C and the gauge height at Chester, Illinois, was 1.4 feet. Another species of crayfish, *O. luteus* occurs in the Mississippi River border in Missouri and may be the more prominent crayfish in this region (Poly and Wetzel 2003).

Habitat: Previous collections of the four endangered species at Grand Tower (Jackson Co., Illinois) were in moderate to strong current over sand or fine gravel substrate. *Macrhybopsis gelida* has been 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, Rowe 1992, Cross and Colllins 1995). Collections also have been reported over firm sand in the lower Missouri and Mississippi rivers (Smith 1979, Klutho 1983, Etnier and Starnes 1993, Pflieger 1997). Sand substrate also has been reported to be associated with young-of-the-year (YOY) (Reigh and Elsen 1979). *Ammocrypta clara* inhabits medium to large rivers in moderate to swift currents, usually over sand or fine gravel substrate, in clear to slightly turbid waters (Becker 1983, Douglas 1974, Etnier and Starnes 1993).

Notropis boops generally inhabits a much different type of habitat than what is normally found in the middle reach of the Mississippi River. This species prefers high-gradient, small to medium-sized upland streams having large, permanent pools of clear water with gravel, sand, or rock substrate and a abundance of aquatic vegetation (Smith

1979, Burr and Warren 1986, Etnier and Starnes 1993, Pflieger 1997). Pflieger (1997) described the ideal habitat for this species as being streams consisting of a series of warm, quiet pools with little flow during drier seasons of the year. Similarly, the crayfish species, *Orconectes placidus,* generally inhabits downstream gravel and rubble riffles of small streams and occasionally is found on the rocky banks or rocky backwater areas of large rivers (Page 1985).

Life History: *Macrhybopsis gelida* grows to a length of 26 to 44 mm by the end of its first summer of life (Pflieger 1997) and is reported to be mature at 76-81 mm SL and two years of age (Stewart 1981, Werdon 1992). Little is known of spawning habits of *M. gelida*. In Wyoming, spawning was reported to begin in early June and continued throughout the summer (Stewart 1980). Specimens in historical collections from the Middle Mississippi River ranged from 11.8 to 44.2 mm SL (Piller et al. 1996).

Nine specimens collected in 2001 all measured under 24.8 mm SL and the two specimens collected in 2003 measured 30.4 mm and 27.3 mm SL. These specimens, all collected in the month of March, would represent YOY and one-year-old sub-adults. Local reproduction in Illinois would be the most likely source for these individuals.

Little is known of the life history and spawning habits of *Ammocrypta clara* due to its restricted habitat and secretive burying behavior. A master's thesis by G. W. Lutterbie reported spawning in late June through July in Wisconsin and calculated lengths of 43, 56, and 61 mm SL for growing seasons 1 through 3, respectively (Becker 1983). Specimens collected in 2003 ranged in length from 24.3 to 43.8 mm SL. The largest specimen, 43.8 mm SL, was collected on 19 April likely representing a one-year-

old sub-adult. All other specimens, 24.3 to 36.0 mm SL, were collected in September and October representing YOY from possible local reproduction in Illinois.

Mississippi River Modifications: The first explorers of the Middle Mississippi River described it as a much wider river than it is today, with numerous side channels, islands, shifting sand or gravel bars, and rocks (Dobney 1975). This was reiterated in 1780 when Thomas Jefferson wrote: "The Mississippi, below the mouth of the Missouri, is always muddy and abounding with sand bars, which frequently change their places." These descriptions of the river are no longer true due to anthropogenic changes undertaken in the early 1800s to control flooding and improve the river for navigation. Included in these modifications were the construction of wing dikes and levees, dredging and straightening of the channel, stabilization of the banks with riprap, and construction of locks and dams above St. Louis (Dobney 1975).

These modifications have resulted in a loss of critical aquatic habitat by eliminating most islands and sand bars and shallow, wide areas, leaving a narrow, deep swift channel. Wing dikes, present throughout the river, direct the current to the middle of the river eliminating flow along the shore. Siltation along the remaining sand and gravel bars are a result of these dikes, again eliminating critical habitat (Etnier and Starnes 1993). Grand Tower, Illinois, is one of only two remaining sites on the Middle Mississippi River that has extensive shoreline areas of sand or gravel substrate with strong current and suitable habitat for the unique aquatic life of big rivers (Piller et al. 1996).

Sampling Bias: High turbidity levels and unstable bottom substrates in the main channel of the Middle Mississippi River have been considered poor habitat for aquatic fauna (U.

S. Army Corps of Engineers 1976). However, other suitable habitat may be available in the central portion of the river channel where deep water prevents sampling by traditional seining methods. It has been suggested that trawling is a successful method for collecting *M. gelida* in Montana (Anonymous 1995). Trawling in the Middle Mississippi River would be potentially hindered by the presence of numerous bottom obstructions, especially embedded logs.

There is some suggestion that seining underestimates true population numbers of particular fish species, and that it should be replaced by trawling (Anonymous 1995). Benthic trawling, including 119 trawls, was conducted on the Middle Mississippi River during fall 2000 and summer 2001. *Macrhybopsis gelida* comprised 1.78% of the total relative abundance with 136 specimens captured. Overall catch per unit effort was 0.38 individuals per minute of trawling (Jackson 2002). This suggests that trawling may be helpful in estimating relative abundance of *M. gelida*. However, only 22 other species were collected during the trawling study, compared to 53 during our current study, which indicates that trawling also has limitations. *Ammocrypta clara* and *N. boops* were not collected by these trawling efforts. Similar to our efforts, historical collections were obtained by seining shoreline areas indicating that at least *M. gelida* probably has declined in abundance in this habitat.

Recommendations

We recommend that the conservation status of *Ammocrypta clara* and *Macrhybopsis gelida* remain as endangered on the Illinois state endangered/threatened species list (Illinois Endangered Species Protection Board 1994). Although *Notropis boops* was not detected in the Mississippi River, Burr et al. (1996) reported that the

species had increased its range and confirmed its historical abundance in the Little Vermilion River. Therefore, this species should be considered for downgrading to the threatened category because it is more common than many other endangered species within the state. In light of the recent publication on the genus *Orconectes* (Poly and Wetzel 2003), further research is needed to determine the true distribution of *O. placidus* in Illinois. At this time, we recommend that the conservation status of this crayfish remain as endangered on the Illinois state endangered/threatened species list (Illinois Endangered Species Protection Board 1994).

Regular monitoring of these species, along with other large river species that seem to be declining in the Middle Mississippi River (*Macrhybopsis meeki, Platygobio gracilis*, and *Hybognathus placitus*) is necessary to document changes in the abundance and distribution of these species. Future surveys should focus on potentially suitable habitat (i.e., strong current over sand and gravel) at Grand Tower and in other localities along the Middle Mississippi River. Many areas with suitable habitat have been changed forever by river modifications including channelization, construction of wing dikes and levees, and addition of riprap. Management of these species in Illinois should focus on habitat preservation and restoration in areas that currently provide habitat for *A. clara* and *M. gelida* especially the sand beach at Devil's Backbone Park at Grand Tower, Illinois.

Summary

Threatened or endangered over most of their ranges, *M. gelida* and *A. clara*, like many other big river species, appear to have a recurring theme regarding their decline, lack of suitable habitat. Critical habitat, sand or gravel bars with strong current, has been lost because of anthropogenic changes. These changes, including channel dredging and

dike, levee, and reservoir construction, have been implemented for navigation and flood control on the Mississippi and Missouri rivers. However, these practices have left the Middle Mississippi River extremely modified and almost entirely devoid of critical habitat for these two fishes. Although both of these species were found in this survey, they continue to be extremely rare and elusive. The taxonomic status of *O. placidus* in Illinois is unclear and the records reported for Grand Tower probably represent another species, *Orconectes luteus*. Until the taxonomy and geography are clarified we do not recommend a conservation status for the crayfish. The three fish species should remain on Illinois' list of threatened and endangered species (IESPB 1994 et seq.).

Literature Cited

Anonymous. 1995. Montana Chapter says two species may not be rare enough for ESA. Fisheries Action News. Fisheries (Bethesda) 20 (12):7.

Bailey, R. M. and M. O. Allum. 1962. Fishes of South Dakota. Miscellaneous Publications, Museum of Zoology, University of Michigan No. 119. 131 pp.

Becker, G. C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison. 1052 pp.

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. 1996. Selected Illinois fishes in jeopardy: new records and status evaluations. Transactions of the Illinois State Academy of Science. 89:169-186.

Burr, B. M. and M. L. Warren. 1986. A distributional atlas of Kentucky fishes. Kentucky Nature Preserves Commission, Frankfort, Kentucky. 398 pp

Burr, B. M., M. L. Warren, Jr., and K. S. Cummings. 1988. New distributional records of Illinois fishes with additions to the known fauna. Transactions of the Illinois State Academy of Science. 81:163-170.

Cross, F. B. 1967. Handbook of fishes of Kansas. Museum of Natural History, University of Kansas, Lawrence. 357 pp.

Cross, F. B. and J. T. Collins. 1995. Fishes in Kansas, 2nd ed. University of Kansas Natural History Museum Public Education Series. 189 pp.

Dimmick, W. W. 1988. Discovery of the western sand darter, *Ammocrypta clara*, in the Mississippi River below the confluence of the Missouri River. Transaction of the Illinois State Academy of Science 81: 211-212.

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.

Douglas N. H. 1974. Freshwater fishes of Louisiana. Claitor's Publishing Division, Baton Rouge, Louisiana. 443 pp.

Etnier, D. A., and W. C. Starnes. 1993. The fishes of Tennessee. University of Tennessee Press, Knoxville, Tennessee. 681 pp.

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, editors). National Biological Survey Report 19.

Illinois Endangered Species Protection Board. 1999. Checklist of endangered and threatened animals and plants of Illinois. 20 pp.

Jackson, A. L. 2002. Status and characteristics of the sturgeon chub, *Macrhybopsis gelida* and sicklefin chub, *Macrhybopsis meeki*. Unpublished Master's Thesis, Southern Illinois University, Carbondale.

Klutho, M. A. 1983. Seasonal, daily, and spatial variation of shoreline fishes in the Mississippi River at Grand Tower, Illinois. Unpublished Master's Thesis, Southern Illinois University, Carbondale.

O'Donnell, D. J. 1935. Annotated list of the fishes of Illinois. Illinois Natural History Survey Bulletin 20 (5): 473-500.

Page, L. M. 1985. The crayfishes and shrimps (Decapoda) of Illinois. Illinois Natural History Survey Bulletin. Vol. 33 Art. 4.

Piller, K. R. , D. J. Eisenhour, and B. M. Burr. 1996. Status survey of the sturgeon chub, *Macrhybopsis gelida*, and the sicklefin chub, *M. meeki*, in the middle Mississippi River, Illinois. Final Report to Division of Natural Heritage, Illinois Department of Natural Resources, Springfield, Illinois.

Pflieger, W. L. 1997. The crayfishes of Missouri. Missouri Department of Conservation, Jefferson City, Missouri. 152 pp.

Pflieger, W. L. 1996. The fishes of Missouri. Missouri Department of Conservation, Jefferson City, Missouri. 372 pp.

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, editors). University of Oklahoma Press, Norman.

Poly, W. J. and J. E. Wetzel. 2003. Distribution and taxonomy of three species of *Orconectes (Decapoda: Cambaridae)* in Illinois, U.S.A. Journal of Crustacean Biology 23 (2): 380-390.

Reigh, R. C. and D. S. Elsen. 1979. Status of the sturgeon chub (*Hybopsis gelida*) and sicklefin chub (*Hybopsis meeki*) in North Dakota. Prairie Naturalist 11:49-52.

Rowe, J. W. 1992. The sturgeon chub and the brook silverside in the Platte River of Nebraska. Prairie Naturalist 24:281-282.

Smith, P. W. 1979. The fishes of Illinois. University of Illinois Press, Urbana, Illinois. 314 pp.

Stewart, D. D.. 1980. A preliminary study of the biology of the sturgeon chub (*Hybopsis gelida*) in the Powder River in Wyominig. American Fisheries Society, Colorado Chapter, Proceedings of Annual Meeting 15:38-41.

Stewart, D. D. 1981. The biology of the sturgeon chub (*Hybopsis gelida* Girard) in Wyoming. Unpublished Master's Thesis, The University of Wyoming, Laramie.

U. S. Army Corps of Engineers. 1976. Mississippi River between the Ohio and Missouri Rivers Regulating Works. Final Environmental Statement. U.S. Government, Washington, D.C.

Warren, M. L., Jr., B. M. Burr, S. J. Walsh, H. L. Bart, Jr., R. C. Cashner, D. A. Etnier, B. J. Freeman, B. R. Kuhajda, R. L. Mayden, H. W. Robinson, S. T. Ross, and W. C. Starnes. 2000. Diversity, distribution, and conservation status of the native freshwater fishes of the southern United States. Fisheries (Bethesda): 25:7-29.

Werdon, S. J. 1992. Population status and characteristics of *Macrhybopsis gelida*, *Platygobio gracilis,* and *Rhinichthys cataractae*. Unpublished Master's Thesis, South Dakota State University, Brookings.

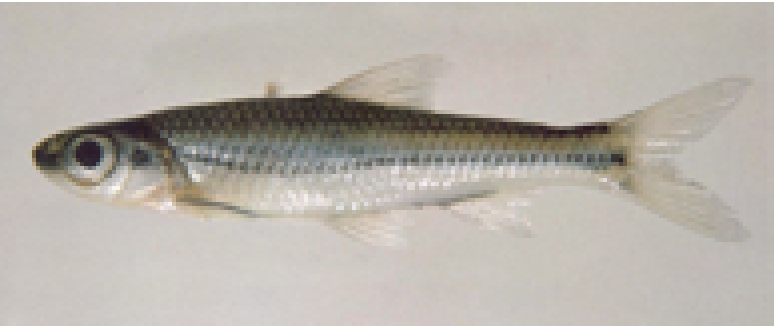
Werdon, S. J. 1993a. Status report on sturgeon chub (*Macrhybopsis gelida*), a candidate endangered or threatened species. U. S. Fish and Wildlife Service, Fish and Wildlife Enhancement, North Dakota State Office, Bismark.

Table 1. Species collected 1970-2003, Mississippi River, Grand Tower, Illlinois

Year	M. gelida	# of collections	N. boops	# of Collections	A. clara	# of collections
1970						
1978	2	1				
1979						
1980						
1981	3	3	1	1		
1982						
1983						
1984			1	1		
1985	1	1			8	4
1986						
1987					1	1
1988			1	1		
1989						
1990						
1991						
1992						
1993						
1994	3	1				
1995	2	2				
1996						
1997					2	1
1998	4	2				
1999	4	2				
2000					1	1
2001	9	1				
2002					2	1
2003	2	2			7	4
Total	**30**	**15**	**3**	**3**	**21**	**12**

Konrad P. Schmidt
Western Sand Darter (Ammocrypta clara)
Konrad Schmidt

10/05/2003



06/27/2003

08/24/2003

09/13/2003