 0030-0950/86/0001-0018 $2.00/0

The Occurrence and Distribution of River Redhorse, *Moxostoma carinatum* and Greater Redhorse, *Moxostoma valenciennesi* in the Sandusky River, Ohio[1]

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ABSTRACT. **Electrofishing collections at 10 locations in the middle Sandusky River mainstem between Tiffin and Fremont revealed the presence of previously unknown populations of river redhorse (*Moxostoma carinatum*) and greater redhorse (*Moxostoma valenciennesi*). The discovery of these populations expands the Lake Erie drainage distribution of both species which have been either declining in abundance or extirpated in many areas. It is doubtful that these species have recently invaded the middle Sandusky River since barriers to upstream fish movements have been in place in the vicinity of Fremont since the early 1800s. Both species showed a preference for locations with a moderate to swift current, pool-run-riffle habitat, and a convoluted bedrock channel with a boulder, rubble, and gravel substrate. Sampling locations that were impounded or where the river was predominantly pooled contained comparatively few or no individuals.**

OHIO J. SCI. 86 (1): 18-21, 1986

INTRODUCTION

The abundance and distribution of the river redhorse (*M. carinatum*) and greater redhorse (*M. valenciennesi*) in Ohio has declined significantly in the past 30 to 40 years (Trautman 1981). The river redhorse, which had previously been classified as endangered in Ohio, is currently recognized as threatened; the greater redhorse is classified as endangered (Ohio Dept. Nat. Res. 1982). The range of the river redhorse includes a large area of the central Mississippi River and the Great Lakes basins (Lee *et al.* 1980). It has recently declined in abundance or been extirpated throughout much of its original range (Jenkins 1970; Becker 1983). In Ohio the decline of this species was seemingly accelerated after 1955 (Trautman 1981). Prior to that time the river redhorse was thought to be restricted to the Ohio River drainage. However, the discovery of an 1893 specimen from the Tiffin River (Jenkins 1970) and the recent discovery of a relict population in the lower Grand River (White and Trautman 1981) changed this perception. The greater redhorse, except for a few scattered records in the central and upper Mississippi basin, is restricted to the Great Lakes drainage where it generally occurs in low numbers (Jenkins 1970; Lee *et al.* 1980). In Ohio, this species has declined since before 1950 with the most recent capture records from the Auglaize River in 1978 (Trautman 1981) and 1985 (Ohio EPA, unpublished data). Both species are thought to be intolerant of siltation, turbidity, and chemical pollution (Jenkins 1970; Trautman 1981; Becker 1983), all of which have contributed to their decline both regionally and in Ohio.

Between 13 July and 19 October 1981, nine locations in the mainstem Sandusky River and one location at the mouth of Honey Creek were electrofished three or four times each (Fig. 1). The electrofishing was part of a biological and water quality survey to evaluate the impact of sources of pollution in the middle Sandusky River (Ohio EPA 1982).

DESCRIPTION OF THE STUDY AREA. The Sandusky River, located in northwest Ohio, is a major tributary of Lake Erie (Fig. 1). It is 210 km in length, has a drainage area of 3680 km^2, an average gradient of 0.8 m/km (2.6 ft/mi), and attains sixth order status in the study area. The study area extended from river kilometer (RK) 75.5, approximately 5 km south of Tiffin, to RK 30.6, approximately 1 km southwest of Fremont. Three dams are located within the study area (Fig. 1), and each dam forms a small impoundment immediately upstream. The largest dam is the 18.3 m high Ballville Dam (RK 29.0), which serves as a permanent barrier to upstream fish movements. The study area lies within the Lake Plains of the Central Lowland Region, which is characterized by nearly flat to gently rolling surfaces and extensive areas of poor drainage. The area is underlaid by consolidated bedrock of sedimentary origin (limestone, dolomite, shale, and sandstone), which is frequently exposed in the river channel. The minimum seven-day average flow, with a recurrence interval of once-in-ten years, is 0.22 m^3/sec near Mexico (RK 77.0) and 0.34 m^3/sec at RK 32.5 upstream from Fremont (Johnson and Metzker 1981). Land use in the study area is 80% farmland, 8% woodland, and 12% urbanized. Most of the former low lying wetland areas have been converted to intensive row crop agricultural land use through extensive ditching and tiling. These activities have resulted in substantial loadings of sediment and nutrients to the Sandusky River during periods of high runoff. Most of the smaller streams in the basin have been subjected to extensive channelization. Very little of this activity has occurred in the larger tributaries since 1960. Except for a very short segment in Tiffin, the mainstem has not been subjected to channel alterations. The only point sources of pollution are located in and downstream from Tiffin, and have no significant impact on resident biological communities or chemical water quality (Ohio EPA 1982).

MATERIALS AND METHODS

Fish were captured with a boat-mounted electrofishing device, which consisted of an electrode system mounted on a 4.3 m john boat. Alternating current (240 VAC) produced by a 3500 watt gasoline powered alternator was converted to direct current (336-762 VDC) by a Smith-Root type VI-A electrofisher at 6–8 amperes and 60 pulses/second. The electrode configuration consisted of four anodes suspended approximately 3 m in front of the bow on a retractable boom, and four cathodes hung from the bow. Sampling was conducted by moving the electrofishing boat downstream in a slow and steady manner, staying as close to the shoreline and submerged structures (e.g. logs, stumps, boulders) as possible. Sampling zones were

[1]Manuscript received 17 May 1985 and in revised form 21 October 1985 (#85-19).

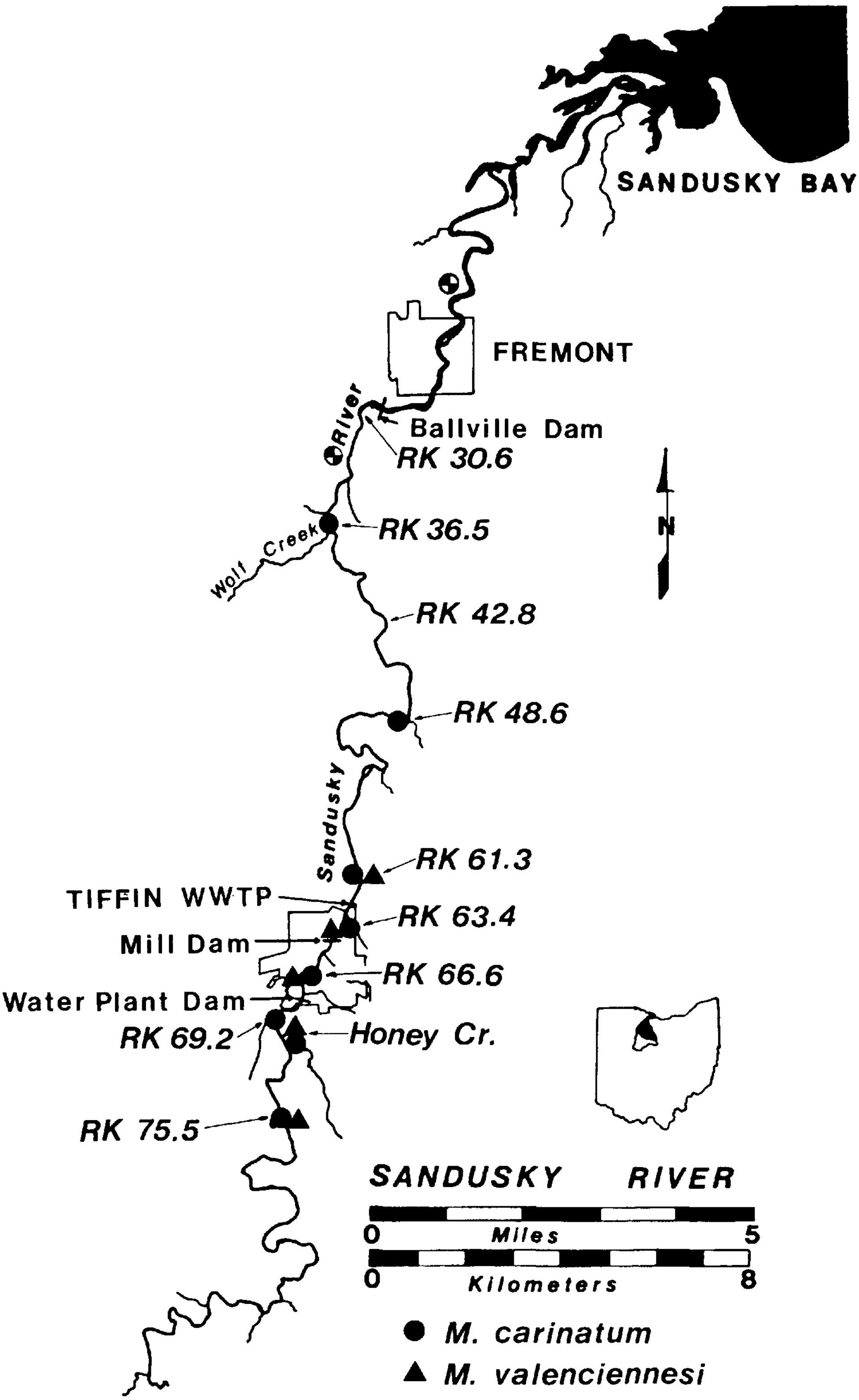

FIGURE 1. Middle Sandusky River study area showing sampling locations (by river kilometer, RK) and capture sites of greater redhorse (*M. valenciennesi*) and river redhorse (*M. carinatum*).

0.43-0.50 km in length and were generally located along the outside of gradual bends in the river, or adjacent to the best available habitat. At two locations the configuration of the river channel required sampling both sides of the river to accumulate the 0.43-0.50 km distance. Immobilized fish were removed from the water with a 2.4-m-long boat net (0.64-cm Atlas mesh) by a netter standing on the bow platform. All sampling operations were conducted by a two or three person crew. Upon capture fish were identified to species, measured to the nearest mm (total length, TL), weighed to the nearest gram, and examined for external tumors, lesions, eroded fins, parasites, and other anomalies. Voucher specimens were preserved in a 10% solution of borax buffered formalin and later transferred to 70% ethyl alcohol. Qualitative observations of substrate, flow, and general habitat features were made at each sampling location. Electrofishing depth (cm) was recorded at 10 locations in each sampling zone and an average depth calculated. Relative abundance was expressed in terms of the number and biomass (kg) of fish per km.

RESULTS AND DISCUSSION

A total of 2870 fish representing 45 species and four hybrids were collected in an electrofishing effort covering a cumulative distance of 18 km in 37 samples. Included in these collections were 38 river redhorse and nine greater redhorse. River redhorse were observed at eight of the 10 sampling locations and greater redhorse occurred at six (Table 1). Length data indicated that most of the river redhorse examined ranged in age from 4 to 10 years (Carlander 1969). Greater redhorse lengths indicated fish were from four to seven years old (Becker 1983). Only two individuals (one of each species) showed any evidence of external anomalies.

The majority of the mainstem had a natural pool-run-riffle morphology that was altered only behind the three dams in the study area. Six of the sampling locations had predominantly hard substrates of bedrock, boulders, rubble, and gravel (Table 2). An 8-km-long segment in and downstream from Tiffin (RK 56-64) consisted of a continuum of shallow runs and riffles over a highly convoluted bedrock bottom with a boulder, rubble, and gravel substrate. The gradient in this segment was considerably higher than anywhere else in the study area. The flow in these areas was sufficiently rapid to discourage widespread deposition of silt on the substrate. In contrast, four sampling locations (RK 69.2, 42.8, 30.6, and Honey Creek) were pooled or impounded, a condition encouraging the increased deposition of silt and fine materials. Although they were distributed throughout the study area, both the river and greater redhorse were collected in highest numbers at the locations with a moderate to swift current, riffle-run habitat, and a convoluted bedrock, boulder, rubble, and gravel substrate. These are the habitat conditions preferred by both species (Trautman 1981; Becker 1983) and where their preferred foods are found. Becker (1983) indicated that isolated populations of river redhorse in Wisconsin rivers were able to survive in similar habitats because of the tendency for the moderate current to keep the substrates relatively silt free. At the six locations where their preferred habitat existed, river redhorse density was nearly eight times higher (3.1/km) than at the pooled and

TABLE 1

Sampling results for river redhorse and greater redhorse in the Sandusky River and Honey Creek, 13 July-19 October 1981.

			River redhorse				Greater redhorse			
River kilometer*	Distance sampled (km)	N	Number	Density (No./km)	Total length range (mm)	Weight range (kg)	Number	Density (No./km)	Total length range (mm)	Weight range (kg)
75.5	2.0**	4	6	2.5	338-620	0.39-2.60	1	0.5	275	0.21
69.2	2.0	4	3	1.5	322-323	0.34-0.37	—	—	—	—
66.6	2.0	4	17	8.5	260-441	0.19-0.98	1	0.5	334	0.41
63.4	1.3	3	1	0.8	318	0.30	4	3.1	290-431	0.24-0.83
61.3	1.2	3	1	0.8	428	0.82	1	0.8	404	0.74
48.6	2.0	4	6	3.0	360-508	0.52-1.42	—	—	—	—
42.8	2.0	4	—	—	—	—	1	0.5	425	0.80
36.5	2.0	4	3	1.5	389-511	0.75-1.40	—	—	—	—
30.6	1.5	3	—	—	—	—	—	—	—	—
Honey Cr.	2.0	4	1	0.5	346	0.46	1	0.5	332	0.34
Totals	18.0	37	38	2.1	260-620	0.19-2.60	9	0.5	275-431	0.21-0.83

*Based on distance from the mouth at Lake Erie.
**Indicates total cumulative distance sampled over 3 or 4 passes; individual zone distances ranged from 0.43-0.50 km.

TABLE 2

Habitat, flow, and substrate characteristics of the 10 sampling locations in the study area based on qualitative observations.

		Percentage of sampling zone									
River kilometer	Flow	Bedrock	Boulder	Rubble	Gravel	Sand	Silt	Clay	Muck	Habitat (Mean depth-cm)*	Gradient (m/km)
75.5	Swift-slow	—	20	—	40	20	—	20	—	Shallow, rocky pool-run (90)	0.10
69.2	Mod.-slow	—	30	25	25	—	—	20	—	Impounded pool (110)	0.10
66.6	Swift-slow	—	35	35	30	—	—	—	—	Shallow pool-run (90)	0.85
63.4	Swift-Mod.	50	30	15	5	—	—	—	—	Shallow riffle-run (80)	2.48
61.3	Swift-Mod.	60	30	7	3	—	—	—	—	Shallow pool-run (45)	2.40
48.6	Moderate	—	40	30	20	—	4	6	—	Long pool, downed trees (80)	0.10
42.8	Slow	—	—	—	20	30	—	—	50	Long pool, downed trees (135)	0.10
36.5	Moderate	25	50	15	5	5	—	—	—	Shallow run-riffle (80)	0.61
30.6	Slow	—	35	25	10	—	—	—	30	Impounded deep pool (200)	0.38
Honey Cr.	Slow	—	25	10	20	25	20	—	—	Impounded, downed trees (100)	0.10

*Indicates electrofishing depth only, does not represent depth of stream channel.

impounded locations (0.4/km). Greater redhorse density was just over two times higher (0.7/km vs. 0.3/km) at the same six locations.

The river and greater redhorse numerically comprised 1.3% and 0.3%, respectively, of the 45 species and four hybrids observed in the study area. The discovery of these species represents first locality records for the Sandusky River basin. Further, it expands the Lake Erie distribution of the river redhorse. Both species have likely been present in the Sandusky River during the post-Wisconsinan period. A recent invasion from Lake Erie seems unlikely since the mainstem has been dammed in various places since the early 1800s. The 18.3-m-high Ballville dam (RK 29.0) was constructed in 1921 and represents an insurmountable barrier to upstream fish movements. Apparently, the river and greater redhorse were overlooked by previous sampling efforts. Adult redhorse in general are difficult to capture with seines which may explain the absence of these two species in previous surveys. Boat electrofishing is a very effective, if not the most effective, method for collecting redhorse. To illustrate this point the Ohio EPA (since 1979) has collected river redhorse at 84 locations throughout Ohio of which more than 60 are new locality records. These include 12 major drainage basins of which eight represent new drainage records (over 40 locations); the known range was significantly expanded in the remaining four. Trautman (1981) acknowledged that the distribution of river redhorse in Ohio was probably underestimated because of their ability to avoid seines. Since effective electrofishing techniques have only recently been employed, the number of new records is not entirely unexpected.

Besides the occurrence of the river and greater redhorse, the middle Sandusky River was additionally unique in that all of the remaining species of *Moxostoma* indigenous to Ohio were found. The golden redhorse (*M. erythrurum*) was the most numerous *Moxostoma* species comprising 8.0% of the total catch (occurred at 9 of 10 locations). Silver redhorse (*M. anisurum*) made up 6.2% (all locations), black redhorse (*M. duquesnei*) made up 4.4% (6 of 10 locations), and shorthead redhorse (*M. macrolepidotum*) comprised 1.6% (7 of 10 locations) of the total catch. In six years of intensive electrofishing in every major drainage basin in Ohio we have never found all six species of *Moxostoma* occurring together. The prominence of redhorse (21.3% by numbers) in the electrofishing collections is an indication of the favorable habitat and good water quality conditions found in the study area.

The collection of river and greater redhorse in the middle Sandusky River is a significant discovery especially in the face of a documented widespread decline of both species throughout much of their respective ranges. Prior to this discovery, the recent distribution of the greater redhorse in Ohio appeared to be restricted to the Auglaize River in Auglaize, Allen, and Putnam Counties. Although Trautman (1981) reported the capture of one individual in the North Fork of Gordon Creek in 1973, intensive electrofishing efforts in this drainage in 1984 by Ohio EPA failed to produce another. Similar efforts in the upper Maumee River mainstem, lower Auglaize River, and the Tiffin River drainage in 1984 yielded no greater redhorse. The river redhorse occupies a somewhat better position in Ohio, occurring in fair to good numbers in the Great Miami, Little Miami, and Scioto River basins. The Lake Erie drainage populations are restricted to the Grand River (White and Trautman 1981), the study area, and the Tiffin River. Although the Tiffin River record dates back to 1893, the 1984 electrofishing effort by Ohio EPA produced one individual in the Tiffin River mainstem 22.7 km upstream from the mouth.

Recent Ohio EPA fish sampling efforts in other Lake Erie tributaries including the upper Sandusky River (1979), lower Huron River (1982, 1984), lower Black River (1982), Rocky River (1981), and Cuyahoga River (1984) failed to produce either species even though habitat conditions at many sampling locations appeared suitable. Water quality conditions were unsuitable in the degraded upper Sandusky River (municipal sewage), lower Black River (municipal sewage, industrial wastes), and Cuyahoga River (municipal sewage, industrial wastes). The Rocky River, although having better water quality than these other streams, is dominated by effluent from municipal wastewater treatment plants. Although there are no previous location records of greater or river redhorse in these rivers, it is quite possible that relict populations may have been overlooked much in the same way that the middle Sandusky River populations were missed. The restoration of suitable water quality conditions in these rivers may make the establishment of one or both species possible.

ACKNOWLEDGMENTS. Messrs. Paul Albeit, Rick Bauer, Tim March, Eric McWilliams, Perry Orndorff, and Richard Schmidt provided assistance in the field. Dr. Ted M. Cavender, Ohio State University Museum of Zoology, provided verifications of the identifications and helpful advice. This work was supported by a grant from the U.S. Environmental Protection Agency under section 205g of the Clean Water Act. Marc Smith and Dave Altfater reviewed the manuscript.

LITERATURE CITED

Becker, G. C. 1983 Fishes of Wisconsin. Univ. Wisconsin Press. Madison, Wisconsin. 1052 p.

Carlander, K. D. 1969 Handbook of freshwater fishery biology. Vol. 1. Life history data on freshwater fishes of the United States and Canada exclusive of the Perciformes. Iowa State Univ. Press, Ames, Iowa. 752 p.

Jenkins, R. E. 1970 Systematic studies of the catostomid fish tribe Moxostomatini. Ph.D. Dissertation, Univ. Michigan, Ann Arbor. 799 p.

Johnson, D. P. and K. D. Metzker 1981 Low-flow characteristics of Ohio streams. U.S. Geological Survey Open-file Report. 81-1195. 285 p.

Lee, D. S., C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister and J. R. Stauffer, Jr. 1980 Atlas of North American freshwater fishes. No. Carolina Biol. Surv. 1980(12): 854 p.

Ohio Department of Natural Resources 1982 Rare species of native Ohio wild animals. Division of Natural Areas and Preserves, Columbus (May 1983). 14 p.

Ohio Environmental Protection Agency 1982 Biological and water quality survey of the lower Sandusky River, Sandusky and Seneca Counties, Ohio. Ohio EPA Tech. Rept. OEPA 82/13. Div. Wastewater Poll. Contr., Columbus. 77 p.

Trautman, M. B. 1981 The fishes of Ohio. Ohio State Univ. Press, Columbus, 782 p.

White, A. M. and M. B. Trautman 1981 Discovery of the river redhorse, *Moxostoma carinatum,* in the Grand River, an Ohio tributary of Lake Erie. Ohio J. Sci. 81 (1): 45-46.