

OCCURRENCE OF THE MISSISSIPPI SILVERSIDES, *MENIDIA AUDENS* (HAY), IN KEYSTONE RESERVOIR AND THE ARKANSAS RIVER¹

Ricardo Gomez and Hague L. Lindsay, Jr.

Oklahoma Fishery Research Laboratory, Norman Oklahoma, and
Department of Life Sciences, University of Tulsa, Tulsa, Oklahoma

The Mississippi silversides, *Menidia audens*, was first encountered in the main stream of the Arkansas River below Keystone Reservoir in May 1970 and in the reservoir proper in September 1971. Seine sampling in October 1971 revealed an established population of *M. audens* in Keystone Reservoir. *M. audens* may have replaced the brook silversides, *Labidesthes sicculus*, in Keystone Reservoir paralleling the succession that took place in Lake Texoma in 1957 as reported by Riggs and Bonn in 1959.

The Mississippi silversides, *Menidia audens* (Hay), was first reported in Oklahoma by Moore and Cross (1). They collected three specimens on April 15, 1949, in the lower Red River in Bryan County near the highway 299 bridge south of Yuba. By 1953 this species had migrated into Lake Texoma (2) and by 1955 it was considered the dominant atherinid in the lake. During this time, *M. audens* almost completely replaced the brook silversides, *Labidesthes sicculus*, in Lake Texoma (3). The known range of *M. audens* in Oklahoma had remained restricted to the Red River system until 1963. Sisk and Stephens (4) discovered a population of *M. audens* in Boomer Lake (Payne County) on February 14, 1964. Shortly thereafter they collected *M. audens* from Boomer Creek, a tributary of the Cimarron River. This population was thought, by Sisk and Stephens, to have developed from a release made by W. H. Irwin, of Oklahoma State University, into Boomer Lake in 1961.

The fish fauna of the Arkansas River has been sampled each year, generally in the spring, since 1956 by investigators from the University of Tulsa. Sampling has been conducted between Muskogee and the Kansas border in the Arkansas River and as far upstream as Oilton in the Cimarron River. Samples were collected with small-mesh seines of various lengths. No attempt was made to establish catch per unit of effort parameters, but rather the objective

was to monitor the species composition and distribution of the fishes of this watershed.

The discovery of *M. audens* in Keystone Reservoir in September, 1971 prompted further investigation, which is reported here.

MATERIALS AND METHODS

During October, 1971 an attempt was made to determine the distribution and abundance of *M. audens* in the headwaters of Keystone Reservoir proper and its tailwaters, as measured by catch per unit of effort. A unit of sampling effort consisted of a 15-meter haul parallel to shore made with a 20 x 4-foot x ¼-inch mesh drag seine. Sampling, which took place from October 14 to 24, 1971, was conducted in sandy, unobstructed beaches which were accessible by road. A total of fifteen sites were sampled at the reservoir, ten in the tailwaters, and four in the headwaters. A total of 33 hauls were made at these sites. All atherinids taken were measured to total-length, and were identified by utilizing scale counts and cephalic morphology as described by Moore (5).

Areas sampled were classified into six categories as follows: upper Cimarron, upper Arkansas, lower Cimarron, lower Arkansas, central pool and tailwaters. The boundaries of these areas in the reservoir were arbitrarily set, but convenient landmarks or shoreline configuration influenced the allocation of boundary lines.

RESULTS AND DISCUSSION

The precedent of the succession of *Menidia audens* over *Labidesthes sicculus* in Lake

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Texoma as described by Riggs and Bonn (2) posed an interesting possibility of repetition in Keystone Reservoir. This possibility was anticipated by Sisk and Stephens (4). *M. audens* were discovered in large numbers in Keystone Reservoir while conducting a population survey by means of a series of cove rotenone samples during September of 1971. Analysis of these rotenone samples yielded large numbers of *M. audens* and a single specimen of *L. sicculus*, which was taken on September 15, 1971, approximately 11 river km from the dam in the Cimarron arm. It was thought that representatives of both genera might be present in sufficient numbers to indicate their densities. However, all sampling conducted in pursuit of this goal, e.g., standardized seine sampling, failed to produce any additional specimens of *L. sicculus*, although this species was frequently collected from tributaries prior to the impoundment of Keystone Reservoir. Available data indicate that *M. audens* has already displaced any pre-existing population of *L. sicculus* which might have occurred in Keystone Reservoir. A single specimen of *M. audens* first appeared in collections from the Arkansas River on May 28, 1970 at the Sand Springs bridge, approximately 13 km below Keystone Dam. Six specimens were subsequently taken June 14, 1970, at the same location, and on June 27, 1970, a collection on the Arkansas River 9.6 km east of Muskogee included one specimen. On August 1, 1970 three specimens of *M. audens* were taken near the 51st Street bridge in Tulsa and on December 14, 1970, a significant occurrence of this species was encountered in the Arkansas River above Keystone Reservoir 9.6 km N-NW of Cleveland in Pawnee County.

Results of the sampling conducted in October 1971 indicate that seine hauls were more productive of *M. audens* in the central pool area of the reservoir, with a grad-

TABLE 1. Relative abundance of *Menidia audens* in various areas of Keystone Reservoir.

Area	Number of fish	Number of hauls	Average catch per haul
Upper Arkansas	0	3	0
Upper Cimarron	0	6	0
Lower Arkansas	18	4	4.5
Lower Cimarron	309	5	61.8
Central pool	1,020	5	204.0
Tail-waters	23	10	2.3

ually reduced yield from stations near the upper end (Table 1). The population of *M. audens* in the tailwaters was considered to be moderate in size during this investigation.

The most likely source of *M. audens* in the Arkansas River system is Boomer Creek. Sisk and Stephens (4) collected a single adult specimen in a pool 3.2 km downstream from Boomer Lake, two weeks after their initial discovery of the species in Boomer Lake in 1964. Boomer Creek is a tributary of Stillwater Creek, which flows into the Cimarron River. The confluence of the Cimarron and Arkansas rivers is in Keystone Reservoir. One seine haul made during October 1971 on the northeast shore of Boomer Lake produced 12 *M. audens*. Stillwater Creek 7.2 km south of Stillwater was also seined, but *M. audens* were not collected.

The only other reservoirs of the Arkansas River system known to have a population of *M. audens* are Spavinaw and Eucha, where the species was introduced as forage. However, it is unlikely that these introductions represent the source of the Keystone population as these fish would have had to travel downstream in the Grand River through two reservoirs and upstream in the Arkansas River, a total distance in excess of 220 km.

M. audens has demonstrated an ability to compete successfully and become established in large impoundments such as Texoma and Keystone. It is foreseeable that with the completion of a navigational system of locks and dams on the Arkansas River the range of *M. audens* may continue to expand.

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