

A SURVEY OF THE FISHES OF THE MUDDY BOGGY RIVER IN SOUTH CENTRAL OKLAHOMA

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A survey of the fishes of the Muddy Boggy River in south central Oklahoma produced 90 species representing 21 families. Eleven additional species have been reported by others, for a total of 101 species known to occur in Muddy Boggy River. Thirty-four species are new records for the Muddy Boggy River drainage. A description of the Muddy Boggy River System, a brief history of ichthyological collections within the drainage, an annotated checklist with remarks on distribution and probable abundance of each species are included.

MUDDY BOGGY RIVER SYSTEM

The Muddy Boggy River, a major tributary of the Red River, is formed by the joining of Muddy Boggy and Clear Boggy Creeks at river mile 24.4. The Boggy heads in eastern Pontotoc and southwestern Hughes counties and flows in a southeasterly direction 154 miles to its confluence with the Red River near Hugo, Oklahoma. The drainage basin of 2,429 square miles includes parts of Pontotoc, Hughes, Pittsburg, Atoka, Johnson, Bryan, Pushmataha, and Choctaw counties in south central Oklahoma. The basin is about 70 miles long and has a maximum width of about 30 miles (Figure 1).

The topography varies from rugged hills in the headwaters to gently rolling terrain in the lower part. The upper part of the drainage area is in rugged hill country with elevations up to 1,000 ft above sea level. With tributary stream beds sloping in excess of 100 ft per mile, the river has an average channel width of about 160 ft and banks about 25 ft high. The bottoms are narrow, averaging about 0.5 mile in width. The channel slopes range from greater than 10 ft per mile at the head to about 1.5 ft per mile near the mouth.

From river mile 25 to its mouth, the uplands change to rolling hills of the Western Hills section of the Gulf Coastal Plains and the valleys widen appreciably, averaging more than 2.5 miles in width. The low water slope is 1.5 ft per mile and high water slope is 2.2 ft per mile. All tributaries in headwaters are short and steep. Those in the lowlands are short, shallow, and filled with dead timbers.

Major tributaries of the River are Sand, Caney Boggy, Rock, East Fork, Coal, Caney (Coon), North Boggy, McGee, Cold Spring, Lick and Crowder creeks. Major tributaries of Clear Boggy Creek are Jackfork, Coal, Goose, Leader, Delaware, Sandy, Caney, Funterhouse, Cowpen, Bois d'Arc and Meyhew creeks.

As it flows southeastward into the Red River, the Boggy passes through four physiographic provinces: (I) A western area, the Arbuckle mountains, is composed of many types of rocks that are complexly deformed, ranging in age from Precambrian through Pennsylvanian, and giving rise to a variety of topographic and drainage characteristics. In this area the headwater gradient is about 100 ft per mile with many small waterfalls and riffles. As the Cretaceous beds begin, the gradient decreases to about 5 ft per mile. All streams in the region have a dendritic drainage pattern. (II) The northeastern part, the Ouachita Mountains, is mainly composed of sandstones, shales, and cherts (Ordovician through Pennsylvanian) that are complexly folded and thrust-faulted northwestward. The topography is mature with good drainage, sharp ridges and narrow valleys. About 75% of the area has moderate to steep slopes. The stream patterns are mainly dendritic, except the minor streams, which generally have trellis patterns. The gradient of McGee Creek is about 6 to 10 ft per mile. North Boggy Creek closely follows the western margin of the Ouachitas, with a gradient of about 3 to 5 ft per mile. (III) The north central area, the Arkoma basin, is composed of Pennsylvanian shale and sandstone that are gently folded into a syn-

streams often occur. In general, trees are restricted to stream edges, since the remaining areas are either grasslands or have been cleared or converted to croplands.

Streams are generally clear, while their headwaters are choked with sandstone and limestone blocks allowing pools to remain even in drought years. Water in Muddy Boggy Creek is less mineralized than that of Clear Boggy Creek. The dissolved solids concentration is usually less than 300 ppm. The chloride concentration rarely exceeds 100 ppm. Factors contributing to the mineralization of the water are the readily soluble limestone in the watershed and oil field brines. Nutrient concentrations indicate that the creek is relatively fertile. There is no known point source of pollution discharging into the mainstream of Muddy Boggy Creek. However, Clear Boggy Creek has a long history of pollution from oil fields.

The only existing major reservoir is Lake Atoka, 4 miles northeast of Atoka. Completed in 1964, it is an Oklahoma City municipal water supply and has a drainage area of 176 square miles. In the planning stage is the Boswell Reservoir, to be located 15 miles west of Hugo, 19 miles upstream from the confluence of Boggy River with the Red River. Another proposed project is Parker Lake, to be at river mile 127. The drainage area will be 172 square miles and will encompass 32 miles of stream in portions of Hughes, Coal, and Pontotoc counties. Another reservoir being planned is the McGee Creek project.

Fish habitats encountered during this study were riffle-pool areas in headwaters and permanent long shallow pools heavily laden with debris and plants in the lowlands. Within the drainage are also some very sandy, shallow spring-fed streams with few pool habitats similar to the streams of western Oklahoma.

ICHTHYOLOGICAL COLLECTIONS

Collections which provide data for this paper on Muddy Boggy River System fishes were made by the author during 1974-1975 from 277 sampling stations and includes 36,080 specimens. Data from collections by G. A. Moore, C. D. Riggs, A. I. Ortenburger, W. Shelton, C. Scalet, B. Branson, F. Wade, R. J. Miller, H. W. Robison, J. McDowell, H. Lindsay, L. Bates, and S. Wilson are also included. In addition museum collections at the University of Oklahoma, Oklahoma State University, Southeastern State University and Murray State College were examined.

Collections made during 1974-75 may be the last before additional damming destroys more riverine habitats. During this survey 18 collections were made between the confluence of Clear and Muddy Boggy Creeks and the Red River, includes 138 from Muddy Boggy Creek, and 121 in Clear Boggy Creek. In addition, collections were made from swamps, ponds, Lake Atoka, and river backwaters in the drainage. Most of the collections from lower, deep-water areas were made with gill nets, while in tributaries and shallow-water areas electro-fishing and minnow seines were used. All specimens were placed in 10% formalin, washed and transferred to alcohol, then cataloged into Oklahoma State University Museum of Zoology or Tulsa University Museum of Zoology.

The first known collection in the drainage was in 1903 by H. Pilsbry (1); this was made at Limestone Gap in North Boggy drainage in Atoka County. The first extensive collections were made from the Muddy Boggy River drainage by the University of Oklahoma Biological Survey in 1929 led by Ortenburger (unpubl. ms.). A series of collections were made in Little Boggy, McGee, Bull, Limestone Gap, and Rock creeks in the upper sections of the drainage. This survey yielded 14 species of fishes.

In 1940, W. Hill collected four species of fishes from Canyon Creek near Jessie. During the 1940's G. A. Moore *et al.* and J. McDowell *et al.* made several collections in the upper headwaters of Clear Boggy Creek near Ada yielding 23 species. During the 1950's collections by C. D. Riggs in the lower sections of Muddy Boggy River yielded 19 species. Additional samples from Clear Boggy Creek headwaters were taken by O. Konales *et al.* and yielded 10 species. During the 1960's additional collections by G. A. Moore and B. Branson *et al.* in Clear Boggy headwaters yielded nine species. In 1963 several collections in lower Muddy Boggy Creek were made by H. Lindsay and L. Bates for the University of Oklahoma Biological Survey and 24 species were collected. During the 1970's W. Shelton and C. Scalet

made 17 collections throughout the headwaters of both Clear and Boggy creeks and Lake Atoka for the University of Oklahoma Biological Survey. They obtained 15 species. Other collections during the 1970's were by F. Wade, H. W. Robison, and R. J. Miller. A study of the fishes of Pontotoc County was undertaken by J. R. Schenck and A. L. Smith in 1973 (2). Six sampling stations were located in the Muddy Boggy River drainage.

Between 1950 and 1970 a number of pond and lake studies were undertaken by the Oklahoma Fishery Research Laboratory in the upper drainage. Many of these ponds were in Atoka County and were later stocked with game fishes. These studies were made for Stringtown Sub-Prison Lake by J. C. Finnell (3), twenty-nine farm ponds in Atoka County by C. M. Kramer (4), Crowley Lake, Canyon Creek, and Stringtown Sub-Prison Lake by R. M. Jenkins (5) and G. E. Hall (6), Ada City Lake by R. M. Jenkins (7), Walter Mayer Lake by C. Wilson (8), and Wistersmith Lake and Boreco Pond in Ada by Collins *et al.* (9). Unpublished sampling records from Oklahoma Game and Fish Department indicate several stocking and sampling studies on Lake Atoka during the late 1960's.

It was the objective of this study to provide information on the species composition and distribution patterns of the fishes inhabiting the Muddy Boggy River prior to faunal alteration from the proposed Boswell and Parker Reservoirs.

In the following list of species of the Muddy Boggy River drainage the number of sampling stations at which a species occurred and the number of specimens collected by the author are indicated in italics in parentheses. Dates in italics indicate times of known collection not reported in the literature.

ANNOTATED CHECKLIST

PETROMYZONTIDAE. Lampreys

1. *Ichthyomyzon castaneus* (Girard). Chestnut lamprey (0-0). One specimen of this species, reported from Chickasaw Creek east of Stringtown. The specimen was removed from a large-mouth bass by P. Motly (S. Wilson, pers. comm.). The specimen was placed in the zoological collection at Murray State College. Rare in the drainage.

ACIPENSERIDAE. Sturgeons

2. *Scaphirhynchus platyrhynchus* (Rafinesque). Shovelnose sturgeon (0-0). Sturgeon were not collected during this survey; however, a game ranger reported seeing this species in a gill net near the mouth of Muddy Boggy in 1970. Rare and should occur only in the lower portions of the drainage.

POLYDONTIDAE. Paddlefish

3. *Polyodon spathula* (Walbaum). Paddlefish (2-7). Seven large paddlefish were collected by the author using a gill net in the lower portion of Muddy Boggy River above confluence with the Red River. Two paddlefish reported in the zoological collections at Murray State College were captured by snag fishermen below Lake Atoka (S. Wilson, pers. comm.). Paddlefish appear to be common in the mainstream of the lower drainage.

LEPISOSTEIDAE. Gars

4. *Lepisosteus oculatus* (Winchell). Spotted gar (2-7). Seven specimens were captured by gill nets from areas of dense aquatic vegetation in Lake Atoka. Rare in the mainstream of the river.
5. *Lepisosteus osseus* (Linnaeus). Longnose gar (3-8). The longnose gar were collected with gill nets in pools below long deep riffles in both Clear and Muddy Boggy creeks, and are common in mainstreams of middle and lower portions of the drainage. One melanistic gar, completely black, lacking any other pigment, including the circle around the eyes, was captured.
6. *Lepisosteus platostomus* (Rafinesque). Shortnose gar (3-8). Shortnose gar are rare in Muddy Boggy River. All specimens were collected in Lake Atoka with gill nets set in shallow water.
7. *Lepisosteus spatula* (Lacepede). Alligator gar (0-0). Although no alligator gar were collected during the

survey, a local net fisherman mentioned taking one specimen with a gill net at the mouth of Muddy Boggy River in 1970. This species is very rare in the drainage.

AMIIDAE. Bowfin

8. *Amia calva* (Linnaeus). Bowfin (1-1). One large specimen was collected from a muddy pool in Lick Creek, close to the mouth of Muddy Boggy River. Fishermen have reported catching bowfin in Caney Creek south of Lone Pine. This is the first known record of the bowfin west of the Kiamichi River. Rare in the drainage.

ANGUILLIDAE. Eel

9. *Anguilla rostrata* (Lesueur). American eel (1-1). One adult eel was collected in Mill Creek at Fittstown with electro-fishing equipment. The first eel collected in this drainage was by Shelton and Scalet in 1970 from Sheep Creek east of Fittstown. Schenck and Smith reported two specimens taken by fishermen below Thompson Lake and a watershed lake on Bois d'Arc Creek in the Clear Boggy drainage (2). These specimens were placed in the East Central State University zoological collections. This species will probably disappear from the river after additional damming blocks their migration from the sea.

CLUPEIDAE. Shads and herrings

10. *Alosa chrysochloris* (Rafinesque). Skipjack herring (1-1). One specimen was captured in a gill net near the mouth of the Muddy Boggy River.
11. *Dorosoma petenense* (Guenther). Threadfin shad (1-2). Two specimens were collected by the author in 1974 from the mainstream of the river near its mouth. This species is common in the Red River and in 1975 the Oklahoma Department of Wildlife Conservation stocked 12,000 threadfin shad in Lake Atoka (Erickson, pers. comm.). The stocking should increase the occurrence of this species in the drainage.
12. *Dorosoma cepedianum* (Lesueur). Gizzard shad (9-15). The gizzard shad occurs in the main channel, tributary streams, and swampy backwater ponds. Rare in the upstream tributaries. Collected in 1970 from Mossy Lake by Wade and from Lake Atoka by Shelton and Scalet.

HIODONTIDAE. Mooneyes.

13. *Hiodon alosoides* (Rafinesque). Goldeye (1-2). Two were collected in lower Muddy Creek southeast of Atoka. The specimens were caught by a gill net set below a long deep riffle. Uncommon in the Boggy drainage.
14. *Hiodon tergisus* (Lesueur). Mooneye (1-4). Four were collected with gill nets, near the mouth of the river at Clay. Rare in the Muddy Boggy drainage.

SALMONIDAE. Trouts.

15. *Salmo gairdneri* (Richardson). Rainbow trout (0-0). In the late 1960's and early 1970's a trout fishing club was established on Mill Creek west of Fittstown. This was a put-and-take fishery but apparently this species did not survive, since collecting in Mill Creek failed to produce a specimen.

ESOCIDAE. Pikes

16. *Esox americanus* (Gmelin). Grass pickerel (10-67). The grass pickerel was common in Lick and McGee creeks in the lower portion of the river. Other specimens were obtained from a bar ditch south of Farris and a small stream near Jasper. This species was found only in the eastern part of the river system, absent from the headwaters of Muddy Boggy Creek, and not collected in the Clear Boggy drainage. Common in the swamps and ponds in the lower flood plain; however, it was not found in the 1960's by O. Ming (pers. comm.) in the same area during his intensive study of this species in eastern Oklahoma.
17. *Esox niger* (Lesueur). Chain pickerel (0-0). Wade (pers. comm.) reported that one specimen was collected near Boggy Depot in a pond near Clear Boggy Creek in 1970. This specimen is in the zoological collection at Southeastern State University.

CYPRINIDAE. Minnows

18. *Campostoma anomalum* (Rafinesque). Stoneroller (110-1769). Common throughout the drainage. Stonerollers appeared in 40% of the collections. Very numerous in the low-order headwater streams with rocky bottoms and clear-water riffles. Rare only in the lower portions of the drainage. First collected by Ortenburger in 1929.
19. *Carassius auratus* (Linnaeus). Goldfish 0-0). The goldfish has been reported from Walter Mayer Ranch Lake by Wilson in 1960 (8). Collins *et al.* found goldfish and twenty-one carp-goldfish hybrids in Wistersmith Lake, in Ada (9). Schenck and Smith reported goldfish in the same lake (2). These goldfish are possibly bait bucket introductions or pet discards.
20. *Cyprinus carpio* (Linnaeus). Carp (3-4). Four specimens were collected by means of the electro-fishing and gill nets set in the mainstream of Clear and Muddy Boggy creeks. Collins *et al.* reported carp and carp-goldfish hybrid from Wistersmith Lake (9). Wade collected carp in Mossy Lake in Bryan County in 1970.
21. *Dionda nubila* (Forbes). Ozark minnow (0-0). One specimen of this species is in the University of Oklahoma Zoological Museum from a 1929 collection made by Ortenburger, six miles east of Wapanucka in Clear Boggy Creek drainage. There are no recent reports of this species in the drainage.
22. *Hybognathus hayi* (Jordan). Cypress minnow (2-4). Four specimens were collected from two localities north of Lane in lower Muddy Boggy Creek. All were found in a series of long, deep pools with large rocks and sandy substrate, below a series of long riffles. Very rare in the Boggy drainage.
23. *Hybognathus nuchalis* (Agassiz). Silvery minnow (5-51). This species was collected in lowland streams with pools and sandy bottoms. Common in the lower sections of the river where it prefers the quiet water in pools and backwater areas not found in the headwaters.
24. *Hybognathus placitus* (Girard). Plains minnow (6-52). A series of seine samples in a backwater pool at the mouth of Muddy Boggy River yielded twenty-three specimens. The plains minnow is common and occurs in large numbers in the Red River, but is rare in the Boggy drainage.
25. *Hybopsis storeriana* (Kirtland). Silver chub (1-2). Two specimens were captured during a seine haul at the mouth of Muddy Boggy River. The silver chub is common in the Red River, but appears to be rare in the Muddy Boggy River.
26. *Notemigonus crysoleucas* (Mitchill). Golden shiner (83-509). Common throughout the drainage, but very abundant in the quiet water of ponds, swamps, and large sluggish tributaries, such as Lick Creek in the lowlands. The golden shiner was found in 30% of all the collections. This species, first reported by Hall (6), has been collected many times by others.
27. *Notropis amnis* (Hubbs and Greene). Pallid shiner (3-7). Rare in the Boggy drainage. Seven specimens were collected at three stations in the lower section of Muddy Boggy Creek north of Lane. This species was found in long, fast-flowing riffles filled with large rocks and gravel. First collected by Moore in 1947 from the headwaters of Clear Boggy Creek, then by Riggs in 1951 from a small tributary of lower Muddy Boggy Creek south of Crystal.
28. *Notropis atherinoides* (Rafinesque). Emerald shiner (29-505). The emerald shiner is apparently rare in headwaters of the drainage and in the lower portion was restricted to large, sluggish pools. This species occurred in large numbers in the lower sections of Muddy Boggy Creek. First collected by Moore as *Notropis percobromus* in 1949 in Clear Boggy Creek headwaters

south of Ada. Collected by Riggs in 1951 from a tributary near Crystal and by Lindsay and Bates in 1963 in the lower sections of the drainage.

29. *Notropis atrocaudalis* (Evermann). Blackspot shiner (5-123). The blackspot shiner was collected in one lowland tributary, Lick Creek, of Muddy Boggy River. The blackspot shiner prefers long shallow lowland pools in areas heavy with plant debris, but with clear water. Uncommon in the drainage.
30. *Notropis bairdi* (Hubbs and Ortenburger). Red River shiner (1-8). This species was collected in Funterhouse Creek, a sandy tributary of Clear Boggy Creek south of Atoka. The Red River shiner is rare in the drainage.
31. *Notropis boops* (Gilbert). Bigeye shiner (106-5758). The bigeye shiner was the most abundant species collected during the survey. This species, recorded in 40% of the collections, was most numerous in the Clear Boggy Creek portion of drainage. It was found in most aquatic habitats except ponds and swamps. It was absent only in the extreme headwaters and at the mouth of the river. Collected by Riggs in 1951 in Mayhew Creek near Boswell. It has since been collected in many other locations.
32. *Notropis buchanani* (Meek). Ghost shiner (12-133). This cyprinid was collected in eleven locations, mostly in large sluggish pools below long, deep riffles in the lower sections of the river. Most specimens were collected near Lane in Muddy Boggy Creek. Rare in the tributaries. First collected by Riggs in 1951 in a tributary of Muddy Boggy Creek south of Crystal.
33. *Notropis camurus* (Jordan and Meek). Bluntnose shiner (0-0). Collected only by Riggs in 1951 from a tributary of Muddy Boggy Creek near Crystal. This specimen, deposited in the O.U. Museum, is the only one recorded from the drainage.
34. *Notropis emiliae* (Hay). Pugnose minnow (6-16). The pugnose minnow appears to be an uncommon resident of the river. It apparently prefers clear, slow-moving waters having an abundance of aquatic vegetation. This species was collected in Lake Atoka and streams emptying into it, and in McGee Creek, in areas with dense vegetation. First reported from Sub-Prison Lake at Stringtown by Hall in 1960 (6). Collected by Shelton and Scalet from Lake Atoka in 1970.
35. *Notropis fumeus* (Evermann). Ribbon shiner (8-21). Rare throughout the drainage. This species was collected in the mainstream of the lower section of the river and its low-gradient tributaries, in areas of long riffles and deep pools. Collected by Shelton and Scalet in 1970 from Muddy Boggy Creek east of Lula in Coal County.
36. *Notropis lutrensis* (Baird and Girard). Red shiner (80-4906). The red shiner was the second most abundant minnow collected, occurring in 29% of the collections. They were most abundant along undercut banks and in pools with a slow current and some plant and animal debris but little silt. This species is the dominant minnow in the Muddy Boggy Creek arm of the river, and rare only in the lower portions. First collected by Moore in 1947, since then by many others.
37. *Notropis ortenburgeri* (Hubbs). Kiamichi shiner (1-13). One collection was made in McGee Creek, a small-sized upland stream with long pools and very small riffles covered with dense aquatic plants, a typical habitat for this species. This location is one-half mile west of the divide between the Kiamichi River and Muddy Boggy River drainages. Very rare in the Boggy system.
38. *Notropis perpallidus* (Hubbs and Black). Colorless shiner (1-3). This species was collected from a long, shallow riffle in Muddy Boggy Creek north of Lane in Atoka County. This rare cyprinid was found in an area of small, shallow riffles with

gravel and rock substrates. The river was very low at the time of the collection.

39. *Notropis pilsbryi* (Fowler). Dusky-striped shiner (0-0). Ortenburger made two collections of this species in 1929 from Clear Boggy and Muddy Boggy creeks. There is no recent record of this species in the Boggy system.
40. *Notropis potteri* (Hubbs and Bonham). Chub shiner (2-22). Two collections of the chub shiner were made from a backwater pool near the Red River and a small tributary near Clay. Very common in the Red River, but rare in the Boggy drainage.
41. *Notropis rubellus* (Agassiz). Rosyface shiner (16-148). Common in areas of long, fast-flowing riffles in the two arms of the river. Rare in the lower portions of the river. It seems to occur most often in the lower sections of the larger tributaries over a fine gravel or sand substrate.
42. *Notropis shumardi* (Girard). Silverband shiner (1-3). The silverband shiner is rare in the drainage. This species was found in the mainstream of lower Muddy Boggy Creek and its larger tributaries and was restricted to larger streams in extremely turbid waters.
43. *Notropis stramineus* (Cope). Sand shiner (28-216). The sand shiner was most numerous in the open-water, riffle-areas over sand bottoms. Its abundance in Clear Boggy Creek and infrequent occurrence in Muddy Boggy Creek indicate that it prefers the clearer water. Collected by Ortenburger in 1929, Moore *et al.* in 1947, and many others.
44. *Notropis umbratilis* (Girard). Redfin shiner (138-4280). The redfin shiner appeared in more collections than any other minnow: 50% of the samples. This species is common throughout the drainage, but prefers the pool environments in the larger streams. Collected by Moore in 1947, Riggs in 1951, Lindsay and Bates in 1963, and by many others.
45. *Notropis venustus* (Girard). Blacktail shiner (36-2008). The blacktail shiner, found throughout the system; was numerous in Clear Boggy Creek, but rare elsewhere in the drainage. This species prefers clear water with gravel substrates. Collected by Moore *et al.* in 1947, Riggs in 1951, and Lindsay and Bates in 1963. The hybrid *N. lutrensis* and *N. venustus* was often found.
46. *Notropis volucellus* (Cope). Mimic shiner (8-35). This species was collected in the lower mainstream of Muddy Boggy Creek, over gravel or hard substrates, with quiet or still water pools. Rare in Clear Boggy Creek.
47. *Notropis whipplei* (Girard). Steelcolor shiner (23-495). The steelcolor shiner is common in the middle and lower mainstream of Muddy Boggy Creek, and absent in the headwaters of Clear Boggy Creek. It was collected in medium-sized streams with clear water and rocky bottoms.
48. *Phenacobius mirabilis* (Girard). Suckermouth minnow (25-95). This species was collected in riffles over gravelly and sandy bottoms with a light silt deposit containing an abundance of organic matter in the form of plant debris. This species was rare in the turbid downstream sections: common in the Clear Boggy Creek where water is clearer. Collected by Ortenburger in 1929, Moore *et al.* in 1947, Lindsay and Bates in 1963, Shelton and Scalet in 1970, and Wade in 1970 from Limestone Creek.
49. *Phoxinus erythrogaster* (Rafinesque). Southern redbelly dace (1-9). This dace was found in only one location, Byrd's Mill Spring Creek west of Fittstown, in the headwaters of Mill Creek. This species was found in a clear, cool, flowing spring with gravel and stony bottom, filled with dense aquatic vegetation. The population in this area appears to be very small. First collected by Shelton and Scalet in 1970, then by Shelton, Scalet, and Randolph in 1973 from the same spring.

50. *Pimephales notatus* (Rafinesque). Bluntnose minnow (64-574). Bluntnose minnows are common in the middle and lower portions of Muddy Boggy Creek. Rare in Clear Boggy Creek and headwaters of Muddy Boggy Creek. This species appears to be more widespread than other *Pimephales*. First collected by Ortenburger in 1929, later in the Sub-Prison Lake at Stringtown by Hall (6) and Finnell (3), Lindsay and Bates in 1963, and many others.
51. *Pimephales promelas* (Rafinesque). Fathead minnow (3-46). This is a common bait and farm pond species and the author suspects that it owes its presence in the upper reaches of Clear Boggy Creek to escapes from one of the many farm ponds in the areas. The fathead minnow was stocked in large numbers during the 1950's and 1960's as forage species in farm ponds by the Oklahoma Game and Fish Department (4). Wade collected several fathead minnows from Mossy Lake in Bryan County. Rare in the drainage.
52. *Pimephales vigilax* (Baird and Girard). Bullhead minnow (52-1057). *P. vigilax* appears to replace *P. notatus* in Clear Boggy Creek and the headwaters of Muddy Boggy Creek. The bullhead minnow was found living mainly in pools and backwaters of the sluggish tributaries. It was common in very turbid waters with sand and silt bottoms. First collected by Ortenburger in 1929.

CATOSTOMIDAE. Suckers.

53. *Carpionodes carpio* (Rafinesque). River carpsucker (2-6). This species is common to the lower mainstream of both the Clear and Muddy Boggy creeks. The river carpsucker was collected in Lake Atoka in gill nets. Large numbers of this species were collected in Lake Atoka during an electro-fishing survey in 1960 by the Oklahoma Game and Fish Department (unpubl. records), and nineteen were captured in Wistersmith Lake in Ada (9). First collected by Ortenburger in 1929 from Muddy Boggy Creek.
55. *Carpionodes velifer* (Rafinesque). Highfin carpsucker (2-3). The highfin carpsucker, a rare catostomid in the drainage, was collected in lower portion of Muddy Boggy River near its mouth. Three specimens were captured by gill nets set in deep waters of the mainstream of the river.
56. *Cyprinella elongatus* (Lesueur). Blue sucker (4-22). The blue sucker was collected from the mainstream of the river below long riffles in deep pools or in deeper portions near the mouth of the river. Collections were made with 300-ft. gill nets with 1.5 to 2.5 inch mesh. It appears that the blue sucker is more abundant than other workers have indicated (10).
57. *Erimyzon oblongus* (Mitchill). Creek chubsucker (2-2). Uncommon in the river. The specimens collected were found in Lick Creek and a small tributary in the lowland portion of the drainage. Both collection sites were filled with patches of *Potamogeton* and had a slight current.
58. *Ictiobus bubalus* (Rafinesque). Smallmouth buffalo (9-40). Common in the downstream sections of the river and Lake Atoka. Collected with gill nets in shallow water in Lake Atoka and below long riffles with quiet pools in the mainstream of the river.
59. *Ictiobus cyprinellus* (Valenciennes). Bigmouth buffalo (3-11). This species inhabits shallow areas in the slow, sluggish, or still waters of the mainstream of the river and was found in the shallow areas of Lake Atoka. It was collected in both areas with gill nets. Collected from Walter Mayer Ranch Lake by Collins *et al.* (9).
60. *Ictiobus niger* (Rafinesque). Black buffalo (1-1). The black buffalo, rare in the Boggy drainage, was found on a deep riffle in Clear Boggy Creek near Boggy Depot. The least numerous of the three buffalo species.
61. *Minytrema melanops* (Rafinesque). Spotted sucker (9-19). The spotted

sucker was found throughout the drainage, in lakes, overflow ponds, sloughs, and clean sluggish streams with sandy, gravelly, or hard clay substrate without silt. This species was more numerous in downstream portions of the drainage. Associated with *Moxostoma erythrurum* in most tributaries. Local fishermen report large numbers of this sucker in the spring spawning runs in Mill Creek. First reported in Sub-Prison Lake at Stringtown by Jenkins in 1954 (5).

62. *Moxostoma duquesnei* (Lesueur). Black redhorse (0-0). Collected by Moore from the headwaters of Clear Boggy south of Ada in 1947. A very rare species in this drainage.
63. *Moxostoma erythrurum* (Rafinesque). Golden redhorse (18-40). Golden redhorses were collected throughout the drainage except in the headwaters of Muddy Boggy Creek which has a high level of siltation. The young of this species were found often in slow-moving streams with soft bottoms. Adults were collected in the mainstream of the river where clear water riffles flow over sand, gravel, boulders, and bedrock, into deep pools free of silt and aquatic vegetation. First collected by Moore in 1947, then by Riggs in 1951.

ICTALURIDAE. Catfishes

64. *Ictalurus furcatus* (Lesueur). Blue catfish (4-5). A rare catfish in the river. Collected in both Clear and Muddy Boggy creeks. Least numerous of the three species of sport catfish.
65. *Ictalurus melas* (Rafinesque). Black bullhead (23-163). The black bullhead was usually found in the downstream sections of small to medium sized streams with low gradient, or in ponds, backwaters of the mainstream of the river. This species was not collected from long riffles in the mainstream of the river. Very common in ponds and lakes: Collins *et al.* reported 467 specimens from Wistersmith Lake (9).
66. *Ictalurus natalis* (Lesueur). Yellow bullhead (19-138). The yellow bullhead was found in waters with heavy vegetation, in shallow ponds and in slow-moving streams with muck bottom and large amounts of plant debris. This bullhead was absent from the mainstream, where other catfish were very numerous. This species was abundant in the downstream waters, while the black bullhead was more common in the middle portions of the drainage. Collected by Riggs in 1951 and many others since.
67. *Noturus gyrinus* (Mitchill). Tadpole madtom (1-1). A specimen was collected from the headwaters of Jack Fork Creek. The specimen was found in slow-moving, clear water with a soft muddy substrate and extensive vegetation. The tadpole madtom was reported by Moore and Cross (11) from Clear Boggy Creek in Pontotoc County, as *Schilbeodes mollis*. Collected by Riggs in 1951 from a tributary near Crystal. A rare species in the Boggy system.
68. *Noturus nocturnus* (Jordan and Gilbert). Freckled madtom (30-362). This species is abundant in the riffles at downstream sections of both arms of Muddy Boggy River. Uncommon in headwaters and near the mouth of Muddy Boggy River. This species prefers the long, deep, fast-flowing riffles of the mainstream. Moore reported the species as *Schilbeodes nocturnus* from Clear Boggy Creek in Pontotoc County (unpubl. ms.). Collected by Shelton and Scalet in 1970, and Lindsay and Bates in 1963.
69. *Ictalurus punctatus* (Rafinesque). Channel catfish (13-745). This species was the most numerous catfish collected. Large numbers were found in the long deep riffles in the mainstream and in the spillway below Lake Atoka. The species has been stocked extensively throughout the drainage during the 1950's and 1960's by the Oklahoma Game and Fish Department in many ponds and lakes (unpubl. records). This spe-

cies was collected by Ortenburger in 1929.

70. *Pylodictis olivaris* (Rafinesque). Flathead catfish (6-73). This species was common in the same downstream riffles as the channel catfish. The young flathead catfish showed a preference for long, deep, fast-flowing riffles with large flat boulders and gravel substrate. Collected by Ortenburger in 1929, Lindsay and Bates in 1963, and Collins *et al.* from Wistersmith Lake (9). The flathead catfish has been stocked in Lake Atoka.

APHREDODERIDAE. Pirate perches

71. *Aphredoderus sayanus* (Gilliams). Pirate perch (7-26). Fairly common in swamps, sluggish streams, and ponds in the Lick Creek area. Collected in streams feeding Lake Atoka and other lowland tributaries. The pirate perch was absent from Clear Boggy Creek arm of the drainage. Hall reported 82 pirate perch from the Sub-Prison Lake at Stringtown (6), and the species was also collected in the same lake by Finnell (3).

CYPRINODONTIDAE. Topminnows

72. *Fundulus kansae* (Garman). Plains killifish (2-63). The plains killifish was collected from two stations in an upstream tributary of Muddy Boggy Creek southwest of Allen in Pontotoc County. The species was thriving in a warm, clear-water stream, in shallow riffles with a fast current and a sandy substrate. Moore in 1947 first collected the plains killifish in the headwaters of Clear Boggy Creek south of Ada.
73. *Fundulus notatus* (Rafinesque). Blackstriped topminnow (35-217). This species, the most abundant cyprinodontid in Muddy Boggy River drainage, was common in quiet waters of the more permanent tributaries. First collected by Moore in 1947, later by Riggs in 1951 and many others.
74. *Fundulus olivaceus* (Storer). Blackspotted topminnow (26-161). The blackspotted topminnow is common in pools and backwater areas, preferring upstream areas while its sibling species *F. notatus* prefers lowland areas. First collected by Wade in 1970 from Shawnee Creek, a tributary of Clear Boggy Creek in Bryan County.

POECILIIDAE. Livebearers

75. *Gambusia affinis* (Baird and Girard). Mosquitofish (143-4208). The mosquitofish is very numerous throughout the drainage; it occurred in 52% of the collections. Found in sluggish streams, swamps, ponds, and quiet water areas of the river, it is common in downstream portions of the river in quiet weedy areas. Collected by Ortenburger in 1929, Moore in 1947, Riggs in 1951, and many others.

ATHERINIDAE. Silversides

76. *Labidesthes sicculus* (Cope). Brook silverside (26-300). Found throughout the drainage but most common in the middle portions of rivers, and rare in downstream segments. Prefers calm, clear waters, but inhabits many small streams with considerable current.
77. *Menidia audens* (Hay). Mississippi silverside (2-13). Rare; the specimens collected were from a backwater pool at the mouth of the river. This is the first known record of this species in the Boggy drainage. This species and threadfin shad were stocked in Lake Atoka during the summer of 1975 to provide forage fish in the lake (Ken Lewis, pers. comm.). The species should increase in abundance if the introduction is as successful as it was in Lake Texoma, where it has become a major forage species.

PERCICHTHYIDAE. Temperate basses

78. *Morone chrysops* (Rafinesque). White bass (1-1). One specimen was collected in a gill net from lower Muddy Boggy Creek north of Lane. This sight feeder appears to be rare in the drainage because of high turbidity, but may move into the river during its spring migration runs from the Red River, where it is common.

79. *Morone saxatilis* (Walbaum). Striped bass (1-3). Three young-of-the-year were captured in a seine haul from a backwater pool near the mouth of the river. This species has been introduced into the Red River from Lake Texoma, where the species was stocked by the Oklahoma Game and Fish Department.

CENTRARCHIDAE. Sunfishes

80. *Chaenobryttus gulosus* (Cuvier). Warmouth sunfish (25-42). Common in quiet sluggish streams of the lower drainage, swamps, and backwaters of the river. Very numerous in Lick Creek. Rare in the headwaters of both Clear and Muddy Boggy creeks. First collected by Riggs in 1951; reported by Hall (6) and Finnell (3) in Sub-Prison Lake at Springtown. Collins *et al.* reported 26 specimens from Wistersmith Lake (9), and Schenck and Smith collected the species from farm ponds (2).
81. *Lepomis cyanellus* (Rafinesque). Green sunfish (193-1878). The green sunfish appeared in more collections (69%) than any other species. The most abundant sunfish is widely distributed throughout the drainage. Very common in smaller, clear streams with pools and rocky bottoms. The green sunfish has been collected by many, but the first was by Ortenburger in 1929.
82. *Lepomis humilis* (Girard). Orangespotted sunfish (47-281). This species is silt tolerant and smaller than other sunfishes. Most common in the sluggish, silty streams and the swamps of the lower portions of the river, the species is widely distributed throughout the drainage. First collected by Ortenburger in 1929.
83. *Lepomis macrochirus* (Rafinesque). Bluegill (135-1113). Bluegill occurs in moderate numbers throughout the system and hybridizes with the green and longear and perhaps other sunfish, but it was not especially abundant at any one station. This was the third most abundant sunfish, occurring in 49% of the collections. This species has been stocked in many farm ponds in the drainage. First collected by Ortenburger in 1929.
84. *Lepomis megalotis* (Rafinesque). Longear sunfish (174-1312). The second most common sunfish in the Muddy Boggy River, this species appeared in 63% of the collections, and is widely distributed throughout the drainage. First collected by Ortenburger in 1929 and since then by many others.
85. *Lepomis microlophus* (Guenther). Redear sunfish (72-179). Redear sunfish were stocked in many farm ponds in the drainage during the 1950's and 1960's by the Oklahoma Game and Fish Department. The redeer is widely distributed in lakes and ponds, but it was not abundant in any collection. The only known collection from a stream was by Miller in 1965.
86. *Micropterus punctulatus* (Rafinesque). Spotted bass (35-73). The spotted bass is found throughout the drainage, but less common than the largemouth bass. This bass is well adapted for small, clear, spring-fed streams such as those in the headwaters of Clear Boggy Creek, where it is very common. First collected by Moore in 1947 and thereafter by Riggs in 1951 from Mayhew Creek.
87. *Micropterus salmoides* (Lacepede). Largemouth bass (55-125). Common throughout the river. The largemouth bass was stocked in many area farm ponds by the Oklahoma Game and Fish Department during the 1950's and 1960's. In addition, *Micropterus salmoides floridanus*, the Florida largemouth bass, was stocked in Lake Atoka in 1975. The largemouth bass was collected first by Ortenburger in 1929.
88. *Pomoxis annularis* (Rafinesque). White crappie (31-195). The white crappie found throughout the drainage, but not very numerous at any one sampling station. Largest numbers were collected in Lake Atoka. The species is tolerant of turbidity and was found in all kinds of wa-

ters. This successful and prolific centrarchid was stocked during the 1950's and 1960's in many ponds and lakes of the area.

89. *Pomoxis nigromaculatus* (Lesueur). Black crappie (4-9). This rare species was found in clear water with thick growth of aquatic vegetation. This species was stocked in many of the ponds in the 1950's and 1960's. A large number of black crappie were reported in Sub-Prison Lake at Stringtown by Hall (6) and Finnell (3).

PERCIDAЕ. Perches

90. *Etheostoma chlorosomum* (Hay). Bluntnose darter (19-46). The bluntnose darter was rare except in the muddy waters of Lick Creek. This species shows a preference for muddy, sluggish streams with soft, muddy bottoms, or muddy bar ditches and backwaters of the river. First reported in Sub-Prison Lake at Stringtown by Hall (6); collected by Riggs in 1951, and Shelton and Scalet in 1970.
91. *Etheostoma gracile* (Girard). Slough darter (53-213). This second most abundant darter collected with wide distribution throughout the drainage. The slough darter was found in quiet or slow-moving, often swampy creeks, where the bottom is soft and covered with organic debris, and fairly dense vegetation. Collected by Riggs in 1951, Lindsay and Bates in 1963, and in Leader Creek by Shelton and Scalet in 1970.
92. *Etheostoma nigrum* (Rafinesque). Johnny darter (2-3). This darter is rare in the Boggy drainage. Two specimens were collected from McGee Creek and the third from a tributary of North Boggy Creek in Pittsburg County. This species was found in small, sandy-bottom streams in areas of shallow riffles with dense plant growth.
93. *Etheostoma parvipinne* (Gilbert and Swain). Goldstripe darter (1-1). One specimen of this species was collected in a deep pool below a small riffle from the West Branch of Caney Creek, a tributary of Clear Boggy Creek, one mile east and six miles south of Atoka. This stream was very small and muddy, with dead trees and logs. Twenty additional specimens were collected by J. Taylor and G. Bendrim in 1967 in two bog areas 0.5 miles northwest and southwest of Boehler. This species is very rare in the Muddy Boggy drainage.
94. *Etheostoma proeliare* (Hay). Cypress darter (1-1). One specimen was collected from a long shallow pool filled with aquatic vegetation near the source of a rocky tributary of McGee Creek. This darter is very rare in Boggy drainage.
95. *Etheostoma radiosum* (Hubbs and Black). Orangebelly darter (112-1549). This species was the most numerous darter in the drainage, and occurred in 40% of the collections. Found in a broad range of habitats, it seems to prefer small, fast-flowing riffles. Moore and Rigney collected and described the holotypes and paratypes of *Poecilichthys radiosus paludosus* (Kiamichi orangebelly darter) from Bois d'Arc Creek in Pontotoc County (12). Collected by Ortenburger in 1929, by Riggs in 1951 and by many others.
96. *Etheostoma spectabile* (Agassiz). Orangethroat darter (8-141). This darter was found in the headwaters of Clear Boggy Creek near Fittstown and in a spring near Bromide. This darter is rare but did occur in large numbers where it was found in the drainage. The orangethroat darter has a much narrower range of habitat than *E. radiosum*. Collected by Moore, 1947, Miller, 1951, in Mill Creek, Shelton and Scalet, from Canyon and Mill Creek, and Wade, 1970, in Shawnee Creek.
97. *Percina caprodes* (Rafinesque). Logperch (1-1). Appears to be rare in Boggy drainage. One specimen was collected with electro-fishing gear in a long, deep riffle on Clear Boggy Creek near Boggy Depot.
98. *Percina copelandi* (Jordan). Channel darter (6-6). Rare in Boggy

drainage. This *Percina* prefers the sand and gravel bars at the interface between the pools and riffles in the mainstream of the river. All collections were from the main channel of lower Muddy Boggy Creek. Moore collected this darter in 1947 from the headwaters of Clear Boggy Creek near Ada.

99. *Percina phoxocephala* (Nelson). Slenderhead darter (11-62). This species appears to be common in areas of deep, rocky fast-flowing riffles. Most were collected by use of electro-fishing gear from mainstream riffles of lower Muddy Boggy Creek. Associated with the dusky darter in most collections. First collected by Lindsay and Bates from Clear Boggy Creek in Choctaw County in 1963.
100. *Percina sciera* (Swain). Dusky darter (20-115). Common throughout drainage in fast-flowing tributaries and sand to sandy gravel substrate. Rare in the upper headwaters of Muddy Boggy Creek which had a high degree of siltation. Four specimens, 190 mm S. L., were collected in the headwaters of Clear Boggy Creek. Side blotches and breast scales were lacking. First reported by Moore in 1974, then by Lindsay and Bates in 1963, and Shelton and Scalet in 1970.

SCIAENIDAE. Drums

101. *Aplodinotus grunniens* (Rafinesque). Freshwater drum (9-40). This species appears to be common in the mainstream of the river. It was found in most gill-net and electro-fishing samples from the lower portions of the drainage.

In addition to the above species, a number of other species may occur but have not been collected yet. This list is based on collections from Red River near the Boggy River mouth.

These species are:

1. *Hybopsis aestivalis* (Girard). River chub.
2. *Notropis blennioides* (Girard). River shiner.
3. *Notropis cornutus* (Mitchell). Common shiner.
4. *Ammocrypta clara* (Jordan and Meek). Western sand darter.
5. *Stizostedion canadense* (Smith). Sauger.
6. *Stizostedion vitreum* (Mitchell). Walleye.
7. *Mugil cephalus* (Linnaeus). Striped mullet.

DISCUSSION

The Muddy Boggy River demonstrates both longitudinal and east-to-west succession in respect to ichthyofauna. Species richness increases progressively downstream and eastward in the drainage. Shelford (14) and Shelden (15) have observed that the linear succession of stream fishes is due predominantly to the addition of species toward the stream mouth, and this is generally true in Muddy Boggy River. Headwater stations yielded 26 species in Muddy Boggy Creek and 30 species in Clear Boggy Creek, and downstream stations yielded 61 species in Clear Boggy Creek and 69 in Muddy Boggy Creek. The eastward succession is indicated by the occurrence of 61 species in the western arm compared to 69 species in the eastern arm of the drainage.

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