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A NEW CATOSTOMID FISH,
MOXOSTOMA (THOBUERNIA) ATRIPINNE, FROM THE
GREEN RIVER DRAINAGE, KENTUCKY AND TENNESSEE

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UNTIL the recent discovery of *Thoburnia hamiltoni* in the Roanoke River system in Virginia (Raney and Lachner, 1946), this nominal genus was thought to contain a single species, *T. rhothoeca* (Thoburn). That fish is characteristic of the James River drainage, Virginia, but occurs also in the headwaters of the Shenandoah and New rivers of the Potomac and Kanawha river systems in Virginia and West Virginia. It is now possible to make known a third kind of *Thoburnia*. Geographically, this is a relict species occurring in headwaters of the Barren River drainage of the Green River system, far to the west of its relatives (Map 1). Morphologically, it is a highly distinctive fish that is less notably adapted to life in mountain torrents than are the other species of *Thoburnia*.

RELATIONSHIPS OF *Thoburnia*

The isolated position once assigned *Thoburnia*, as a tribe (Thoburniini) of the Catostominae, was based on "the striking structural features of the genus: the obsolete air bladder of the adult, the obliterated fontanelle, and the subplicate lips" (Hubbs, 1930: 44). Recent investigations of the Weberian apparatus and the opercular series of the Catostomidae by Nelson (1948; 1949) and on the systematics of the Catostominae by Robins and Raney (1956) have led these authors to conclude that both *Hypentelium* and *Thoburnia* are more closely related to *Moxostoma* than to *Catostomus* and to assign these genera to the tribe Moxostomatini. My observations support this interpretation, especially for *Thoburnia*. Reduction in size of the swimbladder and closure of the fontanelle are apparently adaptive specializations for life in swift water.

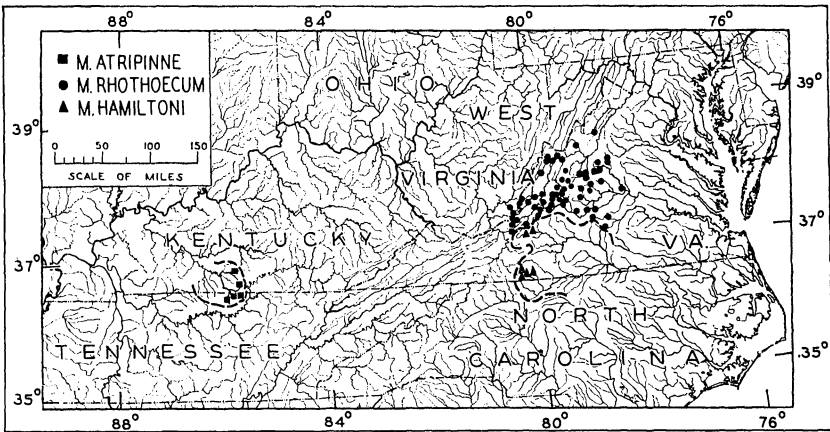
The number of chambers in the swimbladder is perhaps of significance in attempts to reconstruct phylogeny. Two chambers are characteristic of most genera of the Catostomidae, including those of the generalized subfamilies Cycleptinae and Ictiobinae, as well as of *Catostomus* and related genera in the Catostominae. Three chambers are found only in *Moxostoma*, the allied monotypic genus *Lagochila*, and, reportedly as an individual variation, in *Minytrema melanops*. It seems most plausible to interpret the three chambers of the swimbladder of *Moxostoma* as a *de novo* feature, postdating the separation of *Moxostoma* from the lines leading to *Hypentelium* and *Thoburnia*. Thus, *Lagochila lacera* may be regarded as a derivative from the genus *Moxostoma*. The presence of 12 scale rows around the caudal peduncle in *Lagochila lacera* further indicates its derivation from the subgenus *Moxostoma* (the subgenera *Scartomyzon* and *Megapharynx* both have 16 caudal-peduncle rows, as shown by Robins and Raney, 1956). Since *Lagochila lacera* differs from *Moxostoma* only in the modification of its lips (Hubbs, 1930; Trautman, 1957), the advisability of maintaining it as a separate genus may be seriously questioned.

In the light of present information, the number of chambers in the swimbladder, two in *Thoburnia* and three in *Moxostoma*, stands as an invariable distinction between these groups. The swimbladder of *Thoburnia*, though often small, has two well-formed chambers and is not properly described as obsolete (Fig. 1E, F). *Minytrema melanops*, which typically has two chambers, very rarely has three chambers (Hubbs, 1930: 9; and personal communication from Royal D. Suttkus). This variation suggests that difference in number of chambers is not profound and merits cautious use.

In the new species there is notable variation in the size of the swimbladder (Fig. 1B–D). At one extreme, it is a large structure extending posteriorly halfway back on the pelvic fins and with a diameter twice that of the eye or equal to the bony interorbital width. At the other extreme, the second chamber of the bladder may be reduced to a slender projection that does not extend to the anterior extremity of the pelvic girdle and has a diameter no greater than the pupil. Most individuals are variously intermediate. Thus, there is a broad gradient in size of the swimbladder ranging from the short, slender, and almost rudimentary condition found in some individuals of the previously known species of *Thoburnia* (Fig. 1E, F) to the enlarged structure characteristic of most species of *Moxostoma* (Fig. 1A).

The obliteration of the posterior fontanelle, another supposedly distinctive feature of *Thoburnia*, is now shown to be useless as a

generic character. In many species of *Moxostoma* the fontanelle is large (Fig. 2A), but its breadth may be restricted as in *Moxostoma rupiscartes* (Fig. 2B). In the new species of *Thoburnia* the fontanelle is constantly well developed at all ages (Fig. 2C), normally separating the parietals completely. In *Moxostoma* (*Thoburnia*) *rhothoecum* the fontanelle varies notably in development: (1) it may separate the parietals completely and be as large as in the new species (Fig. 2D); (2) be much restricted by a long suture of the parietals and only limited cartila-



MAP 1. Distribution by record stations of three species of *Moxostoma* (subgenus *Thoburnia*). The dashed lines partly delineate the watersheds of the Barren River (range of *M. atripinne*) and the Roanoke River (range of *M. hamiltoni*). In addition to the records plotted by Raney and Lachner (1946), localities of those specimens added to the Cornell University collection until 1952 (provided by Edward C. Raney) and to the University of Michigan Museum of Zoology collection until 1958 are included.

ginous separation of the frontals (Fig. 2E, F); or (3) be completely obliterated (Fig. 2G). The last condition may be found in young as well as in adults. The gradation in development is nearly perfect.

The lips in the species of *Moxostoma* present notable variations in extent, configuration, development of papillae, plicae, and other surface features (see, e.g., Robins and Raney, 1956). There are also marked interspecific differences in lip structure among the species of *Thoburnia* (Table II). These differences furnish some good specific characters but are not such as to justify their use in the distinction of genera.

In the species of *Thoburnia* the sutures between the frontals and parietals lie in a nearly straight line, that is, at right angles to the body axis (Fig. 2C-G), a condition approximately duplicated in *Catostomus catostomus* and closely approached in some species of

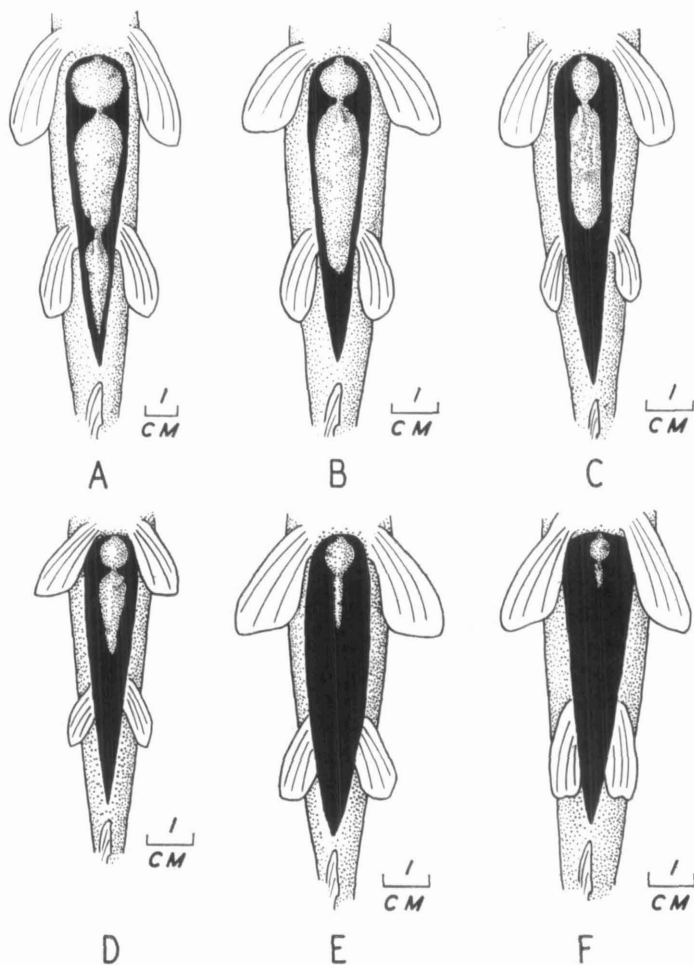


FIG. 1. Ventral views of body in three species of *Moxostoma* showing variable development of swimbladder: A.—*Moxostoma erythrurum*, UMMZ 86247, an adult male 182 mm. in standard length; River Raisin, Dundee, Monroe Co., Mich. B-D.—*Moxostoma atripinne*, adult females 123, 126, and 106 mm. long; Long Fork Creek, Macon Co., Tenn. E.—*Moxostoma rhothoecum*, UMMZ 174485, an adult 120 mm. long; East Swift Run, Shenandoah National Park, Greene Co., Va. F.—*Moxostoma rhothoecum*, UMMZ 171376, an adult 126 mm. long; Looney Creek, Botetourt Co., Va.

Pantosteus. In several species of *Moxostoma* the frontoparietal sutures slant outward and backward from the posterior fontanelle (Fig. 2A, B). This condition, with variations in angle, is duplicated in *Ictiobus*, *Carpiodes*, *Minytrema melanops*, *Erimyzon sucetta*, *Catostomus commersoni*, and *Hypentelium nigricans*. The significance of this variation is not immediately apparent. It may be noted, however, that posterior

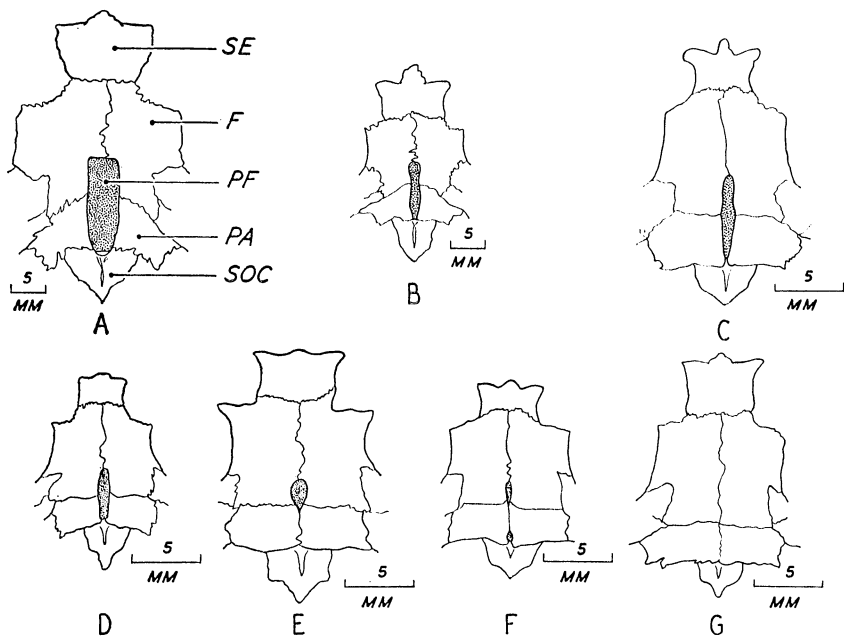


FIG. 2. Dorsal views of skull in four species of *Moxostoma* showing variable development of posterior fontanelle: A.—*Moxostoma poecilurum*, UMMZ 161186-S, a male 268 mm. in standard length; 2.5 mi. N. of Bogue Chitto, Lincoln Co., Miss. B.—*Moxostoma rupiscartes*, UMMZ 165609, an adult 167 mm. long; Chauga River, Oconee Co., S. Car. C.—*Moxostoma atripinne*, UMMZ 169505, an adult female 126 mm. long. D—F.—*Moxostoma rhothoecum*, UMMZ 174485, adults 86, 120, 96 mm. long; East Swift Run, Shenandoah National Park, Greene Co., Va. G.—*Moxostoma rhothoecum*, UMMZ 171376, an adult 126 mm. long; Looney Creek, Botetourt Co., Va. F, frontal; PA, parietal; PF, posterior fontanelle; SE, supraethmoid; SOC, supraoccipital.

displacement of the lateral end of the suture permits an increased area for the origin of the dilator operculi muscle, and seems to be correlated roughly with a slow-water habitat (*Hypentelium* excepted). The relationship seems to merit study.

In several other features the new species agrees with *Moxostoma* (*auct.*) or is more or less intermediate between that genus and the previously described forms of *Thoburnia*. For example, the peritoneum is silvery as in *Moxostoma*; the dorsal fin is tipped with black as in *M. cervinum* and *M. ariommum*, and the stripes on the body are at least superficially more like those of *M. cervinum* and *M. rupiscartes* than those of the other species of *Thoburnia*; the form of the mouth and lips and the size of the eye approach that in some species of *Moxostoma*. Thus, though surely referable to *Thoburnia*, the new species narrows the gap between *Moxostoma* and *Thoburnia*, which further supports the contention that *Thoburnia* is intimately related to *Moxostoma*.

GENERIC PLACEMENT

On the April night in 1947, when the first blackfin sucker was revealed by the light of our collecting torches, Norman J. Wilimovsky and I immediately perceived that it was a striking but undescribed species. We assigned it a provisional manuscript name in *Moxostoma* and, although subsequent study revealed its alliance with *Thoburnia*, the totality of its characters remains—the fish looks like a *Moxostoma*.

The recent researches of Robins and Raney have substantially clarified the taxonomy of *Moxostoma*. In their proposed classification (1956) they define three subgenera and emphasize the intimacy of relationship of one of these (*Scartomyzon*) with *Thoburnia* (pp. 42–43), noting especially the intermediacy in certain features of *M. ariommum*. The closeness of these groups is now further demonstrated by the new *Thoburnia*, which also is intermediate in some characters. *Thoburnia* and *Scartomyzon* share the following: (1) the caudal-peduncle scale count is 16 (7–2–7); (2) the dorsal fin is short, usually with 10 to 12 rays; (3) the caudal fin is small, shallowly forked, and has rounded lobes; and (4) breeding males (in at least certain species of each group) have a sprinkling of granular tubercles over the head. They differ chiefly in the number of chambers in the swimbladder (two in *Thoburnia*, three in *Scartomyzon*) and in the configuration of the frontoparietal suture. Robins and Raney (1956: 6) considered *Scartomyzon* to be the most primitive of the subgenera of *Moxostoma*. If correct, and if the interpretation that a two-chambered swimbladder is antecedent to a three-chambered one is sound, then *Thoburnia* as a group may be regarded as still more generalized than *Scartomyzon*. At the same time it should be recalled that the two eastern species of

Thoburnia are specialized for living in the tumultuous waters of mountain streams.

Individual judgment may vary as to the taxonomic status to be accorded *Thoburnia*. *Scartomyzon* appears to be at least as closely related to *Thoburnia* as to *Megapharynx* and *Moxostoma*. Indeed, species such as *ariommum*, *cervinum*, and *rupiscartes* seem much closer to *Thoburnia* than to *Moxostoma* (s.s.). In my opinion, co-ordinate status for the four groups constitutes the most logical arrangement and, since the morphological data do not appear to justify the recognition of genera, I rank *Thoburnia* among the subgenera of *Moxostoma* (s.l.). Dr. C. Richard Robins, who has examined the new species of *Thoburnia* and with whom I discussed this proposed change, concurs in the decision.

SUBGENERIC DIAGNOSIS

Since the new species differs in certain features from those previously known, it is desirable to present an emended diagnosis of the subgenus *Thoburnia*: catostomid fishes of the genus *Moxostoma* with the dorsal fin short, the principal rays 10, occasionally 9 or 11; body terete; occiput straight; scales rather small, with many strong radii in all fields; lateral line well developed, with 43 to 51 scales on body, caudal peduncle scales usually 16 (7-2-7); Weberian apparatus with the second-third intervertebral space patent, the fourth neural spine of moderate length, with an extreme posterior curvature of the fourth pleural ribs (Nelson, 1948: 236-38); swimbladder of two chambers, slightly to greatly reduced in size; posterior fontanelle well developed (completely separating parietals) to obliterated; frontoparietal sutures in a straight line, perpendicular to body axis; head small; lower lip plicate-papillose to largely plicate, truncate posteriorly; caudal fin small, shallowly forked, with rounded lobes; breeding males with small, granular nuptial tubercles on head; upperparts faintly to boldly striped with light and dark, sharply set off just below axial line from the light underparts.

Moxostoma (Thoburnia) atripinne, new species

Blackfin Sucker

(Pls. I-II; Figs. 1B-D, 2C, 3A-B)

MATERIAL.—The holotype, University of Michigan Museum of Zoology 169506, a tuberculate, mature male 88.8 mm. in standard length, was collected in Salt Lick Creek (which joins Long Fork to flow into the Barren River, a tributary to Green River in the Ohio River Basin)

at state highway 52 bridge, elevation 765 feet, Red Boiling Springs, Macon County, Tennessee, on April 7, 1953, by Howard E. Winn, James J. Keleher, Douglas M. Bailey, and Reeve M. Bailey. This locality, like all those known for the species except that in Fallen Timber Creek, may be located on the Red Boiling Springs Quadrangle, 1945 printing, U. S. Geological Survey. Six paratopotypes, UMMZ 165370, 44 to 66 mm. long, were taken with the holotype.

Additional specimens are as follows: UMMZ 166406 (6), 49 to 67 mm. long, Long Fork, just above state highway 52, 5 mi. WSW of Red Boiling Springs (7.1 mi. by highway), Macon Co., Tenn., May 5, 1952, Marian K., David R., D. M. and R. M. Bailey. UMMZ 169505 (9), 108 to 128 mm., Long Fork (probably at the above station), Macon Co., Tenn., Aug. 9, 1950, Glenn Gentry and Randolph Shields. UMMZ 165352 (5), 41 to 54 mm., Trace Creek (tributary to Line Creek, tributary to Barren River) above state highway 22 crossing, elevation 750 feet, Hermitage Springs, Clay Co., Tenn., Apr. 7, 1953, Winn, Keleher, D. M. and R. M. Bailey. UMMZ 174443 (2), 48 and 58 mm., same locality, Apr. 28, 1954, Winn and Norman Benson. UMMZ 174473 (3), 61 to 85 mm., same locality, Apr. 30, 1954, Winn and Benson. UMMZ 168211S (2), 50 mm., skeletons, same locality, Aug. 8, 1954, Bailey family. UMMZ 165331 (7), 74 to 128 mm., East Fork (tributary to Barren River), just below new bridge on state highway 63, elevation 760 feet, 5 mi. NW of Tompkinsville, Monroe Co., Ky., Apr. 6, 1953, Winn, Keleher, D. M. and R. M. Bailey. UMMZ 154643, 105 mm., Fallen Timber Creek (tributary to Skeggs Creek, tributary to Barren River), just below state highway 90, 8 mi. SE of Glasgow, Barren Co., Ky., Apr. 10, 1947, Norman J. Wilimovsky and R. M. Bailey.

DIAGNOSIS.—A species of the subgenus *Thoburnia* that is unique in having a large black blotch on the distal half of the anterior dorsal rays; upperparts and sides boldly striped with black; peritoneum light, with scattered melanophores; posterior fontanelle rather well developed, persistent; swimbladder only moderately reduced in adults; mouth smaller than in other species, the lips not papillose; eye larger; caudal peduncle somewhat shorter; pectoral fin shorter.

DESCRIPTION.—Proportional measurements are presented in Table I, and many of the characters of the species are evident in the illustrations (Pls. I-II, Figs. 1-2) and the comparisons (Table II).

The color pattern includes features that not only mark the species as striking in appearance among its associates, but serves most effectively to distinguish it from its closest relatives. The jet-black blotch covering the distal half of the anterior 5 or 6 dorsal rays (Pl. I) is espe-

cially noticeable. The sides and upperparts are marked with a series of dark lengthwise stripes, 2 below the lateral line and 6 or 7 between lateral line and dorsal origin, each passing along a line of contact between two horizontal scale rows. The stripes are less obvious in adults than in juveniles. Except on the back, where they are faint, the stripes are dark brownish black and contrast sharply with the intervening olive-gold stripes, which are only slightly wider. The black of the lowermost stripe gives way abruptly to the shining white of the lower side and entire undersurface.

The back is marked with two prominent black blotches or saddles, one at the base of the dorsal, one above the anal base. Each is inclined downward and forward. Fainter saddles may be discerned at the base of the upper caudal rays and near the end of the depressed dorsal rays. There is a diffuse dark blotch on the nape just behind the occiput. On the middle of the side there are 4 or 5 (the anterior two sometimes conjoined) blackish blotches. Except for the conspicuous blotch, the dorsal fin is white, faintly washed with olive, and is immaculate, as are the anal and pelvic fins, which are very pale yellow or olive. The pectoral fin is faintly washed with pinkish olive in adults of both sexes, but is pale yellow in juveniles. The caudal fin is pinkish olive except that near the middle the rays are dark-edged for most of their length. Unlike *Moxostoma cervinum*, which also has black distally on the anterior dorsal rays, the caudal lobes are not black-tipped. In contrast to the other species of *Thoburnia*, in which the peritoneum is black, *M. atripinne* has a silvery peritoneum that is flecked with a few melanophores. The intestine is long, consisting of an S-shaped loop, which extends throughout most of the length of the coelom, and one or two additional anterior coils.

Meristic data on fin rays and scale rows were taken on 40 specimens, as follows (counts for the holotype are indicated by asterisks; frequencies of counts are given in parentheses): principal dorsal rays, 9 (one specimen), 10* (38); principal anal rays, 7* (38), 8 (1); principal caudal rays (branched rays plus two), 17 (1), 18* (37); pectoral rays, 14-14 (3), 14-15 or 15-14 (4), 15-15* (18), 15-16 or 16-15 (10), 16-16 (5); pelvic rays, 8-8 (5), 8-9 or 9-8 (8), 9-9* (27); predorsal scale rows, 16 (2), 17 (15), 18* (17), 19 (5), 21 (1); scale rows from dorsal-fin origin to (but excluding) lateral line, 6 (17), 7* (23); scale rows from anal-fin origin to lateral line, 6 (26), 7* (14); lateral-line scales to base of caudal, 46 (10), 47 (11), 48* (14), 49 (2), 50 (1); body-circumference scale rows (*a*) above lateral lines, 12 (7), 13* (31), 14 (2); (*b*) below lateral lines, 15 (1), 16 (9), 17 (15), 18 (8), 19* (5), 20 (2), and (*c*) total, 29 (1), 30

TABLE I
MEASUREMENTS OF *Moxostoma atripinne*

The proportions are expressed as thousandths of the standard length. Specimens numbered 1, 10, and 11 are from UMMZ 169505; 2 is from UMMZ 154643; 3, the holotype, is UMMZ 169506; 4 and 9 are from UMMZ 165331; 5-8, 12, and 13 are from UMMZ 166406. For data see text.

Measurement	1	2	3	4	5	6	7	8	9	10	11	12	13
Sex	M	M	M	M	M	M	M	M	F	F	F	F	F
Age group	III	III	II	II	I	I	I	I	III	III	III	I	I
Maturity	ad.	ad.	ad.	ad.	juv.	juv.	juv.	juv.	ad.	ad.	ad.	juv.	juv.
Standard length (mm.)	114	105	86	81.5	67	63.7	60.5	51.5	128	127	124	62.5	49
Dorsal origin to snout tip	461	483	462	477	481	471	463	478	478	454	469	480	469
Dorsal origin to caudal base	557	552	574	553	542	549	567	563	543	550	534	547	551
Dorsal origin to occiput	284	310	279	288	275	278	256	272	305	283	293	283	273
Pelvic insertion to snout tip	535	503	514	504	522	527	501	520	505	535	532	507	502
Anal origin to caudal base	228	251	253	255	230	229	248	245	238	217	222	240	241
Body, greatest depth	198	187	209	215	201	204	207	208	191	191	198	208	206
Body, greatest width	187	167	181	189	184	173	175	179	172	170	170	176	173
Caudal peduncle length	154	162	165	156	157	157	162	163	160	142	141	154	155
Caudal peduncle depth	104	100	101	107	101	94	99	99	98	98	102	99	90
Head length	223	210	215	222	224	221	235	239	221	205	221	232	239
Head depth	140	138	147	153	158	151	155	161	130	142	140	155	155

Head width	160	158	166	164	160	159	165	164	153	158	160	163
Interorbital, least bony width	73	71	72	79	81	78	74	73	76	73	78	71
Snout length	95	91	93	92	100	96	99	99	91	98	101	92
Orbit length	58	59	59	67	67	64	68	56	54	60	67	71
Lips, over-all width	66	64	70	65	67	64	60	58	64	70	69	61
Snout tip to posterior border of lips	83	76	74	74	78	75	73	68	71	81	72	73
Suborbital, fleshy width	63	58	63	70	67	63	63	61	60	56	70	61
Dorsal fin, depressed length	254	247	250	269	245	246	233	215	216	241	226	227
Dorsal fin base	137	135	140	147	137	132	127	134	131	139	123	133
Anal fin, depressed length	235	262	231	252	212	204	180	...	213	229	194	188
Caudal fin length	216	230	227	216	264	251	246	190	210	206	258	263
Pectoral fin length	209	230	179	193	218	210	188	...	182	196	186	198
Pelvic fin length	198	190	185	202	167	170	155	...	148	162	165	171

TABLE II

COMPARISON OF THREE SPECIES OF THE SUBGENUS *Thoburnia*

Character	<i>Moxostoma atripinne</i>	<i>Moxostoma rathoecum</i>	<i>Moxostoma hamiltoni</i>
Dorsal fin	With large black blotch	Immaculate	Immaculate
Dark stripes on body	Pronounced on sides and dorsum	Faint on sides, usually invisible on dorsum	Weak on sides, faint on dorsum
Peritoneum	Silvery	Black	Black
Melanophores on lower part of cheek	Few or none	Numerous, small	Numerous, small
Over-all width of lips in head length	3.2 to 3.7	2.4 to 2.8*	2.2 to 2.4*
Distance from tip of snout to posterior border of lower lip in head length	2.8 to 3.3	2.2 to 2.7*	2.0 to 2.2*
Plicae of upper lip	More uniform and regular, few with cross furrows	Quite uniform and regular, few with cross furrows	Less uniform in length, cross furrows common
Form of lower lip	Posterior border truncate; lip little produced posteriorly	Posterior border almost truncate or halves of lip somewhat convex with shallow median notch; lip moderately produced posteriorly	Halves of lower lip each convex behind to form deep median notch; lip notably produced posteriorly
Surface of lower lip	Anterior half plicate; posterior half with few cross furrows that divide the plicae mostly into short ridges, with few that are oval or circular	Anterior half plicate; posterior half with many cross furrows that divide the plicae into short ridges which are mostly oval or subcircular near distal margin	Anterior third largely plicate; middle third with cross furrows forming short ridges and ovals; posterior third mostly with circular papillae
Caudal peduncle length in standard length	6.0 to 7.0	5.4 to 6.2*	5.3 to 6.1*
Pectoral fin length in pectoral-pelvic distance	1.4 to 1.8	1.05 to 1.5	1.1 to 1.5

* Data from Raney and Lachner, 1946.

(3), 31 (8), 32 (13), 33 (8), 34* (4) 35 (3); caudal-peduncle scale rows, 7-2-6 = 15 (1), 7-2-7 = 16* (39).

Radiographs were taken of the lateral aspect of 14 specimens of *Moxostoma atripinne* (UMMZ 165331, 165370, and 169506). Including the 4 vertebrae in the Weberian complex and the urostylar vertebra, total vertebral counts are as follows: 43 (2), 44 (11, including the holotype), and 45 (1). In addition to the vertebrae of the Weberian complex, there are 19 to 21 (usually 20) precaudal vertebrae, and 19 to 21 (usually 19 or 20) caudal vertebrae. There are 16 or 17 pairs of ribs beginning on the vertebra behind the Weberian complex; the first 10 pairs are long, after which the ribs become progressively weaker and shorter. No epineurals or epipleurals are evident on the X-ray plates.

In *Moxostoma atripinne* the pseudobranchium is moderately well developed and exposed. The gillrakers on the first arch number 17 or 18: the lower three or four are more or less rudimentary. The uppermost rakers are short though well developed, the ones in the upper-middle part of the arch are longest and are rather slender and pointed distally, and those on the lower part become progressively shorter and thicker and have blunt tips. The semicircular pharyngeal arch is rather heavy, even in the dorsal part, and has about 40 compressed teeth of which the lowermost are the largest.

The pleural ribs (Nelson, 1948) are short, broad, bluntly rounded distally, and are deflected downward and backward (at an angle of about 45° with the body axis) as well as diverging outward. The esophageal supports, which are long and slightly compressed and pointed distally, are parallel with one another and project backward and downward. The second-third intervertebral space is patent. The space between the united second and fourth pleural ribs is broadly elliptical and opens laterally. The neural complex is much reduced in height and the crest is low.

As is true in many species of the genus (Robins and Raney, 1956), the tripus of *Moxostoma atripinne* (Fig. 3A, B) displays diagnostic features.¹ The fulcrum, which lies somewhat nearer the anterior than the posterior process, rises with a slight forward tilt and crosses the axis of the tripus at a right angle. The lower edge is straight and the anterior process rises rather steeply. The tip of the posterior process is scarcely upturned; anteriorly it rises in a strongly concave arc to a

¹ Robins and Raney (1956: 52, Pl. 1) indicated that their drawings are of the right tripus. A check with both authors confirms that this is in error; the left tripus is shown in lateral and dorsal views, as in my Figure 3. The error carries over into the text descriptions.

well-defined shoulder just behind the fulcrum. The dorsal surface of the anterior shelf is notably concave, with two deep fossae. The shelf rises steeply toward its mesial edge, which is broadly convex. Laterally the shelf rises less; anteriorly the edge is parallel with the axis of the tripus, but posteriorly it flares laterally toward the base of the fulcrum and the external border is strongly concave. The greatest width of the shelf exceeds that of the fulcrum and is contained about 3.5 times in

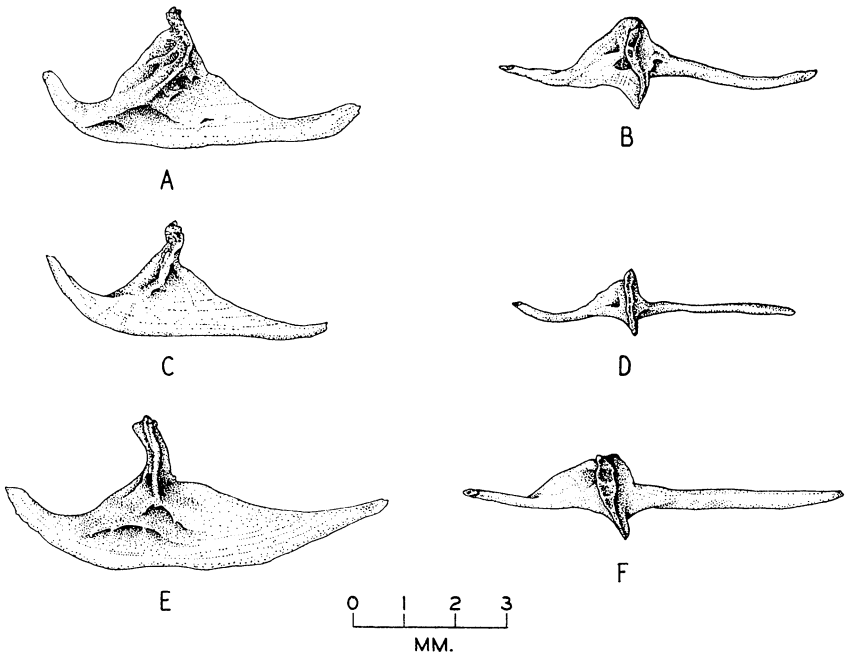


FIG. 3. Form of left tripus in subgenus *Thoburnia* (anterior is to the left). Left column, lateral view; right column, dorsal view. A-B.—*Moxostoma atripinne*, UMMZ 169505, 126 mm. standard length. C-D.—*Moxostoma rhothoecum*, UMMZ 171376, 126 mm. long; Looney Creek, Botetourt Co., Va. E-F.—*Moxostoma hamiltoni*, UMMZ 171388, 150 mm. long; Roanoke River, Montgomery or Roanoke Co., Va.

the length of the tripus. Laterally the tripus is roughened by thickened struts of bone that support the anterior shelf. The mesial face of the tripus is smooth, the structural strengthening for this side of the shelf being provided by the walls of the fossae in the shelf. The fulcrum has a single, wide, transverse articular surface that has a shallow fossa.

In *Moxostoma rhothoecum* and *M. hamiltoni* (Fig. 3C-F) the tripus is similar to that of *M. atripinne*, but the dorsal edge of the posterior process is more shallowly concave, there is no well developed shoulder, and the anterior shelf is almost flat, is narrow, and flares but little posteriorly. The mesial edge of the shelf rises dorsally and is gently convex. The lateral edge is concave but is not elevated; the shelf tips abruptly downward and outward in *hamiltoni*, but is nearly horizontal in *rhothoecum*. The anterior shelf is exceeded by the width of the fulcrum, which is less than one-fourth the length of the tripus. The lateral face is less markedly sculptured than in *M. atripinne*.

Nuptial tubercles (pearl organs) in *Moxostoma atripinne* are rather generally distributed, but only on the anal and caudal fins are they notably enlarged. Since milt was flowing from several specimens (UMMZ 154643 and 165331) at the time of capture, the tubercles are presumed to be at full development. Each anal ray has a single file of large tubercles: these extend out about halfway on the anterior rays, nearly to the distal margin posteriorly, and become progressively larger outward, where they reach maximum size. The caudal rays each have single rows of tubercles basally, but in the distal half of the fin the series branch as do the lepidotrichia into 2, 3, or 4 series. The tubercles become gradually larger from the upper to the lower caudal rays; those of the two lowermost rays and the lower procurrent ray are considerably enlarged, but are smaller than are the largest of the anal fin. There are no pearl organs on the dorsal fin and only tiny tubercles on the ventral surface of the pectoral fin. On the dorsal surface of the paired fins and the ventral face of the pelvics, the rays bear simple or branched series of small, weakly developed pearl organs. On the head (Pl. II) and most of the body there are minute, scattered tubercles; only on the urosome, where they form arcs on the posterior scale borders, are they readily visible macroscopically.

A female (UMMZ 165331, 128 mm. in standard length) taken from a spawning aggregation, is weakly tuberculate. Minute tubercles are present on the sides of the snout and top of the head to the occiput, along scale margins on the urosome, and somewhat larger tubercles line the anal rays. The other fins and most of the body scales are devoid of tubercles.

ETYMOLOGY.—The name *atripinne* (derived from *ater*, black, *pinna*, fin, and *-e*, the neuter of the adjectival suffix *-is*) refers to the distinctive dark blotch on the dorsal fin that sets this species apart from other forms of the subgenus *Thoburnia*.

COMPARISONS.—The most obvious distinguishing characters of *Moxostoma atripinne* are contrasted with those of the previously known species of *Thoburnia* in Table II. The especially sharp differences in pigmentation of the dorsal fin, body, and peritoneum permit instant separation of the new species from the others. Equally distinctive are the small mouth and lips and the form and sculpture of the lower lip (compare Plate II with Raney and Lachner, 1946: Pl. I). In the depressed head, small eye, and large pectoral fin, the two eastern species contrast with *atripinne*, but differ little between themselves. Such characters are adaptations to life in swift water, as the large mouth and expansive lips are presumed to be. The structural separation between *M. atripinne* and *M. rhothoecum* is, on the whole, notably greater than that between *M. rhothoecum* and *M. hamiltoni*, and the genetic alliance of the latter two is assuredly the closer.

GROWTH AND MATURITY.—Like other forms of the subgenus, *Moxostoma atripinne* is a small species. The largest specimen, a female at the beginning of its fourth summer, is 128 mm. in standard length (5.9 inches in total length). The smallest adult, a breeding male, is 72 mm. in standard length (3.5 inches in total length). Of 40 specimens, 31 were collected in April or early May and nine were taken on August 9. All could be aged readily by scale examination. Spring-caught fish all have a marginal annulus and show no new growth. The August fish all have three annuli with good growth for the fourth summer, but it is unlikely that growth for the year was complete. The data on age, length, and maturity are given in Table III. Although the specimens are few, it is probable that none mature as yearlings, that males are usually but not invariably mature when two years old, and that all fish are mature at three years of age. The single two-year old female is a juvenile, but more specimens are needed to determine whether this is typical. The scanty data suggest that females grow somewhat faster and probably reach a greater maximum size than do the males.

REPRODUCTION.—Three collections of *Moxostoma atripinne* contained fish in breeding condition, with the sex products flowing freely when the fish were handled. They were taken in the period April 6 to 10, at water temperatures of 54° to 65° F. One night collection and one daytime collection each contained single adult males taken on riffle areas only a few inches deep over gravel, rubble, and bedrock. A spawning aggregation consisting of six males and one female was captured in night seining in the East Fork of the Barren River. The water was swift, about 3 inches deep, and all fish were concentrated

in a small area. Repeated seining elsewhere on the same and adjacent riffles took no additional specimens.

HABITAT.—With the exception of Fallen Timber Creek, where a specimen was taken in murky water shortly after a heavy shower, the collection stations were notable for their clarity. All had alternating pools and riffles, a bottom composed largely of gravel and rubble with some exposed limestone bedrock (mostly bedrock at the type locality),

TABLE III
AGE, SIZE, AND MATURITY OF *Moxostoma atripinne*

Age Group	Month of Capture	Sex	Maturity	Number	Standard Length (mm.)	
					Range	Mean
I	Apr.-May	M and F	juv.	20	40-67	55
II	Apr.	M	juv.	1	75	75
II	Apr.-May	M	ad.	7	72-87.5	82
II	Apr.	F	juv.	1	85	85
III	Apr.	M	ad.	1	105	105
III	Apr.	F	ad.	1	128	128
III	Aug.	M	ad.	2	110-115	113
III	Aug.	F	ad.	7	106-127	121

and all were rather small or moderate-sized creeks ranging in width from about 12 to 60 feet. These streams had a scanty algal flora and few backwater areas.

RANGE.—All record stations (Map 1) lie in the upland, headwater areas of the Barren River near the Kentucky-Tennessee boundary. Recent surveys conducted by Dr. William M. Clay, University of Louisville and the Museum of Zoology, include many fish collections from lower elevations in the Barren system and throughout the upper basin of the Green River to the north and northeast. These, like others from the region, failed to take *Moxostoma atripinne*, which is therefore interpreted as a species of sharply circumscribed distribution.

ACKNOWLEDGMENTS

Many persons have contributed to the presentation of this novelty. For their companionship and assistance I am indebted to my field associates, whose names appear in the listing of material collected. Mr. Glenn Gentry, Tennessee Department of Conservation, apprised me of the occurrence of this species in Tennessee streams after I had searched in vain to add to the first individual taken in Kentucky. Mr. John William Hardy, University of Kansas, obtained two specimens of *Moxostoma atripinne* and recognized it as a new species. He generously deferred publication when he learned of the advanced preparation of this manuscript. I wish to thank Museum of Zoology associates Mrs. Elizabeth M. Anthony, who prepared the map and text figures, and William L. Brudon, who is responsible for Plate I. This study was assisted by a grant from the Horace H. Rackham School of Graduate Studies of The University of Michigan.

For two decades (1927–1947) Grace Eager served as staff artist of the Museum of Zoology, a period during which she produced charcoal-pencil drawings of unsurpassed quality covering a broad range of zoological subjects. Among the more important of these are the many illustrations of fishes published largely by Carl L. Hubbs and his associates. A list of the published papers illustrated by her appears in the *Report of the Director of the Museum of Zoology for 1947–48* (1948, Univ. Mich. Official Publ., 50 (46): 10–15). A number of her finished drawings of fishes are yet unpublished. Her last creative work, completed but unsigned at the time of her death, appears here as Plate II. I am deeply grateful for the privilege of having known and worked with Miss Eager.

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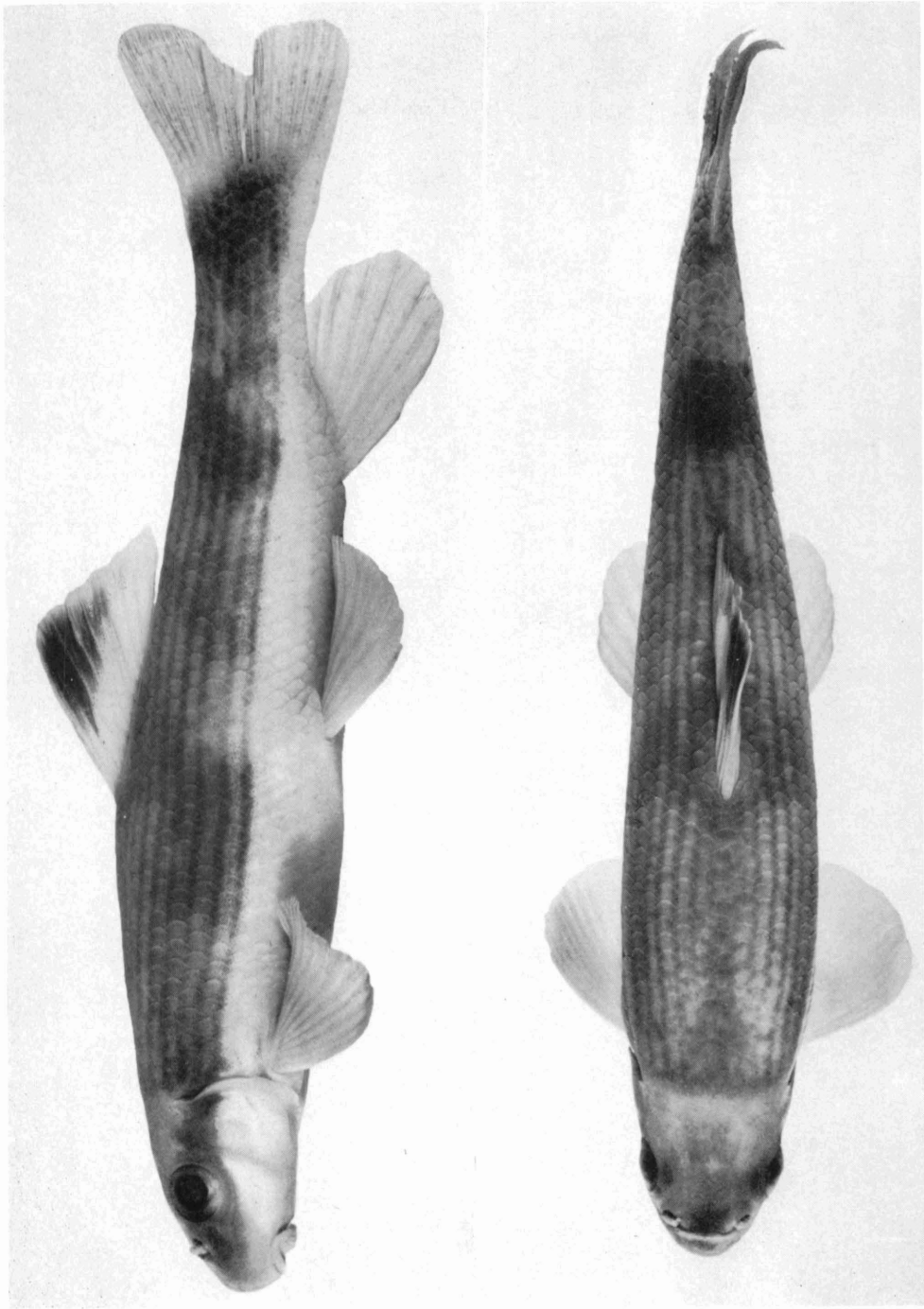
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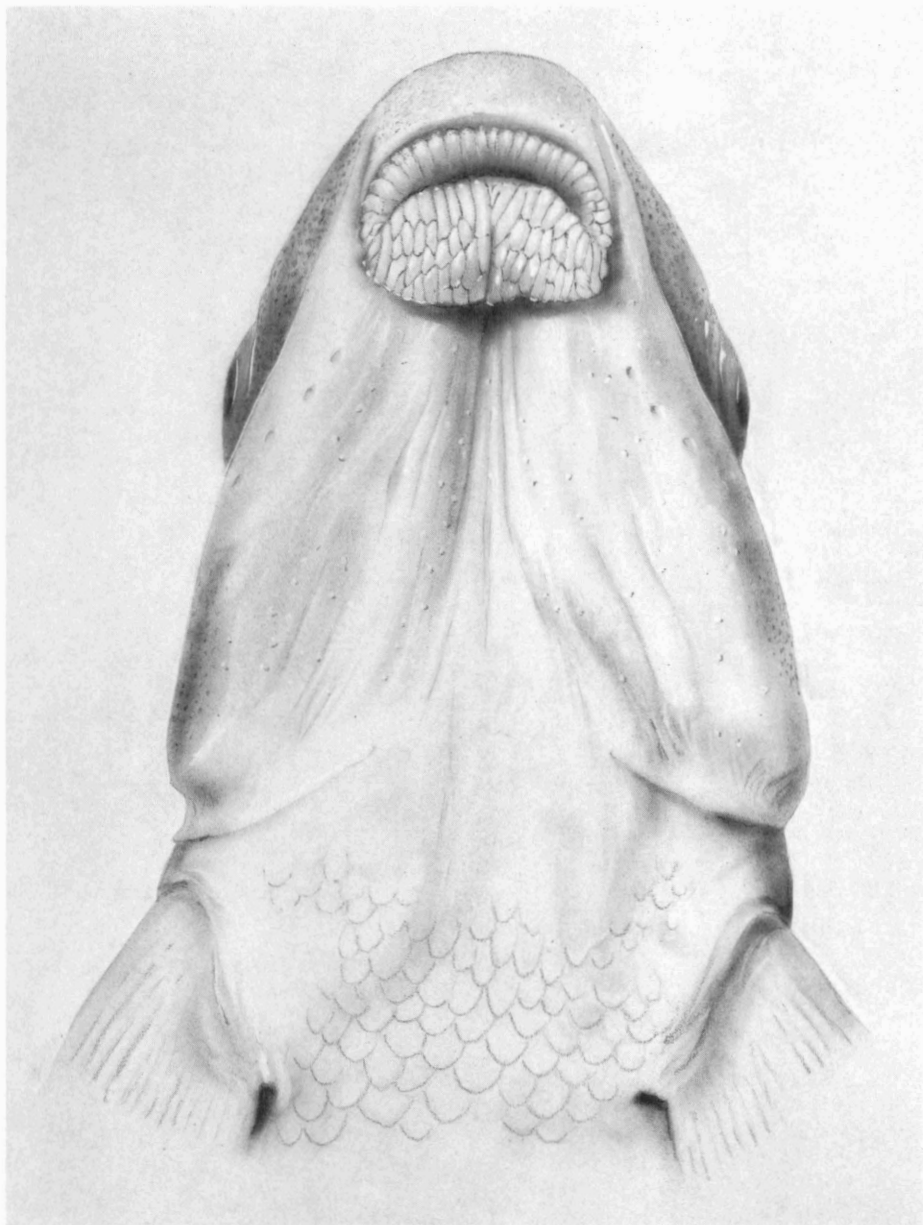
PLATES

PLATE I



Moxostoma atripinne, the holotype, a breeding male 86 mm. in standard length, in lateral and dorsal views. Photographs by William L. Brudon.

PLATE II



Moxostoma atripinne, UMMZ 154643, an adult male 105 mm. in standard length. Ventral view of head showing details of lip structure and minute, scattered nuptial tubercles. Grace Eager, del.

