

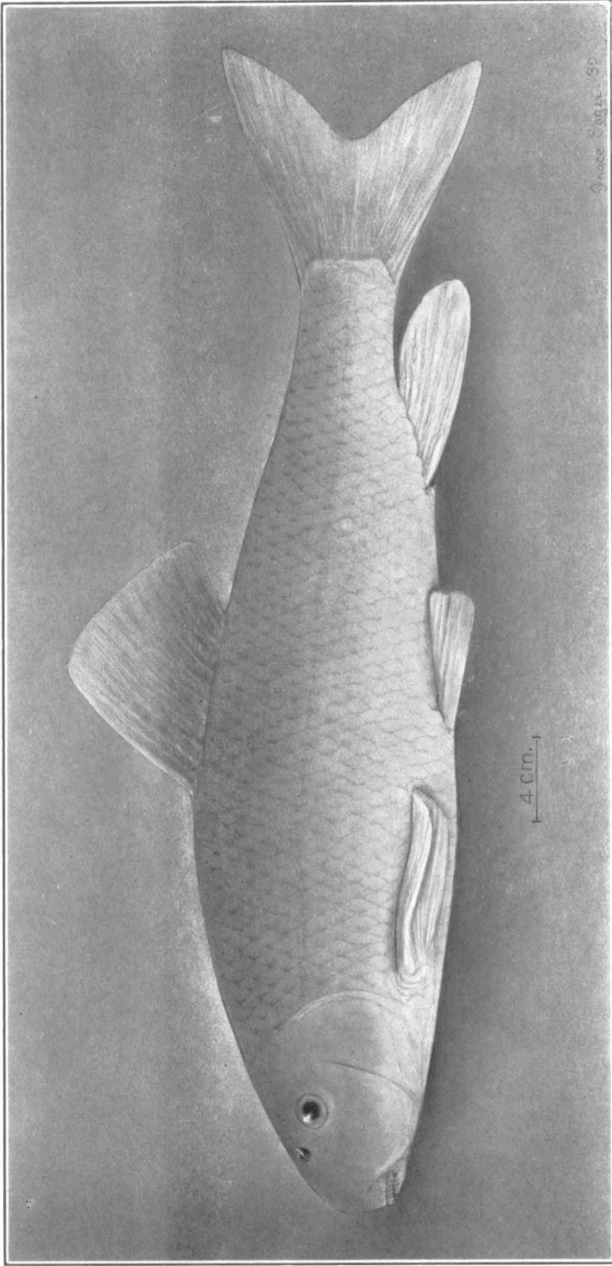
UNIVERSITY OF MICHIGAN
MUSEUM OF ZOOLOGY

Miscellaneous Publications No. 20

Materials for a Revision of the Catostomid
Fishes of Eastern North America

BY
CARL L. HUBBS

ANN ARBOR, MICHIGAN
PUBLISHED BY THE UNIVERSITY
April 30, 1930



J. Rose, Seattle, 1901

Morostoma rubreques, new species. Holotype.

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FREDERICK M. GAIGE,
Director of the Museum of Zoology,
University of Michigan.

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MATERIALS FOR A REVISION OF THE CATOSTOMID FISHES OF EASTERN NORTH AMERICA

BY CARL L. HUBBS

I. INTRODUCTION

In few groups of North American freshwater fishes have ichthyologists exhibited as little agreement as to specific limits or as to nomenclature, as in the suckers or Catostomidae. Specific names have been juggled back and forth between distinct species and even between different genera, and the concept of the species variously broadened or restricted. There is little similarity between the classifications adopted in 1817 (Le Sueur), 1820 (Rafinesque), 1842 (De Kay), 1844 (Valenciennes), 1845 (Kirtland), 1846 (Storer), 1855 (Agassiz), 1868 (Günther), 1870 (Cope), 1878 (Jordan), 1896 (Jordan and Evermann), and 1913 (Fowler). There has been, it is true, a general agreement among workers other than the last named since 1896, but only because of the great weight of authority which is firmly attached to Jordan and Evermann's masterpiece, *The Fishes of North and Middle America*. Forbes and Richardson (1909 and 1920), for example, adopt in full the systematic treatment accorded the suckers by Jordan and Evermann.

In a recent general study of the group, made chiefly at the Museum of Comparative Zoology, I have found that many taxonomic and nomenclatorial errors exist in the current classification—errors of fact, interpretation, and omission. It is to correct these errors that the present paper is now published. Unfortunately it is not feasible to make of this contribution a satisfactory, comprehensive synopsis of the family. It will require a considerable period of time to obtain and study adequate material of the numerous species of *Moxostoma* described by Cope from North Carolina and not critically studied for half a century; to investigate further several poorly-known Western and Middle American forms; to verify a considerable number of striking osteological characters discovered in a preliminary study of sucker skeletons; and to extend the anatomical investigation, and to make a really critical revision of the species still referred to *Catostomus*. It is hoped that material can rapidly be gathered to make these supplementary investigations possible. In the meantime, this paper may serve to give a better understanding of the systematics of those Catostomidae occurring east of the Rocky Mountains, north of Texas and of southern Virginia, and

throughout the Mississippi, Great Lakes, Hudson Bay drainage basins. The forms of *Erimyzon* from all parts of their range are reviewed.

The following new names are introduced in this paper—

Moxostomatini, new tribe name

Erimyzonini, new tribe name

Catostomini, new tribe name

Thoburniini, new tribe name

Carpiodes forbesi, new species name

Moxostoma rubreques, new species

Erimyzon oblongus connectens, new subspecies

The four new tribes into which the Catostominae are divided are introduced and defined in the key to the genera. The three new species and subspecies are described in sections III, IV, and V.

Seven forms are resurrected from synonymy, and regarded as valid—

Moxostoma duquesnii (Le Sueur)

Moxostoma breviceps (Cope)

Erimyzon tenuis (Agassiz).

Erimyzon sucetta kennerlyi (Girard)

Erimyzon oblongus (Mitchill)—as a distinct species

Erimyzon oblongus claviformis (Girard)

Hypentelium etowanum (Jordan)

A number of additional changes in nomenclature appear necessary—

Carpiodes urus Agassiz is a synonym of *Ictiobus bubalus* Rafinesque.

Ictiobus urus of later authors becomes *I. niger* (Rafinesque).

Carpiodes thompsoni Agassiz is a synonym of *C. cyprinus* (Le Sueur).

C. thompsoni of Forbes and Richardson is provisionally assigned a new name, *C. forbesi*.

Carpiodes difformis Cope is a synonym of *C. velifer* (Rafinesque). *Carpiodes velifer* of authors is identical with *C. cyprinus* Le Sueur.

Moxostoma aureolum of recent authors is a complex of three distinct species, *M. duquesnii* (Le Sueur), *M. rubreques* (new species) and *M. erythrurum* (Rafinesque). *Moxostoma breviceps* of later authors, in large part, and *M. lesueurii*, are synonyms of the true *M. aureolum* (Le Sueur).

Catostomus fasciolaris Rafinesque is abstracted from the synonymy of “*Erimyzon sucetta oblongus*” and referred to *Percina caprodes caprodes*.

A number of these systematic discoveries and nomenclatorial findings have been given advance notice in recent publications by myself and associates: Hubbs (1930); Hubbs and Brown (1929); Hubbs and Ortenburger (1929a and 1929b).

II. THE GENERA AND THEIR CLASSIFICATION

The genera accepted in this paper are the same as those admitted by me in 1926 (p. 18), plus three not known from the Great Lakes region. Preliminary comparisons of the skeletons suggest that additional genera may be warranted, but the apparent differences should be confirmed, and the skeletons of other species should be studied, before further generic division is proposed. In view of additional characters not mentioned in 1926, the separation of *Megastomatobus* from *Ictiobus* is well confirmed. Agassiz's differentiation of these genera in 1855 was clean-cut and decisive, but later authors did not give proper emphasis to the characters he used. The genus *Thoburnia*, inadequately characterized by Jordan and Snyder in 1917, proves to be one of the most aberrant genera in the family, for it lacks an air-bladder in the adult and has the fontanelle wholly obliterated.

In the following analysis of the catostomid genera of eastern North America, and also in the keys to the species of *Moxostoma* and of *Erimyzon*, I am trying out a new type of key. This form, it appears, has a number of distinct advantages. The use of a common number for sections being directly compared, and of letters for successive coordinate sections (*1a*, *1b*, *1c*, etc.), avoids the use of primed or doubled letters in keys running beyond the limits of the alphabet, avoids the typographically awkward doubling, tripling or quadrupling of letters in second, third, and fourth elements of a comparison in the system adopted, for example, by Jordan and Evermann (1896), or avoids the use of a superior index number, which is confusable with footnote reference numbers and has the undesirable appearance of a power coefficient. A more general comparison of genera (or species) than is possible in most types of keys is made by the inclusion, for convenience within brackets, of items not in themselves necessary to the operation of that particular section of the key for identification purposes. These items are grouped under an initial number which is the same as that used for corresponding items elsewhere in the key. These items having the same number are similarly indented, but may be located under different major divisions of the key. For example, item *2a* under *1a* is not needed for running down genera belonging to *1a*, but gives a valuable comparison of all the genera under that primary division with the two main subdivisions, *2b* and *2c*, under the coordinate group *1b*. The suggestion for this treatment came to me from using Garman's keys (1913, etc.). The added comparisons are of value in better indicating relationships, in illustrating the phenomena of parallel evolution and of the varied recombination of a few characters in the several elements of a group. Since they add new features in the key, they decrease the chance for arriving at an erroneous identification, particularly when not all characters in the specimen at hand are developed or readily

appreciable. In such cases the added comparisons will materially facilitate identifications. This new type of key, therefore, has the advantages of showing relationships better and of making identifications more certain and easy.

KEY TO THE EASTERN AMERICAN GENERA OF CATOSTOMIDAE

- 1a.—Dorsal fin elongate, as in the carp covering nearly half the length of the body; containing more than 20 developed rays.
- [2a.—Air-bladder of two chambers.]
- 3a.—Eye in front part of head. Body deep, as in the carp; the head large and not abruptly slenderer than the body. Scales large, in 40 or fewer rows. Lips smooth or weakly plicate. Posterior fontanelle well-developed. (Subfamily *Ictiobinae*)
- 4a.—Anterior fontanelle much reduced or obliterated by the close union of frontals with ethmoid. Cheek somewhat shallow and foreshortened (distance from eye to lower posterior angle of preopercle about $\frac{3}{4}$ that to upper corner of gill-cleft). Subopercle broadest at middle, subsemicircular.
- 5a.—Lower pharyngeal arch thin, more than twice as high as wide, with a developed ridge on outer face, with a long and slender symphyseal peduncle. Teeth of lower pharyngeal weak; with inner cusp usually produced beyond the typically serrated and sloping crown. Gill-rakers on first arch longer, the largest longer than the gill-filaments of anterior row; nearly 100 as counted from posterior face of arch; alternating processes near inner edge of each raker antler-like. Mouth large and very oblique: upper lip about level with lower margin of orbit; upper jaw about as long as snout. Lips thin, only faintly striate1. MEGASTOMATOBUS
- 5b.—Lower pharyngeal arch very heavy, about as wide as high, with a very strong ridge, and a shorter, blunter peduncle. Teeth of lower pharyngeal strong; with inner cusp usually not produced as far as the typically round, smooth, transverse crown. Gill-rakers on first arch all shorter than the longest filaments of anterior row; fewer than 60 as counted from posterior face of arch; alternating processes near inner edge of each raker smooth and wart-like. Mouth small, lower, and less oblique: upper lip far below lower margin of orbit; upper jaw distinctly shorter than snout. Lips fuller, and more or less coarsely striate2. ICTIOBUS
- 4b.—Anterior fontanelle well developed, separating anterior edges of frontals and notching ethmoid. Cheek relatively deep and long (eye about equidistant from the upper corner of gill-cleft and posteroventral angle of preopercle). Subopercle broadest below its middle, subtriangular.
- [5c.—Lower pharyngeal arch compressed to almost paper thinness, with ridge on outer face obsolescent; with symphyseal peduncle short. The teeth very fine; with inner cusp produced beyond the thin crown. Gill-rakers intermediate in length and strength between those of *Megastomatobus* and *Ictiobus*; the processes wart-like. Mouth small, inferior: upper jaw much shorter than snout. Lips thin, feebly plicate].....3. CARPIODES
- 3b.—Eye in hind part of head. Body attenuate; head very small and abruptly slenderer than body. Scales smaller, in more than 50 rows. Lips papillose. Posterior fontanelle obliterated by the union of the parietals. (Subfamily *Cycleptinae*)

[5d.—Lower pharyngeal arch and teeth about as in *Megastomatobus*.]

4. CYCLEPTUS

1b.—Dorsal fin short, much less than half as long as the back; with 9 to 18 developed rays. (Subfamily *Catostominae*)

[3c.—Eye near middle of head, or farther back.]

2b.—Air-bladder of three chambers. (Tribe **Moxostomatini**, new name.)

[7a.—Posterior fontanelle wide. Jaws without specialized hard sheaths. Lips plicate, or plicato-papillose (papillose in *Moxostoma pappilosum*); the posterior angulated or truncate behind.]

[8a.—Lateral line normally well-developed (except in young). Mouth inferior, horizontal (slightly oblique in *Placopharynx*).]

[9a.—Head convex above: the orbital rim not elevated. Eye near middle of head. Breast and pectoral fins little flattened and widened. Scales in fewer than 50 rows, scarcely reduced in size anteriorly. Coloration blotched, spotted, or plain.]

10a.—Premaxillaries protractile. Lower lip with the two sides widely conjoined.

11a.—Lower pharyngeal arch only moderately heavy, distinctly narrower than high in cross-section; with teeth all markedly compressed so as to form a comb-like series. Mouth strictly inferior. Lips smaller and thinner.....5. MOXOSTOMA

11b.—Lower pharyngeal arch very heavy, subtriangular in cross-section; with teeth which become much enlarged downward, subcylindrical, reduced in number. Mouth somewhat oblique. Lips very large and thick.....6. PLACOPHARYNX

10b.—Premaxillaries non-protractile. Lower lip separated into two conspicuous lobes.

[11c.—Lower pharyngeal arch and teeth as in 11a. Mouth inferior]7. LAGOCHILA

2c.—Air-bladder of two chambers (very rarely three-chambered in *Minytrema*).

6a.—Lateral line more or less obsolescent in adult. Body deeper and more compressed: greatest depth more than one-fifth the standard length. (Tribe **Erimyzonini**, new name.)

[7b.—Posterior fontanelle well-developed. Jaws without specialized, squarish, hardened sheaths. Lips plicate; the lower deeply angulated behind.]

8b.—Lateral line somewhat developed in adult. Body less oblong in form, shaped as in *Moxostoma*. Vertebrae about 37. Mouth inferior, horizontal. Color pattern consisting (except in the pale, obscurely mottled young) of rows of black spots, one on each scale.

8. MINYTREMA

8c.—Lateral line wholly lacking at all ages. Body more oblong. Vertebrae about 34. Mouth only subinferior, somewhat oblique. Color pattern consisting of two lengthwise streaks in young, more or less combined with or replaced by narrow, vertical bars in adult.

9. ERIMYZON

6b.—Lateral line well-developed in adult. Body more terete: greatest depth less than one-fifth the standard length. (Tribe **Catostomini**, new tribe name.)

- 7c.—Posterior fontanelle well-developed. Jaws without specialized, squarish, hardened sheaths. Lips papillose; the lower truncate behind.
- 9b.—Head convex above: the orbital rim not elevated. Eye near middle of head. Breast and pectoral fins little widened and flattened. Scales smaller, in more than 50 rows, markedly reduced in size anteriorly. Body blotched or plain. Air-bladder large (except in *C. latipinnis*)10. CATOSTOMUS
- 9c.—Head concave above: the orbital rims broadly elevated. Eye far behind middle of head in adult. Breast and pectoral fins much widened and flattened. Scales larger, in fewer than 50 rows, scarcely reduced in size anteriorly. Body obliquely barred. Air-bladder considerably reduced11. HYPENTELIUM
- 7d.—Posterior fontanelle markedly reduced or obliterated by the union of the parietals in the adult. Jaws with squarish, hardened sheaths (scarcely better developed in *Pantosteus plebeius* than in *Catostomus griseus*). Lips papillose; the lower truncate behind.
- [9d.—Head convex above. Eye usually behind middle of head. Breast and pectoral fins little widened and flattened. Scales small, in more than 70 rows, reduced in size anteriorly. Body blotched or plain. Air-bladder considerably reduced]12. PANTOSTEUS
- 2d.—Air-bladder obsolete in adult; of two chambers in young. (Tribe **Thoburniini**, new name.)
- [6c.—Lateral line well-developed. Body subterete.]
- [7e.—Posterior fontanelle completely obliterated by union of parietals. Jaws without squarish, hardened sheaths. Upper lip plicate, lower plicato-papillose; lower lip truncate behind.]
- [9e.—Head convex above; small. Eye behind middle of head. Breast and pectoral fins much widened and flattened. Scales large, in fewer than 50 rows, scarcely reduced anteriorly. Body variegated: a prominent interrupted lateral band]13. THOBUURNIA

III. SYNONYMIES OF THE BUFFALO FISHES AND QUILLBACKS

In revising the catostomid collections of the Museum of Comparative Zoology at Harvard University, I learned that the synonymies of the ictiobine species are incorrectly given in current publications. Some of the conclusions here stated are provisionally given in Hubbs and Ortensburger (1929b) and Hubbs (1930).

One species, somewhat doubtful, was found to be without an available name.

1. *Megastomatobus cyprinella* (Valenciennes)

Jordan and Evermann (1896: 164) failed to include in the synonymy of this species two names proposed by Agassiz (1855: 81), namely *Ichthyobus Stolleyi*, collected by George Stolley in the Osage River, Missouri, and *Ichthyobus Rauchii*, obtained by Dr. Rauch at Burlington, Iowa. The types of both of these nominal species were located in the Harvard collec-

tions, and found to be referable to *M. cyprinella*. In the same collections are topotypes of *I. Rauchii* collected by the Hassler Expedition; examples from Omaha, Quincy, St. Louis, and from Rockport, Ohio. The example from the last-named locality, since it was collected November, 1854, by Dr. Kirtland, proves the early if not native occurrence of the species in the Lake Erie drainage.

2. *Ictiobus niger* (Rafinesque)

Rafinesque's very brief account of *Catostomus niger* (1820: 56, p. 112 of 1899 reprint) has often been held to be unidentifiable, and for this reason this species is currently assigned another name (*I. urus*). The only characters of specific value given by Rafinesque for *niger* were: "Entirely black . . . entirely similar to the common Buffalo-fish, but larger, weighing sometimes upwards of fifty pounds, and living in separate schools." Inasmuch as these statements properly qualify the species commonly known as *I. urus* (see Forbes and Richardson's account—1909 and 1920: 70 to 72), I propose that the name *niger* be retained. To do so is especially to the point, now that it is evident that Agassiz's name *urus* does not apply to the same form. Agassiz, in his 1855 review, did resurrect the name *niger* for the present species, but in the same paper he based two nominal species on the same form: *Bubalichthys bonasus*, collected by George Stolley in the Osage River, Missouri, and *B. vitulus* (*Carpiodes vitulus* Agassiz, 1854: 356), obtained for Agassiz by Owen in the Wabash. All of the pertinent material is yet preserved.

Other interesting examples of *I. niger* in the Museum of Comparative Zoology are the specimens from San Pedro, Coahuila, Mexico, erroneously recorded by Garman (1881: 89) as *Ichthyobus tumidus*; two large ones taken by Stolley in Texas in 1853, with much swollen nuchal region; old specimens from Omaha, Quincy, Cincinnati, and others from Burlington, Iowa; also one from Homer, Michigan, sent to Agassiz by T. C. Norton, indicating that the species was probably native to the Lake Michigan drainage.

In addition to its larger size and darker color, characters mentioned above, the slenderer but thicker body, and the less elevated and less sharpened back of *I. niger* serve to distinguish it from *I. bubalus*. In old specimens the nuchal region becomes much swollen, but the back is not sharpened and farther back does not become elevated. The depth of the body is contained 2.6 to 3.2 times in the standard length, as opposed to 2.2 to 2.8 times (except in young smaller than 80 mm.). This species further differs from *I. niger*, as pointed out by Forbes and Richardson (1909 and 1920: 71-72), in having a smaller eye, and a larger and less inferior mouth, with the mandible less included. These differences may be indicated by a single

character index, a comparison of the greatest distance from mandibular symphysis to extreme end of maxillary with the length of the orbit, between its free rims. In the larger young to smaller adults this measurement is greater, usually much greater than the orbit in *niger*, but less than or barely equal to the orbit in *bubalus*. In large adults, the mouth measurement becomes somewhat greater than the orbital length in *bubalus*, but at comparable sizes that measurement is twice the orbit in *niger*. In young, about two to four inches long, the mouth measurement in *niger* about equals the orbit, but in *bubalus* is only about two-thirds the orbit.

3. *Ictiobus bubalus* (Rafinesque)

Rafinesque's description of his *Amblodon* or *Catostomus bubalus*, it seems to me, should be considered as not clearly identifiable, for it applies almost equally well to any of the three northern species of buffaloes. The fact that he separated *C. niger* as a distinct species in 1820 (p. 112 of 1899 reprint), of larger size and darker coloration, does indicate that he probably had the razor-back buffalo in mind in naming *bubalus*. Nevertheless the name should apparently rest on the species first definitely indicated under this name. Fortunately Kirtland's first descriptive account of *C. bubalus* (1845: 266) is clearly based on the razor-back buffalo. The subcarinate back as described, and the form of the head and body as figured by him, admit of no other interpretation. The name *bubalus* may, therefore, be retained for the species usually so named.

Since *bubalus* is the type-species of *Ictiobus*, the current use of that generic name is likewise confirmed. Agassiz (1855) was not justified in renaming *Ictiobus* as *Bubalichthys*, nor in using *Ichthyobus* (reformed spelling) for the genus here called *Megastomatobus*. It may be noted in passing that the treatment accorded the name *bubalus* by Agassiz in 1855 and by Jordan in 1878 was in neither case concordant with the modern rules of nomenclature.

Agassiz's *Carpiodes urus* (1854: 355) has generally been thought identifiable with the species here called *I. niger*, and in most modern papers that species is known as *Ictiobus urus*. The type of *urus*, recently examined, is, however, clearly an example of *bubalus*. So also is the type of *Carpiodes taurus* Agassiz (1854: 355), but the type of *C. vitulus*, described in the same paper, is referable to *I. niger*. The specimens from Burlington, Iowa, and St. Louis, Missouri, named *Bubalichthys urus* by Agassiz, are likewise *I. bubalus*.

A type of *Carpiodes tumidus* Baird and Girard, from Fort Brown, Texas, also in the Museum of Comparative Zoology, is a young buffalo fish about 100 mm. long. It has a mere trace of the anterior fontanelle, and

the proportions of cheek and subopercle characteristic of *Ictiobus*. The distance from the mandibular symphysis to the end of the maxillary is only two-thirds as long as the orbit. The depth of the body is two-fifths its length. There are 26 dorsal rays and 35 scales to caudal base. For these reasons the name *Carpiodes tumidus* should be transferred from the synonymy of "*Carpiodes velifer*" to that of *Ictiobus bubalus*.

Other specimens of *Ictiobus bubalus* in the Museum of Comparative Zoology came from Lebanon, Tennessee, and from Homer, Michigan. The latter locality, on the St. Joseph River, is the first definite record of the species from the Great Lakes drainage.

4. *Carpiodes forbesi*, new species name

This name is based on Forbes and Richardson's description and figure of *Carpiodes thompsoni* (1909 and 1920: 79, fig. 20). The specimens from which these authors drew up their description will be the types of the new name; the one from which the figure was taken may be taken as the holotype. The Illinois River drainage of Illinois will be quotable as the type locality. The species has definitely been recorded only from points along the Illinois River. Two young specimens from Quincy, Illinois, in the Museum of Comparative Zoology, appear referable to *Carpiodes forbesi*, although they may only be *C. cyprinus*. They show the following characters: length to caudal about 75 mm.; depth one-third the length; lobes of lower lip meeting at a right angle; scales 37; dorsal rays 28, and 32.

I am not convinced that this species is valid, but I propose for it a name, for the sake of convenience and emphasis. That the name *thompsoni* is erroneously associated with it, is shown in the account of the following species. There is likewise no good evidence that *C. forbesi* occurs in the Great Lakes, for all the specimens we have seen from the lakes proper are *C. cyprinus*.

There is a strong possibility that this rare type will prove to be a hybrid between *Carpiodes cyprinus* and *Carpiodes carpio*. Hybridization would explain the large size attained.

The large size, relatively slender form and the low dorsal of many rays ("XXX") attributed by Cope (1870: 480) to his *Carpiodes nummifer*, suggest that he might have had the present species rather than, as generally supposed, *Carpiodes carpio*. But a new examination of the type seems to show that Cope really did have *carpio*. A recent enumeration of the dorsal rays, kindly made by Henry W. Fowler, indicates only 23 principal rays.

We quote here Forbes and Richardson's account of their *Carpiodes thompsoni* because this becomes the type description of *C. forbesi*.

"Body elongate, subfusiform, the back little arched and the ventral line nearly straight, in general form and proportions very close to *C. carpio*,

depth 2.8 to 3.2 in length. Larger than *difformis* and *velifer*, known to reach a weight of 3 to 5 lb, and said by lake fishermen to grow much larger [this hearsay evidence not applicable]. Color not different from that of *carpio*. Head moderate, its length 3.7 to 4, depth 4.5 to 5.1, width 5.7 to 6.4 in length of body; snout long, bluntly pointed, 3 to 3.4 in head; nostrils situated well back from end of snout, distance from anterior opening to tip of muzzle greater than diameter of eye; mouth narrower and longer than in the two preceding species, subterminal and somewhat oblique, the tip of the lower lip far in advance of the nostrils; lips evidently plicate, not very thin, the halves of the lower one meeting at a rather wide angle; interorbital space 2.4 to 2.7 in head; eye small, 5 to 6.4, usually more than 5.5. Dorsal rays 25 to 30, usually nearer 30, anterior rays slender, little elevated, scarcely more than half the length of base of fin. Scales somewhat smaller and more closely imbricated than in the two preceding species [*carpio* and *difformis* intended], 7, 38 to 40, 6, usually 39 in longitudinal series; lateral line complete, nearly straight.

"This species can be separated with readiness from both the preceding [*carpio* and *difformis* intended] by its longer nose, more oblique mouth, and more posterior nostrils; it is easily distinguished from the next [*velifer* = *cyprinus* intended] when adult by its larger size and by the differences in general proportions, and by the shortness of the first dorsal rays. The young of these two species can not be separated with any certainty.

"This carp-sucker belongs to the fauna of the Great Lake region [this statement is erroneous] and is but rarely taken in the inland waters of Illinois, our adult specimens numbering a very few from the Illinois River at Ottawa, Henry, Havana, and Meredosia. It is too rare in our waters to be commercially important. Its special habits are unknown."

5. *Carpiodes cyprinus* (Le Sueur)

I still see no reason for distinguishing the Mississippi Valley representatives of *cyprinus* as a distinct species. The supposed distinction in the strength of the opercular ridges arose, I presume, from a confusion of western specimens with a distinct Western species, having stronger ridges—the form commonly called *C. difformis*, but here named *C. velifer*. I see also no grounds for separating the Great Lakes form, called *thompsoni* by Jordan and Evermann and other writers, from either the Atlantic Coast or Mississippi Valley form.

Of the names listed by Jordan and Evermann (1896: 167) as synonyms of their *Carpiodes velifer* (that is, the nominally distinct western representative of *C. cyprinus*), *Carpiodes tumidus* Baird and Girard belongs with *Ictiobus bubalus*; *Carpiodes damalis* Girard is a clear synonym of *C. carpio* Rafinesque, and *C. grayi* Cope was apparently also based on that species.

An examination of Agassiz's (1855: 191) type of *Carpiodes Thompsoni* from Burlington, Vermont, proves that Forbes and Richardson (1909 and 1920: 79) wrongly applied the name *thompsoni* to the form here called *C. forbesi*. Surely the original *thompsoni* is identical with the form they wrongly called *velifer*, but which I regard as identical with *C. cyprinus*. To demonstrate my point I give for the type of *Carpiodes Thompsoni* the characters used by Forbes and Richardson in their excellent key to the species of *Carpiodes*: snout, 2.8; distance from anterior nostril to end of snout greater than length of orbit; depth, 2.2; highest dorsal ray nine-tenths base of fin; halves of lower lip meeting at less than a right angle; dorsal rays, 26; scales, 37. Perhaps the fact that *C. cyprinus* reaches a rather large size in the Great Lakes led Forbes and Richardson to identify their large species (here named *forbesi*) with *thompsoni*. But the large individuals of the Great Lakes retain the characters of *cyprinus*.

6. *Carpiodes carpio* (Rafinesque)

An examination of the types of *Carpiodes bison* Agassiz (1854: 356) and of *Carpiodes damalis* Girard (1856: 170), in the Museum of Comparative Zoology, show that both these nominal species are synonyms of *C. carpio*. *Carpiodes grayi* Cope (1870: 482) appears to be another synonym of *carpio*, which is the common species of the western states.

7. *Carpiodes velifer* (Rafinesque)

A reconsideration of the available evidence seems to indicate the necessity of using this name for the species later described as *Carpiodes difformis* by Cope (1870: 480). Rafinesque's description (1820: 56) applies about as well to *cyprinus* as to *difformis*, and may have been based on either or, more likely, on both; it could not apply to any other species, however. The next account of *Catostomus velifer* of any apparent significance, that of Kirtland (1838: 169, 192), also does not appear wholly discriminative, for he applies the name to the "Carp of the Ohio," which he then thought to be evidently different from Le Sueur's *cyprinus*. Kirtland's 1845 account (p. 275, pl. 22, fig. 2) also helps us little, for he recognized then only one species of *Carpiodes* in Lake Erie as well as in the Ohio, under the name of *Sclerognathus cyprinus*. His description applies as well to the one as to the other species, perhaps better to both. His figure, showing the body subrhomboidal rather than suboblong, strong ridges on the opercles and few dorsal rays, obviously represents *difformis*. The first definite restriction of the name *velifer* appears to be that of Agassiz, who in 1855 (p. 76) separated examples of *cyprinus* as a new species, *thompsoni*, and distinguished *velifer* from it by the characters of the more rounded scales and more strongly striate opercle—two of the readiest means of distinguishing *difformis* from *cyprinus*. Fur-

ther, I have studied Agassiz's specimens of *velifer*, and find them all to be of the *difformis* type. For these reasons, I abstract the name *velifer* from the *C. cyprinus* group, and refer *Carpiodes difformis* Cope to the synonymy of *Carpiodes velifer* (Rafinesque).

Catostomus anisopterus Rafinesque and "Catostomus sp. Le Sueur" of Rafinesque appear likewise to refer to the same species.

IV. THE SPECIES OF *Moxostoma*

In the generally accepted classification of *Moxostoma*, which I too have adopted (1926: 22), the species in the Great Lakes and Mississippi fauna, west of the Alleghenian divide and north of Texas, are reduced to four: *aureolum*, *anisurum*, *poecilurum* and a fourth, *breviceps*, which I have indicated as a synonym of *lesueurii*. It has lately become clearly evident, however, that the number of species has been unduly reduced. Three additional ones must now be recognized in this region. For these species I propose that we use the names *Moxostoma duquesnii* (Le Sueur), black or fine-scaled mullet; *Moxostoma rubreques* Hubbs, new species, the redhorse; and *Moxostoma breviceps* (Cope), the short-head redhorse. The name *aureolum* of the more recent (but not the older) authors must be returned to the species now called *lesueurii*, while the complex called *aureolum* by Jordan and Evermann (1896: 192) and subsequent writers must surely be divided into three, *Moxostoma duquesnii*, *M. rubreques*, and *M. erythrurum*.

The characters of *M. duquesnii* are in part intermediate between those of *erythrurum* and those of the true *aureolum*, but are largely quite distinctive, while *breviceps* in general agrees closely with *aureolum*. *M. rubreques*, although a strongly marked species, the largest and popularly the best known of the group, has apparently not been given an available scientific name. The distinctive features of all these forms are indicated in the following key. The form of key employed, and its advantages, are explained in the paragraph preceding the key to the genera.

All seven of these species of the Great Lakes and Mississippi fauna dealt with in the key are discussed in sequence after the key. I also add some discussion of the East Coast representatives of the *breviceps* group, *M. macrolepidotum* and *M. conus*.

REVISED ANALYSIS AND COMPARISON OF THE MISSISSIPPI AND GREAT LAKES SPECIES OF *MOXOSTOMA*

- 1a.—Body more nearly terete; caudal peduncle more slender (its least depth typically less than two-thirds its length from end of anal base). Physiognomy approaching that of *Catostomus catostomus*; the snout more produced, usually slightly longer than greatest postorbital length of head, including membrane. Eye usually smaller, less than half snout in large young, and less than two-fifths snout in small adults. Scales usually smaller: typically 44 to 47 (extreme range, 42 to 49) to end of hypural. Pelvic rays most frequently 10 (but often 9, and rarely 8 or 11).

- [2a.—Halves of lower lip meeting in a rather obtuse angle in the young, but often in a straight line in the adult; mouth of moderate size. Head rather squarish, and of medium length (in adult contained about 4.3 to 4.7 times in standard length; in young one to three inches long, about 3.5 or 3.6 times). Dorsal fin pointed in front, and with the edge rather falcate in the adult (but less so usually than in *aureolum*, and much less so than in *breviceps*). Region from occiput to dorsal little elevated; dorsal contour of body scarcely sigmoid.]
- [3a.—Plicae of lips coarse, sometimes considerably broken by transverse creases. Developed dorsal rays 12 to 14, usually 13. Dorsal fin usually very small; its depressed length much less than two-thirds distance forward to tip of snout; its basal length shorter than distance forward to occiput. Extreme variation in depth 3.7 (?) to 5.0 (usually about 4.7).]
- [4a.—Body without dark spots or crescents on scale bases; caudal fin (also dorsal) slaty; tip of dorsal blackish near margin. Size small, the breeding adults usually much less than 40 cm. in length to caudal. Nuptial tubercles developed only on anal and caudal fins. Occipital region not swollen.].....1. *M. duquesnii* (black or fine-scaled mullet)
- 1b.—Body less terete; caudal peduncle deeper and shorter (its least depth typically more than two-thirds its length). Physiognomy approaching that of *Catostomus commersonnii*; the snout ordinarily less produced, usually slightly shorter than greatest postorbital length of head. Eye usually larger (except in *rubreques*), in young more than half length of snout, and in small adults more than two-fifths of the snout. Scales usually larger: typically 39 to 45 (extreme range, 38 to 47) to end of hypural. Pelvic rays usually 9 (but often 8, and very rarely 7 or 10), except in *breviceps*, which has 10 rays.
- 2b.—Halves of lower lip meeting at a rather sharp angle (sometimes becoming very obtuse in large adults, and obliterated when mouth is protruded); mouth rather large. Head more squarish when seen from side, front, or above, and longer (in adult contained 3.7 to 4.4 times in standard length; in young one to three inches long, 3.3 to 3.7 times). Dorsal fin ordinarily rather rounded at front, and with the edge nearly straight (slightly convex to moderately concave). Region from occiput to dorsal fin less elevated, and not so much more strongly arched than the other regions of the body; dorsal contour of body scarcely sigmoid; ventral contour more evenly curved.
- 3b.—Plicae of lips not broken up by transverse creases into papilla-like elements (except rarely to a slight degree toward angle of mouth); lips less constricted. Developed dorsal rays 11 to 15, usually fewer than 15. Length of depressed dorsal fin less than two-thirds distance from dorsal fin to tip of snout; dorsal base decidedly less than distance from dorsal fin to occiput. Body slenderer as a rule (depth ordinarily contained more than 3.5 times in standard length in adult; in extreme variation, 3.35 to 4.4 times).
- 4b.—Body with dark spots or crescents on the scale bases; caudal fin bright red; tip of dorsal whitish near margin in adult. Size large (to 12 or 16 pounds); the adults usually more than 40 cm. long to caudal. Adults living mainly in large rivers and lakes (except when spawning). Nuptial tubercles developed only on anal and caudal fins of breeding males. Occipital region much more swollen and convex. Head in young one or two inches long, usually much larger, 3.25 to 3.5 in standard length. Eye smaller, less than one-fourth head in young; less than one-seventh head in adult. Scales 42 to 46.....2. *M. rubreques* (redhorse)

- 4c.—Body without dark spots or crescents; caudal fin olive; tip of dorsal always black or blackish near margin. Size smaller, probably not reaching more than 40 cm. Adults living chiefly in smaller streams. Nuptial tubercles extensively developed, in breeding males only, over body and head, as well as on all the fins. Occipital region more or less strongly depressed. Head in young one to three inches long, 3.5 to 3.7 in standard length. Eye larger, more than one-fourth head in young and half-grown; more than one-seventh head in adult. Scales 38 to 44, usually 39 to 42.....3. *M. erythrurum* (golden or common mullet)
- 3c.—Plicae of lips more or less completely broken up, by transverse creases, into papilla-like elements; lips notably constricted. Developed dorsal rays 14 to 17, usually 15 or 16. Length of depressed dorsal fin more than two-thirds distance from dorsal fin to tip of snout; dorsal base about equal to distance forward to occiput. Body usually deeper (depth ordinarily contained less than 3.5 times in length in adult; in extreme variation, 3.1 to 4.1 times).
- [4d.—Body without dark spots on bases of scales; caudal fin olive; tip of dorsal dark near margin. Size large (to 8 pounds at least); the adults usually more than 40 cm. long to caudal. Adults living chiefly in large rivers or lakes (except when spawning). Nuptial tubercles developed only on anal and caudal fins, but in both sexes (most strongly in males). Occipital region not conspicuously swollen. Head in young one to three inches long, large, 3.0 to 3.5 in standard length. Eye large, more than one-fourth length of head in young; more than one-seventh head in adult. Scales 38 to 44, usually 40 to 42.].....4. *M. anisurum* (silver or bay mullet)
- 2c.—Halves of lower lip meeting in a straight line (in the very young at an obtuse angle; the margin often somewhat convex in adults); mouth small. Head bluntly subconical, and short (in adult contained 4.3 to 5.4 times in standard length; in young one to three inches long, about 3.5 to 3.8 times). Dorsal fin rather sharply pointed in front, and with the edge more or less strongly falcate. Region from occiput to dorsal fin more elevated and more strongly arched as compared with the other contours (the form resembling that of the whitefish); the dorsal contour typically sigmoid; ventral contour flatter before anus, but more oblique along anal base.
- [3d.—Plicae of lips typically weaker than in *erythrurum*, often broken up into papilla-like elements, but sometimes not at all disrupted (the plicae strong and very regular in *M. poecilurum*); lips less constricted laterally than in *anisurum*. Developed dorsal rays 12 to 14, usually 12 or 13. Length of depressed dorsal fin less than two-thirds distance forward to tip of snout; dorsal base shorter than distance forward to occiput. Body usually slender, but sometimes deep (extreme variation in depth, 3.4 to 4.4).]
- [4e.—Body with dark spots on bases of scales; caudal fin more or less bright red (not described in *breviceps*). Tip of dorsal dark near margin. Size moderate, often larger than in *erythrurum* and *duquesnii*, but probably never so great as in large examples of *rubreque* and *anisurum*. Adults living chiefly in large rivers and lakes (except in spawning season). Nuptial tubercles developed only on anal and caudal fin of breeding males (not described for *poecilurum*). Head short and deep, subconic, but not conspicuously swollen in occipital region. Eye large, more than one-fourth length of head in young; more than one-seventh head in adult (rather smaller in *poecilurum*). Scales 41 to 45, usually 42 to 44.]

- 5a.—Pelvic rays typically 9 (rarely 10; extreme variation, 8 to 11). Dorsal fin rather weakly falcate; anteriorly only moderately exerted, so that the tip does not extend so far back as the end of the last ray, when depressed. Upper lobe of caudal usually not much or not at all narrower and longer than the lower lobe.
- 6a.—Lower caudal lobe neither notably narrower nor longer than the upper, and without black streak. Spots on scales forming vertical dashes or crescents; the pale streaks weak or absent. Eye larger; body more robust.....5. *M. aureolum* (northern redhorse)
- 6b.—Lower caudal lobe decidedly narrower and somewhat longer than the upper, boldly marked with a black streak above the pale lower border. Spots on scales united into lengthwise dark streaks, separated by conspicuous pale lines.....6. *M. poecilurum* (black-tail redhorse)
- 5b.—Pelvic rays typically 10. Dorsal fin very strongly falcate; anteriorly sharply exerted, so that the tip usually extends to or beyond the end of the last ray, when depressed. Upper lobe of caudal distinctly narrower and longer than the lower lobe.....7. *M. breviceps* (short-head redhorse)

As indicated in the preceding analysis, nearly all of the distinctive features of the seven species of *Moxostoma* there dealt with are of only usual significance. There are perhaps only two known characters, which when taken alone are invariably trenchant, namely the coloration of *M. poecilurum*, and the nuptial tubercles of *erythrurum*, which are much more extensively developed than in the other species (but this character is shown only by breeding males, and is clearly distinctive of only the one species).¹

Despite this troublesome overlap in individual characters, each of the seven species possesses enough average differences from each of the others, that its ensemble of characters, once thoroughly learned, is ordinarily sufficient for ready identification. It is thought that a careful analysis of each individual with the key here presented will make it possible to identify with certainty more than nine-tenths of the specimens at hand, even though they be as small as two inches. While it is admittedly unfortunate that this analysis will not more trenchantly and invariably distinguish between the species, it does not now seem possible to express the known differences in a more useful way.

1. *Moxostoma duquesnii* (Le Sueur)

Black or fine-scaled mullet

As already indicated, I identify one of the generally neglected species of *Moxostoma* with *Catostomus Duquesnii* Le Sueur (1817: 105). This name was first applied to a 19-inch redhorse obtained by Say at Pittsburgh, and deposited in the Academy of Natural Sciences of Philadelphia, doubt-

¹ Reighard (1920) has given a good account of the nuptial tubercles or pearl organs of *Moxostoma erythrurum* (called *aureolum* by him).

less as a dried mount; finding the specimen there while engaged in the first revision of the suckers of the United States, Le Sueur based on it his account of the new species *Duquesnii*. The specimen itself has probably long been lost, for neither Cope (1870) nor Fowler (1913) make any mention of it. The description, it is true, is brief and general, but a careful study of the wording confirms Cope's and Fowler's view that it was based on the species here accorded the name *duquesnii*. The following analysis of the original account, which is reprinted by Jordan and Evermann (1896: 198), indicates how well it applies to the form we have (items of generic value only are omitted):

1. "Head large and long . . . about one-fifth part of the whole fish," including of course the caudal fin. The description applies much better to *rubreques*, *erythrurum*, or *duquesnii* than to *aureolum* or *breviceps*; the measurement fits *rubreques* and *erythrurum* most closely, and *aureolum* and *breviceps* least well. (These names are here used as indicated in the preceding key.)

2. "Mouth wide . . . furnished with thick, plicated and very large lips." This pertains least satisfactorily to *aureolum* and *breviceps*, fairly well to the other species mentioned above, and best of all to *Placopharynx carinatus*. The value of the lip description taken from a specimen which almost certainly was dried is, however, open to grave doubt.

3. "Snout strong" fits *duquesnii* best.

4. "Dorsal fin quadrangular." This statement best describes the dorsal of *erythrurum*, *carinatus*, *rubreques*, or *anisurum*, less well that of *duquesnii* or *aureolum*, and certainly not that of *breviceps*.

5. "Body long, a little compressed . . . length from the snout to the extremity of the caudal fin 19 inches; depth $3\frac{1}{2}$ inches; thickness 2 inches." A form thus indicated is most like that of *duquesnii*, too slender for either *erythrurum* or *carinatus*, and decidedly too slender for *anisurum*.

6. "Pectoral fins pretty large" applies better to any of the other species than *carinatus*.

7. "D. 14. V. 10." The number of dorsal rays virtually excludes *anisurum* from consideration. Since the count probably includes one small ray at the front of the fin, and would thus be given now as 13, it applies somewhat better to *breviceps*, *aureolum*, and *duquesnii* than to *erythrurum* or *rubreques*, which less consistently show this number.

The number of pelvic (ventral) rays assigned by Le Sueur to his *Catostomus Duquesnii*, which is 10, is perhaps the most valuable item in the original account. The species we here call *M. duquesnii* is the only known redhorse, other than *M. breviceps*, which usually has that many pelvic rays, and Le Sueur correctly counted 9 in *aureolum*. It is apparently this item

which prompted Cope (1870) to assign the name *duquesnii* to the same form that we do, and it certainly was this point which led Rafinesque (1820) to refer the species to a distinct subgenus. Jordan (1878: 123), on the contrary, thought that this difference in pelvic ray number was purely a matter of individual variation, writing: "In regard to the number of ventral rays, my experience is that in every species of the genus the normal number is *nine*, but that ten-rayed individuals occur in the proportion of about one in twenty in any of the species. I have seen specimens of *duquesnii* with nine rays on one side and ten on the other. I have therefore discarded all consideration of the number of ventral rays as a specific character,"—and so have subsequent authors. But after having separated the species here called *duquesnii* on other grounds, I checked up on the number of pelvic rays and found that the distinction does generally hold: in about two-thirds of the cases, the rays are ten in number in *duquesnii*, whereas this number occurs but rarely in the other species, *breviceps* excepted. A table of original counts is appended.

TABLE I
PELVIC RAYS IN NINE SPECIES OF *Moxostoma* AND IN *Placopharynx*

	Pelvic rays					Average
	7	8	9	10	11	
<i>Moxostoma duquesnii</i>	—	4	51	101	2	9.6
<i>Moxostoma rubreques</i>	—	3	50	1	—	9.0
<i>Moxostoma erythrurum</i>	4	17	102	3	—	8.8
<i>Moxostoma anisurum</i>	—	2	75	2	—	9.0
<i>Moxostoma aureolum</i>	1	7	136	9	—	9.0
<i>Moxostoma breviceps</i>	—	—	1	25	—	10.0
<i>Moxostoma macrolepidotum</i>	—	—	10	—	—	9.0
<i>Moxostoma conus</i>	—	1	31	2	—	9.0
<i>Moxostoma poecilurum</i>	—	—	2	—	—	9.0
<i>Placopharynx carinatus</i>	—	1	13	2	—	9.1

The original figure of *Catostomus Duquesnii*, which was published subsequently to the volume containing the description, but not later than 1822 (see discussion in account of *M. aureolum*), even more obviously than the description is based on the present species. The small, posterior eye, long snout, slender body form, long caudal peduncle, and somewhat falcate dorsal fin, are all rather well indicated.

For these various reasons I have thought it proper to identify this species of *Moxostoma* with *Catostomus Duquesnii* Le Sueur, 1817. I therefore recommend that it be called *Moxostoma duquesnii* (Le Sueur).

The history of the name *duquesnii* (often altered to “*duquesnei*” or “*duquesni*”) has indeed been a varied one, and since the interpretations of later authors might be construed as having a bearing on the application of the name, a brief outline of this history is in order. Rafinesque (1820: 60) accepted the species, apparently largely from Le Sueur’s account, and referred it to his own subgenus *Decactylus* on account of the number of pelvic rays. De Kay (1842: 203) and Valenciennes (Cuvier and Valenciennes, 1844: 458) apparently knew the species only from the original account. Kirtland (1845: 268, pl. 20, fig. 1 and pl. 21, fig. 2) apparently used the name *Catostomus Duquesnii* for all the creek-inhabiting species of *Moxostoma*, since he accurately separated out but one species, *anisurus*, in the work cited (in earlier and later reports he corrected separated *aureolum*); his descriptions indicate that he confused at least two species under one name in 1845, calling *duquesnii* or *aureolum* or *breviceps* (or all three) the males, and *erythrurum* or *rubreques* the females; his figures, particularly that given for the male, strongly suggest the true *duquesnii*; he gives no ray counts for the complex. Storer (1846: 423) merely copied from the descriptions of Le Sueur and Kirtland. Agassiz (1855: 89) thought Rafinesque’s *C. erythrurus* to be identical with “*Ptychostomus*” *duquesnii*. Günther (1868: 18) described what seems to have been an example of *M. erythrurum* as *Catostomus duquesnii*. Cope (1870: 476) described a topotype of *C. Duquesnii* as *Ptychostomus duquesnei*, and in so doing clearly differentiated for the first time the species here assigned the same name. Jordan (1878: 120) used the name *duquesnei* for the “subspecies” of *Myxostoma macrolepidotum* characterized by the large size of the head, therefore for the two forms here called *Moxostoma rubreques* and *M. erythrurum*; in this course he was generally followed for many years. Jordan and Evermann (1896: 198), however, used the name *aureolum* for the whole complex of *duquesnii* plus *rubreques* plus *erythrurum*, and applied the name *duquesnii* to the species of *Placopharynx*, previously (and since) called *P. carinatus* Cope. Fowler (1913: 58) followed Cope in applying the name *duquesnii* to the fine-scaled redhorse, and this is the course which we too now adopt.

The only name which now appears definitely quotable as a synonym of *Moxostoma duquesnii* is that of *Moxostoma alleghaniensis* Nichols (1911: 275, pl. 11, fig. 1), described from the Tennessee basin of North Carolina. The description and figure given by Nichols clearly represent the species under discussion. A reexamination of the type has confirmed this view. Therefore, if the name *duquesnii* should for any reason be held inapplicable, the fine-scaled redhorse may be called *Moxostoma alleghaniense* Nichols.

Following Jordan (1878), most writers prior to 1896 seem often to have recognized the two forms here called *duquesnii* and *aureolum*, but generally

referred their examples of *duquesnii* to "*Moxostoma macrolepidotum*, var. *macrolepidotum*," and their specimens of *erythrurum* and *rubreques* to "*Moxostoma macrolepidotum*, var. *duquesnei*." Jordan and Evermann (1896), Forbes and Richardson (1909), and most other writers since 1896 have completely confounded *M. duquesnii* with "*M. aureolum*."

When recognized as distinct and not confused with the species we now call *erythrurum*, *Moxostoma duquesnii* has been regarded as confined to the Ohio drainage basin, in the Alleghany region, although no doubt often recorded from localities far removed therefrom, under various names now referred to the synonymy of distinct species, or of forms thought to be different. That the range of *duquesnii* is a wider one is indicated by the material preserved in the Museum of Zoology of the University of Michigan. We have it from southern parts of Ontario (Hubbs and Brown, 1929: 21), Michigan, Ohio, and Kentucky; from the Tennessee River drainage of Virginia and the Alabama River drainage of Georgia; from Wisconsin, and from southern Arkansas and eastern Oklahoma (Hubbs and Ortenburger, 1929a: 22, and 1929b: 64). In the Museum of Comparative Zoology there are specimens of *duquesnii* from several points in the Ohio basin of Ohio and Indiana, and from the Tennessee River drainage of Tennessee, Alabama, and Georgia. Since Forbes and Richardson's description of *M. "aureolum"* (1909 and 1920: 90) clearly covers the characters of this species as well as of *rubreques* and *erythrurum*, it is obvious that *duquesnii* occurs in Illinois. It is as yet not represented in any collections examined from the Lake Superior, Hudson Bay, or Missouri drainage basins, where the true *aureolum* appears to be the commonest species.

Greeley has recently carried the known range of *M. duquesnii* northeastward to the Lake Erie (Greeley, 1929: 169) and Lake Champlain (MS) drainages of New York state.

In central Michigan, *M. duquesnii* is known as the "black mullet" by those who distinguish it from the other species. It spawns there in the spring, and runs with the other species of *Moxostoma* occurring in the same region. The actual time of spawning is apparently earlier than for

TABLE II
COMPARATIVE SIZES OF THE YOUNG OF TWO SPECIES OF *Moxostoma* TAKEN IN ELK RIVER,
OKLAHOMA, ON JULY 11, 1927

	Length to caudal base, mm.													No.	Aver.
	18	19	20	21	22	23	24	25	26	27	28	29			
<i>M. erythrurum</i>	4	25	47	66	45	23	8	3	2	1	—	—	224	21.15	
<i>M. duquesnii</i>	—	—	—	2	6	34	73	87	38	30	10	1	281	24.88	

erythrurum, for the first young encountered in the Oklahoma-Arkansas field work of 1927 were *duquesnii*, and later in the season the young of this species were the larger. To illustrate this point, I give (on p. 23) the length of each of the 505 young specimens of these two species taken July 11, 1927, in Elk River, Oklahoma. Similar size relations were noted for the young of the same two species taken in Ontario.

2. *Moxostoma rubreques*, new species

Redhorse

Although the largest and best known species of *Moxostoma* within its range,—the “redhorse” of most fishermen,—this form has apparently never been differentiated or named by ichthyologists, except by Valenciennes. This author (in Cuvier and Valenciennes, 1844: 457, pl. 517) gave a description and figure which may be recognized as based on this form. He called it *Catostomus carpio*, but since Rafinesque had already used this identical name, we may not now employ it. Günther (1868: 20) wrongly used the name of Valenciennes for the species now called *M. anisurum*, and in this error he was followed by Cope (1870: 469 and 476), and by Jordan (1878: 115 and 118) and his early associates. Later Jordan synonymized the name *carpio* with *anisurum*, and no one has taken the pains to verify this action. The description of Valenciennes might be mistaken to apply to *anisurum*, for the dorsal fin is said to be very long and of 16 rays. But the figure shows that the base of the fin was not nearly as long as it is in *anisurum*, for it was only two-thirds as long as the distance forward to the occiput: the base was long in absolute length because the specimen was large (25½ inches long), and long relatively, because the fin was low. Valenciennes included one short ray in his dorsal fin count, and the figure shows only 14 rays as we count them. Furthermore, the body was much too slender for an adult of *anisurum*, and the figure shows clearly spots on the scale bases, which are absent in that species. The only other species in Lake Ontario with spotted scales is *M. aureolum*, but *Catostomus carpio* could not have been based on that species, for several reasons: the size was too great; the edge of the dorsal fin was convex rather than concave; the dorsal and ventral contours were evenly curved, the dorsal contour not sigmoid, the ventral not flat to the anal and not especially inclined along the base of that fin.

Rafinesque probably also knew this species and his name *erythrurus* (1820: 59) was I suppose inspired by its characteristically red caudal fin. But in his description he states that the “tail” is olive and that the length of the fish is about one foot. Therefore I think his name should be associated with the small creek species which differs from *rubreques* in lacking

the red color of the caudal fin. Rafinesque's account contains no other items of distinctive value, and might of course be regarded as a compound. Cope (1870: 469, 474) can not be regarded as first reviser of the complex under consideration, for his *Ptychostomus erythrurus*, though cleared of *duquesnii*, certainly remained a compound of *erythrurum* and *rubreques*. My present action, as that of the first reviser, should suffice to fix on the two species in question the names I here give them.

The key to the species of *Moxostoma* embodies a rather extended comparison of *M. rubreques* with the other species inhabiting the Great Lakes and upper Mississippi Valley region. The large size, swollen occiput, rounded dorsal, red caudal, and spotted scales give to the species such a distinctiveness that it can be recognized at a moment's glance—after one has learned to know it. Why this very well marked form has passed so long unrecognized by ichthyologists now appears a perplexing puzzle. Only an undue trust in authority could have blindfolded us to differences so obvious.

The range of *Moxostoma rubreques*, as indicated by material in the Museum of Zoology, is perhaps moderately restricted. The species is common through Michigan, and in the Lake Michigan and Mississippi River drainages of Wisconsin. It extends into eastern Minnesota (about Minneapolis) and Forbes and Richardson indicate its presence in Illinois. Mr. M. B. Trautman tells me that it is probably the chief form caught in the streams of southern Ohio in the spring, and he has sent me a specimen from the Ohio River drainage of that state. Some young specimens from the Cumberland River basin in Kentucky are probably referable to *rubreques*, as are also two adults killed in the Holston or Tennessee River somewhere between Saltville, Virginia, and Knoxville, Tennessee. The specimens described by Cope (1870: 474) under the name of *Ptychostomus erythrurus* from the Youghiogheny River in Pennsylvania, were apparently *rubreques*, as was doubtless the twelve-pound specimen he mentioned from the French Broad in Tennessee. Hubbs and Brown (1929: 21) report young supposedly of this species from the Lake Huron and Lake St. Clair drainages of Ontario, and Dymond, Hart, and Pritchard (1929: 18) record adults, which I have designated as paratypes of the species, from the Lake Ontario drainage of Ontario. The type of *Catostomus carpio Valenciennes* was from Lake Ontario. M. D. Pirnie has described to me a redhorse caught in Salmon River, Oswego County, New York, which must have belonged to the present species. Mr. John R. Greeley has taken the species in the Niagara River drainage of New York (in Ellicott Creek, near Tonawanda), and also still farther east, in the Lake Champlain basin of New York (Big Chazy River, at Coopersville). *Moxostoma rubreques* therefore ranges far

into the northeast, but it is not known to accompany *duquesnii* and *erythrurum* into the southwestern states.

I have selected as the holotype of *Moxostoma rubreques* the specimen figured on the frontispiece, a ripe female 440 mm. long (to caudal), collected by Carl L. Hubbs and T. H. Langlois in Au Sable River, just below Foote Dam, Michigan, April 11, 1925. It is cataloged as No. 73194, Museum of Zoology, University of Michigan. Paratypes are yearling to adult specimens from Minnesota, Wisconsin, Michigan, Ohio, New York, and Ontario. The measurements given first, in the description which follows, in each case are taken from the type, while those given in parentheses are from 19 half-grown to adult paratypes, 163 to 460 mm. in standard length, 18 from Michigan and 1 from Ontario. The counts are taken from the yearling paratypes as well as the larger ones.

Dorsal rays 13 (13 in fifteen paratypes, 14 in nine and 15 in one; no doubt sometimes 12); caudal, 18 (principal rays); anal 7; pectoral, 17 (16 in seven paratypes, 17 in fifteen, 18 in three); pelvic, 9 (rarely 8; see table I, p. 21). Scales 7 (6 to 9, unusually 7)—44 (42 to 46)—8 (6 to 8, usually 7), counting small scales at front of dorsal and anal fins, but not including scales on base of caudal rays.

Moxostoma rubreques is a heavily-built fish, swollen behind as well as before the dorsal fin. The turgid nape grades evenly into the highly arched occiput. The ventral contour is rather evenly curved from mouth to end of anal. The greatest depth, below front of dorsal, is contained 3.4 (3.35 to 4.15) times in the standard length. The width goes 1.4 (1.3 to 1.6) times in the head. The caudal peduncle is moderately deep and short: the least depth enters the head 2.55 (2.15 to 2.75) times, and enters the length of the caudal peduncle, from end of anal base, 1.3 (1.1 to 1.5) times.

The form of the head is highly distinctive, on account of the greatly swollen occiput: as seen from in front the contour of the head is an even, complete semicircle above the lower orbital margins. The interorbital shares in the high arching of the head: it rises above the eye (in vertical projection) a distance half again as great as the diameter of the eye. The swelling of the upper part of the head is due to a thick growth of connective and gelatinous tissue between the skin and the skull. The characteristic physiognomy is enhanced by the small size of the eye, which is contained 7.9 (5.7 to 8.8) times in the head. (These distinctive features of head form become increasingly striking with advancing age.)

The head is of average size, as it is contained 3.95 (3.7 to 4.1) times in the standard length. The least or bony interorbital width enters the head 2.25 (2.15 to 2.6) times; the greatest postorbital length, measured downward and backward, 1.8 (1.7 to 2.1) times. The snout is typically much shorter

(never longer) than this postorbital length: the snout measures 2.2 (2.1 to 2.6) times in the head. The snout is heavy, both deep and thick; it projects a little beyond the mouth, in a wide curve (in some paratypes, the projection is much greater, in others it is barely evident). The lips are evenly turgid and not constricted: the upper one does not overlap the lower as it does in *anisurum*. They unite behind in an obtuse angle (in some examples the angle is scarcely apparent; in the young it is acute). The lips are rather evenly and coarsely plicate, but many of the ridges are once divided distally, and those of the lower lip near the angle of the mouth are more or less broken up into papillae.

The gill-rakers (examined in an adult paratype) are of the usual catostomid type. Those of the anterior row on the outer arch are less than half as large as the longer gill filaments. The longer ones, near the center of the evenly curved upper portion of the arch, are thin, and triangular as seen from above, with a base two-fifths the height. The fleshy tips are slightly hooked inward and are somewhat expanded and sharpened vertically. The upper ones are shortened. The lower ones become transformed into wide ridges across the expanded lower face of the arch. The rakers number 29 in the anterior and 37 in the posterior series. These posterior ones, like those in both series of the subsequent arches, are low, asymmetrical, pointed triangles. The inner edge of each gill-raker is crenulated, and bears a separated double row of small, fleshy, pointed tubercles.

The lower pharyngeals are about as in other species of *Moxostoma*. The arch is moderately heavy. The dentition is comb-like. The teeth are rather strong but not molars.

The dorsal fin is moderately large in area, because the whole fin is high. The edge is nearly straight when the fin is uplifted (varying from slightly concave to somewhat convex, never distinctly falcate). The total length of the fin when depressed against the back is just about equal to the interspace between dorsal fin and occiput. The length of the dorsal base is contained 1.35 (1.35 to 1.75) times in the distance forward to occiput. The height of the dorsal fin (length of longest ray) varies from slightly less to slightly more than the basal length, and is contained 1.25 (1.1 to 1.4) times in the head. The caudal lobes are about symmetrical in thickness and length. The length of the caudal enters the head 1.0 (0.8 to 1.15) times. The length of the depressed anal measures 1.1 (1.0 to 1.3) times in the head. The pectoral goes 1.25 (1.25 to 1.5) times into the distance between the origins of the paired fins; the pelvic, 1.6 (1.45 to 1.9) times in the distance between the insertion of pelvic and anal fins.

In life *Moxostoma rubreques* may be at once distinguished from *M. duquesnii* and *M. erythrurum*, with which Jordan and Evermann and others

have united it under the inapplicable name of *M. aureolum*, by the bright red color of the fins, especially of the caudal. The red on the fins is probably brighter than in any other species of *Moxostoma* in the interior of North America, and it is of course this color which gives the fish the popular name of "redhorse." As in the other "red-tailed" species of the same region, the bases of the scales are conspicuously marked by dark spots or crescents. Particularly peculiar to *rubreques* is the whitish tip to the dorsal lobe, in the adult.

To make the identification of yearlings and young of *Moxostoma rubreques* more easy, and to show the variations of the proportions with age, I present the measurements of seven yearlings, 50 to 87 mm. in standard length, and of seven young, 19 to 27 mm. long. The yearlings, all paratypes, are from Michigan, Ohio, Wisconsin, and Minnesota; the young are from Wisconsin. The measurements are expressed in the same fashion as in the description given above. For each item the measurements are given first for the yearlings, and then, in parentheses, for the young:

Depth, 3.65 to 4.25 (3.7 to 4.4); depth of caudal peduncle 2.4 to 2.7 (2.7 to 3.35) in head, and 1.15 to 1.25 (1.2 to 1.7) in length of caudal peduncle; width of body, 1.45 to 1.8 (1.7 to 1.9); head, 3.5 to 3.9 (3.25 to 3.5); eye, 4.25 to 5.1 (4.0 to 5.0); interorbital, 2.6 to 2.9 (2.6 to 2.8); postorbital, 1.9 to 2.2 (2.0 to 2.2); snout, 2.3 to 2.7 (2.6 to 3.0); dorsal base, 1.2 to 1.4 (1.2 to 1.5); height of dorsal, 1.1 to 1.4 (1.35 to 2.0); caudal, 0.9 to 1.1 (1.1 to 1.2); depressed anal, 1.2 to 1.6 (1.6 to 1.7); pectoral, 1.2 to 1.3 (1.3 to 1.5); pelvic, 1.3 to 1.6 (1.6 to 1.8).

The name *rubreques* is a translation into Latin of the vernacular, "redhorse."

3. *Moxostoma erythrurum* (Rafinesque)

Golden or common mullet

I retain this name for the small species which is generally the commonest in smaller streams throughout the Mississippi Valley, and in the southern part of the Great Lakes basin. The reasons for so using the name are explained in the account of the two preceding species. I have seen specimens of *erythrurum* from southern Ontario through Michigan and Wisconsin to eastern Minnesota, thence southward in the west through Illinois, Iowa, Missouri, Arkansas, and Oklahoma, and in the east through Ohio and Indiana, Kentucky and Tennessee, and into northern Alabama and Georgia.

Many characteristics of this form are indicated in the key to the species of the genus. It is probably the one which has most frequently been recorded by authors under the erroneous names of *Moxostoma macrolepidotum duquesnii* and *Moxostoma aureolum*.

I see no occasion for identifying *Rutilus melanurus* Rafinesque (1820: 51) with this or any other sucker.

4. *Moxostoma anisurum* (Rafinesque)

Silver or bay mullet

The characters of this large "mullet" are given in the key to the species, and something of the history of the name is recited in the account of *Moxostoma breviceps* (species 7). The confusion of *Catostomus carpio* with this species is treated in the discussion of *M. rubreques*. The vernacular names given are those actually heard in Michigan.

5. *Moxostoma aureolum* (Le Sueur)

Northern redhorse

This is the species long confounded with *M. breviceps* by Jordan and Evermann (1896: 196) and most subsequent authors, and the one identified with *M. lesueurii* (Richardson) by me (Hubbs, 1926: 23; Dymond, 1926: 35, and Hubbs and Greene, 1928: 379). It is the species figured as *M. breviceps* by Forbes and Richardson (1909: col. pl. opp. p. 92). It was generally and correctly identified with Le Sueur's *Catostomus aureolus* (1817: 95) until Jordan and Evermann (1896: 192) without warrant transferred the name *Moxostoma aureolum* to the complex here divided into its constituent parts: *M. duquesnii*, *M. rubreques* and *M. erythrurum*. It is the species figured as *Catostomus aureolus* by De Kay (1842: pl. 42, fig. 133). It was called *Ptychostomus aureolus* by Agassiz (1855: 89) and Cope (1870: 476), and *Moxostoma aureolum* by Jordan (1878: 124) and his early associates.

It is obvious that neither Jordan and Evermann nor their followers ever studied the type-figure of *aureolus*. The plate is indeed often missing, for it was not included with part 1 of volume I of the Journal of the Philadelphia Academy, which contains the description and which appeared in 1817. The plates for Le Sueur's sucker paper were, however, later made available to zoologists, and hence, in accord with recent opinions of the International Commission on Zoological Nomenclature, must be regarded as properly "published." It was noted in part 2 of volume 2 of the same journal (1822, p. 411): "The following additional plates for volume I have been lately published, and may be had on application, price \$1."

The original account of *Catostomus aureolus* could apply only to the form later called *lesueurii* or the one here named *rubreques*, because it applies only to these two among the five Great Lakes species in the "deep carmine colour" of the caudal fin, and in the conspicuous darkening of the scale bases. The latter point is especially well shown in the plate. It seems clear that the type represents *lesueurii* rather than *rubreques*, because the figure shows a small subconic head, scarcely more than one-fifth the standard length; the occipital region not swollen, but the predorsal contour strongly

convex; the ventral contour flattish to the origin of the anal and especially inclined along the base of that fin, and the edge of the dorsal fin definitely concave (although the fin as drawn is too low). In one differential respect the figure agrees better with *rubreques*, namely in the size of the scales which are indicated as even finer than in that form. But ichthyologists of Le Sueur's period paid little definite attention to scale size, and Le Sueur himself drew many more scales on his plate of *Coregonus albus*, published at the same time, than are found in any Lake Erie species of the genus *Leucichthys*.

A further reason for identifying *M. lesueurii* with *M. aureolum* is the fact that this type is almost the only one taken in the present fisheries of Lake Erie, from which Le Sueur took his *aureolum*.

As a synonym of *Moxostoma aureolum* we should quote *Catostomus oneida* De Kay (1842: 198), which was described as having the back much arched and the head small. I have seen *aureolum* from Oneida Lake.

There was certainly no excuse, other than general ignorance of the American fauna, for the action of Valenciennes (in Cuvier and Valenciennes, 1844: 439) and Günther (1868: 16), who used the name *aureolus* for the common sucker (*Catostomus commersonnii*). Valenciennes (p. 447) identified specimens of *aureolum* from Lake Ontario as *C. macrolepidotus*.

Moxostoma aureolum is chiefly a northern and northwestern species. In the Ohio Valley it is not known east or south of Indiana, apparently being replaced there by the related *M. breviceps*. Similarly on the east coast it is replaced by *M. macrolepidotum*, and in the Gulf streams other than the Mississippi by *M. poecilurum*. In the St. Lawrence drainage it extends into Lake Champlain. It appears to be the chief species of the northwest, and ranges into Wyoming and Montana. It is generally common through the Missouri system, and there is a specimen in the Museum of Comparative Zoology from as far south as the Osage River in Missouri.

6. *Moxostoma poecilurum* Jordan

Black-tail redbhorse

The characters of this strongly marked Gulf Coast species are indicated in the key given above. Its relationships appear to be most intimate with *M. aureolum*, although some of its characters suggest *M. rupiscartes*. Two specimens were recently collected, by a Museum of Zoology Expedition, in a tributary of the Alabama River, at Benton, Alabama. Both have 12 dorsal rays.

7. *Moxostoma breviceps* (Cope)

Short-head redbhorse

Like *duquesnii*, another species now buried in synonymy, *Moxostoma breviceps* (Cope) has had a varied history. It was named by Cope (1870:

478), who accurately described its main distinctive features. Jordan (1878: 126) also distinguished it satisfactorily, but, since he identified it with Rafinesque's *Catostomus anisurus* (1820: 54), he called it *Myxostoma anisura*. While the species agrees with Rafinesque's account in having the caudal fin unsymmetrically lobed (as do also some specimens of the true *anisurum*), it differs in having fewer dorsal rays, and presumably would not have been named "carp"; we think it much more probable that Rafinesque had the species currently known as *Moxostoma anisurum*.² In this treatment Jordan was generally followed for several years, but Jordan and Evermann (1896: 196) used the name *anisurum* for the species with which that name was associated by Kirtland (1845: 269, pl. 20, fig. 2) as well as by recent authors in general, and recognized *breviceps* as a distinct species. Jordan and Evermann, and nearly all subsequent authors, however, confounded *breviceps* with the similar form of the Great Lakes which had previously been generally and correctly called *aureolum*, and has lately been identified with *lesueurii*.

The true *Moxostoma breviceps*, as thus restricted, has been known only from the main streams in the Upper Ohio basin, in Pennsylvania, Ohio, and Kentucky. Five specimens examined were found dead in the Tennessee River at Knoxville, after having been killed by pollution introduced into the Clinch at Saltville, Virginia (collected by Prof. E. B. Powers). In the Museum of Comparative Zoology there are specimens of *breviceps* from Lebanon, Tennessee; Little Hickman, Kentucky; and Cincinnati, Ohio. Others have recently been collected in the Ohio River drainage of Ohio by M. B. Trautman.

It can not be stated now whether or not the ranges of *breviceps* and *aureolum* overlap. They at least rather closely approach one another, for *breviceps* occurs in the Ohio River drainage of southern Ohio, and H. R. Becker has recently collected typical *aureolum* in the Ohio drainage of Indiana (in the Wabash River below New Harmony). It will be a matter of considerable interest to determine the interrelationships of the two types along any line of contact, if such exists.

8. *Moxostoma macrolepidotum* (Le Sueur)

Eastern redhorse

This species, so far as definitely known, is confined to the streams tributary to Delaware and Chesapeake Bays, where it appears to be the sole representative of the genus. Its name has been erroneously applied to *M. erythrurum* and *M. aureolum* (q. v.).

² Agassiz (1855) identified *C. anisurus* as a species of chub sucker (*Moxostoma* Agassiz = *Erimyzon* Jordan): an action without any warrant whatever.

The original figure of *Catostomus macrolepidotus*, published subsequently to the description (1817: 94) but not later than 1822 (see account of *M. aureolum*), and later copied by De Kay (1842: pl. 77, fig. 242), is a crude representation, but not identifiable with any other species. One of the most inaccurate features is the shape of the dorsal fin, but Le Sueur at the end of his article pointed out specifically that other specimens, received later than the type, do not show so marked an emargination of the border. He poorly guessed that he was dealing with a marked sexual dimorphism in the shape of the dorsal fin. His type was either erroneously figured, or was injured or abnormal.

Moxostoma macrolepidotum agrees with *M. aureolum* in all the characters assigned to the latter in the key to the Mississippi and Great Lakes species of the genus, except that the head is longer. The following characters were determined from five specimens 136 to 315 mm. long to caudal, all in the Museum of Comparative Zoology, and from Chesapeake Bay and Havre de Grace, Maryland; Carlisle and Columbia, Pennsylvania, and Nichols, New York. Dorsal rays, 12 to 14, usually 13; pelvic rays, 9-9 in all; scales 41 to 44; head 4.2 to 4.35; depth, 3.2 to 3.55.

I have collected young of this species in the Patuxent River, Maryland.

9. *Moxostoma conus* (Cope)

I identify with *Ptychostomus conus* Cope (1870: 478), seventeen red-horses from "Columbia, North Carolina," preserved in the Museum of Comparative Zoology. They might, however, with about equal probability be identified with *Ptychostomus crassilabris* Cope (1870: 477). I further note that in form, proportions, color, and counts, *Ptychostomus coregonus* Cope (1870: 472) is likewise in agreement with *conus*. Very likely *coregonus* and *crassilabris* both will prove identical with *conus*.

This material represents a species very similar to *aureolum* and *breviceps* in form of head and body, and in having the scale bases darkened. The head is very short (4.6 to 5.2 in total); the dorsal fin strongly falcate; the upper caudal lobe narrower and usually longer than the lower, but sometimes shorter; depth, 4.1 to 4.4; scales, 42 to 45. In comparison with *macrolepidotum* the body is more slender, the head shorter, the fins more pointed. When compared with *breviceps*, it is found to have the fins usually less pointed and the pelvic rays usually 9 (9-8 in one, 9-9 in fourteen, 9-10 in two) instead of 10. It differs from *aureolum* in having the fins more pointed in the average, the body usually more slender and the mouth smaller. According to Cope's accounts, the fins in *conus* are less red than they are in *aureolum*.

V. THE SPECIES AND THEIR SUBSPECIES IN *Erimyzon*

The current classification of the chub-suckers (see Jordan and Evermann, 1896: 185-186), differentiating only two subspecies, the southern *Erimyzon sucetta sucetta* and a northern *E. s. oblongus*, is distinctly erroneous and insufficient. This has been apparent for some time, but it was not until I restudied the material in the Museum of Comparative Zoology that it became evident that there are three distinct species of *Erimyzon*, two of which are divisible into western and eastern—but not northern and southern—subspecies. One of these species, *E. oblongus*, is divisible into three subspecies. The total number of recognizable forms is therefore six instead of two.

The six forms of *Erimyzon* may be compared in key form.

ANALYSIS AND COMPARISON OF THE SPECIES AND THEIR SUBSPECIES
IN *Erimyzon*

- 1a.—Anal fin of male not bilobed, but more pointed and longer, more than two diameters of eye longer than head. Fins as a whole more angular; dorsal fin in half-grown rather sharply pointed. Fourth tubercle on head of breeding males, the one just before upper half of eye, about as strong as the other three.
- [2a.—Ridges of posterior field of scale more close-set and regular than in the other species, not strongly differentiated from those of the other fields. Scale rows, 40 to 42. Developed gill-rakers on lower limb of outer arch, 9 or 10; the longest less than half the length of the raker-bearing portion of the limb. Head rather small (in half-grown and adult, 3.9 to 4.3 in standard length). Eye large (at 60 mm. standard length, contained about 4.0 times in head; at 80 mm., 4.5 times; at 110 mm., 5.0 times; at 160 mm., 6.0 times; at 200 mm., 6.75 times; at 250 mm., 7.5 times.)
- [3a.—Dorsal rays consistently 11. Depth of body in half-grown to adult, 3.0 to 3.7 in standard length. Bony interorbital width, in half-grown to adult, 2.3 to 2.6 in head. Size large, at least to 253 mm. (standard length). Mobile River System.].....1. *Erimyzon tenuis*
- 1b.—Anal fin of male bilobed; the anterior lobe somewhat pointed, but the posterior one broadly rounded; the fin little or not longer than head. Fins more rounded; dorsal fin in half-grown as well as adult considerably rounded. Fourth tubercle on head of breeding males absent or more or less reduced.
- 2b.—Ridges of posterior field of scale only moderately spaced (more widely than in *tenuis*, less so than in *oblongus*), tending to become strongly zigzag with age. Scale rows, 34 to 38. Developed gill-rakers on lower limb of outer arch, 6 to 9; the longest about two-thirds the length of the raker-bearing portion of the limb. Head averaging somewhat larger (in half-grown to adult, 3.25 to 3.8 in standard length). Eye rather larger (at 40 mm. standard length, usually contained less than 4.5 times in head; at 60 mm., less than 5.0 times; at 80 mm., less than 5.5 times; at 100 mm., less than 6.0 times; at 120 mm., less than 6.5 times; at 160 mm., less than 7.0 times; at 200 mm., less than 7.5 times). Young with the caudal fin usually reddish; large young and yearlings usually in barred-striped color phase.....(2. *Erimyzon sucetta*)

- 3b.—Dorsal rays more frequently 12 than 11. Scale rows usually 35 or 36. Depth in adult often more than one-third the standard length. [Bony interorbital width in half-grown to adult, 2.5 to 3.0 in head. Size large, at least to 213 mm. (standard length).] *East of Allegheny Mountains, from New York to Florida*.....2a. *Erimyzon sucetta sucetta*
- 3c.—Dorsal rays more frequently 11 than 12 (except locally?). Scale rows usually 36 to 38. Depth in adult seldom more than one-third the standard length. [Bony interorbital width, in half-grown to adult, 2.4 to 2.9 in head. Size large, at least to 204 mm. (standard length).] *West of Allegheny Mountains, from lower Great Lakes above Niagara Falls to Texas*.
2b. *Erimyzon sucetta kennekerlii*
- 2c.—Ridges of posterior field of scale very widely spaced, remaining evenly curved or only weakly zigzag. Scale rows, 39 to 45. Developed gill-rakers on lower limb of outer arch, 7 to 10; the longest about half the length of the raker-bearing portion of the limb. Head averaging somewhat shorter (in half-grown to adult, 3.45 to 4.2 in standard length). Eye typically smaller, often very small (at each specified length usually contained in the head more instead of less times than the figure given under 2b). Young with the caudal fin merely amber; large young and yearlings usually (but not always) in the juvenile striped color phase.....(3. *Erimyzon oblongus*)
- 3d.—Dorsal fin large, with 11 to 14 rays, usually 12. Scale rows, 40 to 45, usually 41 to 43. Depth in half-grown and adults contained 2.75 to 3.8 times in standard length, usually less than 3.4 times. Bony interorbital width, in half-grown to adult, 2.25 to 2.65 in head. Size large, at least to 263 mm. (standard length). *Atlantic drainage, New England at least to Virginia, including Lake Ontario basin*.....3a. *Erimyzon oblongus oblongus*
- 3e.—(Characters intermediate.) Dorsal rays, 11 or 12, usually 11. Scale rows, 40 to 44 (average, 41.1). Depth in half-grown to adults, 3.25 to 3.8 in standard length. Bony interorbital width, in half-grown to adult, 2.5 to 2.7 in head. Size probably moderate; the largest seen 143 mm. long. *Altamaha River system, Georgia*.....3b. *Erimyzon oblongus connectens*
- 3f.—Dorsal fin smaller, with only 10 or 11 rays, usually 10. Scale rows 39 to 43, usually 39 to 41. Depth in half-grown and adults contained 3.15 to 4.2 times in standard length, usually more than 3.4 times. Bony interorbital width, in half-grown to adult, 2.6 to 3.0 in head. Size very small; the largest seen 132 mm. long, usually much smaller. *West of Allegheny Mountains, from the lower Great Lakes, above Niagara Falls, to Oklahoma and Alabama*.
3c. *Erimyzon oblongus claviformis*

1. *Erimyzon tenuis* (Agassiz)

Although only known from the type-series in the Museum of Comparative Zoology, sent to Agassiz from near Mobile, Alabama, this species is the most distinct in the genus. Contrary to Jordan's statement (1878: 147), *Moxostoma tenue* Agassiz (1855: 88) was adequately diagnosed, by the following statement: "it differs from the others by its more elongated form, and less prominent differences between males and females." The lesser sexual dimorphism thus referred to by Agassiz lies in the anal fin, which in *tenuis* does not become bilobed in the adult male, but remains narrow and

pointed, about as in *Catostomus*. The name *tenuis* must be lifted from the synonymy of *E. sucetta*, where it has rested for half a century. The additional features which distinguish *Erimyzon tenuis* from all other chub-suckers are outlined in the preceding key.

As indicated by Agassiz, this species of *Erimyzon*, like the others, is horizontally striped when young. The smallest one seen, 66 mm. in standard length, shows a dark brown band, as wide as eye, extending from tip of snout through the eye and back to a large elongated black spot at base of caudal. The band is accompanied above by a sharply edged light streak, of somewhat narrower width, which meets its fellow to form a V on the top of the snout. The midline in front of the dorsal fin is also a pale streak. The front edge of the dorsal is blackish; the rest of the fin, dusky. The anal is darkened on its front edge and its tip. The caudal is dusky, especially toward its edge. The paired fins are pale on their outer edges, toward their tips.

2a. *Erimyzon sucetta sucetta* (Lacépède)

Lacépède's account and figure of *Cyprinus sucetta*, published in his *Histoire Naturelle des Poissons* (5, 1803, pp. 503, 606 and 610, pl. 15, fig. 2; another edition,—10, 1803, p. 291, pl. 9, fig. 2, and 11, 1803, pp. 81, 86; still another edition, 13, 1804, pp. 39, 127 and 131, pl. 1, fig. 2), was drawn from the manuscript of Bose, and therefore refers to some chub-sucker caught in the vicinity of Charleston, South Carolina. Inasmuch as the present form is very much the commoner in that region (it is the only one represented in the collections made there by Agassiz), and since this is the form with which all other authors, except Jordan in 1878, associated or tried to associate this name, we may adhere to present usage. Jordan, in the paper cited (1878: 144), confounded *sucetta* with *oblongus*, and renamed the true *sucetta* as a new species, *Erimyzon goodei*. That name appears to be the only synonym of *E. s. sucetta*.

Lacépède's species was referred to as *Catostomus sucetta* by Le Sueur (1817: 109), De Kay (1842: 203), and other early authors. Valenciennes (Cuvier and Valenciennes, 1844: 466) reformed the spelling to read *C. suceti*, but the earlier Latinization of the French *sucet* seems no worse, and, of course, should be retained.

The typical or eastern form of *Erimyzon sucetta* is represented in the Museum of Comparative Zoology and our Museum of Zoology by specimens from New York, Pennsylvania, Virginia, South Carolina, Georgia, and Florida.

2b. *Erimyzon sucetta kennerlyi* (Girard)

A western form of *Erimyzon sucetta* may be provisionally distinguished, although it is not nearly so different from its eastern cognate as is the west-

ern *E. oblongus claviformis* from the eastern *E. o. oblongus*. The average differences, in number of dorsal rays (Table III), number of scale rows (Table VII), and depth of body, are indicated in the key to the species and subspecies. There may also be a slight average difference in number of pelvic rays (Table V).

TABLE III. NUMBER OF PRINCIPAL DORSAL FIN RAYS IN THE SPECIES AND SUBSPECIES OF *Erimyzon*

	Dorsal rays					Average
	10	11	12	13	14	
<i>Erimyzon tenuis</i>	—	14	—	—	—	11.0
<i>Erimyzon sucetta sucetta</i>	—	16	50	5	—	11.8
<i>Erimyzon sucetta kennerlyi</i>	1	59	21	2	—	11.2
<i>Erimyzon oblongus oblongus</i>	—	7	45	10	1	12.1
<i>Erimyzon oblongus connectens</i>	—	7	1	—	—	11.1
<i>Erimyzon oblongus claviformis</i>	79	8	—	—	—	10.1

Two names have been based on this form, *Moxostoma kennerlyi* Girard (1856: 171, and 1859: 34, pl. 20, fig. 7-9), and *Moxostoma campbelli* Girard (1856: 172, and 1859: 35, pl. 20, fig. 4-6). Of these two names, both based on Texas specimens, and of identical date, I choose the former. The types of *kennerlyi*, found in the National and Harvard museums, show the characters indicated in Table IV, and have the scale structure and gill-raker characters indicated in the key as distinctive of the species *E. sucetta*. No remaining specimens of *campbelli* were found, but the figure indicates that the name was based on the species *sucetta* rather than *oblongus*.

TABLE IV. CHARACTERS OF TYPES OF *Moxostoma kennerlyi* Girard = *Erimyzon sucetta kennerlyi*

Museum	Length to C., mm.	Depth in length	Head in length	Eye in head	Inter-orbital	Scale rows	Dorsal rays	Pelvic rays
M. C. Z.	70.5	3.4	3.5	4.6	2.75	37	11	9-9
U. S. N. M.	—	—	—	—	—	—	—	9-8
“	—	—	—	—	—	—	—	9-9
“	67	3.6	3.75	4.6	2.6	37	11	9-9
“	74	3.4	3.7	4.65	—	36	11	—
“	75	3.6	3.75	4.3	2.65	37	11	9-9
“	80	3.6	3.7	4.7	2.6	37	11	9-9
“	120	3.4	3.95	5.5	2.5	37	11	9-9

The material at hand does not show intergradation between *kennerlii* and *sucetta*, but since the two appear very imperfectly differentiated, they should be maintained as subspecies. Material from the intervening locality of Mobile, Alabama (in Museum of Comparative Zoology), which might be expected to show intergradation, on the contrary is so distinctive as to suggest that an unnamed form is represented. The three Mobile specimens agree with *E. s. kennerlii* in having 11 dorsal rays (they are not listed in Table III), but differ from that and all other subspecies in having 10 pelvic rays, except on one side of one specimen. Although only three specimens of the aberrant type are at hand, the five pelvic fins with 10 rays suggest that this is a very frequent if not usual number in chub-suckers of the *sucetta* type about Mobile. Our data on pelvic-ray variation in *Erimyzon* are given in tabular form (Table V).

TABLE V. NUMBER OF PELVIC RAYS IN SPECIES AND SUBSPECIES OF *Erimyzon*

	Pelvic rays			
	8	9	10	Average
<i>Erimyzon tenuis</i>	—	25	3	9.1
<i>Erimyzon sucetta sucetta</i>	4	95	11	9.1
Aberrant Mobile specimens	—	1	5	9.8
<i>Erimyzon sucetta kennerlii</i>	14	102	2	8.9
<i>Erimyzon oblongus oblongus</i>	6	47	—	8.9
<i>Erimyzon oblongus connectens</i>	1	15	—	8.9
<i>Erimyzon oblongus claviformis</i>	13	90	4	8.9

One of these aberrant Mobile specimens, a nuptial male, shows an additional characteristic not observed in other specimens of *Erimyzon*. Its head is armed with several smaller accessory tubercles, in addition to the three primary ones.

3a. *Erimyzon oblongus oblongus* (Mitchill)

Mitchill's description (1815: 459) of *Cyprinus oblongus* contains no clear indication as to whether he had the species here called *oblongus*, or the one named *sucetta*. It appears possible, however, to retain the name, because this form is very much the commoner about New York, the type-locality of *oblongus*, and because the name *oblongus* has been used for the present form by all subsequent authors who have adopted the name, including De Kay (1842: 193, pl. 42, fig. 136).

De Kay's action would have settled the case conclusively, if Le Sueur had not thrice renamed the same species in the meantime. *Catostomus gibbosus* Le Sueur (1817: 92), from the Connecticut River, near Northampton,

Massachusetts, which locality is beyond the known northern limit for *sucetta* (New York), and from which place topotypic material has been examined, is based on a poor description and on a fair figure, representing a large adult of the present form. *Catostomus tuberculatus* Le Sueur (1817: 104), from near Germantown, Pennsylvania, is illustrated by a figure which is a fair representation of a breeding male of *E. o. oblongus*. *Catostomus vittatus* Le Sueur (1817: 104), from Wissahickon River, near Philadelphia, is supposedly the young of *E. o. oblongus*, which form tends to retain the juvenile striped color phase longer than *E. sucetta*. The current synonymizing of these three names of Le Sueur with *Cyprinus oblongus* Mitchill may apparently be legitimately followed.

As mentioned above, De Kay in 1842 used Mitchill's name *oblongus* for the form here called *Erimyzon oblongus oblongus*, but oddly referred the species to the genus *Labeo*. Later (1842: 394), on account of a prior *Labeo oblongus*, he renamed the New York form *Labeo elongatus*. De Kay also proposed two other nominal species of chub-suckers. *Labeo elegans* De Kay (1842: 192, pl. 31, fig. 100), from New York, to judge from the locality as well as the figure, was probably also based on *oblongus*, as is generally supposed. Likewise *Labeo esopus* De Kay (1842: 192), from the interior of New York state, may probably be retained as a synonym of *oblongus*, especially as the large size and gibbous nape described for *esopus* best suggest *E. o. oblongus*.

We have taken *E. o. oblongus* as far north as a tributary of the Merrimac River, 2 miles east of New Hampton, New Hampshire, and have examined specimens in the Museum of Comparative Zoology from numerous points in Massachusetts, New York, New Jersey, Pennsylvania, and Maryland; the largest example seen, 263 mm. long to caudal fin, came from Virginia. Recent collections in New York state by J. R. Greeley and T. L. Hankinson show that *Erimyzon oblongus oblongus* occurs in the Lake Ontario drainage, where it appears to be the only representative of the genus. *Erimyzon oblongus claviformis* and *Erimyzon sucetta kennerlyi* apparently do not range east of Niagara Falls (Hubbs and Brown, 1929: 3).

3b. *Erimyzon oblongus connectens*, new subspecies

I find that the Altamaha River system of Georgia is populated by a representative of *Erimyzon oblongus* as well as by *Erimyzon sucetta*. It is interesting that this form of *oblongus* should bridge over completely the rather wide gap between *E. oblongus oblongus* and *E. oblongus claviformis*, in characters as well as in distribution. While apparently not completely differentiated from either of the other forms, it appears sufficiently distinct to warrant its recognition as an intermediate subspecies. Whether it actually intergrades with either the eastern or the western subspecies I can

not say. The single specimen of the eastern form which I have seen from as far south as Virginia is typical of *E. o. oblongus*, and I have examined only *sucetta* from South Carolina. Material in the Museum of Comparative Zoology from Mobile and elsewhere in Alabama is good *E. o. claviformis*, and none of *oblongus* from any stream system between the Alabama and the Altamaha has come to my notice.

Apparently *E. o. connectens* is intermediate between *oblongus* and *claviformis* in all five of the characters by which these forms are known to differ from one another. The data make up Table VI.

TABLE VI. CHARACTERS OF THE THREE SUBSPECIES OF *Erimyzon oblongus*. THE MEASUREMENTS ARE BASED ON HALF-GROWN TO ADULT SPECIMENS

	Subspecies		
	<i>oblongus</i>	<i>connectens</i>	<i>claviformis</i>
Dorsal rays (see Table III)			
Range	11 to 14	11 or 12	10 or 11
Usually	12	11	10
Average	12.1	11.1	10.1
Scale rows (see Table VII)			
Range	40 to 45	40 to 44	39 to 43
Usually	41 to 43	?	39 to 41
Average	42.4	41.0	40.3
Depth of body (in standard length)			
Range	2.75 to 3.8	3.25 to 3.8	3.15 to 4.2
Usually	less than 3.4	?	more than 3.4
Bony interorbital (in head)	2.25 to 2.65	2.5 to 2.7	2.6 to 3.0
Largest specimen seen	263 mm. (often more than 200 mm.)	143 mm. (few seen)	132 mm. (seldom so large)

The holotype of *Erimyzon oblongus connectens* is a fine specimen 105 mm. long to caudal, collected by H. R. Becker and E. P. Creaser in a tributary to Swift Creek, Altamaha River system, Georgia (No. 88,370 Museum of Zoology). Two paratypes were taken with the holotype, and nothing was secured in the Altamaha system near Dublin, Georgia. Four other specimens of the same form, from Athens, Georgia, were found in the Museum of Comparative Zoology.

3c. *Erimyzon oblongus claviformis* (Girard)

The Western form of *Erimyzon oblongus* agrees with the typical subspecies in scale structure, in having more scales than *E. sucetta* (Table VII), in length and number of gill-rakers, in the small size of head and of eye, and in the coloration of the young, all as outlined in the key. It differs from *E. o. oblongus* in the smaller dorsal fin, with fewer rays (Table III); usually in the lower scale count (Table VII); almost always in the narrower

interorbital; and the much smaller size attained. The comparison is outlined in the key and in Table VI.

These differences are more striking at first glance than the resemblances. Full specific distinction might appropriately be granted the two forms, were it not for the existence of the intermediate form *E. o. connectens*, which apparently is not fully differentiated from either.

TABLE VII. NUMBER OF TRANSVERSE SCALE ROWS TO END OF HYPURAL IN THE SPECIES AND SUBSPECIES OF *Erimyzon*

	Transverse scale rows											Average	
	34	35	36	37	38	39	40	41	42	43	44		45
<i>Erimyzon tenuis</i>	—	—	—	—	—	—	1	6	3	—	—	—	41.2
<i>Erimyzon sucetta sucetta</i>	8	26	17	5	—	—	—	—	—	—	—	—	35.3
<i>Erimyzon sucetta kennerlyi</i>	3	10	18	26	16	—	—	—	—	—	—	—	36.6
<i>Erimyzon oblongus oblongus</i>	—	—	—	—	—	—	3	10	20	11	7	5	42.4
<i>Erimyzon oblongus connectens</i>	—	—	—	—	—	—	4	2	1	—	1	—	41.1
<i>Erimyzon oblongus claviformis</i>	—	—	—	—	—	8	10	7	3	1	—	—	40.3

This well-marked western form of *Erimyzon oblongus* has apparently been given but one name, *claviformis*. The types of *Moxostoma claviformis* Girard (1856, 171; 1858, 219, pl. 48, fig. 5-9), preserved in the National and Harvard collections, show the scale and gill-raker characters indicated in the key as characteristic of the species *oblongus*, and counts and measurements sufficiently typical of the western subspecies (Table VIII).

Rafinesque's *Catostomus fasciolaris* (1820, 58) has been quoted as a synonym of "*Erimyzon sucetta oblongus*," but his account seems to me to fit *Percina caprodes caprodes* much better. The description is one of those based upon Audubon's sketches, which were either roughly drawn up from memory, or put together, as a practical joke, to fool the gullible Rafinesque. In this case Rafinesque was not sure whether the species was a *Catostomus* or a *Fundulus*. The transverse black bars (about twenty) and the long dorsal fin ("longitudinal reaching the end of the anal fin") occur together in no American freshwater fish excepting *Percina caprodes caprodes*. The name "pike sucker" might well have been applied to *Percina*, because of its resemblance to a pike and its sucker-like mouth: I have heard *Percina* called "pickerel minnow."

The dorsal rays average rather high, although not so high as in typical *oblongus* (compare Table III). There seems to be a tendency for 11 rays to occur more frequently in the Southwest than elsewhere in the range of *claviformis*, for our other southwestern specimens (Hubbs and Ortenburger, 1929b: 62) have either 11 or 10 dorsal rays. This variation does not ap-

TABLE VIII. CHARACTERS OF TYPES OF *Moxostoma claviformis* Girard = *Erimyzon oblongus claviformis*

Museum	Length to C., mm.	Depth in length	Head in length	Eye in head	Inter-orbital	Scale rows	Dorsal rays	Pelvic rays
U. S. N. M.	64	3.7	3.7	5.3	3.0	40	11	9-9
“	74	3.5	3.75	5.6	2.8	40	11	9-9
M. C. Z.	65	3.7	3.65	5.5	2.8	40	10	9-9

pear to be an intergradation toward *E. o. connectens*, since the specimens I have seen from the Tennessee and Alabama River systems all have 10 dorsal rays.

VI. THE SPECIES OF HYPENTELIUM

1. *Hypentelium etowanum* (Jordan)

Jordan (1877: 346) noted that the black suckers of the Alabama River basin differed from ordinary *nigricans* in a number of characters. He named the southern form “*Catostomus nigricans* var. *etowanus*. Var. nov.,” and discussed it in these words—

“My specimens of this species from the Etowah agree closely with each other, and differ somewhat from northern specimens. The southern form is, perhaps, a recognizable variety, which may be termed *etowanus*.

“This form may be characterized as follows:—

“Head shortish, $4\frac{1}{3}$ to $4\frac{1}{2}$ in length; eye moderate, about as in *nigricans*. Form, scales, etc., as in var. *nigricans*. Lat. l., 48. D. uniformly I, 10. A., 1, 7. V., 9. Pectorals shorter and broader than in *nigricans*, $4\frac{1}{2}$ to 5 in length of body.

“Body nearly black above, the color running down on the sides, and changing abruptly into the silvery hue of the belly. A whitish spot at the base of each scale,—these forming conspicuous pale streaks along the rows of scales. Dorsal black edged; other fins decidedly red in life.

“*Habitat*. Water basin of the Etowah and Oostanaula, abounding in rapids and clear places. Known as Hog-molly (Mullet), Crawl-a-bottom, and Hog Sucker.

“A number of specimens of this variety, compared with *nigricans* of the same size, show the following differences:—

“ * D. I, 11; head long ($4\frac{1}{2}$ in length); pectorals long; 4 to $4\frac{1}{2}$ in length of body; lower fins olivaceous or dull orange; colors relatively dull; scales without streaks. Northern.

..... NIGRICANS.

“** D. I, 10; head shorter ($4\frac{1}{3}$); pectorals shorter ($4\frac{3}{4}$); lower fins red; colors brighter; pale stripes along the rows of scales. Southern.

..... ETOWANUS.”

In his 1878 review (pp. 159 and 162; see also p. 54), Jordan accepted the form with about the same characterization.

In subsequent papers by Jordan and his associates, the form *etowanus* is not recognized. I now find, however, that the *Hypentelium* of the Alabama basin in Georgia and Alabama may be satisfactorily distinguished from *nigricans* by the ensemble of characters used by Jordan in 1877. When showing their life colors, the two forms may be told apart at a glance. The Alabama form is the more highly colored. The back is almost black anteriorly and on the head. The lighter bands and head mottlings are of a rich dark chestnut. The narial flap is reddish brown; the lower part of the snout suffused with reddish; the lips orange, brightest on anterior portion of upper lip. Lower fins bright orange red. Distal part of dorsal conspicuously blackened on membranes; basal part of dorsal with some orange.

The general physiognomy of *etowanum* and *nigricans* is very different. This difference is due to the lesser modification of *etowanum*. The flattening of the breast and enlargement of the pectoral fins, and the elongation of the head and especially the elevation of the supraorbital region, are not carried to the extreme in *etowanum* that they are in *nigricans*. The adult of *etowanum* has about the physiognomy of the young of *nigricans*.

The difference in the number of dorsal rays pointed out by Jordan generally holds good. There is some overlap, however, and in a few places, as

TABLE IX. VARIATION IN DORSAL RAYS IN *Hypentelium*

States	Drainage basin	Developed dorsal rays				
		9	10	11	12	Ave.
Alabama	Alabama	7	33	2	—	9.9
Georgia	Alabama	8	81	10	—	10.1
Ontario	Lakes Huron, Erie, Ontario	—	14	65	11	11.0
New York	Ontario; Susquehanna	—	1	22	1	11.0
Pennsylvania	Atlantic	—	—	19	2	11.1
Maryland						
West Virginia						
Wisconsin	Mississippi; Great Lakes	1	3	62	1	10.9
Michigan						
Missouri						
Arkansas	Mississippi	—	—	13	—	11.0
Oklahoma						
Indiana						
Ohio	Ohio	—	2	15	—	10.9
Kentucky	Ohio, Green, Cumberland	—	—	17	2	11.1
Tennessee	Cumberland, Tennessee	1	5	45	3	10.9
Virginia	Tennessee	—	—	9	1	11.1
Alabama	Tennessee	—	—	7	—	11.0
Georgia						
<i>Hypentelium etowanum</i> (totals)		15	114	12	—	9.96
<i>Hypentelium nigricans</i> (totals)		2	25	274	21	10.98

in Ontario, I find a tendency for only 10 rays to be developed frequently in *nigricans*. I have not found, however, that this variation is geographic. In the Tennessee basin, even in Alabama, *nigricans* remains typical in dorsal ray number as well as in other characters. My counts are given in Table IX.

I regard *etowanum* as a distinct species, because I have found no satisfactory evidence of the intergradation of the forms, and because I believe it would always be possible to distinguish fresh adults of the two forms.

It would be interesting to know the characters of the *Hypentelium* of the Savannah River system, of Georgia and South Carolina.

2. *Hypentelium nigricans* (Rafinesque)

This species seems to be fairly consistent in its characters throughout its wide range: Ontario and New York to Virginia, Michigan and Wisconsin to Oklahoma and northern Alabama and Georgia.

VII. THOBUERNIA RHOTHOECA (THOBUERN)

Although it is one of the most distinctive members of the Catostomidae, and noteworthy as being one of the most perfectly adapted among all North American fishes for life in the mountain torrents, *Thoburnia rhotioeca* has remained until the present rather vaguely understood. It was, indeed, collected and recorded many years ago by both Cope and Jordan, but was confused by both of them with the very different though superficially somewhat similar *Moxostoma cervinum*. Cope (1868: 236, and 1870: 478) described *Tertulus cervinus* (referred by him to *Ptychostomus* in 1870) from the swift headwaters of the Roanoke and the James. His figure (1868: pl. 24, fig. 3) surely represents the species now called *Moxostoma cervinum*, which is certainly known only from the Roanoke system, as does also one of his types in the Museum of Comparative Zoology. His note on color changes with age, however, shows that his young specimens, which I suppose came from the James, were *T. rhotioeca* ("The young have a broad lateral band, which, as they grow older, breaks into quadrate spots before disappearing"). Jordan (1889: 109 and 122) similarly recorded *Moxostoma cervinum* from both the James and the Roanoke, and also described the coloration of *Thoburnia rhotioeca* as that of the young of *M. cervinum*. One of Jordan's specimens of "*cervinum*," from Buffalo Creek, near Lexington, Virginia, in the James system, now in the Museum of Comparative Zoology, is a typical example of *Thoburnia rhotioeca*. Jordan's error was caused obviously by following the authority of Cope, for he made the identical mistake.

This form was first described by Thoburn (in Jordan and Evermann, 1896: 181), who clearly indicated its specific distinctness, but failed to note

its striking structural peculiarities. He, therefore, referred it to *Catostomus*, as *C. rhothoecus*. The type specimens were in a lot with confused locality, "collected by Dr. Charles H. Gilbert, at some point in eastern Tennessee or southwestern Virginia, thought to be from French Broad River at Wolf Creek, Tennessee." From our recently acquired knowledge of the species, it is highly probable that the types came from western Virginia, rather than from the French Broad. No one has before or since discovered the species in the well-seined upper Tennessee system.

Catostomus rhothoecus was next referred to in 1917, when Jordan and Snyder (in Jordan, 1917: 88) based on it a new genus, *Thoburnia*, "distinguishable from *Hypentelium* by the very small head, the skull not concave between the eyes." This diagnosis, especially since it is accompanied by a type designation, must be regarded as adequate, although it makes no mention of the striking structural features of the genus: the obsolete air-bladder of the adult, the obliterated fontanelle, and the subplicate lips.

The species remained of doubtful geographic status until it was rediscovered by Fowler (1922: 9, pl. 1; and 1923: 12), in the James River system of Virginia. Fowler also overlooked the generic features, and referred the species to *Catostomus* and gave no reference to the generic name which Jordan and Snyder had proposed five years earlier.

While working in the Museum of Comparative Zoology in 1928, I found 34 specimens of *Thoburnia rhothoeca*, with the following data: Buffalo Creek, near Lexington, Virginia (the specimen recorded by Jordan as *Moxostoma cervinum*); "Highland County, Virginia," and "12 mi. from Monliverey (south), Highland Co., W. Va." (doubtless corrupted from "12 miles south of Monterey, Highland County, Virginia"), and "White Sulphur Springs, W. Va." All of these localities are in the James River system, with the exception of the last one, which is within the Kanawha River system. These two systems have peculiar faunas so distinct from one another that I went to the White Sulphur Springs region to try to verify the record. I did not take *Thoburnia rhothoeca* in the Kanawha drainage, either about White Sulphur Springs, or elsewhere. The species was found, however, in several localities in the James system. It was common in a tributary of Dunlap Creek, a headwater feeder of the James, near the West Virginia line, only a few miles from White Sulphur Springs. Here it lived with *Clinostomus vandoisulus* and *Notropis cornutus*, neither of which were seined anywhere in the Kanawha system of West Virginia, but both of which were with the *Thoburnia* material labelled "White Sulphur Springs." I suppose, therefore, that these specimens in the Harvard collection were either erroneously labelled or that they were taken just over the stream divide, in the headwaters of the James.

Thoburnia rorthoeca lives in the swifter portions of the turbulent mountain streams. In correlation with its life in the torrents, its structure is much modified. The head is small, convex, decurved; the skull thick, with obliterated fontanelle, and the air bladder is obsolete in the adult.

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