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MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN, NO. 48

A REVISION OF THE BLACK BASSES (*MICROPTERUS* AND *HURO*) WITH DESCRIPTIONS OF FOUR NEW FORMS

BY
CARL L. HUBBS and REEVE M. BAILEY

ANN ARBOR
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JULY 27, 1940

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FREDERICK M. GAIGE
Director of the Museum of Zoology

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CONTENTS

PLATES

(Plates I to VI face page 51)

FIGURES IN THE TEXT

MAPS

(Maps 1 and 2 follow Plate VI)

A REVISION OF THE BLACK BASSES (*MICROPTERUS* AND *HURO*), WITH DESCRIPTIONS OF FOUR NEW FORMS

INTRODUCTION

UNTIL recently the North American fresh-water centrarchids known as black bass had long been referred to 1 genus and 2 species, *Micropterus dolomieu* and *Micropterus salmoides*. In 1926 the largemouthed species *salmoides* was set apart in a distinct genus, *Aplites* (Hubbs, 1926: 69 and 71), and in the following year a third species, *Micropterus pseudaplites*, was described (Hubbs, 1927). Except for differences of opinion regarding the generic and specific nomenclature of the largemouthed bass, this classification of the black basses has been generally followed. It has now become evident, however, that the spotted bass (*Micropterus pseudaplites*) was in all probability described by Rafinesque, and it is proposed that the name *Micropterus punctulatus* be used for this species.

There is evidence indicating the existence of a fourth species of black bass, here named *Micropterus coosae*, and of 3 new subspecies: *M. punctulatus wichitae*, *M. p. henshalli*, and *M. dolomieu velox*. The 4 new black basses described in this paper are compared with the 3 forms previously recognized. The largemouthed bass is characterized in the key and is discussed nomenclatorially. According to present interpretations, its name should stand as *Huro salmoides* (Lacépède). No analysis has been made of the local variations of this species, although there are indications that it is a complex of subspecies.

Even after the separation of the 4 additional species and subspecies, the classification of the forms of *Micropterus* in certain regions appears to be confused or incomplete. In the southern part of the Ohio River drainage basin *Micropterus dolomieu* differs considerably from the typical subspecies, and in several characters approaches *M. d. velox*. In the southern states the characters of the forms of *Micropterus* are confused, which suggests that other localized variants remain unnamed (see Map 1) or that interspecific hybridization has caused the observed variation (pp. 19–20, 28 and 41). Two specimens are definitely indicated as hybrids between *M. dolomieu* and *M. p. punctulatus*, and another is interpreted as a hybrid between *M. coosae* and *M. p. henshalli* (pp. 39–41).

The group of the black basses (*Micropterus* and *Huro*) is regarded as a tribe (*Micropterini*, new name) of the subfamily Lepominae.

In summary, the proposed classification and nomenclature of the black basses is as follows:

Family Centrarchidae Cope[1]
Subfamily 1. Lepominae Gill[2]
Tribe 1. Micropterini,[3] new name
Genus 1. *Micropterus* Lacépède
1. *M. punctulatus* (Rafinesque), spotted bass
1*a*. *M. p. punctulatus* (Rafinesque), northern spotted bass.
1*b*. *M. p. henshalli,* new subspecies, Alabama spotted bass.
1*c*. *M. p. wichitae,* new subspecies, Wichita spotted bass.
2. *M. coosae,* new species, redeyed bass
3. *M. dolomieu* Lacépède, smallmouthed bass
3*a*. *M. d. velox,* new subspecies, Neosho smallmouthed bass
3*b*. *M. d. dolomieu* Lacépède, northern smallmouthed bass
Genus 2. *Huro* Cuvier
4. *H. salmoides* (Lacépède), largemouthed bass
(Subspecies not yet delimited)

Materials and Acknowledgments

This revision of the black basses is based on a critical examination of the extensive material deposited in the following collections:

University of Michigan Museum of Zoology (U.M.M.Z.)
United States National Museum (U.S.N.M.)
Museum of Comparative Zoology (M.C.Z.)
Academy of Natural Sciences of Philadelphia (P.A.N.S.)
University of Oklahoma Museum of Zoology (U.O.M.Z.)
Alabama Polytechnic Institute (A.P.I.)
Iowa State College (I.S.C.)
Southern Biological Supply Company (S.B.S.C.)
Illinois State Natural History Survey (material of *Micropterus punctulatus*)

We are very grateful to the directors and curators of these institutions for their generosity in making the material in their care available to us.

F. E. Guyton, of Alabama Polytechnic Institute, has graciously granted us priority in the naming of *Micropterus coosae,* which he also recognized as a new species. A. I. Ortenburger, of the University of Oklahoma, has

[1] Cope (1868: 216).

[2] Gill (1864: 92); Jordan (1877*b*: 31).

[3] This group has been called Micropterinae by Gill (in Jordan, 1877*b*: 31) and others, and the name Micropteridae was proposed for the family by Fowler (1906: 513).

given us permission to describe *M. punctulatus wichitae,* almost all of the specimens of which were collected under his supervision. Records and other information of material value in rounding out our treatment of the basses have been freely placed at our disposal by Milton B. Trautman, David H. Thompson, Edward C. Raney, Percy Viosca, Jr., Eugene R. Kuhne, and other ichthyologists.

Methods Used in Counting and Measuring

In the vertebral count the hypural is included as 1 vertebra, and the first vertebra with a well-developed haemal spine is treated as the first caudal vertebra. The scales are counted: (*a*) along the lateral line, from the last one in contact with the shoulder girdle to the structural base of the caudal fin; (*b*) above the lateral line, downward and backward from the origin of the dorsal fin to but not including the lateral-line row, and including the small scales near the origin of the fin; (*c*) below the lateral line, from the origin of the anal fin, including the small scales, upward and forward to but not including the lateral-line row; (*d*) around the caudal peduncle, enumerating the minimum number of rows around the slenderest point of the caudal peduncle; and (*e*) on the cheek, counting the rows which cross the shortest line from the eye to the posteroventral angle of the preopercle. The last ray of the dorsal and anal fins is always treated as a double ray divided to the base of the fin. In the pectoral fin all rays are enumerated, including the short uppermost ray which closely adheres to the second one (the first well-developed ray) and all small rays at the ventral end of the fin.

The measurements, made with dividers and read to the nearest 0.1 mm., on a steel rule, are expressed as thousandths of the standard length (the length from the anterior end of the upper jaw to the structural base of the caudal rays; distinguished from the total length, which is measured from the tip of the mandible to the end of the caudal fin). For the type specimens only, the proportions are also expressed as the number of times each given measurement enters either the standard length or the length of the head, when the measurement is stepped over the curve of the body or head. The length of the caudal peduncle is taken from the posterior end of the anal base to the base of the caudal rays at the lateral line. The length of the pectoral fin is the distance from the base of the uppermost ray to the tip of the fin; that of the pelvic fin is the distance from the base of the spine to the tip of the fin. The head is measured from the front end of the upper jaw to the tip of the opercular membrane. The length of the orbit is obtained by placing the tips of the dividers at the edges of the eye and spreading them with a gentle pressure. The interorbital width is measured by pressing the points together to approximate as nearly as

practicable the least bony width. The length of the lower jaw is taken from its anteriormost tip to the posterior end of the angular.

In the description of each new form, the measurements and counts of the holotype are given. Ranges and averages of the measurements are presented in Table III, and frequencies and averages for the counts in Tables IV–VII. The body proportions are expressed as the number of times each measurement, as taken with dividers, may be stepped into the standard length, and as thousandths of this length. The head proportions are similarly expressed with the head length as the base.

KEY TO THE FORMS OF *MICROPTERUS* AND *HURO*[4]

1a.—Centrarchidae with 3 anal spines (very rarely 2 or 4); 6 branchiostegals (very rarely 7[5]); villiform teeth on palatines and ectopterygoids, but none on entopterygoids, present or absent on glossohyal; bifid opercle (with lower lobe much longer than upper, especially in adult), rigid to tip; large mouth (maxillary extending at least to below center of pupil); well-developed supramaxillary; entire preopercle; 31–33 vertebrae; 14 or 15 precaudal vertebrae (very rarely 13 or 16); 55–81 scales along lateral line; 9–20 scale rows on cheek; 9–11 dorsal spines; anal base less than half dorsal base; moderately compressed, elongate body (depth about one-third to one-fifth standard length in juveniles, but increasing with age); size, large (greater than 12 inches as the maximum in all species).—Tribe **Micropterini** (new name) of the subfamily Lepominae.

2a.—Pyloric caeca typically simple (occasionally 1 or 2 branched). Outline of spinous dorsal weakly curved to moderately angulate; spinous and soft portions of fin well connected; the shortest spine at emargination of fin (typically the ninth spine), 1.1 to 2.5 in longest spine. Anal and soft dorsal with scales on interradial membranes near their bases. Cheek scales, usually in 12 or more rows (occasionally 10 or 11 in *coosae* and 11 in *punctulatus*); mouth, moderate (upper jaw extending little or not at all beyond eye in adult). ..... Genus *Micropterus*

3a.—Dorsal soft rays, 12 (infrequently 11 or 13); anal soft rays, 10 (occasionally 9 or 11); pectoral rays, 15 or 16 (very rarely 14 or 17). Scales above lateral line, 7–10; below lateral line, 14–19. Vertebrae, normally 14 + 18 = 32. Larger individuals with a dark streak along each ventrolateral scale row. (See alternatives *3b* and *3c*.)

4a.—Color pattern consisting chiefly of a lateral series of dark blotches which tend to be confluent, so as to form an irregular longitudinal stripe; basal caudal spot (and opercular spot) prominent; dark band on caudal lobes of young conspicuous. Caudal peduncle typically more slender and elongate. Predorsal contour flatter; the muzzle more produced. Shortest dorsal spine at emargination of fin, not more than 0.6 as long as the longest spine (see also *3b*).

1. *Micropterus punctulatus*

[4] This key is purportedly natural, with a single exception: The characters of *Micropterus punctulatus wichitae* (a form highly localized in Oklahoma) call for its separation from the other subspecies of *punctulatus*.

[5] On 1 side of 1 specimen (of *Huro salmoides*), out of 146 counts for the tribe.

5a.—Scales along lateral line, usually 60–68 (extreme range, 55–72); around caudal peduncle, usually 23–26 (extreme range, 22–27). Pectoral rays, more frequently 15 than 16. Typically less elongate (at comparable sizes). *Southern Ohio and West Virginia to southern Illinois, southeastern Kansas, eastern and southern Oklahoma, and eastern Texas; east to Mississippi and to the Tennessee River drainage of Tennessee, Alabama, and Virginia; recently introduced into California and South Africa.* ..... 1a. *M. p. punctulatus*

5b.—Scales along lateral line, usually 68–75 (extreme range, 68–77); around caudal peduncle, usually 27–28 (extreme range, 26–29). Pectoral rays, more frequently 16 than 15. Typically more elongate (at comparable sizes). *Alabama River system of Mississippi, Alabama, and Georgia, intergrading with typical punctulatus near the coast along the eastern part of the Gulf of Mexico.* ..... 1b. *M. p. henshalli*

4b.—Color pattern consisting principally of vertical dark bars, which are frequently faint and always obscured with age, and on the caudal peduncle are often modified into light-centered rhombs; basal caudal spot not prominent; band on caudal lobes of young faint or obsolete. Caudal peduncle typically deeper and shorter. Predorsal contour more rounded (simulating that of *M. d. dolomieu*). Shortest dorsal spine at emargination of fin, typically more than 0.6 as long as the longest spine (about as in *M. d. dolomieu*).

5c.—Scales along lateral line, usually 67–72 (extreme range, 63–77); around caudal peduncle, usually 26–30 (extreme range, 25–31). Typically robust. *Southeastern streams from the Alabama to the Savannah, generally in the uplands.* ..... 2. *Micropterus coosae*

3b.[6]—Dorsal soft rays, 12–14, usually 13; anal soft rays, 10 (frequently 11, rarely 9); pectoral rays, 14–17, usually 15 or 16. Scales above lateral line, 8–11, usually 9; below lateral line, 15–19. Vertebrae, 14 or 15 + 17 or 18 = 32 (occasionally 31 or 33). Larger individuals with or without streaks along ventrolateral scale rows.

4c.—Color pattern very variable, in the young approaching that of *M. dolomieu,* with age becoming banded as in *punctulatus* or very much speckled; basal caudal spot well developed in young, sometimes disrupted in adult; dark band on caudal lobes of young conspicuous. Caudal peduncle about as in *M. p. punctulatus.* Predorsal contour variable, but generally flattish and the muzzle produced. Shortest dorsal spine at emargination of fin, typically less than 0.6 as long as the longest spine.

[6] Note that the items *3b, 4c,* and *5d* apply only to a form confined to a very small area in Oklahoma.

5d.—Scales along lateral line, 62–70; around caudal peduncle, 23–29. Typically rather elongate. *West Cache Creek in Wichita Mountains, Oklahoma.*

1c. *Micropterus punctulatus wichitae*

3c.—Dorsal soft rays, 13–15 (very rarely 12); anal soft rays, 11 (occasionally 10 or 12, very rarely 9); pectoral rays, 16–18 (almost never 15). Scales above lateral line, 12 or 13 (rarely 11 or 14); below lateral line, usually 20–23 (range, 19–25). Vertebrae, normally 15 + 17 = 32. No regular streaks along ventrolateral scale rows.

4d.—Color pattern consisting of bars (but note differences described in items *6a* and *6b*); basal caudal spot moderately developed in young, obsolescent with age; dark bands on caudal lobes of young conspicuous. Caudal peduncle typically deep and short. Shortest dorsal spine at emargination of fin more than half as long as longest spine.

5e.—Scales along lateral line, usually 69–77 (extreme range, 67–81); around caudal peduncle, usually 29–31 (extreme range, 28–32). ..... 3. *Micropterus dolomieu*

6a.—Dorsal rays, usually X, 13; ranging from IX (commonly) to XI (rarely), 11–15 (2 counts of 11, 4 of 15); sum of dorsal spines and soft rays, 21–23 in about 76 per cent of specimens counted. Predorsal contour straighter and form more slender, especially in young; depth, 3.8–4.3 in young less than 75 mm. long. Lower jaw projecting so that the teeth are visible from above. Teeth developed on tongue in more than half the specimens. Dark bars of young generally less elevated and broader, in large young tending to form hollow rhombs. *Tributaries of the Arkansas River system in northeastern Oklahoma and western Arkansas and the headwaters of the same streams in Missouri (and presumably in Kansas).*

3a. *M. d. velox*

6b.—Dorsal rays, usually X, 14; ranging from IX to XI (rarely varying from X), 13 (rarely; 1 count of 12) to 15; sum of dorsal spines and soft rays, 24 or 25 in more than 90 per cent of specimens counted. Predorsal contour more rounded and form more robust; depth, typically 3.2–3.8 in young less than 75 mm. long. Lower jaw typically little projecting, with the teeth scarcely or not visible from above. Teeth usually lacking on tongue (except toward the south). Dark bars of young typically very high and narrow, not tending to form hollow rhombs. *Originally from Quebec to northern Minnesota, south to Arkansas and the*

Tennessee River drainage of Alabama; not east of the Allegheny Mountains.

3b. *M. d. dolomieu*

2b.—Pyloric caeca mostly bifid near base. Outline of spinous dorsal sharply angulate; spinous and soft portions of fin almost separated; the shortest spine at emargination of fin, 2.4–3.9 in longest spine, and membranes between short spines deeply incised. Anal and soft dorsal without scales on interradial membranes (not considering the basal sheath of scales). Cheek scales in 9–12 rows. Mouth, large (upper jaw extending beyond eye in adults). ..... Genus *Huro*

3d.—Dorsal soft rays, usually 12 or 13 (rarely 11 or 14); anal soft rays, 11 (rarely 10 or 12); pectoral rays, usually 14 or 15 (extreme range, 13–17). Scales above lateral line, 7–9; below lateral line, 14–17. Vertebrae usually 15 + 17 = 32. No regular streaks along ventrolateral scale rows.

4e.—Color pattern consisting chiefly of a rather regular longitudinal dark stripe; basal caudal spot small, but distinct, especially in young; dark band on caudal lobes of young usually faint, varying from absent to rather well developed (best developed in south). Caudal peduncle rather robust. Predorsal contour rather strongly elevated, and becoming concave with age.

5f.—Scales along lateral line, usually 59–68 (extreme range, 58–69); around caudal peduncle, usually 26–28 (extreme range, 24–30). Typically rather robust. *Originally from southern Canada throughout the entire Great Lakes system and Mississippi Valley to northeastern Mexico and Florida, and north along the coastal plain to Virginia.* ..... 4. *Huro salmoides*

GENUS *MICROPTERUS* LACÉPÈDE

Micropterus.—Lacépède, 1802: 324–26. Haplotype, *Micropterus dolomieu* Lacépède.

Calliurus.—Rafinesque, 1819: 420. Haplotype, *Calliurus punctulatus* Rafinesque.

Aplites.—Rafinesque, 1820: 30. Logotype, *Lepomis pallida* Rafinesque, designated by Jordan and Gilbert, 1877: 86.

Nemocampsis.—Rafinesque, 1820: 31. Haplotype, *Lepomis flexuolaris* Rafinesque.

Dioplites.—Rafinesque, 1820: 32. Logotype, *Lepomis salmonea* Rafinesque, designated by Jordan and Gilbert, 1877: 86.

Aplesion.—Rafinesque, 1820: 36. Logotype, *Etheostoma calliura* Rafinesque, designated by Jordan and Gilbert, 1877: 86.

Grystes.—Cuvier, in Cuvier and Valenciennes, 1829: 54. Logotype, *Labrus salmoides* Lacépède, designated by Jordan and Gilbert, 1877: 88 (*Grystes salmoides* [Lacépède] Cuvier = *Micropterus d. dolomieu*). Spelled *Gristes* by some authors.

The synonymy given above includes references to the original description of *Micropterus* and its synonyms, with type designations. A full synonymy, with the characterizations given by subsequent as well as original describers, was elaborated by Henshall (1881: 65–78). Of the names listed by Henshall, *Huro* alone seems applicable to the genus now recog-

nized for the largemouthed bass. *Aplites* Rafinesque and *Grystes* Cuvier have also been applied to that genus (see p. 36), but are now interpreted as synonyms of *Micropterus*.

We here recognize as referable to *Micropterus* 3 species and a total of 6 forms.

SPOTTED BASS

1. *Micropterus punctulatus* (Rafinesque)

This name, as indicated in the synonymy of the typical subspecies, is accepted as applicable to the recently described species known as spotted bass or Kentucky bass. In addition to *M. p. punctulatus* we recognize 2 new subspecies.

NORTHERN SPOTTED BASS

1a. *Micropterus punctulatus punctulatus* (Rafinesque)

(Map 1; Pl. I, Fig. 2; Pl. II, Fig. 1.)

Calliurus punctulatus.—Rafinesque, 1819: 420 (original description; Ohio River); 1820: 26–27 (spelled *punctulatuse*, presumably by misprint; locality more specifically stated as Falls of the Ohio and neighboring streams).

Micropterus punctulatus.—Kuhne, 1939: 100 (characters and habitat). Harrison, 1939: 1–5 (introduction into South Africa).

Micropterus punctulatus punctulatus.—Kuhne, 1939: Fig. 66.

?Lepomis pallida.—Rafinesque, 1820: 30–31 (original description; the Ohio River, Miami River, Hockhocking River, etc.; not clearly identifiable, but here interpreted as a complex of this species and *M. d. dolomieu*, and as nomenclatorially referable to *punctulatus*).

?Etheostoma calliura.—Rafinesque, 1820: 36 (original description; the Ohio River, Salt River, etc.; not clearly identifiable, but here interpreted as a complex of this species and *M. d. dolomieu*, and as nomenclatorially referable to *punctulatus*).

Dioplites Treculii.—Vaillant and Bocourt, 1874: Pl. 4, Fig. 2 (original indication by figure; San Antonio de Bexar, Texas).

Micropterus nuecensis var. *treculii.*—Vaillant and Bocourt, 1883: 142 (original text description).

Micropterus floridanus (misidentification; not *Cichla floridana* LeSueur; see Hubbs, 1927: 3).—Cope, 1880: 31–32 (comparisons; Johnson Fork of Llano River, Texas).

Micropterus salmoides (misidentifications; not of Lacépède; see Hubbs, 1927: 3–4).—Jordan and Gilbert, 1886: 21 (comparison; Rio Colorado, Texas). Henshall, 1889: 29, and 1904: 45 (in part; variants from St. Francis River, Arkansas). Goldsborough and Clark, 1908: 37 (in part; variants from Iaeger, West Virginia).

Micropterus pseudaplites.—Hubbs, MS, in Ortenburger and Hubbs, 1927: 137 (*nomen nudum*); Hubbs, 1927: 1–15, Pl. 1, Figs. 2, 3, 5, Pl. 2, map (original description; Forbush Creek, Mill Springs, Kentucky; range). Jordan, 1929: 146 (diagnosis). Jordan, Evermann, and Clark, 1930: 298 (misspelled *pseudoplites*). Viosca, 1932: 95–98, 1 pl., 1 map (ecology). Howland, 1932*a*: 1–19, 5 figs.; 1932*b*: 88–94; and 1933: 185–88 (ecology, distribution, and propagation in Ohio). Wickliff and Trautman, 1935: 19, 1 fig., 1 map (Ohio). Hubbs and Bailey, 1938: 15–18, Pl. 1, Fig. 2 (comparison). Brown, 1939: 310, 312, Fig. 112 (introduction into California).

Since this species was described by Hubbs (1927) as *Micropterus pseudaplites,* its distinctness has been abundantly confirmed by the subsequent authors cited above, in the last item of the synonymy. The work of Howland and of Wickliff and Trautman, as well as our own examinations, has shown that it is the most abundant bass of the upper Ohio River and of the parts of Ohio adjacent to that river. This discovery has led to a reopening of the question as to whether Rafinesque had this form when he described several nominal species of bass from the same region. Although the presumably clearer and certainly less impounded waters of Rafinesque's time would have favored the smallmouthed bass (*M. d. dolomieu*) rather than the spotted bass, it can hardly be questioned that the present form was common, and in all probability was handled by Rafinesque.

A re-examination of Rafinesque's descriptions in the light of this evidence indicates that his oldest name for a bass, *Calliurus punctulatus* (1819: 420), was based on the species named *Micropterus pseudaplites* by Hubbs. The original description was as follows:

> *C. punctulatus.* Olivâtre, parsemé de points noirs très-rapprochés, ligne latérale peu courbée; queue bilobée, jaune à la base, noire au milieu, blanche au bout. D.$\frac{10}{14}$, A.$\frac{3}{10}$, P. 15, D. 24. Noms vulgaires de l'Ohio *Black-perch* et Fine-tail.

This description applies best to the spotted bass with respect to the prominent black spots, which suggested the name, and to the number of anal and pectoral rays, but not to the number of dorsal rays. The supplementary description in *Ichthyologia Ohiensis* (1820: 26–27) applies, in the following characters, much better to the spotted bass than to the other species: "Lower jaw longer: body . . . . crowded with blackish dots: head . . . . flattened above: tail . . . . base yellow . . . . from four to twelve inches long . . . . anal fin with 13 rays . . . . Pectoral . . . . with 15 rays." Only the indicated number (14) of dorsal soft rays applies better to *M. dolomieu.* It seems sufficiently clear that the name *Micropterus punctulatus* (Rafinesque) belongs with the spotted bass, replacing *M. pseudaplites* Hubbs. We are told by Milton B. Trautman that the vernacular name "painted-tail," attributed by Rafinesque to his *C. punctulatus,* may still be heard in Ohio.

Two of Rafinesque's names dating from 1820 may be associated nomenclatorially with this species (see synonymy), although the characters as given fit *punctulatus* in part and *dolomieu* in part. His other names seem to fit *dolomieu* better, and may be listed in the synonymy of that species.

The figure of *Dioplites Treculii* Vaillant and Bocourt and the subsequent description of "*Micropterus nuecensis* var. *treculii*" agree somewhat better with *Micropterus punctulatus* than with *Huro salmoides.* A

gracious re-examination of the type specimen by Jacques Pellegrin confirms this indication. He reports the following characters: dorsal, IX, 12; anal, III, 10; pectorals, 15–15; scales, 8–60–15; lingual teeth present (as a small patch); small scales evident on membranes between dorsal soft rays; upper jaw, 2.2 in head; no dark lines visible [likely faded?] along scale rows below lateral line; standard length, 240 mm.; total length, 297 mm. The name *treculii* will be available for a subspecies, if the variations exhibited by the species in the vicinity of San Antonio, Texas, be deemed sufficient to warrant nomenclatorial recognition.

The characters of this subspecies are stated in the key. Variational data are given in Tables II–VII. The distribution of the form is indicated by the numerous record stations plotted on Map 1.

R. W. Eschmeyer sends us information on a spotted bass larger than any previously reported. This fish, 17½ inches long and weighing 3 pounds, 15 ounces, was caught in Norris Lake, Tennessee.

ALABAMA SPOTTED BASS

1b. *Micropterus punctulatus henshalli,* new subspecies

(Map 1; Pl. I, Fig. 3; Pl. IV, Fig. 1.)

Micropterus pallidus (in part; misidentifications, not *Lepomis pallida* Rafinesque).—Jordan, 1877*a:* 314; and Jordan and Brayton, 1878: 46 (Coosa River system, Georgia).

Micropterus pseudaplites.—Hubbs, 1927: 13 (in part; record for Etowah River, Georgia).

This form represents the species in the Alabama River system in Mississippi, Alabama, and Georgia, and intergrades with *M. p. punctulatus* in the lower Escambia River system in Escambia and Conecuh counties, Alabama, and from the Pascagoula and Pearl River systems in Mississippi to the tributaries of Lake Pontchartrain in Mississippi and Louisiana. It agrees with the typical subspecies in most respects and differs chiefly in the smaller size of the scales (see items *5a* and *5b* of the key and Tables V–VI) and in the more elongate form at comparable sizes (compare Figs. 2 and 3, Pl. 1). The pectoral rays average higher, and are more frequently 16 than 15, rather than the reverse (Table IV).

Inadequate material from the Chattahoochee, Apalachicola, Ocmulgee, and Savannah River systems (of Georgia, Alabama, Florida, and South Carolina) prevents a clear understanding of the black basses of these drainage basins. It seems not improbable that at least 1 additional form may be represented in the southeast. A large specimen from the Chipola River in the Apalachicola River system in western Florida has distinctive features and remains unidentified (Map 1). The problem is receiving further study.

HOLOTYPE.—U.M.M.Z. No. 118297; an immature, yearling female 113

mm. in standard length, 138 mm. over all; collected by F. E. Guyton on June 27, 1931, in Uphapee Creek, tributary to Tallapoosa River of the Alabama River system, 4 miles east of Tuskegee, Macon County, Alabama.

DESCRIPTION.—The form is elongate, becoming more robust with age; greatest depth, 4.0 (238). Least depth of caudal peduncle, 9.1 (104). The caudal peduncle is elongate; its length, 4.0 (248). The body is moderately compressed; greatest width, 6.3 (158). Length of head, 2.95 (338); relatively larger in young. The dorsal fin is rather deeply emarginate; the shortest spine at the rather deep emargination of the dorsal fin is contained 2.0 times in (is 51 per cent of) the longest; the fifth and longest spine, 12.3 (80); the spinous part becomes relatively lower with age. The rounded soft dorsal agrees with that of the genotype, *M. d. dolomieu,* in having scales on the membranes near the base; its height is less than the basal length and about equal to the height of the anal; longest ray, 7.5 (129). The graduated anal spines become relatively shorter with age; the third and longest, 4.5 in head (73). The rounded anal fin becomes relatively slightly lower with age; the membranes bear scales near the base; longest ray, 7.1 (136). The pectoral fin is short and rounded; length, 6.3 (153). The pelvic is short and becomes relatively somewhat shorter with age; length, 6.3 (154). Length of caudal fin from middle of base to tip of longest ray, 4.3 (227); length of shortest median ray, 6.4 (146), or 1.6 in the length of the fin. Tip of snout to origin of dorsal, 2.3 (411); tip of lower jaw to insertion of pelvic, 2.8 (359); thence to origin of anal, 3.5 (282).

Width of slender head, 2.0 (486); increasing with age. Length of snout, 3.5 (289); increasing slightly with age. The orbit becomes relatively much smaller with age; length, 4.9 (207). The flat interorbital becomes wider with age; least bony width, 5.0 (202). The maxillary extends to below the posterior margin of the pupil; length of upper jaw, 2.1 (454); increasing with age. The lower jaw projects slightly; the length, increasing with age, 1.7 (564).

Dorsal, X, 12; anal, III, 10; pectorals, 17–17 (usually 15 or 16). Scales, 9–74–19; 29 rows around caudal peduncle and 15 rows on cheek. Vertebrae, $14+18=32$ in 17 paratypes, $14+17=31$ in 1, and $13+19=32$ in 1.

Glossohyal teeth forming a small patch in the holotype, but absent in 2 specimens of the 22 examined for this character. Gill-rakers on first arch, $2+6$ (usually $2+6$ or $2+7$, very rarely $2+8$ or $3+7$). Pyloric caeca not branched at base.

Largest specimen examined, 166 mm. in standard length and 203 mm. in total length.

The diamond-shaped, dark blotches forming a mid-lateral series on the

body of the young become confluent posteriorly in some specimens to form a rather regular stripe on the caudal peduncle. In older specimens the blotches become progressively more confluent, so that the lateral stripe is more regular, approaching that of *Huro*. The dorsum and dorsolateral region are irregularly blotched or mottled, in sharp contrast to the lighter color below the lateral band. The ventrolateral longitudinal streaks characteristic of the adult of *M. p. punctulatus* are imperfectly developed in the holotype of *M. p. henshalli,* but are well shown by other specimens. The characteristically dark basal caudal spot serves as one of the best criteria for distinguishing *M. p. henshalli* from *M. coosae,* which lives in the same region. The spinous dorsal, anal, and paired fins are immaculate. Two broken longitudinal streaks on the soft dorsal roughly divide the fin into thirds. The basal half of the caudal fin is immaculate, except for a dusky stain on the median rays. A conspicuous subterminal black band is evident on the tail fin of the young, and is still clearly recognizable in the holotype. Three brownish streaks radiate backward and downward from the eye; the uppermost streak is darkened posteriorly to form a pronounced black opercular spot.

The 66 type specimens were obtained at the following localities. The records are entered on Map 1. The abbreviations for the museums are explained on p. 8. F. E. Guyton, of Alabama Polytechnic Institute, has generously allowed us to study and record his material of this subspecies.

ALABAMA.—Uphapee Creek, tributary of Tallapoosa River (a branch of Alabama River), 4 miles east of Tuskegee, Macon Co., June 27, 1931, F. E. Guyton: U.M.M.Z. No. 118297 (holotype); U.M.M.Z. No. 111265 (9); A.P.I. (10). Opintlocco Creek, 3 miles southeast of Tuskegee, September 13, 1937, Guyton: U.M.M.Z. No. 123949 (5). Camp Hill, Tallapoosa Co., October 7, 1930, Guyton: A.P.I. (1). Talladega Creek, tributary to Coosa River, 5 miles southwest of Talladega, Talladega Co., August 9, 1936, Hubbs family: U.M.M.Z. No. 118289 (5). Line Creek, near Montgomery, October 7, 1938, Guyton: U.M.M.Z. No. 124135 (6). Alabama River, at Selma, Dallas Co., September 18, 1929, E. P. Creaser and H. R. Becker: U.M.M.Z. No. 88843 (1). Tributary of Alabama River at Benton, on the Lowndes and Dallas county line, September 18, 1929, Creaser and Becker: U.M.M.Z. No. 88838 (3). Wetumpka, Josiah Skinner: U.S.N.M. No. 26269 (1). Creek 7 miles southwest of Warrior, Jefferson Co., September 4, 1939, Reeve M. Bailey: I.S.C. B39–86 (1).

GEORGIA.—Tributary to Coosa River, east of Coosa, Floyd Co., September 1, 1929, Creaser and Becker: U.M.M.Z. No. 88235 (1). Armuchee Creek, tributary to Oostanaula River (tributary to Coosa River), Armuchee, Floyd Co., September 1, 1929, Creaser and Becker: U.M.M.Z. No. 88248 (3). Tributary to Coosa River, 5 miles northwest of Cedartown,

Polk Co., August 31, 1929, Creaser and Becker: U.M.M.Z. No. 88192 (11). Etowah River, near Rome, Jordan and Brayton: U.S.N.M. No. 31142 (1).

MISSISSIPPI.—Oldtown Creek, tributary to Tombigbee River, Lee Co., June 14, 1937, J. S. Dolley: U.M.M.Z. No. 104103 (1). Tombigbee River, 2.5 miles north of Amory, Monroe Co., August 16, 1939, Bailey: I.S.C. B39–41 (6).

We take pleasure in naming this form for the late James A. Henshall, to whom credit is largely due not only for raising the black basses to their position of high esteem in the minds of the sportsmen of the country, but also for determining their proper nomenclature.

WICHITA SPOTTED BASS

1c. *Micropterus punctulatus wichitae,* new subspecies

(Map 1; and Pl. VI.)

Micropterus dolomieu, Micropterus pseudaplites, and hybrids.—Hubbs and Ortenburger, 1929*a*: 42; and 1929*b*: 105–6 (preliminary identification of the types of *wichitae*).

As indicated in the synonymy, the type specimens of this subspecies were first interpreted as representing a local fusion through hybridization of *Micropterus dolomieu* and *M. pseudaplites* (=*punctulatus*). There is considerable evidence in favor of this view. The young (Pl. VI) are rather variably intermediate in color pattern, being less strongly barred than in *dolomieu* but more definitely barred than in *punctulatus.* Larger individuals exhibit greater variation in color pattern than is shown by any other form of black bass. Some resemble typical *punctulatus* so closely in all features of coloration as to be virtually indistinguishable in general view, whereas others, like the holotype, are peculiarly speckled on the body and caudal base and lack the well-defined lateral band and the regular row of spots on the ventrolateral scales (Pl. VI). As depicted in the same plate, there is considerable variation in the production of the muzzle and in the flattening of the predorsal contour—characters in which *punctulatus* differs from *dolomieu.* The vertebral formula, instead of being almost constantly 14 + 18 as in the other subspecies of *punctulatus* or 15 + 17 as in both forms of *dolomieu,* is 14 + 18 or 15 + 17 with almost equal frequency, thus varying much more than in any other form in the genus (Table VII). Similarly, the number of anal rays (Table IV) varies more than in other black basses: there are frequently 11 as in *dolomieu,* rather than almost consistently 10 as in the other forms of *punctulatus.* The typical number of dorsal soft rays, 13, is intermediate between the characteristic number of 12 for *punctulatus* and of 14 for typical *dolomieu,* but agrees with the usual number for *velox.* This subspecies of *dolomieu* is rather definitely approached by *M. punctulatus wichitae* not only in this and in other characters, but also in distribution (Maps 1 and 2).

Evidence accumulates, however, to indicate that the bass of West Cache Creek in the Wichita Mountains do not represent a partially fused complex of *dolomieu* and *punctulatus*. The variations in coloration and in form are not correlated, as they would probably be if that relationship held. For example, the larger paratype figured on Plate VI contrasts sharply with the holotype in that it has the typical coloration of *punctulatus;* yet it approaches *dolomieu* in that the muzzle is less produced and the anterodorsal profile is more rounded than in *punctulatus* or in the holotype of *wichitae*. The number of soft dorsal rays is typically 13, whether the specimens otherwise approach *dolomieu* (with 13 or 14 rays) or typical *punctulatus* (with 12 rays). Perhaps the strongest evidence against the idea that the specimens represent either a fusing or a fused hybrid stock is that the number of scale rows (Table V), particularly in the series above and below the lateral line, corresponds rather well with that of the other subspecies of *punctulatus* and is notably lower than in either form of *dolomieu*. If either a complex of forms or hybrids were involved, it would be expected that the average scale-row counts would be definitely intermediate between the values for the 2 species suspected of being the parent forms. We find such intermediacy in characters to hold consistently for supposed hybrid basses (pp. 39–41) and for proved hybrids between other species of the family (Hubbs and Hubbs, 1933; Bailey and Lagler, 1938). Another reason against the theory that the bass we call *wichitae* are hybrids is that the testes, when sectioned, showed normal spermatogenesis, which was never observed in hybrid centrarchids (Hubbs and Hubbs, 1933). As indicated in the paper just cited, hybrid centrarchids are typically infertile, whereas the Wichita spotted bass must be fertile.

A fish-culturist suggested to us that the Wichita bass may be the product of hybridization between native spotted bass [*punctulatus*] and smallmouthed bass [*dolomieu*], which he said had been stocked in Cache Creek. But the supposed stocking of smallmouths would have been too recent to explain the production of so homogeneous a stock, with some uniformly intermediate characters and other features as in typical *punctulatus*. No native stock of *dolomieu* occurs near the Wichita Mountains. The recent finding in the National Museum of a specimen of *M. p. wichitae* collected in 1906 argues strongly against the fish-culturist's idea.

If hybridization produced the bass under discussion, the evidence indicates that the interbreeding took place long ago, that the original hybrids were fertile, and that the characters of the population have become stabilized through inbreeding. This hypothesis would be difficult to prove or disprove. It strikes us as no more plausible than the view that the similarities between *wichitae* and *dolomieu* are caused by parallel development, or the view that *wichitae* is a relict of a generally extinct transitional stage between *punctulatus* and *dolomieu*.

It should be noted that the range of *wichitae* is confined to a single creek system, and that its mountain habitat lies just within the western limit of the range of typical *punctulatus* (Map 1). Whether or not there is intergradation about the mountains has not been determined. There is some evidence of the presence in Texas of populations (subspecies?) intermediate between the 2 forms or combining their characters. This evidence is supported by few specimens, and for the time being will not be elaborated. In the Brazos River system there is a race with prominent light spangles on the upper sides and with 12 to 14 soft dorsal rays, but otherwise like typical *punctulatus*. In the Guadalupe River we have taken fingerling bass which approach *dolomieu* quite as much as do the fingerlings of *wichitae,* but which agree with typical *punctulatus* in having 12 dorsal soft rays.

Whether or not populations will be found with characters intermediate between those of the 2 forms, *wichitae* will probably be retained as only subspecifically distinct, because some of the specimens, standing at the end of a continuous series of variations, are indistinguishable from typical *punctulatus*. Furthermore, as noted above, the scale-row counts are in distinctive agreement.

HOLOTYPE.—U.M.M.Z. No. 118299; an immature, yearling female 122.5 mm. in standard length, 151 mm. over all; collected by an expedition of the Museum of Zoology of the University of Oklahoma on June 6, 1927, near the headwaters of West Cache Creek, in the Wichita Mountains, 9 miles northwest of Cache, Comanche County, Oklahoma. Cache Creek flows through Red Run into Red River.

DESCRIPTION.—The form is elongate and streamlined; greatest depth, 4.0 (249). Least depth of caudal peduncle, 9.0 (114). The body is moderately compressed; greatest width, 7.2 (140). Length of head, 2.9 (351). The shortest spine at the moderately depressed emargination of the dorsal fin is 55 per cent of the longest; the fourth and longest spine, 12.1 (83). The rounded soft dorsal is longer than it is high, and is about as high as the anal; longest ray, 7.0 (147). The weak anal spines are graduated; the third and longest, 5.1 in head (68). The anal fin is rounded; longest soft ray, 7.0 (147). Length of the short pelvic fin, 6.6 (155); the first soft ray is not produced. Length of the caudal fin from the middle of its base to the tip of the longest ray, 4.2 (240); length of shortest median ray, 5.9 (171), or 1.35 in the length of the fin. Tip of snout to origin of dorsal, 2.4 (441); tip of lower jaw to insertion of pelvic, 2.9 (351); thence to origin of anal, 3.4 (296).

Width of head, 2.35 (430). The predorsal contour is little curved, and the muzzle is produced; length of snout, 3.7 (279). Orbital length, 5.0 (198). Least bony interorbital width, 5.3 (188). The maxillary extends to below the posterior margin of the eye; length of upper jaw, 2.1 (468). The lower jaw projects; its length is 1.7 (572).

Dorsal, X, 13; anal, III, 10; pectorals, 16–16. Scales, 10—66—16; 23 rows around caudal peduncle and 15 rows on cheek. There are no embedded scales on either arm of the preopercle.

The glossohyal bears a well-developed median patch of teeth. Gill-rakers on anterior arch, 2 + 6.

The color of the holotype in alcohol is light brownish, shading to darker above. The sides are densely freckled with irregular dark brown spots, which are concentrated along the middle of the sides but do not form a conspicuous dark lateral band as in *M. p. punctulatus*. No regular ventro-lateral dark streaks are developed. The basal caudal spot is somewhat disrupted. The proximal part of the caudal fin is obscurely marked with small, dark speckles on the interradial membranes. There is no dark transverse band across the caudal lobes (but this mark is well developed in the young). Three oblique brownish lines cross the cheeks, as in other forms of the genus. The opercular spot is prominent.

The young vary confusingly in coloration, but fingerlings (Pl. VI) may usually be distinguished with confidence from those of related forms. In specimens shorter than about 30 mm. the pattern is similar to that of the young of *punctulatus:* the strong, irregular, mid-lateral stripe terminates in a conspicuous basal caudal spot. Larger young exhibit a highly variable number of transverse bars, which simulate those of *M. d. dolomieu* but typically are not so deep and are frequently more or less confluent.

With the exception of 1 example in the National Museum, the 441 type specimens are all in the University of Michigan Museum of Zoology, and the University of Oklahoma Museum of Zoology. We owe thanks to A. I. Ortenburger, of the University of Oklahoma, for the privilege of studying and reporting on the types series.

OKLAHOMA.—Collections from West Cache Creek (tributary to Red Run; Red River system), Wichita National Forest, Wichita Mountains, Comanche Co.—Near Camp Boulder, 7 miles northwest of Cache, June 9 to 13, 1926, A. I. Ortenburger: U.M.M.Z. Nos. 80300 (52), 80310 (4), 80315 (94), and 80323 (15); U.O.M.Z. Nos. 6297 (67), 6312 (135), 6318 (19), 6322 (1), and 6324 (7). Nine miles northwest of Cache, June 6, 1927, University of Oklahoma Museum of Zoology Expedition: U.M.M.Z. Nos. 81146 (42) and 118299 (holotype). One-fourth mile south of Camp Boulder, June 6, 1928: U.M.M.Z. No. 108773 (1). Narrows, Cache Creek, Wichita Reserve, August 23, 1906, W. D. Dean: U.S.N.M. No. 77940 (1).

Blue Beaver Creek (tributary to West Cache Creek), 4 miles east of Cache, Comanche Co., June 28, 1928, Oklahoma Biological Survey: U.M.M.Z. No. 108774 (2).

This species is named for the Wichita Mountains, Oklahoma, to which the subspecies seems to be confined.

REDEYED BASS

2. *Micropterus coosae,* new species

(Map 2; Pl. I, Fig. 4; Pl. V.)

Micropterus salmoides (misidentifications; not *Labrus salmoides* Lacépède).—Jordan, 1877*a:* 314–15, 355, 358 (brief characterization as possible variety; Georgia records).

Micropterus salmoides var. *salmoides.*—Jordan and Brayton, 1878: 31–32 (diagnosis, as southern variety; Georgia records).

Micropterus dolomieu var. *dolomieu* (misidentifications; not *M. dolomieu* Lacépède).—Henshall, 1881: 36–37, 82; 1904: 11, 32 (after Jordan).

Micropterus dolomiei.—Jordan and Gilbert, 1883: 485, 916 (in part).

Micropterus dolomieu.—Jordan and Evermann, 1896: 1011–12 (in part).

Micropterus pseudaplites (misidentification).—Hubbs, 1927: 13 (records for Augusta and for Little River near Rome, Georgia).

Micropterus coosae (virtual *nomen nudum;* name taken from manuscript for present paper).—Swingle and Smith, 1939: 334 (production in pond).

Despite the fact that some of the distinctions between this southeastern species and *M. dolomieu* were appreciated and published by Jordan as early as 1877, it has never been given a valid scientific name. Its early designation as *Micropterus salmoides* var. *salmoides* was all but lost sight of after it was shown that the name *salmoides* had been wrongly applied to *M. dolomieu.* The specific distinctness of the species, indicated by Hubbs (1932), is shown in the numerous features by which items *3a, 4b,* and *5c* of the key (for *coosae*) are contrasted with items *3c, 4d,* and *5e* (for *dolomieu*).

In many structural features, *coosae* is more like *punctulatus* than *dolomieu,* and these resemblances are probably indicative of close relationship. It typically differs from *punctulatus* and simulates *dolomieu* in the well-rounded predorsal contour, rather robust caudal peduncle, and little-notched dorsal fin (Pl. I). From both *punctulatus* and *dolomieu* it differs sharply in color. (Contrast item *4b* of key with, respectively, items *4a* and *4d.*) In some color features *coosae* strongly resembles *dolomieu;* in others it is unlike any form referred to the genus.

The ranges of *coosae* and *dolomieu* apparently do not overlap (unless it be through the stocking of the northern smallmouth within the range of *coosae* at some point unrepresented by collections at hand),[7] but the characters of the 2 forms are so distinct as to lead to the belief that they would not intergrade. The distribution of *coosae* widely overlaps that of *M. punctulatus henshalli. M. coosae* is more of an upland form, however, and the mutual occurrences may have resulted from the recent immigration of the one form into the range of the other. They do not seem to intergrade,

[7] Specimens of *M. d. dolomieu,* as well as *M. coosae,* from the private pond of James H. Reeves near Calhoun, Georgia, were recently submitted to us by Percy Viosca, Jr.

although there is some evidence (p. 28) that they hybridize, at least occasionally. Distributional and structural evidence suggests that *coosae* may have been differentiated *in situ* from an ancient *punctulatus*-like form that was speciating in the direction of *dolomieu,* and that *punctulatus* later reinvaded the same territory, becoming modified there into subspecies *henshalli.*

HOLOTYPE.—U.M.M.Z. No. 97729; a subadult female, 106.5 mm. in standard length, 131 mm. in total length (in the third summer of life); collected by H. R. Becker on July 3, 1928, in Fisher Creek, tributary to Big Will's Creek of the Coosa River system, along the old highway between Attalla and Boaz, Etowah County, Alabama.

DESCRIPTION.—The moderately elongate form becomes more robust with age; greatest depth, 3.5 (294). Least depth of caudal peduncle, 7.9 (131); increasing slightly with age. The caudal peduncle is only moderately attenuate; length, 4.8 (219). The body is subterete; greatest width, 6.9 (155). Length of head, 3.0 (349); relatively larger in the young. The shortest spine at the slight emargination of the dorsal fin is 75 per cent of the longest (1.3 in longest), becoming relatively longer with age; fifth and longest spine, 14.6 (71); the spinous dorsal becomes relatively lower with age. The rounded soft dorsal agrees with that of the genotype, *M. d. dolomieu,* in having scales on its base; the height of this fin is less than its basal length and is equal to the height of the anal; longest ray of each fin, 7.1 (146). The graduated anal spines become relatively shorter with age; the third and longest, 5.2 in head (67). The rounded anal fin becomes relatively slightly lower with age; the membranes bear scales near the base. The pectoral fin is short and rounded; its length, 6.1 (172). The short pelvic becomes relatively somewhat shorter with age, 6.9 (153). The caudal fin has rounded lobes; length from base of fin to tip of longest ray, 4.5 (230); length of shortest median ray, 5.9 (177), or 1.3 in caudal length. Tip of snout to origin of dorsal, 2.5 (422); tip of lower jaw to insertion of pelvic, 2.9 (370); thence to origin of anal, 3.5 (313).

Width of head, 2.0 (478); increasing relatively with age. The predorsal contour is moderately curved. Length of snout, 3.7 (274); increasing relatively with age. The orbit becomes relatively much smaller with age; its length, 4.5 (226). The flat interorbital becomes wider with age; least bony width, 5.1 (191). The maxillary extends to below the posterior margin of the pupil; length of upper jaw, 2.3 (433); increasing with age. The lower jaw slightly projects; its length, 1.8 (543); increasing with age.

Dorsal, X, 12; anal, III, 10; pectorals 16–16.[8] Scales, 9—76—18; 28 rows around caudal peduncle, and 14 rows on cheek. Scales (of the holo-

[8] One aberrant individual has 10 pectoral rays on one side and 16 on the other; the fin with 10 rays is apparently uninjured and is of normal shape, though much smaller than its mate.

type) from the pectoral region just below the lateral line are subquadrate (transverse diameter, 4.5 mm.; longitudinal diameter, 5.0 mm.); the focus lies apicad from the center; the apical margin is not distinctly dentate, but the apical field bears a narrow triangular patch of rather weak ctenii, extending almost from the focus; the basal corners are squarish; and there are 5–9 strong basal radii. Scales are well developed on the opercle, subopercle, and interopercle; there are a few embedded scales on the preopercle.

In 32 specimens counted there is no variation in the number of precaudal vertebrae, 14. The caudal vertebrae number 18 in 26 specimens, 17 in 3, and 19 in 3. This normal number, $14+18=32$, is characteristic, also, of *M. p. punctulatus* and *M. p. henshalli*. *M. d. dolomieu* and *M. d. velox* usually have $15+17=32$ vertebrae.

The bony margins of the lacrymal, suborbitals, preopercle, and the opercular series are entire. The branchiostegals constantly number 6–6. The opercle ends in a flat, rigid, angular projection which is longer than a more rounded process on the upper posterior margin of the bone.

Depressible villiform teeth form broad bands on the dentaries and premaxillaries. Villiform teeth occur in a triangular patch on the head of the vomer and in an elongate band on each palatine; they are also developed, but are reduced in size, on the ectopterygoids. Weak glossohyal teeth form a small patch in the holotype, but are absent in 9 out of 42 specimens, without any apparent correlation with age or sex. The narrow and elongate lower pharyngeal bones bear acuminate teeth in a patch 3.25 times as long as wide (in an adult paratype). Gill-rakers, $2+6$, the last a mere knob ($1+5$ in 1, $2+5$ in 11, and $2+6$ in 14). The pyloric caeca are typically unbranched (occasionally one is branched) and number about 7–9.

The largest specimen examined measures 215 mm. in standard length and 261 mm. (10.25 inches) in total length.

Transverse flexuous bands are more or less developed on the sides in the young, but disappear rapidly with age. The bands are often reduced to a mid-lateral series of distinct quadrate light-centered blotches on the caudal peduncle. (In the young of *henshalli* these blotches are usually confluent and lack the light centers.) As in *M. punctulatus*, a series of longitudinal dark streaks becomes developed with age on the median lines of the ventrolateral scale rows. A small basal caudal spot is present in the young, but fades with age. (In *henshalli* the spot is stronger, larger, and persists throughout life.) The subterminal black band across the caudal lobes, so prominent in the young of the other species in the genus, is very indistinct in the young of *coosae*. At all ages the posterior tip of the opercle is marked with a large dark spot similar to that of *punctulatus* and *henshalli*. In the young of *coosae* the soft dorsal, the caudal, and the anterior part of the anal are brick-red in life, and the margin of the soft dorsal, anal, caudal, and

pelvic fins are white. In 1 yearling the sides are bronzy olive and bright, metallic blue, in alternating streaks, grading on the back into an olive background, with blue spangles on the scales.

ECONOMIC IMPORTANCE.—A note by H. S. Swingle accompanying the specimens from Lake Auburn, Alabama, gives the following information:

> Locally known as red-eyed bass. Highly regarded by local fishermen because of their gameness. Maximum recorded weight, 2 pounds. A stream fish, it apparently cannot reproduce in a pond; or if it reproduces the spawn die. The young after reaching a length of several inches can stand pond water and grow rapidly. Flesh of good quality, somewhat drier than that of the large-mouthed bass. Can be caught on worms, artificial lures, or live minnows.

From a naturalist's point of view it seems highly advisable that the stocking of bass in the waters of the Alabama River system be restricted to that of the redeyed bass, Alabama spotted bass, and largemouthed bass. These are the native species of the area. All too often the introduction of exotic species has exterminated the local forms.

The 134 type specimens of *Micropterus coosae* are all deposited in the University of Michigan Museum of Zoology, the United States National Museum, Iowa State College, the Southern Biological Supply Company, and in the Alabama Polytechnic Institute collection made by F. E. Guyton, who has generously allowed us to study and report on this bass, which he has also recognized as a new species. The record stations are plotted on Map 2.

ALABAMA RIVER SYSTEM IN ALABAMA.—Fisher Creek, tributary to Big Will's Creek and Coosa River, on old highway between Boaz and Attalla, Etowah Co., July 3, 1928, H. R. Becker: U.M.M.Z. Nos. 97729 (holotype) and 96762 (2). "Coal Creek," Coosa River system, about 5 miles from Gadsden (probably Black Creek, Etowah Co.), July 3, 1928, Becker: U.M.M.Z. No. 96772 (1). Lake Auburn, F. E. Guyton: U.M.M.Z. No. 111255 (5) and A.P.I. (5). Lake Auburn, April 26, 1932, Guyton: U.M.M.Z. No. 111258 (1) and A.P.I. (1). Lake Auburn, June 17, 1932, Guyton: U.M.M.Z. No. 111261 (7) and A.P.I. (1). Lake Auburn, June 9, 1932, Guyton: U.M.M.Z. No. 111263 (4). Lake Auburn, June 21, 1932, Guyton: U.M.M.Z. No. 111264 (2) and A.P.I. (3). Small stream near Milltown, Chambers Co., July 5, 1932, Guyton: U.M.M.Z. No. 111262 (1) and A.P.I. (2). Between Opelika and Waverly, Lee Co., October 7, 1930, Guyton: U.M.M.Z. No. 111260 (2). Same locality, September 13, 1930, Guyton: A.P.I. (1). Willmore Dam, October 24, 1930, Sturkey: U.M.M.Z. No. 111256 (2). Lake Willmore, October 12, 1935, Guyton: A.P.I. (1). Fairhope, Baldwin Co., October 28, 1930: U.M.M.Z. No. 111257 (1). Definite locality not stated, Guyton: A.P.I. (5). Talladega Creek, 5 miles southwest of Talladega, Talladega Co., August 9, 1936, Hubbs family: U.M.M.Z. No. 118290 (9). Auburn, November 8, 1937, Guyton: U.M.M.Z. No. 105528 (2). Loblockee Creek,

Auburn, September 19, 1938, Guyton: U.M.M.Z. No. 105529 (2) and December 12, 1938: U.M.M.Z. No. 105530 (2).

COOSA RIVER SYSTEM IN GEORGIA.—Branch of Lake Creek (tributary of Cedar Creek), about 5 miles north of Cedartown, Polk Co., August 31, 1929, E. P. Creaser and H. R. Becker: U.M.M.Z. No. 88178 (2). Cedar Creek, 1 mile north of Cedartown, Polk Co., on Cave Springs Road, August 31, 1929, Creaser and Becker: U.M.M.Z. No. 88181 (3). Tributary of Coosa River, 5 miles west of Coosa, Floyd Co., September 1, 1929, Creaser and Becker: U.M.M.Z. No. 88205 (4). Tributary of Coosa River, 3 miles west of Coosa, September 1, 1929, Creaser and Becker: U.M.M.Z. No. 88226 (4). Tributary of Coosa River, east of Coosa, September 1, 1929, Creaser and Becker: U.M.M.Z. No. 88227 (1). Tributary of Oostanaula River, about 6 miles northwest of Rome, Floyd Co., September 1, 1929, Creaser and Becker: U.M.M.Z. No. 88236 (1). Armuchee Creek, tributary to Oostanaula River, at Armuchee, Floyd Co., September 1, 1929, Creaser and Becker: U.M.M.Z. No. 88249 (3). Spring Creek, tributary of Etowah River, at Spring Creek (about 10 miles southeast of Rome), Floyd Co., September 2, 1929, Creaser and Becker: U.M.M.Z. No. 88272 (1). East branch of Allatoona Creek, Etowah River system, 1 mile south of Acworth, Cobb Co., September 2, 1929, Creaser and Becker: U.M.M.Z. No. 88289 (2). Little Cedar Creek, branch of Big Cedar Creek, Cave Spring, Floyd Co., July 4, 1928, Becker: U.M.M.Z. No. 96785 (2). Stream 7.3 miles south of Dalton on U.S. Highway 41, Whitfield Co., August 7, 1936, Hubbs family: U.M.M.Z. No. 118293 (20). Oostanaula River, at mouth of Spring Branch, Gordon Co., 2 miles northeast of U.S. Highway 41 between Resaca and Calhoun, August 8, 1936, Hubbs family: U.M.M.Z. No. 118292 (1). Little River, on top of Lookout Mountain, near Rome, August 22, 1897, W. M. Tower: U.S.N.M. No. 73542 (1). Top of Lookout Mountain, 1935, H. J. Jolly: U.S.N.M. No. 101076 (1). Etowah River, Jordan and Brayton: U.S.N.M. No. 31152 (1). High Tower River, Etowah River drainage, 4 miles southwest of Dahlonega, Lumpkin Co., August 25, 1939, Reeve M. Bailey: I.S.C. B39–59 (3). Tributary of Etowah River, at Clanton, Cherokee Co., August 25, 1939, Bailey: I.S.C. B39–58 (2). Tributary of Etowah River, 5 miles south-southeast of Rome, Floyd Co., August 24, 1939, Bailey: I.S.C. B39–56 (10).

CHATTAHOOCHEE RIVER SYSTEM IN ALABAMA.—Turkey Creek, about 7 miles above its mouth, which is about 12 miles above Columbus, Georgia, July 5, 1932, Guyton: U.M.M.Z. No. 111259 (2) and A.P.I. (3).

CHATTAHOOCHEE RIVER SYSTEM IN GEORGIA.—Cane Creek, 1.25 miles west-southwest of Dahlonega, Lumpkin Co., August 25, 1939, Reeve M. Bailey: I.S.C. B39–60 (2). Nancy Creek, tributary of Chattahoochee River, about 10 miles north of Atlanta, September 2, 1929, Creaser and Becker: U.M.M.Z. No. 88290 (1). Fish pond formed by damming Mulberry Creek, on Blue

Spring Farm near Hamilton, October 2, 1930, Percy Viosca, Jr.: S.B.S.C. (5 aberrant adults not designated as paratypes; their aberrancy seems due to emaciation, caused by living in a pond overstocked with sunfish).

SAVANNAH RIVER SYSTEM IN GEORGIA (on South Carolina line).—Augusta, March 17, 1877, William Phillips: U.S.N.M. No. 17112 (1).

The few specimens examined from the upper or middle waters of the Chattahoochee and Savannah river systems appear typical of *coosae,* but 4 series of young to half-grown specimens from the drainage basin of the Black Warrior branch of the Alabama River (see next paragraph), and one large fish from Chipola River in the Apalachicola River system in Jackson County, western Florida (see p. 16), do not correspond perfectly with either *coosae* or *punctulatus henshalli.* To determine whether they represent variants, subspecies, species, hybrids, or intergrades will require further study (which is contemplated).

We have provisionally identified with this species 45 young specimens from Blount Springs Creek, tributary to Mulberry Fork of Black Warrior River, in Blount County, Alabama, about 10 miles north of Warrior (collected by E. P. Creaser and H. R. Becker: U.M.M.Z. No. 88850). In most characters these are identical with *coosae;* they differ chiefly in having the dorsal fin more deeply emarginate. The lowest dorsal spine is 42–61 (mean 52) per cent of the longest, rather than 62–77 (mean 71) per cent as in typical *coosae.* The relatively deep emargination of the dorsal fin can be explained only in part as due to the small size (31–60 mm.) of the Blount Spring specimens. In recently collected specimens from the Black Warrior system the corresponding index values vary according to the size of the fish, as follows:

.615 in a 130-millimeter specimen from Duck Creek, 12.7 miles northeast of Cullman, Cullman Co., Alabama.

.60 in a 55.5-millimeter fish from the same locality.

.52–.59 in 9 bass 46–86 mm. long, from a creek 0.5 miles east of Cleveland, Blount Co., Alabama.

.61 in 1 that is 74.5 mm. long, from a tributary to Locust Fork, 3 miles north-northeast of Oneonta, Blount Co., Alabama.

Subsequent material may indicate that a distinct subspecies or, at least, race, inhabits the Tombigbee and Black Warrior river systems, or possibly that the aberrant characters displayed by the specimens at hand are the result of hybridization between *coosae* and *henshalli.* The color pattern is somewhat intermediate in the Blount Creek series.

The name *coosae* refers to the Coosa River system, in which the holotype and most other type specimens were collected.

SMALLMOUTHED BASS

3. *Micropterus dolomieu* Lacépède

The smallmouthed bass is divisible into at least 2 subspecies. The most distinct of the variants from the typical or northern smallmouthed bass of the Great Lakes and adjacent regions is the southwestern form here named *M. d. velox,* which occurs with *M. p. punctulatus* in the tributaries of the Arkansas River in northeastern Oklahoma and western Arkansas, and in the headwaters of the same streams in Missouri and presumably in Kansas. Intergrades between *M. d. dolomieu* and *M. d. velox* occur elsewhere in the Ozark region—to be specific, in the drainage basins of the Red and Ouachita rivers in Arkansas and Oklahoma, and of the White River and its main tributary, the Black River, in Arkansas and Missouri, and in the upper part of the St. Francis River basin in Missouri (Map 2). These intergrades generally approach and at times agree with *velox* in form and color, but are closer to typical *dolomieu* in the number of dorsal rays (Tables I and IV). In some parts of the intergrade range the rays seem to be quite as numerous as in *M. d. dolomieu.* In the remainder of the range, 13 soft dorsal rays and a total of 23 dorsal rays are rather frequent, though nowhere are these numbers as often represented as are 14 soft dorsal rays and a total of 24 dorsal rays (the modal numbers in typical *dolomieu*). The intergrades tend, therefore, to show a combination of characters, rather than to be equally intermediate in all features. There is a possibility that an extended variational analysis would provide grounds for the recognition of an intermediate subspecies in place of what are here interpreted as intergrades.

Toward the southeast this species exhibits variations which may prove sufficient for subspecific recognition. In that region glossohyal teeth are more often developed than in the north, and the form tends to be more streamlined. The extreme of this variational trend apparently is in the mountains of the Tennessee River drainage basin, where the bass are especially slender and have somewhat produced muzzles, in this and some other respects approaching *M. d. velox.* In usually having 14 dorsal rays and in the coloration of the young, however, they remain more like typical *dolomieu.* In the form of the spinous dorsal, the more extreme of these southeastern variants approach *M. punctulatus.* Their ground color is more blue-gray than usual and the dark markings are dusky golden. The fins are bluish gray and dusky lemon-gold; the latter color becomes rather bright toward the lower border of the anal and pelvic fins and on the basal part of the soft dorsal.

NEOSHO SMALLMOUTHED BASS

3a. *Micropterus dolomieu velox,* new subspecies

(Map 2; Pl. I, Fig. 5; Pl. IV, Fig. 2.)

Micropterus dolomieu (incomplete identification).—Hubbs and Ortenburger, 1929*b*: 105 (records from Arkansas River system).

Much has been written regarding the Ozark smallmouthed bass, but almost entirely from the sportsman's viewpoint. It would seem to be an especially gamey fish, as one might have assumed from its streamlined form, strong dentition, and swift-water habitat.

The differences between *M. d. velox* and *M. d. dolomieu* are set forth as items *6a* and *6b* in the key (p. 12). The distinctions in form and color appear particularly clear when one compares the younger fish (Pl. I, Figs. 5 and 6). Average differences in measurements, given in Table III, are largely obscured by age variation. Overlapping differences in counts are indicated in the frequency tables IV–VII. The distinction in number of dorsal rays is best brought out by tabulating the sum of the spinous and soft rays (Table I). It will be seen that 76 per cent of the 411 specimens of *velox* counted have 21–23 total dorsal rays, whereas 93 per cent of the 229 individuals of *dolomieu* tabulated have 24 or 25 dorsal rays. In the terms of Ginsburg (1938), the index of intergradation is only 16 per cent—indicating, in his view (which we do not wish to champion), a subspecific rather than a racial distinction. On the sole basis of the total dorsal-ray count, if the line of separation be assumed to lie between the counts of 23 and 24, 82 per cent of the 640 specimens of both subspecies, as counted, could be correctly identified, and a much higher proportion (nearly 100 per cent) could be separated with the supplementary use of other characters.

Some of the limited overlap in characters may well have arisen through the stocking of one or both subspecies within the range of the other form. No typical specimens of *dolomieu* could be identified in the rather extensive material from the Neosho (Grand) River system and adjacent tributaries of the Arkansas River, but the characters of the populations in these waters may have been modified, at least locally, by an interbreeding of the local fish with introduced individuals of the northern smallmouthed bass.

TABLE I

FREQUENCY DISTRIBUTION OF THE TOTAL NUMBER OF DORSAL RAYS (SPINES PLUS SOFT RAYS) IN THE SUBSPECIES OF *MICROPTERUS DOLOMIEU*

	TOTAL NUMBER OF DORSAL RAYS							
	21	22	23	24	25	26	Number	Average
M. d. velox	2	24	286	98	1	...	411	23.18
Intergrades	...	1	71	251	12	1	336	23.85
M. d. dolomieu	...	1	16	195	17	...	229	24.00

HOLOTYPE.—U.M.M.Z. No. 118296; a subadult male 159 mm. in standard length, 197 mm. in total length (in the third summer of life), collected by Carl L. Hubbs and Milton B. Trautman on September 13, 1935, in Elk River, tributary to the Grand (Neosho) River of the Arkansas River system, at Turkey Ford, T. 25 N., R. 24 E., Delaware County, Oklahoma.

DESCRIPTION.—The form is more elongate than that of typical *dolomieu,* especially in the young, and becomes more robust with age; greatest depth, 3.6 (292). Least depth of caudal peduncle, 8.0 (128). Length of the moderately attenuate caudal peduncle, 4.6 (224). Greatest width of the slightly compressed body, 6.7 (158). Length of head, 2.85 (367); relatively larger in young. The shortest dorsal spine at the slight emargination of the dorsal fin is 72 per cent of the longest (1.4 in longest); the fifth and highest spine, 13.1 (78); the spinous dorsal has a gently curved contour and becomes relatively lower with age. The interradial membranes of the rounded soft dorsal bear scales near the base; the height of the soft dorsal is less than the basal length of the fin, and is about equal to the height of the anal; longest ray, 7.2 (144). The graduated anal spines become relatively shorter with age; the third and longest, 6.5 in head (57). The rounded anal fin becomes relatively slightly lower with age; the membranes bear scales near the base; longest ray, 7.3 (143). Length of the short and rounded pectoral fin, 6.0 (169); relatively longer in young. The pelvic is short and becomes relatively somewhat shorter with age; its length, 6.3 (160). Length of the caudal fin from middle of base to tip of longest ray, 4.5 (230); length of shortest median ray, 6.0 (173), or 1.3 in caudal length. Tip of snout to origin of dorsal, 2.4 (438); tip of lower jaw to insertion of pelvic, 2.8 (377); thence to origin of anal, 3.6 (291).

Width of head, 2.2 (466); increasing with age. At comparable sizes the almost straight contour of the snout and frontal region forms a sharper angle with the lower contour of the head than in *M. d. dolomieu.* Length of snout, 3.5 (289). The orbit decreases much in relative size with age; its length, 6.0 (180). Bony interorbital width, 5.2 (192). The mouth increases in relative size with age (that of the holotype is larger than in specimens of *dolomieu* of like size, but this difference does not hold for young specimens); the maxillary extends to below the posterior margin of the eye; length of upper jaw, 2.1 (469). The lower jaw projects so far as to render the strong teeth visible from above; its length (increasing with age), 1.7 (579). Least suborbital width (increasing with age), 2.8 (360).

Dorsal, X, 13; anal, III, 10 (usually 11); pectorals, 17–17. Scales 14—73—25; 31 rows around caudal peduncle, and 19 rows on cheek. Vertebrae, 15 + 17 = 32 in 63 of the 79 paratypes counted. Occasional specimens have 14 or 16 precaudal and 16 or 18 caudal vertebrae.

Glossohyal teeth are lacking in the holotype, but form a weak patch in 40 of the 67 specimens examined (without any apparent correlation with sex or size). These teeth on the tongue are rarely developed in specimens from the northern part of the range of typical *dolomieu,* but are commonly present in examples from the Tennessee and Ohio river systems. Gill-rakers on the first arch, 2 + 5 (usually 2 + 5, infrequently 2 + 6).

The holotype is the largest specimen examined, but the subspecies no doubt attains a much greater size, since the habitat of this form is famous for smallmouthed-bass fishing.

Larger specimens are rather uniformly colored, with the exception of a dark opercular spot and 3 oblique, brownish lines passing downward and backward from the eye. The back is dark greenish olive, fading gradually to the white belly. The transverse bands on the sides of the young are fainter than usual in the young of *M. d. dolomieu,* are not so deep, and are characteristically broader; some bars on the caudal peduncle are usually expanded to form open, light-centered rhombs. (The bars are seldom thus modified in *M. d. dolomieu.*) The young have a very dark transverse band on the caudal lobes; also a weak and often diffuse or broken basal caudal spot.

All 452 specimens examined are in the collections of the University of Michigan Museum of Zoology and of the University of Oklahoma Museum of Zoology, and all are designated as types. Those that are atypical of *velox* in number of dorsal rays are typical in form and coloration.

MISSOURI.—Shoal Creek, tributary of Grand River, 12 miles west of Monett, Newton Co., 4 miles west of Barry Co. line, September 8, 1935, Carl L. Hubbs and Milton B. Trautman: U.M.M.Z. No. 103044 (35). Butler Creek, tributary of Elk River, just south of Noel and about 1 mile north of the Arkansas line, September 13, 1935, Hubbs and Trautman: U.M.M.Z. No. 103196 (114). Elk River at its confluence with Indian River, McDonald Co., August 8–18, 1930, J. Clark Salyer, II: U.M.M.Z. No. 97035 (29). Headwaters of Hickory Creek, Neosho River drainage, 3 miles above Federal Hatchery, Neosho, Newton Co., September 8, 1935, Hubbs and Trautman: U.M.M.Z. No. 103064 (1). Shoal and Hickory creeks, near Neosho: U.S.N.M. No. 42986 (1).

OKLAHOMA.—Elk River, tributary of Grand River, Turkey Ford, Delaware Co., September 13, 1935, Hubbs and Trautman: U.M.M.Z. No. 118296 (holotype) and 103190 (59). Flint Creek, tributary of Illinois River, at Flint Creek, Delaware Co., March 27, 1932, Trowbridge and Strode: U.M.M.Z. No. 108349 (1). Lost Creek, tributary of Grand River, just north of Wyandotte, Ottawa Co., T. 27 N., R. 24 E., September 13, 1935, Hubbs and Trautman: U.M.M.Z. No. 103161 (3). Grand River about 4 miles east of Choteau, Mayes Co., September 12, 1935, Hubbs and Trautman, U.M.M.Z. No. 103121 (37). Illinois River, 2 miles north of Scraper, Cherokee Co., W. F. Blair and F. A. Blair, July 8, 1936: U.M.M.Z. No. 116450 (19); July 9, 1936: U.M.M.Z. No. 116460 (1); July 11, 1936: U.M.M.Z. No. 116496 (5). Spavinaw Creek, tributary of Grand River, just above Spavinaw Lake, Delaware Co., August 12, 1936, W. F. Blair and A. D. Aldrich: U.M.M.Z. No. 116682 (5). Spring Creek, tributary of Grand River, about 8 miles north

of Moodys, Cherokee Co., August 31, 1936, Blair: U.M.M.Z. No. 116802 (11). Saline Creek, tributary of Grand River, Mayes Co., Blair: U.M.M.Z. No. 118060 (14). Courthouse Creek, Adair Co., July 11, 1929, University of Oklahoma Expedition (Univ. Okla. Exp.): U.M.M.Z. No. 120396 (1). Camp Garland, about 5 miles south of Locust Grove on Spring Creek, Univ. Okla. Exp.: U.M.M.Z. No. 120403 (2). Spavinaw Creek, 7 miles south of Jay, Delaware Co., July 10, 1927, Univ. Okla. Exp.: U.O.M.Z. Nos. 7493 (1) and 7782 (1). (Probably 1 of these specimens came from Flint Creek, in the same region [see records by Hubbs and Ortenburger, 1929*b*: 105].) Elk River, tributary to Grand River, 7 miles north of Grove, Univ. Okla. Exp.: U.O.M.Z. No. 7582 (10). Illinois River, Sequoyah Co., 2 miles northeast of Gore, July 5, 1929, Univ. Okla. Exp.: U.O.M.Z. No. 15481 (2). Barren Fork of Illinois River, 1 mile south of Barren Fork, Adair Co., July 11, 1929, Univ. Okla. Exp.: U.O.M.Z. No. 15479 (2). Barren Fork, near Proctor, Adair Co., April 29, 1939, G. A. Moore and party: U.M.M.Z. No. 127183 (3). Fourteen Mile Creek, 2 miles west of Hulbert, Cherokee Co., July 12, 1929, Univ. Okla. Exp.: U.O.M.Z. No. 15483 (5). Neosho River, 5 miles southeast of Wagoner, Wagoner Co., July 12, 1929, Univ. Okla. Exp.: U.O.M.Z. No. 15482 (1). Sallisaw, Meek: U.S.N.M. No. 62008 (4).

ARKANSAS.—Fourche la Fave River, 11 miles south of Waldron, Scott Co., July 1, 1927, Univ. Okla. Exp.: U.M.M.Z. No. 81139 (1). Bear Creek, Fourche la Fave River system, near Hollis, Perry Co., June 17, 1938, J. D. Black: U.M.M.Z. No. 123048 (8). Clear Creek, 15 miles southeast of Winslow, Crawford Co., June 29, 1938, Black: U.M.M.Z. No. 123363 (1). Schaberg Creek, tributary to Arkansas River, Schaberg, Crawford Co., August 5, 1938, Black: U.M.M.Z. Nos. 123833 (10) and 123845 (19). Schaberg Creek, August 17, 1939, Black: U.M.M.Z. No. 128680 (14). Little Sugar Creek, tributary to Elk River, 1 mile north of Avoca, July 8, 1938, Black: U.M.M.Z. No. 123489 (2). Illinois River, Prairie Grove, Meek: U.S.N.M. Nos. 59125 (1) and 62011 (2). Illinois River, Ladds Mill, Meek: U.S.N.M. No. 59167 (7). Wildcat Creek, tributary to Illinois River, 12 miles west of Springdale, Benton Co., July 1, 1938, Black: U.M.M.Z. No. 123460 (2). Butler Creek, 1 mile north of Sulphur Springs, Benton Co., July 20, 1939, Black: U.M.M.Z. No. 128346 (1). Spavinaw Creek, 6 miles south of Maysville, Benton Co., July 20, 1939, Black: U.M.M.Z. No. 128355 (2). Osage River, tributary of Illinois River, 5 miles east of Siloam Springs, Benton Co., July 20, 1939: U.M.M.Z. No. 128357 (1). Barren Fork, one-half mile northeast of Dutch Mills, Washington Co., July 17, 1938, Black: U.M.M.Z. No. 123720 (8). Evansville Creek, near Evansville, Washington Co., July 17, 1938, Black: U.M.M.Z. No. 123735 (7).

The specimens interpreted as intergrades between *M. d. dolomieu* and *M. d. velox* are discussed under the species heading and are spotted on Map 2.

The name *velox* ("swift") refers to the streamlined form of this subspecies and to its fine reputation as a game fish.

NORTHERN SMALLMOUTHED BASS

3b. *Micropterus dolomieu dolomieu* Lacépède

(Map 2; Pl. I, Fig. 6; Pl. II, Fig. 2; Pl. III, Fig. 1.)

Micropterus dolomieu.—Lacépède, 1802: 324–26, Pl. 3, Fig. 3 (original description; no locality given). Henshall, 1881: 84, etc., figs. opposite pp. 60, 78, and 135 (excellent synonymy). McKay, 1881: 93. Borne, 1883: 221–24 (introduced into Germany from Greenwood Lake, New York). Jordan and Gilbert, 1883: 485, 916 (in part; emended spelling *dolomiei*). Bollman, 1891: 577, Pl. 72, Fig. 2. Boulenger, 1895: 4, 15–16, Fig. 2 (spelled *dolomiei*). Jordan and Evermann, 1896: 1011–12 (in part); 1900: 3267, Pl. 162, Figs. 430–30*a*. Henshall, 1904: 35 *et passim*, figs. opposite pp. 22 and 32. Fowler, 1906: 520. Forbes and Richardson, 1909 and 1920: 262–66, colored pl. (frontispiece). Jordan, 1929: 146. Jordan, Evermann, and Clark, 1930: 298. Hubbs and Bailey, 1938. Kuhne, 1939: 94–98 (ecology, etc.). Brown, 1939: 310–12, Figs. 110–11 (introduction into California; characters).

Microptères de Lacépède.—Cuvier, in Cuvier and Valenciennes, 1830: v–vi of introduction (*M. dolomieu* Lacépède = *Gristes salmoides* (Cuvier); name *salmoides* selected).

Micropterus dolomieu dolomieu.—Bailey, 1938: 174. Kuhne, 1939: Fig. 65.

Bodianus Achigan.—Rafinesque, 1817: 120 (original description; New York and Canada).

Lepomis achigan.—Gill, 1860: 20.

Micropterus salmoides var. *achigan.*—Jordan and Brayton, 1878: 30.

Micropterus dolomieu var. *achigan.*—Henshall, 1881: 16, 82; 1904: 11, 32.

?Lepomis pallida.—Rafinesque, 1820: 30–31 (original description; from the Ohio, Miami, Hockhocking, etc.; probably a complex of *M. d. dolomieu* and *M. p. punctulatus;* interpreted by us as nomenclatorially referable to *dolomieu;* name preoccupied by *Labrus palladus* Mitchill, 1815, if the reference to *Lepomis* of *palladus* and of the emended name *pallidus* be interpreted as having made Rafinesque's name a homonym).

Lepomis trifasciata.—Rafinesque, 1820: 31 (original description; Ohio River and other streams).

Lepomis flexuolaris.—Rafinesque, 1820: 31 (original description; Ohio River and tributary streams).

Lepomis Salmonea.—Rafinesque, 1820: 32 (original description; Kentucky, Ohio, Green, and Licking rivers).

Lepomis notata.—Rafinesque, 1820: 32 (original description; Ohio Valley).

?Etheostoma calliura.—Rafinesque, 1820: 36 (original description; the Ohio and Salt rivers, etc.; probably a complex of *M. d. dolomieu* and *M. p. punctulatus;* interpreted by us as nomenclatorially referable to *dolomieu*).

Cichla fasciata.—LeSueur, 1822: 216–18 (original description; Lake Erie at Erie and Buffalo, and Lake George); Kirtland, 1838: 191 (*fasciata* and *Ohioensis* identical).

Centrarchus fasciatus.—De Kay, 1842: 28–29 (records). Kirtland, 1845: 28–30. Garlick, 1857: 105–7, fig. on p. 105. Günther, 1859: 258.

Grystes fasciatus.—Agassiz, 1850: 295–96.

Micropterus fasciatus.—Gill, in Cope, 1865: 83 (records). Cope, 1868: 216, 247

(records); 1870: 450 (not found east of the great watershed in North Carolina).

Cichla Ohioensis.—LeSueur, 1822: 218–19 (original description; Ohio River).

Cichla minima.—LeSueur, 1822: 220–21 (original description; lagoons of Lake Erie). Kirtland, 1838: 191.

Grystes salmoides (misidentifications; not of Lacépède).—Cuvier, in Cuvier and Valenciennes, 3, 1829: 54–58, Pl. 45 (New York and Wabash River). De Kay, 1842: 26, Pl. 69, Fig. 223. Günther, 1859: 252.

Micropterus salmoides.—Jordan, 1876: 230; 1877*b*: 34.

Cichla variabilis.—LeSueur, MS (*nomen nudum*), in Cuvier and Valenciennes, 1829: 55.

Dioplites variabilis (LeSueur), in Vaillant and Bocourt, 1874: Pl. 4, Fig. 4.

Micropterus variabilis.—Vaillant and Bocourt, in Jordan, 1880: 224 (first description under this name: "This is the ordinary northern small-mouthed Black Bass, *Micropterus achigan*, or var. *achigan* of authors, *Micropterus salmoides achigan* of the present writer"; Wabash River, Indiana; type specimen in Paris Museum examined). LeSueur, in Vaillant and Bocourt, 1883.

Centrarchus obscurus.—De Kay, 1842: 30, Pl. 17, Fig. 48 (original description; Onondaga Creek, New York). Günther, 1859: 258.

The separation of *Micropterus coosae* and other forms of black bass calls for a more precise identification of the original type of *Micropterus dolomieu* (Paris Museum No. 5243), which is without known locality. After having examined this specimen, Jordan (1880: 219) identified it as the southern variety of the smallmouthed bass (*"Micropterus salmoides* var. *salmoides"* Jordan and Brayton, 1878: 31–32 = *Micropterus coosae*). Vaillant and Bocourt (1883), on the contrary, characterized *dolomieu* as having even smaller scales than the northern form, which they called *variabilis*. Confronted by this conflicting evidence, we asked Jacques Pellegrin to re-examine the type of *dolomieu*, in accordance with the methods we have followed (see pp. 9–10), so as to determine its diagnostic characters in terms of the present revision. He has reported the characters of the type to be as follows:

Dorsal, X, 7 + 3 (an accidental injury having widely separated the soft dorsal into 2 fins); anal, III, 11; pectorals, 18–18. Scales, 10—74—17. Lingual teeth present posteriorly. Rows of small scales evident between the dorsal soft rays. Upper jaw extending to below posterior border of eye; its length, $2\frac{1}{3}$ in head. Dark lines visible along the rows of scales below the lateral line. Standard length, 210 mm.; total length, 258 mm.

Considering these characters, we regard it as safe to continue the application of the name *dolomieu* to the northern smallmouthed bass. The pectoral-ray counts are entirely distinctive and preclude identification with *coosae*. Likewise, the number of lateral-line scales, the anal-ray count, and the indicated length of the soft dorsal, point to the northern smallmouth. The fact that the counts of the scale rows above and below the lateral line are lower than those which we give is probably without significance, as the minute scales near the fins would not likely be countable in the ancient type.

Since *Micropterus dolomieu* is not native to South Carolina, the suggestion of some authors that the type locality of the species lay in that state seems highly improbable. It is hypothecated that the type locality may have been Lake Champlain, which was the only readily accessible part of the range of the northern smallmouthed bass in the time of Dolomieu.

The typical subspecies of *Micropterus dolomieu* is diagnosed in the key (p. 12). Variational data are presented in Tables I–VII. Record stations are given on Map 2.

GENUS *HURO* CUVIER

Huro.—Cuvier, in Cuvier and Valenciennes, 1828: 93 (124–25). Haplotype, *Huro nigricans* Cuvier.
Grystes.—Of authors; not of Cuvier.
Aplites.—Of authors; not of Rafinesque.
Micropterus.—Of authors, in part; not of Lacépède.

Until recently the largemouthed bass and smallmouthed bass were considered as congeneric, but Hubbs (1926: 71), primarily on the basis of differences in the structure of the pyloric caeca and in the squamation of the dorsal and anal fins, referred them to separate genera, *Micropterus* and *Aplites*. The recent discovery that there are not 2 but at least 4 species of black bass has necessitated a revision of the generic status. The 4 new forms described in this paper, as well as *M. pseudaplites* Hubbs = *M. punctulatus* (Rafinesque), agree with *M. dolomieu* in the structure of the pyloric caeca and in the squamation of the fins, and are consequently assigned to the genus *Micropterus*. *Huro* is thus left with a single species, *salmoides*.

Recent additions to our distributional knowledge of the various species of black bass reopens the question of the generic name to be applied to the largemouthed species. Earlier workers generally confounded *M. punctulatus* with *salmoides,* and this confusion probably led to erroneous records of the largemouth in the Ohio Valley (the type locality of *Lepomis pallida* Rafinesque, which is the genotype of *Aplites*). The recent exhaustive fish survey of Ohio by Milton B. Trautman has revealed that the largemouth, despite intensive stocking, is rare and is almost wholly confined to man-made still waters in the southern part of the state, whereas *punctulatus* is abundant and is generally distributed there. We again turn to the original description of *Lepomis pallida* and find no statement diagnostic of the largemouth, other than the probably erroneous statement that the dorsal is almost divided into 2 fins. Since the characters given apply in part to *Micropterus d. dolomieu* and in part to *M. p. punctulatus* we consider the name as a complex, and as nomenclatorially referable to *punctulatus*. The name *Aplites* is thereby relegated to the synonymy of *Micropterus* Rafinesque, 1820, leaving *Huro* Cuvier, 1828, as the valid name for the present genus. (See also synonymy of *Micropterus,* on p. 13.)

The distinctive characters of *Huro* are given in the key on p. 13. It is believed that *Huro* represents a specialized offshoot of *Micropterus,* but that no living species of that genus is directly ancestral to *Huro* (Fig. 1). *Huro salmoides* is very similar in color pattern to *M. punctulatus,* and it is presumed that the common and probably primitive characters of color pattern preserved in these species are older than the structural differences which separate the genera.

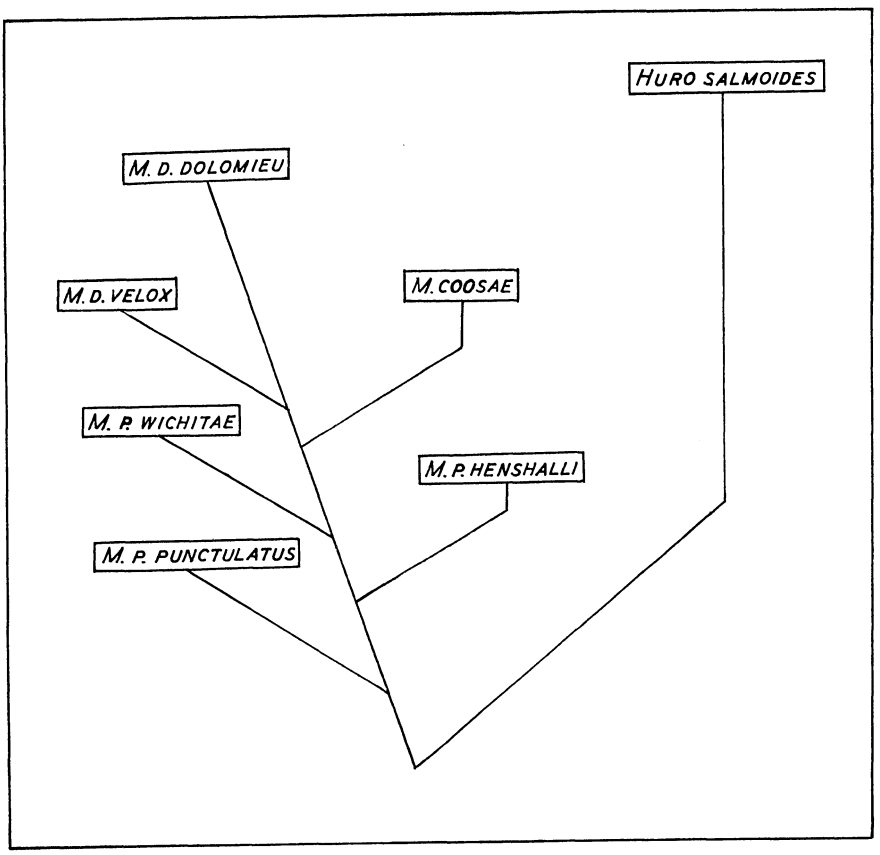

FIG. 1. A theoretical phylogeny of the seven recognized forms of black bass.

LARGEMOUTHED BASS

4. *Huro salmoides* (Lacépède)

(Pl. I, Fig. 1; Pl. III, Fig. 2.)

Labrus salmoides.—Lacépède, 1802: 716–18, Pl. 5, Fig. 2 (opposite p. 158) (original description; "les rivières de la Caroline"; Charleston, South Carolina, may be regarded as the probable type locality, since that city was the center of Bosc's collecting).

Grystes salmoides.—Agassiz, 1850: 296. Holbrook, 1860: 28–31, colored Pl. 4, Fig. 2 (branched pyloric caeca noted; abundant in Florida, Georgia, and the Carolinas, but not found north of Virginia).

Dioplites salmoides.—Vaillant and Bocourt, 1874: Pl. 4.

Micropterus salmoides.—Gill, 1864: 93. Henshall, 1881: 110, etc., figs. opposite pp. 62 and 65 (excellent synonymy). McKay, 1881: 93. Jordan and Gilbert, 1883: 484–85. Bollman, 1891: 577–78, Pl. 72, Fig. 3. Jordan and Evermann, 1896: 1012; 1900: 3268, Pl. 163, Fig. 432. Henshall, 1904: 41, etc., figs. opposite pp. 24 and 38. Fowler, 1906: 520. Forbes and Richardson, 1909 and 1920: 262, 267–69, colored pl. (frontispiece).

Aplites salmoides.—Hubbs, 1926: 71 (removed from *Micropterus*).

Huro salmoides.—Jordan, 1929: 145–46. Hubbs and Cooper, 1936: 13. Hubbs and Bailey, 1938: 15, 18–20, Pl. 1, Fig. 3. Kuhne, 1939: 94, Fig. 64.

Micropterus salmonoides.—Boulenger, 1895: 16–18 (emended spelling).

Perca trutta.—Bosc, MS, in Lacépède, 1802: 717 (based on same description and figure as *L. salmoides*).

Cichla Floridana.—LeSueur, 1822: 219–20 (original description; eastern Florida).

Micropterus floridanus.—Goode, 1876: 63. Jordan and Copeland, 1876: 137.

Huro floridana.—Jordan, Evermann, and Clark, 1930: 297.

Huro nigricans.—Cuvier, in Cuvier and Valenciennes, 1828: 93 (125–26), Pl. 17 (original description; Lake Huron). De Kay, 1842: 15, Pl. 69, Fig. 224. Günther, 1859: 255.

Grystes nigricans.—Agassiz, 1850: 297.

Micropterus nigricans.—Cope, 1865: 83; 1868: 216 (lower part of James River, Virginia); 1870: 451. Jordan, 1876: 229–30.

Grystes nobilis.—Agassiz, 1854: 297–98 (original description; Tennessee River, Huntsville, Alabama).[9]

Grystes nuecensis.—Baird and Girard, 1854: 25 (original description; Rio Frio and Rio Nueces, Texas).

Dioplites nuecensis.—Girard, 1858: 4–5; 1859: 3–5, Pl. 1, Figs. 1–4.

Grystes megastoma.—Garlick, 1857: 108–10, fig. on p. 108 (original description; bays of Lake Erie and mouths of tributary streams).

Micropterus pallidus (misidentifications; not of Rafinesque).—Jordan, 1877*a:* 314 (in part); 1877*b:* 34, 43.

Perca flavescens × *Huro floridana* (misidentification of a hunchbacked *Huro* as an interfamily hybrid).—Fowler, 1935: 23, Fig. 51.

As indicated by Jordan (1880: 220), *Labrus salmoides* was described by Lacépède solely on the basis of the manuscript communication and drawing furnished by Bosc. Among the characters assigned to this fish in the original account, the toothless tongue, the large size (6 or 7 decimeters), the abundance, and the large mouth (clearly indicated in the figure) are so diagnostic of the largemouthed bass that it is difficult to understand how the name was ever thought applicable to *M. dolomieu.* The same characters preclude the identification of *Labrus salmoides* with *Micropterus coosae,* the only other black bass native to South Carolina. *Cichla floridana* LeSueur, *Huro nigricans* Cuvier, *Grystes nobilis* Agassiz, *Grystes nuecensis* Baird and Girard,

[9] Cotypes of *Grystes nobilis,* M.C.Z. Nos. 9661 (5) and 21786 (3) were found referable to *Huro salmoides.*

and *Grystes megastoma* Garlick are all quotable as synonyms of *salmoides* on the basis of the characters indicated in the original descriptions and figures.

The specific characters and range of *Huro salmoides* are stated and compared with those of all recognized forms of *Micropterus,* in the key to the species of the 2 genera. Fin-ray, scale, and vertebral counts are given in Tables IV–VII.

Considerable evidence, including that presented by Viosca (1932), indicates that *Huro salmoides* will be found on careful study to be a complex of at least 2 subspecies or species. Such an investigation remains to be made.

CONCLUSIONS OF GENERAL SYSTEMATIC INTEREST

The increase in the number of recognized species and subspecies of black bass from 2 or 3 to 7 is a new confirmation of the richness of the fresh-water fish fauna of eastern North America. Evidence that at least 4 additional forms of *Micropterus* may prove worthy of nomenclatorial recognition constitutes one indication, among many, that the task of differentiating and naming the members of this fauna still remains incomplete.

The great variability of fresh-water fishes in numerical characters is well illustrated in *Micropterus* (Tables I–VII).

The phenomenon of peripheral differentiation is strikingly exemplified in the black basses. The evidence for this conclusion is briefly stated on pages 7, 16, 19–21, and 28–30, and is presented in part on the distributional maps (Maps 1 and 2).

Interspecific hybrids among the black basses appear to be extremely rare. No authentic hybrid involving *Huro* is yet known: Fowler's (1935: 23, Fig. 51) identification of a hunchbacked *Huro* as an interfamily hybrid (*"Perca flavescens* × *Huro floridana"*) is too absurd for further comment. Specimens tentatively reported as hybrids between *Micropterus pseudaplites* (= *M. punctulatus*) and *M. dolomieu* by Hubbs and Ortenburger (1929*a:* 42; and 1929*b:* 105) are now believed to represent an extremely variable form (*wichitae*) allied to *M. punctulatus,* and restricted to West Cache Creek in southwestern Oklahoma (p. 19). On the basis of its intermediate color pattern, a young bass collected in Talladega Creek, Talladega County, Alabama (Coosa River system), in association with series of *M. coosae* and *M. punctulatus henshalli,* is interpreted as a hybrid between these 2 species. Two which are almost certainly hybrids between *Micropterus d. dolomieu* and *M. p. punctulatus* were collected respectively in southeastern Missouri and in northern Alabama. The structural characters of these specimens are compared with those of the presumed parent species in Table II.

The hybrid from Missouri (U.M.M.Z. No. 115758), a young specimen 56.5 mm. in standard length, collected in Black River, Sec. 8, T. 25 N., R. 6 E.,

TABLE II

CHARACTERS OF HYBRIDS BETWEEN *MICROPTERUS D. DOLOMIEU* AND *M. P. PUNCTULATUS*

Character	*dolomieu dolomieu*	Hybrid (Alabama)	Hybrid (Missouri)	*punctulatus punctulatus*
Dorsal soft rays	Usually 14	12	13	Usually 12
Anal soft rays	Usually 11	10	11	Usually 10
Scale rows in lateral line	Average, 74.4 (usually 71–77)	66	67	Average, 63.7 (usually 60–68)
Above lateral line	(11) 12 or 13	10	10	(7) 8 (9)
Below lateral line	(19) 20 or 21 (23)	18	18	(14) 15–17 (18)
Around caudal peduncle	29–32	26	27	(22) 23–26 (27)
Pectoral rays	(16) 17 (18)	17–17	16–16	(14) 15 (16)
Vertebrae	15 + 17	14 + 18	.....	14 + 18

on July 22, 1937, is intermediate in color pattern between *M. d. dolomieu* and *M. p. punctulatus.* The dark lateral band of *M. p. punctulatus* is disrupted into a series of distinct dark blotches which correspond in position to the intersections of the vertical bands of young *M. d. dolomieu* and the longitudinal band of *M. p. punctulatus,* but do not extend so far dorsad and ventrad as do the bars in *M. d. dolomieu.* A series of solid dark rhomboidal blotches extends along the lateral line on the caudal peduncle. A large basal caudal spot is present, and the caudal band is very dark.

The *dolomieu* × *punctulatus* hybrid from Alabama (U.M.M.Z. No. 117437), a young specimen 76.2 mm. in standard length, collected in Elk River, tributary to Tennessee River, Limestone County, Alabama, during October, 1936, is very unlike the preceding specimen in color pattern, although agreeing well in structural features. A number of dark scales are scattered irregularly over the body, but, although the preservation is excellent, there is no characteristic pattern of vertical bars as in young *dolomieu* nor any marked lateral band as in *punctulatus.* A number of faint, light-centered rhombs along the lateral line on the caudal peduncle are strongly suggestive of the pattern in *velox* and *coosae.* The basal caudal spot is obscure, and the caudal band is very faint (much more as in yearling than as in young specimens of either species).

There is some evidence, however, to support a view that hybridization is a frequent and significant phenomenon in *Micropterus.* Although the types of *M. punctulatus wichitae* almost certainly do not represent a fusing population of *M. p. punctulatus* and *M. dolomieu,* as once thought, it may well be that the form *wichitae* is the product of earlier hybridization between the 2 species (see p. 19). Similarly, the aberrant specimens from the basin of Black Warrior River (p. 28) may represent *in toto* the product of the present or past hybridization between *M. p. henshalli* and *M. coosae.* At other localities *henshalli* and *coosae* may hybridize extensively. In the collection

from Talladega Creek, Alabama, several specimens are none too readily referable to either form, and the most intermediate example is definitely thought to be a hybrid. In the Wichita Mountains of Oklahoma, as well as in Blount Springs and Talladega Creek in Alabama, the color pattern and other characters vary in such a way as to suggest the possibility of extensive hybridization, past or present.

The characters of the various forms of black bass suggest the possibility that hybridization may have played an important part in the process of their speciation. As noted in the original description of *Micropterus pseudaplites* (=*M. p. punctulatus*), this form in most characters is intermediate between *Micropterus dolomieu* and *Huro salmoides,* or combines the characters of the 2 species (Hubbs, 1927). In most of the distinctive features, *M. d. velox* approaches *M. punctulatus,* so that one might assign its origin theoretically to past hybridization between *M. punctulatus* and *M. d. dolomieu,* followed by backcrossing with *dolomieu* and inbreeding (plus selection?) to produce constant characters. *M. p. wichitae,* the intermediacy of which between *M. p. punctulatus* and *M. dolomieu* has already been stressed, might have been differentiated by an almost identical process, involving, however, a backcrossing with *M. p. punctulatus* before inbreeding set in to standardize the characters imperfectly. *M. coosae* might have been produced through the complete amalgamation of a small southeastern population of *M. dolomieu* into a more abundant stock of a *punctulatus*-like form; with subsequent changes after the characters became stabilized through inbreeding.

At present it can neither be proved nor disproved that the speciation of the black basses has been the result of hybridization. An alternative explanation is that the intermediate characteristics of some forms reflect independent speciation, resulting perhaps from parallel mutation or atavism. A second alternative is that the intermediacy of such forms is due to their origin from ancestors which in the phylogeny of the group intervened between the 2 other forms concerned. A theoretical phylogeny in line with this explanation of the characters of the several black basses is given in Figure 1. We do not venture to choose between these alternative theories concerning the origin of the species of black bass, but plan to study the problem further.

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TABLE III

MEASUREMENTS OF THE SIX RECOGNIZED FORMS OF *MICROPTERUS*

The proportions are expressed as thousandths of the standard length, of the head length, or of the length of the highest dorsal spine. For each character there is given in italics the average value and in parenthesis the range of variation. Proportions which increase with age are designated (+); those which decrease with age by (−).

Species or Subspecies Number of Measurements	*M. p. punctulatus* 30–32*	*M. p. henshalli*† 27–34	*M. p. wichitae* 9–10	*M. coosae* 23–26	*M. d. velox* 32–38‡	*M. d. dolomieu* 19–20
Proportions of standard length						
Head length (−)	*357* (318–79)	*356* (333–86)	*351* (328–67)	*358* (336–75)	*364* (348–81)	*352* (324–74)
Greatest depth (+)	*248* (216–330)	*231* (214–67)	*258* (243–85)	*278* (253–99)	*261* (222–92)	*302* (282–345)
Least depth (+)	*116* (99–135)	*107* (98–114)	*119* (110–28)	*125* (116–38)	*118* (106–32)	*122* (111–32)
Body width (+)	*144* (121–99)	*142* (123–66)	*146* (125–85)	*154* (143–69)	*144* (129–71)	*164* (148–80)
Caudal peduncle length	*240* (208–69)	*234* (215–54)	*228* (204–42)	*228* (212–43)	*215* (195–254)	*212* (186–228)
Pectoral length	*187* (152–204)	*180* (152–204)	*179* (171–89)	*183* (165–97)	*182* (157–211)	*173* (162–89)
Pelvic length (−)	*176* (155–91)	*164* (151–81)	*165* (155–73)	*169* (159–85)	*175* (159–92)	*167* (154–74)
Highest dorsal spine (−)	*97* (78–109)	*95* (80–106)	*89* (75–97)	*86* (68–101)	*91* (76–103)	*82* (72–96)
Lowest dorsal spine (−)	*52* (38–63)	*46* (33–58)	*52* (44–58)	*60* (48–74)	*57* (45–67)	*54* (44–67)
Highest dorsal soft ray	*147* (132–63)	*143* (112–66)	*151* (128–67)	*155* (136–73)	*146* (135–65)	*139* (128–62)
Highest anal spine (−)	*78* (45–89)	*80* (67–90)	*77* (68–88)	*78* (52–99)	*77* (57–93)	*73* (56–89)
Highest anal soft ray (−)	*148* (129–65)	*147* (132–72)	*148* (141–57)	*156* (141–73)	*144* (130–57)	*141* (125–52)
Proportions of head length						
Head width (+)	*445* (390–572)	*447* (416–521)	*457* (430–533)	*481* (442–534)	*430* (401–502)	*510* (468–565)
Orbit length (−)	*238* (167–291)	*272* (199–315)	*206* (178–254)	*234* (173–289)	*241* (180–283)	*209* (142–247)
Interorbital width (+)	*210* (183–291)	*212* (188–238)	*215* (188–245)	*199* (182–216)	*203* (167–226)	*219* (196–249)
Snout length (+)	*275* (248–95)	*285* (245–307)	*284* (261–300)	*275* (244–99)	*287* (271–305)	*294* (272–310)
Upper jaw length (+)	*454* (410–513)	*430* (392–463)	*453* (433–69)	*429* (385–470)	*438* (407–69)	*438* (416–60)
Lower jaw length (+)	*560* (526–613)	*550* (496–581)	*561* (539–89)	*540* (481–579)	*556* (515–99)	*551* (529–70)
Proportion of length of highest dorsal spine						
Lowest dorsal spine (+)	*533* (452–600)	*480* (364–578)	*585* (485–707)	*707* (617–772)	*631* (488–746)	*652* (542–837)

* Only 21 measurements for the length of the caudal peduncle.

† The 34 measured specimens of *M. p. henshalli* averaged only 53.4 mm. in standard length (range, 26–135 mm.).

‡ More measurements were used for 3 characters: 145 for the greatest depth, 141 for the least depth, and 139 for the body width.

TABLE IV

FREQUENCY DISTRIBUTION OF THE NUMBER OF FIN RAYS IN *MICROPTERUS* AND *HURO*

(For method of counting, see p. 9.)

	Number of Dorsal Spines				
	9	10	11	Number	Average
M. p. punctulatus	18	194	7	219	9.95
M. p. henshalli	4	48	...	52	9.92
M. p. wichitae	15	86	6	107	9.91
M. coosae	7	90	12	109	10.05
M. d. velox	62	330	3	395	9.85
Intergrades	20	311	5	336	9.96
M. d. dolomieu	11	211	7	229	9.98
Huro salmoides	2	67	7	76	10.07

	Number of Dorsal Soft Rays						
	11	12	13	14	15	Number	Average
M. p. punctulatus	29	159	25	1	.....	214	11.99
M. p. henshalli	1	43	8	.....	.....	52	12.13
M. p. wichitae	.....	18	80	10	.....	108	12.93
M. coosae	9	92	8	.....	.....	109	11.99
M. d. velox	2	13	255	140	4	414	13.31
Intergrades	.....	1	64	249	22	336	13.87
M. d. dolomieu	.....	1	17	200	21	239	14.01
Huro salmoides	1	13	55	7	.....	76	12.89

	Number of Anal Spines				
	2	3	4	Number	Average
M. p. punctulatus	1	211	2	214	3.00
M. p. henshalli	.....	51	.....	51	3.00
M. p. wichitae	.....	100	.....	100	3.00
M. coosae	1	105	.....	106	2.99
M. d. velox	2	213	.....	215	2.99
M. d. dolomieu	.....	137	.....	137	3.00
Huro salmoides	2	74	.....	76	2.97

	Number of Anal Soft Rays					
	9	10	11	12	Number	Average
M. p. punctulatus	19	176	18	.....	213	10.00
M. p. henshalli	1	49	1	.....	51	10.00
M. p. wichitae	9	62	29	.....	100	10.20
M. coosae	13	87	6	.....	106	9.93
M. d. velox	2	55	147	11	215	10.78
M. d. dolomieu	1	8	127	1	137	10.93
Huro salmoides	.....	8	60	8	76	11.00

	Number of Pectoral Rays (Both Fins)							
	13	14	15	16	17	18	Number	Average
M. p. punctulatus	...	26	290	91	2	.....	409	15.17
M. p. henshalli	...	1	26	67	5	.....	99	15.77
M. p. wichitae	...	5	47	21	3	.....	76	15.29
*M. coosae**	...	2	109	98	1	.....	211	15.44
M. d. velox	...	.....	.....	41	203	58	302	17.06
M. d. dolomieu	...	.....	1	57	111	13	182	16.75
Huro salmoides	3	71	80	1	1	.....	156	14.53

* One count of 11, not entered in the table, was used in computing the average.

TABLE V

FREQUENCY DISTRIBUTION OF THE NUMBER OF SCALES IN *MICROPTERUS* AND *HURO*

(For method of counting, see p. 9.)

	Number of Scales Above Lateral Line									
	7	8	9	10	11	12	13	14	Number	Average
M. p. punctulatus	11	126	49	.....	.....	.....	.....	...	186	8.20
M. p. henshalli	.....	2	40	8	.....	.....	.....	...	50	9.12
M. p. wichitae	.....	5	18	1	1	.....	.....	...	25	8.92
M. coosae	.....	5	44	17	.....	.....	.....	...	66	9.12
M. d. velox	.....	.....	.....	.....	.....	11	14	3	28	12.71
M. d. dolomieu	.....	.....	.....	.....	4	28	29	...	61	12.41
Huro salmoides	11	32	6	.....	.....	.....	.....	...	49	7.90

	Number of Scales Below Lateral Line													
	14	15	16	17	18	19	20	21	22	23	24	25	Number	Average
M. p. punctulatus	6	70	80	26	3	.....	.....	.....	.....	.....	.....	.....	185	15.73
M. p. henshalli	...	.....	2	20	21	7	.....	.....	.....	.....	.....	.....	50	17.66
M. p. wichitae	...	2	16	4	2	1	.....	.....	.....	.....	.....	.....	25	16.36
M. coosae	...	2	26	27	7	3	.....	.....	.....	.....	.....	.....	65	16.74
M. d. velox	...	.....	.....	.....	.....	.....	6	10	7	5	.....	1	29	21.52
M. d. dolomieu	...	.....	.....	.....	.....	5	17	23	6	10	.....	.....	61	20.98
Huro salmoides	5	20	14	10	.....	.....	.....	.....	.....	.....	.....	.....	49	15.59

TABLE V—(*Continued*)

	Number of Scales Around Caudal Peduncle												
	22	23	24	25	26	27	28	29	30	31	32	Number	Average
M. p. punctulatus	4	43	72	75	20	12	.....	.....	.....	.....	.....	226	24.44
Intergrades	.....	.....	6	13	6	1	.....	.....	.....	.....	.....	26	25.08
M. p. henshalli	.....	.....	.....	.....	2	17	15	4	.....	.....	.....	38	27.55
M. p. wichitae	.....	1	3	1	5	2	.....	2	.....	.....	.....	14	25.86
M. coosae	.....	.....	.....	2	7	9	23	13	16	3	.....	73	28.34
M. d. velox	.....	.....	.....	.....	.....	.....	1	5	14	7	.....	27	30.00
M. d. dolomieu	.....	.....	.....	.....	.....	.....	.....	6	4	4	1	15	30.00
Huro salmoides	.....	.....	3	2	18	5	10	1	1	.....	.....	40	26.60

	Number of Rows of Scales on Cheek												
	9	10	11	12	13	14	15	16	17	18	19	20	Number	Average
M. p. punctulatus	.....	.....	1	5	22	40	51	30	6	1	.....	.....	155	14.63
M. p. henshalli	.....	.....	.....	.....	1	3	9	11	5	.....	.....	.....	29	15.55
M. p. wichitae	.....	.....	.....	.....	.....	2	2	3	.....	.....	.....	.....	7	15.14
M. coosae	.....	1	9	25	18	9	1	.....	.....	.....	.....	.....	63	12.44
M. d. velox	.....	.....	.....	.....	.....	3	5	23	15	9	6	2	63	16.76
M. d. dolomieu	.....	.....	.....	.....	.....	11	24	33	12	1	.....	.....	81	15.60
Huro salmoides	1	12	15	6	.....	.....	.....	.....	.....	.....	.....	.....	34	10.76

TABLE VI

FREQUENCY DISTRIBUTION OF THE NUMBER OF LATERAL-LINE SCALES IN *MICROPTERUS* AND *HURO*

Scales	*M. p. punctulatus**	Intergrades	*M. p. kenshalli*	*M. p. wichitae*	*M. coosae*	*M. d. velox*	*M. d. dolomieu*	*Huro salmoides*
55	1	.....	.....	.....	.....	.....	.....	.....
56	.....	.....	.....	.....	.....	.....	.....	.....
57	1	.....	.....	.....	.....	.....	.....	.....
58	4	.....	.....	.....	.....	.....	.....	1
59	2	.....	.....	.....	.....	.....	.....	4
60	12	.....	.....	.....	.....	.....	.....	3
61	19	.....	.....	.....	.....	.....	.....	11
62	23	1	.....	3	.....	.....	.....	7
63	38	1	.....	3	2	.....	.....	14
64	32	5	.....	2	2	.....	.....	15
65	34	4	.....	1	4	.....	.....	10
66	22	3	.....	6	4	.....	.....	9
67	11	6	.....	7	10	5	.....	4
68	11	3	5	6	11	8	2	4
69	3	1	3	3	17	14	.....	1
70	.....	1	7	2	14	19	2	.....
71	1	.....	8	.....	16	14	6	.....
72	.....	1	5	.....	12	20	11	.....
73	.....	.....	10	.....	6	24	13	.....
74	.....	.....	6	.....	2	18	11	.....
75	.....	.....	9	.....	1	10	22	.....
76	.....	.....	3	.....	2	5	8	.....
77	.....	.....	1	.....	1	3	8	.....
78	.....	.....	.....	.....	.....	1	3	.....
79	.....	.....	.....	.....	.....	.....	4	.....
80	.....	.....	.....	.....	.....	.....	1	.....
81	.....	.....	.....	.....	.....	.....	1	.....
Number	214	26	57	33	104	141	92	83
Average	63.71	66.54	72.26	66.30	69.61	71.86	74.37	63.54

* Counts of the lateral-line scales for specimens from the upper Kanawha (New) River system in West Virginia and Virginia are excluded, because in this region the count is somewhat higher than over the remainder of the range; the highest count for the subspecies is 72.

TABLE VII

FREQUENCY DISTRIBUTION OF THE NUMBER OF VERTEBRAE IN *MICROPTERUS* AND *HURO*

	Number of Precaudal Vertebrae					
	13	14	15	16	Number	Average
M. p. punctulatus	2	43	1	.....	46	13.98
M. p. henshalli	1	19	.....	.....	20	13.95
M. p. wichitae	.....	8	13	.....	21	14.62
M. coosae	.....	32	.....	.....	32	14.00
M. d. velox	.....	4	74	1	79	14.96
M. d. dolomieu	.....	1	68	2	71	15.01
Huro salmoides	.....	1	12	.....	13	14.92

	Number of Caudal Vertebrae					
	16	17	18	19	Number	Average
M. p. punctulatus	.....	2	42	2	46	18.00
M. p. henshalli	.....	1	18	1	20	18.00
M. p. wichitae	.....	12	10	.....	22	17.45
M. coosae	.....	3	26	3	32	18.00
M. d. velox	1	65	13	.....	79	17.15
M. d. dolomieu	3	68	.....	.....	71	16.96
Huro salmoides	.....	11	2	.....	13	17.15

	Total Number of Vertebrae				
	31	32	33	Number	Average
M. p. punctulatus	3	41	2	46	31.98
M. p. henshalli	1	19	.....	20	31.95
M. p. wichitae	1	17	4	22	32.14
M. coosae	3	26	3	32	32.00
M. d. velox	2	66	11	79	32.11
M. d. dolomieu	2	69	.....	71	31.97
Huro salmoides	.....	12	1	13	32.08

PLATE I

Fingerlings of six forms of black bass

FIG. 1 (uppermost). *Huro salmoides:* U.M.M.Z. No. 111890, a specimen 46 mm. in standard length, from Blanche Lake, Newaygo County, Michigan.

FIG. 2. *Micropterus punctulatus punctulatus:* U.M.M.Z. No. 97098, a specimen 49 mm. in standard length, from Caneville Creek, 32 miles north of Parsons, Kansas.

FIG. 3. *Micropterus punctulatus henshalli:* U.M.M.Z. No. 118289, a paratype 47 mm. in standard length, from Talladega Creek, Talladega County, Alabama.

FIG. 4. *Micropterus coosae:* U.M.M.Z. No. 118293, a paratype 55 mm. in standard length, from a stream 7.3 miles south of Dalton, Georgia.

FIG. 5. *Micropterus dolomieu velox:* U.M.M.Z. No. 103190, a paratype 52 mm. in standard length, from Elk River, at Turkey Ford, Oklahoma (type locality).

FIG. 6. *Micropterus dolomieu dolomieu:* U.M.M.Z. No. 69948, a specimen 44 mm. in standard length, from West Twin Lake, Montmorency County, Michigan.

NOTE: Fingerlings of *Micropterus punctulatus wichitae* are illustrated on Plate VI.

(Photographs by F. W. Ouradnik.)

PLATE I

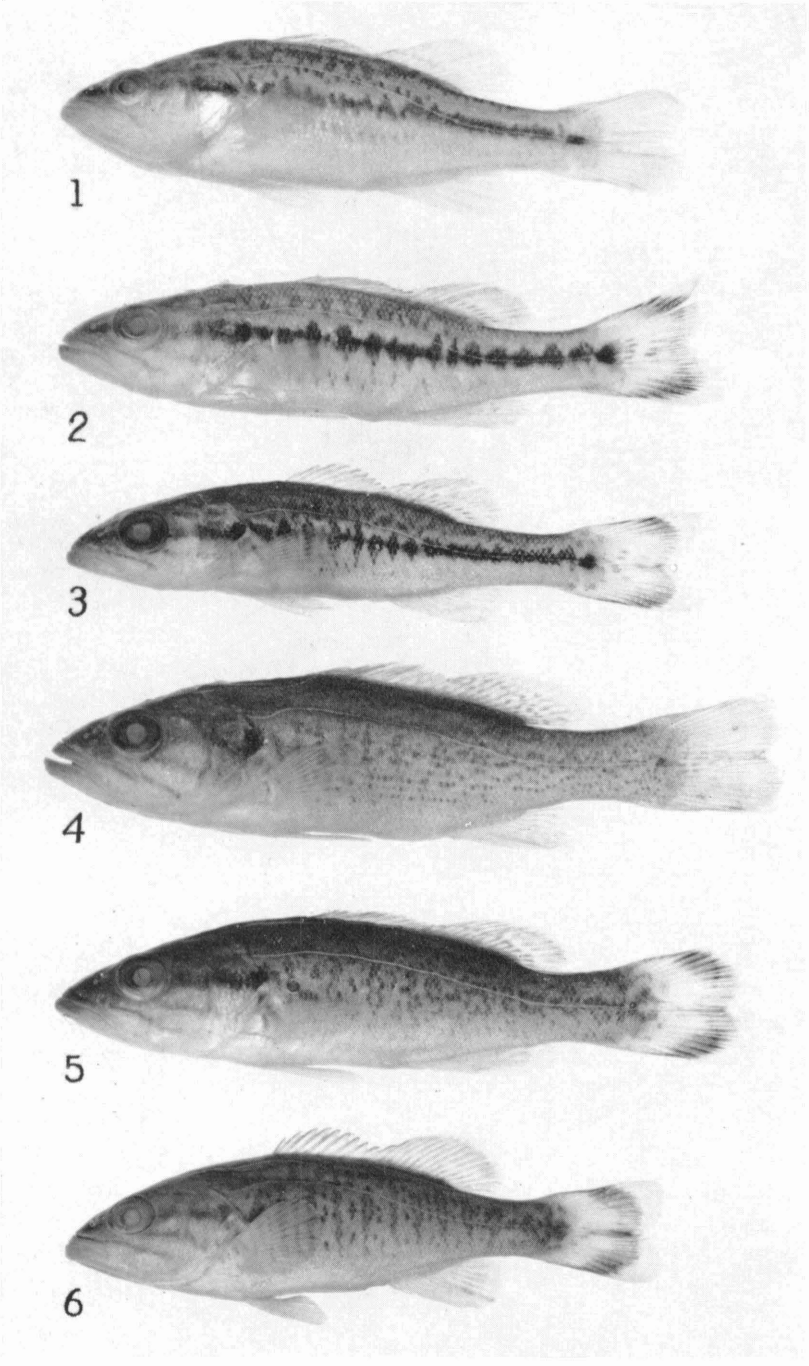


PLATE II

Adult bass from Tennessee

FIG. 1. *Micropterus punctulatus punctulatus.*

FIG. 2. *Micropterus dolomieu dolomieu* (southeastern race).

(Photographs furnished by Eugene R. Kuhne.)

PLATE II

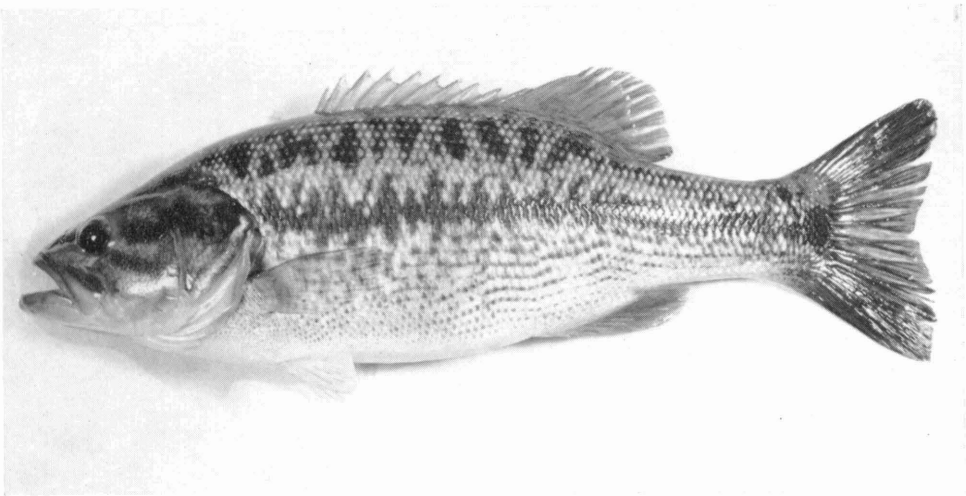


FIG. 1

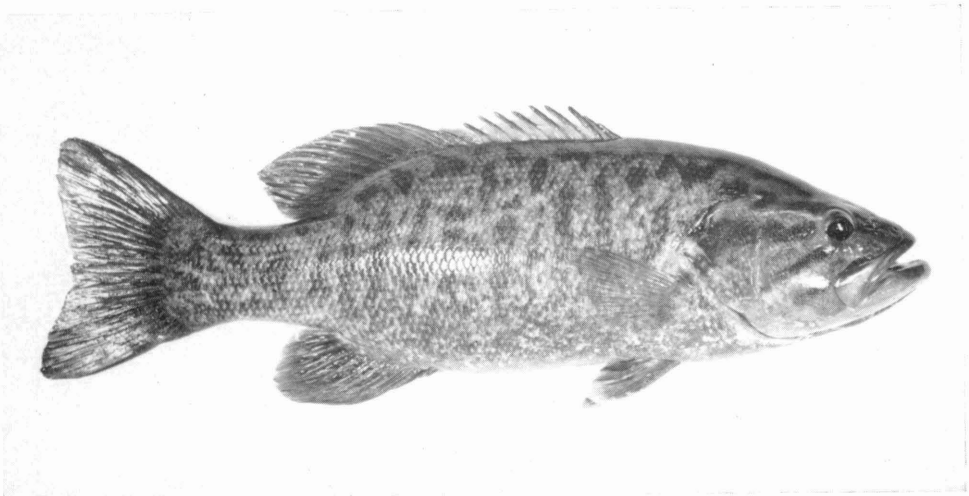


FIG. 2

PLATE III

Adult bass from Michigan and Tennessee

FIG. 1. *Micropterus dolomieu dolomieu:* U.M.M.Z. No. 122276, a specimen 267 mm. in standard length, from Wolf Lake Hatchery, Michigan (photograph by F. W. Ouradnik).

FIG. 2. *Huro salmoides:* from a Tennessee specimen (photograph furnished by Eugene R. Kuhne).

PLATE III

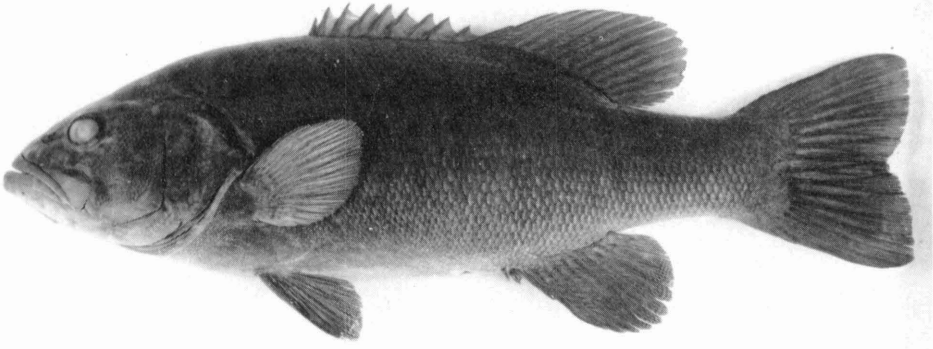


FIG. 1

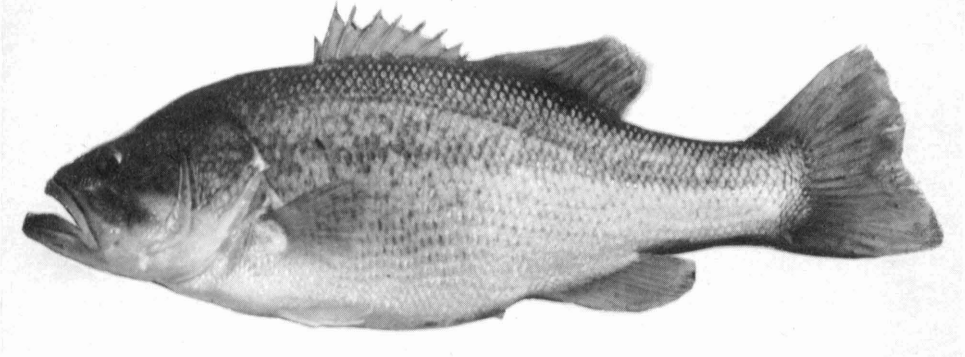


FIG. 2

PLATE IV

Two new subspecies of black bass

FIG. 1. *Micropterus punctulatus henshalli:* U.M.M.Z. No. 111265, a paratype 96 mm. in standard length, from Uphapee Creek, near Tuskegee, Alabama (type locality).

FIG. 2. *Micropterus dolomieu velox:* U.M.M.Z. No. 118296, the holotype, 159 mm. in standard length, from Elk River, at Turkey Ford, Oklahoma.

(Photographs by F. W. Ouradnik.)

PLATE IV

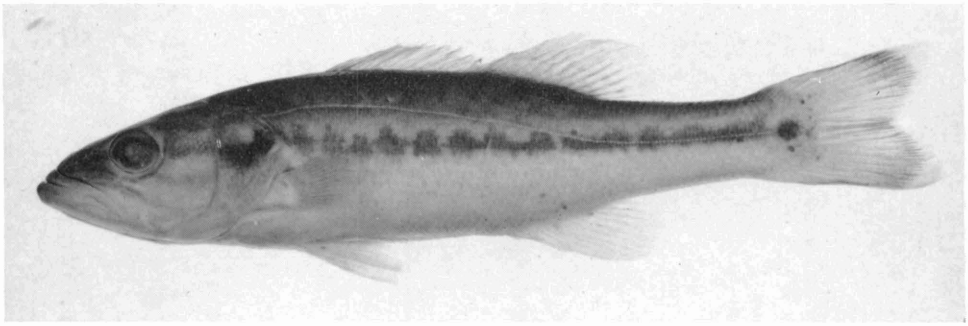


FIG. 1

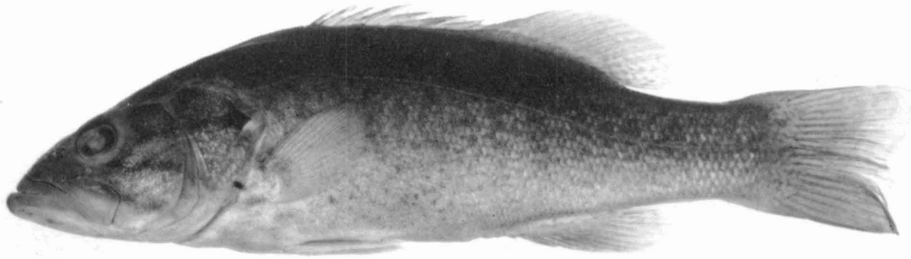


FIG. 2

PLATE V

Holotype and fingerling paratype of *Micropterus coosae*

(Drawing by Grace Eager.)

PLATE V

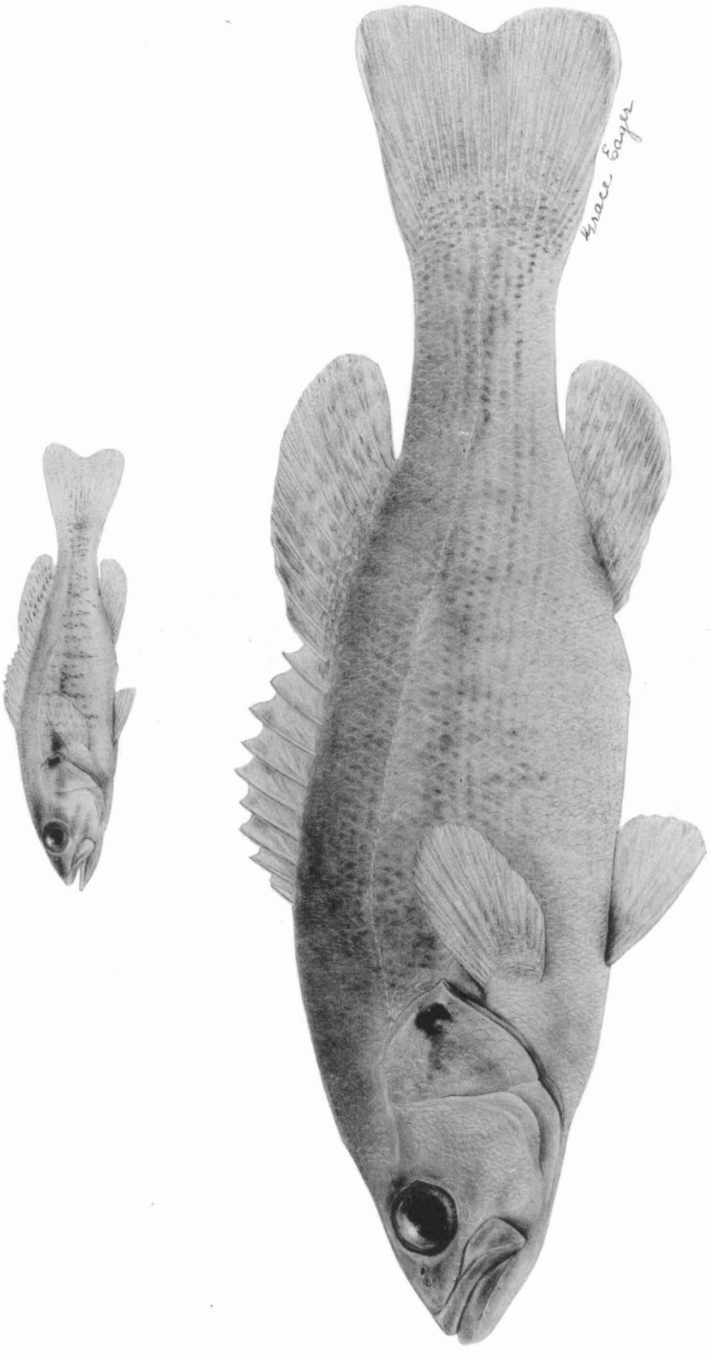
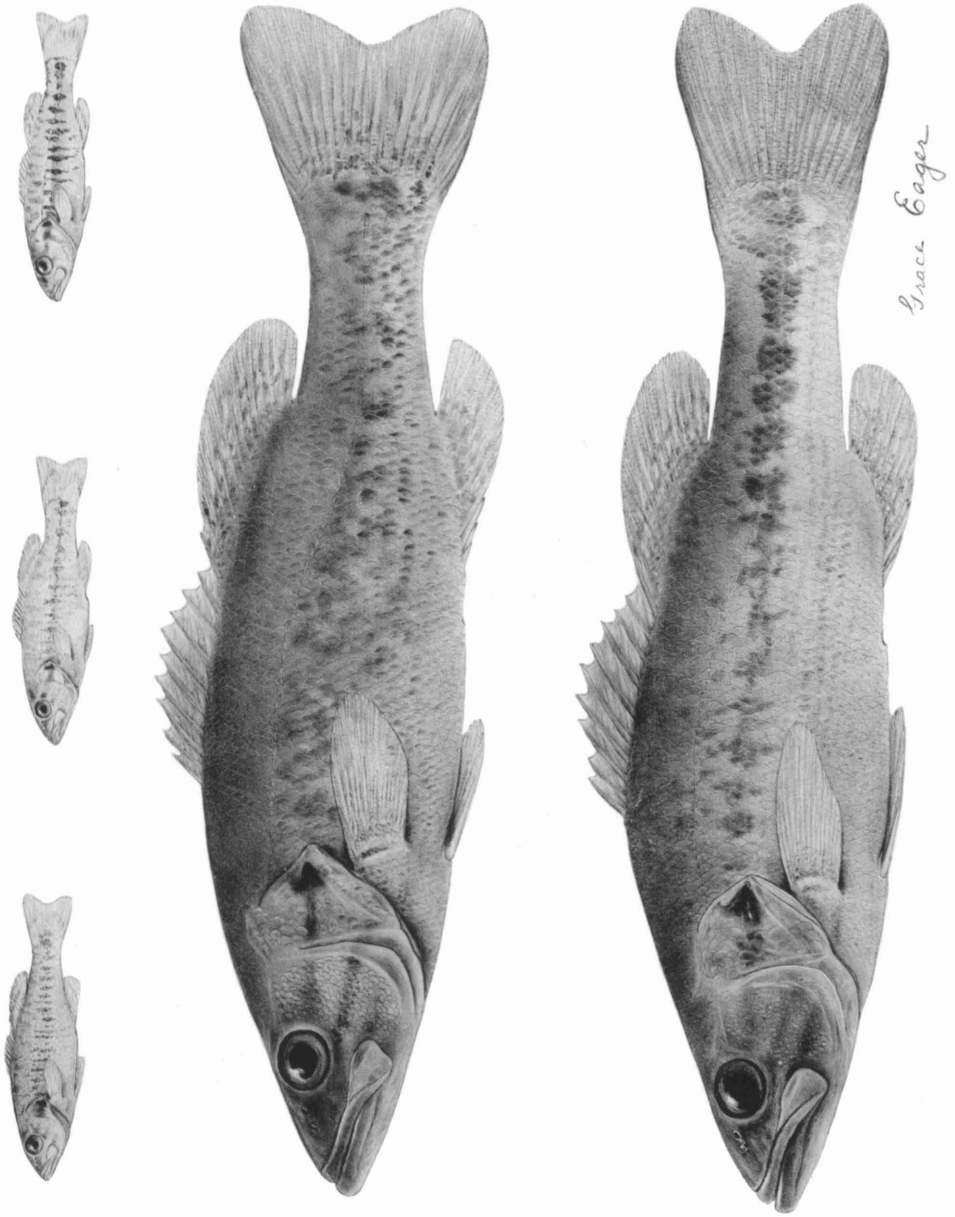


PLATE VI

Micropterus punctulatus wichitae

As indicated in the description of the species, this plate shows the speckled holotype and below this a specimen of similar size but colored more like typical *M. p. punctulatus*. The three fingerlings are to the same scale.

PLATE VI



MAP 1. Distribution, by record stations, of the subspecies of *Micropterus punctulatus*.

A solid line marks the stream divide separating the ranges of *M. p. punctulatus* and *M. p. henshalli*. The concentrations of dots in Ohio, Illinois, Alabama, and Missouri reflect intensive surveys, whereas incomplete ichthyological explorations explain the paucity of records in Indiana, western Tennessee, west-central Alabama, Mississippi, and some other regions within the range of the species. The undetermined subspecies of Florida and Texas are referred to in the text (pp. 16, 21, and 28).

Some doubt is attached to the occurrence of *M. p. punctulatus* in Otter Creek, Oklahoma, just west of the isolated range of *M. p. wichitae*. This record is based on a single specimen which might represent a stock of *wichitae*, although it agrees well with typical *punctulatus* in coloration and other characters: dorsal rays, X, 12; anal rays, III, 10; pectoral rays, 15–16; scales, 8—65—16; 14 rows on cheek, and 25 around caudal peduncle.

With the exceptions indicated below, all entries are for specimens examined by the authors, and mostly deposited in the University of Michigan Museum of Zoology, United States National Museum, Museum of Comparative Zoology, Philadelphia Academy of Natural Sciences, American Museum of Natural History, and University of Oklahoma Museum of Zoology.

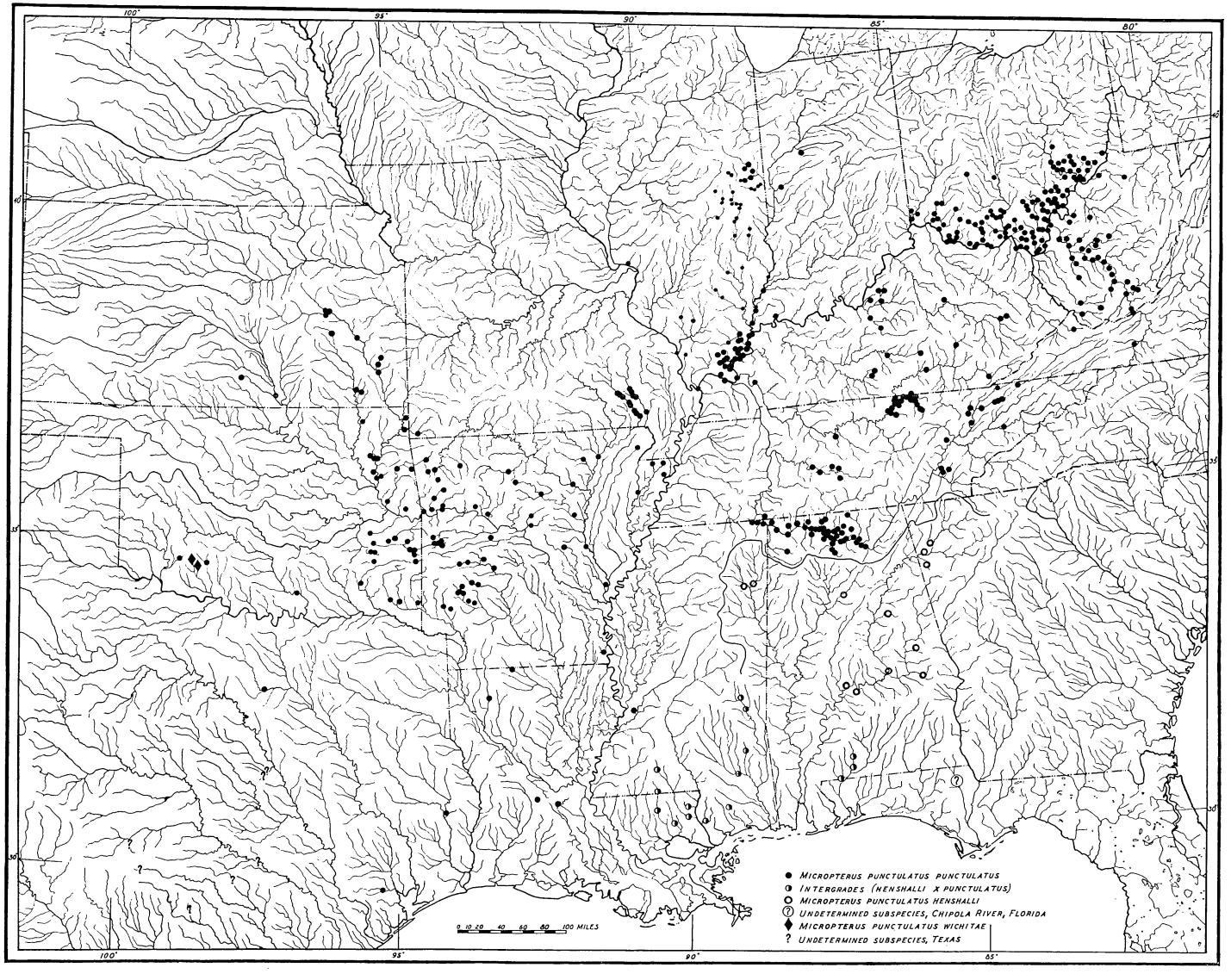
The indicated record stations for the undetermined subspecies of Texas include literature reports clearly based on *M. punctulatus*, but no other records based solely on the literature have been utilized.

Many of the entries for Illinois and the northernmost one for Indiana were furnished by David H. Thompson, of the Illinois State Natural History Survey. The small dots in the Ohio and Big Muddy river systems of Illinois are copied from Forbes and Richardson's distributional map for *Micropterus salmoides*, since David H. Thompson is of the opinion that almost all of these records pertain to *M. punctulatus*.

The Ohio entries are taken in large part from the distributional map for this state prepared by Milton B. Trautman.

West Virginia localities have been furnished by Edward C. Raney.

We wish to express our appreciation to these ichthyologists for their aid in contributing to the completeness of this map.


100°
95°
90°
85°
80°
40°
35°
30°
MICROPTERUS PUNCTULATUS PUNCTULATUS
INTERGRADES (HENSHALLI X PUNCTULATUS)
MICROPTERUS PUNCTULATUS HENSHALLI
UNDETERMINED SUBSPECIES, CHIPOLA RIVER, FLORIDA
MICROPTERUS PUNCTULATUS WICHITAE
UNDETERMINED SUBSPECIES, TEXAS
0 10 20 40 60 80 100 MILES

MAP 1

MAP 2. Distribution, by record stations, of *Micropterus dolomieu* and *M. coosae*.

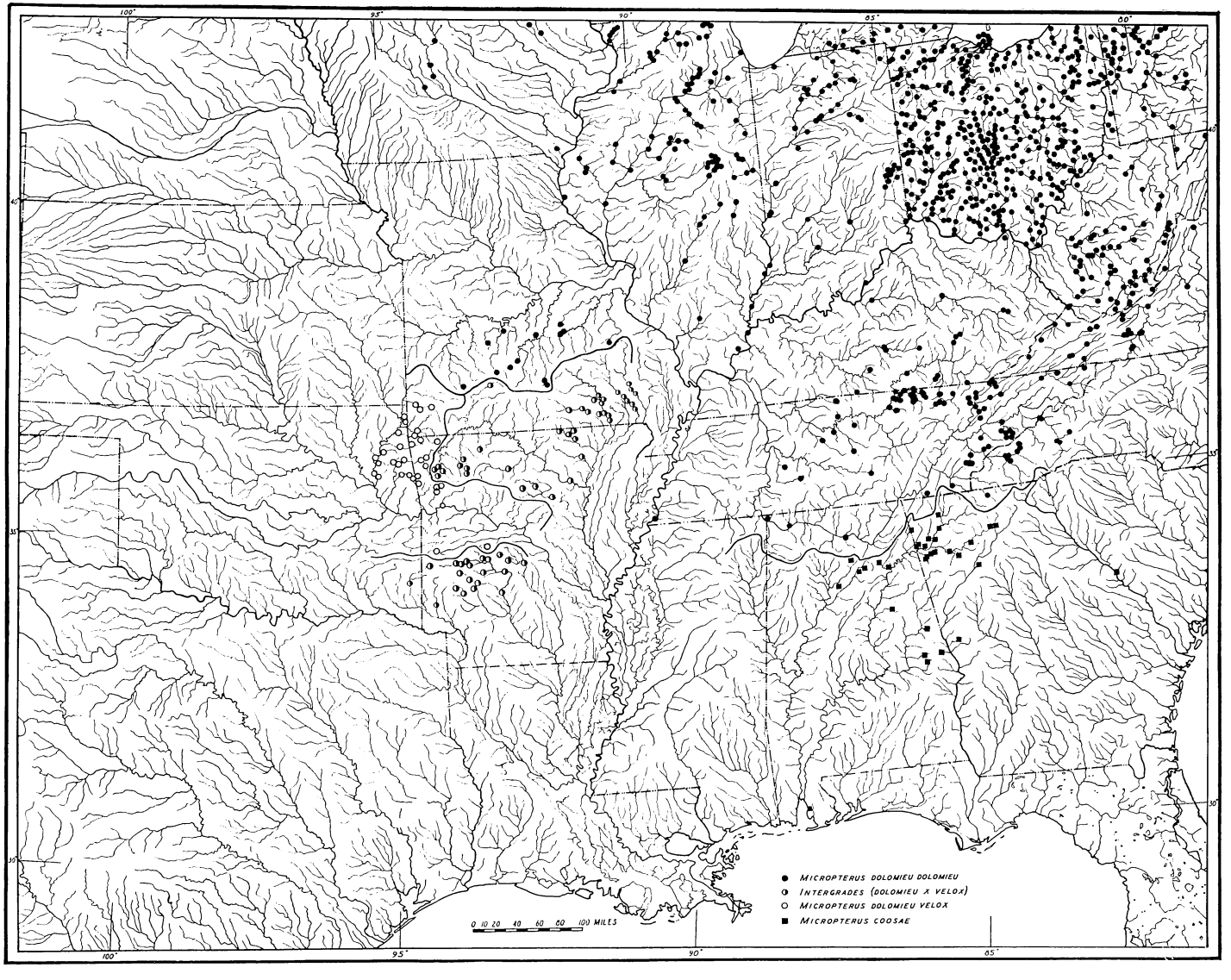
The northern and northeastern part of the range of *M. d. dolomieu* is not included. In the area of this map no distinction can be made between natural habitats and the presence of the form in certain areas because of stocking.

A heavy line follows the stream divide separating the ranges of *Micropterus dolomieu* and *M. coosae*. Other lines, in the Southwest, follow the stream divides which separate the territories occupied by *Micropterus d. dolomieu*, intergrades, and *M. d. velox*.

The concentrations of dots in Ohio and certain other regions reflect intensive surveys.

With the exceptions indicated below, all entries are for specimens examined by the authors. Most of this material is deposited in the United States National Museum, University of Michigan Museum of Zoology, Museum of Comparative Zoology, Philadelphia Academy of Natural Sciences, University of Oklahoma Museum of Zoology, Iowa State College, and Alabama Polytechnic Institute.

For certain northern states we have copied the records given on maps for *M. d. dolomieu*. For Illinois we have used Forbes and Richardson's published map, including all southern entries, since David H. Thompson feels reasonably sure that these were based on smallmouthed rather than on spotted bass; David H. Thompson has supplied some supplementary records for Illinois. For Ohio we have copied Milton B. Trautman's map. For West Virginia and Pennsylvania we have utilized locality records furnished by Edward C. Raney. We are indebted to these men for their generous aid.


100°
95°
90°
85°
80°
40°
35°
30°
MICROPTERUS DOLOMIEU DOLOMIEU
INTERGRADES (DOLOMIEU X VELOX)
MICROPTERUS DOLOMIEU VELOX
MICROPTERUS COOSAE
0 10 20 40 60 80 100 MILES

MAP 2

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