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ALLODONTICHTHYS HUBBSI, A NEW SPECIES OF
GOODEID FISH FROM SOUTHWESTERN MEXICO

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INTRODUCTION

The diversity of the Mexican family Goodeidae is once again emphasized by the new species described below which is restricted to a single drainage on the Pacific slope of Jalisco, México, well south of the Río Lerma basin, the center of abundance of these viviparous fishes. The most noteworthy trait of this fish, its distinctive karyotype that is unique for the family, was described by Uyeno and Miller (1972). We now formally name this species.

ALLODONTICHTHYS HUBBSI, NEW SPECIES

Figs. 1-6

DIAGNOSIS. — A bottom-dwelling, riffle-inhabiting species of *Allo-dontichthys*, closely related to *A. tamazulae* Turner, with nearly uniform body depth, the back strongly mottled and covered with white patches in life, the outer jaw teeth tricuspid (except laterally), a sexually dimorphic chromosome number of $2n=41$ in the male and $2n=42$ in the female, and with a combination of 3-3 mandibular, 4-4 lacrimal, and 7-7 preopercular pores. It was probably derived

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from *Allodontichthys tamazulae* or a common ancestral stock; this genus was assigned to the subfamily Girardinichthyinae by Turner (1946).

MATERIAL. — All specimens were collected in the State of Jalisco, México. Holotype, UMMZ 200221, adult male 48.3 mm SL, from tributary to Río Tuxpan, at hwy bridge, 8 km N Pihuamo, R. R. Miller and J. T. Greenbank, 8 March 1955. Paratopotypes: 14 juveniles to adults, UMMZ 172153, 22–44 mm. Paratypes: 14 adults, UMMZ 172158, 29–61 mm including 2 cleared and stained, from Río Tuxpan at hwy 110 bridge, 4.8 km S of turnoff to Ciudad Guzmán, Miller and Greenbank, same date; 2 juveniles, UMMZ 172165, 18 and 23 mm, from tributary to Río Tamazula, 1 km E La Garita, Miller and Greenbank, same date; 3 adults, UMMZ 189–603, 28–39 mm, from Río Terrero, 0.8 km W of town of 21 de Noviembre (16 km N Pihuamo), Miller and J. M. Fitzsimons, 24–25 Feb. 1970; 45 juveniles to adults, UMMZ 191682, 22–51 mm including 5 cleared and stained and 10 karyotyped, and USNM 220574 (2♂, 2♀, 2 juv.), 23–39 mm, from same locality, Miller and T. M. Cavender, 15 Feb. 1971; and 20 juveniles to adults, UMMZ 198841, 21–49 mm, from same locality, R. R. and F. H. Miller and D. I. Lyons, 18 Feb. 1976.

DESCRIPTION. — Body form and coloration of the adult male and female are shown in Figure 1. Proportional measurements appear in Table 1. Methods of counting and measuring are those used by Mil-

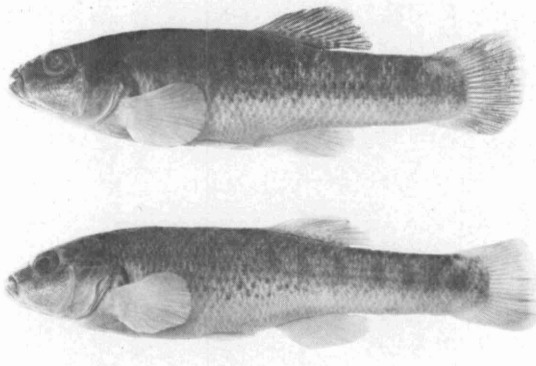


Figure 1. *Allodontichthys hubbsi*, new species. Above, male holotype, UMMZ 200221, 48.3 mm SL; below, female paratype, UMMZ 172158, 50.9 mm SL.

TABLE 1
 PROPORTIONAL MEASUREMENTS OF *ALLODONTICHTHYS HUBBSI* IN THOUSANDTHS OF STANDARD LENGTH.
 BASED ON UMMZ 172153, 172158, 191682, 200221. HOLOTYPE INCLUDED WITH MALES.

Measurement	Holo- type ♂	8 Males			8 Females		
		Range	Average	Range	Average	Range	Average
Standard length, mm	48.3	28.8-51.8	39.6	28.0-50.9		38.4	
Predorsal length	563	554-575	565	566-599		578	
Prepelvic length	455	437-457	448	446-485		467	
Anal origin to caudal base	453	437-461	452	397-442		427	
Body, depth	275	260-275	266	243-298		264	
Width	180	164-188	174	169-206		183	
Head, length	294	281-297	290	261-290		280	
Depth	211	197-211	202	179-200		189	
Width	197	174-205	190	185-206		195	
Caudal peduncle, length	302	292-316	303	283-308		293	
Depth	157	142-157	150	130-149		140	
Interorbital, bony width	89	83-91	86	79-88		83	
Preorbital width	50	42-55	48	42-48		45	
Postorbital length	130	129-135	131	116-131		125	
Snout length	104	90-104	95	85-96		90	

TABLE 1 continued

Measurement	Holo- type ♂	8 Males		8 Females	
		Range	Average	Range	Average
Orbit length	68	64-80	71	61-79	68
Mouth width	104	90-104	99	90-98	94
Mandible length	79	72-84	77	63-77	71
Dorsal fin, basal length	180	160-186	172	154-169	161
Depressed length	288	267-297	283	235-273	253
Anal fin, basal length	151	144-162	152	115-145	131
Depressed length	251	233-259	244	198-227	213
Middle caudal rays, length	199	191-217	202	187-207	196
Pectoral length	197	197-211	203	179-200	189
Pelvic length	126	126-131	128	120-134	127

ler (1948:9–13); the rudimentary, anteriormost anal ray of the male (visible in cleared and stained material or on radiographs) is included in the anal-ray counts, and the last two closely approximated rays of both dorsal and anal fins are counted as one ray.

Body elongate and terete anteriorly, laterally compressed posteriorly, the origin of the dorsal fin before the middle of the body length (more anterior in male than female) and in advance of, to nearly over, the anal-fin origin.

Dorsal rays: 14 (17), 15 (17), 16 (2), the first 1 to 3 rays variably unbranched; anal rays: 14 (6), 15 (10), 16 (16), 17 (4), usually 16 in males, the first 7 that are set off from the posterior ones unbranched in males, 1 to 5 of the anterior rays variably unbranched in females; pectoral rays (both fins counted): 16 (16), 17 (46), 18 (10), the uppermost splint excluded from the count; pelvic rays (both fins counted): invariably 6 (66); principal caudal rays: 20 (5), 21 (15), 22 (14), 23 (2). Scale counts, except for those in lateral series, are best estimates, as scales are frequently regenerated (perhaps because of rigorous habitat — see below). Lateral series: 40 (3), 41 (8), 42 (14), 43 (1), 44 (3), 45 (1); between dorsal- and anal-fin origins: 15 (6), 16 (13), 17 (10), 18 (1); predorsal scales (very irregular): 28 (2), 29 (9), 30 (13), 31 (4), 32 (1), 33 (1); around caudal peduncle: 20 (9), 21 (20), 22 (1); around body: 38 (1), 40 (13), 41 (3), 42 (9), 44 (2), 46 (2). The holotype has dorsal ii,12, anal vii,8, pectorals 17–17, pelvics, 6–6, caudal, 22, 41 lateral scales, 17 from dorsal to anal, 30 predorsal, 21 around peduncle, and about 40 around body.

Vertebral counts (including hypural complex as one), taken from radiographs, are: 34 (5), 35 (26), 36 (10), 37 (3), from three different localities; the holotype has 34. This is a moderate number which, for living species of goodeids, varies from 29 to 42 (including unpublished data). Branchiostegal rays number 4 in 15 specimens.

The total number of gill rakers on the first arch (all rudiments included) number: 18 (1), 19 (2), 21 (2), 22 (6), 23 (9), 24 (5), 25 (3), 26 (1), 27 (1); the holotype has 26.

The sensory pores and canals of the lateral-line system on the head show little variation (both sides counted): mandibular, 3–3 (27), 3–4 (2), 4–4 (1); lacrimal, 4–4 (30); preopercular, 7–7 (29), 7–8 (1). The holotype has the typical counts. The arrangement of pores and canals on top of the head is consistently of Type II, as described by Gosline (1949), in which the supraorbital canal is discontinuous between pores

2a and 2b. This condition is typical of the other species of *Allodontichthys*, but they have 4–4 mandibular pores.

The jaw teeth of the gently curved outer row are usually strongly tricuspid except at each margin, where 1 or 2 teeth may be weakly tricuspid or only shouldered (Fig. 2); the prominent central cusp is

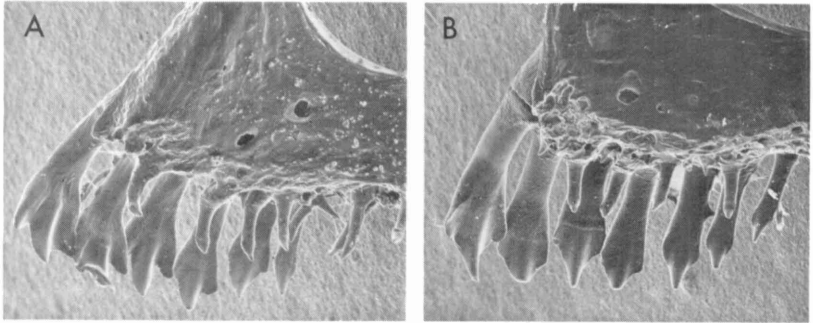


Figure 2. SEM photographs of teeth on right premaxilla, posterior view, x 45. A, *Allodontichthys hubbsi*, UMMZ 191682; B, *Allodontichthys tamazulae*, UMMZ 172159; from cleared and stained specimens taken from Río Terrero.

long and either spatulate or pointed, and the lateral cusps are small and sharply pointed. The teeth are strongly recurved. The number of teeth in the outer row of the upper jaw varies from 9 to 14 in specimens 28 to 60 mm SL. There is an irregularly-arranged band of small, conic, recurved teeth lying behind the outer row in both jaws.

The structure of the single, median ovary is entire (Hubbs and Turner, 1939: Table II), with a septum attached dorsally and ventrally. This septum is neither folded nor branched. The trophotaeniae (Fig. 3), drawn from embryos about 10 mm in total length, are flattened and ribbon-shaped. They are attached to the perianal lip along the anterior margin, sides, and/or posterior margin. Sometimes trophotaeniae are lacking along the anterior margin but are short and narrow when present. Those along the sides are wide, long, and branched, and often extend to the caudal fin. Trophotaeniae may also be lacking along the posterior margin of the perianal lip. The number of termini ranges from 6 to 10.

KARYOLOGY. — In a recently completed survey of chromosome num-

ber and morphology in the Goodeidae (Uyeno, Miller, and Fitzsimons, MS), all species but *A. hubbsi* lacked detectable sexual dimorphism in

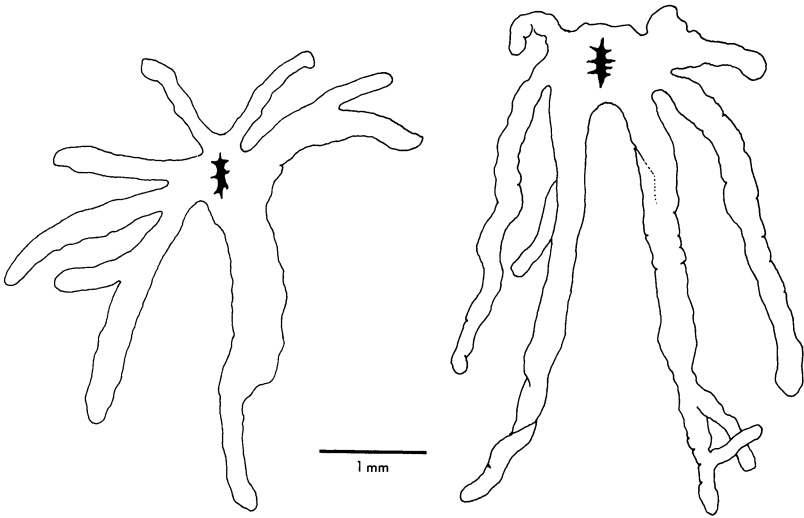


Figure 3. Trophotaeniae from embryos of *Allodontichthys hubbsi*, UMMZ 172158.

the karyotype. The new species has multiple sex chromosomes (Uyeno and Miller, 1972), with a diploid number of 41 in the male and 42 in the female (Fig. 4). The material used was gill epithelium, involving 60 cells from four females and 60 cells from five males. The male has 7 large metacentrics, 2 small metacentrics, 2 small submetacentrics or subtelocentrics, 2 medium-sized subtelocentrics, and 28 acrocentrics of medium to small size. The female has 6 large metacentrics, 2 small metacentrics, 2 small submetacentrics or subtelocentrics, 2 medium-sized subtelocentrics, and 30 acrocentrics of medium to small size. Thus the male has 1 more large metacentric chromosome and 2 fewer acrocentric chromosomes than the female.

COLORATION AND DIMORPHISM. — In preservative (ethanol), the dorsal fin of males has 3 to 5 irregular rows of dark spots, often strongly developed, that extend from near the base to well out onto the fin. The other fins are clear. There are as many as 9 to 11 bars on the upper half of the body that are broad and distinct posteriorly but become narrow and irregular in advance of the dorsal fin; they are

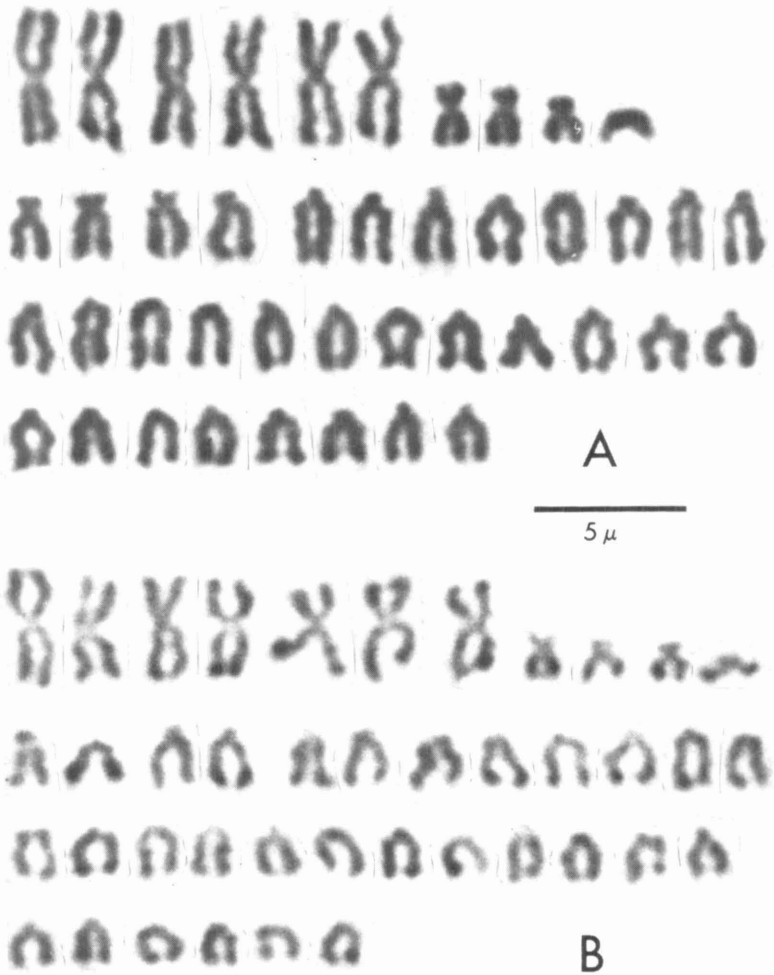


Figure 4. Karyotypes of *Allodontichthys hubbsi*. A, female, $2n=42$; B, male, $2n=41$. (From Uyeno and Miller, 1972.)

more conspicuous in smaller males. The bars are often disrupted between back and midside to form lateral spots or blotches, especially in smaller males; in these specimens the back has a strongly mottled appearance. Barring is often indistinct in larger males (Fig. 1). Females have from 1 to 3 irregular rows of dark spots, generally along the lower half of the dorsal fin, that are usually less conspicuous than

those in the male. The other fins are clear except that one fish shows a few, weak dark dashes on the interradiial membranes of the caudal fin near its midbase. There are 5 to 8 irregular bars, blotches, or spots along the midside, from caudal base to about dorsal origin, that are generally discontinuous with the irregular barring and spotting on the back. In smaller females and juveniles there is a tendency for the spots along the midside to coalesce into a lateral stripe.

In both sexes there are narrow to broad dark crescents outlining the posterior margins of the scales along the upper sides, most prominent in males. Near the midside and slightly below, dark pigment tends to be centered on the scales to form irregular longitudinal rows of spots (Fig. 1). The lower sides and venter are light. A prominent, dark, scapular bar or blotch, often crescent-shaped, occurs above and just behind the base of the pectoral fin in both sexes. In life, no bright colors were noted. The species may be most readily distinguished from its closest relative, *Allodontichthys tamazulae*, by the coloration of the back which in *A. hubbsi* is strongly mottled and has iridescent white patches, whereas in *A. tamazulae* it is strongly speckled (pepper-like) and lacks patches.

The sexes are not sharply dimorphic except for the anal fin. The male has the dorsal and anal fins farther forward, the pelvic fins more anterior, a greater distance between anal origin and caudal base, a somewhat longer head and postorbital, the caudal peduncle deeper, a greater length of the depressed dorsal and anal fins and of their bases, and a somewhat longer pectoral fin (Table 1).

SWIMBLADDER AND OTOLITH. — As expected from their bottom-dwelling behavior (see next section), the swimbladders of *Allodontichthys hubbsi* and *A. tamazulae* are considerably smaller than that of the broad-mouthed *Ilyodon* at Río Terrero, where all three species are syntopic. Examination was made of two freshly-killed individuals of each species, as follows: *A. hubbsi*, male 39.7 mm SL, female 34.5 mm; *A. tamazulae*, male 41 mm, male 47 mm; and *Ilyodon xantusi*, male 59 mm, and male 40 mm. In *Ilyodon* the anterior end of the swimbladder extends to the first rib (attached to the second vertebra), whereas in the two species of *Allodontichthys* it extends only to between the fourth and fifth ribs.

Goodeid otoliths have not been described before. Comparison was made between the sagitta of *A. hubbsi* and *A. tamazulae*, based on the

same specimens used in studying the swimbladders. We follow Morrow (1979) in otolith nomenclature. In *A. hubbsi* (Fig. 5A) the sulcus (central groove) is almost straight; the excisural notch is weak or absent; the excisura minor and the collum are absent; and the crista superior is moderately elevated to form a rather narrow but prominent ridge with its dorsal wall deeply undercut. *Allodontichthys tamazulae* (Fig. 5B) differs from *A. hubbsi* in having the excisural notch well developed, the posterodorsal margin round rather than nearly straight, and the crista superior strongly elevated to form a much broader ridge that is more strongly undercut.

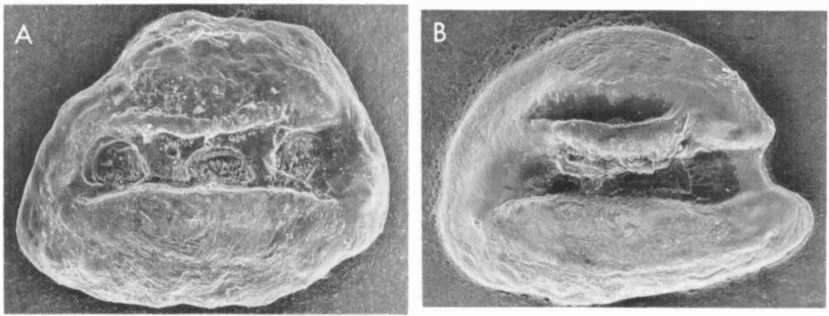


Figure 5. SEM photographs of mesial view of left otolith. A, *Allodontichthys hubbsi*, x 38, and B, *A. tamazulae*, x 40. Both are from Río Terrero.

HABITAT. — The new species has been taken at four stations within the Río Tuxpan drainage, the upper part of the Río Coahuayana basin which enters the Pacific Ocean along the Colima-Michoacán boundary. In recent years this fish has been found at only one of these stations, Río Terrero, but it may also still occur at the type locality, only 8 km distant. It lives in a very specialized habitat, among and under the stones and boulders of rocky riffles, in streams generally 3 to 8 m wide (but up to 30 m in Río Tuxpan, where it was scarce) that have abundant green algae on the rocks and along the stream margins and often riparian trees (including *Salix*) shading part of the habitat. At Río Terrero, the long rocky riffles (Fig. 6) are separated by pools up to 8 x 20 m in major dimensions. The current was moderate to fairly swift during dry-season visits but no doubt becomes torrential at times during the wet summer months. The water was clear but quite easily muddied because of the silt amongst



Figure 6. Habitat at Río Terrero of *Allodontichthys hubbsi* and *A. tamazulae*. Photographed 15 February 1971.

the rocks and boulders. Water temperatures on several visits to Río Terrero and to the type locality varied from 18 to 22°C with air temperatures generally higher (24 to 28°). Method of capture, similar to that used for collecting North American sculpins or darters, involved setting a small seine with rocks holding down the lead-line, and kicking strenuously through about a 3-meter section of the riffle so as to dislodge loose rocks and boulders and drive the fish into the net, which was then lifted by the person holding it. Generally the riffles at Río Terrero were 1–2 m wide, but some were 3 m. Depth of water varied from about 2.5 to 15 cm. Considerable effort was required to obtain even small numbers of this fish, which suggests that it is sparsely distributed in its riffle habitat.

Observations at Río Terrero and in aquaria in Ann Arbor by Dolores I. Kingston indicate that this species is solitary and that adults are very aggressive; males will kill each other and females if confined to small aquaria. Juveniles, observed on riffles at Río Terrero, had a peculiar mode of swimming that resembled a slow-moving tadpole; they hugged the bottom, hovering close to rock surfaces. Adults were

not seen and may not venture far from rock cover much of the time. The mode of swimming of the sympatric *Allodontichthys tamazulae* shows a darter-like behavior, with short dashes between rocks. In both species, newborn are negatively buoyant at birth, evidently an adaptation for the riffle habitat.

COMPARISONS. — The new species is most closely related to *Allodontichthys tamazulae* which it resembles in general body form and coloration, position and size of fins, vertebral number (33–36 in other species of *Allodontichthys*), branchiostegal-ray number (4 in both), acoustico-lateralis system (differing only in having 3–3 vs 4–4 mandibular pores), and habitat predilections. The two species are commonly syntopic in the Río Tuxpan basin, whereas the other described species, *A. zonistius* (Hubbs), is allopatric, occurring to the west in the Río Armería basin. The karyotypes of both *Allodontichthys tamazulae* and *A. zonistius* (Uyeno, Miller, and Fitzsimons, MS), $2n=48$, are characterised by 2 small metacentrics, 2 submetacentrics, and 44 acrocentrics. Although the karyotype of *A. hubbsi* is unique in the family, it can readily be derived from that of the other species of *Allodontichthys* by a pericentric inversion that involved one pair of submetacentric or subtelocentric chromosomes, and 6 (♀) or 7 (♂) Robertsonian fusions that involved 12 (♀) or 14 (♂) acrocentric chromosomes. These chromosomal rearrangements might have played an important role in the speciation of this new species by acting as a cytogenetic isolating mechanism that maintains species integrity. Additionally, although the outer jaw teeth of the other species of *Allodontichthys* are typically conic rather than tricuspid, they are strongly shouldered as are those at the lateral margins of each jaw in *A. hubbsi* and they even may approach the tricuspid condition seen in the new species (Fig. 2B). Thus the tricuspid teeth are believed to be derived from the shouldered, pointed teeth of *A. tamazulae* or its precursor.

ASSOCIATES. — Eight species in four families have been taken with the new species. Characidae: *Astyanax fasciatus*; Cyprinidae: *Algansea aphaenea*; Goodeidae: *Xenotoca eiseni*, *X. melanosoma*, *Allodontichthys tamazulae*, *Ilyodon furcidens*, and *I. xantusi*; and Gobiidae: *Sicydium multipunctatum*. At Río Terrero, the only species syntopic with *Allodontichthys hubbsi* are *A. tamazulae* and *Ilyodon furcidens* (the

narrow-mouthed morphotype), as determined from surface observations, snorkling, and seining.

ETYMOLOGY. — This species is named for the late Carl L. Hubbs whose early studies on goodeids set the stage for subsequent understanding of this compact but highly diversified family.

ACKNOWLEDGMENTS

The following made important contributions to the completion of this paper. Dolores I. Kingston provided observations on live fish in field and laboratory. The SEM photographs of teeth and otoliths were taken by Michael Leonard Smith who also read the manuscript. Figure 1 was prepared by W. L. Brudon. Field work was supported by the Horace H. Rackham School of Graduate Studies and by National Science Foundation grants to R. R. Miller, most recently NSF BMS72-02378. Permission to collect in México was kindly granted by the Dirección General de Regiones Pesqueras.

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