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Two New Species of Fishes of the Genus *Gambusia* (Poeciliidae) from Northeastern Mexico

W. L. MINCKLEY

Gambusia longispinis, a species restricted to the semi-isolated, intermontane basin surrounding Cuatro Ciénegas, Coahuila, México, and *Gambusia marshi*, which is found more or less throughout the Río Salado basin of northern México, are described. The former species is a member

of the *G. nobilis* species group of Texas and northern México, whereas the latter belong to the subgenus *Heterophallina* that is found more to the south. *Gambusia marshi* appears somewhat differentiated in certain isolated waters of the Cuatro Ciénegas area and may represent a complex.

IN the late 1930's, E. G. Marsh, Jr. made extensive collections of animals and plants from northeastern México in the basin of the Río Salado and elsewhere. Of this material, the fishes were deposited at the University of Michigan Museum of Zoology, where they were identified by Carl L. Hubbs; however, descriptions of the species were delayed at that time. Further collections in the Río Salado system, by L. V. Guerra in 1951, and by myself and others in 1958, 1960, and 1961, have provided a large amount of material from the area, particularly from the semi-isolated, intermontane basin that encloses the town of Cuatro Ciénegas in central Coahuila.

The fishes of the Cuatro Ciénegas area present many problems of great zoogeographic and evolutionary interest, and are now being studied by Carl L. Hubbs, Robert R. Miller, and myself. The following descriptions are presented now to facilitate later publication. Of the 2 gambusias described here, 1 appears endemic to the Cuatro Ciénegas basin; the other species, however, is widespread in the Río Salado system, and may represent a complex. Accordingly, the description of the latter form is based on material from 1 locality, to circumvent possible taxonomic complications when the problems are fully analyzed.

Counts and measurements were made as outlined by Hubbs and Lagler (1958), and all measurements were made with dividers over the contour of the body. Terminology of the elements of the gonopodium and of

the gonopodial suspensorium of males follows that of Hubbs and Springer (1957).

Gambusia longispinis, sp. nov.

Figs. 1-3

Material.—The 97 extant specimens are from five localities within the Cuatro Ciénegas basin. All are deposited at the University of Michigan Museum of Zoology.

The holotype, an adult male 20.4 mm in standard length, was collected from a small marsh adjacent to the La Angostura Canal, ca. 4 miles S, 6 miles W of Cuatro Ciénegas, Coahuila (UMMZ 179620). It was taken by seine on 8 April 1961, by R. R. Miller, Carl L. Hubbs, G. H. Miller, W. L. Minckley, and J. Lugo, Jr.

Paratypes are as follows: UMMZ 130382, 50 specimens, collected by Marsh on 15 August 1939, ca. 4 miles SSW Cuatro Ciénegas (field No. XV);³ UMMZ 130393-130394, 20 specimens, collected by Marsh on 17 August 1939, ca. 3 miles SW Cuatro Ciénegas (field No. XVI); UMMZ 179619, 3 specimens, taken by R. R. Miller, Hubbs, and Minckley, 6 April 1961, from Puente Colorado, 6 to 7 miles S Cuatro Ciénegas; UMMZ 179621, 15 specimens, collected with the holotype; and UMMZ 179622, 6 specimens, collected by R. R. Miller, Hubbs, and Minckley, 10 April 1961, from Puente Chiquito, 4.2 miles S Cuatro Ciénegas.

Diagnosis.—A small, delicate, but thick-bodied *Gambusia*, allied to the *G. nobilis* group by the distal spines of the third ray of the modified anal fin of the male (gono-

¹ Contribution No. 57 (New Series) from the Department of Biology, University of Louisville, Louisville 8, Kentucky.

² I wish to thank Drs. Robert R. Miller, Carl L. Hubbs, and Louis A. Krumholz for reading and criticizing the manuscript. My field expenses in México were defrayed by a Sigma Xi-RESA research grant.

³ Unfortunately, the notes pertaining to collections XV and XVI that were made by E. G. Marsh, Jr., were lost in México (personal communication, April 1961). The locality data for UMMZ 130382, 130393, and 130394 were estimated from notations made by Marsh on a map that was in the possession of Hubbs and is now at the University of Michigan Museum of Zoology.

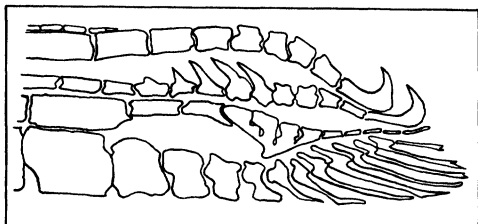


Fig. 1. Distal tip of the gonopodium of a paratype of *Gambusia longispinis* from UMMZ 130382. This illustration, and those in Figs. 3-5, were prepared by use of a camera lucida.

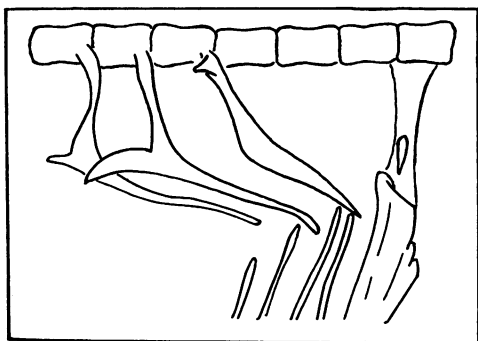


Fig. 3. Gonopodial suspensorium of a paratype of *Gambusia longispinis* from UMMZ 130382.

podium) projecting greatly beyond the terminal hook of the fourth ray, and by having the largest segment of the third ray (including its elongate spine) greater in the width than the combined length of the bases of all spine-bearing segments (Hubbs, 1927:1; Hubbs and Springer, 1957:279). The species is differentiated from other known members of the *nobilis* species group by the size of the terminal hooks on the distal ends of rays 4p and 5a, and by the combination of 7 to 8 (typically 8) dorsal fin rays, the extension of the tip of ray 4a of the gonopodium beyond the tip of ray 4p (Fig. 1), and the presence of a broad, dark, lateral stripe in life.

Description.—Counts of fin rays: dorsal typically 8 (sometimes 7, rarely 9), anal 9 (rarely 8 or 10), pectorals 13 (12 to 14), and pelvics 6. There are 30 to 31 (rarely 29 or 32) scales in the lateral series, and 15 to 17 scales before the dorsal fin.

The body is thick. The predorsal region is gently rounded from a point just anterior

to the origin of the dorsal fin to the tip of the snout, especially in the females (Fig. 2b). This slope of the anterior part of the body appears indicative of a midwater rather than a surface habit, and this was borne out in observation of specimens held in aquaria. The mouth is wide and directed somewhat forward and dorsally. The eye is located in the upper three-fourths of the head, and in the anterior half; the postorbital length is only slightly less than the distance from the back of the orbit to the tip of the snout.

The fins are supported by delicate rays, and are generally rounded. The dorsal fin of the male is somewhat more square than that of the female; its depressed length is slightly less than the length of the head. The depressed dorsal fin in females enters the head length 1.2 to 1.4 times. The caudal fin is expanded dorsoventrally and rounded. The pelvic fins are small, reaching to near the base of the gonopodium in males, but only to the anus in females. The pelvic fins are adnate to the belly, totally or in part, along their inner margins. The pectoral fins of the male are slightly modified on their leading edges, apparently as a specialization for copulatory function as is variously developed in other species of the genus (Hubbs, 1957; Hubbs and Reynolds, 1957; Rosen and Tucker, 1961).

The tip of the modified anal fin of the male bears 8 to 10 spines on the segments of ray 3, and these are generally erect (Fig. 1). The first (proximal) spine is typically almost opposite to the tip of the elbow, or sometimes slightly distal. The anterior branch of the fourth ray bears a relatively massive elbow, made up of 4 (rarely 3) fused

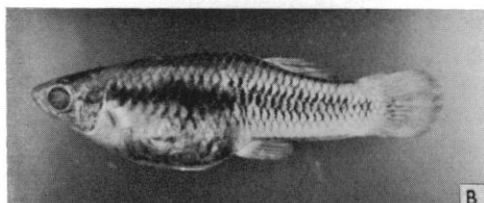
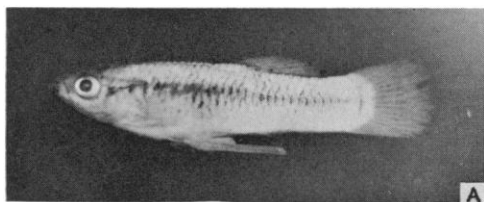


Fig. 2. Holotype of *Gambusia longispinis* (A), and a female paratype from UMMZ 179622.

elements. The elbow is compressed and little recurved. The posterior branch of ray 4 bears 3 to 5 strongly developed, retrorse serrae, and one smaller serra. The most distal serra is approximately opposite the apex of the elbow, or slightly proximal. The terminal hook of ray 4p is long, recurved, and distally rounded to slightly angular. The fifth ray bears an equally large terminal hook, which is rounded, but sometimes truncate, distally. The gonopodial suspensorium (Fig. 3) has 3 gonopophyses (modified haemal spines), all of which are strongly developed. The first is somewhat sigmoid, with its delicate parapophysis bearing a small rib. The second is greatly produced, with a large, spatulate uncinat process that is subhorizontal. This process curves ventrally at its posterior tip. The third gonopophysis is smaller, with a spur-like uncinat process. The ligostyle is an inverted tear-shape, and is embedded in a strong ligament. The compound interhaemal (interhaemals II, III, and IV) is flared dorsally and is firmly attached to the vertebral column by the ligament mentioned previously. The air bladder extends posteriorly almost to the tip of the uncinat process of the third gonopophysis.

The ground color of *G. longispinis* is light yellowish-brown in preserved material, with the margins of the scale pockets outlined to form a cross-hatched appearance on the dorsum and venter. There is a distinct predorsal stripe that is sometimes obscured in dark individuals, but there is no evidence of a postdorsal stripe in most. A thin, discrete, postanal stripe is present.

Notes on the life colors of the large, unusually dark, female shown in Fig. 2b were provided by Carl L. Hubbs as follows: "margins of scale pockets black, intensified behind head to form serrated band on trunk; strong blue and violet reflections on lower sides, chiefly blue on cheeks, opercles, and pectoral bases, violet behind; upper parts olive, lower caudal peduncle amber; eye and muzzle dusky; trace of orange below dark lateral band; vertical fins sooty-gray all over, more dusky at margins."

Color notes were also recorded for a mature male that was preserved from stock in the laboratory. These were taken while observing the fish through a binocular microscope at magnifications of 14 to 60 \times : suborbital, opercle, and prepectoral area

iridescent sky-blue, suffused with yellow; dorsum of body light yellow, with dark outlines on scale pockets; lateral band of intensified dark scale pocket margins, iridescent sky-blue in center of pockets; area below lateral band with much blue, especially on abdomen; venter of caudal peduncle pinkish-yellow, darkest yellow beneath; interradials of dorsal with discrete yellow chromatophores in middle of fin, these also present in interradials of lower third of caudal; anal with pink chromatophores on interradials of posterior 4 rays; dark-gold chromatophores on bases of rays 5, 6, and 7 (also on interradials); shaft of anal fin with melanophores along leading edge, clear at tip.

Name.—The name *longispinis* is from the Latin, meaning long spines, in reference to the strikingly elongated spines of the distal segments of ray 3 of the gonopodium, which are longer than the combined basal length of the spine-bearing segments.

Gambusia marshi, Minckley and Craddock,
*sp. nov.*⁴

Figs. 4, 5a–b, 6a–b

Gambusia patruelis, Garman, 1881:93 (misidentification, specimens from Monclova, Coahuila).

Gambusia gracilis, Garman, 1885:93 (misidentification, specimens from Monclova, Coahuila).

Gambusia affinis, Meek, 1904:130 (exclusive of other synonymy and most range).

Gambusia senilis, Hubbs, 1926:32 (exclusive of most synonymy and range).

Gambusia (Heterophallina) sp., Carl L. Hubbs, in Hubbs and Springer, 1957: 299 (reidentified Garman's records, see above; resurrected from synonymy with *G. senilis*).

Material.—This description is based on the holotype, a mature male 24.2 mm in standard length, collected by Minckley, Craddock, Donald R. Tindall, and Charles B. Stone on 16 August 1960, from the Río Salado de los Nadadores near its junction with the Río Salado de Monclova, 1 mile S of Hermanas, Coahuila (UMMZ 179167), and on 63 paratypes from the same collection (UMMZ 179168). Many additional specimens have been examined in preliminary analyses of

⁴ This description was prepared jointly by W. L. Minckley and James E. Craddock.

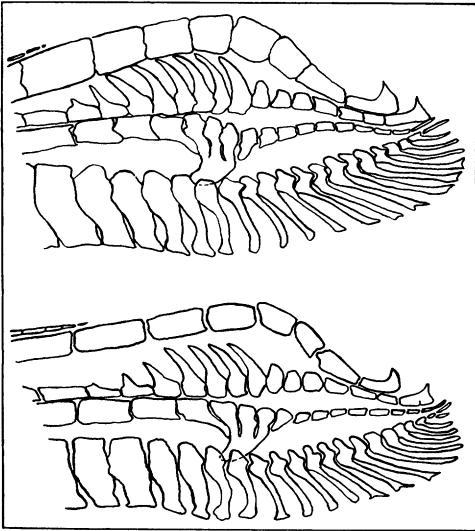


Fig. 4. Distal tips of the gonopodia of 2 paratypes of *Gambusia marshi*.

variation, and these will be listed in a subsequent publication.

Diagnosis.—A large, robust species of the subgenus *Heterophallina* Hubbs (1926:26) of *Gambusia*. The species is markedly differentiated from other known species of that subgenus by its robust configuration, by the most distal serrae on ray 4p of the gonopodium of the male being distal to the middle of the elbow (Fig. 4), by the distal extension of ray 4a of the gonopodium past the tip of ray 4p, and by the highly developed and generally erect distal spines of ray 3 of the gonopodium.

Description.—Counts of fin rays: dorsal 9 (8 to 11), anal 10 (9 to 11), pectorals 13 (12 to 15), and pelvics 6. There are 30 or 31 scales in the lateral series (rarely 32), and 16 to 17 scales anterior to the dorsal fin.

The body is narrow, but relatively deep. The head is large, stepping into the standard length about 3.6 times, and is flattened above, with the mouth directed dorsally. The dorsal contour, anterior to the dorsal fin, assumes a gentle, downward curve to the nape, then bends upward to the snout.

The dorsal fin is far back on the body; predorsal length steps into the standard length about 1.6 times in males and 1.5 times in females. The dorsal fin is rounded, and its depressed length enters the standard length 3.3 times in males and 3.7 times in females. The anal fin is large and rounded

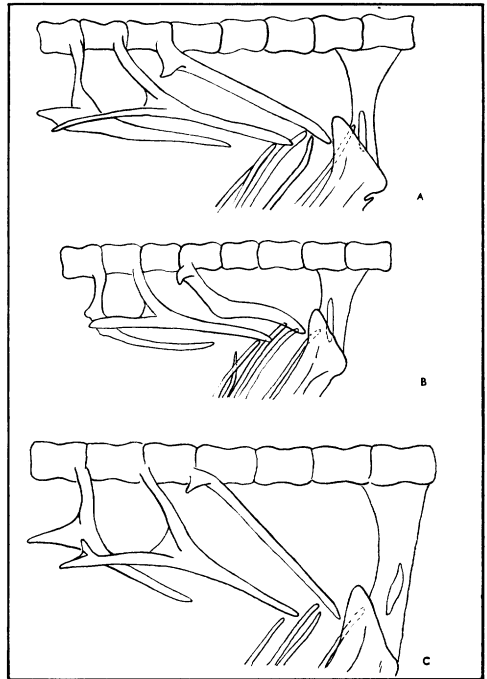


Fig. 5. Gonopodial suspensoria of 2 paratypes of *Gambusia marshi* (A–B), and of a large, sub-adult male from Río Cañon (= Cañon del Agua), 3.3 miles N of Cuatro Ciénegas, Coahuila.

in females; in males it is modified into a gonopodium. The caudal is not excessively expanded dorsoventrally, and is broadly rounded posteriorly. The pectoral fins are short and rounded in females, and are elongate and upcurved at the tips in adult males. The pelvic fins reach to the anus in females, to slightly past the base of the gonopodium in males, and are adnate to the belly along their inner margins.

The gonopodial tip of the male has 12 to 15 spine-bearing segments on ray 3 distal to the tip of the elbow, and two-thirds of these are generally erect. The more distal spines extend past the tips of the other gonopodial rays (Fig. 4). There is an extension of tissue along the spinous area of the gonopodial tip that forms a conspicuous flap in some individuals. Ray 4a includes a large, recurved elbow made up of 2 to 3 fused elements. The terminus of ray 4a exceeds ray 4p in its distal extension. Ray 4p bears 6 to 8 large, strongly recurved serrae, of which the most distal serra is blunt and is typically opposite the distal end of the base of the elbow. The terminal hook of ray 4p

is short and strongly angulate distally. Ray 5a also bears a short, thick terminal hook, which is somewhat less angulate at its distal end.

The gonopodial suspensoria of 2 paratypes were examined. The first gonopophysis is long and slim in 1 specimen, but is somewhat spatulate in the other (Fig. 5a–b). Each bears a rib on its parapophysis. The second gonopophysis is similar in each paratype, with a long, tapering uncinat process and a long, subhorizontal anterior extension. The left uncinat process of the second gonopophysis illustrated in Fig. 5a has a small bifurcation at its tip (not shown). The resultant dorsal process is discussed more fully below. The third gonopophysis is also long and thin anteriorly, and has a thick uncinat process in 1 paratype and a small projection in the other.

Unfortunately, we have but few notes on the life colors of the population of *G. marshi* from Hermanas. In the type series the ground color is yellowish-white in preservative, with a thin, diffuse lateral band passing from the upper edge of the orbit, along the abdomen, and, in most, to the base of the caudal. The abdomen below the lateral band has one-half to 1 scale rows with dark-outlined scale pockets, and the dorsum has the scale pockets generally outlined to give a cross-hatched appearance. The dorsolateral area is irregularly spotted with darker melanophores, which are present on the edges of the scale pockets and sometimes appear linear in arrangement. There are narrow, discrete predorsal and postanal stripes, but the postdorsal area lacks a discrete stripe although it is more heavily pigmented than the rest of the dorsum. There are sometimes 2, often 1, irregular rows of melanophores on the dorsal fin, and on the caudal, but these are obscured in a number of specimens by a scattering of melanophores. The head is darkened above, with the pigments most intense posterior to the eyes. Scattered melanophores are present on the sides of the snout, and the chin is also blackened with pigment that is most intense at the tip. The branchiostegal region and the breast are almost immaculate.

On 4 April 1961, Miller, Hubbs, and Minckley collected a series of *G. marshi* (UMMZ 179618) from the type locality on which the following life colors were noted: "Males with light bar at base of caudal, an

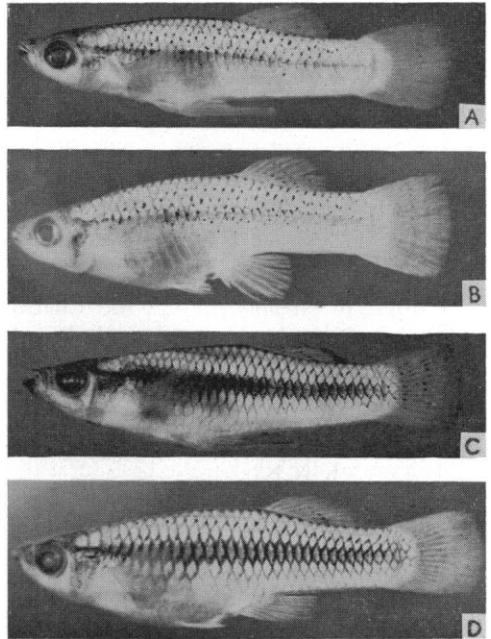


Fig. 6. Holotype of *Gambusia marshi* (A), a female paratype (B), and a male and female of *G. marshi* ("black phase") from El Anteojo, ca. 5 miles W Cuatro Ciénegas, Coahuila (University of Kansas Museum of Natural History, No. 4388).

orange to light yellow area in middle of caudal fin, and a dark terminal bar; dorsal fin slightly orange, tipped with dusky; pelvics orange in some; over-all body steely-blue in lateral aspect, yellowish dorsally, with a dark middorsal stripe."

Variation.—One of the most interesting aspects of variation in this species (or complex) is the presence of a dorsal process on the uncinat process of the second gonopophysis; this forms a bifurcation (Fig. 5c). This is most highly developed in some populations that also show the "black phase" color pattern shown in Fig. 6c–d, and a greater proportion of the black fish are found in Cuatro Ciénegas basin than elsewhere. However, preliminary work also indicates a remarkable lack of constancy of occurrence of the process. It may occur on both sides of the paired uncinat processes, on either the right or left, or may be absent. To our knowledge, this structure has not been recorded previously in the poeciliids, and its significance is unknown.

The greatest variations between populations are in the basic color pattern (see

Fig. 6). Some fish are an over-all brassy-yellow, with extremely dark markings ("black phase"), whereas other populations have extensive dorsolateral spotting ("spotted phase," described here). At some localities, the 2 types appear to occur together in pure stocks; however, at other places the 2-color phases grade into each other. Observations in the field have indicated no gross ecological explanations for these variations, but generally the spotted form is found in streams, and more often in streams outside the Cuatro Ciénegas basin. The black phase is found in springs and marshes inside that basin. Specimens superficially resembling both phases have, however, been collected inside and outside of the basin. Analyses of this problem are under way on the basis of available preserved material and through experimentation with live stocks in the laboratory.

Range.—Specimens referable to this species, or complex, were examined from Río Sabinas de Coahuila, from the mainstream of the Río Salado, and from the Río Salado de los Nadadores and many of its tributaries. Apparently, the species has not been taken from the Río Sabinas de Nuevo Leon. For a map of the Río Salado system see Hubbs and Hubbs (1958:298-9).

Name.—The name *marshi* is in honor of E. G. Marsh, Jr., now of the Gus Engling Wildlife Refuge, Texas, who first discovered the Cuatro Ciénegas area for zoology, and who contributed many specimens of fishes, and other vertebrates, from northern Mexico.

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Courtship Preferences of *Gambusia affinis* Associated with the Sympatry of the Parental Populations

CLARK HUBBS AND EXALTON A. DELCO, JR.

Males of the fish genus *Gambusia* were isolated in observational tanks. Two females were introduced into the tank simultaneously. The males' courtship activities were recorded. Those reared in isolated cultures preferred females of their own species. Males of *G. affinis* populations sympatric

with a related species (*G. geiseri*) were more discriminating in courtship than allopatric males. Males reared in mixed cultures are less discriminating than those reared in isolation, but no interspecific copulations were observed in sympatric stocks reared in mixed cultures.

INTERSPECIFIC isolation mechanisms are well known in animals (Dobzhansky, 1951; Mayr, 1942, etc.). Unfortunately few of the studies have contrasted different populations of a species with regard to their potential

to produce hybrids with related species. Dobzhansky (1940) theorized that it would be selectively advantageous for sympatric populations to reinforce their isolation mechanisms in order to conserve gametes. That