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STUDIES OF THE FISHES OF THE ORDER CYPRINODONTES

VIII. *Gambusia gaigei*, A NEW SPECIES FROM THE RIO GRANDE

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I

IN THE sixth paper of this series (Hubbs, 1926: 21–23, and 32–34), I distinguished, brought together and compared a group of three closely related species of *Gambusia: G. senilis* Girard, of the Sota la Marina, Conchos and Sauz basins of northeastern Mexico; *G. nobilis* (Baird and Girard) of the Pecos drainage basin in Texas and New Mexico; and *G. affinis* (Baird and Girard) of the San Antonio–Guadalupe system in eastern Texas. This species group (section h^1 of my key) is differentiated from other divisions of the subgenus *Gambusia* primarily by gonopodial characters: the distal spines of ray 3 (of the modified male anal fin) are very long, projecting far beyond the hook at tip of ray 4; the largest segment is about equal to the combined basal length of all the spine-bearing segments. Other common characters more or less diagnostic of the *nobilis* group are the development of a diffuse lateral band extending from eye to caudal base, and of dusky or black

markings on the anal fin of the female. The dorsal rays are usually 8, sometimes 7 or 9.

II

When the paper referred to was written, we had available no males of *G. nobilis*, the close relationship of which to *senilis* and *affinis* was hypothecated on the basis of its general agreement with them in form and color, and of its occurrence in a neighboring stream system. This hypothesis is now confirmed by the study of seven male specimens with perfect gonopodia. Two of these, each 17 mm. long, were collected by W. A. and H. J. Clark on January 8, 1927, in canals of the Zimmerman Reservoir near Imperial, north of Fort Stockton, Texas—the water derived from the Pecos River. Three other males, 19 to 25 mm. in standard length, together with four half-grown specimens, were obtained by Charles E. and May D. Burt on July 16, 1928, in a mountain stream one mile and a half northwest of Toyahvale, Texas. Two others, 21 and 22 mm. long, were obtained by the same collectors in an irrigation ditch one mile northwest of Toyahvale, in company with young, and pregnant females as large as 40 mm. to caudal. The gonopodia or intromittent organs (modified anal fins) of these males show the following characters: the third ray is much enlarged; its segments are mostly very long and wide; the terminal joints, about 8, are produced into very long slender spines, as in the other species of the same group; most of these spines are fully erect; the largest are as long as the combined basal length of all the spine-bearing segments, and extend far beyond the terminal hooks of rays 4 and 5; the transverse sutures of the bases of the spine-bearing segments are strongly angulated, but their inner (posterior) edges are not elongated into definite processes. The anterior branch of the fourth ray is rather slender throughout; subdistally it is modified into the usual elbow. The posterior branch of the same ray bears, as does the anterior branch of the fifth, a well-developed terminal hook; its four serrae are developed almost opposite the elbow, as the overlap of the bases of the two structures is decidedly

more than half the total basal length of either. The serrae are but little curved and are usually only slightly directed retrorsely from a position perpendicular to the ray. They are slender and so long that one, with its base, is as long as the basal length of three of the serra-bearing segments.

These males of *G. nobilis* vary in general tone from light to dark. The scale pockets over all the body except the abdomen are edged with blackish brown. The usual black spots on the body are obsolescent in some, in others fairly well developed, especially along the axial series of scales, but they are never conspicuous. There is a very fine axial black streak, surrounded by a slight to strong suffusion of brown; a broad predorsal streak; a dusky to blackish band made up of much broadened scale-pocket margins on the upper edge of caudal peduncle; in some only a bare trace of a black streak, in others a well-developed one, forward from caudal fin along the suffusedly darkened lower edge of the caudal peduncle. There is the usual oblique suborbital bar and usually a dark blotch about the preopercular edge; the lips are pale to dusky, usually little if any darker than the surrounding parts of the muzzle. The vertical fins are all more or less dark, but usually not marked in a definite pattern. The dorsal usually shows a trace of a subbasal row of black spots and of a dark margin, and these markings are sometimes conspicuously developed. The caudal is in some specimens crossed by a single weak row of spots beyond its middle.

The males of *nobilis* show the following proportions: head, 3.6; depth, 3.7 to 4.0; depth of caudal peduncle, 1.55 to 1.65 in head; eye, 3.0; interorbital, 2.35; lateral projection of gape about two thirds of the eye length; exposed premaxillary about one sixth as long as wide. The front of the snout behind the premaxillaries is slightly convex forward, between blunt lateral processes.

III

A fourth species of the *Gambusia nobilis* group may now be indicated, and named **Gambusia gaigei** in honor of the collec-

tor of the type series, F. M. Gaige, curator of insects in the Museum of Zoology. The holotype (Cat. No. 84527, Univ. Mich. Mus. Zool.) and the series of paratypes were netted on August 3, 1928, from a marshy cattail slough fed by springs, located close to the Rio Grande at Boquillas, Brewster County, Texas, opposite the Mexican village of the same name. The holotype is 21.5 mm. long from tip of premaxillaries to base of caudal rays; the other 16 males with perfect or almost perfect gonopodia are 17 to 23 mm. long; the largest of several mature females is 25 mm. long.

Gambusia gaigei differs from *G. senilis* of northeastern Mexico in at least eleven respects:

1. The size is smaller. We have a specimen of *senilis* 37 mm. in standard length, and larger ones have been reported.
2. The muzzle is more blunt.
3. The mouth is more strictly transverse; the lateral projection of the gape is only one half instead of two thirds as long as the eye.
4. The mandible is shorter, somewhat less than instead of decidedly more than one third as long as the head.
5. The upper lip is much narrower, almost concealed when the mouth is tightly closed, and then not nearly one sixth as long as wide.
6. The margins of the scale pockets on the side of the abdomen are obsolescent instead of notably blackened.
7. The dark spots on the body are much larger and blacker.
8. The suffused lateral band is much less distinct, almost obsolescent in females.
9. The dorsal fin is much more definitely marked by a subbasal row of spots and a dark margin.
10. The anal fin of the female is less splashed with black medially but more strongly darkened distally.
11. The lips are more or less blackened.

Whether differences of significance exist in the structure of the gonopodium I cannot say, as I have no males of *senilis* at hand. Regan's figure of the gonopodium of *senilis* (1913: fig. 168E on p. 983) indicates less developed inner (posterior) processes on the spine-bearing segments of ray 3 and does not show the flasklike neck and swelling of the anterior branch of ray 4, a feature characteristic of *gaigei.*

This species is well differentiated from *Gambusia nobilis,* which it approaches closely in general appearance as well as in distribution. It differs from that form in no fewer than sixteen characters:

1. The size is smaller. We have specimens of *nobilis* as long as 40 mm. (standard length).
2. The head is much less flattened, as seen from either the side or the front.
3. The mouth is more nearly transverse. The lateral projection of the gape is about one half instead of at least two thirds as long as the eye.
4. The mandible is shorter, somewhat less instead of distinctly more than one third as long as the head.
5. The upper lip is narrower, almost concealed when the mouth is tightly closed, and then not nearly one sixth as long as wide.
6. The spots on the body are larger, more crescentic, less specklike.
7. The dorsal fin is not merely dusky, but is marked by a subbasal row of spots and a more definite dark margin (some males of *nobilis* have the dorsal about as distinctly marked as in *gaigei*).
8. The black blotch surrounding the anus and anal fin is restricted to the anus.
9. The orange area on the anal fin is not confined to a definite basal bar, but is diffused into the less darkened medial part of the fin, with which the darkened border forms a sharper contrast.

10. The lips, instead of being pale, or at least not much darker than the rest of the muzzle, are more or less sharply blackened.
11. The gonopodium is less blackened.
12. The lobe composed of the spines of ray 3 of the gonopodium is usually more sharply set off (by a notch) from the more proximal portion of the ray.
13. The internal (posterior) angles of the spine-bearing segments of ray 3 are much more produced, forming definite retrorse processes.
14. The anterior branch of ray 4 is strongly bottle-shaped below the elbow, instead of being but slightly swollen.
15. The serrae of the posterior branch of ray 4 extend outward to a point barely opposite the basal part of the elbow, instead of largely overlapping that structure.
16. The serrae are usually shorter and more retrorse.

On comparing *Gambusia gaigei* with *G. affinis* (the true *affinis*, of the San Antonio–Guadalupe river system of Texas, not the species usually so named), I find seventeen apparent differences:

1. It is apparently slightly smaller. The largest specimen at hand is 25 rather than 31 mm.
2. The body is more robust. The least depth of the caudal peduncle is decidedly more than half as great as the length of the head.
3. The mandible is much weaker; its rami less elevated; the tip less truncate, and less produced; the length of muzzle from eye is little more than one fourth, instead of about one third, as long as the head.
4. The upper lip is much narrower, about one eighth instead of about one fourth or one fifth as long as wide.
5. The dorsal fin is inserted more posteriorly, in the female 1.7 to 1.9, instead of 1.55 to 1.7, times as far from tip of snout as from base of caudal.
6. The black spots on the body are larger and more crescentic or wedge-shaped.

7. The conspicuous row of spots on the dorsal fin is subbasal, not median.
8. The dorsal fin is more or less conspicuously black-edged.
9. The anal fin of the female is more strongly darkened distally.
10. The caudal fin lacks the black spots usually shown by *affinis*.
11. The predorsal, axial and postanal streaks are very much fainter, often obsolescent.
12. The suborbital bar is fairly well developed in both sexes, while in *affinis* it is rudimentary in males and absent in females.
13. The lobe composed of the upright spines of ray 3 of the gonopodium has a convex rather than a concave border.
14. The same lobe is generally set off from the rest of ray 3 by a slight notch, not evident in *affinis*.
15. The internal (posterior) angles of the spine-bearing segments of ray 3 are much more produced, forming definite retrorse processes.
16. The anterior branch of ray 4 of the gonopodium is bottle-shaped below the elbow, and not uniformly slender.
17. The serrae of ray 4 overlap the elbow, instead of being separated from it by a distinct interval. In this respect *affinis* stands alone in the subgenus, a fact which should have been indicated in the diagnosis of the group (section g^1) in my 1926 key, p. 22. Geiser's figures of gonopodia of *G. affinis* (1923, fig. 15–18 on p. 188), identified by him as "*Gambusia senilis* (*nobilis*)," do not completely confirm this nor the other gonopodial distinctions here pointed out, although his specimens came from the same locality as ours (San Marcos, Texas). Our ten males with perfect gonopodia, nevertheless, uniformly show all of these distinctions.

IV

Having differentiated *Gambusia gaigei* from its nearest relatives, I offer now a description of the species. The measurements or counts first given are those of the holotype (21.5 mm. long from tip of snout to base of caudal); those given in parentheses are first of male paratypes, 17 to 23 mm. in standard length, and second of female paratypes, 16 to 25 mm. long. The two sets of values for the paratypes are separated by a semicolon.

The body axis is less angulated than in most species of *Gambusia,* suggesting a more strictly mid-water swimming habit. The dorsal contour rises from the tip of the premaxillaries—opposite upper edge of pupil—in a rather even curve, in some cases somewhat depressed at the occiput, toward the front of the dorsal fin. The profile becomes approximately horizontal about half the length of the head before the dorsal, then moderately oblique along the dorsal base and again nearly horizontal on the caudal peduncle. The lower edge of the deep caudal peduncle is also nearly straight and the least depth of the body remains at its narrowest considerably more than half as great as the head length. The ventral contour in all specimens other than heavily pregnant females is rather evenly arched from the mouth to the end of the anal base. The greatest depth of the body is contained 3.6 (3.4 to 3.75; 3.0 to 3.75) times in the standard length.

The head is not very long, as its length is contained 4.0 (3.5 to 4.1; 3.5 to 3.8) times in length to caudal, but it is deep (the depth below occiput is a pupil's length longer than distance from tip of snout to hind edge of orbit). The contours of the head are rather swollen; the profile and the interorbital are both distinctly (though not strongly) convex. The greatest width of the head is just equal to the combined length of snout and orbit; the least interorbital width enters the head 2.35 (2.3 to 2.6; 2.0 to 2.4) times, and is usually greater in females than in males. The length of the round eye about equals that of the snout, is about two thirds the least interorbital width and is contained 3.2 (3.0 to 3.4) times in head.

The mouth is moderately wide, but chiefly transverse; the lateral projection of the gape is only half as long as the eye. The front of the snout behind the premaxillaries is a straight line between the two bony lateral projections. The premaxillaries fit so tightly within the rostral fold that the length of the upper lip is not more than one eighth its width when the mouth is tightly closed. The mandible is, for a *Gambusia,* relatively weak, little projecting, rather thin and not greatly elevated within the mouth, somewhat less than one third as long as the head; it is strongly oblique and its margin as seen from below is wider than a semicircle.

Scales in 29 (29 to 31) series. Each scale has a conspicuous round focus considerably apicad from the center in the adult, and entirely exposed beyond the overlapping scale in front. The first ridges are concentric about the focus; the latter ones tend to follow the altered scale margin. The adult scale has horizontal upper and lower edges, each about two thirds as long as the height of the scale. The anterior border of the scale is slightly bowed, the posterior edge rather strongly arched, especially medially. The radii are strong, radiating, about twelve.

Dorsal rays 8 (7 to 9); anal, 10—counting rudiments and calculating the last ray as a divided one. The dorsal is posteriorly inserted, as its origin lies over the posterior third or the end of the anal base (in females), 1.5 (1.4 to 1.6) times as distant from tip of snout as from end of hypural in males, 1.7 to 1.9 times as distant in females. The depressed length of the dorsal enters the head 1.2 (1.0 to 1.25; 1.25 to 1.4) times). The caudal fin is subtruncate; 1.2 (1.15 to 1.4; 1.25 to 1.4). The pectoral extends in the males to above the middle of the anal base, in females beyond front of the pelvics but not to the anus; length, 1.2 (1.2 to 1.6; 1.25 to 1.6). The small pelvic fin extends to the origin of the anal in the males, to the anus in the females.

The gonopodium, the anal fin of the male modified as an intromittent organ, is about one third as long as the fish (2.8 to 3.2 in standard length). The third ray is much enlarged,

with very long and wide segments; its terminal joints are produced into very long and slender spines, mostly erect, the largest as long as the combined basal length of all the spine-bearing segments. The lobe formed by these spines is set off from the rest of the ray by a slight notch, has a convex border and extends far beyond the well-developed terminal hooks of rays 4 and 5. The inner or posterior angles of the spine-bearing segments are extended into definite retrorse processes somewhat resembling the spines themselves. The anterior branch of the fourth ray is slender below the usual elbow, then abruptly dilated like a bottle below its neck. The serrae of the posterior branch of ray 4 are short, not longer than the basal length of two serra-bearing articulations, and strongly retrorse; the distalmost serra only is opposite the proximal part of the elbow.

Gambusia gaigei is a brightly colored species and might make a very attractive aquarium fish. When fairly fresh in alcohol, the specimens were described as follows. The males are largely olive golden, with rather indefinite orange streaks along the scale rows. The margins of the scale pockets are dark brown, becoming narrower and fading out toward the belly, but intensified here and there on the sides to form irregular inky black wedges or crescents, which doubtless represent the smaller rounder spots of other species of *Gambusia*. The streaks on the body are not conspicuous: the predorsal one is merely dusky; the one on the upper edge of the caudal peduncle is absent or represented only by darkened scale borders; the axial streak is so narrow or so weak as to be inconspicuous and incomplete (it is surrounded by a rather weak suffusion of brown); the postanal streak is weak (absent to moderately developed). The anus is black, but the surrounding region is pale. The dorsal fin is greenish golden along its base, below a subbasal row of blackish spots, thence orange-red to the blackened margin. The caudal fin is bright golden basally, becoming somewhat dusky toward its edges, and black in a very fine streak along its extreme upper and lower edges. The gonopodium (male anal) is orange at its base, otherwise

whitish with few pigment cells. The top of the head is olive-blackish. The lips are blackish or dusky. There is some orange on the snout. The suborbital bar is black, always well developed.

Females are somewhat plainer in color. Their anal fins, however, are largely orange; this color is brightest basally, but is not confined to a definite basal band as in *G. nobilis*; the fin has a considerable amount of black pigment medially, and it becomes black toward its tip. The suborbital bar in the females is evident at least as a rudiment, and is often well developed.

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