Xiphophorus gordoni, A New Species of Platyfish from Coahuila, México

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Xiphophorus gordoni, the third new species of this genus to be made known since 1959, is described and figured from the arid, semi-isolated Cuatro Ciénegas basin of central Coahuila, México. It is based on meristic, morphometric, and osteological data—and observations of living material in the field and laboratory—involving more than 200 individuals. The new species is related to X. *couchianus*, from the vicinity of Monterrey, and to X. *variatus xiphidium*, from the basin of the Río Soto la Marina—possibly more intimately to the latter. X. *gordoni* is known only from a single body of water, of which a photograph is presented. It is one of a number of fishes endemic to the Cuatro Ciénegas basin.

Although platyfishes and swordtails have been studied and collected intensively in Middle America since 1930 by Myron Gordon and his associates and successors, and their distribution, genetics, cytology, endocrinology, embryology, and behavior are better known *in toto* than that of any other natural group of fishes, the number of known species continues to rise. In March 1957, R. R. and M. Miller collected two new species in well-traveled parts of Oaxaca and Veracruz that were subsequently described by Alvarez (1959:69–71) and by Rosen (1960:89–92, Figs. 8–9). In April 1961, a third undescribed species was discovered during our exploration with Carl L. Hubbs of the semi-isolated, intermontane Cuatro Ciénegas basin of central Coahuila, México. Thus, in the span of only four years, the number of known species of *Xiphophorus* has been increased by 50 per cent. Whether such an increase will continue to occur through discovery of additional species in the near future is problematical.

This new species is one of a number of endemic fishes restricted to the Cuatro Ciénegas basin. The description of two others —*Gambusia longispinis* Minckley (1962) and a new species of *Lucania* (Hubbs and Miller, in press)—have recently appeared or are in press, and the descriptions of additional forms are being prepared.

It is particularly fitting that this fish be named for the late Myron Gordon, for it is largely due to his efforts that we know so much about the biology of this genus of poeciliids (Atz and Rosen, 1959).

Xiphophorus gordoni *new species*
Northern platyfish[1]
(Figs. 1–5)

Diagnosis.—A species of *Xiphophorus* resembling *X. couchianus* (Girard) and *X. variatus xiphidium* (Gordon), but distinguishable from both by the following combination of characters: dorsal rays, 10–12, usually 11; caudal rays usually 17 or 18; total vertebrae, 29 or 30; gill rakers usually 16 or 17; distal serrae of ray 4p of the gonopodium not converging markedly at their tips; 9–12 (rarely 13) proximal, serra-bearing segments on ray 4p; number of spines on ray 3, 7–9 (rarely 9); first three rays, especially ray 3, of the gonopodium with much black pigment in life; males lacking pronounced longitudinal rows of black dashes on the sides of the caudal peduncle; posterior edge of coracoid produced into a flat process that extends past the base of the pectoral fin; and lacrimal pores predominantly 2.

Types.—The holotype (UMMZ 179866), a mature male 24.0 mm standard length (Fig. 1), came from Laguna Santa Tecla (Fig. 2), about 20 airline miles south–southeast of the town of Cuatro Ciénegas, Coahuila, México; it was captured on 9 April 1961, by R. R. Miller, Carl L. Hubbs, W. L. Minckley, D. R. Tindall, and José Lugo, Jr. An adult female (UMMZ 179867), 24.6 mm standard length, taken with the holotype, is

[1] This vernacular, used by Rosen (1960:66) for *X. couchianus*, is more appropriate for the present species, the northernmost known in the genus. We suggest that *couchianus* be called Monterrey platyfish, in reference to its original distribution in and around that city.

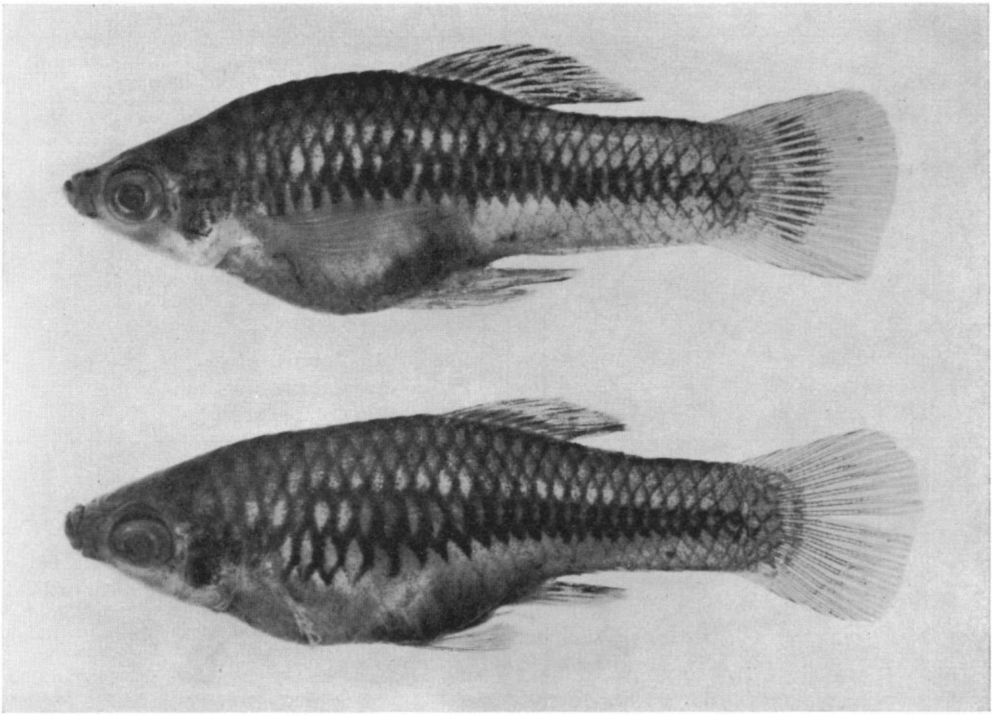

Fig. 1. Male holotype (above) and female allotype (below) of *Xiphophorus gordoni*, UMMZ 179866–67, 24.0 and 24.6 mm in standard length, respectively. Photographed by W. L. Cristanelli.

designated as allotype (Fig. 1). One hundred ninety-three paratypes (UMMZ 179868), also collected with the holotype, represent young to adult (male and female), 7.0 to 29.8 mm long. Wild stock and laboratory-reared offspring maintained at the University of Louisville were utilized in obtaining data on skeletal morphology, life colors, and behavior.

Description.—The following counts and measurements were made as outlined by Miller (1948:8–13). Measurements were stepped over the body part with a pair of fine dividers under appropriate magnification; they are not comparable to those for *Xiphophorus* published by Rosen (1960:63 and 142, footnote) who expressed the proportions mathematically and used different techniques for measuring head length and body depth. Counts of a given character are followed by the number of fish possessing it in parentheses, and some are compared with counts for related species of *Xiphophorus* in Tables 1 and 2. Eleven males 17.5 to 29.8 mm standard length (average 22.5), and 11 females 20.0 to 28.2 mm long (average 23.6) were measured. The data for the sexes were combined when no sexual dimorphism was evident. The count or measurement for the holotype is indicated by italics.

Dorsal rays, 10 (12), *11* (85), 12 (3), the first two rays unbranched in *97* and the first three in 3; anal rays *9* (37), the first three rays consistently unbranched; pectoral rays, *12* (4), *13* (70); pelvic rays consistently *6*; principal caudal rays (branched rays plus two), 16 (1), 17 (18), *18* (15), 19 (2), 20 (1). Scales in lateral series, 26 (16), *27* (21); scales around body, *21* (8), 22 (25); scales around caudal peduncle, *16* (37). Gill rakers (total on first arch), 15 (2), 16 (12), 17 (14), 18 (3), 19 (1). Head pores: mandibular, *0* (30); preopercular, 5 (2), 6 (22), 7 (46), 8 (4); and lachrymal, 0 (12), *2* (60), *3* (2). The total number of vertebrae (including the hypural plate) varies from *29* to 30 (Table 1).

Proportional measurements in standard length: head length, *3.5* to 3.7; body depth, 2.6 to 3.2; caudal peduncle depth, 5.0 to 5.5 (males) and 5.3 to 5.7 (females); caudal peduncle length, 2.55 to 2.85 (males) and 2.9 to 3.4 (females); dorsal fin base, *4.6* to 5.3

TABLE 1. NUMBERS OF VERTEBRAE IN THREE SPECIES OF *Xiphophorus*

Species	Number of Vertebrae					Locality
	27	28	29	30	Mean	
X. couchianus						
(Rosen, 1960:129)	1	8	—	—	27.9	Río Santa Catarina system
(UMMZ 179165)	—	23	1	—	28.0	Río Santa Catarina system
X. gordoni						
(UMMZ 179866–68)	—	—	32	2	29.1	Santa Tecla, possibly of the Río Salado system
(Laboratory stock)	—	—	8	—	29.0	Santa Tecla, possibly of the Río Salado system
X. variatus xiphidium						
(Rosen, *loc. cit.*)	2	7	—	—	27.8	Río Corona system
(Rosen, *loc. cit.*)	—	8	—	—	28.0	Río Caballero system
(UMMZ 108663, paratypes)	—	28	2	—	28.1	Río Corona system

(males) and 5.0 to 5.5 (females); length of depressed dorsal fin, 2.6 to 3.2 (males) and 3.3 to 3.7 (females); anal fin base, 10.0 to 12.2 (females only measured); length of depressed anal fin, 3.85 to 4.55 (males) and 4.75 to 5.5 (females). In head length: snout, 2.1 to 3.5, eye, 2.6 to 3.1; postorbital, 2.35 to 2.7; bony interorbital, 1.9 to 2.2; pectoral fin, 0.9 to 1.1 (males) and 1.1 to 1.3 (females); pelvic fin, 1.2 to 1.6 (males) and 1.5 to 1.8 (females); caudal fin, 0.9 to 1.1; dorsal fin base, 1.25 to 1.5; length of depressed dorsal,

Fig. 2. Laguna Santa Tecla, Cuatro Ciénegas basin, Coahuila, México, 9 April 1961. From polaroid print by R. R. Miller.

TABLE 2. COMPARISONS OF SOME MERISTIC CHARACTERS OF *Xiphophorus gordoni* WITH THOSE OF *X. couchianus* AND *X. variatus xiphidium*[1]

Species	Total Dorsal Fin Rays							Unbranched Dorsal Fin Rays				
	8	9	10	11	12	*N*	Mean	1	2	3	*N*	Mean
gordoni	—	—	12	85	3	100	10.9	—	64	3	67	2.0
couchianus	2	50	8	—	—	60	9.1	31	29	—	60	1.5
v. xiphidium	—	11	46	3	—	60	9.9	6	47	—	53	1.9

Species	Caudal Fin Rays (Branched plus 2)									Scales in Lateral Series				
	14	15	16	17	18	19	20	*N*	Mean	25	26	27	*N*	Mean
gordoni	—	—	1	18	15	2	1	37	17.6	—	17	20	37	26.5
couchianus	—	—	—	6	24	—	—	30	17.8	5	21	4	30	26.0
v. xiphidium	2	14	37	6	—	—	—	59	15.8	4	26	—	30	25.9

Species	Gill Rakers on First Arch									Scales Around Body					
	13	14	15	16	17	18	19	*N*	Mean	21	22	23	24	*N*	Mean
gordoni	—	—	2	12	14	3	1	32	16.7	8	25	—	—	33	21.7
couchianus	1	7	14	7	1	—	—	30	15.0	3	24	3	—	30	22.0
v. xiphidium	—	—	2	12	13	3	—	30	16.6	—	3	22	5	30	23.1

[1] Counts for *gordoni* are based on the types, for *couchianus* on UMMZ 179165, 179228, and 180002, and for *variatus xiphidium* on UMMZ 108663–64, 124404, and 169600.

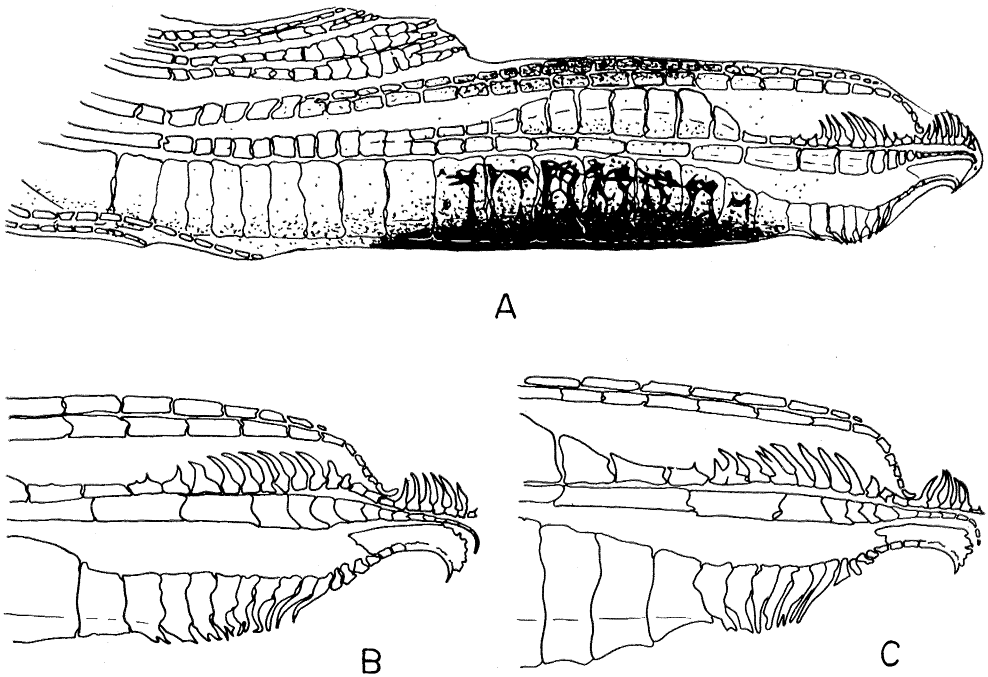

Fig. 3. A, gonopodium of *Xiphophorus gordoni* (from cleared and stained, aquarium-maintained paratype), 35 mm S.L.; B, tip of gonopodium of paratype of *X. gordoni*, 28 mm S.L.; C, tip of gonopodium of *X. couchianus*, 26 mm S.L. (UMMZ 179165). Figures 3–5 were drawn by W. L. Minckley.

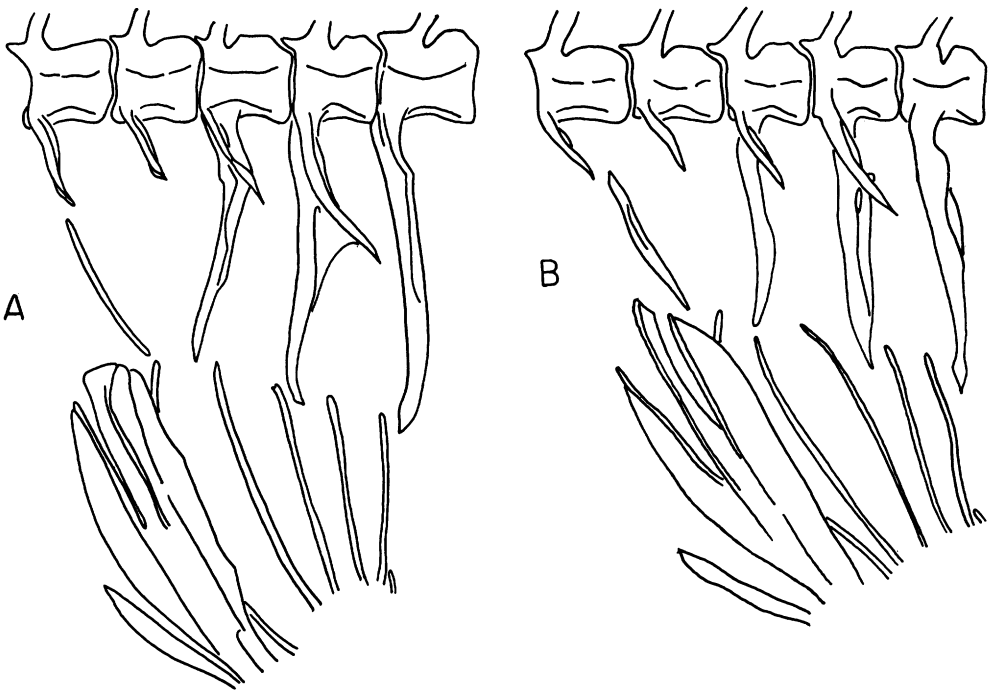

Fig. 4. A portion of the axial skeleton and suspensorium of the anal fin of (A) *X. gordoni*, 35 mm S.L., and (B) *X. couchianus*, 29 mm S.L., to show the modified hemal and interhemal spines (ligastyle, gonapophyses, gonactinosts).

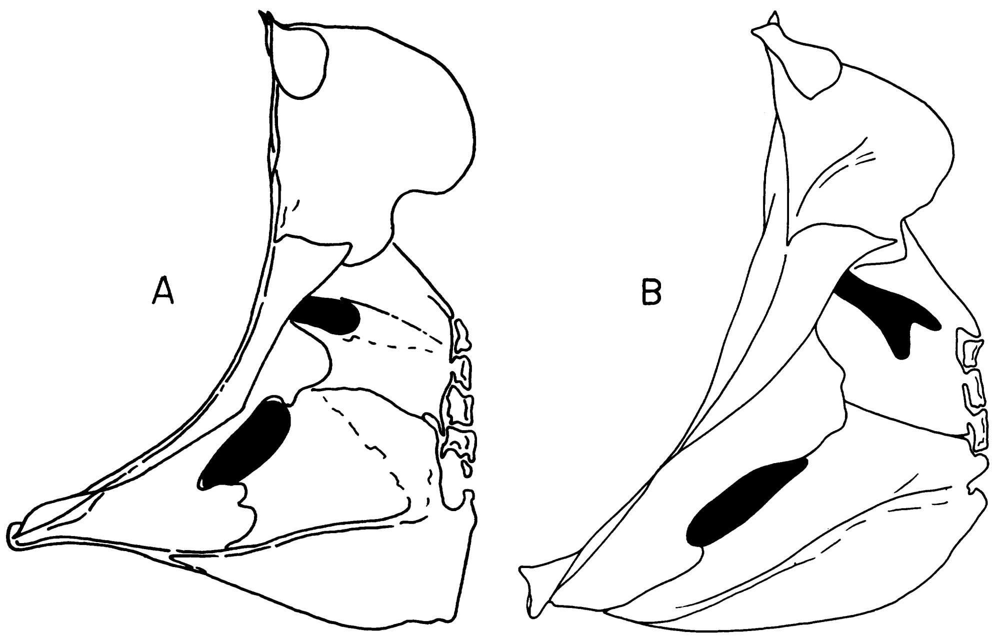

Fig. 5. Left pectoral girdle of (A) *X. gordoni*, 31-mm male, and (B) *X. couchianus*, 31-mm female (UMMZ 179165); the latter was selected for showing as close to a process as has yet been found in *couchianus* (see Rosen, 1960:199, fig. 38A, for the more typical shape of the coracoid).

0.6 to 1.0 (males) and 0.85 to 1.0 (females); base of anal, 2.95 to 3.4 (females only measured); length of depressed anal fin, 1.1 to 1.25 (males) and 1.3 to 1.5 (females).

The distance between the caudal fin base and dorsal origin when stepped into the predorsal length varies from 0.95 to 1.05 (males) and from 1.05 to 1.2 (females); and the distance between the caudal fin base and the anal origin when stepped into the predorsal length gives ratios of 1.05 to 1.3 (males) and 1.25 to 1.5 (females).

Skeletal characteristics of 12 specimens were studied after the fish had been cleared and stained following techniques described by Rosen and Bailey (1959:2). Two of the fish were paratypes and 10 were from laboratory stocks that originated from individuals collected with the type series. Figures were traced from photographs or from images projected on ground glass by a scale-reading device. Gonopodia were examined on intact fish, and on slides prepared with balsam (Rosen, 1960:63–4) or with TURTOX CMC-S, nonresinous, stain mountant. Terminology of the gonopodial elements is from Gordon and Rosen (1951:418–21), for the gonapophyses from Rosen and Gordon (1953:11–3), and for other skeletal attributes from Rosen (1960).

The thickened third ray of the gonopodium of adult males bears seven to nine (rarely 9) spines on its anterior margin, and these converge toward one another (Fig. 3A–B). The tips of some of the spines are bifid. The distal hook of ray 3 is long and recurved, lying closely bound to a long, distally rounded to angulate blade. The anterior branch of ray 4 bears no hooks or other modification, but its tip is curved over the distal end of the blade of ray 3. Ray 4p bears a short, greatly expanded section just distal to the center of its length (Fig. 3A), which acts as a dorsal rotational surface of the structure during copulation (Rosen and Gordon, 1953:18–20, Figs. 12, 24). This ray bears 9 to 12 proximal serrae, 7 to 9 of which are strongly developed. This group of retrorse serrae is separated from the expanded dorsal rotational area by two or three relatively unmodified segments. The distal serrae of ray 4p generally number 8 (rarely 7 or 9), and are erect to slightly retrorse distally. There is no marked tendency for the distal serrae of ray 4p to converge at their tips as is characteristic of *Xiphophorus couchianus* (Fig. 3C). The fifth gonapodial ray curves toward the distal serrae of ray 4p in a smooth arc, and the relatively unmodified terminal segment lies near to, or touches, the most proximal serra of the distal series on ray 4p.

The first modified hemal spine, or ligastyle, lies embedded in a ligament that attaches the gonactinost complex to the vertebral column (Fig. 4A). It is elongate, somewhat curved, and lies just ventral to the twelfth vertebra (rarely below the eleventh). The second modified hemal spine, the most anterior gonapophysis, rises from the fourteenth vertebra (as typical in poeciliids) and is directed slightly anteriad. Small parapophyses are closely appressed to its shaft, giving the impression of uncinatoid processes that are directed mostly downward. According to Rosen (1960:191), true uncini occur only rarely in *Xiphophorus.* The second gonapophysis, with a somewhat sinuous, vertically oriented shaft, has a much larger parapophyseal inclusion (in most individuals) that extends ventrally and caudally and is attached to the main shaft of the gonapophysis throughout most of its length by a thin shelf of bone. The third gonapophysis slants posteriad, but bends anteriorly to terminate almost directly below its origin. A small, posterolateral projection that is usually present on each side appears to represent reduced parapophyses fused to the shaft.

The highly modified interhemal spines, gonactinosts I through IV, are broadened (Fig. 4A). The first is directed cephalad and is sharp-pointed. Gonactinosts II, III, and IV are strongly fused along their edges, forming a broad, bony plate that is bowed anteriorly, truncate dorsally, and somewhat straight on its posterior margin. The entire complex structure is inclined forward, and its upper edge is notched.

The coracoid portion of the pectoral girdle of the 12 cleared specimens of *Xiphophorus gordoni* (Fig. 5A) possesses a thin process extending posterior to the pectoral fin base. This process is strongly developed in 11 specimens, extending far past the fin base, but in one it extends only slightly beyond—similar to that illustrated for *X. variatus xiphidium* by Rosen (1960:Fig. 38C).

Life colors were recorded for six adults of *Xiphophorus gordoni* by aquarium observation, by anesthetizing the specimens with quinaldine (Muench, 1958), and after they were preserved in formalin, and were compared with color patterns of wild-caught specimens. *Dorsal fin*: heavily pigmented in breeding males, less so in females; series of black blotches on interradials of proximal half; series of yellowish, but largely unpigmented, areas immediately distal to darkened blotches, appearing as a light band in middle of fin; distal third of fin uniformly covered by melanophores, appearing dusky to black; dorsal rays appearing as light lines in fin, margined by small, elongate melanophores. *Caudal fin*: dorsal and ventral margins blackened with tiny melanophores extending from, and confluent with, middorsal and midventral streaks of caudal peduncle; small melanophores on interradials of posterior margin, but rarely more anteriad than posterior branching of rays; large, stellate melanophores also present, but rare, along posterior margin; interradials with elongate blotches from point of scalation to slightly past primary (proximal) branching of rays, arranged in rows and following each ray; distinct blotch of melanophores present in "crotch" of primary dichotomy of rays; each caudal ray outlined by small, elongate melanophores along its margin; area of fin just past primary branching of rays, and to point of secondary branching, with only scattered melanophores, appearing yellow in males. *Anal fin*: gonopodium of male with most pigment associated with rays; all rays with scattered, stellate melanophores except at gonopodial tip, which is unpigmented; no pronounced development of small, marginal melanophores along rays as in dorsal and caudal fins; third ray with heavy concentration of melanophores on anterior side (Figs. 1, 3A), becoming jet black in expanded portion and appearing as a reticulum of pigment; rays 1 and 2 with pigment concentrated at their distal ends; rays 4 and 5 generally pigmented; ray 5 with expanded portion blackened with scattered melanophores; pigmentation of rays 6 to 10 obscured by development of thickened, whitish tissue that forms distinct, knoblike terminal structures, especially in large males; anal fin of female with scattered melanophores, lacking specific areas of concentration. *Pectoral and pelvic fins*: generally without distinctive markings or with few scattered melanophores concentrated along rays; pelvics of males with blotch of cencentrated melanophores variously developed on expanded portion of second ray at branching. *Body*: olivaceous above with yellow suffusion; lateral band distinct and jet black in breeding males, obscured by darkened dorsal reticulum of pigment in females; centers of scale pockets in lateral band generally lacking concentrated melanophores, giving iridescent blue reflections in strong light; 2 to 7 vertical black bars variously developed, becoming most intense in breeding males; region of anus, surrounding belly, and to slightly behind anus blackened in both sexes; lower part of head, belly, and sides white; muzzle and chin black; dark middorsal stripe present, and thin; a deeply embedded streak present on venter of caudal peduncle; longitudinal rows of dashes on venter of caudal peduncle rarely present, never more than four dashes per row.

Habitat.—Although the hydrography of the Cuatro Ciénegas basin has not yet been fully worked out, *Xiphophorus gordoni* is thus far known only from Laguna Santa Tecla (Fig. 2), which lies in the southeastern end of the valley of Cuatro Ciénegas (see Webb, *et al.*, 1963:Fig. 1). The outflow of the laguna is toward the north, possibly into an original stream (now largely modified into a canal called La Polilla) that drained the eastern side of the basin.

The open, very clear waters of the laguna contained no platyfish insofar as we could determine, but they were found in a small, spring-fed ditch entering the laguna (Fig. 2, right foreground) and in vegetation-choked, silt-bottomed, marshy areas adjacent to the outlet of the laguna. During his visit to Laguna Santa Tecla in July 1961, Klaus Kallman also failed to take *X. gordoni* in open waters, recovering them only in the tributary ditch (pers. comm.). A few individuals were observed swimming about 4 to 6 inches below the surface along the edge of the outlet, and they probably occurred in small numbers in overhanging vegetation and beneath undercut banks of the slow-flowing canal itself. The outlet varied from 4 to 15 feet wide, averaging about 6 feet, with depth of water from 1 to 2 feet. The air temperature was 79°F at 4:45 PM, the water 84°F at 2:15 PM and 4:45 PM. *Nymphaea* was sparse both in the laguna and in its outlet, but *Typha, Juncus, Eleocharis,* and *Scirpus* were common emergent plants. Submergent aquatic plants included a few clumps of filamentous algae and an extremely abundant, palmelloid alga that was incorporated in the bottom sediment and on its surface. Because the bottom comprised largely flocculent silt (rarely firm sand) and mud, the water was easily roiled and cleared slowly.

Comparisons and relationships.—Comparisons of selected meristic characters of *Xiphophorus gordoni* with those of *X. couchianus* and *X. variatus xiphidium* are given in Tables 1 and 2, and Figures 3 to 5 allow comparison of other features of *gordoni* with those of *couchianus.*

The corresponding color patterns of *Xiphophorus gordoni* and *X. couchianus,* and their geographic proximity, suggest that these two species are more closely related than is either to the southern species of platyfishes. Both lack macromelanophore markings and tail patterns, both are sharply bicolored, and both have rows of spots on the caudal peduncle, although these are very weak in *gordoni* which also lacks the 2 to 5 prominent dark, oval to quadrate spots on the mid-sides of *couchianus* (best developed in mature males). Certain characters, however, indicate a close relationship of *gordoni* with *X. variatus.* For example, the distal end of the gonopodium of *gordoni* lacks converging serrae on the tip of ray 3 (or the serrae show only a tendency toward convergence) and thus is quite different from that of *couchianus* (Fig. 3) and similar to *X. variatus xiphidium* (see Rosen, 1960:Fig. 3D–E); the gonapophyses of *gordoni* often have a parapophyseal inclusion that is attached to the shaft by a thin shelf of bone, a condition that is relatively uncommon in *couchianus,* but relatively common in *xiphidium;* males of *gordoni* have their lower caudal rays elongated, suggesting the sword that occurs in *xiphidium* (Rosen, 1960:83) but which is totally lacking in *couchianus;* and the number of gill rakers is the same in *gordoni* and *xiphidium.* A striking resemblance between the new species and *variatus* is the conspicuous blackening of the distal part of the third ray of the gonopodium (Fig. 3A), a condition not observed in *couchianus. X. v. xiphidium* is identical with *gordoni* in this feature; in the few males of *X. v. variatus* examined, the base of the gonopodium is also blackened, and no blackening of the gonopod was seen in *X. v. evelynae.* On the basis of these features, we suggest that *X. variatus* (*xiphidium*) and *X. gordoni* may be more closely related than is indicated by their present geographic positions.

Xiphophorus gordoni occupies a range that lies about 100 miles to the west and 100 miles to the north of that of *X. couchianus;* the latter occurs in springs and streams of certain headwaters of the Río San Juan near Monterrey, Nuevo León (Rosen, 1960:Fig. 4, misplaced dots for record stations of *X. couchianus* by one stream to the north); *X. variatus xiphidium* occurs in the Río Soto la Marina system which lies south and east of Monterrey in Tamaulipas. No platyfishes are known from the Río San Fernando which is between the Soto la Marina and the Río Grande systems.

Invasion to the north by a *Xiphophorus* stock may have occurred by overland stream capture between tributaries of the Río Grande and the Río Soto la Marina, directly or indirectly, rather than via coastal freshwater passages as postulated by Rosen (1960: 171–2), or both types of dispersal may have been utilized. The hypothesis that distribution may have been effected by stream capture is somewhat strengthened by the presence of *Gambusia marshi* Minckley and Craddock in the Río Salado system of northern México. Forms related to that species are distributed in the Río Soto la Marina system and south, but are not known to occur in streams between the Río Salado (a tributary of the Río Grande) and the Soto la Marina. Further research is in progress on other aspects of these problems, in connection with the origin of the fauna of the Cuatro Ciénegas basin and the high percentage of endemism exhibited by its fishes and other organisms.

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Some Changes in Morphology During Ontogeny in the Pirateperch, *Aphredoderus s. sayanus*[1]

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The anal fin formula of half-grown and adult *Aphredoderus* is III, 6–7, sometimes II, 6–7, and not II, 6, as described in much of the earlier literature. Very young individuals possess either one or two anal spines. As they transform, the first soft ray loses its segmentations and fuses into a typical spine, so that after 20 mm total length some adults possess two, but most possess three anal spines. There is a concurrent reduction of one soft ray in the anal fin after the formation of the third spine. The very small first anal spine is virtually always present, but becomes proportionately smaller with growth, hence has been neglected by most ichthyologists.

The anterior shift of the vent is accompanied by a similar migration of the urinogenital duct. The shift was seen to begin at the preanal fin region in a 9-mm fish and to proceed progressively forward at larger sizes to the jugular area. The shift of the vent involves passage of the intestine and duct through a foramen formed by the crossed posterior forks of the pelvic girdle and through a ventral abdominal muscular wall area anterior to the pelvic fins. The relationship between standard length and snout-to-vent length is allometric in young stages and isometric in adults.

THIS paper describes the number and development of anal spines and the allometric aspects of the vent in the eastern pirateperch, *Aphredoderus s. sayanus* (Gilliams). The literature, with few exceptions, has perpetuated an error regarding the number of anal spines in adults of the monotypic family Aphredoderidae. The phenomenon of anal spine transformation from a soft ray, heretofore unknown in this family, is discussed and illustrated. The gross anatomical aspects of the ontogenetic migration of the lower vent, lower intestine, and urinogenital duct from the preanal region to the thoracic area are

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