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A NEW POECILIID FISH, *PHALLICHTHYS TICO*,  
FROM COSTA RICA

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By WILLIAM A. BUSSING



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DAVID K. CALDWELL  
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# A NEW POECILIID FISH, *PHALLICHTHYS TICO*, FROM COSTA RICA

By WILLIAM A. BUSSING<sup>1</sup>

**ABSTRACT:** A new poeciliid fish, *Phallichthys tico*, is described from near Tilarán, Provincia de Guanacaste, Costa Rica. Its ecology, and relationships to other species of the genus are discussed. Certain characters of the new species necessitate expansion of the genus.

During the course of fieldwork on the ichthyofauna of Costa Rica in the summer of 1961, an undescribed fish of the family Poeciliidae was collected in a swamp near Tilarán, Provincia de Guanacaste. Subsequently, in 1962, a large series of the new form was collected while I was carrying out an intensive ecologic analysis of the fishes of the Río Puerto Viejo, Provincia de Heredia, Costa Rica. The characteristics of the new species indicate a close relationship to *Phallichthys amates* and *Phallichthys fairweatheri*, also of Middle America. It differs significantly from the previously known members of the genus, particularly in the gonopodial suspensorium and its inclusion in *Phallichthys* requires expansion of the generic limits to a considerable degree.

## ***Phallichthys tico*, new species**

Figures 1-3.

**Holotype:** LACM 2780; a male 17.4 mm. standard length collected by W. A. Bussing in the Río Puerto Viejo 5.5 kilometers downstream from junction with the Río Sarapiquí and 6.5 kilometers SE of the Pueblo of Puerto Viejo, Sarapiquí drainage, Provincia de Heredia, Costa Rica, on June 14, 1962.

**Paratypes:** LACM 2781; 20 males 12.4 to 17.6 mm. standard length and 92 juveniles and females 9.0 to 22.1 mm. standard length, same data as the holotype. UMMZ 180304; 3 males 13.7 to 14.6 mm. standard length and 3 females 17.5 to 19.2 mm. standard length, same data as the holotype. LACM 2782; 12 males 12.1 to 17.7 mm. standard length and 18 juveniles and females 7.8 to 32.9 mm. standard length collected by W. A. Bussing and Salvador Jiménez C. in a swamp 200 feet from the Río San Luís, 9 kilometers NNE of Tilarán, Arenal drainage, Provincia de Guanacaste, Costa Rica, on August 21, 1961.

The type specimens are deposited in the Los Angeles County Museum (LACM), the University of Michigan Museum of Zoology (UMMZ), the University of Miami Ichthyological Museum and the American Museum of Natural History.

**Diagnosis:** This diminutive *Phallichthys* is immediately distinguished from the other two known species of the genus by the presence of a prominent black blotch on the posterior quarter of the dorsal fin in both sexes. Other outstanding

<sup>1</sup> Department of Biology, University of Southern California, Los Angeles.



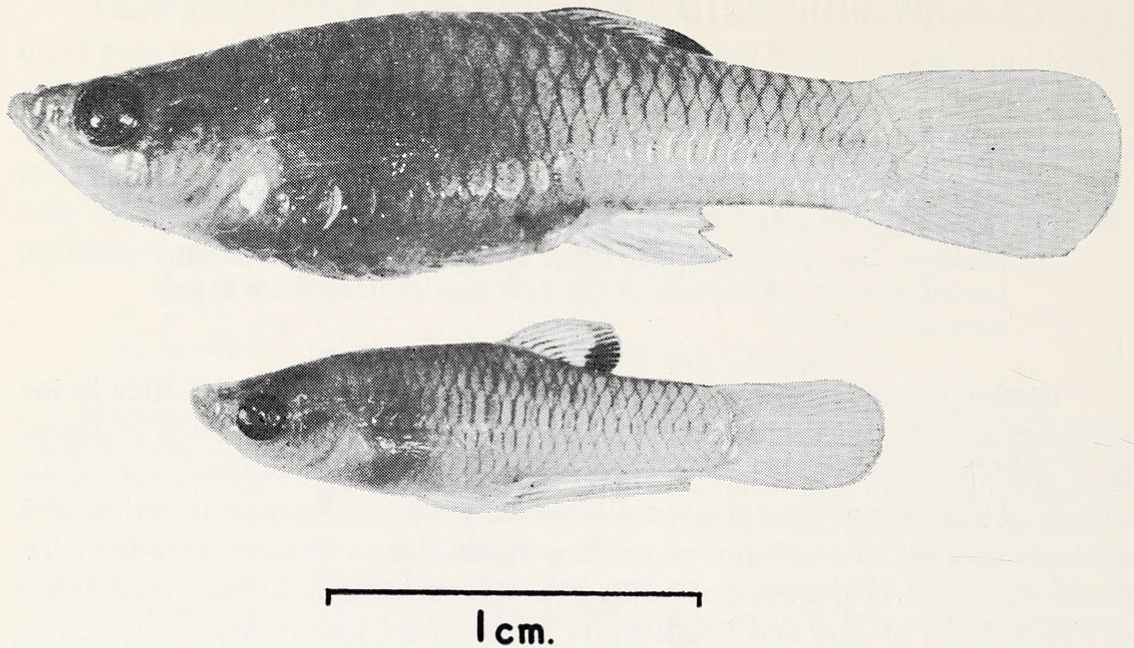


Figure 1. Adult pair of *Phallichthys tico*, n. sp., female above, male below. Photograph by the author.

differences follow for which counts and measurements (expressed in percent of SL) are given, first for *P. tico*, followed by those for *P. fairweatheri* and *P. amates*, respectively, in parentheses. Standard length, largest male collected 17.7 mm. (30 mm., 40 mm.); largest female 32.9 (44 mm., 56 mm.). Depth of adult males 25-30 (39-41, 33-41); adult females 28-34 (37-40, 37-40). Depressed length of dorsal fin of males 24-28 (33-38, 30-47); females 20-25 (29-33, 27-37). Total gill rakers on first arch 10-12 (20-25, 20-22). Ray 4p of gonopodium with symmetrical serrae on both right and left halves (serrae on both halves but unsymmetrical, serrae on right half only). Large distal uncini on gonapophysis I (small proximal uncini present, usually no uncini present but occasionally distal uncini). Membranous knob on end of gonopodium (no such knob, no such knob).

**General Description:** General appearance robust but not deep-bodied. Predorsal profile of female very slightly convex; male profile more strongly convex. Greatest depth of female slightly more than male but deep part of body extended farther anteriorly giving a considerably deeper aspect to the female. Body contours of both sexes gently rounded. Mouth opening dorsally.

Dorsal originates at highest point on body in both sexes. Dorsal origin slightly in advance of anal origin in females, in males origin of dorsal fin slightly behind origin of gonopodium. Dorsal fin rounded in both sexes. In females anal fin truncate or very slightly rounded. Short pelvic fins of females not quite reaching origin of anal fin. Second and third pelvic fin rays of males elongated and extending beyond origin of anal fin. Gill rakers 10-12 on first gill arch, upper 8-9 widely spaced and of moderate length, lower 2-4 greatly reduced. Dorsal rays usually 8, seldom 7 or 9; anal rays 10, seldom 9; pectoral



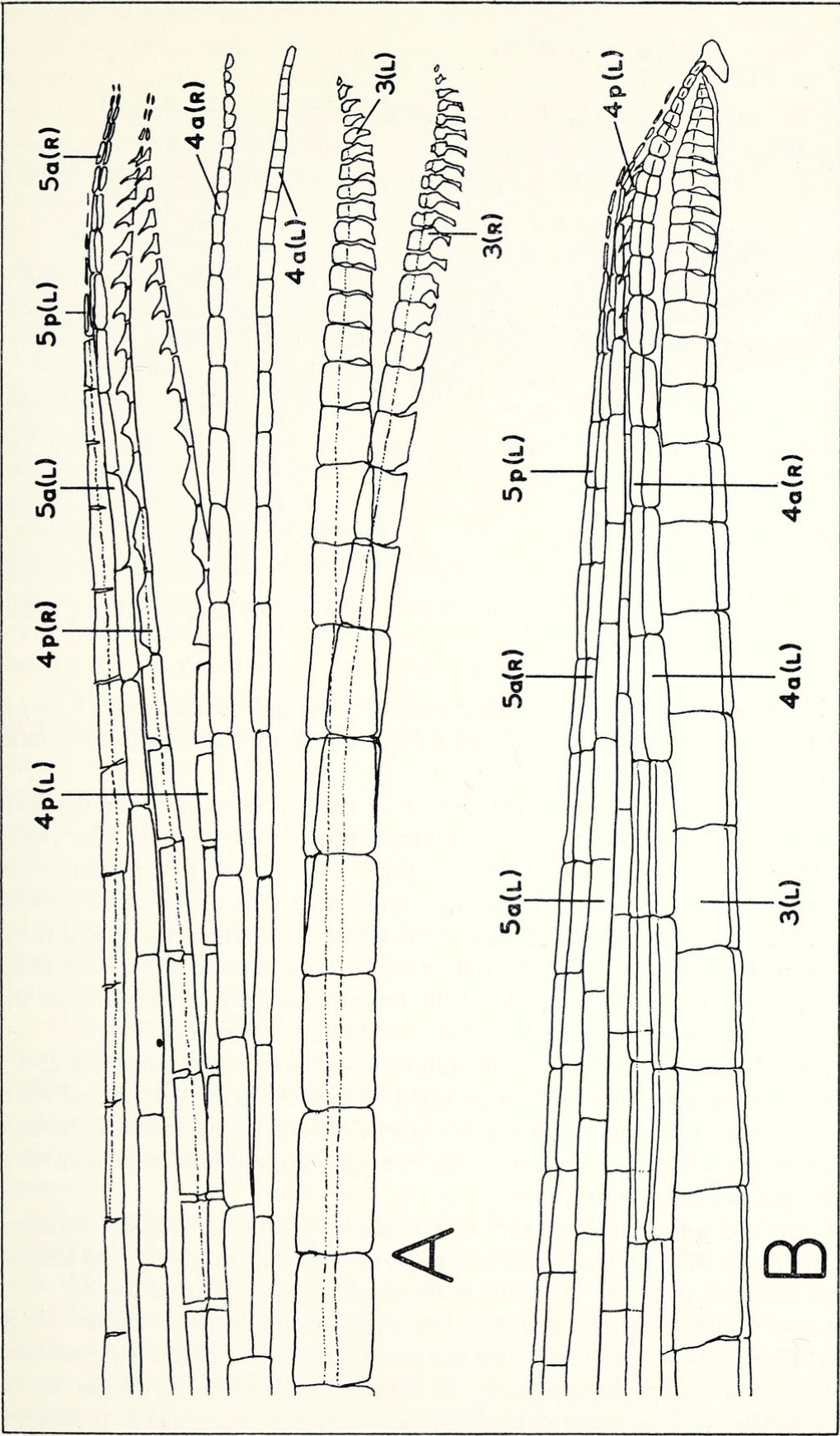


Figure 2. Gonopodium of *Phallichthys tico*, n. sp. A. Partial dissection to reveal symmetry of gonopodium. B. Natural orientation of gonopodium showing membranous knob and crest.



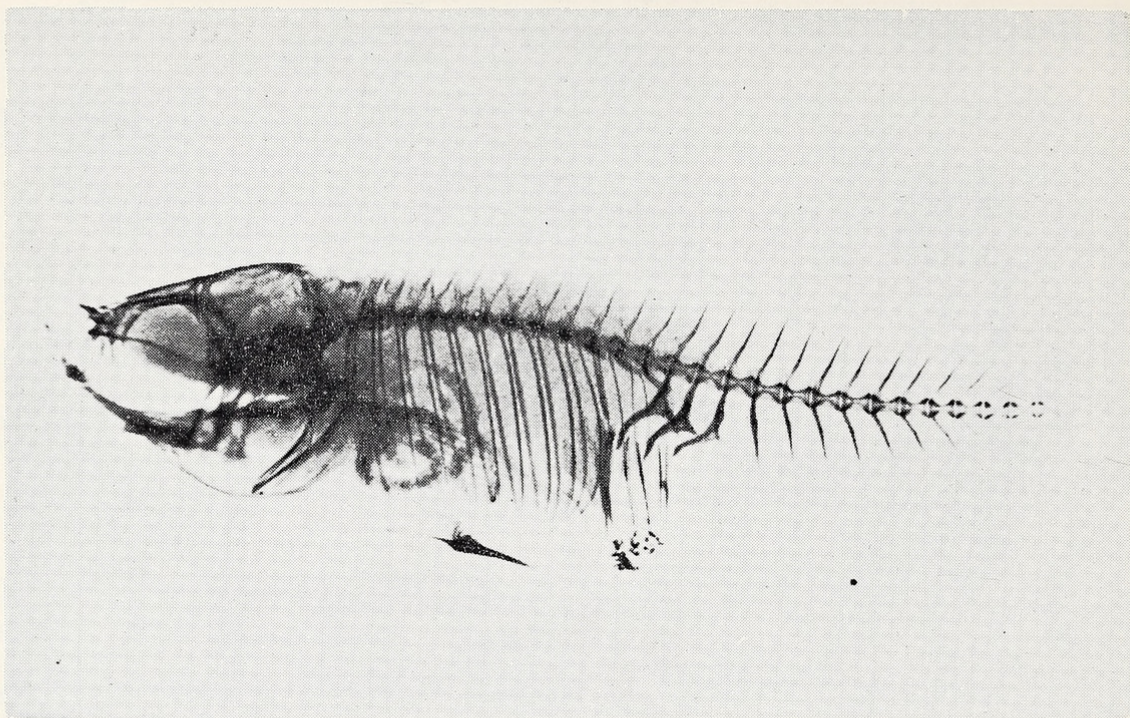


Figure 3. Radiograph of an adult male of *Phallichthys tico*, n. sp., (LACM 2781) to show gonopodial suspensorium.

rays 11, occasionally 10 or 12; pelvic rays 6; principal caudal rays 13, occasionally 12 or 14. Scales in lateral series 26 or 27. Vertebrae usually 29, occasionally 30 including urostyle.

**Measurements:** Body measurements were made according to the methods described in Rosen and Bailey (1959) and recorded in Tables 1 and 2 for ready comparison with tables of measurements for *P. amates* and *P. fairweatheri* in Rosen and Bailey. The small collection made near Tilarán contains several females (largest 32.9 mm. SL) larger than any taken from the Río Puerto Viejo (largest 22.1 mm. SL). The only proportional difference between these two populations is the deeper body of the female specimens from Tilarán, the result of an advanced state of pregnancy in the latter females.

**Gonopodium:** Gonopodium of mature males consists of rays 3, 4 and 5 of anal fin forming a shallow trough open to the left. Ray 3 deep and compressed. Last 10-12 segments on ray 3(r) forming long thin spines which curve to the left and form the bottom of the trough. Corresponding segments on ray 3 (l) not produced into spines.

Right and left halves of ray 4 symmetrical. Ray 4a slender, tapering gradually to tip. Ray 4p also slender but last 11 segments modified into slender retrorse serrae, 2 or 3 tiny segments without serrae at very tip of ray 4p.

Ray 5 symmetrical and composed of anterior and posterior halves which together form a V-shaped groove on the posterior surface of the gonopodium. Rays slender and tapering gradually to tip, terminal segments of ray 5a extending farther than end of ray 5p. Right and left halves of rays 6 to 10 sym-



metrical; rays 6, 7 and 8 constricted near middle of ray and split into anterior and posterior elements distally; rays 9 and 10 split only into right and left halves.

Ray 4a forms tip of gonopodium from which hangs a membranous knob shaped like the head of a bird. A subterminal membranous crest on anterior margin of ray 3 similar to, but much smaller than that found in the genus *Xenophallus*.

Gonapophysis I curved forward, a pair of long, slender uncini arise near center of gonapophysis and curve sharply downward. Uncini of gonapophysis II straight, of moderate length and projecting posteroventrally. Gonapophysis III lacks uncini.

Gonactinost 1 free, gonactinosts 2, 3 and 4 fused into an expanded plate, lateral wings produced along entire length of gonactinost 4. Gonactinosts 5, 6, 7, 8 and 9 free and slender, interdigitating with gonapophyses; gonactinost 10 reduced, one-third the length of other gonactinosts. Lateral wing-like processes midway along gonactinost 9 in mature males.

*Dentition:* Two rows of teeth present in each jaw, those of the premaxillary and dentary alike in structure. Teeth of the outer row sharp-pointed, long, slender and incurved, attached on the outside surface of the tooth-bearing bone. Inner series about one half the length of the outer series. Teeth of both series gradually reduced in length toward edge of jaws.

*Coloration:* Ground color in life tan overlaid by a reticular pattern formed by dermal melanophores under the scales. Scales at first appear edged in black but on close examination it is seen that the reticular pattern showing through the scales actually edges the scale pocket which encloses each scale. Pectoral, ventral, anal and caudal fins clear, a fleeting iridescent blue often seen on the dorsal and anal fins of both sexes in life, as in *P. amates pittieri*. Interradial membrane between distal part of other dorsal rays slightly pigmented. Base of dorsal fin also pigmented in some specimens. One or two small superficial irregular blotches above anus in females. A series of obscure thin vertical bands along the body sometimes present on immature specimens.

*Relationships:* *Phallichthys tico* forms a natural group with the other members of the genus on the basis of the robust or deep body; long, thin gonopodium showing few specializations such as hooks, claws and serrae; the modification of rays 6 and 7 of the anal fin in mature males; the pigment patches occurring above the anus of the female and the general agreement in most other characters.

Important differences exist however, which necessitate expansion of the genus *Phallichthys*. The following discussion points out however, that some of these differences can be correlated with variation occurring in other species of *Phallichthys* and in other genera. The long distal uncini on gonapophysis I arise about midway along the gonapophysis in *P. tico* but show no great departure from the condition of the proximal uncini in *P. fairweatheri*. In addition a cleared and stained male specimen of *P. amates pittieri* from the Río



Puerto Viejo has long distal uncini on gonapophysis I, indicating that this character varies in different populations of the same species. The fact that *P. tico* has paired rather than unilateral development of serrae on ray 4p is not significant since this feature is known to vary (Bailey, *in litt.*) within the genus *Poeciliopsis*. A few minute serrae are sometimes found on ray 4p(r) in dextral species (*P. fairweatheri*) and on ray 4p(l) in members of the Río Puerto Viejo population of *P. pittieri* (a sinistral species).

Other differences show possible relationships or examples of parallelism with other genera. The broadly expanded primary gonactinostal complex is similar to that of other genera (i.e. *Carlhubbisia* and *Poeciliopsis*). The entire gonopodial suspensorium, with the exception of the long ligastyle, and the gonopodium is strikingly similar to that found in some members of the genus *Poeciliopsis* (see Alvarez and Aguilar, 1957) but the new species is distinct in body depth and other characters. *P. tico* like *P. fairweatheri* has a long liga-

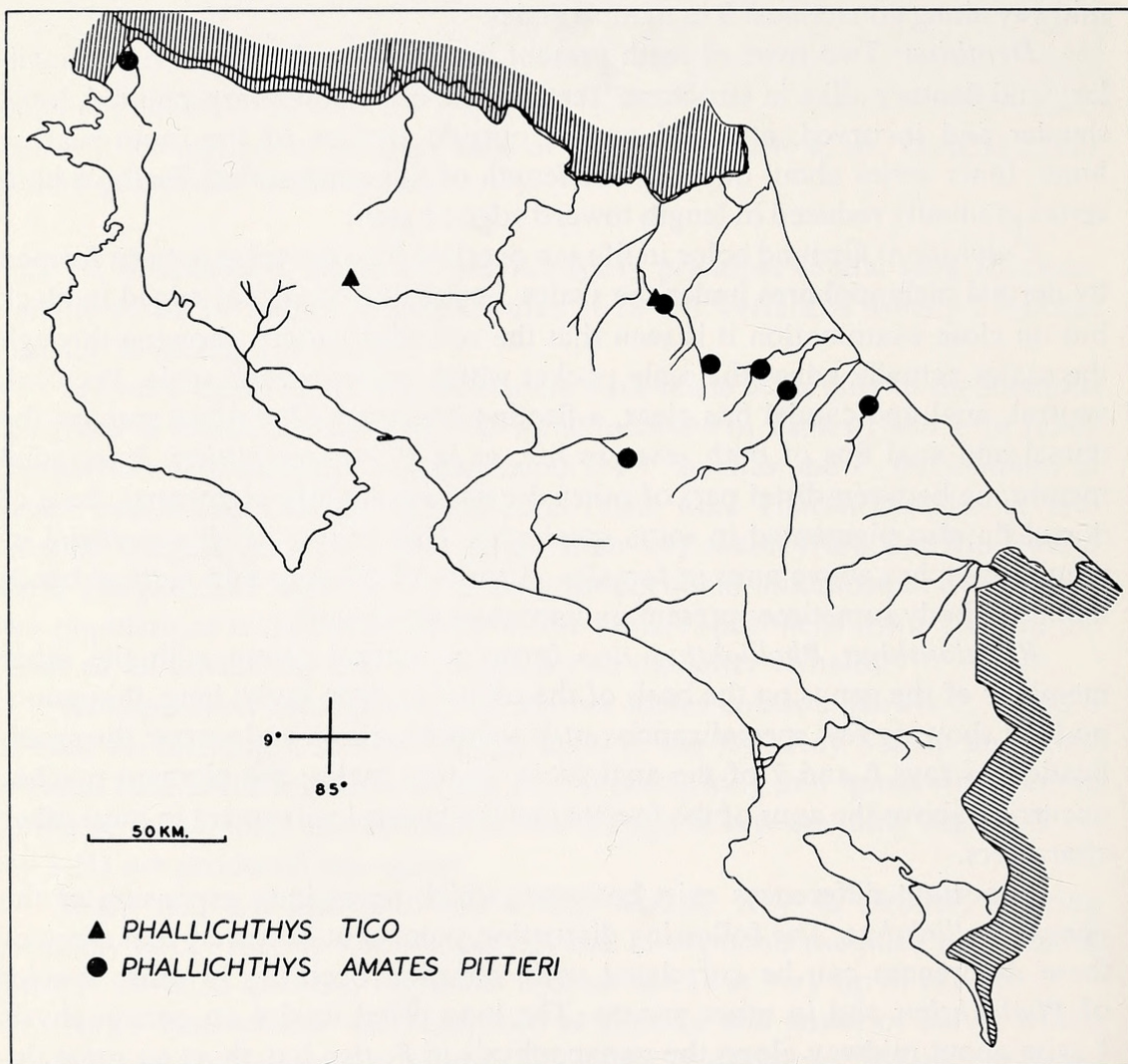


Figure 4. República de Costa Rica showing distribution by collection localities of *Phallichthys tico*, n. sp., and *Phallichthys amates pittieri*.



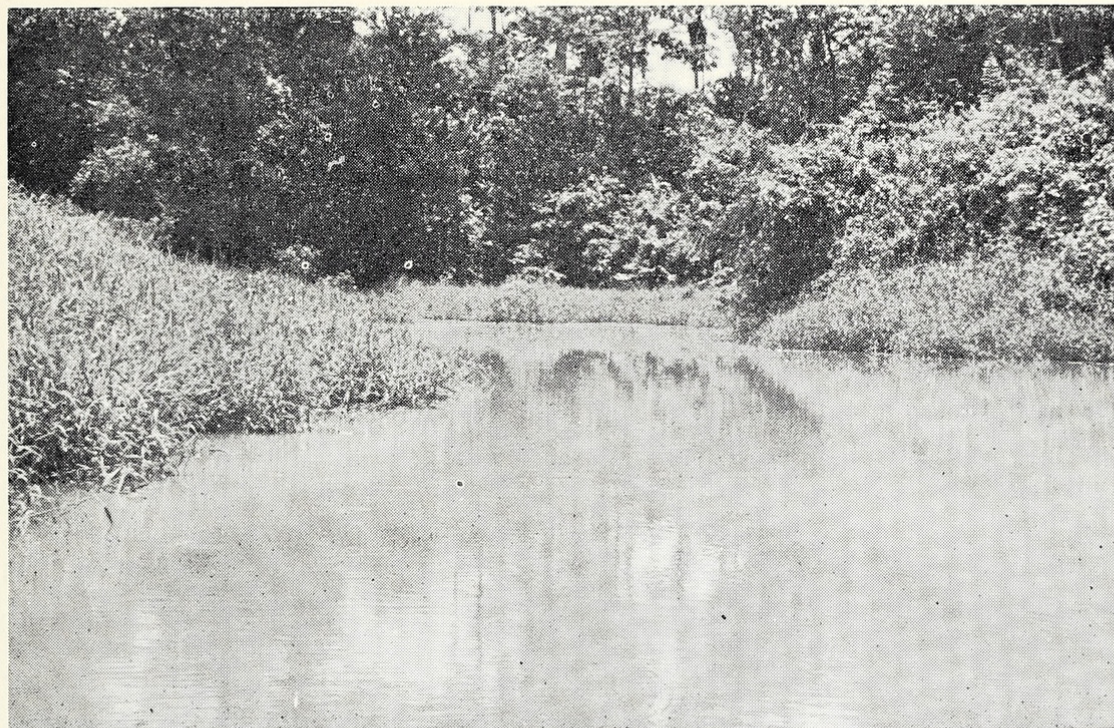


Figure 5. Type locality, backwater of the Río Puerto Viejo, Costa Rica. Photograph by the author.

style which apparently correlates with the short primary gonactinostal complex rather than for a deep body as suggested by Rosen and Bailey (1959).

*Phallichthys* may be expanded to include the following: body moderately deep (25-30% of SL) to deep (33-41% of SL); dorsal and ventral margins of body angular or not angular; ray 4p of gonopodium with row of unpaired distal serrae on either right or left half of ray or with paired symmetrical or unsymmetrical distal serrae; uncini of first gonapophysis, if present, either short and emerging near base of vertebra or long and located distally; primary gonactinostal complex either narrow or widely expanded.

*P. tico* shows evidence of being the most specialized member of the genus, although its exact relationships to the other two species are not obvious. *P. tico* is basically similar to previous described *Phallichthys* but shows some affinity to other poeciliid genera, especially *Poeciliopsis*.

*Range:* The species is known only from Costa Rica in two localities about 110 kilometers apart: the Río Puerto Viejo and a swamp near the Río San Luís. Both rivers ultimately connect with the Río San Juan which flows into the Caribbean. The known range will surely be expanded through further collecting and it is likely that the poorly known rivers on the Atlantic slope of Nicaragua will yield specimens of this species as well as *P. amates*. *P. tico* is sympatric in part of its range with *P. amates pittieri* (Fig. 4).

*Habitat and Ecology:* The type locality is in a small (ca. 200 sq. m.) backwater pool which was formerly part of the main river channel of the Río Puerto Viejo. It is now connected to the main river at only one point and be-



comes almost isolated during the dry season. During high waters the area may be under 3 meters of water and the pool becomes a part of the main stream. The topography of the pool changes little although the bottom is composed of over 6 meters of soft mud which is continually emitting gases of decomposition. Thick grasses line the indistinct shoreline on all sides (Fig. 5). The average water depth is less than 0.5 meter but deeper holes are present. As one leaves the main river there is a sharp change from clear to highly turbid water of a milky brown color. A rich plankton population was present as opposed to the relatively poor plankton content of the main river. No higher aquatic plants were present but a large quantity of brown algal scum floated at the surface as did patches of the "oily" material characteristic of stagnant pools. A partial chemical and physical analysis of water taken 5 cm. below the surface at 11:00 A.M. November 21, 1962, follows: temperature 30°C.; pH 6.4; reserve pH 7.3; oxygen 1.9 ppm; free carbon dioxide 24.0 ppm; bicarbonate alkalinity 115.5 ppm; hardness 109.0 ppm; chloride 5.3 ppm. The analysis was made when the water was low and the pool well isolated. The difference between the pH and the reserve pH (pH after water sample agitated for 2 minutes) indicates that the acid condition was due largely to dissolved carbon dioxide and is borne out by the high carbon dioxide analysis. The bicarbonate alkalinity is also increased due to the high carbon dioxide content. In contrast, a typical analysis of the main river water shows it to be clearer, soft, of neutral pH and high in oxygen, and it appears to consist principally of rain water with very few dissolved mineral substances. The conditions of the isolated backwater are unique along this river which has very few shallow protected shores that would provide *P. tico* a suitable habitat. Other species inhabiting the inner reaches of the pool are *Phallichthys amates pittieri*, *Mollienisia spheonops*, *Rhoadsia eigenmanni* and *Cichlasoma friedrichstahli*.

The Tilarán habitat is a shallow, clear-water swamp extending over several hectares. *P. tico* is found in the deeper (0.3 meter) sections where it retreats into dense grass clumps when approached. The temperature was 24°C. during the early morning; no chemical measurements were taken. *Brachyrhaphis episcopi* and *Rivulus isthmensis* also inhabit these swampy pools. Specimens were collected with dip net and rotenone.

Individuals of the new species stay close to shore at all times; they frequent shallow mud shores or hover in small aggregations of 20 to 30 individuals a few centimeters below the surface near grassy shores. They are very easily frightened and disappear into vegetation at the slightest disturbance. Seining was not feasible at either locality and all specimens were taken either with a hand dip net plunged very rapidly beneath them or with rotenone.

Although the fish is usually found in midwater, it frequently browses on the bottom in shallow water. Food consists principally of plant material (one-celled green and brown algae and diatoms); but protozoans are also taken. Small crustaceans were not detected in analyses of the digestive tract although they were plentiful at the Puerto Viejo habitat. In an aquarium *P. tico* remains







TABLE 2  
Body measurements of 10 female specimens of *Phallichthys tico* expressed in thousandths of standard length.

Measurement	LACM 2782			LACM 2781						
Standard length (mm)	32.9	28.1	23.1	22.1	21.4	20.4	20.2	19.0	18.8	17.7
Body, greatest depth	343	306	320	303	285	294	297	289	292	282
Caudal peduncle, least depth	161	163	164	167	168	166	173	168	170	158
Dorsal origin to snout tip	589	572	571	579	584	602	594	594	585	587
Anal origin to mandibular symphysis	671	647	623	642	626	647	638	657	632	621
Dorsal origin to caudal base	431	448	458	447	439	441	445	447	452	457
Anal origin to caudal base	395	398	432	416	411	416	425	431	425	423
Head length	264	281	294	289	289	294	297	294	303	305
Head width	200	199	203	208	210	215	212	215	212	192
Snout length	91	88	90	99	98	107	94	105	101	96
Orbit length	75	78	82	95	93	98	99	94	101	101
Postorbital length of head	115	131	134	117	126	127	133	136	127	141
Interorbital, bony width	136	138	151	153	149	156	153	157	154	146
Mouth, over-all width	103	106	116	126	121	132	123	126	111	107
Dorsal fin, depressed length	224	231	238	244	242	250	257	247	244	248
Anal fin, depressed length	203	220	225	235	224	235	237	236	223	220
Caudal fin length	249	277	303	316	322	328	326	331	319	316
Pectoral fin length	197	181	216	230	224	235	217	215	223	209
Pelvic fin length	136	142	147	162	168	171	168	163	159	152



hidden in the area of densest vegetation at the surface or the bottom, and ventures into midwater only when undisturbed. It readily accepts *Tubifex* worms and prepared dry foods.

The species is named *tico* in honor of the República de Costa Rica, the only country from which the species is known.

*Acknowledgments:* I wish to thank the government of Costa Rica and the U.S. State Department for making my stay in Costa Rica possible. I am grateful to the University of Costa Rica which afforded me excellent laboratory facilities, equipment and assistance; to Leslie R. and Lydia Holdridge who generously offered the use of their home at Finca La Selva and provided transportation by dugout to the finca and on many of my collecting trips; to Jay M. Savage for his many helpful suggestions and for reviewing the manuscript; to Donn E. Rosen, Reeve M. Bailey and Luis R. Rivas for their advice concerning the relationships of the species and for reviewing the manuscript and to my wife, Myrna López de Bussing, Salvador Jiménez C., Alexis Obando and Rafael Chavarría S. who assisted in the collecting.

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