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

By William A. Bussing
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DAVID K. CALDWELL

Editor
A NEW POECILIID FISH, PHALlichthys tico,  
FROM COSTA RICA

By WILLIAM A. BUSSING 1

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

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Figure 1. Adult pair of Phallocetris 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.
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 Rio 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 posterodorsally. 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 Rio
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. *Carihubbsia* 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.*
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 decom-
position. 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; bicar-
bonate 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 Phallicthys amates pittieri, Mel-
liaesia sphenops, Rhoadsia eigenmanni and Cichlasoma friedrichstahli.

The Tilarán habitat is a shallow, clear-water swamp extending over sev-
eral 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. Brachy-
rhaphis episcopi and Rivulus isthmensis also inhabit these swampy pools. Spe-
cimens were collected with dip net and rotenone.

Individuals of the new species stay close to shore at all times; they fre-
quent shallow mud shores or hover in small aggregations of 20 to 30 indi-
guals a few centimeters below the surface near grassy shores. They are very
easily frightened and disappear into vegetation at the slightest disturbance.
Sorting 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 1

Body measurements of 10 male specimens of *Phallichthys tico* expressed in thousandths of standard length.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>LACM 2781</th>
<th>Holotype</th>
<th>LACM 2781</th>
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<tr>
<td>Standard length (mm)</td>
<td>17.6</td>
<td>17.4</td>
<td>17.1</td>
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<tr>
<td>Body, greatest depth</td>
<td>289</td>
<td>298</td>
<td>269</td>
</tr>
<tr>
<td>Caudal peduncle, least depth</td>
<td>164</td>
<td>183</td>
<td>163</td>
</tr>
<tr>
<td>Dorsal origin to snout tip</td>
<td>539</td>
<td>528</td>
<td>573</td>
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<tr>
<td>Anal origin to mandibular symphysis</td>
<td>568</td>
<td>557</td>
<td>538</td>
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<tr>
<td>Dorsal origin to caudal base</td>
<td>482</td>
<td>465</td>
<td>467</td>
</tr>
<tr>
<td>Anal origin to caudal base</td>
<td>505</td>
<td>522</td>
<td>479</td>
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<tr>
<td>Head length</td>
<td>301</td>
<td>298</td>
<td>304</td>
</tr>
<tr>
<td>Head width</td>
<td>193</td>
<td>195</td>
<td>198</td>
</tr>
<tr>
<td>Snout length</td>
<td>90</td>
<td>97</td>
<td>105</td>
</tr>
<tr>
<td>Orbit length</td>
<td>96</td>
<td>102</td>
<td>111</td>
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<tr>
<td>Postorbital length of head</td>
<td>136</td>
<td>137</td>
<td>128</td>
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<tr>
<td>Interorbital, bony width</td>
<td>136</td>
<td>143</td>
<td>140</td>
</tr>
<tr>
<td>Mouth, over-all width</td>
<td>119</td>
<td>114</td>
<td>122</td>
</tr>
<tr>
<td>Dorsal fin, depressed length</td>
<td>255</td>
<td>264</td>
<td>251</td>
</tr>
<tr>
<td>Anal fin, depressed length</td>
<td>392</td>
<td>408</td>
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<tr>
<td>Caudal fin length</td>
<td>318</td>
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<tr>
<td>Pectoral fin length</td>
<td>210</td>
<td>224</td>
<td>216</td>
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<tr>
<td>Pelvic fin length</td>
<td>181</td>
<td>183</td>
<td>175</td>
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Table 2

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

<table>
<thead>
<tr>
<th>Measurement</th>
<th>LACM 2782</th>
<th>LACM 2781</th>
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<tbody>
<tr>
<td>Standard length (mm)</td>
<td>32.9</td>
<td>28.1</td>
</tr>
<tr>
<td>Body, greatest depth</td>
<td>343</td>
<td>306</td>
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<tr>
<td>Caudal peduncle, least depth</td>
<td>161</td>
<td>163</td>
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<tr>
<td>Dorsal origin to snout tip</td>
<td>589</td>
<td>572</td>
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<td>Anal origin to mandibular symphysis</td>
<td>671</td>
<td>647</td>
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<tr>
<td>Dorsal origin to caudal base</td>
<td>431</td>
<td>448</td>
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<tr>
<td>Anal origin to caudal base</td>
<td>395</td>
<td>398</td>
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<td>Head length</td>
<td>264</td>
<td>281</td>
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<tr>
<td>Head width</td>
<td>200</td>
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<td>Snout length</td>
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<td>88</td>
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<td>Orbit length</td>
<td>75</td>
<td>78</td>
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<td>Postorbital length of head</td>
<td>115</td>
<td>131</td>
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<tr>
<td>Interorbital, bony width</td>
<td>136</td>
<td>138</td>
</tr>
<tr>
<td>Mouth, over-all width</td>
<td>103</td>
<td>106</td>
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<tr>
<td>Dorsal fin, depressed length</td>
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</tr>
<tr>
<td>Pelvic fin length</td>
<td>136</td>
<td>142</td>
</tr>
</tbody>
</table>
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 Chavarriá S. who assisted in the collecting.

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