Rev. Biol. Trop. 7(1): 7-33, 1959.

Systematic and Ecological Notes on Some Fishes Collected in the Vicinity of Tortuguero, Caribbean Coast of Costa Rica

by

David K. Caldwell*, Larry H. Ogren**, and Leonard Giovannoli***

(Received for publication December 2, 1958.)

The fishes listed in this report represent collections made primarily by Ogren and Giovannoli while they were in Costa Rica during the summers of 1956-58 and 1955, respectively, as University of Florida Research Assistants engaged in a study of the ecology and migrations of sea turtles (National Science Foundation Grants G-1684 and G-5479, University of Florida-Principal Investigator, Archie Carr). A few additional specimens, designated in the following annotated list, were taken by others who were at Tortuguero during the months Ogren and Giovannoli were collecting.

Since the specimens were taken during only one season of the year, with limited equipment, and only incidental to the turtle work, this list is not intended as a presentation of the entire fish fauna of the area. However, the locality is isolated, and knowledge of some of the fish species augments what is known of the ecology and ranges of fishes known to occur in neighboring or distant countries to the north or south. This is particularly true of the marine species, as practically nothing has been written concerning their actual occurrence in Caribbean Costa Rican waters.

---

* Fishery Research Biologist, United States. Fish and Wildlife Service, South Atlantic Fishery Investigations, Brunswick, Georgia, and Collaborator of the Florida State Museum.

** Research Assistant, University of Florida.

*** Formerly Research Assistant of the Florida State Museum; now resides near Micanopy, Florida.

Tortuguero is a small sawmill and turtle-fishing village approximately 52 miles northwest of Puerto Limón and 17 miles southeast of Barra del Colorado, on the Caribbean coast of Costa Rica, Central America (CARR and GIOVANNOLI, 10).

The village is on a barrier island separated from the mainland by a brackish lagoon (Figure 1). Rio Tortuguero and Agua Fria are the primary sources of fresh water feeding the lagoon in the vicinity of Tortuguero, though creeks of varying sizes also enter it near the village. A water hyacinth—and log—filled creek (Caño Palma) connects this lagoon with the neighboring Simon lagoon to the north, but the obstructions are so dense that there is no navigable inside water passage to Tortuguero from that direction. Tortuguero lagoon is choked with hyacinths to the south of its confluence with the Tortuguero River, and only during heavy rains when there is considerable water in the lagoon can an occasional motor launch push its way through the five miles of water hyacinths and establish inside water passage with the village of Parismina. Río Tortuguero is one of many rivers draining the highland of Caribbean Costa Rica, but is not directly connected by fresh water with the large Nicaraguan lakes, as shown on some maps. However, the coastal fresh and brackish-water fish fauna of the Tortuguero area has a vague connection (especially during times of flood) with these lakes via the brackish creeks and lagoons connecting the Tortuguero lagoon, via Simon lagoon, with the Río San Juan—draining lake Nicaragua and entering the sea at Barra del Colorado.

Unless otherwise noted, the identifications and systematic notes were made by Caldwell, and the specimens are deposited in the University of Florida Collections (UF). A few specimens are deposited in the collections of the Academy of Natural Sciences of Philadelphia (ANSP).

Lengths are standard length, unless otherwise stated, in millimeters, and were taken with a ruler and dividers. The points of the dividers were placed at the tip of the snout and at the base of the mid-caudal rays.

ACKNOWLEDGMENTS

Aside from the indirect support from the National Science Foundation, we wish especially to thank Teodoro Quirós C. of the Atlantic Trading Company at Tortuguero and Leo Martínez of that village for their consistent cooperation in furthering the collecting. Kay Eoff, of the University of Florida, aided Ogren in collecting in the summer of 1958. William W. Anderson, Frederick H. Berry, and Jack W. Gehringer, of the United States Fish and Wildlife Service at Brunswick, Georgia; Archie Carr, of the University of Florida; Robert R. Miller, of the University of Michigan; and Loren P. Woods, of the Chicago Natural History Museum, were all generous in making comments and suggestions regarding the manuscript.

COLLECTING STATIONS

Although the fishes were collected within a short distance of the village

of Tortuguero, three major habitats (marine, brackish, and freshwater) are represented. The following variously-detailed ecological notes were made by Ogren and Giovannoli, and it should be emphasized that the data are based on those conditions which existed at the time of the specific collections. Due to great seasonal and annual variation in rainfall, which so markedly affect the volume of water coming down the rivers, some of the brackish stations might be quite saline during a dry spell and freshwater stations may prove brackish. Conversely, saline stations might on occasion be quite fresh. Mileages are water miles. Station numbers refer to Figure 1. Species numbers refer to the annotated list in this paper.

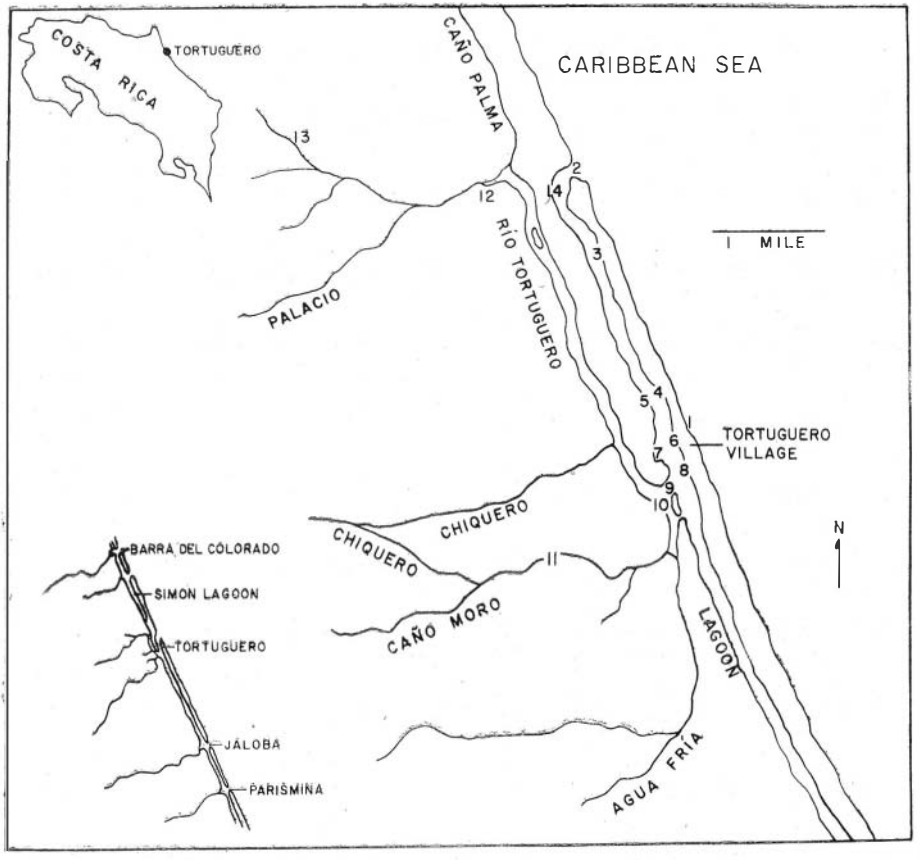

Fig. 1: Map showing Tortuguero and its relationship to other localities in Caribbean Costa Rica. Numerals refer to collecting stations described in the text. The village is located at latitude 10° 34' N., longitude 83° 32' W.

Station 1. Open beach near the village of Tortuguero. The beach is black volcanic sand, and slopes sharply into rather deep water. A heavy surf was almost always present.

Station 1A. August 14, 1955. Giovannoli. Fishes literally driven onto the beach in their frantic efforts to evade capture by larger predatory fishes. This is apparently a frequent phenomenon, as the children of the village seem to expect it and eagerly gather the small fishes.

Species: 2, 3, 4, 5, 21, 24.

Station 1B. July 15, 1956. Ogren. Fish found dead on beach.

Species: 37.

Station 1C. July 30. 1958. Ogren field number 451. Fish scooped as it buried in the sand at the surf line as a wave retreated.

Species: 45.

Station 2. Just inside the inlet, where the Tortuguero lagoon enters the sea.

Station 2A. August 26, 1955. Giovannoli and Carr. The river, swollen by rains at the time of collection, flowed with such volume into the lagoon that it was only slightly saline nearly to the inlet, even at high tide. Shark with remora attached taken with hook and line.

Species: 1, 54.

Station 2B. July 29, 1959. Ogren and Eoff. Ogren field number 449. *Caranx* and *Oligoplites* caught on jigs. *Echeneis* and shark caught on baited hooks.

Species: 1, 26, 27, 54.

Station 3 Tortuguero lagoon about ¾ mile from inlet. September 1, 1956. Ogren and Obid Martínez. Ogren field number 152. Time, 1300 - 1400 hours. Incoming tide, water brackish. Bank gently shelving to several feet from shore, then rapid drop-off. Depth at collecting point to four feet. Bottom sandy. Floating water hyacinths (*Eichornia*) only aquatic vegetation. Fish seined, water baited with bananas.

Species: 9, 11, 16, 22, 23, 25, 32, 33, 36, 41, 42, 47, 49, 53, 55.

Station 4. East bank of Tortuguero lagoon, about 2 miles from inlet. Bottom sandy muck. Depth about 3½ feet at shore, dropping off sharply to 20-25 feet. Water brackish, brown stained. Water hyacinths and grass (*Panicum*).

Station 4A. July 25, 1955. Giovannoli. Fish shaken from hyacinth roots.

Species: 55.

Station 4B. July 27, 1955. Giovannoli. Cichlids taken with hook and line. Eleotrids shaken from hyacinth roots.

Species: 40, 49.

Station 4C. September 3, 1956. Ogren. Ogren field number 157. Fish taken with cast net around submerged brush pile. Incoming tide. Water turbid.

Species: 8, 9, 11, 12, 52, 53.

Station 4D. September 9, 1956. Ogren. Ogren field number 175. Fish taken with a cast net around brush pile. Falling tide. Some water turbidity.

Species: 1, 9, 41, 43, 54.

***Station 4E.* July 28, 1957. Ogren. Ogren field number 233. Fish in association with hyacinths, seined.**

Species: 31.

Station 4F. August 31 and September 1, 1957. Ogren. Ogren field number 277. Fish seined around hyacinths.

Species: 19, 46, 49.

Station 5. West bank of Tortuguero lagoon across from Station 4, about 2 miles from inlet, at the edge of a river swamp forest. July 28, 1956. Ogren. Ogren field number 48. Mid-afternoon. Bottom sand (flats). Depth 1-3½ feet, shallows extending well out from shore. No current. Submerged aquatic plants (*Potamogeton* and *Najas*) present. Water turbid with a slight brown stain. Fish seined near bank.

Species: 22, 36, 41, 42, 49, 51, 52, 53.

Station 6 East bank of Tortuguero lagoon, about 2½ miles from inlet, in back of the sawmill at a boatshed and landing. Depth ½-6 feet. Water brown and brackish. Bottom sandy. Some hyacinths near shore, no other aquatic plants.

Station 6A. August 22, 1955. Giovannoli. Fish associated with hyacinth roots.

Species: 11, 40, 41, 42, 44, 46, 47, 49, 51, 55.

Station 6B. July 13, 1956. Ogren. Ogren field number 1. Time, 2400 hours. Falling tide, slight current. Fish, swimming at surface, collected by dipping with a seine with the aid of a headlight.

Species: 22.

Station 6C. July 13, 1956. Ogren. Ogren field number 2. Time, 2400 hours. Falling tide, slight current. Fish, swimming near the bare bottom in an open area, seined.

Species: 36, 49.

Station 6D. July 13, 1956. Ogren. Ogren field number 3. Time, 2400 hours. Falling tide, slight current. Fish, near bank around hyacinth roots, seined.

Species: 11, 12, 40.

Station 6E. July 15, 1956. Ogren. Ogren field number 4. Time, 1500 hours. Fish taken by seine near shore in an area that was baited with dead crabs.

Species: 9, 11, 22, 41, 47, 53.

Station 6F. July 16, 1956. Ogren. Ogren field number 5. Time, 1000 hours. Fish taken as at Station 6E.

Species: 9, 11, 16, 28, 41, 47, 49, 53.

Station 6G. July 17, 1956. Ogren. Ogren field number 7. Fish collected during morning and afternoon. Specimens taken as at Station 6E.

Species: 41, 55.

Station 6H. July 24, 1956. Ogren. Ogren field number 25. Time, 1500 hours. Depth 3 feet. Fish seined near sandy shore.

Species: 9, 11, 12, 13, 41, 47, 49, 55.

Station 6I. August 25, 1956. Ogren. Ogren field number 131. Time, 2130-2200 hours. Low tide. Fish collected with a dipnet by the light of a headlight.

Species: 22.

Station 6J. August 28, 1956. Ogren. Ogren field number 141. Time, 2200 hours. Water low, depth 4 feet. Some muck associated with sandy bottom. Fish

collected with dip net.

Species: 22.

Station 6K. July 9, 1958. Ogren. Ogren field number 420. Collected by dipnetting at night.

Species: 22, 23.

Station 6L. July 16, 1958. Ogren. Ogren field number 430. Collected by dipnetting in shallow water near bank, among drifting hyacinths. Incoming tide.

Species: 11, 22, 29, 33, 34, 46.

Station 6M. July 17, 1958. Ogren. Ogren field number 431. Time, 1900-2100 hours. Dipnetted. High tide.

Species: 6, 11, 19, 22, 29, 31, 33, 35, 36.

Station 6N. July 18, 1958. Ogren. Ogren field number 434. Dipnetted at night.

Species: 6, 11, 19, 22, 29, 30, 33, 34, 36, 46, 47, 55.

Station 6P. July 24, 1958. Ogren. Ogren field numbers 441 and 442. Fish caught in trap baited with coconut meat.

Species: 48, 55.

Station 6Q. July 27, 1958. Ogren. Ogren field number 448. Fish caught in trap baited with coconut meat and shrimp.

Species: 30, 31, 41, 43, 49.

Station 6R. July 30, 1958. Ogren. Ogren field number 452. Fish caught in trap baited with coconut meat.

Species: 40.

Station 6S. August 2, 1958. Ogren. Ogren field number 455. Fish seined during the late evening.

Species: 9, 11, 16, 29, 33, 36, 40, 41, 42, 43, 47, 50.

Station 6T. August 30, 1958. Ogren. Time, 2000 hours. Dipnetted.

Species: 23.

Station 7. Tortuguero lagoon across from Station 6, about 2½ miles from inlet. Shallow flats extending about 25 yards out into the river. Depth 1-3 feet. Sand bottom. Aquatic vegetation: *Potamogeton, Najas, Utricularia,* and filamentous green algae.

Station 7A. July 24, 1957. Ogren. Ogren field number 225. Night. Fish at surface, collected by hitting with a machete and by hand-grabbing.

Species: 15.

Station 7B. July 11, 1958. Ogren. Ogren field numbers 422, 423, and 424. Time, 1930-2100 hours. Incoming tide. Fish dipnetted.

Species: 14, 15, 22.

Station 8. East bank of Tortuguero lagoon, about 2 ¾ miles from inlet. September 2, 1956. Ogren. Ogren field number 155. Bottom muck. Slight current, estimated 2-3 mph. Water high, depth 6 feet. Water highly turbid, with some brown stain. Large fish taken near shore with hook and line. Eleotrids shaken from hyacinth roots.

Species: 31, 40, 43, 46, 48.

Station 9. At point of land, to the north, where the Tortuguero river enters the lagoon, about 3 miles from inlet. July 12, 1957. Stephen Carr. Ogren field number 205. Afternoon. Silt bottom. Hyacinths, while floating, attached to and growing well out from bank, along with *Panicum* grass. Fish collected with hook and line from deep water alongside hyacinths, shrimp bait.

Species: 38, 39.

Station 10. Near confluence of the Tortuguero river, Caño Moro and other creeks, and lagoon. Silty bottom. Hyacinths as at Station 9.

Station 10A. July 13, 1957. Ogren. Ogren field number 208. Night. Fish shaken from hyacinth roots.

Species: 46.

Station 10B. August 10, 1957. Ogren. Ogren field numbers 247 and 248. Night. Fish taken by hook and line with shrimp bait.

Species: 40, 41.

Station 11. Caño Moro, about 5 miles from inlet. September 9, 1956. Ogren. Ogren field number 176. Afternoon. Water deep, fresh, creek steep-banked. Fish collected with hook and line.

Species: 40.

Station 12. Tortuguero river, about 6 miles from inlet. August 26, 1956. Ogren. Ogren field number 136. Fish found dead near river.

Species: 10.

Station 13. Tortuguero river, about 8 miles from inlet. August 26, 1956. Ogren. Ogren field number 134. Mid-afternoon. Water fresh, highly turbid, brown stained. River in flood, current 2-3 mph. River, running through a river-swamp forest (no hardwoods), about 30-40 yards wide at point of collection. Spiny palm most abundant shore vegetation. Fish collected near shore. Cichlids, under hyacinths, taken with hook and line and shrimp bait. *Eleotris* shaken from hyacinth roots.

Species: 41, 43, 49.

Station 14. Small creek emptying into lagoon about ½ mile from inlet. Water clear, bottom sandy. Depth 1-3 feet. Dense *Potomogeton.*

Station 14A. August 19, 1958. Ogren. Ogren field number 461. Low tide. Fish collected with rotenone.

Species: 14, 17, 20, 31, 36, 43, 53.

Station 14B. September 3, 1958. Ogren. Ogren field number 475. Incoming tide. Fish collected with rotenone.

Species: 6, 7, 14, 15, 17, 18, 25, 26, 43, 49, 51, 52, 53, 55.

ANNOTATED LIST OF FISHES

Unless otherwise stated, in listing the specimens of each species, the first figure is the University of Florida Collections catalog number, the next, the number of specimens in the lot, the third (in parentheses) their size range (standard length) in millimeters, and finally, the station at which the fishes were collected.

CARCHARHINIDAE

1. *Carcharhinus* sp.

One specimen, approximately 5½ feet long, not saved, was taken at Station 2A; another shark, possibly also this genus, was taken at Station 4D. Teeth, UF 7173, Station 2B.

The first specimen was tentatively identified as *Carcharhinus leucas* (Müller and Henle) by Archie Carr, who caught the fish. His identification was based on a general familiarity with this species and with the keys and descriptions of sharks (studied later from memory) from BIGELOW and SCHROEDER (4). His identification is corroborated by the ecological and geographical data presented for this species by BIGELOW and SCHROEDER (4 : 341-43). The teeth are tentatively identified as this species also—by Stewart Springer, United States Fish and Wildlife Service.

CLUPEIDAE

2. *Sardinella anchovia* Valenciennes [1]

UF 5655, 9 (67 to 83), 1A.

3. *Harengula pensacolae caribbaea* Rivas

UF 5653, 14 (69 to 102), 1A.

4. *Opisthonema oglinum* (Lesueur)

UF 5654, 14 (66 to 98), 1A

ENGRAULIDAE

5. *Anchoviella* sp.

UF 5651, 1 (77), 1A.

Based on HILDEBRAND'S (15) keys ot the anchovies, this specimen would be identified as *A. pallida* (Starks). However, since it differed somewhat from HILDEBRAND'S description of *A. pallida,* the Costa Rican specimen was sent to Dr. Daniel Cohen, then of Stanford University, who compared it with the holotype of *A. pallida.* He has kindly given permission for his measurements to be included here, and they appear as Table 1. Since the Tortuguero example is in some ways more like *A. venezuelae* Fowler than *A. pallida,* Hildebrand's (15 : 135) measurements of the holotype and paratype of *A. venezuelae* are included in Table 1 for comparison. The Costa Rican specimen differs from the others, but since the differences seem to be of a lesser magnitude than those between *A. pallida* and *A. venezuelae* —which HILDEBRAND considered synonymous— no nameable taxonomic significance is presently ascribed to them. However, with the collection and study

[1] With the exception of *Oostethus lineatus* which follows, all references to a single author in species described by "Cuvier and Valenciennes" follow BAILEY (1).

of adequate samples of all three forms, three taxons may prove warranted. If, in reality, *A. pallida, A. venezuelae,* and the Tortuguero specimen are synonymous, the latter specimen apparently constitutes a range extension from Caño Guanoco, Venezuela (FOWLER, 12 : 407) to northern Caribbean Costa Rican, a shoreline distance of approximately 2000 miles.

TABLE 1

Selected counts and body proportions for three forms of Anchoviella *from Central and South America*

Character	*A.* sp.[1] (76.5 mm.)	*A. venezuelae*[2] (58 mm.) holotype	(63 mm.) paratype	*A. pallida* holotype (82 mm.)[1]	(80 mm.)[2]
Dorsal fin rays	14 or 15	14	12	14	14
Anal fin rays	24	25	26	24	24
Pectoral fin rays	14	13	12	13	13
Gill rakers on first left arch	37 + 45	33 + 40	—	—	34 + 45
Scale Rows	39	34	36	ca. 38	ca. 38
Standard length/ Character Specified					
Depth	3.3	3.8	3.9	3.6	3.5
Head	3.1	3.4	3.5	3.5	3.5
Postorbital head length	5.0	6.3	6.1	6.3	5.9
Anal base	4.7	3.6	3.5	3.7	3.5
Dorsal base	6.2	—	—	7.4	—
Predorsal length	1.9	—	—	1.9	—
Preanal length	1.6	—	—	1.6	—
Head length/ Character specified					
Snout	5.7	6.0	6.0	6.2	6.4
Horizontal diameter of eye	3.4	4.3	4.2	4.2	4.5

[1] Counts and measurements by Daniel M. Cohen
[2] Counts and measurements from Hildebrand (1943: 134-135)

6. *Anchoa lamprotaenia* Hildebrand

UF 7192, 1 (58), 6M; UF 7193, 1 (65), 6N; UF 7190, 288 (39-64), 14B.

Live-color notes made by Ogren show that the fishes have a silver cheek and lateral stripe. The body is white below the stripe, rather transparent above, and has scattered black pigment spots on the dorsum and posterioventer portions—in the latter region extending to the anal fin.

OPHICHTHIDAE

7. *Myrophis punctatus* Lütken

UF 7181, 3 (88-105), 14B.

CHARACIDAE

With the exception of UF 7134, identified by Caldwell, all of the material in this family was identified by James E. Böhlke of the Academy of Natural Sciences of Philadelphia.

8. *Hyphessobrycon tortuguerae* Böhlke

UF 5741, 1 (39.0), 4C, holotype; UF 5836, 3 (24.2-24.8), 4C, paratypes; ANSP 80986, 2 (26.8, 27.5), 4C, paratypes; ANSP 80987, 1 (27.5), 4C, paratype (cleared and stained).

This species was described from the Tortuguero material and discussed in detail by BOHLKE (6).

9. *Astyanax fasciatus æneus* (Günther)

UF 5727, 23 (21-64), 3; ANSP 80858, 12 (20-78), 3; UF 5740, 3 (24-45), 4C; UF 5834, 1 (78), 4D; UF 5744, 4 (46-61), 6E; ANSP 80860, 1 (60), 6E; UF 5751, 2 (43, 47), 6F; ANSP 80859, 2 (49, 61), 6F; UF 5835, 2 (62, 72), 6H; UF 7134, 9 (56-69), 6S.

The anal fin ray counts (by BOHLKE for the ANSP specimens, by Caldwell for the UF material) for these specimens were as follows; the last two rays, split to the base were counted as one:

iv,24	iv,25	iv,26	iv,27	iv,28	iv,29
3	17	16	17	3	3

Live-color notes made by Ogren show that the caudal, anal, and pelvic fins were brick red, with the upper and lower portions of the first and the leading edges of the latter two fins even brighter (and darker) than the rest of the fin. The dorsal and pectoral fins, while red, were much less intensely so. The dorsal portion of the body was metallic black, and the dark stripe on the caudal peduncle very conspicuous.

SYNBRANCHIDAE

10. *Synbranchus marmoratus* Bloch

UF 5799, 1 (about 150 mm total length), 12.

The specimen, mangled as if by a terrestrial predator, was found well back from the river on the forest floor.

POECILIIDAE

11. *Mollienesia sphenops* (Valenciennes)

UF 5782, 17 (25-68), 3; UF 5795, 32 (21-49), 4C; UF 5666, 35 (14-65), 6A; UF 5768, 2 (each 28), 6D; UF 5780, 1 (32), 6E; UF 5767, 2 (16, 19), 6F; UF 5827, 30 (25-74), 6H; UF 7151, 1 (51), 6L; UF 7145, 2 (15, 68), 6M; UF 7139, 1 (78), 6N; UF 7133, 4 (30-38), 6S.

Counting the last two rays, split to the base, as one, a sample of these specimens shows the following dorsal fin-ray counts:

8	9	10
9	41	3

As pointed out by CARR and GIOVANNOLI (9 : 17), the relationships of this species complex are still questionable, and though a number of subspecies have been described, no subspecific designation is definitely assigned the Tortuguero specimens. By description and geographical locale, the Tortuguero material fits well the nominal subspecific form *M. s. tropica* (Meek) as discussed by MEEK (25 : 117).

12. *Phallichthys pittieri* (Meek)

UF 5820, 4 (27-39), 4C; UF 5797, 1 (43), 6D; UF 5823, 1 (33), 6H.

In eye diameter and length of head, the specimens from Tortuguero more closely resemble *Poeciliopsis isthmensis* Regan than *P. pittieri* (see REGAN, 32 : 996-97). However, HUBBS (17 : 71), after examining series of both nominal forms, placed *P. isthmensis* in the synonomy of *P. pittieri,* and his decision is followed here. He also suggests (HUBBS, 16:10; 17:70) that both these forms may prove to be identical with *Phallichthys* [= *Poeciliopsis*] *amates* (Miller).

13. *Belonesox belizanus* Kner

UF 5807, 1 (32), 6H.

No previous record has been found for this species in Costa Rica.

BELONIDAE

14. *Strongylura marina* (Walbaum)

UF 7175, 8 (224-392), 7B; UF 7180, 2 (139, 160), 14A; UF 7186, 3 (168-204), 14B.

These specimens were tentatively identified by Frederick H. Berry, and the following comment is his: "In having 15 to 16 dorsal fin rays (modally 15), dorsal origin over 4th or 5th ray of anal fin, and the absence of a narrow dark raised line on the peduncle, these specimens are distinguishable, according to BREDER (7 : 24), from *Strongylura timucu* (Walbaum), their apparent closest relative. However, according to available literature,*S. timucu* would be the expected species in Costa Rica and if the identification of these specimens is correct, they apparently constitute a range extension in the western Atlantic from the continental waters of the United States".

HEMIRAMPHIDAE

15.*Hyporhamphus roberti* (Valenciennes)

UF 5375, 1 (117), 7A; UF 7174, 16 (87-186), 7B; UF 7185, 1 (70), 14B.

These specimens were identified by Frederick H. Berry, who is presently making a taxonomic study of this family in the western North Atlantic.

There is apparently no previous record for this species from Costa Rica. MILLER (29) states that it occurs from Panama southward, though BEEBE and TEE-VAN (2 : 63) listed it from Bermuda (as *H. hildebrandi* Jordan and Evermann) and JORDAN, EVERMANN, and CLARK (21 : 198) stated that it extends in its range north to Rhode Island, in the United States. Robert R. Miller writes that he collected specimens (now in the United States National Museum) in Guatemala in 1946-47.

PLEURONECTIDAE

16. *Citharichthys spilopterus* Günther

UF 5787, 2 (31, 42), 3; UF 5766, 1 (60), 6F; UF 7195, 3 (43-92), 6S.

SOLEIDAE

17. *Trinectes maculatus fasciatus* (Lacépéde)

UF 7178, 1 (17), 14A; UF 7187, 1 (19), 14B.

18. *Achirus lineatus* (Linnaeus)

UF 7188, 1 (25), 14B.

SYNGNATHIDAE

19. *Oostethus lineatus* (Valenciennes) [2]

UF 5833, 1 (83), 4F; UF 7191, 1 (77), 6M; UF 7194, 4 (79-90), 6N.

UF 5833 differs from the characters for this species as presented by HERALD (14 : 134) in that it has only 18 tail rings, while he gives a range of 23 to 27 in his key. Three of the other five Tortuguero specimens have 22 tail rings, and the other two 23. Three specimens of *O. lineatus* from the northern Atlantic coast of Florida (UF 6835, 6836, and 1811) were compared and the latter two were found to have 22 tail rings, while the first had 23. Of eight specimens from the Yateras River in Cuba (UF, uncataloged), two had 22, five had 23, and one had 24 tail rings. It is thus apparent that the range of variation in this character for this species of pipefish must be clarified.

20. *Pseudophallus mindii* (Meek and Hildebrand)

UF 7179, 3 (62-91), 14A.

---

[2] Rather than Valenciennes *in* Cuvier and Valenciennes, this should be cited as Valenciennes *in* Kaup, 1856, *fide* JORDAN and EVERMANN, 19 : 773

ATHERINIDAE

21. *Coleotropis* sp.

UF 5652, 1 (76), 1A.

This specimen, which is clearly a *Coleotropis* as defined by MYERS and WADE (30 : 136) and SCHULTZ (34 : key to genera of atherinids), seems to differ significantly from the only two nominal species presently ascribed to this genus - *C. blackburni* Schultz from Venezuela, and *C. starksi* (Meek and Hildebrand) from the Pacific coast of Panama. However, since all of the differences found are proportional, and thus possibly attributable to age or abnormality, and since only one specimen is at hand (despite serious efforts by Ogren to obtain others during the summers he was collecting), no specific name is presently applied to it. A detailed description (by Caldwell) is herewith presented and a photograph appears as Figure 2. Counts and measurements were taken and recorded in the manner described by SCHULTZ (34 : 5).

By comparing measurements of the Tortuguero specimen (76 mm) and the holotype (82 mm) and a paratype (45 mm) of *C. blackburni*—the latter two sets of figures from SCHULTZ (35 : 106)—the Costa Rican specimen differs markedly in the relationship of depth to standard length (16% as compared to 18.9 and 21. 2% for *C. blackburni* the character increasing with length in the latter species. Differences in the least depth of the caudal peduncle in relation to standard length (9 % in *Coleotropis* sp. as compared to 9.9 and 9.6 % for *C. blackburni*—the character also increasing with length in the latter species) and the length of the caudal peduncle (22 % of standard length in *Coleotropis* sp. as compared to 20.6 and 20.7% in *C. blackburni*) are much less marked, but contribute to the overall illusion of slimness in *Coleotropis* sp. It should be noted especially that the 76-mm Costa Rican fish is still slimmer than the 45-mm. specimen of *C. blackburni*. Thus since it more closely approaches in size the 82-mm specimen of *C. blackburni*, the proportional differences between the two larger fishes should be considered particularly significant. The Tortuguero specimen is a much slimmer fish than *C. blackburni*.

Detailed measurements of the Tortuguero fish are presented in Table 2. Also included in the table are the same measurements expressed as percent of standard length and as the number of times they may be divided into standard length. The measurements were taken with dividers and a ruler.

The following counts were made: Dorsal rays IV - 1, i, 7; anal rays 1, i, 21; pectoral rays i, 13 on each side; pelvic rays 1, 5 on each side; 15 branched caudal rays. 46 scale rows from the head to the mid-caudal base; 5 rows between the origin of the first dorsal fin and the lateral line and 4 rows between the lateral line and the anal fin origin.

Seven scales between the bases of the dorsal fins. 16 zig—zag rows of scales around the least depth of the caudal peduncle. Gill rakers 3 + 1 +16 on the first right gill arch.

TABLE 2

Selected measurements and body proportions for a 16 mm. Coleotropis *from Tortuguero, Costa Rica*

Character	Empirical Length (mm.)	Character as % of Standard Length	Standard Length/ Character
Head	16	21	4.8
Greatest depth	12.5	16	6.1
Snout	5	7	15.2
Bony orbit	4.5	6	16.9
Postorbital head length	7.5	10	10.1
Interorbital width	4.5	6	16.9
Caudal peduncle	16.5	22	4.6
Depth of caudal peduncle	6.5	9	11.7
Greatest head width	8	11	9.5
Pelvic insertion to anal origin	11	14	6.9
Snout to first dorsal origin	41.2	54	1.8
Snout to second dorsal origin	52	68	1.5
Snout to anal origin	39	51	1.9
Snout to pectoral insertion	19.9	26	3.8
Origin of first dorsal fin to origin of second dorsal fin	11	14	6.9
Anal fin origin to center of anus	3.5	5	21.1
Longest firts dorsal fin ray	5	7	15.2
Longest second dorsal fin ray	9.5	13	8.0
Longest anal fin ray	11	14	6.9
Longest pectoral ray	12	16	6.3
Longest pelvic fin ray	8.5	11	8.9
Last second dorsal ray	4.3	6	17.7
Depressed second dorsal fin	11.5	15	6.6
Depressed anal fin	25	33	3.0
Base of second dorsal fin	7	9	10.9
Base of anal fin	20.5	27	3.7
Accessory pelvic scale	3	4	25.3
Snout to pelvic fin origin	28.5	38	2.7
Snout to pectoral fin origin	17	22	4.5

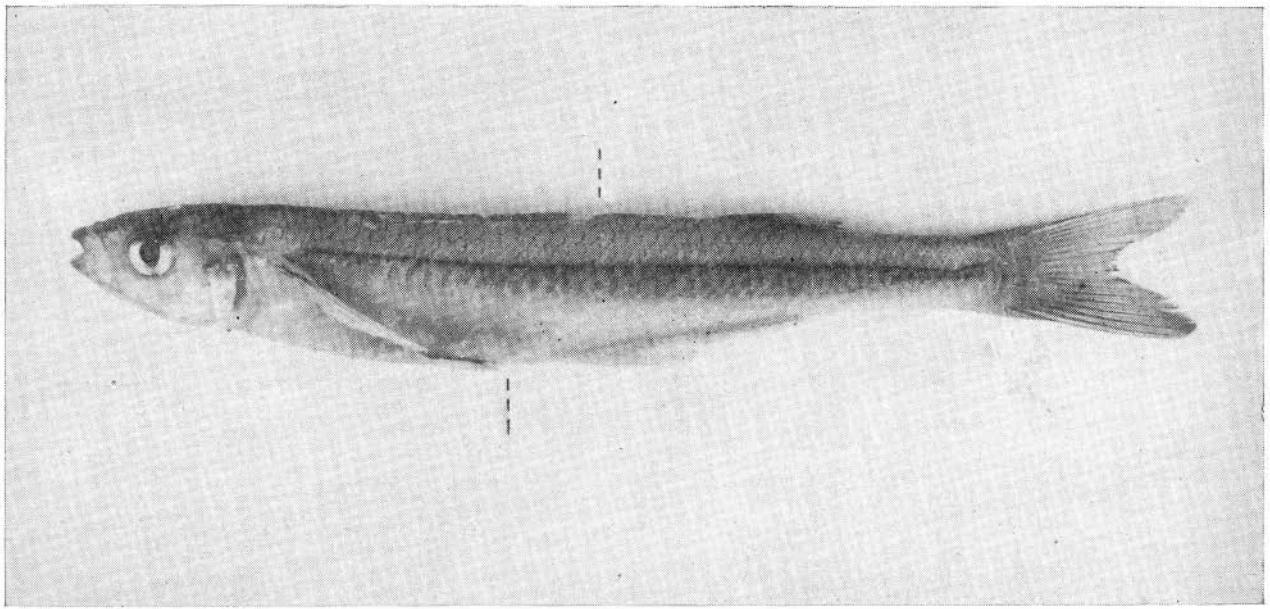

Fig. 2: *Coleotropis* sp., 76 mm. in standard length, UF 5652, from Tortuguero, Caribbean Costa Rica. Dotted lines indicate position of spinous dorsal origin and anus.

Into the length of the head, the snout may be divided 3.2 times, the orbit 3.6, the interorbital 3.6, and the postorbital 2.1 times.

The subjective description of *C. blackburni* (SCHULTZ, 35 : 108) fits the Tortuguero specimen in all respects except for the relationship of depth of caudal peduncle to its length (2 ½ in *Coleotropis* sp. as compared to less than 2 in *C. blackburni)* and the silver color of the lateral stripe. The silvery lateral stripe (band) is not present as such on the Tortuguero individual. Instead, it appears as a brown stripe which may, through an artifact of preservation, be all that remains of the silvery stripe. The brown band occupies exactly the same position on the fish, and has the same proportional relationships, as the silver one on *C. blackburni.* The other characters of dark pigment (as described by Schultz, 1949: 109) are the same on the Costa Rican specimen as they are on the Venezuelan ones.

One of the largest paratypes of *C. blackburni* was examined (on loan from the United States National Museum through the kindness of Dr. Schultz) by Caldwell and no differences other than noted above were readily discernible.

Coleotropis sp. differs from *C. starksi* in the depth of the body (much less in the former) and in the characters which distinguish *C. starksi* from *C. blackburni.*

The single specimen was taken on the open beach, and as none was taken in the river and lagoon nearby and since Ogren did not actually collect in the open surf, the lack of succes noted above in obtaining other specimens is possibly more a function of restricted ecological niche than actual rarity of the form in Costa Rica. MEEK and HILDEGRAND (27) did not list atherinids presently ascribed to *Coleotropis* from the Atlantic side of Panama, and Loren Woods writes that up to 1958 no specimens have been received by him from Panama. FOWLER (13) lists no *Coleotropis* from Colombia, nor have I seen any records for it anywhere in the Caribbean other than that of SCHULTZ (35 : 108). This apparent discontinuity in range between Venezuela and Costa Rica will perhaps be significant in determining the relationship between the Tortuguero specimen and *C. blackburni.* If, however, with the study of significant samples of both forms, they prove synonymous, the Costa Rican fish must represent a range extension of the Venezuelan one of approximately 1200 shoreline miles.

22. *Thyrinops chagresi* (Meek and Hildebrand)

UF 5786, 39 (41-92), 3; UF 5809, 5 (35-60), 5; UF 5811, 8 (29-54, 101, 103), 6B; UF 5793, 2 (42, 51), 6E; UF 5805, 12 (41-79), 6I; UF 5821, 4 (32-77), 6J; UF 7159, 2 (86, 94), 6K; UF 7148, 14 (39-83), 6L; UF 7142, 3 (52-90), 6M; UF 7141, 3 (95-98), 6N; UF 7171, 6 (99-106), 7B.

The use of the generic name *Thyrinops* Hubbs is based on the recent revisionary work of SCHULTZ (34 : 28). JORDAN and HUBBS (22 : 59) place the species in the genus *Thyrina* Jordan and Culver. MYERS and WADE (30 : 138) note this genus name is preoccupied, however, and show that *Melaniris* Meek should be applied to the species formerly included in *Thyrina.* SCHULTZ (34 : 30) restricts *Melaniris* to include a single Pacific drainage species, leaving *Thyrinops* as the next available generic name for the remaining species of *Thyrina.*

MEEK and HILDEBRAND (27 : pl. 20, fig. 1) are apparently in error in depicting the location of the origin of the first dorsal fin of their species. As they note in their description (p. 267), and as seen on the Tortuguero specimens, this fin originates well back of the anal fin origin.

Fish-eating bats (*Noctilio*) were seen (by Ogren) to prey on this species at Tortuguero. The method of hunting as exhibited by these bats has been described and illustrated in detail by BLOEDEL (5).

MUGILIDAE

23. *Mugil curema* Valenciennes

UF 5837, 5 (26-27), 3; UF 7158, 1 (258), 6K; UF 7168, 1 (199), 6T.

Although small, the specimens in UF 5837 agree closely with the characters for Central American *Mugil* as presented by MEEK and HILDEBRAND (27), and comparison with similar-sized specimens of *M. curema* from Georgia and closely-related *M. incilis* from Panama prove the identity of the small Costa Rican specimens to be the former species. William W. Anderson has made extensive studies on small mullets, and the initial identification is his. He collaborated with Caldwell on the final decision as to proper specific designation for these specimens. The large specimens clearly belong to this species.

POLYNEMIDAE

24. *Polydactylus virginicus* (Linnaeus)

UF 5656, 1 (45), 1A.

CARANGIDAE

All of the specimens in this family were identified by Frederick H. Berry, who has recently completed a comprehensive study (BERRY, 3) of young *Caranx* in the Western North Atlantic.

25. *Caranx latus* Agassiz

26. *Caranx hippos* (Linnaeus)

UF 5726, 5 (45-56), 3; UF 5848, 1 (51), 14B.
UF 5844, 2 (260, 297), 2B; UF 5847, 2 (44, 48), 14B.

27. *Oligoplites palometa* (Cuvier)

UF 5845, 3 (284-323), 2B.

CENTROPOMIDAE

28. *Centropomus ensiferus* Poey

UF 5828, 1 (20), 6F.

Since the specimen is quite small, the specific name *C. ensiferus* is assigned tentatively. However, based on a combination of characters given for members of this genus in the keys by MEEK and HILDEBRAND (28 : 419 f.) and SCHULTZ (35 : 115), the following counts made on the Tortuguero specimen seem to place this young individual to species: Dorsal VIII - 1, 10; anal III, 6; scales about 45-50 along the side; all gill rakers on lower limb of first arch 16.

29. *Centropomus pectinatus* Poey

UF 7152, 1 (42), 6L; UF 7160, 1 (61), 6M; UF 7161, 1 (38), 6N, UF 7167, 2 (40, 48), 6S.

30. *Centropomus parallelus* Poey

UF 7163, 1 (93), 6N; UF 7153, 1 (84), 6Q.

LUTJANIDAE

31. *Lutjanus jocu* (Bloch and Schneider)

UF 5843, 1 (120), 4E; UF 7143, 1 (37), 6M; UF 7157, 1 (138), 6Q; UF 5817, 1 (185), 8; UF 5850, 2 (18, 20), 14A.

RIVAS (33 : 152) notes that this species often ascends fresh waters.

POMADASYIDAE

32. *Pomadasys crocro* (Cuvier)

GERRIDAE

UF 5784, 27 (32-50), 3.

33. *Diapterus rhombeus* (Cuvier)

UF 5773, 4 (40-62), 3; UF 7147, 1 (36), 6L; UF 7146, 2 (39, 41), 6M; UF 7137, 4 (33-36), 6N; UF 7130, 9 (29-48), 6S.

In using the name *Diapterus rhombeus,* we follow SCHULTZ (35), much of whose discussion on gerrids is based on the unpublished revisionary work of Luis R. Rivas.

34. *Diapterus olisthostomus* (Goode and Bean)

UF 7149, 1 (56), 6L; UF 7135, 1 (49), 6N.

35. *Eugerres* sp.

At station 6M, Ogren collected a 203 mm gerrid which, on the basis of color (as noted by SCHULTZ, 35) appears to have belonged to this genus. Unfortunately, the specimen did not preserve properly and was discarded without gill-raker and fin-ray counts being made. According to Ogren, its total length was 223 mm, greatest depth 102 mm, and head length 65 mm. It had 13 distinct brown lateral stripes above, and 14-15 obscure ones below. The pelvic fins were yellow-orange toward the center; the anal similar in color, but less intense; the pectorals colorless; and the dorsal and caudal blue-black.

36. *Eucinostomus pseudogula* Poey

UF 5790, 2 (40, 46), 3; UF 5778, 1 (25), 5; UF 5829, 3 (22-29), 6C; UF 7144, 5 (34-56), 6M; UF 7136, 5 (39-62), 6N; UF 7131, 1 (42), 6S; UF 7169, 3 (15 each), 14A.

As for the other species in this family, I follow SCHULTZ (35). If the key to the genus *Eucinostomus* as presented by CURRAN (11) is utilized, the Costa Rican specimens would be identified as *E. melanopterus*.

SCIAENIDAE

37. *Ophioscion costaricensis* Caldwell

UF 5831, 1 (117), 1B, holotype; UF 5830, 1 (110), 1B, paratype.

This species was described from Tortuguero material and discussed in detail by CALDWELL (8).

38. *Micropogon furnieri* (Desmarest)

UF 5838, 4 (193 - 239), 9.

39. *Bairdiella ronchus* (Cuvier)

UF 5839, 5 (158-196), 9.

CICHLIDAE

40. *Cichlasoma friedrichsthali* (Heckel)

UF 5667, 5 (63-116), 4B; UF 5660, 1 (110), 6A; UF 5798, 3 (21-64), 6D;

UF 7166, 1 (96), 6R; UF 7128, 7 (28-117), 6S; UF 5816, 2 (144, 153), 8; UF 5840, 1 (107), 10B.

The specimens from Tortuguero agree well with the descriptions and keys presented for Central American cichlids by REGAN (31) and for Costa Rican cichlids by MEEK (25). HUBBS (18) and CARR and GIOVANNOLI (9) have discussed the relationships of this species with others closely allied to it.

The local name for *C. friedrichsthali* is "Guapote".

41. *Cichlasoma citrinellum* (Günther)

UF 5785, 1 (61), 3; UF 5819, 1 (84), 4D; UF 5810, 2 (20, 76), 5; UF 5659, 1 (86), 6A; UF 5792, 1 (55), 6E; UF5791, 3 (42-60), 6F; UF 5813, 1 (81), 6G; UF 5825, 3 (25-63), 6H; UF 7154, 1 (92), 6Q; UF 7126, 4 (33-71), 6S; UF 5841, 1 (139), 10B; UF 5802, 1 (111), 13.

MEEK (25 : 125) notes that this species had not been taken in lowland streams of Costa Rica, being listed as occurring in the highlands at an altitude of over 3000 feet and abundant in the Nicaraguan lakes Managua and Nicaragua. These specimens authenticate his speculation that it shold occur in lowland streams.

The local name for this species is "Crana".

42. *Cichlasoma centrarchus* (Gill and Bransford)

UF 5789, 1(75), 3; UF 5822, 2 (19, 62), 5; UF 5561, 3 (15-35), 6A; UF 7132, 1 (42), 6S.

The Tortuguero specimens fit well the descriptions and keys given by REGAN (31) and MEEK (24). Though both these authors list the habitat of *C. centrarchus* as the nearby Lake Nicaragua, no previous record has been found for its occurrence in Costa Rica.

43. *Cichlasoma maculicauda* Regan

UF 5803,1 (75), 4D; UF 7155, 1 (43), 6Q; UF 7129, 1 (64), 6S; UF 5818, 3 (150-191), 8; UF 5801, 2 (180, 182), 13; UF 7170, 5 (24-29), 14A; UF 7182, 143 (10-12), 14B.

MEEK (25 : 127) noted that this species had not yet been recorded from Costa Rica, but stated that since it occurs in lowland streams and sometimes brackish water, in Guatemala and Panama, it should be expected in similar habitats in Costa Rica.

Ogren noted that 2 large adults of this species were in their vicinity when the very small individuals from station 14B were collected, perhaps indicating parental care by this species.

The Mosquito-indian name for this species is "Tuba", which means "Friend". The name is in reference to the almost universal availability of the fish in the area, and the indian along the river feels that as long as he has his ever-carried handline and some sort of bait (usually some of the shrimps which abound in the roots of the water hyacinths) he will not starve.

44. *Herotilapia multispinosa* Günther

UF 5662, 2 (80, 91), 6A.

DACTYLOSCOPIDAE

45. *Dactylagnus* sp.

UF 7176, 1 (44), 1C.

A description of this specimen, representing an undescribed form, will be published elsewhere at some future date by Böhlke and Caldwell.

ELEOTRIDAE

46. *Dormitator maculatus* (Bloch)

UF 5806, 2 (35, 45), 4F; UF 5663, 28 (10-53), 6A; UF 7150, 3 (16-19), 6L; UF 7138, 1 (45), 6N; UF 5808, 1 (65), 8; UF 5842, 1 (75), 10A.

These specimens seem to belong to the large-headed group of this species as described by JORDAN and EVERMANN. (20 : 2196)

47. *Gobiomorus dormitor* Lacépéde

UF 5783, 4 (36-61), 3; UF 5665, 1 (21), 6A; UF 5770, 1 (44), 6E; UF 5769, 2 (54, 56), 6F; UF 5826, 3 (50-82), 6H; UF 7162, 1 (101), 6N; UF 7127, 2 (85, 89), 6S.

48. *Eleotris pisonis* (Gmelin)

UF 7164, 1 (280), 6P; UF 5765, 1 (87), 8.

49. *Eleotris amblyopsis* (Cope)

UF 5788, 2 (32, 41), 3; UF 5669, 2 (20, 21), 4B; UF 5763, 2 (58, 67), 4F; UF 5775, 18 (24-67), 5; UF 5664, 43 (14-70), 6A; UF 5774, 3 (22-35), 6C; UF 5776, 3 (24-33), 6F; UF 5782, 1 (34), 6H; UF 7156, 1 (66), 6Q; UF 5832, 1 (62), 13; UF 5849, 12 (19-47), 14B.

No reason was found, on the basis of available literature, to distinguish this species from *E. isthmensis* Meek and Hildebrand. The characters which they give for their new species (MEEK and HILDERBAND, 26 : 359) seem to overlap those given for the older-named *E. amblyopsis* by JORDAN and EVERMANN (20 : 2199).

50. *Microeleotris mindii* Meek and Hildebrand

UF 7196, 4 (34-42), 6S.

GOBIIDAE

51. *Garmannia spes* Ginsburg

UF 5779, 2 (23, 24), 5; UF 5670, 1 (23), 6A; UF 7184, 1 (20), 14B.

52. *Evorthodus lyricus* (Girard)

UF 5771, 1 (37), 4C; UF 5764, 2 (25, 32), 5; UF 7189, 1 (35), 14B.

53. *Gobionellus claytonii* (Meek)

UF 5804, 14 (20-49), 3; UF 5796, 2 (23, 31), 4C; UF 5800, 4 (26-51), 5; UF 5794, 3 (28-41), 6E; UF 5777, 1 (25), 6F; UF 7177, 4 (10-28), 14A; UF 7183, 12 (26-44), 14B.

ECHENEIDAE

54. *Echeneis naucrates* Linnaeus

UF 5657, 1 (155), 2A; UF 7172, 2 (111, 170), 2B; UF 5814, 1 (174), 4D.

TETRAODONTIDAE

55. *Sphoeroides testudineus* (Linnaeus)

UF 5772, 1 (87), 3; UF 5668, 3 (90-122), 4A; UF 5658, 1 (92), 6A; UF 5812, 4 (92-103), 6G; UF 5824, 1 (99), 6H; UF 7140, 2 (70, 121), 6N; UF 7165, 3 (70-124), 6P; UF 5846, 3 (41-50), 14 B.

RESUMEN

Se presenta una lista anotada de peces recogidos en las cercanías de Tortuguero, en la costa atlántica de Costa Rica, durante los meses de julio a septiembre de 1955 por L. Giovannoli y de 1956-58 por L. H. Ogren, o por compañeros de éstos. Las localidades descritas se indican en el mapa, fig. 1; junto a la descrip-

ción de las condiciones en que se hizo cada colección se anotan las especies recogidas, numeradas según la lista sistemática presente. Al enumerar las especies en esta última, se indican las localidades, el número de ejemplares en cada colección, la longitud en milímetros, a menos que se indique otra cosa, de la punta del hocico a la base de los radios caudales medios.

LITERATURE CITED

1. BAILEY, R. M.
   1951. The authorship of names proposed in Cuvier and Valenciennes' "Histoire Naturelle des Poissons" *Copeia,* 1951, 3 : 249-251.

2. BEEBE, W., & J. TEE-VAN.
   1933. *Field book of the shore fishes of Bermuda.* New York: G. P. Putnam's Sons, pp. vii-xvi + 1-337, illus.

3. BERRY, F. H.
   [MS] *Development, distribution, and identification of young jack crevalles* (Caranx) *off the Atlantic coast of the southeastern United States.* U. S. Fish and Wildlife Serv., Fish. Bull., *in press.*

4. BIGELOW, H. B., and W. C. SCHROEDER.
   1948. Sharks. *In* Tee-Van, J.; *Fishes of the western North Atlantic.* New Haven: Sears Foundation, Bingham Oceanogr. Lab., pp. 59-576.

5. BLOEDEL, P.
   1955. Hunting methods of fish-eating bats, particularly *Nocteilio leporinus. Jour. Mammal.,* 36, (3) : 390-399.

6. BÖHLKE, J. E.
   1958. Studies on fishes of the family Characidæ. N° 16. A new *Hyphessobrycon* from Costa Rica. *Bull. Florida State Mus., Biol. Sci.,* 3 (4): 173-178, 1 fig.

7. BREDER, C. M., Jr.
   1932. On the habits and development of certain Atlantic Synentognathi. *Papers from Tortugas Lab.,* 28, (1) : 1-35, 10 figs., 12 pls.

8. CALDWELL, D. K.
   1958. A new fish of the genus *Ophioscion.* family Sciaenidæ, from Caribbean Costa Rica. *Quart. Jour. Florida Acad. Sci.* 21 (2): 117-124, 1 fig.

9. CARR, A., & L. GIOVANNOLI
   1950. The fishes of the Choluteca drainage of southern Honduras. *Occas. Pap. Mus. Zool., Univ. Michigan,* No. 523, pp. 1-38, 2 pls.

10. CARR, A., & L. GIOVANNOLI
    1957. The ecology and migrations of sea turtles, 2. Results of field work in Costa Rica, 1955. *Amer. Mus. Novitates,* No. 1835, pp 1-32.

11. CURRAN, H. W.
    1942. *A systematic revision of the gerrid fishes referred to the genus* Eucinostomus, *with a discussion of their distribution and speciation.* Unpublished doctoral dissertation, University of Michigan.

12. FOWLER, H. W.
1931. Fishes obtained by the Barber Asphalt Company in Trinidad and Venezuela in 1930. *Proc. Acad. Nat. Sci. Philadelphia,* 83: 391-410.

13. FOWLER, H. W.
1953. The shore fishes of the Colombian Caribbean. *Caldasia,* 6 (27): 43-73.

14. HERALD. E. S.
1942. Three new pipefishes from the Atlantic coast of North and South America, with a key to the Atlantic American species. *Stanford Ichthyol. Bull.,* 2 (4) : 125-134.

15. HILDEBRAND, S. F.
1943. A review of the American anchovies (Family Engraulidae). *Bull. Bingham Oceanogr. Coll.,* 8, art. 2: 1-165.

16. HUBBS, C. L.
1924. Studies of the fishes of the order Cyprinodontes. *Univ. Michigan Mus. Zool., Misc. Publ.,* No. 13: 1-31, 4 pls.

17. HUBBS, C. L.
1926. Studies of the fishes of the order Cyprinodontes. VI. *Univ. Michigan Mus. Zool,. Misc. Publ.,* No. 16: 1-87.

18. HUBBS, C. L.
1935. Fresh-water fishes collected in British Honduras and Guatemala. *Univ. Michigan Mus. Zool., Misc. Publ.,* No. 28: 3-22, 4 pls., 1 map.

19. JORDAN, D. S., & B. W. EVERMANN.
1896. The fishes of North and Middle America. *Bull. U. S. Natl. Mus.* 47, pt. 1, p. i-lx + 1-1240.

20. JORDAN, D. S., & B. W EVERMANN
1898. The fishes of North and Middle America. *Bull. U. S. Natl. Mus.* 47, pt. 3, pp. v-xxiv + 2183[a]-3136.

21. JORDAN, D. S., B. W. EVERMANN, & H. W. CLARK
1930. Check list of the fishes and fishlike vertebrates of North and Middle America north of the northern boundary of Venezuela and Colombia. *Rept. U. S. Comm. Fish.,* 1928, pt. 2: 1-670.

22. JORDAN, D. S., & C. L. HUBBS
1919. Studies in Ichthyology. A monographic review of the family of Atherinidae or silversides. *Leland Stanford Junior Univ. Publ., univ. ser.,* pp. 1-87, 12 pls.

23. KAUP, J. J.
1856. *Catalogue of the lophobranchiate fish in the collection of the British Museum.* London, 1856. (Ref. copied).

24. MEEK, S. E.
1907. Synopsis of the fishes of the Great Lakes of Nicaragua. *Field Columbian Mus., Zool. Ser.,* 7 (4): 97-132.

25. MEEK, S. E.
1914. An annotated list of fishes known to occur in the fresh waters of Costa Rica. *Field Mus. Nat. Hist., Zool Ser.,* 10 (10) : 101-134.

26. MEEK, S. E., & S. F. HILDEBRAND
1916. The fishes of the fresh water of Panama. *Field Mus. Nat. Hist., Zool. Ser.,* 10 (15) : 217-374.

27. MEEK, S. E., & S. F. HILDEBRAND
1923. The marine fishes of Panama. *Field Mus. Nat. Hist., Zool. Serv.,* 15 (1) : v-xi + 1-330.

28. MEEK, S. E., & S. F. HILDEBRAND
1925. The marine fishes of Panama. *Field Mus. Nat. Hist., Zool. Ser.,* 15 (2) : xv-xix + 331-707.

29. MILLER, R. R.
1945. The use of the names *Hyporhamphus roberti* and *Hyporhamphus hildebrandi* for the same halfbeak fish of tropical America. *Copeia,* 1945 (4) : 235.

30. MYERS, C. S., & C. B. WADE
1942. The Pacific American atherinid fishes of the genera *Eurystole, Nectarges, Coleotropis,* and *Melanorhinus. Allan Hancock, Pacific Exped.* 9 (5) : 113-149, 3 pls.

31. REGAN, C. T.
1906-08. Pisces. *In Biologia Centrali-Americana,* 8: i-xxxiii + 1-203, 26 pls.

32. REGAN, C. T.
1913. A revision of the cyprinodont fishes of the subfamily Poeciliinae. *Proc. Zool Soc., London,* 58 (4) : 977-1018, 3 pls.

33. RIVAS, L. R.
1949. A record of lutjanid fish (*Lutjanus cyanopterus*) for the Atlantic coast of the United States, with note on related species of the genus. *Copeia,* 1949 (2) : 150-152.

34. SCHULTZ, L. P.
1948. A revision of six subfamilies of atherine fishes, with descriptions of new genera and species. *Proc. U. S. Natl. Mus.,* 98 : 1-48, 2 pls.

35. SCHULTZ, L. P.
1949. A further contribution to the ichthyology of Venezuela. *Proc. U. S. Natl. Mus.,* 99 : 1-211, 3 pls.

BIBLIOGRAPHY

In addition to the papers noted in the section on Literature Cited, many of which were helpful in identifying species other than those for which the paper is cited, the following publications were found to be particularly useful in the study of the Tortuguero material. The combined lists also summarize the majority of the papers which deal directly with the ichthyofauna of Costa Rica.

FOWLER, H. W.
1903. Notes on a few fishes from the Mosquito Coast of Nicaragua. *Proc. Acad. Nat. Sci. Philadelphia,* 55: 346-350.
1916. Cold-blooded vertebrates from Costa Rica and the Canal Zone. *Ibid.* vol. 68, pp. 389-414, 4 figs.
1923. Fishes from Nicaragua. *Ibid.,* vol. 75, pp. 23-32.

GINSBURG, I.
1932. A revision of the genus *Gobionellus* (Family Gobiidae). *Bull. Bingham Oceangr. Coll.,* vol. 4. art. 2, pp. 1-51.
1933. A revision of the genus *Gobiosoma* (Family Gobiidae) with an account of the Genus *Garmannia. Ibid.,* vol. 4, art. 5, pp. 1-59.
1944. A description of a new gobiid fish from Venezuela, with notes on the genus *Garmannia. Jour. Wash. Acad. Sci.,* vol. 34, no, 11, pp. 375-380.

GÜNTHER, A.
1868. An account of the fishes of the states of Central America, based on collections made by *Capt. J. M. Dow, F. Godman, Esq.,* and *O. Salvin, Esq. Trans. Zool. Soc. London,* 6 (7): 377-494, pls. 64-87, 1 map.

HILDEBRAND, S. F.
1925. Fishes of the Republic of El Salvador, Central America. *Bull. U. S. Bur. Fish.,* 41:237-287.
1938. A new catalogue of the fresh-water fishes of Panama. *Field Mus. Nat. Hist., Zool. Ser.,* 22 (4): 215-359.

JORDAN, D. S., & B. W. EVERMANN.
1898. The fishes of North and Middle America. *Bull. U. S. Natl. Mus.,* 47 (2): i-xxx + 1241-2183.
1900. [Same title] *Ibid.,* no. 47, pt. 4, pp. i-ci + 3137-3313.

MEEK, S. E.
1906. Description of three new species of fishes from Middle America. *Field Columbian Mus., Zool. Ser.,* 7 (3): 93-95.
1908a. Notes on fresh-water fishes from Mexico and Central America. *Ibid.,* vol. 7, no. 5, pp. 133 157.
1908b The zoology of Lakes Amatitlan and Atitlan, Guatemala, with special reference to ichthyology. *Ibid.,* vol. 7, no. 6 pp. 159-206.
1909. New species of fishes from tropical America. *Ibid.,* vol. 7, no. 7, pp. 207-211.
1912. New species of fishes from Costa Rica. *Field Mus. Nat. Hist., Zool. Ser.,* 10, (7): 69-75.

MEEK, S. E., & S. F. HILDEBRAND.
1912. Descriptions of new fishes from Panama. *Field Mus. Nat. Hist., Zool. Ser.,* vol. 10, no. 6, pp. 67-68.
1913. New species of fishes from Panama. *Ibid.,* vol. 10, no. 8, pp. 77-91.
1928. The marine fishes of Panama. *Ibid.,* vol. 15, pp. xxv - xxxi + 709-1045.

NORMAN, J. R.
1934. *A systematic monograph of the flatfishes* (Heterosomata). *Vol. 1.* Psettodidae, Bothidae, Pleuronectidae. London: British Museum (Natural History), viii + 459 pp., 317 figs.

PARR, A. E.
1930. Teleostean shore and shallow-water fishes from the Bahamas and Turks Island. *Bull. Bingham Oceanographic Coll.,* 3, (4): 1-148, 38 figs.

RIVAS, L. R.
1950. A revision of the American clupeid fishes of the genus *Harengula,* with descriptions of four new subspecies. *Proc. U. S. Natl. Mus.,* 100: 275-309.

SCHULTZ, L. P.
1945. Three new sciaenid fishes of the genus *Ophioscion* from the Atlantic coasts of Central and South America. *Proc. U. S. Natl. Mus.,* 96: 123-137.

STOREY, MARGARET.
1938. West Indian clupeid fishes of the genus *Harengula* with notes on *H. thrissina* from the Pacific coast. *Stanford Ichthyol. Bull.,* 1 (1): 3-56,