
*The Fishes of the Rio Chucunaque Drainage,
Eastern Panama*

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**Article III.—THE FISHES OF THE RIO CHUCUNAQUE
DRAINAGE, EASTERN PANAMA**

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INTRODUCTION

The Rio Chucunaque, a part of the Pacific drainage of Eastern Panama occupying a considerable portion of the Province of Darien, had never been explored from a zoölogical standpoint up to the time of entry

of the Marsh-Darien Expedition. The chief reason for this neglect seems to have been the persistent reports of hostile Indians within the area it traverses. Today, however, there is no material reason to keep students from this river system, which in many respects is rather similar to others fairly well known and, except for the normal difficulties to be encountered in exploring any of this section of the American tropics, there appear to be no unusual obstacles. The legends of war-like Indians have, however, been sufficient to keep out all biologists up to this time. Even as late as 1916, Meek and Hildebrand state in brief reference to the Chucunaque: "This stream lies almost wholly within the San Blas region. Its exploration was therefore not undertaken." This simple statement they considered as sufficient explanation as to why they did not ascend the river in their study of the fishes of Panama, so prevalent has been the belief in the danger of the area. Whatever conditions may have obtained in the past, or how the natives would regard a small or poorly equipped outfit, it is certain that our well equipped party, consisting of ten white men and an equal number of blacks, encountered no serious difficulties with the Indians. See Breder, 1925*c*, for further details regarding general field experiences.

The primary scientific objects of the expedition were anthropological and ethnological but my personal concern was with the herpetology and secondarily with the ichthyology of the region, in the interests of The American Museum of Natural History. The presence of myself as well as of the students of other sciences was due entirely to the financial generosity and public spirit of R. O. Marsh, and I wish to take this opportunity to thank him for making it possible for me to gather the large amount of data which was accumulated on our memorable trip, on a part of which this paper is based.

The time spent afield in this drainage extended from February 9, 1924, the date of our entry at the mouth of the river, to May 8, when we crossed over the continental divide into the Atlantic drainage, making approximately three months, a rather small portion of which was devoted to studying and collecting fishes.

Dr. Samuel F. Hildebrand, of the U. S. Bureau of Fisheries, the ichthyologist who explored the most closely adjacent region and who is thoroughly conversant with the fauna, having actually taken part in the description of nearly thirty per cent of the species we encountered, has been of very great aid to me in taxonomic matters. I am likewise indebted to Dr. W.K. Gregory, Mr. J. T. Nichols and Dr. E. W. Gudger of the American Museum for various suggestions and criticisms, and to my father for editorial assistance.

The object of the field work was to obtain a representative collection of fishes from this neglected drainage in series sufficiently large, if possible, to cast some light on their life histories, especially by use of the statistical method.

Therefore, the present paper, aside from being a regional list, is a presentation of various data on habits, life histories and general natural history as revealed in the field and subsequently in the laboratory. It is hoped that by this method of approach a maximum degree of utility will be attained, especially in view of the small amount of data, other than descriptive and distributional, extant on the fishes of Central and Northern South America. The present paper, coupled with the report by Meek and Hildebrand on the fishes of the Rio Tuyra contained in 'The Fishes of the Fresh Waters of Panama,' 1916, covers it is believed the fish fauna of the Tuyra basin, of which the Chucunaque is a part, in a fair approach to completeness. In the expectation that this territory will be developed commercially in a comparatively short time, with probably a considerable disturbance of the present primeval conditions, the discussion of the present status in all respects is given rather fully. A key to the fishes known from this basin is inserted for the convenience of others concerned with the fishes of this basin. Some philosophic discussion is added, as suggested by the conditions found in the region under consideration.

METHODS

FIELD METHODS.—Many methods of collecting were employed and approximately in the following order of frequency. Seine, 40- and 20-foot; fish trap, eel-pot type; dip net, various sizes and styles; hook and line; dynamite; poison. Aside from the specimens preserved, many others were examined, including those taken by the natives for food. Often when large series were taken they were measured, opened, and examined in the field. It is on these, as well as those preserved and subsequently examined in the laboratory that the various statistical data are based.

LABORATORY METHODS.—Aside from the identifications, all specimens were measured, and most were examined internally, for stomach contents and state of gonads. These data were then used for the statistical studies, the digested results of which are presented here in a more readily available form.

THE AQUATIC HABITAT

The geographical location of the Rio Chucunaque is indicated clearly on the accompanying map, Figure 1. This river and its tributaries run through unbroken, virgin jungle for nearly their entire lengths. The negro village of Yavisa, not far distant from its mouth, is the only settlement that we found on the main river, save for a few scattered huts, the Indians living only on the numerous tributary streams. These villages form the only breaks in the otherwise solid jungle walls flanking either shore. Up to and beyond the mouth of the Rio Membrillo the Chucunaque wanders through a plain, as its meandering indicates. The exact width of this we did not determine, on account of the dense growth flanking the stream, although numerous excursions proved that it must be considerable. Above this point the hills begin to close in slowly and the river straightens out very slightly. The Rio Sucubti, up which we branched on our main trip, runs rapidly up into the Serriana del Darien, and we were here confronted by a series of difficult rapids over which we spent much time and effort.

In most places the vegetation reaches to the water and overshadows its edges, while in some a fringing beach delimits water from jungle. The almost complete lack of aquatic vegetation of this drainage system was rather unexpected. This might have been anticipated in the lower turbid and tidal portion of the river, but hardly in the clear upper part. Aside from small patches of filamentous algæ, nothing was seen except a small amount of *Azzola* just below the mouth of the Rio Membrillo, and from there upwards a small amount of a *Lemna*-like form was occasionally seen mixed with it. This is the total number of aquatic plants seen. None whatever of the entirely submerged species were found. On the other hand, numerous reed-like forms growing along the banks with just their roots submerged were common. However, much submerged brush was encountered especially on the upper courses, and this formed excellent cover for fishes which might be expected in weedy places. How the floating aquatic plants are able to withstand the tremendous floodings to which these streams are subject in the rainy season is not clear.

The great Pacific tides have their effect on the Chucunaque about as far inland as the mouth of the Rio Canglon (Plate III, A). This makes a very unpleasant river on its lower reaches, as extensive mud flats flanking both banks are exposed on each receding tide. Just below Yavisa, at our first base camp, the rise and fall of tide was carefully studied by Dr. H. L. Fairchild of the University of Rochester, who found the extreme differences in the water level, as recorded by him, to amount to

six feet. The spring tides at Panama City sometimes reach seventeen feet. Realizing this, it is not hard to understand the great tidal variation so far inland in this stream that travels for such a distance at practically its base level. Figure 2 graphically presents the tidal periods, which, of course, are modified by the constant flow seaward of the fresh water. This diagram is based on Dr. Fairchild's observations.

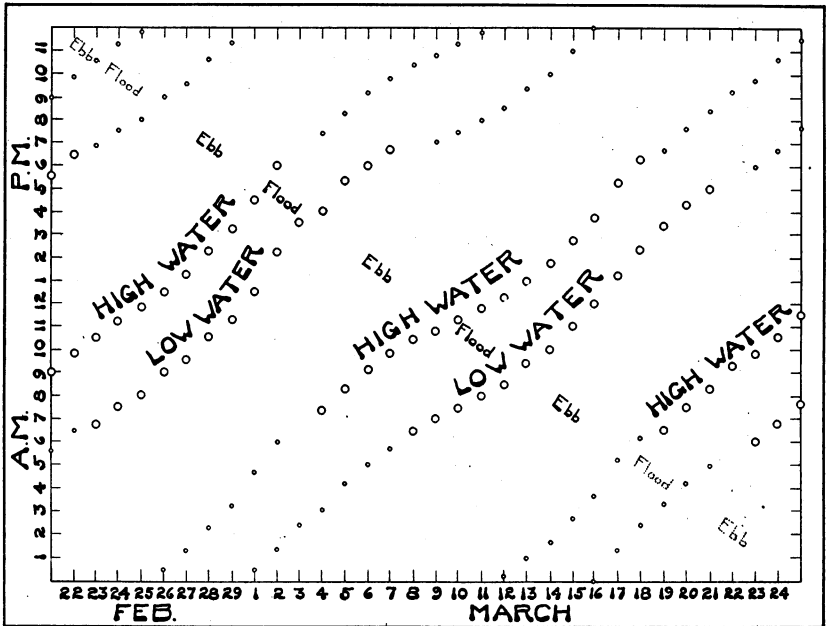


Fig. 2. The tides in the Rio Chucunaque, near Yavisa, between February 21 and March 25, 1924. Based on observations made by Dr. H. L. Fairchild.

The large circles indicate observed times of high and low water. The small circles indicate projected times after nightfall. High water is here understood to mean the highest reach of tide immediately after the passage of the somewhat higher crest of the bore that rapidly passes as the tide rushes up stream.

As a result of these tides, the lower reaches are bottomed with soft flocculent mud for most part, except where some current sweeps clean a sand or gravel bar (Plate II, A). The upper reaches, above the effect of tide, are bottomed chiefly by a soft, decomposing, calcareous rock, while on the side streams boulders make their appearance, graduated in size, becoming extremely large as the foot hills are approached.

The temperatures of the various waters were taken irregularly and only as more important duties allowed. They are all given graphically in

Figure 3 with the localities referable to the map, Figure 1. The general decline in temperature as the river was ascended, and also the cooling effect of quantities of rain water entering the streams is likewise indicated.

While it is not the purpose of this paper to discuss the life zones of this region, it may not be out of place to call attention to the general features.¹ Goldman, 1920, shows theoretical conditions on his map essentially as we found them. As I interpret his criteria of zonal regions, however, the following slight extensions in detail may be made. A "tongue" of the arid lower tropical zone follows up the Chucunaque to about the mouth of the Rio Membrillo, similar to that he found and showed on his map following up the Rio Tuyra. A very small extension of the humid lower tropical zone extends toward the junction of the Chucunaque and Tuyra, changing conditions markedly on the upper courses of the two small streams collected in near our Yavisa camp. A small "tongue" of the arid lower tropical zone follows up each of the side streams below the Membrillo also, but for only a very short distance. At the extreme headwaters of the Rio Sucubti and its tributaries, near the continental divide, a narrow ribbon of the upper tropical zone is encountered, but, once over the divide, one is immediately plunged again into the humid lower tropical zone. This is in keeping with Goldman's views as to the upper tropical zone dropping down rather low on the south side of these mountains, dependent on their altitude, and, although he does not show it on his map, it seems likely that a slight band of this zone runs for considerable distance, with few interruptions, along this slope of the divide.

Detailed data as to the conditions obtained in the various streams are given separately under the heading "Distribution of the Chucunaque Fishes," pages 143 to 152.

THE FISHES OF THE RIO CHUCUNAQUE DRAINAGE

ANNOTATED LIST OF SPECIES

The following list of species is annotated as fully as the available material would allow. In order to make the data as convenient as possible for reference it has been arranged for each species according to various subheads. These cover not only the particular data which they ordinarily imply but also related data, not sufficiently distinct to warrant a new caption, those that are used being selected for their brevity and conciseness. The following explanations are given as a guide.

¹A more complete treatment of the life zones of this region will be given elsewhere, as the fishes do not show a very great response to the changes which so strongly impress the terrestrial forms of this region. Such effect as has been noted is mentioned under the section "Distribution of the Chucunaque Fishes."

VARIATION.—Individual variations deemed worthy of note, especially if they exceed the limits set by descriptions from other localities.

OCCURRENCE.—Places of greatest abundance, types of environment associated with, and all related data.

GROWTH.—Rates of growth, times of spawning, sizes at which maturity is attained, probable lengths of spawning seasons, sizes of gonads, eggs, and all related data.

FOOD.—Examinations of stomach contents, feeding habits, types of alimentary tracts, and all related data.

BEHAVIOR.—Miscellaneous notes based on field observations of the activities and not especially related to any of the preceding headings.

SPECIMENS.—Number of examples preserved and their range of sizes (mm. in standard lengths). Periods of collecting and localities of all examples identified including those not preserved. The localities mentioned are either named on the map, Figure 1, or are explained in the section on distribution, pages 143 to 152.

In cases where data are insufficient some of the headings are omitted, and in others some self-explanatory ones are added. No synonymy is given, as it is felt to be superfluous in view of the recent papers by Meek and Hildebrand, 1916, and Eigenmann, 1922, especially as the nomenclature of the latter is followed practically throughout. Under the heading "Growth" some tentative inferences are drawn, which, while not proven fact, will, it is hoped, serve as a guide to others. The data are far from exhaustive, being frequently exceedingly fragmentary, but, since there has been such a paucity of other than purely taxonomic and distributional work on these fishes as previously noted, it is believed that any information will be of use in building a foundation on which to erect a comprehensive knowledge of this fascinating faunal region. Whilst this is primarily a regional list of an hitherto untouched area, there is nothing unexpected in its content, which fits in normally with the adjacent drainages. It is believed that the data presented give concrete evidences of the reasons for the views expressed in other parts of the paper.

Pristidæ

***Pristis microdon* Latham**

VARIATION.—Five examples showed the following variations in the number of rostral teeth.

Right Side	18	18	20	21	21
Left Side	18	18	20	19	21

OCURRENCE.—Common in the Rio Chucunaque even far above tide water. Seen as far inland as the mouth of the Rio Membrillo, where it is apparently stopped by rather shallow, but steep rapids. Taken as far up the Rio Chico as ascended. In purely fresh waters it was seen most frequently lying on sandy bottoms in rather deep and quiet pools.

GROWTH.—Only small examples were found and conversation with the natives failed to reveal a knowledge of larger specimens. The innumerable “saws” seen at the villages were all from fish of about the size taken. Eight examples ranged from 770 to 965 mm. and showed a mode of 850 mm. Three of these showed the following proportions in mm.

Total Length	Length of Saw	Span of Pectorals
864	216	241
889	229	241
965	247	254

FOOD.—All that were found to contain food had their stomachs and spiral valves full of decapod remains alone, except one which held a trace of vegetable matter, possibly engulfed accidentally.

BEHAVIOR.—The natives have a wholesome fear of these fish, the belief running that they maliciously attempt to strike with their armed rostrum even when out of water. Being naturally sceptical, I held a seined specimen by its tail and watched its contortions at some length, fully expecting it to swing harmlessly pendulum-wise from side to side. It was somewhat of a surprise to see it twist and turn in a manner suggesting that it was attempting to drive its rostral teeth into my none too distant lower limbs. While I should not be tempted to imply that this is what it actually was trying to do, the appearances certainly might lead one to that conclusion and are ample proof for these simple people.

That these fish are preyed upon by *Crocodylus acutus* Cuvier was demonstrated one day while wading in water not quite knee deep. I had approached a specimen resting on the bottom to within about fifteen feet and stood watching it, when suddenly a great brute not noted before made a vicious lunge at it missing by a matter of inches. As the crocodile was not much under six meters in length, the situation, while interesting, was not devoid of apprehension.

SPECIMENS.—Five examples ranging from 770 to 965 mm. February 19 to April 1. Rio Chucunaque, at the island below Yavisa, at Yavisa and the mouth of the Rio Membrillo; Rio Chico, slightly above the Indian village.

Siluridæ***Rhamdia wagneri* (Günther)**

OCURRENCE.—A very common species, taken in both the main streams and their smaller confluent, from below the head of tide up to the feet of falls. Generally more abundant and larger in the former. Taken in all streams visited except the Rio Tupisa, and it doubtless occurs there. Most common in the Chucunaque proper.

GROWTH.—The collections fall into two groups. Their range and modal sizes are as follows for the two periods respectively.

	Feb. 9 to Mar. 6	April 11 to April 27
Maximum	279 mm.	397 mm.
Minimum	71	88
Mode	120 and 220	(of main group 245 and 290 mm.)

The reason for this hiatus in the collection is not evident, although it may mean that they are comparatively scarce in the Chucunaque between Yavisa and the mouth of the Sucubti. The figures are taken to be a fair indication of the rate of growth for the period included. The bimodal appearance of the frequency curve disappears in the second group, but the two smallest were well separated from the bulk of the specimens and may represent the missing mode. This suggests that the smaller represents those of the last breeding season, while those of the larger are of one or more seasons preceding that. Ripe examples were taken only after April 12, from which it is inferred that the breeding season starts about that time. The fact that only green individuals were taken in February is believed to mean that the last breeding season was well past. A projection of the growth curve of the smaller group would place them as having hatched sometime in November. None of these were mature and it may be that they spawn near the close of the next season, although it would mean an extremely rapid development of the gonads. It may be that they spawn first in their second year.

FOOD.—Like many silurids, these fish were found to be entirely omniverous, although they do not seem to be as thoroughly scavenger in nature as *Pimelodella* and *Pimelodus*. Numerous examples were found to be empty, but these were nearly all very fat or ripe, while the leaner examples generally had well-filled stomachs, often to the point of prominent external distension. The following tabulation lists the relative volumetric percentages of the materials found.

Fish (including bones, scales spines, small characins and one <i>Achirus</i>)	21
Fish Eggs	21
Decapod Fragments	21
Insect Fragments	33
Débris (including splinters of wood and one-half of a wooden button 14 mm. in diameter from a 150 mm. fish near Yavisa)	4

This species took the hook readily, much after the manner of *Ameiurus*.

SPECIMENS.—Forty-four examples ranging from 71 to 398 mm. February 9 to April 27. Rio Chucunaque, at the island below Yavisa at Yavisa, both creeks near the Yavisa base camp and below the mouth of the Rio Sucubti; Rio Chico, at the Indian village; Rio Tuquesa, near its mouth, Rio Sucubti, well above the mouth and in the creek near the Indian village.

Pimelodella chagresi (Steindachner)

VARIATION.—In the present series the insertion of the dorsal varies from the position given by Meek and Hildebrand, 1916, "about midway between the tip of snout and origin of adipose" to about midway between front of eye and origin of adipose. The dorsal, instead of being plain as these writers found it, in the present specimens shows six dark streaks on the membrane, one just anterior and parallel to each ray and about equal to their width, covering the distal seven-eighths of the fin. That there is a transposition in the generic key given by these writers, Dr. Hildebrand recognizes. The humeral process in this species is "spine-like" and that of *Pimelodus* is "broad, not spine-like," which statements are reversed in their key.

OCCURRENCE.—Common about Yavisa and as far up the Chucunaque as the mouth of the Rio Sucubti, but not nearly so abundant as the preceding and subsequent species at any place. Taken in numerous side streams as noted below, often in localities where no other silurids were obtained.

GROWTH.—No sexually mature examples were taken, excepting the largest (109 mm.), a green female. It is believed that the others were spawned the previous fall, judging from their size and growth trend.

FOOD.—Stomach examination was not very productive, for most of the material was too well digested to report upon definitely. Mixed with a nondescript paste decapod fragments were occasionally found, and I am led to believe that their feeding habits are rather similar to those of *Pimelodus*.

SPECIMENS.—Ninety-seven examples ranging from 36 to 109 mm. February 9 to April 4. Rio Chucunaque, at the island below Yavisa, at Yavisa, and below the mouth of the Rio Sucubti; Rio Chico, just above its mouth; Rio Tupisa, just above its mouth; Rio Metiti, just above its mouth; Rio Membrillo, at its mouth. Seen in several side streams not collected in.

***Pimelodus clarias punctatus* (Meek and Hildebrand)**

VARIATION.—The punctulation of the young that Meek and Hildebrand use largely as a basis for differentiating this subspecies was found to be very inconstant in the present series. Several specimens, smaller than any taken by them, are immaculate, although the smallest, one of 71 mm., is faintly dotted, while intermediate examples are frequently heavily marked in this manner. None above 148 mm. showed any spots. In numerous specimens the ventrals are inserted slightly posterior to the last dorsal ray and in others this varies to strictly under it, as given by the describers. While doubtless this form should stand, especially when the difference in the occipital process is considered, it appears to be one of those that requires a good series in order to thoroughly differentiate it.

OCCURRENCE.—Approximately as common as *Rhamdia* at Yavisa but not found above the mouth of the Tuquesa, where only a single example was taken. The only other locality at which this species was taken was a little above the mouth of the Rio Chico.

GROWTH.—It is inferred, judging from the state of the gonads and sizes of the smaller individuals, that the spawning season had ended near the end of the rainy season. Only fish above 148 mm. are mature and these were thoroughly spent.

FOOD.—Like *Rhamdia*, this species seems to be entirely omniverous, but it is a more promiscuous scavenger. The relatively enormous amount of débris is accounted for by the fact that those living near Yavisa, where most of them were taken, appeared to subsist to a large extent on human fæces. The relative percentages of the stomach contents follow.

Fish Fragments	2
Decapod Fragments	6
Insect Fragments	4
Débris	88

The high percentage of débris marks them at once as scavengers of the first order. An analysis of it shows it to be made up as follows.

Vegetation (leaves, grass, wood fiber and one entire bean)	20
Piece of Rubber Tubing (part of my own apparatus)	2
Piece of Bird Intestine (lost bait?)	1
Unidentifiable Débris (about one half of this was human fæces)	77

SPECIMENS.—Seventy examples ranging from 71 to 224 mm. February 15 to March 20. Rio Chucunaque, at Yavisa, about five miles above the mouth of the Rio Tupisa, and at the mouth of the Rio Tuquesa; Rio Chico, just above the mouth.

Trachycorystes amblops (Meek and Hildebrand)

VARIATION.—The present single specimen, smaller than any taken by Meek and Hildebrand, 1916, shows these differences in coloration: pectorals dusky above, especially on the spine; upper caudal lobe suffused with the same hue.

OCCURRENCE.—Taken near Yavisa on a set line at night.

FOOD.—The specimen had swallowed an immense piece of bait, hook and all, intended for a much larger fish, demonstrating the great distensibility of the stomach, which was so swollen that it looked not unlike the half absorbed yolk sac of a young trout.

SPECIMENS.—One example of 68 mm. March 22. Rio Chucunaque, just below Yavisa.

Ageneiosus caucanus Steindachner

VARIATION.—The present specimens, both smaller than those of Meek and Hildebrand, 1916, differed from their description in that they were largely translucent in life. Many of the internal structures, such as the optic lobes and olfactory bulbs, could be plainly seen, although the viscera were protected by a completely opaque and argenteous peritoneum. This translucence was lost in preservation. The coloration is as follows; flanks unmarked; a broken black band on either side of the median line of the back about an eye's diameter in width and half as far apart, meeting around the insertion of the dorsal fin and converging again on the peduncle; caudal immaculate, as is the dorsal except on its spine. Both specimens show the greatest depth mentioned by the above writers. The head of the smaller is 3.2 and the larger 3.4 indicating a natural trend to a smaller head with age, that is, towards the largest head of these writers, 3.5. The ventrals reach slightly beyond the origin of the anal as in *A. dentatus* Kner but this too is no doubt a character of youth.

OCCURRENCE.—Taken only at the island below Yavisa.

FOOD.—One contained decapod fragments.

SPECIMENS.—Two examples of 63 and 95 mm. March 15 to 21. Rio Chucunaque, at the island below Yavisa.

Astroblepidæ

***Astroblepus longifilis* (Steindachner)**

VARIATION.—The present series show the following variations from the description of Meek and Hildebrand, 1916, (*Cyclopium pirrense*). Only the first dorsal ray produced, reaching past the last when depressed; pectoral filament slightly longer than head; distance from last anal ray to caudal 2 in head. These differences seem to be quite constant but this material is probably smaller than the examples upon which they based their figures.

OCCURRENCE.—Taken only in the Sucubti, in the creek near the Indian village above its falls. This is the most northern locality that any species of this family has been taken in, although it is not new to the Tuyra basin.

GROWTH.—Apparently the breeding season is just about well started in the latter part of April. The size of the young suggest that the previous one had ended before the close of the rainy season. The male's genital process is smooth, pointed, circular in cross section, flexible and nearly white in color. A male of 70 mm. has such a process 16.5 mm. long. In a ripe female of 52 mm. both ovaries are developed and are 12.5 mm. long, measured from the pore to the anterior end and slightly over 1.5 mm. in greatest diameter. The eggs are arranged in a double row of about thirty to each ovary. They range from 0.50 to 1.00 mm. in diameter and show a mode of 0.75 mm.

FOOD.—Apparently entirely insectivorous. The stomachs contained various fragments, among which could be made out the remains of roaches.

BEHAVIOR.—Found generally under leaves and sticks partly out of water. When disturbed, they could wriggle over the rocks at considerable speed and generally sought shelter under débris in preference to diving into deep holes.

SPECIMENS.—Seven examples ranging from 38 to 71 mm. April 23 to 29. Rio Sucubti, in the creek at the Indian village, above the falls.

Callichthyidæ

***Hoplosternum punctatum* Meek and Hildebrand**

VARIATION.—Out of the present series a sample of fifty show the following variations of the characters which are used to separate this species from *H. magdalenæ* Eigenmann.

Number of Pre-adipose Azygous Plates		
No. of Individuals	No. of Plates	Percentage
1	4	2
40	5	80
9	6	18

The V-shaped naked area between the coracoids varies greatly in its conformation, but there is a general tendency for it to close up with age. The relationship between its length and the width between the pectorals is as follows.

	No. of Individuals	Percentage
Length of Coracoids = Width between Pectorals	5	10
Length of Coracoids > Width between Pectorals	45	90

The insertion of the dorsal in reference to the distance between the origin of the adipose and the tip of the snout shows the following variations.

	No. of Individuals	Percentage
Slightly Nearer Snout than Adipose	7	14
About Midway between Snout and Adipose	24	48
Slightly Nearer Adipose than Snout	19	38

Mr. Hildebrand kindly examined nine of these and from his measurements and comparisons with his own material I am able to present the following more detailed data. The insertion of the dorsal of these specimens was found to vary as follows, the measurement being taken from the posterior edge of the first scute in front of the dorsal, where the fin actually originates, instead of what uncritically appears to be the base of the first ray. In seven the origin of the dorsal is midway between the tip of the snout and the posterior margin of the first scute in advance of the adipose. In two, this distance reaches the posterior margin of the second scute in advance of the adipose. In one, it reaches nearly to the end of the base of the adipose. This character is thus more variable than previously shown and indicates a tendency for the present material to have the dorsal slightly more posterior in reference to the adipose. However, in view of the fact that the present series numbers 183 individuals and those previously known were only four, it is not considered sufficient variation to warrant taxonomic recognition at present, especially as all the larger ones, none of which is as large as the describers' material, agree well with the description except in coloration. The present series is less profusely spotted than the previous specimens and

shows a tendency to become lighter in color and less spotted with age, which is not in accord with the others, although this is exceedingly variable and probably without particular taxonomic significance.

OCCURRENCE.—Taken only at the creek just above our base camp near Yavisa and in the one below our base camp on the Rio Sucubti. Only found in very muddy holes, the dry season remainder of small streams. Over three hundred were seen in the latter locality in a small pool, the largest diameter of which was not quite six feet, with many other species and individuals. All of them suffered from a lack of oxygen with the exception of a few small loricariates, *Rivulus*, and the present species. These are apparently thoroughly adapted to this periodic drying. This is the first record of this family from Tuyra basin, the present species being only known from north of this drainage.

GROWTH.—Green fish were taken in February and March; ripe ones in April. The size of the immature was found to range from 30 to 54 mm. with a mode of 40 mm., in April and would seem to be nearly a year old. If this is the case, it would make two years the age of the first spawning, unless there is no pronounced spawning season, which seems unlikely. The following data pertain to the ovaries of a ripe female of 66 mm. Both developed, 17 mm., from the pore to the anterior end, 6 mm. in greatest diameter. The ovarian eggs range from 0.90 to 1.10 mm. and show a mode of 1.00 mm.

FOOD.—The food was found to be practically anything organic, including insects, crustaceans, fish and organic débris. Vegetation ingested, however, seems to be more accidental than otherwise.

SPECIMENS.—One hundred and eighty-three examples ranging from 30 to 66 mm. March 1 to April 15. Rio Chucunaque, creek just above the base camp near Yavisa; Rio Sucubti, first creek below base camp.

Loricariidæ

***Plecostomus plecostomus panamensis* Eigenmann**

OCCURRENCE.—Not very common, taken only in the Rio Chico and Sucubti and the latter's confluent. It appears to be a fish of the smaller streams, the very young being seen only in the creek-like tributaries in moderately clear water.

GROWTH.—Ripe fish were taken in March and green ones in April. It may be that the former were laggards of the last season, and the latter precocious individuals of the coming one, unless the time of spawning is exceedingly irregular and protracted. However, all the smaller ones seen, not many of which were preserved, were about 80 mm., which would

suggest that the height of the spawning season was last seen near the end of the rainy season. The material, however, is too scant to base any definite conclusion on. The following measurements pertain to the ovaries of a ripe female of 217 mm. Both developed. Length from the pore to the anterior end 51 mm., greatest diameter 14 mm. The ovarian eggs range from 2.40 to 2.55 mm. in diameter and show a mode of 2.50 mm.

FOOD.—The exceedingly long and much convoluted intestines were all packed with soft flocculent mud, algæ, *et cetera*, which had obviously been scraped from submerged surfaces, as field observation substantiated, for this and other similar species could often be seen through the clear water industriously rasping off the organic slime from rocks. Apparently only the finest particles of matter were swallowed, for no asperities could be detected in the smooth intestinal paste. There appears to be a certain amount of similarity between the food gathering and utilizing apparatus of these fish and that of generalized anuran tadpoles. That is, the scraping mouth is of the same general functional constitution; the long convoluted intestine is rather analogous, and the food and feeding methods are not dissimilar. On opening a specimen of this species, the intestine is seen to be in spiral coils, giving the same general effect that *Bufo* tadpoles do when viewed ventrally. Here, however, the similarity appears to stop. The digestive tract of the 217 mm. female (290 mm. in total length) was found to measure 5693 mm. in length from esophagus to vent, or over 19 times as long as the entire fish.

SPECIMENS.—Five examples ranging from 84 to 217 mm. March 12 to April 27, Rio Chico, slightly above the mouth; Rio Sucubti, first creek below the base camp and at the Indian village.

***Lasiancistrus planiceps* (Meek and Hildebrand)**

OCCURRENCE.—Taken in the Rio Chico, the upper Chucunaque, the Sucubti and the latter's confluent in clear water.

GROWTH.—Green adults taken from February to April and immature fish of from 73 to 120 mm. during the same period, suggesting a rainy season spawning period.

FOOD.—Similar in all essential respects to the preceding species in digestive tract and food.

SPECIMENS.—Eight examples ranging from 73 to 172 mm. February 18 to April 29. Rio Chucunaque, above the mouth of the Rio Chiati; Rio Chico, at the Indian village; Rio Sucubti, at the Indian village and in the creek near it, below the falls.

***Chætostomus fischeri* Steindachner**

OCURRENCE.—Taken only in the Rio Chico and Sucubti in clear water.

GROWTH.—All examples were found to be spent. Apparently the breeding season was well over.

FOOD.—The food and digestive tract is essentially similar to that of the preceding species. In one example of 172 mm. (218 mm. in total length), the intestinal tract measured 2181 mm. from esophagus to vent or over ten times as long as the entire fish.

FOOD.—Six examples ranging from 156 to 190 mm. March 12 to April 27. Rio Chico, slightly above its mouth; Rio Sucubti, at the Indian village.

***Ancistrus spinosus* Meek and Hildebrand**

VARIATION.—Known previously from only two specimens, both of which were mature. Therefore the measurements that are not included in the range of variations given in the original description, as extended by three immature specimens in the present series, are tabulated below.

Standard Lengths in mm.	40.0	42.0	48.0
Depth in Length	5.6	4.9	5.1
Snouth in Head	2.0	1.9	2.0
Interorbital in Head	2.6	2.4	2.3
Eye in Head	5.0	5.3	5.8
Mandibular Ramus in Interorbital	3.0	3.0	3.6
Dorsal Spine in Head	1.3	1.2	1.2

The only differences shown by the two adults of the present series from the describers' material are that in both cases the depth is slightly less, 5.0 and 5.3 in the male and female respectively and slightly less than the interorbital. This species, while close to *A. centrolepis* Regan, does not show the round dark ventral spots of the latter and the female lacks the high number of marginal tentacles. In the present material both the male and female are dark below and unspotted in any sense. The immature are rather similar in this respect but one has a single light patch and another two, but both, however, are irregular and possibly the result of injury.

OCURRENCE.—Taken only in the Rio Chico, the Sucubti and the latter's confluent in clear water in company with *Chætostomus*.

GROWTH.—Green fish taken in February and young of 42 mm. in April, suggesting this as a rainy season spawner.

FOOD.—Essentially similar to the preceding species. Here also the intestine is many times the length of the entire animal.

SPECIMENS.—Five examples ranging from 40 to 150 mm. February 18 to April 27. Rio Chico, at the Indian village; Rio Sucubti, in the first and second creeks below the base camp at the Indian village and in the creek near it.

***Loricaria altipinnis* Breder**

OCCURRENCE.—Known only from the Rio Chucunaque and its confluent (Breder, 1925*b*), see Fig. 4. Most frequently taken in small pools in the dry beds of evaporating side streams.

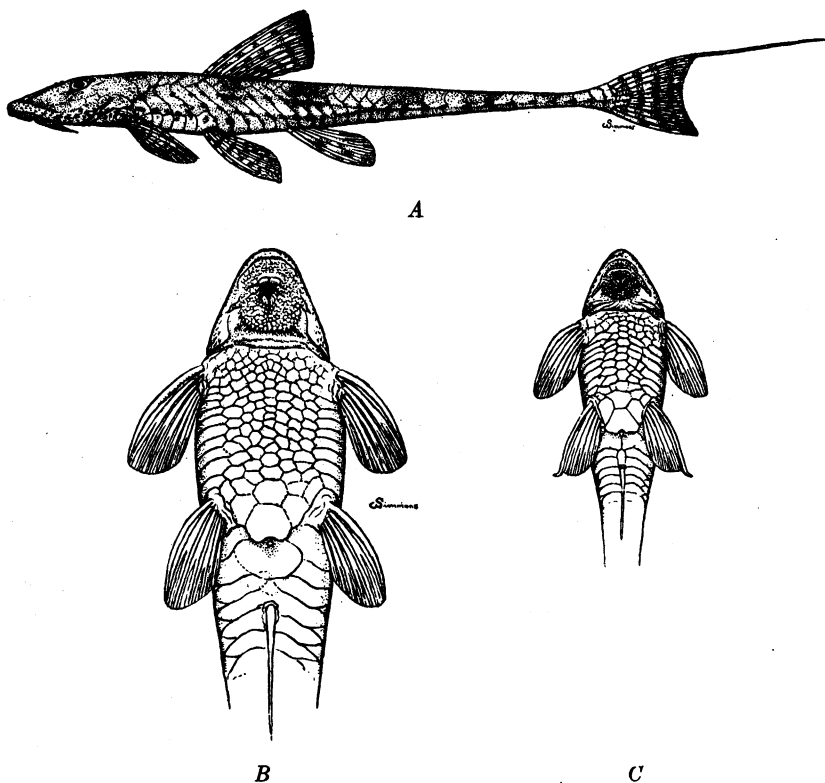


Fig. 4. *Loricaria altipinnis* Breder. A.—Lateral view of adult. B.—Ventral view of adult. C.—Ventral view of immature.

GROWTH.—The size of the smaller fish suggests that the breeding season ended sometime near the end of the rainy period.

FOOD.—Similar to the other members of this family.

SPECIMENS.—Twelve examples ranging from 40 to 174 mm. March 3 to April 16. Rio Chucunaque, creek above the Rio Tuquesa, and above the Rio Chiati; Rio Chico, at the Indian village (type locality); Rio Sucubti, at the base camp and in the first and second creeks below it.

***Loricaria fimbriata* Eigenmann and Vance**

VARIATION.—Meek and Hildebrand, 1916, state in regard to their then recently described *Loricaria capetensis*:

This species [*L. fimbriata*] differs from *L. capetensis* in the smaller and more delicate scutes on abdomen and in the shorter and differently shaped dorsal and anal fins. The abdomen of the present single small specimen is entirely naked and the vertical fins incline to *L. capetensis*. However, it is referred to *L. fimbriata* with little doubt as both these characters seem to be associated with age. Mr. Hildebrand, who kindly examined the specimen, wrote as follows concerning it:

The single small fish with the naked belly agrees with the specimens in our collection which I identified as *L. fimbriata*. The smallest specimen which I had for comparison was about 75 mm. I am not at all sure about the validity of this and related described forms. Age apparently has something to do with the development of the ventral plates. Our specimens of *L. capetensis* are so much larger than the ones which we have, as well as yours, of *L. fimbriata* that the comparison is not satisfactory. The difference in the shape of the fins (possibly also age characters) in the two, by comparison, is quite pronounced, hence I think you can dismiss the character without further bother.

There are three closely related species not geographically remote, of which this is one, which show certain tendencies that suggest that possibly they should all be reduced to one. They may be compared as follows.

	Abdominal Scutes	Lengths in mm.
<i>Loricaria fimbriata</i> E. and V.	Very weak (absent in smallest)	50-80
<i>Loricaria capetensis</i> M. and H.	Somewhat stronger	162-164
<i>Loricaria seminuda</i> E. and V.	Stronger	Larger than above

Aside from numerous small differences, such as the slight reduction of the orbital notch in *L. fimbriata*, which probably alone mean nothing, it is noted that these three species known from individuals in different size groups only progressively show a strengthening of the abdominal scutes accompanied by an increase in size. As pointed out above, there is reason to believe that the development of these scutes increases with size and age and it seems not improbable that only a single form is represented here. If a careful comparison of all available material proved this to be the case, *L. fimbriata* should stand.

OCCURRENCE.—Rio Tupisa.

SPECIMENS.—One example of 54 mm. March 23. Rio Tupisa, some distance above its mouth.

Loricaria variegata Steindachner

VARIATION.—The present series varies beyond the limits of the Meek and Hildebrand, 1916, description as follows. The cross-row of scutes between the pectorals is obsolescent in some specimens being merely represented by a few scattered asperities on the otherwise smooth skin. In some cases the plates anterior to the vent are scarcely enlarged and the caudal varies from strongly immarginate to forked. The longest caudal filament (99 mm.) is on a male of 199 mm., as measured from the tip of the second, not produced, caudal ray.

OCCURRENCE.—Taken in the Rio Chucunaque, Chico and Sucubti.

GROWTH.—Green fish and a single post-larva of 16 mm., Plate I, A, B, C, were taken in March and ripe ones in April, suggesting the beginning of an irregular spawning season. The sizes of the immature examples suggested that the preceding season ended near the end of the rainy season. All those below 150 mm. are immature. The following data pertain to the ovaries of a female of 210 mm. Both developed, 29 mm. long from the pore to the anterior end, 1.2 mm. in greatest diameter. The ovarian eggs range from 2.50 to 3.00 mm. and show a mode of 2.85 mm.

FOOD.—The intestine was packed with material similar to that found in the preceding species, but, as with other members of this genus, the intestine is much shorter. In a male of 109 mm. (total length 179 mm., over all length including caudal filament 196 mm.) the intestinal length was 245 mm., or less than one and one-half times as long as the fish, without the attenuated caudal filament. The spiral arrangement of the intestinal tube could be well seen in this species and was wound as in the diagram, Plate I, D, that is, the anterior part spiraled in and the posterior part spiraled out, so making a double tube. When unrolled, the inward and outward turns held together more firmly by mesenteries than the separate double coils, but these too could be separated without rupture. The visceral cavity is much smaller in this genus than in those of more stocky build.

SPECIMENS.—Nine examples ranging from 16 to 210 mm. March 14 to April 9. Rio Chucunaque, at Yavisa; Rio Chico, about one mile above its mouth; Rio Sucubti, at the base camp.

***Sturisoma panamense* (Eigenmann and Eigenmann)**

OCURRENCE.—Taken in the Rio Chucunaque, Chico and Tupisa, apparently not reaching very far up towards the headwaters.

GROWTH.—Green fish taken in February and ripe ones in March, together with the immature examples, suggests that the spawning season extends over the rainy period. Specimens under 150 mm. were all found to be immature. The following data pertain to the ovaries of a ripe female of 194 mm. Both developed, length measured from the anterior end to the pore 22 mm., greatest diameter 17 mm. The ovarian eggs range from 1.4 to 1.7 mm. in diameter and show a mode of 1.6 mm.

FOOD.—Similar to the other species of this family. In this genus the intestinal tract is longer and the visceral cavity larger than in *Loricaria*, it being somewhat intermediate in size between that and the less elongate *Plecostominae*.

SPECIMENS.—Twenty-two examples ranging from 55 to 216 mm. February 18 to March 30. Rio Chucunaque, at Yavisa and above the mouth of the Rio Sansan; Rio Chico, slightly above the mouth and at the Indian village; Rio Tupisa, some distance above the mouth.

***Sturisoma citurense* (Meek and Hildebrand)**

OCURRENCE.—Taken only in the Rio Chucunaque and Tuquesa.

GROWTH.—Green fish were taken in February, from which it is inferred that the spawning season was to begin later. The sizes of the immature examples indicate that the last season ended near the end of the rainy season.

FOOD.—Food and digestive tract similar to that of *S. panamense*.

SPECIMENS.—Seven examples ranging from 89 to 170 mm. February 15 to March 20. Rio Chucunaque, at Yavisa; Rio Tuquesa, slightly above its mouth.

Characidae***Curimatus magdalenæ* Steindachner**

VARIATION.—Predorsal scales in some individuals exceeding 12 by 1 or 2. One specimen with only 34 scales along the lateral line.

OCURRENCE.—Common, especially in the smaller creeks and pools, where the water is quiet and the bottom muddy.

GROWTH.—Even in the largest examples of the present series, the sex organs are not evident, which may indicate that the breeding season was shortly passed. The growth curve of the young fish suggested that they were hatched sometime in early December. Between February 15

and April 4 there appeared to be a modal growth of 7 mm., 55 to 60–65 mm. or an increase of nearly 12 per cent.

FOOD.—While the general appearance is in no way similar to *Mugil*, there is a marked parallelism in the alimentary tract. The mouth has a peculiar conformation similar to that marking *Mugil*, a notch in the upper jaw receiving a short pointed prolongation of the lower, from which the cleft falls away on either side in graceful curves. This, with its toothless condition and the long and much convoluted intestine, at once shows the species to be non-raptorial, in contrast to most of the other local members of the family. The intestinal tract is even longer than that in most species of *Mugil* and rather resembles those of the Loricariidæ in length and general appearance, but on preservation becomes too delicate for satisfactory measurement. All were found to be uniformly filled with a soft dark paste, mostly mud and algæ, similar to that found in the typical bottom-dwelling loricariates. It is inferred from this and from field observations that these fish generally crop similar growths from the often exposed and tangled roots of stream-side trees that the armored cats are hardly able to reach conveniently, for surely the present species is anything but a typical bottom fish in build. It would seem probable therefore that these do not come into undue conflict with the loricariates in feeding, each filling a slightly different but fundamentally similar feeding district.

SPECIMENS.—Fifty-four examples ranging from 48 to 127 mm. February 15 to April 16. Rio Chucunaque, creek above the base camp near Yavisa, and above the Rio Membrillo; Rio Chico, at the Indian village, and far above my own ascent, taken by Glen R. Townsend; Rio Tuquesa, about one mile above the mouth; Rio Sucubti, in the first and second creek below the base camp, and at the Indian village.

Apareiodon dariensis (Meek and Hildebrand)

VARIATION.—The present single example is smaller than the describers' material and shows these differences, attributable to the lesser age. Head 4.1; ventral outline somewhat convex, which, however, in part at least is due to a very full stomach; head slightly deeper than wide; lower lateral band very faint and broken; bars on fins all exceedingly faint; lower lip and premaxillary teeth as in the type specimen, see Fig. 5, A.

OCCURRENCE.—The single example was seined from a locality similar to that mentioned by the describers as the habitat of this species. What are thought to be larger examples were occasionally seen from this

locality upwards, and all in rocky places where successful seining was nearly impossible.

FOOD.—The stomach was full of the remains of small insects, algæ and débris.

SPECIMENS.—One example of 48 mm. April 2. Rio Chucunaque, slightly above the mouth of the Rio Chiati.

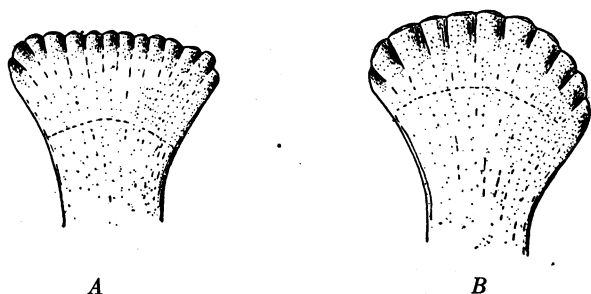


Fig. 5. Premaxillary teeth of *Apareiodon* from the Chucunaque drainage. A.—*A. darwensis* (Meek and Hildebrand); B.—*A. compressus* Breder.

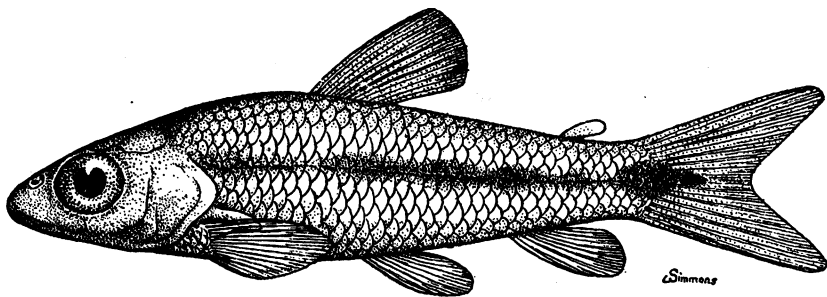


Fig. 6. *Apareiodon compressus* Breder.

***Apareiodon compressus* Breder**

OCCURRENCE.—A single immature example known from a clear swift stretch of the Rio Tuquesa (Breder, 1925b). See Fig. 5, B and Fig. 6.

SPECIMENS.—One example (type) of 23 mm. March 3. Rio Tuquesa, at a point about one-quarter mile above its mouth.

***Characidium marshi* Breder**

OCCURRENCE.—Known only from the Rio Sucubti, its tributaries, and the Chucunaque, near the mouth of the former (Breder, 1925b). See Fig. 7. Adult examples from the creek at the Indian village only.

Most common above the falls in that creek in quiet pools between drops in the rapidly ascending gradient of the stream bed. It would seem that the smaller fish had been washed down below their normal habitat.

GROWTH.—Apparently a dry season spawner. Nearly half-grown examples were found near the beginning of the rainy season, when the adults were all green.

FOOD.—Probably rather an indiscriminate feeder, taking any living organism small enough to be negotiated.

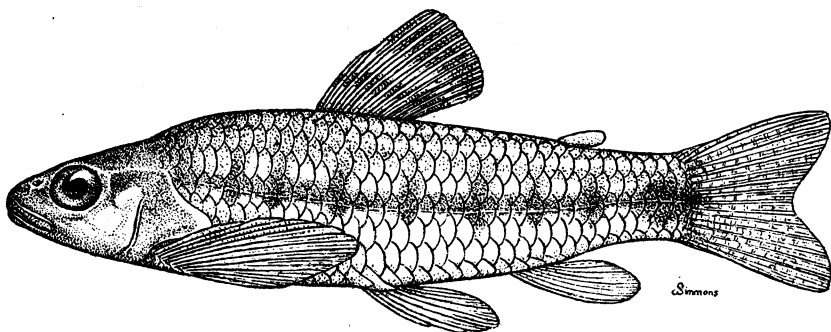


Fig. 7. *Characidium marshi* Breder.

SPECIMENS.—Ten examples ranging from 15 to 30 mm. April 2 to 27. Rio Chucunaque, near the mouth of the Sucubti; Rio Sucubti, at the base camp, in the first creek below it and the creek at the Indian village above falls (type locality) and below.

***Piabucina festæ* Boulenger**

VARIATION.—There is a distinct dark spot near the bases of the fourth, fifth, and sixth dorsal rays, the fifth passing through its center, which is not mentioned in descriptions. The “golden streak in front of the dorsal,” which Meek and Hildebrand, 1916, found, was noticed in the field and served well as a recognition character. Some of the present examples are slimmer than they mentioned, one being 4.5.

OCCURRENCE.—Taken mainly in small streams, there common, especially in limpid pools at the foot of falls and between rapids. When first seen in life, they might have been taken for Mugilidæ of some sort, but there the resemblance stopped.

GROWTH.—None appeared to be ripe and judging from the growth curves of the smaller fish the last spawning season probably ended sometime in November.

FOOD.—Of the examples examined a little over 52 per cent were empty. The remainder showed the species to be entirely carnivorous and chiefly insectivorous. The relative percentages of the stomach contents were as follows.

Fish (small characin remains)	11
Hymenoptera (ants and stingless bees)	16
Coleoptera (aquatic beetles)	15
Débris (mostly insect fragments of small size)	58

ABNORMALITY.—Fishes which have lost their caudal fin through accident, if of a normal ichthyized type, generally tip up the end of the vertebral column as the wound heals over, so as to bring the anal fin into play as a substitute. See Nichols, 1921, and Breder, 1925*a*. A specimen of this species which had been so mutilated was taken, but time had been insufficient to completely heal the wound. However, the tipping of the column upwards was already well marked, showing the rapidity with which this may take place at times, for it is most unlikely that a specimen could endure with a raw wound such as this for long.

SPECIMENS.—Forty examples ranging from 54 to 130 mm. February 15 to April 27. Rio Chucunaque, below Yavisa, in both creeks near the base camp below Yavisa, below the falls; Rio Sucubti, at the base camp, in the first creek below it and the creek near the Indian village.

***Phanagoniates macrolepis* (Meek and Hildebrand)**

VARIATION.—A single example from the Rio Chico is much darker than the others, and is the only one which shows the lateral band, more than very faintly. In this fish it is pronounced, especially posteriorly. The anterior edge of the first pectoral ray is black in all, a distinct mark, not previously noted.

OCCURRENCE.—Rare. Taken only in the Rio Chico and Sucubti far above the head of tide in clear rapid water.

SPECIMENS.—Three examples ranging from 25 to 36 mm. February 18 to April 11. Rio Chico, at the Indian village; Rio Sucubti, at the base camp.

***Compsura gorgonæ* (Evermann and Goldsborough)**

VARIATION.—An occasional specimen shows the V-shaped markings over the anal, characteristic of this species, only very faintly, overlapping the condition sometimes found in *Pseudocheirodon affinis*.

OCCURRENCE.—Taken only well above the head of tide water on the upper reaches of the Rio Chucunaque and its confluent and only in

company with *Pseudocheirodon affinis*, but much less numerous. In localities where found they were outnumbered by the latter about five to one.

GROWTH.—No ripe or very young examples were taken, so the breeding season is not indicated. All collections show a mode of 20 to 25 mm.

FOOD.—Apparently any small organism or fragment, dead or alive that they can swallow or bite pieces from.

SPECIMENS.—Eighty examples ranging from 15 to 27 mm. April 1 to 16. Rio Membrillo, at its mouth; Rio Sucubti, at the base camp and in the second creek below it.

Pseudocheirodon affinis Meek and Hildebrand

VARIATION.—The V-shaped markings above the anal, characteristic of *Compsura gorgonæ*, are sometimes faintly suggested in specimens unquestionably of this species.

OCCURRENCE.—Taken only above the head of tide, becoming more abundant as the headwaters were approached, generally being found in large schools in quiet and comparatively deep pools.

GROWTH.—Eight series of adult fish were taken as follows, measurements in mm.

Date	Max.	Min.	Mode	Locality	No. of Examples
March 4	34	23	25-30	Rio Tuquesa	12
14	30	27	25-30	" "	5
30	35	20	30-35	" Chucunaque	44
31	31	20	25-30	" Metiti	18
April 1	36	22	20-25	" Membrillo	41
2	31	20	25-30	" Chucunaque	54
4	37	25	25-30	" Sucubti	16
11	36	20	20-25	" "	373
16	26	19	20-25	" "	6

From this it is evident that the modes decreased as the river was ascended, which may be interpreted variously. One thing that it suggests is a smaller average growth on the part of the headwater fish. The spawning season seems to have ended near the end of the rainy period, as none were ripe and on March 3 some 13 mm. fish were taken, and, on April 15, some of 16 mm. which were quite separate from those listed above.

FOOD.—The food of this species appears to be practically identical with that of *Compsura gorgonæ*.

SPECIMENS.—Five hundred and eighty-seven examples ranging from 13 to 37 mm. March 4 to April 16. Rio Chucunaque, above the Rio Sansan, above the Rio Chioti, and below the Rio Sucubti; Rio Tupisa, well above the mouth; Rio Tuquesa, slightly above the mouth and about one mile farther; Rio Metiti, at its mouth; Rio Membrillo, at its mouth; Rio Sucubti, at the base camp and in the second creek below it.

***Brycon striatulus* (Kner)**

VARIATION.—In the present material the origin of the anal is somewhat in advance of the last dorsal ray. The caudal and humeral spots and the vertical barring are indistinct but the dark lateral band is pronounced in all.

OCCURRENCE.—Not common. Taken in the Chucunaque at Yavisa and near the Rio Tuquesa, in the latter and in the Rio Chico.

GROWTH.—None of the present specimens were found to be ripe. Their condition and the sizes of the smaller fish suggest that the spawning season was well over.

FOOD.—The stomach contents of these raptorial appearing fish was rather unexpected. The percentages follow.

Fish Remains	3
Crustacean Remains	5
Insect Remains	28
Vegetable Matter	38
Débris	26

The fish remains consisted merely of fragments, as did that of the crustaceans. The insects for a large part were made up of ants. The vegetable matter, aside from a small amount of woody fiber, consisted wholly of seeds, buds, and similar parts. About one-half of the débris appeared to be human fæces. The stomach contents, as here shown, and the comparatively long intestines, which were found in all cases to be well packed with a completely digested paste, hardly fit with the rapacious appearance of this species. However, the large amount of buds and seeds may in part, at least, be explained by the fact that these fish rise readily to almost any small object alighting on the surface. It would seem that they use scant discrimination before swallowing, accepting practically anything that presents itself. It is interesting to note that this species in many ways resembles certain salmonids. The form is not dissimilar; they rise to objects on the surface in a rather similar manner; insects, especially ants, are an important dietary item; and there are present a relatively high number of pyloric cæca. Incidentally, the closely related

B. chagrensis (Kner) from the Atlantic drainage is called "salmon" by the local anglers of the Canal Zone. Strangely enough, although much of their food suggests a bottom feeding habit, their physical appearance certainly belies it.

SPECIMENS.—Twenty-six examples ranging from 40 to 163 mm. February 15 to March 20. Rio Chucunaque, at Yavisa and at the mouth of the Rio Tuquesa; Rio Chico, at the Indian village; Rio Tupisa, well above the mouth; Rio Tuquesa, about one mile above the mouth.

***Astyanax ruberrimus* Eigenmann**

VARIATION.—The dark peduncular spot is very faint in most of the present examples. In some of the smaller examples, of 25 mm. and under, the spot is clear centrally, making the mark a dark irregular ring. There is considerable variation in the shape of this mark throughout, in some it being nearly oval, in others nearly triangular, and in some as a simple widening of the lateral band.

OCCURRENCE.—The most abundant fish of the entire drainage, found practically everywhere from below the head of tide upwards to where held back by falls. Present even in the extreme headwaters of the Rio Sucubti far above the Indian village.

GROWTH.—The position of the modes of two rather large series taken on February 15 and March 19, respectively, at Yavisa showed a shift upward of 10 mm. (55–60 to 65–70). These were accompanied by two higher and static modes (75–80) which these smaller fish were rapidly approaching, although both groups were mature. During April on the upper reaches much smaller fish, of from 25 to 35 mm., were collected. Ripe and nearly ripe fish were taken throughout the collecting period, with an increase in the percentage showing sexual development as the rainy season approached. None under 20 mm. were taken and these on the upper reaches suggested a rainy season period of greatest breeding activity that lagged in the headwaters. Fish under 40 mm. appeared to be immature, although young males were ripe at 50 mm. and females at a slightly larger size. The following data pertains to a ripe female of 98 mm. Both ovaries developed, 34 mm. long, 19 mm. wide, very flattened, roughly triangular in outline with the longest leg downward. The ovarian eggs range from 0.5 to 0.8 mm. and show a mode of 0.6 mm.

FOOD.—Stomach examination of a large number from various localities showed that their food was in the main little varied by location. Empty fish were generally very fatty. The relative percentages of the food appeared as follows.

Fish Remains (large bones)	3
Insect Remains	9
Crustacean Remains	2
Vegetable Matter	17
Débris	69

The vegetable matter was made up as follows.

Seeds and Buds	20
Fibrous Material	80

The seeds and buds were apparently taken as noted for *Brycon striatulus*, the fiber probably while picking about for small organisms amid brush, the powerful jaws snapping off all manner of woody structures. The débris was made up as follows.

Unidentified Débris	63
Sand	3
Human Fæces	34

The fæces, of course, was chiefly found in the stomachs of specimens taken near Negro and Indian villages. Here the percentage ran high. In those from near Yavisa it amounted to over 40 per cent of the entire food. This scavenger habit was fully born out by observation.

BEHAVIOR.—These fish are uncommonly fearless, swarming about any commotion in or near the water. They made bathing a rather exciting sport, closing in, often by the hundreds, and snapping at one with their sharp teeth. While, of course, unable to do any damage, indeed rarely drawing blood, their teeth were sufficient to give the sensation of a sharp pin prick. Their method was not to nibble, but to grasp a small amount of skin and hang on, vigorously shaking in "bulldog fashion." Only violent movements would keep them off and then on the slightest cessation they would close in again. At our base camp on the Rio Sucubti a slight rise in the level of the water caused a small inlet to form under one side of the mess table. Here they would savagely tear apart any crumbs that might be tossed their way. Strangely enough, though suffering such proximity, they were most difficult to catch with a dip net, so great was their manœuvring ability. They sensed danger rapidly and could be quickly frightened away with a dip net. In less than a half-hour they would return and the performance could be repeated with a few caught each time. Their ferocity was such that even a slightly injured member of a school was at once torn apart to form food for the rest. As a result, even in the present large series none showing any wounds are to be found and it is doubtful if any in a school ever survive more than the slightest injury. This was made the object of experiment on several occasions and always with the same outcome. They appear to

be imbued with the same spirit that pervades the larger and evil-famed *Serrasalmo* of farther south.

SPECIMENS.—Four hundred and seventy-five examples ranging from 20 to 110 mm. February 8 to April 27. Rio Chucunaque, at the island below Yavisa, at Yavisa, in both creeks near the base camp below Yavisa, above the Rio Tupisa and all localities up to the mouth of the Rio Sucubti; Rio Chico, at the Indian village, above and below; Rio Tupisa, at all points; Rio Tuquesa, at all points; Rio Metiti, at its mouth; Rio Membrillo, at its mouth; Rio Sucubti, at the base camp, in the second creek below, at the Indian village, and in the creek near it below the falls. Seen at the last collecting site, high on the Sucubti.

***Astyanax fasciatus* (Cuvier)**

VARIATION.—The present specimens, preserved, show a slightly more silvery color than similar examples of *A. ruberrimus*. In the present series of both these species, 497 examples in all, much difficulty was found in separating the two and there is some doubt in my mind as to whether they should be considered as distinct. However, Mr. Hildebrand wrote as follows concerning these fish: "I had no difficulty whatever with our very large series. I am wondering if preservation has anything to do with it, as it is noticed that most of your specimens are badly bleached? Perhaps the character is worth nothing. It however is backed up significantly by size and distribution." It may be that bleaching has something to do with the case but I am reasonably sure that it is not the complete answer and that there is a great amount of overlapping, if not intergradation, in the Chucunaque material at least, for none of the other species show this "bleaching" to any prominent extent. Therefore, it is with some reserve that I include both, although if truly distinct the present series certainly contains them both, as well as numerous examples incapable of clear distinction at present. The bare possibility remains, of course, that, while distinguishable in the Tuyra, there may be a breaking down of characters in the Chucunaque, but data are insufficient at this time to speculate profitably thereon.

OCCURRENCE.—Taken only in the Rio Chico in company with *A. ruberrimus*.

GROWTH.—In March partly developed females were taken. Only those above 75 mm. apparently were mature. This contrasts with *A. ruberrimus* which was found to mature at 40 mm. The younger fish taken then and in February are too scattered in size to give a reasonable growth-curve, although the species is probably a rainy season spawner.

FOOD.—Stomach examination showed the following percentages of foods to be present.

Insect Remains	10
Vegetation	10
General Débris	80

Two-thirds of the vegetation consisted of buds and seeds and the remainder of algæ. The débris was probably algæ also, at least in part. This species seemingly gets the seeds and buds in a manner similar to that mentioned for *Brycon striatulus*.

SPECIMENS.—Twenty-two examples ranging from 36 to 95 mm. between February 20 to March 20. Rio Chico, from a point slightly above its mouth and at the Indian village.

***Bryconamericus emperador* (Eigenmann and Ogle)**

OCCURRENCE.—Found only above the head of tide, in company with *Astyanax* but of much less frequency. Meek and Hildebrand, 1916, say "always found in company with *Astyanax ruberrimus* but much less abundant except in the Rio Tuyra where it outnumbers the latter." Strangely, in the Chucunaque, a branch of the Tuyra, the relative frequencies were as in other drainage basins and not as in the Tuyra itself.

GROWTH.—A single fish was ripe, the others immature. This specimen, a female of 51 mm., taken on April 27, has both ovaries developed, the right largest. It measures 18.5 mm. long and 9.5 mm. wide, is very much flattened and rather triangular in outline, the longest leg uppermost. The ovarian eggs range from 0.6 to 1.0 mm. in diameter and show a mode of 0.8 mm. The remaining fish are so scattered in sizes as to make a fair estimate of the growth rate practically impossible, although it seems likely that this species spawns during the rainy season.

FOOD.—Practically identical with that of *Astyanax*: insects, vegetation, general débris, *et cetera*.

SPECIMENS.—Twenty-six examples ranging from 22 to 51 mm. February 9 to April 27. Rio Chucunaque, in the creek above the base camp near Yavisa, above the Rio Sansan, below and above the Rio Chiati; Rio Chico, at the Indian village; Rio Metiti, at its mouth; Rio Membrillo, at its mouth; Rio Sucubti, at the base camp, in the second creek below and in the creek at the Indian village.

***Hemibrycon dariensis* Meek and Hildebrand**

VARIATION.—In life the dorsal quadrant of the iris was generally a deep red, especially in the larger examples, although few retained this in alcohol. However, it was very prominent in the field and could be

noticed in the swimming fish in clear shallow water, serving as a good recognition character, since none of the other species encountered showed it. Young under 20 mm. show the dark coloration of the central caudal rays only faintly. In the largest examples the tips of all the caudal rays are dark in addition to the dark band following the central rays forming an indefinite Y-shaped mark on the caudal, with the base cephalad.

OCCURRENCE.—Common from below the head of tide to the headwaters. Most abundant in clear running water.

GROWTH.—No ripe examples were taken. Small specimens showed no upward shift of the modal lengths between March 3 and March 31, remaining at 22 mm. The general size and condition however suggest a rainy season spawning period.

FOOD.—The food of those examined was about equally divided between insect remains and general débris. It seems probable that they would take anything that they might be able to master.

SPECIMENS.—Four hundred and fifty-eight examples ranging from 17 to 55 mm. February 10 to April 24. Rio Chucunaque, at the island below Yavisa, at Yavisa, at the mouth of the Rio Canglon, above the Rio Sansan, below the Rio Metiti, above the Rio Chiatí, and below the Rio Sucubti; Rio Chico, at the Indian village and above; Rio Tupisa, a little above the mouth; Rio Tuquesa, about one mile above the mouth; Rio Metiti, at its mouth; Rio Membrillo, at its mouth; Rio Sucubti, at the base camp and the Indian village.

Creagrutus affinis Steindachner

VARIATION.—Generally, examples under 25 mm. lack the shoulder spot characteristic of the larger specimens.

OCCURRENCE.—Taken only above the head of tide, increasingly common as the brooklike conditions of the headwaters were approached.

GROWTH.—No ripe fish were taken. Series of immature examples taken on April 1, 2 and 4 showed identical modes with one taken on March 3; 27 mm. This may mean that the spawning season is slightly more advanced down stream in the rather warmer waters, as the early collection was made at the mouth of the Rio Tuquesa and the others above the Rio Membrillo.

FOOD.—Examination of stomach contents showed that at all sizes the specimens had fed on insects and general débris in about equal quantities. Probably, like many species of the North American Cyprinidae, they will feed on anything at all that they are able to negotiate.

SPECIMENS.—One hundred and forty-five examples ranging from 18 to 58 mm. February 18 to April 11. Rio Chucunaque, in the creek at the base camp below Yavisa, and below the Rio Sucubti; Rio Chico, at the Indian village; Rio Tuquesa, about one mile above the mouth; Rio Metiti, at its mouth; Rio Membrillo, at its mouth.

***Gephyrocharax atricaudata* (Meek and Hildebrand)**

VARIATION.—Small examples of 25 mm. and under have the peduncular spot as in *G. intermedius* Meek and Hildebrand, and the humeral spot exceedingly faint. The intensity of these marks and the pigmentation varies greatly from one collection to another, even in the course of a few miles in the same stream. However, they vary directly to one another and not inversely as one would expect if *G. atricaudata* and *G. intermedius* intergraded and were not worthy of specific recognition.

OCCURRENCE.—Taken from below the head of tide to far into the headwaters, becoming increasingly common with recession from the sea.

GROWTH.—No ripe fish were taken. Judging from the size of the small fishes taken in late March and early April, with a mode of 25–30 mm., and the condition of the largest fish, the season appeared to be well passed.

FOOD.—The food contained in the rather smaller stomachs of this species was made up of about one-half insect remains and one-half general débris. They appear from field observations to feed chiefly from the surface, as their superior mouths suggest.

SPECIMENS.—Two hundred and twenty-two examples ranging from 18 to 40 mm. February 25 to April 27. Rio Chucunaque, at the island below Yavisa, in the creek below the base camp near Yavisa, at the mouth of the Rio Canglon, and below the Rio Sucubti; Rio Chico, at the Indian village; Rio Tuquesa, about one mile from the mouth; Rio Metiti, at its mouth; Rio Membrillo, at its mouth; Rio Sucubti, at the base camp and in the creek at the Indian village.

***Thoracocharax maculatus* (Steindachner)**

OCCURRENCE.—Taken commonly only above the head of tide, in some places abundant, especially in fast small side streams.

GROWTH.—The breeding season apparently begins in the latter part of April and the growth suggests that the preceding one ends sometime in December. Between March 3 and April 9 there is an apparent growth of 6 mm., 35 to 41 mm., or an increase of nearly 15 per cent. The following data pertain to a ripe female of 68 mm. Ovaries both developed,

24 mm. long from the pore to the anterior end, 6 mm. in greatest width, band shaped. On account of the curious form of this species the ovaries rise from the vent and run diagonally forward at an angle of about 60° from the vertical. The ovarian eggs range from 0.4 to 0.8 mm. in diameter and show a mode of 0.6 mm. Examples under 45 mm. are all immature.

FOOD.—These fish appear to be entirely insectivorous. Their habit seems to be to lie near the surface in the shade of overhanging vegetation and to snap at small objects alighting on the surface. At night they are generally found to be more active.

BEHAVIOR.—Many of the more generalized characins are given to extensive leaping. The only difference that seems to exist between their leaps and the "flight" of the present species is that the former fall back nearly where they started, describing a somewhat "hair-pin" parabolic arc, whereas *Thoracocharax* by virtue of its wing-like pectorals has a more flattened trajectory. Occasionally they indulge in a more sustained "flight," but that is not often. At night they were sometimes seen to leap in a shoal and travel five feet or more before cutting into the water again. At such times they often rise to a height of six inches or more from the water's surface. It is interesting to note in this connection that practically the entire dilated anterior ventral section is devoted to pectoral muscles. That is, the region anterior of a line drawn from the base of the pectorals to the tiny ventrals is so constituted, the viscera occupying a somewhat triangular area behind this. Superficially there appears to be no striking similarity between this characin and the exocetids, but when viewed dorsally there is a pronounced one which is destroyed in the lateral aspect by the great dilation devoted to pectoral muscles. See Breder, 1926, p. 249 and Fig. 73.

SPECIMENS.—Fifty-six examples ranging from 24 to 68 mm. March 3 to April 16. Rio Chucunaque, at the island below Yavisa, at Yavisa, in the creek just above the Rio Tuquesa, above the Rio Sansan, below the Rio Metiti and below the Rio Membrillo; Rio Tuquesa, a short distance above the mouth; Rio Metiti, at its mouth; Rio Membrillo, at its mouth; Rio Sucubti, in the first and second creeks below the base camp. Seen in the Rio Chico.

***Rosboides occidentalis* Meek and Hildebrand**

VARIATION.—Correspondence with Mr. Hildebrand revealed that the humeral spot illustrated by Meek and Hildebrand, 1916, as placed astride of the lateral line should really be entirely above it, as Eigenmann, 1922, noted: However, examination of the present material showed that

while this is true of the bulk of the specimens, about 15 per cent had the lateral line passing through the spot in such a manner that about one-sixth of it was below.

OCURRENCE.—Not common, but taken in all the larger streams except the Rio Chico and Tupisa. Apparently more numerous on the upper reaches.

GROWTH.—No large examples taken in this drainage, none exceeding 72 mm., although numerous examples of less size are sexually mature. The possibility of a smaller race suggests itself, although the taxonomic agreement is good. All below 40 mm. immature. The mature fish are all green. On the other hand, a series of sixteen examples taken from the Rio Tapia near Panama City on February 1 and 2 ranges from 45 to 139 mm. and shows a mode of 115 mm. A ripe female from this locality of 116 mm. has ovaries, both developed, of 21 mm. in length and 5 mm. in greatest width. The ovarian eggs range from 0.60 to 0.90 mm. in diameter and show a mode of 0.75 mm. It is inferred that the spawning season lasts through the dry season and that the smallest Chucunaque material was of this year's earlier spawning and the larger from last year developing their gonads for the next, their first season of activity.

FOOD.—An examination of the stomach contents of both the Chucunaque and Tapia material showed the following. Of these examined, 37 per cent were empty and very fatty. Those that had taken food contained the following materials.

Fish Remains (bones, scales and small characins)	42
Insect Remains	53
General Débris	5

One-half of the fish remains consisted of large scales that must have come from fishes considerably larger than the feeder. Some were from *Ctenolucius* and others probably from some cichlid. The inference seems to be that these fish, probably attacking some large examples in a school, often were able to remove only some of the scaly armament. Their forward-directed jaw teeth were probably responsible for this. It is interesting to note in this connection that the species itself is armed only with scales, which for a characin are small and thin. These scales are, however, very adherent and would not be likely to be easily removed in this manner. This is especially pertinent since this species, in common with others such as *Astyanax*, will attack and destroy a fellow showing the slightest abrasion. One fish of 72 mm. contained a *Gephyrocharax* of 28 mm. The insect remains consisted mainly of small fragments and one contained a *Hydrophilus*-like form.

SPECIMENS.—Forty-nine examples ranging from 16 to 72 mm. March 4 to April 27. Rio Chucunaque, at Yavisa and below the mouth of the Rio Sucubti; Rio Tuquesa, about one mile above the mouth; Rio Membrillo, at its mouth; Rio Sucubti, at the base camp, in the second creek below it and in the creek at the Indian village.

Ctenolucius beani (Fowler)

OCCURRENCE.—Abundant, especially about Yavisa, where the immature examples congregate in great shoals. Large adult examples were found only on the upper reaches, however, where they were invariably solitary, frequently basking near the surface in the shade of some stream-side shrub in a manner suggesting that of *Esox reticulatus* (Le Sueur).

GROWTH.—This species appears to be a wet-season spawner, as ripe fish were taken in April and the immature taken earlier were of such size as to indicate that the season ended sometime near the end of the rainy season. The position of the modes of two rather large series measured at Yavisa on February 15 and March 20 showed a shift upwards of 20 mm. 150 to 170 mm., or an increase of nearly 12 per cent in 34 days. The following data pertain to the ovaries of a ripe female of 301 mm. Both developed, length from the pore to the anterior end 97 mm. greatest width 12 mm., flattened, more or less band-shaped. The ovarian eggs range from 0.5 to 1.10 mm. and show a mode of 0.8 mm. A ripe male of 195 mm. had a weight of 142 grams when fresh, stomach empty. All examples below 175 mm. immature, but the largest of these very fat (preparatory to the development of the gonads?).

FOOD.—Of the eighty-seven examples examined 60 per cent were empty. The food contained in the remainder was present in the following proportions.

Fish (mostly small characins)	42
Decapods	58

The entire structure of these fish leads one to the natural conclusion that they are entirely predatory, which the stomach contents bear out. Aside from the raptorial external appearance, the digestive tract is little more than a straight tube which seems incapable of containing any great amount of food at one time. It seems likely that the rate of metabolism must be consequently high. It is believed that the above relative amounts present an unfair average, for nearly all the decapods were found in one collection. Omitting this group, the percentages appear as follows.

Fish	83
Decapods	17

This is thought to represent a more usual quantitative relationship. The group which had eaten so freely of decapods (fourteen had taken them, to one that had taken fish) was the second series at Yavisa (March 20, see under growth). There does not seem to be any connection between this and the stage of the tide, for they were all taken on an ebbing flow. However, it seems likely that some disturbance caused small fishes to be less in evidence and decapods more so sometime before our seining operations. Among the fish remains which were identifiable were *Gephyrocharax*, 30 mm. in a fish of 150 mm. and *Pimelodella*, 46 mm. in a fish of 142 mm.

SPECIMENS.—One hundred and forty examples ranging from 112 to 301 mm. February 15 to April 13. Rio Chucunaque, at the island below Yavisa, at Yavisa, in the creek above the camp near Yavisa, above the Rio Sansan, above the Rio Chiati and below the Rio Sucubti; Rio Chico, at the Indian village; Rio Metiti, at its mouth; Rio Sucubti, at the base camp and the Indian village. Seen in second creek below the Sucubti base camp.

***Hoplias malabaricus* (Bloch)**

VARIATION.—Some of the larger individuals tend to the description of *H. microlepis* (Günther). That is, certain of these individuals have the last anal ray split, $9\frac{1}{2}$ and $10\frac{1}{2}$; the scale rows over the peduncle amount to 11; and there are five complete rows of scales between the lateral line and the anal. On the other hand, numerous examples fit the descriptions of *H. malabaricus* perfectly. Therefore, in the absence of large series of both species, the present collection is referred to the latter, as it was made within the range of that and not of the former. These variations suggest, however, that these two forms intergrade or overlap and are possibly worthy of only sub-specific distinction.

OCCURRENCE.—Generally distributed, but more common in the larger streams, mostly small examples being found in the lesser tributaries.

GROWTH.—In the latter part of April the mature were just becoming ripe and the young of the earliest dates suggested that the previous spawning season had ended sometime near the end of the rainy season. The lengths of five females which contained no food were related to their weights as follows.

Length	Weight	State of Gonads
210 mm.	340 grams	Green
250	340	Ripe
265	283	Green
280	397	Green
295	397	Ripe

The first had lost one eye but the wound was completely healed over.

FOOD.—The stomachs examined contained decapods and fish in nearly equal amounts. The fish remains consisted mostly of characins, probably all *Astyanax*. Several times these voracious fish were actually seen to strike into schools of *Astyanax* and catch one, always holding it crosswise in the mouth before turning it head first for swallowing. A single small *Cichlasoma* (probably *C. umbriferum*) was removed from one stomach.

SPECIMENS.—Fifteen examples ranging from 67 to 295 mm. February 20 to April 27. Rio Chucunaque, at the island below Yavisa, and below the Rio Sucubti; Rio Chico, at the Indian village; Rio Membrillo, at its mouth; Rio Sucubti, in the first creek below the base camp, at the Indian village and in the creek near it.

Gymnotidae

Sternopygus dariensis Meek and Hildebrand

OCCURRENCE.—Common about the mouth of the Rio Chucunaque, its lower reaches and in the Rio Tupisa. Found in the former nearly as far up-stream as the mouth of the Rio Sucubti, but known only from below the head of tide in the Tuyra. An old Negro said that this species migrated to the larger streams during the dry season, but was found far up the smaller courses in the rainy period.

FOOD.—The few examined that were not empty contained debris and some decapod remains.

SPECIMENS.—Five examples ranging from 206 to 460 mm. February 9 to April 4. Rio Chucunaque, at Yavisa and just below the mouth of the Rio Sucubti; Rio Tupisa, about three miles above its mouth. (Extra Limal. —Rio Tuyra, at El Real de Santa Maria, just above the mouth of the Rio Chucunaque.)

Hypopomus brevirostris (Steindachner)

OCCURRENCE.—Taken only in the Rio Sucubti at the Indian village.

FOOD.—The stomachs contained only a small amount of debris and one a parasitic worm.

BEHAVIOR.—Apparently entirely nocturnal. Seen only at night, by the aid of a search light, but common at the one locality at which

found. They hid under stones and débris when the light was directed at them. Digging in this rubbish in the day disclosed them and, though not rapid swimmers, their skill at hiding made capture difficult.

ABNORMALITY.—All but one have defective caudal filaments, apparently due to injury.

SPECIMENS.—Four examples ranging from 42 to 85 mm. (to end of anal). April 26 to 29. Rio Sucubti, at the Indian village.

Synbranchidæ

***Synbranchus marmoratus* Bloch**

VARIATION.—In view of the fact that Meek and Hildebrand, 1923, based their redescription on a single example from Darien, the range of variation shown in the present collection is deemed worthy of record. Included in this are four not from the Tuyra basin, three being from the Rio Tapia, near Panama City, and one from Caledonia on the Atlantic coast near the Colombian border (See Breder, 1925*d*). The total lengths of the entire lot (12 specimens) range from 67 to 440 mm. Tail, in head and trunk 2.2 to 2.8; head, in head and trunk, 5.9 to 7.3; depth, in head 2.2 to 3.0 (example from the Atlantic coast emaciated, 3.0); snout, in head 5.9 to 7.8; eye, in snout 1.3 to 2.1; gape, in head, measured from tip of lower jaw to angle of mouth, 3.1 to 3.6. The coloration varies from an extremely dark hue in some individuals to a lighter and much spotted condition in others. Descriptions of the two extremes follow. Dark phase, dark slaty gray above, a little lighter below. Light phase, dark bluish black above, lighter below, a pale bluish, with large vandyke brown spots closely set, some confluent into irregular blotches averaging about the size of the eye. All but the smallest show a fine light line ventrally, running from the vent forward to a point about one-third the distance from the snout. There seems to be a general disposition for the spotting to become more prominent with age together with a lightening of the ventral section. In specimens that show little spotting its area of greatest concentration is on the underside of the head, that is, anterior to the median gill orifice. The difference between the life coloration and the colors of alcoholics is comparatively slight.

OCCURRENCE.—Taken only in the Rio Sucubti and its confluent, but there common, especially in the smaller streams. This species was always found buried under sand or rocks, which probably accounts for the fact that Meek and Hildebrand, themselves, collected none. Calcium carbide used as poison brought them from their retreats in great numbers, both from the lower reaches of the Sucubti's tributaries and from above falls that stopped the ascent of other fishes. Just how they attained

these heights is not clear, for in one stream especially a drop of approximately fifty or seventy-five feet held back all the normal river fauna, only the typical highland species being there present. Here they were taken with *Astroblepus*, *Rivulus* and *Characidiium*. Even at flood times the waters here must fall nearly vertically. The only reasonable hypothesis seems to be that they may have worked their way around it through the wet grass, although to do so they must have traveled far over to one side, as there is a very sharp declivity for a great distance on either side of this falls.

GROWTH.—Examples in excess of 240 mm. were either ripe or spent, four examples being in the latter condition,—six, considering those taken earlier and later from other drainages,—while one was in the former state. From this it would seem probable that the spawning season was drawing to a close. The sizes of the immature individuals suggest that the breeding period started some time near the end of the rainy season. From the growth curves it is tentatively inferred that individuals up to 212 mm., all immature, are from the most recent breeding season; those between 248 and 262 mm. from the preceding year, and the larger from some time earlier. The following data pertain to the ovary of a ripe female of 385 mm. in total length. Left ovary only developed, length from the pore to the anterior end 90 mm. greatest diameter 3 mm. Full of bright yellow eggs, which range from 1.00 to 1.20 mm. in diameter and show a mode of 1.10 mm.

FOOD.—This species appears to be chiefly piscivorous and probably lies in wait for its prey under débris, darting at it as it passes. The few not empty revealed the following stomach contents which are given in their relative percentages.

Fish (small characins)	40
Decapod Fragments	10
Insect Fragments (including parts of roaches and ant lions)	30
Débris	20

SPECIMENS.—Eight examples ranging from 67 to 400 mm. (total length). April 16 to 29. Rio Sucubti, in the second creek below camp and in the creek near the Indian village above and below the falls.

Clupeidæ

Ilisha fürthii (Steindachner)

VARIATION.—Slight differences seen in the present material are believed to be entirely due to age, as only very young specimens were obtained.

OCCURRENCE.—Taken only in tide water at Yavisa and below.

GROWTH.—Three large larvæ (18 to 22 mm.) were taken on March 21 and are tentatively included under this species. The smallest fish which did not show the elongate body of these larvæ measured 23 mm.

SPECIMENS.—Thirty-nine examples ranging from 18 to 43 mm. February 25 to March 21. Rio Chucunaque, at the island below Yavisa and at Yavisa.

Engraulidæ

***Anchovia curta* (Jordan and Gilbert)**

VARIATION.—Considering the small sizes of the present specimens they agree well with the existing descriptions, although the scales are not particularly deciduous.

OCCURRENCE.—Taken in tide water in the Rio Chucunaque.

GROWTH.—There is an apparent modal growth of 5 mm. between February 26 and March 14. That is, two fair-sized series show modes of 30 to 35 and of 35 to 40 on these dates respectively, an increase in length of nearly 13 per cent in 17 days.

SPECIMENS.—Forty-two examples ranging from 22 to 46 mm. February 26 to March 14. Rio Chucunaque, at Yavisa and just above the mouth of the Rio Tupisa.

Pociliidæ

***Allogambusia cana* (Meek and Hildebrand)**

OCCURRENCE.—Not common. Taken only in and near the Rio Sucubti. The describers' material was taken in a somewhat similar situation on the upper Tuyra, which indicates the habitat of the species as being well back from the sea.

GROWTH.—Largest male, 16 mm.; largest female, 20 mm.; apparently breeding continuously.

FOOD.—Apparently this species feeds on almost any organism small enough for it to engulf or of such a nature that it can be picked apart. They could often be seen picking around amid submerged débris.

SPECIMENS.—Eleven examples, three males ranging from 15 to 16 mm. eight immature and females ranging from 14 to 20 mm. April 4 to 15. Rio Chucunaque, just below the mouth of the Rio Sucubti; Rio Sucubti, in the first creek below the base camp.

***Darionichthys darionensis* (Meek and Hildebrand)**

OCCURRENCE.—Common in both the main streams and small tributaries from well below the reach of tide water upward. In the Sucubti it seems to be partly replaced by *Allogambusia cana*. At the

island below Yavisa, taken in numbers from small tidal pools (fresh water) of only a few inches in depth, standing in the blazing sun, often over 95° in temperature. Here they seemed to be perfectly comfortable.

GROWTH.—Largest male, 22.; largest female, 31 mm.; breeding apparently continuously. The proportions of the sexes as suggested by the present material is about one male to seven females, although this varied greatly from one collection to another. The difference in sizes of the sexes introduces a factor which interferes with obtaining a correct estimate in this manner.

FOOD.—Apparently similar in all ways to that of *Allogambusia cana*.

SPECIMENS.—One hundred and eighty-three examples, forty-two males ranging from 16 to 22 mm., one hundred and forty-one immature and females ranging from 14 to 31 mm. February 9 to April 4. Rio Chucunaque, at the island below Yavisa, at Yavisa, in the creek above the base camp near Yavisa, at the mouth of the Rio Canglon, above the Rio Sansan, at the mouth of the Rio Metiti, above the Rio Chiati and below the Rio Sucubti; Rio Chico, at the Indian village; Rio Tupisa, a little above the mouth and 3 miles above; Rio Tuquesa, near its mouth and one mile above; Rio Membrillo, at its mouth; Rio Sucubti, at the base camp.

Mollienisia sphenops (Cuvier and Valenciennes)

OCCURRENCE.—Taken only in the headwaters of the Rio Sucubti and its tributaries. Common where found, at dusk numerous examples lying close to shore. This is the first record of this species from the Tuyra basin.

GROWTH.—Largest male, 48 mm.; largest female, 57 mm. Apparently they begin breeding at an early age and continue throughout the year.

FOOD.—Rather omnivorous feeders, with a tendency toward eating algæ, as their mouths and comparatively long intestines indicate.

BEHAVIOR.—They appeared to be stupefied under the influence of an electric flashlight, lying quite still and frequently suffering themselves to be picked up in an ordinary drinking cup at night. During the day they were rather wary and difficult to capture. The tails of all the males seen were mutilated, suggesting considerable fighting.

SPECIMENS.—Twenty examples, three males ranging from 30 to 48 mm., seventeen females ranging from 20 to 57 mm. April 25 to May 7. Rio Sucubti, in the creek at the Indian village and at the last camp on the Pacific slope, high in the Sucubti headwaters.

***Allopoecilia caucana* (Steindachner)**

OCURRENCE.—Taken only in the small tributaries of the Rio Sucubti.

GROWTH.—Largest male, 21 mm.; largest female, 32 mm.; apparently breeding throughout the year.

FOOD.—Practically identical with that of *Mollienisia sphenops*.

SPECIMENS.—Forty-six examples, eight males ranging from 15 to 21 mm., thirty-eight immature and females ranging from 12 to 32 mm. April 15 to 27. Rio Sucubti, in the first and second creeks below the base camp and in creek at the Indian village.

***Rivulus chucunaque chucunaque* Breder**

OCURRENCE.—Known only from two small side streams near Yavisa, in one only above a considerable falls holding back all the river fauna, and in the other both above and below a similar falls, but becoming more common above (Breder, 1925*b*). See Fig. 8. Found chiefly in pot holes containing water left by the receding dry season streams. See Plate III, *B*.

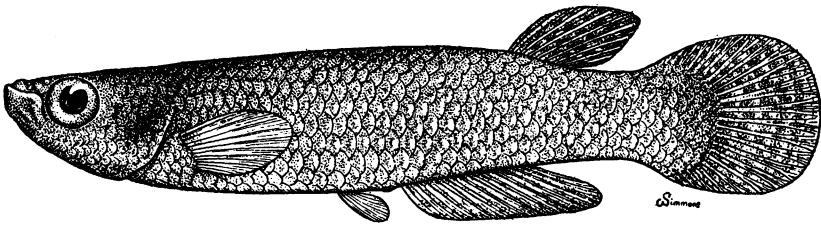


Fig. 8. *Rivulus chucunaque chucunaque* Breder.

GROWTH.—Judging from the size of the younger fish and the condition of the adults, the spawning season was well past, probably starting sometime near the close of the rainy season.

FOOD.—Insects and other small organisms.

BEHAVIOR.—Sometimes found on land flipping along (in search of water?) and occasionally buried to a depth of two inches in damp jungle debris (æstivating?). The lagoon-like nests of *Hyla rosenbergi*¹ Boulenger were common along the stretches of the creeks inhabited by this species and it may be that *Rivulus* is one of the enemies that the construction of these nests is intended to thwart. Once an example was found in a recently constructed nest in company with the male frog that had no

¹See Breder, 1925*c*, for a description of these nests.

doubt made it. The fish seemed not at all concerned by the presence of the frog but the latter was exceedingly nervous and the nest was not laid in although the following day the fish was gone.

SPECIMENS.—Thirty-three examples ranging from 25 to 45 mm. February 9 to March 6. Rio Chucunaque, in the creek above the base camp near Yavisa above the falls only (type locality) and in the one below camp both above and below the falls.

Rivulus chucunaque sucubti Breder

OCCURRENCE.—Known only from the side streams of the Rio Sucubti, mostly above falls in a habitat similar to that of *R. c. chucunaque* (Breder, 1925*b*). See Fig. 9.

GROWTH.—Apparently identical with that of the preceding race.

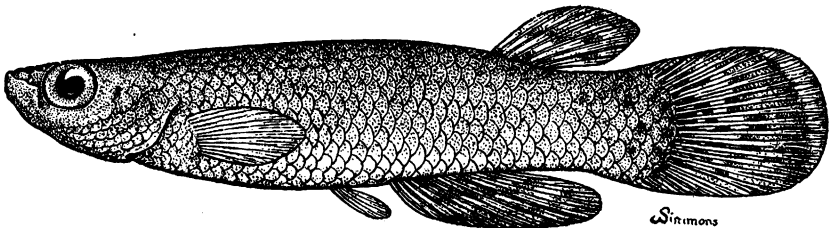


Fig. 9. *Rivulus chucunaque sucubti* Breder.

FOOD.—Apparently closely similar to that of the preceding.

SPECIMENS.—Forty-six examples ranging from 18 to 47 mm. April 15 to 29. Rio Sucubti, in the first creek below the base camp and in the creek at the Indian village, above the falls (type locality) and below.

Syngnathidæ

Syngnathus elcapitanense (Meek and Hildebrand)

OCCURRENCE.—Taken only in the Rio Chico, a little above the Indian village. At this place the water is entirely fresh and well above the reach of the tidal backwash and the general appearance of the stream is not dissimilar to that of many northern trout streams. Here the specimens were seined out of a deep hole. It would appear that this species is rapidly adapting itself to a fluviatile existence, since of the eleven that Meek and Hildebrand, 1923, took, all but one were from fresh water. It is one of the most interesting examples of the intruding marine fauna of this region in that its powers of locomotion are comparatively slight and a rapid up-stream migration seems unlikely.

BEHAVIOR.—Due to their thrashing around when captured, the Indians of this river do not distinguish them from snakes and hold them in customary dread.

SPECIMENS.—Two examples of 70 (immature) and 134 mm. (male). February 18. Rio Chico, above the Indian village.

Mugilidæ

Mugil curema Cuvier and Valenciennes

VARIATION.—While freely accepting the Meek and Hildebrand, 1923, synonymization of *M. hospes* Jordan and Culver, if it should be shown that this is more than a nominal species, the present material should be referred to it, as it agrees with *M. hospes* and not with *M. curema* as differentiated by Gilbert and Starks, 1904.

OCCURRENCE.—Taken only once at Yavisa, but then in great numbers, although this locality was seined repeatedly both before and after this single collection. A few very young, referred to this species, were later taken farther down stream.

GROWTH.—The large specimens which ranged from 110 to 135 mm. and showed a mode of 122 mm. appeared to be spent and were probably just beginning to build up, and the young ranging from 20 to 47 mm. with a mode of 25 mm. indicated that spawning season was well past.

FOOD.—As is usual with these fishes, the long intestine was filled with mud and algæ.

SPECIMENS.—Eighty-seven examples ranging from 20 to 135 mm. February 15 to March 15. Rio Chucunaque, at the island below Yavisa and at Yavisa.

Centropomidæ

Centropomus unionensis (Bocourt)

OCCURRENCE.—Common only in tide water, but occasional examples taken as far inland as the mouth of the Rio Metiti.

GROWTH.—At the island below Yavisa, where very young examples were common, there was clearly a modal growth of 5 mm. between February 25 and March 15 (25–30 to 30–35 mm.). Fish of a larger class, 90 to 120 mm. were taken occasionally near these dates, but showed no evidences of maturing.

FOOD.—Decapods were the only food found in the stomachs of those examined.

SPECIMENS.—One hundred and one examples ranging from 17 to 120 mm. February 25 to March 31. Rio Chucunaque, at the island below Yavisa; Rio Metiti, at its mouth.

Sciænidæ***Stellifer fürthii* (Steindachner)?**

VARIATION.—The present small specimens are only provisionally referred to this species, for, although they may represent an undescribed form, I do not feel justified in describing them as new since they do not show fully adult characters. Both this and the following species show considerable differences from the descriptions of adults of known Panama forms, some of which may be simply youthful characters, although others seem to be of such a fundamental nature that they suggest either more variation than is known or warrant taxonomic recognition. It is even conceivable that these two forms represent estuarine races. The varying characters which would seem to be referable to age are a greater number of preopercular spines, head slightly larger, and caudal fin strongly lanceolate, about twice pectoral. More serious, however, is the discrepancy in fin counts, the four present examples constantly having dorsal X-I, 23 and anal II, 8 as against dorsal XI-I or XII-I, 22 to 25 and anal II, 9 or 10. The only Panama species this agrees with is *S. colonensis* Meek and Hildebrand, from the Atlantic. It may be that these specimens should be properly considered a Pacific record of this form, but without intermediates and larger examples to compare it with I prefer to hold judgment in abeyance.

OCCURRENCE.—Taken only at the island below Yavisa.

FOOD.—One example opened for taxonomic purposes contained many small beetle larvæ.

SPECIMENS.—Four examples ranging from 24.5 to 32 mm. February 25. Rio Chucunaque, at the island below Yavisa.

***Stellifer melanocheir* Eigenmann?**

VARIATION.—I can not place the present single specimen with satisfaction, although it clearly belongs to the narrow-headed, large-mouthed group. (See the discussion of the preceding species.) The nonagreeing characters which seem referable to its small size are as follows: inter-orbital, 3.9; no small knob on chin; second anal spine not nearly as long as soft rays; first and second dorsal spines not noticeably stronger than the rest. The fin counts are dorsal, X-I, 20 and anal II, 8 as against dorsal XI, 23 and anal II, 8. In many ways the specimen approaches *S. mindii* Meek and Hildebrand of the Atlantic, especially in fin counts, in a manner parallel to the approach of the preceding to *S. colonensis*, but the same attitude is retained concerning the recording of this form from the Pacific. If the present provisional identification is correct, it should stand as a specific addition to the Panama fauna.

SPECIMENS.—One example of 38 mm. March 15. Rio Chucunaque, at the island below Yavisa.

Cichlidae

Geophagus crassilabris Steindachner

OCCURRENCE.—Taken only in the Rio Tupisa, the Sucubti and its confluents.

GROWTH.—Small examples only were taken, showing that breeding activity at least had been recent.

SPECIMENS.—Twenty-four examples ranging from 20 to 35 mm. March 23 to April 27. Rio Tupisa, well above its mouth; Rio Sucubti, at the base camp and in the creek at the Indian village.

Æquidens cœruleopunctatus (Kner and Steindachner)

OCCURRENCE.—Abundant, especially in the smaller streams, and in stagnant pools.

GROWTH.—The collections reveal a large number of size groups, so confused that it is virtually impossible to form a reasonable growth curve. Ripe fish and exceedingly young fry were common during our entire stay, as well as numbers that were probably spawned some time in the early fall. It is judged that these fish, which guard their young, like many members of this family, rear their broods throughout the dry season. The following data pertains to a female of 86 mm.: ovaries both developed, length from the pore to the anterior end 21 mm., greatest diameter 4 mm.; the ovarian eggs range from 0.6 to 1.0 mm. in diameter and show a mode of 0.8 mm. Examples under 70 mm. were all immature.

FOOD.—This species appears to be largely insectivorous. Most of the stomachs contained a large amount of miscellaneous débris, vegetation, etc., probably much of which was ingested accidentally in the pursuit of burrowing insects, worms, and the like. The digestive tract, however, is comparatively long for a fish of this type.

SPECIMENS.—One hundred and forty-eight examples ranging from 12.5 to 82 mm. February 9 to April 27. Rio Chucunaque, in the creek above the base camp near Yavisa, at Yavisa, above the Rio Chiatí and below the Rio Sucubti; Rio Chico, at the Indian village; Rio Tupisa, just above its mouth; Rio Tuquesa, about one mile above its mouth; Rio Membrillo, at its mouth; Rio Sucubti, in the first and second creeks below the base camp, at the base camp, at the Indian village and in the creek near it.

Neotroplus panamensis Meek and Hildebrand

VARIATION.—The present single specimen is slightly more robust and more elongate in body and with somewhat longer fins than specimens from the Rio Chagres. It also lacks the dark spot shown on the sides of the latter. Very likely this represents a racial differentiation across the divide, but, in view of the slight differences shown by the present example, it was considered unwise to describe the form as new, since in all probability examples from the Chagres could be found which would reach or even exceed the proportional differences seen in this single fish.

OCCURRENCE.—Taken near Yavisa. Not previously known from the Tuyra basin. This is the most southern record for the genus.

SPECIMENS.—One example of 82 mm. February 25. Rio Chucunaque, just below the base camp near Yavisa.

Cichlasoma tuyrense Meek and Hildebrand

OCCURRENCE.—Not common, taken principally on the lower reaches of the Chucunaque, in situations where *Æquidens* was usually to be found.

GROWTH.—None are developed sexually; and the series is too small to draw any inferences concerning growth, although breeding activity must have been recent.

FOOD.—The feeding of this species is essentially the same as that of *Æquidens*. The organisms on which these two species feed break down very rapidly, making detailed identification difficult.

SPECIMENS.—Fourteen examples ranging from 42 to 102 mm. February 9 to April 4. Rio Chucunaque, in the creek above the Yavisa base camp, at Yavisa and below the mouth of the Rio Sucubti; Rio Chico, at the Indian village.

Cichlasoma calobrense Meek and Hildebrand

OCCURRENCE.—Taken only in a small tributary of the Rio Sucubti.

GROWTH.—The size of the specimens indicates very recent breeding activity.

SPECIMENS.—Five examples ranging from 20 to 26 mm. April 27. Rio Sucubti, in the creek, near the Indian village.

Cichlasoma umbriferum Meek and Hildebrand

VARIATION.—The coloration of the breeding fish, especially the males, is strikingly brilliant, as they take on a variety of hues both delicate and vivid. The most striking marks of the breeding fish are as follows.

The general ground color of the body is a pleasing sea green. On the nape, throat, and lower parts of the operculum there are variously scattered, small, deep rose-red spots. The black longitudinal band stands out prominently. The ventral fins are a jet black and edged with a rather transparent iridescent bluish green that flashes brightly as the fish manoeuvres. The caudal is sprinkled all over with spots of this latter metallic coloration that defies accurate description. The peduncular ocellus stands out contrastingly and the dark, reddish brown iris gives the eye a vicious look in its green setting.

OCCURRENCE.—Common only in the Rio Sucubti, where they for most part lay quietly in the deepest pools. Only taken above the head of tide.

GROWTH.—Material is insufficient to estimate the growth, but apparently the breeding season^a is under way in April. The following lengths and weights were noted, April 12 to 14, which indicate considerable variation from one fish to another of equal length.

Length	Weight	Sex and Condition
165 mm.	227 grams	Female, Immature
215	340	Female, Green
230	502	Female, Ripe
230	680	Female, Ripe
240	737	Male, Spent
255	680	Female, Ripe
330	1598	Male, Green
340	1305	Female, Green

Those above 236 mm. are records for size, as this is the largest total length in the original description.

FOOD.—Their stomach contents were all of a decapod nature, consisting of prawn-like forms and small land crabs. However, they took the hook readily on small characins and gave considerable fight, comparing not unfavorably with *Micropetrus salmoides* (Lacépède) in their ability to "snag" a hook.

SPECIMENS.—Twenty-six examples ranging from 15 to 340 mm. February 18 to April 14. Rio Chucunaque, below the Rio Sucubti; Rio Chico, at the Indian village, and far above my own ascent, taken by Glen R. Townsend; Rio Sucubti, at the base camp and at the Indian village.

Gobiidæ

Dormitator latifrons (Richardson)

OCCURRENCE.—Taken only in the stagnant pools of the tidal portion of a small creek near Yavisa. Not previously known from the Tuyra basin.

SPECIMENS.—Three examples ranging from 36 to 38 mm. February 9 to March 6. Rio Chucunaque, in the creek, above the base camp near Yavisa.

***Electris picta* Kner and Steindachner**

OCCURRENCE.—Not taken above the Rio Tupisa, nor common at any place. This is an addition to the fish fauna of the Tuyra basin, the Rio Bayano being the nearest stream in which previously taken.

FOOD.—The remains of fish, mostly characins, and decapods were found in two stomachs, the others being empty.

SPECIMENS.—Nine examples ranging from 23 to 360 mm. February 25 to March 16. Rio Chucunaque, at the island below Yavisa, in the creek above the base camp near Yavisa; Rio Tupisa, at its mouth.

***Philypnus maculatus* (Günther)**

VARIATION.—Two examples showed fewer scales along the lateral line than recorded, 53 and 54.

OCCURRENCE.—Taken in both large and small streams, but not especially common. A single small example was taken in the Sucubti at the Indian village and some were seen still higher, close to the continental divide, which appears to be an unusual height in a stream for the species to reach.

GROWTH.—No ripe fish were seen and the series is too small to speculate on the growth.

FOOD.—The food of this species is essentially the same as that which Meek and Hildebrand, 1916, gave for *P. dormitor* (Lacépède). On one occasion an example was seen to rush into a school of *Astyanax* and catch one as described for *Hoplias malabaricus*. Indeed, the habits of these two superficially rather similar fishes seem to be very much alike, especially in regard to feeding and lying in wait for their prey.

SPECIMENS.—Eleven examples ranging from 31 to 193 mm. February 9 to April 11. Rio Chucunaque, at the island below Yavisa, in the creek above the Yavisa base camp and at Yavisa; Rio Tuquesa, just above the mouth; Rio Sucubti, at the Indian village. Seen higher, at the last collecting station on the Sucubti.

***Gobius daguae* Eigenmann**

VARIATION.—The head of the present specimen is a little larger than the description indicates, 3.8, but this and other minor differences are doubtless characteristics variable with size and age.

OCCURRENCE.—Not previously known from other than the type locality, the mouth of the Rio Dauga, considerably southeast of the Tuyra basin. It is, of course, an addition to the Tuyra fauna and to Panama as well.

SPECIMENS.—One example of 59 mm. March 15. Rio Chucunaque, at the island below Yavisa.

***Microgobius miraflorensis* Gilbert and Starks**

OCCURRENCE.—Taken only in tide water, over very soft flocculent mud, in which they lay halfburied.

GROWTH.—Two large series taken on February 25 and March 21, respectively, showed a modal increase of from 20–25 to 25–30 mm. or 5 mm. One large ripe female of this latter date contained eggs which ranged from 0.25 to 0.35 mm. in diameter and showed a mode of 0.30 mm.

FOOD.—This species appears to feed on practically any small organism available.

SPECIMENS.—Two hundred and eighty examples ranging from 14 to 34 mm. February 25 to March 21. Rio Chucunaque, at the island below Yavisa; Rio Tupisa, slightly above the mouth.

Pleuronectidæ

***Citharichthys gilberti* Jenkins and Evermann**

OCCURRENCE.—Taken only well below the head of tide.

SPECIMENS.—Two examples of 35 and 37 mm. March 11 to February 25. Rio Chucunaque, near the island below Yavisa.

Soleidæ

***Achirus panamensis* (Steindachner)**

OCCURRENCE.—Taken in tide water nearly as far as its reach in the Tupisa.

SPECIMENS.—Two examples of 25 and 30 mm. February 23 to 26. Rio Chucunaque, at Yavisa (from the stomach of a *Rhambdia wagneri*); Rio Tupisa, about one and one-half miles above its mouth.

DISTRIBUTION OF THE CHUCUNAQUE FISHES

The fauna of the Rio Chucunaque and its tributaries very naturally divides itself into various more or less distinct units, which may be considered separately. The main stream may be considered first and then the various side streams from the former's mouth upwards.

RIO CHUCUNAQUE.—This master stream divides into two chief divisions. The lower tidal portion, extending from the mouth to about the Rio Canglon, bottomed and shored in the main by soft mud, with tidal reverses in flow, is marked by an extensive intrusion of marine forms which comprise nearly one-third of the species found on these lower reaches, although it is entirely fresh so far as we could determine. This ecological area includes, besides the main stream, such portions of the various side branches as are effected by the tides in the same manner. These are the mouths of the creek just above the base camp near Yavisa,¹ the Rio Tupisa and Icuapati. This aquatic habitat is all within the arid lower tropical zone, see Plate II, A and B, and Plate III, A.

FISHES OF THE TIDAL CHUCUNAQUE DRAINAGE

Marine	<i>Ageneiosus caucanus*</i>
	<i>Loricaria variegata</i>
<i>Pristis microdon</i>	<i>Sturisoma panamense</i>
<i>Ilisha fürthii*</i>	<i>S. citurense</i>
<i>Anchovia curta*</i>	<i>Piabucina festæ</i>
<i>Mugil curema*</i>	<i>Brycon striatulus</i>
<i>Centropomus unionensis</i>	<i>Astyanax ruberrimus</i>
<i>Stellifer fürthii?*</i>	<i>Hemibrycon dariensis</i>
<i>S. melanocheir?*</i>	<i>Gephyrocharax atricuadata</i>
<i>Gobius daguæ*</i>	<i>Thoracocharax maculatus</i>
<i>Microgobius miraflorensis*</i>	<i>Ræboides occidentalis</i>
<i>Citharichthys gilberti*</i>	<i>Ctenolucius beani</i>
<i>Achirus panamensis*</i>	<i>Hoplias malabaricus</i>
	<i>Sternopygus dariensis</i>
Fresh Water	<i>Darienichthys darienensis</i>
	<i>Æquidens cæruleopunctatus</i>
<i>Rhamdia wagneri</i>	<i>Neetroplus panamensis*</i>
<i>Pimelodella chagresi</i>	<i>Cichlasoma tuyrense</i>
<i>Pimelodus c. punctatus</i>	<i>Dormitator latifrons*</i>
<i>Trachycorystes amblops*</i>	<i>Eleotris picta*</i>
	<i>Philypnus maculatus</i>

Species marked with "*" were taken only in this area.

Of this list, only two out of the eleven marine forms were taken above tide water whereas eighteen of the twenty-three fresh-water forms were taken above the reach of tidal effect. Of the two marine species, one (*Centropomus unionensis*) is represented by only two examples, but far inland, at the mouth of the Metiti, whereas *Pristis* is known to follow up streams generally. A single marine form, not taken in tide water, *Syngnathus elecapitanense* was found far up the Chico. Of the fresh-

¹See map, Fig. 10.

water forms, *Pimelodus c. punctatus* and *Sturisoma citurense* extended only slightly above the reach of tide, and this is probably true of the others taken only in tide water, except possibly *Neetroplus panamensis*, of which there is only a single specimen. *Dormitator latifrons* was taken only in the tidal portion of the creek above the base camp near Yavisa. From this tabulation it is clear that we have here to do with the upper part of the interdigitation of the marine and fresh-water faunas.

Above the reach of tide the Chucunaque is much clearer and has a rocky bottom for most part and in it were found the following forms

FISHES OF THE UPPER CHUCUNAQUE

<i>Pristis microdon</i>	<i>Hemibrycon dariensis</i>
<i>Rhamdia wagneri</i>	<i>Creagrutus affinis</i> *
<i>Pimelodella chagresi</i>	<i>Gephyrocharax atricuada</i>
<i>Pimelodus c. punctatus</i>	<i>Thoracocharax maculatus</i>
<i>Lasiancistrus planiceps</i> *	<i>Ræboides occidentalis</i>
<i>Loricaria altipinnis</i> *	<i>Ctenolucius beani</i>
<i>Sturisoma panamense</i>	<i>Hoplias malabaricus</i>
<i>Curimatus magdalenæ</i> *	<i>Sternopygus dariensis</i>
<i>Apareiodon dariensis</i> *	<i>Allogambusia cana</i> *
<i>Characidium marshi</i> *	<i>Darienichthys dareinensis</i>
<i>Pseudocheirodon affinis</i>	<i>Centropomus unionensis</i>
<i>Brycon striatulus</i>	<i>Æquidens cæruleopunctatus</i>
<i>Astyanax ruberrimus</i>	<i>Cichlasoma tuyrense</i>
<i>Bryconamericus emperador</i> *	<i>C. umbriferum</i>

Species marked "*" were not taken in the tidal portion.

Loricaria variegata, taken below the head of tide and in side streams, doubtless occurs on the upper Chucunaque, as no doubt do several of the others, such as *Compsura*, taken only in the more workable tributaries, although *Compsura* is decidedly characteristic of the smaller runs. Probably far above the mouth of the Rio Sucubti, where we did not reach, the conditions are very similar to those in that stream, which we traced to its source.

CREEK ABOVE THE BASE CAMP AT YAVISA.—The accompanying sketch map, Figure 10, gives a fair idea of the smaller creeks along the lower stretches of the Chucunaque, of which this one is typical. The mouth is affected by the tide and inhabited by the typical tide-water forms. Above this, in the dry season, is a series of stagnant or nearly stagnant pools in which the concentration of fish life is great and the mortality heavy, due to asphyxiation and the ease with which piscivorous animals capture the imprisoned fishes. This condition obtains on the flood plain of the Chucunaque up to a point where there is an abrupt

outcropping of fossiliferous limestone forming a wet-season cataract, with the result of a large deep basin which in the dry season harbors a variety of fishes in greater comfort than do the puddles farther down. Above this, a drop of about 35 feet, the stream emerges from a heavy growth of the humid lower tropical zone, which meets the river plain and the arid lower zone most abruptly. The pools continue, chiefly in pot holes of various sizes and harbor the sparse fish fauna in relatively great comfort, see Plate III, B. The four habitats of this stream were examined in great detail and were found to hold the following. The lists are believed to be complete.

FISHES OF THE CREEK ABOVE THE BASE CAMP NEAR YAVISA

Tidal Waters

Rhamdia wagneri
Curimatus magdalenæ
Astyanax ruberrimus
Ctenolucius beani
Darienichthys darienensis
Æquidens cæruleopunctatus
Dormitator latifrons
Eleotris picta
Philypnus maculatus

Lower Pools

Hoplosternum punctatum
Curimatus magdalenæ
Astyanax ruberrimus
Darienichthys darienensis
Æquidens cæruleopunctatus

Pool at Base of Falls

Curimatus magdalenæ
Piabucina festæ
Astyanax ruberrimus
Bryconamericus emperador
Creagrutus affinis
Darienichthys darienensis
Æquidens cæruleopunctatus
Cichlasoma tuyrense

Above Falls

Rivulus c. chucunaque

A complete collection of the fishes in the pool at the base of the falls was taken with a single charge of explosive.

CREEK BELOW THE BASE CAMP AT YAVISA.—This, another stream similar to the preceding, and examined to some extent, had three distinct falls, close together, of from 30 to 50 feet each. The mouth of the stream was not visited and it may even wind around and enter the Tuyra direct. At the farthest point down-stream attained it was heading for the junction of the Tuyra and Chucunaque on their common flood plain. There was considerably more water in this stream during the dry season than in the other, at all times there being a perceptible flow, but a

much poorer fauna although in other respects entirely similar to the former. The boundary between the arid and humid zones was much less distinct along this stream. The fauna was made up as follows:

FISHES OF THE CREEK BELOW THE BASE CAMP NEAR YAVISA

Flowing Lower Part

Rhamdia wagneri
Astyanax ruberrimus
Gephyrocharax atricaudata
Rivulus c. chucunaque

Pool at Base of Lowest Falls

Piabucina festæ
Astyanax ruberrimus

Above Falls

Rivulus c. chucunaque

The reason for this difference in the fauna of these two small streams is not clear, but doubtless accounts for the presence of *Rivulus* below the falls, which had very probably been swept down, and was able to survive there, whereas it could not in the other on account of the more numerous larger fishes.

RIO CHICO.—The pitch of the bed of this stream precludes much tidal effect even a short distance above the mouth. The water in the dry season was exceedingly clear, which, coupled with the clean banks, made it one of the most pleasant streams encountered on the Pacific lowlands. Notwithstanding the nature of this stream, as there are no notable rapids, *Pristis* and *Syngnathus* ascend it relatively far. This is the only stream in which the latter was taken. A tongue of the arid lower zone follows up it for some distance, see Plate IV, A and B. The fresh-water species were as follows.

FRESH-WATER FISHES OF THE CHICO

<i>Rhamdia wagneri</i>	<i>Astyanax ruberrimus</i>
<i>Pimelodella chagresi</i>	<i>A. fasciatus</i>
<i>Pimelodus c. punctatus</i>	<i>Bryconamericus emperador</i>
<i>Plecostomus p. panamensis</i>	<i>Hemibrycon dariensis</i>
<i>Lasiancistrus planiceps</i>	<i>Creagrutus affinis</i>
<i>Chaetostomus fischeri</i>	<i>Gephyrocharax atricaudata</i>
<i>Ancistrus spinosus</i>	<i>Thoracocharax maculatus</i>
<i>Loricaria altipinnis</i>	<i>Ctenolucius beani</i>
<i>L. variegata</i>	<i>Hoplias malabaricus</i>
<i>Sturisoma panamense</i>	<i>Darienicthys darienensis</i>
<i>Curimatus magdalenzæ</i>	<i>Æquidens caeruleopunctatus</i>
<i>Phanagoniastes macrolepis</i>	<i>Cichlasoma tuyrense</i>
<i>Brycon striatulus</i>	<i>C. umbriferum</i>

RIO TUPISA.—This stream on its lower courses is practically a counterpart of the Chucunaque, on a small scale, meandering for considerable distance over the flood plain of the latter. At about three

miles from its mouth the tidal effect gives out and from there on it takes on an appearance not vastly different from that of the Rio Chico, though smaller, passing from the arid to the humid lower zone. The fishes taken in it were as follows.

FISHES OF THE TUPISA

In Tidal Effect	Above Tidal Effect.
<i>Pimelodella chagresi</i>	<i>Loricaria fimbriata</i>
<i>Pimelodus c. punctatus</i>	<i>Sturisoma panamense</i>
<i>Astyanax ruberrimus</i>	<i>Pseudocheirodon affinis</i>
<i>Hemibrycon dariensis</i>	<i>Brycon striatulus</i>
<i>Anchovia curta</i>	<i>Astyanax ruberrimus</i>
<i>Darienichthys darienensis</i>	<i>Hemibrycon dariensis</i>
<i>Æquidens cæruleopunctatus</i>	<i>Sternopygus dariensis</i>
<i>Electris picta</i>	<i>Darienichthys darienensis</i>
<i>Microgobius miraflorensis</i>	<i>Geophagus crassilabris</i>
<i>Achirus panamensis</i>	

RIO ICUANATI.—Tidal effect is perceptible only on the extreme lower reaches. Above this it becomes a slight creek of an irregular but comparatively steep ascent. Not collected in but seen to be typical of various similar, nearly dry, side streams.

RIO CANGLON.—Without flow while visited, bedded in soft mud, suggesting some tidal effect, with a few barren puddles as far as ascended.

RIO TUQUESA.—A swift clear stream, easily navigated by dug-outs, not influenced by tide, reaching the humid lower zone rapidly. Explored for a few miles above the mouth. The following species were taken.

FISHES OF THE TUQUESA

<i>Rhamdia wagneri</i>	<i>Hemibrycon dariensis</i>
<i>Pimelodus c. punctatus</i>	<i>Creagrutus affinis</i>
<i>Sturisoma citurense</i>	<i>Gephyrocharax atricuada</i>
<i>Curimatus magdalenæ</i>	<i>Thoracocharax maculatus</i>
<i>Apareiodon compressus</i>	<i>Ræboides occidentalis</i>
<i>Pseudocheirodon affinis</i>	<i>Darienichthys darienensis</i>
<i>Brycon striatulus</i>	<i>Æquidens cæruleopunctatus</i>
<i>Astyanax ruberrimus</i>	<i>Philypnus maculatus</i>

CREEK NEAR THE RIO TUQUESA.—A small creek about one-half mile above the Tuquesa, emptying into the Chucunaque from the opposite bank, was dry except for a few stagnant puddles that contained only *Loricaria altipinnis* and *Thoracocharax maculatus*.

RIO FELIX, SANSAN, UCURGANTI, OSSA AND CHIATI.—These streams were passed on our forced travel without being collected in. Only the latter had sufficient water in to be navigable by dugout. It was with

some regret that I passed this, an attractive-looking stream of a slow-flowing nature, which contrasted strongly with most of the others which were either nearly dry or of comparatively swift water.

RIO METITI.—This stream was practically without flow, but a dammed up pool at its mouth contained the following.

FISHES OF THE METITI

<i>Pimelodella chagresi</i>	<i>Hemibrycon dariensis</i>
<i>Pseudocheiroduon affinis</i>	<i>Gephyrocharax atricaudata</i>
<i>Astyanax ruberrimus</i>	<i>Thoracocharax maculatus</i>
<i>Bryconamericus emperador</i>	<i>Ctenolucius beani</i>
<i>Creagrutus affinis</i>	<i>Centropomus unionensis</i>

RIO MEMBRILLO.—A comparatively large stream limiting the downstream territory of the Cuna Indians. It resembles the Chiati more closely than the others from a standpoint of general conditions. Here the humid lower zone began to show evidences of reaching to the banks of the main stream. A collection made just above the mouth yielded the following.

FISHES OF THE MEMBRILLO

<i>Pimelodella chagresi</i>	<i>Creagrutus affinis</i>
<i>Compsura gorgonzæ</i>	<i>Gephyrocharax atricaudata</i>
<i>Pseudocheiroduon affinis</i>	<i>Thoracocharax maculatus</i>
<i>Astyanax ruberrimus</i>	<i>Ræboides occidentalis</i>
<i>Bryconamericus emperador</i>	<i>Hoplias malabaricus</i>
<i>Hemibrycon dariensis</i>	<i>Darienichthys darienensis</i>
	<i>Æquidens cæruleopunctatus</i>

RIO SUCUBTI.—Three main types of habitat were visited in the drainage dominated by this stream. One is represented by the main stream itself and includes collecting sites from below our base camp to the Indian village and between, and the lower part of a small stream at the village, all within the humid lower zone. The Sucubti proper yielded the following species.

FISHES OF THE SUCUBTI

<i>Rhamdia wagneri</i>	<i>Astyanax ruberrimus</i>
<i>Plecostomus p. panamense</i>	<i>Bryconamericus emperador</i>
<i>Lasiancistrus planiceps</i>	<i>Hemibrycon dariensis</i>
<i>Chætostomus fisheri</i>	<i>Gephyrocharax atricaudata</i>
<i>Ancistrus spinosus</i>	<i>Ræboides occidentalis</i>
<i>Loricaria altipinnis</i>	<i>Ctenolucius beani</i>
<i>L. variegata</i>	<i>Hoplias malabaricus</i>
<i>Curimatus magdalenæ</i>	<i>Hypopomus brevirostris</i>
<i>Characidium marshi</i>	<i>Darienichthys darienensis</i>

<i>Piabucina festæ</i>	<i>Molliensia sphenops</i>
<i>Phanagoniates macrolepis</i>	<i>Geophagus crassilabris</i>
<i>Compsura gorgonæ</i>	<i>Æquidens cæruleopunctatus</i>
<i>Pseudocheiironodon affinis</i>	<i>Cichlasoma umbriferum</i>
	<i>Philypnus maculatus</i>

The second type of habitat is represented by two nearly dry streams below the base camp. The first contained a single pool of not over six feet in diameter and held the following, no individuals of which were over 50 mm., but some present in great numbers, making the place a nearly solid mass of wriggling fish.

FISHES OF THE FIRST CREEK BELOW THE SUCUBTI BASE CAMP

<i>Hoplosternum punctatum</i>	<i>Thoracocharax maculatus</i>
<i>Plecostomus p. panamense</i>	<i>Hoplias malabaricus</i>
<i>Ancistrus spinosus</i>	<i>Allogambusia cana.</i>
<i>Loricaria altipinnis</i>	<i>Allopæcilia caucana</i>
<i>Curimatus magdalænæ</i>	<i>Rivulus c. sucubti</i>
<i>Characidium marshi</i>	<i>Æquidens cæruleopunctatus</i>
<i>Piabucina festæ</i>	

The second stream below the base camp contained more water, although it was not running, and was well covered with *Lemna*. This contained the following species.

FISHES OF THE SECOND CREEK BELOW THE SUCUBTI BASE CAMP

<i>Ancistrus spinosus</i>	<i>Bryconamericus emperador</i>
<i>Loricaria altipinnis</i>	<i>Thoracocharax maculatus</i>
<i>Curimatus magdalænæ</i>	<i>Ræboides occidentalis</i>
<i>Compsura gorgonæ</i>	<i>Ctenolucius beani</i>
<i>Pseudocheiironodon affinis</i>	<i>Synbranchus marmoratus</i>
<i>Astyanax ruberrimus</i>	<i>Allopæcilia caucana</i>
	<i>Æquidens cæruleopunctatus</i>

The third type of habitat is represented by conditions above a fall in a stream near the Indian village which there touched the upper tropical zone. The forms below the falls, see Plate V, typical of the main stream, were as follows.

FISHES OF THE CREEK AT THE SUCUBTI INDIAN VILLAGE BELOW FALLS)

<i>Rhamdia wagneri</i>	<i>Hoplias malabaricus</i>
<i>Lasiancistrus planiceps</i>	<i>Synbranchus marmoratus</i>
<i>Ancistrus spinosus</i>	<i>Molliensia sphenops</i>
<i>Characidium marshi</i>	<i>Allopæcilia caucana</i>
<i>Piabucina festæ</i>	<i>Rivulus c. sucubti</i>
<i>Astyanax ruberrimus</i>	<i>Geophagus crassilabris</i>
<i>Bryconamericus emperador</i>	<i>Æquidens cæruleopunctatus</i>
<i>Gephyrocharax atricaudata</i>	<i>Cichlasoma calobrense</i>
<i>Ræboides occidentalis</i>	

Above the falls the following were taken.

FISHES OF THE CREEK AT THE SUCUBTI INDIAN VILLAGE (ABOVE FALLS)

Astroblepus Inogifilis
Characidium marshi

Synbranchus marmoratus
Rivulus c. sucubti

The Rio Asinati was passed at flood time and appeared to be quite similar to the other branch, the Sucubti. The last collecting station was high in the main stream in territory which I would refer to as the upper tropical zone. Here *Mollienisia sphenops* was taken and *Astyanax ruberrimus* and *Philypnus maculatus* were seen. From this point we crossed over the divide and entered the Atlantic drainage. While not within the province of this paper, I wish here to record a regret concerning the circumstances which made it impossible to do any fresh-water collecting on this slope. A small collection of marine fishes was made (Breder, 1925 d) but our resources were practically at an end and so the fishes of the short Atlantic streams from Porto Bello to the Rio Atrato still remain virtually unknown.

DISCUSSION.—The preceding lists of fishes and descriptions of habitats, it is believed, give a fair index to the types of associations and conditions in which these fishes live. This survey of the Rio Chucunaque drainage fits well with Eigenmann's ideas of the distribution of the fishes of Central and northern South America and needs no elaboration.

The following forms have their range extended slightly southward by the present survey.

Hoplosternum punctatum
Neotroplus panamensis

The following have their ranges extended slightly to the northward, although all within the Tuyra basin.

Pimelodus c. punctatus
Trachycorystes amblops
Ageneiosus caucanus
Astroblepus longifillis
Lasiancistrus planiceps
Loricaria fimbriata
Apareiodon darinensis

Piabucina festæ
Phanagoniates macrolepis
Hemibrycon dariensis
Creagrutus affinis
Hoplias malabaricus
Sternopygus dariensis
Allogambusia cana
Cichlasoma umbriferum

ETHNOLOGICAL NOTES

Fishes play an important rôle in the diets of the three types of people now inhabiting various parts of the Rio Chucunaque drainage, and these three may be treated separately.

THE NEGRO.—The only negro village on this river system is Yavisa, and, except for a few scattered huts not far from this place, it represents the entire negro population. Their method of catching fish is simply to angle for them by drop line, usually from a dug-out canoe. They obtain the hooks in trade and, as they usually fish on the bottom with a stone for a sinker, the bulk of their catches are silurids of the three most common species. Next in abundance, they take *Sternopygus*. A single wicker trap was seen, not in use, made somewhat after the fashion of a northern lobster pot. They hold many queer views about the local fishes, insisting that the cichlids are the young of marine fishes and when they reach a certain size they descend to the sea and become “dangerously” large. No doubt they confuse them with the larger serranids of Panama Bay.

THE CHOCOI.—The Chocoi Indians on the side streams of the lower Chucunaque appear to use no white mans’ methods in fish catching, although no doubt they could obtain hooks and line from the down-stream negroes. They employ methods which would be nearly useless in the deep and muddy stream passing the negro settlement. In the upper side streams the water is, however, exceedingly clear and their spears and other methods suffice for their requirements. The spears they use are usually made of a black palm shaft about eight or ten feet long and generally tipped with a piece of iron about one-eighth of an inch square that has been garnered from some unknown source, probably in trade downstream, and which they work to a point. In the absence of this iron the wood is simply sharpened. In these clear waters they use their spears with telling effect. The small *Pristis* and the loricariates seem to be their especial prey, probably because such fish are usually a stationery mark to aim at, and we found both extremely palatable. See Plate IV, *B*. However, they not infrequently take a silurid, a cichlid, or even one of the larger characins. Often they simply jab their spear into a tangled mass of débris, such as is generally to be found at the base of an upturned tree, and usually in a short time capture large numbers of loricariates. Even without spears, they are still able to catch fish with comparative ease by resorting to the simple expedient of diving overboard and catching them with their hands. The loricariates are usually their target for such activity and the divers invariably bring the fish up between their teeth, placing them there, head first, to enable them to have more freedom of hand movement. Occasionally they even capture a cichlid in this manner. Just how they are able to do it I am at a loss to say, for all that could ever be seen was the diving overboard followed by a great flurry in the water and an emergence the next moment with the fish. I tried to teach

these people the art of seining, for purely selfish reasons, but after a few trials gave it up for it seemed too complicated for their simple minds. They then gave me much valuable aid by using their own methods which to me were even more impossible than were mine to them.

THE CUNA.—The Cuna Indians of the Rio Sucubti, a more advanced and entirely different type of Indian, are not nearly as much given to splashing around in the water as are the Chocois, so their fishing operations are chiefly confined to spearing and to shooting their fish with bow and arrow. Their spears are a little more refined than those of the Chocoi. The actual spear is nearly the same but it is imbedded in a short length of black palm, which is fastened to a considerable length of hollow reed, although the entire affair is not as long as that of the Chocoi. Often points of black palm are used here too and were probably the exclusive tips before the white man's iron became available. The arrows are similar but still shorter and sometimes have multiple tips. They are shot from bows of hard wood about four feet in length. These people are really very skillful in the use of these two implements, often shooting their fish on the "wing," but they do not resort to swimming after them. Their coastwise relatives of the San Blas use many other methods of fishing in the sea (Breder, 1925*d*), but they are outside the scope of this paper. Many of the fishing devices of these peoples, collected by other members of the party, are now on deposit at the National Museum at Washington, D. C.

The names of the various species as spoken by these three peoples are given in the following table. The utter difference between the Chocoi and the Cuna languages is well indicated, but it will be noted that both of them have borrowed some names from the negroes who speak a sort of mongrel Spanish. The animosity that exists between the two types of Indians is expressed by the fact that they seem not to have borrowed anything from each other in the way of language. Each professes to be unable to understand the other, although they have both borrowed from the negroes, for whom neither has any regard, but whom both seem to fear and hate less than they fear and hate each other. The spelling of the native names is purely phonetic and the syllabication is indicated.

SPECIES	NATIVE NAMES OF FISHES		
	NEGRO	CHOCOI	CUNA
<i>Pristis microdon</i>	Pez espada	Mona	Su-coo
S'luridæ (in general)	Bagre	—	Too-la
<i>Rhamdia wagneri</i>	Congo	Char-ee	—
<i>Pimelodella chagresi</i>	Baloura	Lo-me-ma	—

<i>Pimelodus c. punctatus</i>	Baloura	Lo-me-ma	—
<i>Ageneiosus caucanus</i>	—	En-sevede	—
<i>Hoplosternum punctatum</i>	We-chu-ah	—	—
Plecostominæ (in general)	Wa-co-co	Oom-peh	See-go
Loricarinæ (in general)	Wa-co-co	Da-a-chee-chee	Pe-lu-lu
<i>Apareiodon dariensis</i>	—	—	Ar-chu-gua
<i>Characidium marshi</i>	—	—	Ar-chu-gua
<i>Brycon striatulus</i>	Sardina	E-bee	—
<i>Astyanax ruberrimus</i>	Sardina	Chelu	Oo-new-cha
<i>Astyanax fasciatus</i>	Sardina	Chelu	—
<i>Hemibrycon dariensis</i>	Sardina	Am-a	—
<i>Thoracocharax maculatus</i>	Pe-chu-na	We-lu-we-lu	—
<i>Ræboides occidentalis</i>	—	—	Es-co
<i>Pabucina festæ</i>	Candelario	Corruba	Ah-hoo
<i>Ctenolucius beani</i>	Kinchampa	A-goo-ha	—
<i>Hoplias malabaricus</i>	Peje perro	Wa-wime-ah	Too-goo
<i>Sternopygus dariensis</i>	Macana	—	—
<i>Hypopomus brevirostris</i>	—	—	Wa-se-co
<i>Synbranchus marmoratus</i>	—	—	Yar-be
Clupeidæ (in general)	Sardina	—	Sardina
Pœciliidæ (in general)	—	—	Av-oo
<i>Syngnathus elcapitanense</i>	Culebra	Culebra	Time-mass-su
Cichlidæ (in general)	Mojarra	E-bee	Qua-va

THE FISHES OF THE TUYRA BASIN

COMPARISON OF THE FISHES FROM THE RIO CHUCUNAQUE AND TUYRA

As can be seen from the accompanying map, Figure 1, the Chucunaque and the Tuyra river systems drain the low and, for most part, level valley between the ridges which parallel either coast of Darien, and which these main streams also parallel roughly, converging a little below El Real de Santa Maria on the Tuyra to cut jointly to the sea. The main trend of these streams lies in a nearly straight line, the Chucunaque running about southeast and the Tuyra northwest. From descriptions of the Tuyra above the highest point I reached, it would seem to be very much like the Chucunaque in its general aspect. As together they form a single drainage unit, the Tuyra basin, the fish faunas should be expected to be practically identical. This was found to be the case except for a certain few odd differences.

Considering only the truly fresh-water forms, a comparison with those known from the Tuyra shows that nine forms have been taken from that river which were not found in the Chucunaque, and ten forms not known from the Tuyra have been taken in the Chucunaque, half of which are new. These differential species are as follows.

FROM THE TUYRA

- **Arius tuyra*¹ Meek and Hildebrand
 **Pygidium striatum* Meek and Hildebrand
 **Leptoancistrus canensis* Meek and Hildebrand
Loricaria capetensis Meek and Hildebrand
L. latiura Eigenmann and Vance
Brycon argenteus Meek and Hildebrand
 **Eigenmannia virescens* (Valenciennes)
 **Sternarchus rostratus* Meek and Hildebrand
 **Awaous transandeanus* (Günther)

FROM THE CHUCUNAQUE

- **Hoplosternum punctatum*
*Loricaria altpinnis***
*Apareiodon compressus***
 Characidium marshi*
Mollienisia sphenops
 Rivulus c. chucunaque*
 R. c. sucubti*
 **Neetroplus panamensis*
 **Dormitator latifrons*
 **Eleotris picta*

Species preceded by "*" belong to genera not represented in the other branch. Species followed by "**" are new, being recently described (Breder, 1925b) and not yet known from any other stream system.

Of the six genera new to the Tuyra basin, two are distinctly South American, *Hoplosternum* and *Characidium*; two are northern derivatives, *Rivulus* and *Neetroplus*, and two are of marine origin, *Dormitator* and *Eleotris*.

It is believed that these forms known respectively from only one of these convergent streams occur in the other and simply represent those missed by either Tuyra collectors or myself. However, when it is recalled that the list of Tuyra species amounts to 51 and the present list of Chucunaque fresh-water fishes to 53 it is evident that 62 is the present number of known forms from this entire drainage basin, and the differences do not then seem so significant.

The most striking difference is the lack of *Rivulus* from the Tuyra, for it was exceedingly common in the side streams of the Chucunaque. I cannot believe that Meek and Hildebrand overlooked it in their thorough survey of the Tuyra nor can I conceive that they did not reach places where it might be expected to occur. The presence of *Astroblepus* in their collections practically eliminates that as a possibility, for in the Chucunaque, at least, this fish lives only in places suited to *Rivulus*, which I always found greatly outnumbering it. On the other hand, I did not find their *Pygidium* although especial efforts were made to do so. *Mollienisia sphenops*, so common elsewhere, although unknown from the Tuyra, was only taken in one spot, high up in the Scubuti.

So far as recorded, comparatively few marine forms are known from the Tuyra. Only two are common to both, *Pristis microdon* and *Syngnathus elcapitanense*. Of the others, no genera is common to both. They follow.

¹Possibly this should be considered a marine form. See the following list.

FROM THE TUYRA

Felichthys pinnimaculatus (Steindachner)
Netuma oscula (Jordan and Gilbert)
*Arius tuyra*¹ Meek and Hildebrand
Ophioscion strabo Gilbert

FROM THE CHUCUNAQUE

Ilisha fürthii
Anchovia curta
Mugil curema
Centropomus unionensis
Stellifer fürthii?
S. melanocheir?
Gobius daguæ
Microgobius miraflorensis
Citharichthys gilberti
Achirus panamensis

This brings the total number of species and subspecies, fresh-water and marine, to 77.

The following list gives the total number of species known from the Tuyra basin and indicates their presence or absence in the two branches.

FISHES OF THE TUYRA BASIN

SPECIES	RIO TUYRA	RIO CHUCUNAQUE
Pristidæ		
<i>Pristis microdon</i>	×	×
Siluridæ		
<i>Felichthys pinnimaculatus</i>	×	..
<i>Netuma oscula</i>	×	..
<i>Arius tuyra</i>	×	..
<i>Rhamdia wagneri</i>	×	×
<i>Pimelodella chagresi</i>	×	×
<i>Pimelodus clarias punctatus</i>	×	×
<i>Trachycorystes amblops</i>	×	×
<i>Ageneiosus caucanus</i>	×	×
Astroblepidæ		
<i>Astroblepus longifilis</i>	×	×
Pygidiidæ		
<i>Pygidium striatum</i>	×	..
Callichthyidæ		
<i>Hoplosternum punctatum</i>	..	×
Loricariidæ		
<i>Plecostomus plecostomus panamensis</i>	×	×
<i>Lasiancistrus planiceps</i>	×	×
<i>Leptoancistrus canensis</i>	×	..
<i>Chætostomus fischeri</i>	×	×
<i>Ancistrus spinosus</i>	×	×
<i>Loricaria altipinnis</i>	..	×
<i>Loricaria latiura</i>	×	..

¹Possibly this should be considered a fresh-water form. See the preceding list.

FISHES OF THE TUYRA BASIN (continued)

SPECIES	RIO TUYRA	RIO CHUCUNAQUE
<i>Loricaria capetensis</i>	×	..
<i>Loricaria fimbriata</i>	×	×
<i>Loricaria variegata</i>	×	×
<i>Sturisoma panamense</i>	×	×
<i>Sturisoma citurense</i>	×	×
Characidae		
<i>Curimatus magdalenæ</i>	×	×
<i>Apareiodon dariensis</i>	×	×
<i>Apareiodon compressus</i>	..	×
<i>Characidium marshi</i>	..	×
<i>Piabucina festæ</i>	×	×
<i>Phanagoniates macrolepis</i>	×	×
<i>Compsura gorgonzæ</i>	×	×
<i>Pseudocheirodon affinis</i>	×	×
<i>Brycon argenteus</i>	×	..
<i>Brycon striatulus</i>	×	×
<i>Astyanax ruberrimus</i>	×	×
<i>Astyanax fasciatus</i>	×	×
<i>Bryconamericus emperador</i>	×	×
<i>Hemibrycon dariensis</i>	×	×
<i>Creagrutus affinis</i>	×	×
<i>Gephyrocharax atricaudata</i>	×	×
<i>Thoracocharax maculatus</i>	×	×
<i>Ræboides occidentalis</i>	×	×
<i>Ctenolucius beani</i>	×	×
<i>Hoplias malabaricus</i>	×	×
Gymnotidae		
<i>Sternopygus dariensis</i>	×	×
<i>Eigenmannia virescens</i>	×	..
<i>Hypopomus brevirostris</i>	×	×
<i>Sternarchus rostratus</i>	×	..
Synbranchidae		
<i>Synbranchus marmoratus</i>	×	×
Clupeidae		
<i>Ilisha fürthii</i>	..	×
Engraulidae		
<i>Anchovia curta</i>	..	×
Pœciliidae		
<i>Allogambusia cana</i>	×	×
<i>Darienichthys darienensis</i>	×	×
<i>Mollienisia sphenops</i>	..	×
<i>Allopœcilia caucana</i>	×	×
<i>Rivulus chucunaque chucunaque</i>	..	×
<i>Rivulus chucunaque sucubti</i>	..	×

FISHES OF THE TUYRA BASIN (continued)

SPECIES	RIO TUYRA	RIO CHUCUNAQUE
Syngnathidæ		
<i>Syngnathus elcapitanense</i>	×	×
Mugilidæ		
<i>Mugil curema</i>	..	×
Centropomidæ		
<i>Centropomus unionensis</i>	..	×
Sciaenidæ		
<i>Stellifer fürthii?</i>	..	×
<i>Stellifer melanocheir?</i>	..	×
<i>Ophioscion strabo</i>	×	..
Cichlidæ		
<i>Geophagus crassilabris</i>	×	×
<i>Æquidens cæruleopunctatus</i>	×	×
<i>Neotroplus panamensis</i>	..	×
<i>Cichlasoma tuyerense</i>	×	×
<i>Cichlasoma calobrense</i>	×	×
<i>Cichlasoma umbriferum</i>	×	×
Gobiidæ		
<i>Dormitator latifrons</i>	..	×
<i>Eleotris picta</i>	..	×
<i>Philypnus maculatus</i>	×	×
<i>Gobius daguæ</i>	..	×
<i>Microgobius miraflorensis</i>	..	×
<i>Awaous transandeanus</i>	×	..
Pleuronectidæ		
<i>Citharichthys gilberti</i>	..	×
Soleidæ		
<i>Achirus panamensis</i>	..	×

“×” signifies that the species is known to be present.

KEY TO THE FISHES OF THE TUYRA BASIN

As the present paper extends our knowledge of the fishes of the Tuyra basin to include the branch, previously unknown, which forms nearly half of the system, it is felt that a rather comprehensive amount of data is at hand concerning the species present in this natural unit of fish environment, especially in view of the slight differences between the known faunas of the two branches. Therefore, the following artificial key has been compiled, drawing freely on all available sources, for the use of travelers and others interested in this region. While it is primarily intended to separate the fishes of this basin, one from another, definite specific characters have been added wherever possible without unduly lengthening the key. It is dichotomous throughout. The capital letters

key to families, and beginning afresh under each family the lower case letters key direct to the individual species, the genera being mentioned only where more than one species occurs. For taxonomic descriptions, see Meek and Hildebrand, 1916, 1923, 1925; Eigenmann, 1922, Gilbert and Starks, 1904, and Breder, 1925b.

- A.—Gill openings 5, a long rostral process armed with saw-like teeth. . PRISTIDÆ.
 a.—Origin of first dorsal in advance of ventrals, a small lower caudal lobe present, 17 to 23 teeth on each edge of rostrum. . *Pristis microdon*.
 AA.—Gill openings 1, no toothed rostral process.
 B.—Fish symmetrical, not with both eyes on one side of head, coloration of sides similar.
 C.—Ventral fins abdominal or absent.
 D.—Oral region with 1 or more pairs of evident barbels.
 E.—Body scaleless, naked.
 F.—Adipose fin present.
 G.—Mouth terminal or subterminal, the lips not reverted to form a sucking disc.

SILURIDÆ.

- a.—Nares approximated.
 b.—Lower jaw with a single pair of barbels; maxillary barbel compressed, band-shaped; anal 29 to 32, black blotch on anterior part.
Felichthys pinamaculatus.
 bb.—Lower jaw with 2 pairs of barbels; maxillary barbel not band-shaped.
 c.—Teeth on jaws pointed or slightly bluntish, vomerine and palatine teeth more or less bluntish, the palatine teeth in large patches with a backward projection, extending on the pterygoids, width of base of occipital process about 2 in length, snout strongly projecting, about two-thirds of width of the band of teeth on upper jaw exposed when the mouth is closed. *Netuma oscula*.
 cc.—Teeth in upper jaw pointed, posterior teeth near symphysis on lower jaw blunt, others pointed, vomerine teeth wanting, palatine teeth granular, in small or moderate patches, without backward projection, teeth on upper jaw in quadrate patches slightly longer than broad, well separated by a median line and constriction, teeth on lower jaw in a broad band, mostly blunt, only those on anterior margin of band pointed, gill-rakers 13 or 14. *Arius tuya*.
 aa.—Nares remote.
 d.—Eye with a free orbital margin, adipose fin longer than anal.
 e.—Occipital process failing to reach dorsal plate, adipose much longer than head. *Rhamdia wagneri*.
 ee.—Occipital process reaching dorsal plate, adipose shorter or not very much longer than head.
 f.—Fontanel continued beyond eyes, humeral process spine-like, a prominent black lateral band, adipose longer than head.
Pimelodella chagresi.
 ff.—Fontanel not continued beyond eyes, humeral process broad, not spine-like, young fish more or less spotted, adipose shorter than head.
Pimelodus clarias punctatus.

- dd.—Eye without a free orbital margin; adipose fins shorter than anal.
- g.—3 pairs of barbels, caudal obliquely truncate, emarginate or deeply concave, head not especially depressed. *Trachycorystes amblops*.
- gg.—1 pair of barbels, maxillary, nearly obsolescent, caudal forked, head greatly depressed and flattened, shovel-shaped. *Ageneiosus caucanus*.
- GG.—Mouth inferior, the lips reverted to form a sucking disc. ASTROBLEPIDÆ.
- a.—Teeth small, eye small, superior, adipose a long fold reaching from dorsal to caudal, maxillary barbels only. *Astroblepus longifilis*.
- FF.—Adipose fin absent. PYGIDIIDÆ.
- a.—Dorsal midway between gill opening and tip of caudal, body spotted with darker. *Pygidium striatum*.
- EE.—Body armed mostly or wholly with bony plates.
- H.—Sides with two series of bony plates, mouth terminal or subterminal, not forming a sucking disc. CALLICHTHYIDÆ.
- a.—Usually 5 or 6 azygous pre-adipose plates, body profusely spotted.
Hoplosternum punctatum.
- HH.—Sides and back and frequently the ventral surface armed with bony plates, mouth inferior, forming a sucking disc. LORICARIIDÆ.
- a.—Body rather short, robust, caudal peduncle short, compressed, adipose and anal present (except in *Leptoancistrus*).
- b.—Scutes on back and sides distinctly carinate; opercle firmly attached to the interopercle and not independently movable, spotted blow.
Plecostomus plecos omus panamensis.
- bb.—Scutes on sides and back without prominent ridges or carinations, opercle more or less freely moveable.
- c.—Margin of snout with granules and bristles.
- d.—Mandibular ramus noticeably shorter than interorbital, last dorsal ray failing to reach adipose, dorsal spine longer than snout and eye.
Lasiancistrus planiceps.
- dd.—Mandibular ramus nearly equal to interorbital, adipose and anal absent). *Leptoancistrus canensis*.
- cc.—Margin of snout naked, with or without tentacles.
- e.—Snout without tentacles; mandibular ramus about equal to interorbital; interopercle with one to three spines on two basal bones.
Chaetostomus fischeri.
- ee.—Margin of snout bearing tentacles, long and numerous in the male, short and few in the female, mandibular ramus much narrower than interorbital, male plain below, female with faint pale spots.
Ancistrus spinosus.
- aa.—Body long and slender; caudal peduncle very long, strongly depressed, adipose fin absent, anal present.
- f.—Eye with a distinct posterior orbital notch; teeth usually bifid and in small or moderate numbers. LORICARIA.
- g.—Ventral surface of abdomen completely armed with bony plates.
- h.—Lateral keels two, becoming approximated on the 16th scute, no evident naked area behind pectoral, 3 to 7 series of irregular plates on abdomen, between lateral scutes, predorsal scutes feebly carinate, anterior dorsal rays when depressed reaching beyond posterior.
L. altipinnis.

- hh.—Lateral keels three, the upper present on 8th to 9th scute, the other two approximating on the 16th to 18th scute, predorsal plates strongly carinate, 2 series of plates on abdomen between lateral scutes, a naked area behind pectoral..... *L. lativra*.
- gg.—Ventral surface partly naked.
- i.—Lateral keels 3, lower lip with short fringes, maxillary barbel never reaching gill opening, 8 to 10 teeth on each side of upper jaw.
- j.—Anterior rays of dorsal reaching past posterior when deflexed, the longest ray notably longer than head; anterior rays of anal reaching past posterior rays when depressed, the longest ray longer than width of head..... *L. capeensis*.
- jj.—Rays of dorsal and anal co-terminous when depressed, longest dorsal ray shorter than head, longest anal ray equal to width of head.
L. fimbriata.
- ii.—Lateral keels 2, margin of lower lip with long fringes; maxillary barbel reaching to or past gill-opening; 3 or 4 teeth on each side in upper jaw..... *L. variegata*.
- ff.—Eye without an orbital notch, teeth setiform, numerous.... STURISOMA.
- k.—Snout somewhat produced, pointed, its upper profile concave, lateral scutes 33 to 35; caudal fin with a dark longitudinal bar on each lobe.
S. panamense.
- kk.—Snout broadly obtuse, its upper profile convex, later alscutes 30 to 31, no dark bars on caudal lobes..... *S. citurensis*.
- DD.—Oral region without barbels.
- I.—Dorsal and anal fins without spines.
- J.—Adipose fin present (except in *Phanagoniates* and *Hoplias*), head naked, lateral line present at least in part (except in *Piabucina*), teeth present in both jaws (at except in *Curimatus* and *Apareiodon*)..... CHARACIDÆ.
- a.—Caudal fin forked.
- b.—Scales cycloid.
- c.—(Teeth absent) no gill rakers, intestine very long, sides plain, no peduncular spot, ventrals under dorsal..... *Curimatus magdalenæ*.
- cc.—Teeth present in (one or) both jaws.
- d.—(Teeth present in upper jaw only), spatulate in form with a pectinate margin, lower jaw scoop-shaped..... APAREIODON.
- e.—Sides marked with 2 dark parallel bands, each caudal lobe and anal with 2 oblique dark bars, about 14 denticulations on each tooth.
A. dariensis.
- ee.—Sides with a faint median band, a prominent dark spot, at base of caudal, fins plain, about 11 denticulations on each tooth.
A. compressus.
- dd.—Teeth present in both jaws.
- f.—Premaxillary teeth in a single series.
- g.—Anal fin short not over 12 rays, lateral line complete or absent, mandibular teeth in 1 or 2 series.
- h.—Mandibular teeth in a single series, tricuspid, maxillary without teeth, lateral line complete, fish resembling the genus *Eltheostoma* of North America, scales moderate, 35..... *Characidium marshi*,

- hh.—Mandibular teeth in two series, outer series multicuspid (lateral line wanting), fish not resembling *Etheostoma*, body sub-cylindrical, scales large, 28. *Piabucina festæ*.
- gg.—Anal fin long 16 to 44 rays, lateral line incomplete, mandibular teeth in 1 series.
- i.—Anal over 39 rays (adipose absent) *Phanagoniates macrolepis*.
- ii.—Anal 16 to 24 rays, adipose present.
- j.—Male with a lobe of large scales extending along base of middle caudal rays. *Compsura gorgonzæ*.
- jj.—Caudal of male without enlarged scales. *Pseudochirodon affinis*.
- ff.—Premaxillary teeth in 2 or more series.
- k.—Dorsal origin in advance of anal origin.
- l.—Premaxillary with 3 or 4 series of teeth anteriorly, 2 or 3 laterally.
- m.—Mandible with 2 series of teeth, the inner composed of only 2 canines a little behind anterior teeth of first series. BRYCON.
- n.—Scales 43 to 58, anal fin 24 to 30, about equal to head. *B. argenteus*.
- nn.—Scales 64 to 80, anal fin 32 to 37, longer than head. *B. striatulus*.
- mm.—Mandible with 1 series of teeth.
- o.—Second suborbital not in contact with the preorbital below, leaving a naked area between, premaxillary teeth regularly placed.
- ASTYANAX.
- p.—Sides with a plumbeous lateral band ending in a large well-defined caudal spot. *A. ruberrimus*.
- pp.—Sides with a dark plumbeous lateral band, darkest and most distinct posteriorly, sometimes faintly visible on caudal rays, no caudal spot. *A. fasciatus*.
- oo.—Second suborbital in contact with preorbital below.
- q.—A prominent peduncular spot, not extending onto caudal rays, few teeth along the upper portion of the maxillary.
- Bryconamericus emperador*.
- qq.—No peduncular spot, lateral band extending to tips of central caudal rays, teeth along entire or nearly entire edge of maxillary.
- Hembrycon dariensis*.
- ll.—Premaxillary with 3 series of teeth, mandible with 1 series, anal fin with not more than 17 rays, body long, little compressed.
- Creagrutus affinis*.
- kk.—Anal origin in advance of dorsal origin.
- r.—Premaxillary with 2 series of teeth, mandible with 1.
- s.—Thoracic region not greatly dilated and compressed, a dark median band, forking at caudal and following both margins to tip of rays.
- Gephyrocharax atricaudata*.
- ss.—Thoracic region greatly dilated and compressed, forming a semicircular disc. *Thoracocharax maculatus*.
- rr.—Premaxillary with 3 series of teeth, mandible with 2 series, the first of only 2 teeth on edge of jaw, directed forward, anterior profile trenchant, anal only slightly in advance of dorsal, about 40 rays, a dark scapular spot. *Ræboides occidentalis*.
- bb.—Scales ctenoid, jaws beak-like, palatines with a few teeth, body elongate, sides striped horizontally. *Ctenolucius beani*.

- aa.—Caudal not forked, rounded (adipose fin absent), palatines with a few teeth, brownish in color, body sub-cylindrical, jaws armed with numerous canines. *Hoplias malabaricus*.
- JJ.—No adipose fin present.
- K.—Body elongate or eel-like, ventral fins absent, not armed with bony rings.
- L.—Dorsal absent (except as a filament in *Sternarchus*), pectorals present, anal large and long, tail tapering to a fine point, gill openings lateral, body compressed. GYMNOTIDÆ.
- a.—Caudal fin and dorsal filament absent.
- b.—Orbital margin free, teeth present in both jaws, in two more or less distinct patches in upper jaw and in a single patch in lower jaw. *Sternopygus dariensis*.
- bb.—Orbital margin not free, eye covered by a transparent membrane.
- c.—Teeth present in both jaws; origin of anal under or slightly behind base of pectorals. *Eigenmannia virescens*.
- cc.—Teeth wanting; origin of anal about the length of pectoral fin behind gill opening. *Hypopomus brevirostris*.
- aa.—Caudal fin and (dorsal filament present); mouth large, its angle little, if any, in front of eyes. *Sternarchus ros'ra'us*.
- LL.—Dorsal present, confluent with anal around tail, no pectorals, gill openings median, united ventrally, body cylindrical. SYNBRANCHIDÆ.
- a.—Variouly marbled with slaty and brown. *Synbranchus marmoratus*.
- KK.—Body not especially elongate, unless armed with bony rings, ventrals present.
- M.—Lateral line absent, not especially elongate or armed with bony rings.
- N.—Head and body compressed.
- O.—Mouth moderate, terminal, usually more or less oblique. CLUPEIDÆ.
- a.—Anal fin long, 46–50 rays, dorsal inserted posterior to ventrals but in advance of anal; scales 56 to 61. *Ilisha fürthii*.
- OO.—Mouth large, inferior, usually horizontal, the snout overhanging the mouth, mandible long and slender. ENGRAULIDÆ.
- a.—Gill membranes free from isthmus and separate, maxillary long and narrow reaching past articulation of mandible, anal 25 to 30 depth 4.4 to 4.8. *Anchovia curta*.
- NN.—Body compressed, head depressed, mouth superior. PÆCILIIDÆ.
- a.—Males with anal fin advanced and modified into an intromittent organ (species ovoviviparous).
- b.—Ventral fins in both sexes similar, distal portion of produced rays of anal fin male directed forward.
- c.—First produced ray of intromittent organ with a recurved spur below its apex, directed upward and forward, male with a black spot, about size of pupil on sides in advance of vertical from origin of dorsal, dorsal with a dusky spot at base of posterior fourth of fin, females plain, males with very faint cross-bars. *Alogambusia cana*.
- cc.—First produced ray without a recurved spur below its apex, anteriorly serrate, bearing a hook at apex directed forward and downward, a dark area at base of anal rays, females plain, males with numerous cross-bars, but no spot on sides. *Darienichthys darienensis*.

- bb.—Ventral fins in male enlarged, the second ray notably produced, the first prolonged ray of anal bearing a small antrorse hook at apex and a small fleshy flap.
- d.—Dorsal fin with 10 to 11 rays, anal with 10, dorsal and caudal spotted with black. *Mollienisia sphenops*.
- dd.—Dorsal fin with 7 to 8 rays, anal with 8 to 9, dorsal with a dark spot on its base, the rest of dorsal and anal unspotted. *Allopoecilia carucana*.
- aa.—Anal fin in males not modified into an intromittent organ (species oviparous) *RIVULUS*.
- e.—Anal 13 to 14, at least some bright colors, sides bluish with horizontal rows of pink dots, caudal tipped with bright blue.
- f.—Nine longitudinal rows of scales between dorsal and anal, blue tip on caudal less than half eye in width, ventrals scarcely reaching vent.
R. chucunaque chucunaque.
- ff.—Eight longitudinal rows of scales between dorsal and anal, blue tip on caudal about half eye, ventrals usually reaching anal.
R. chucunaque sucubti.
- MM.—Body elongate, armed with bony rings, mouth small, at end of long snout.
SYNGNATHIDÆ.
- a.—Head 9.2 to 10.5, anal absent, dorsal 30 to 32, caudal rings 37 to 38, dorsal over 7 or 8 rings. *Syngnathus elcapitanense*.
- II.—Dorsal and anal fins with spines anteriorly.
- P.—First dorsal with 4 stiff spines, anal with 3 (2 in very young), body long.
MUGILIDÆ.
- a.—No teeth on vomer or palatines, mouth cleft chiefly transverse, anal rays 9, scales 33 to 41, head deeper than wide, upper lip thin.
Mugil curema.
- CC.—Ventral fins thoracic, sometimes united to form a sucking disc.
- PP.—Dorsal fin with more than 4 spines.
- Q.—Lateral line extending onto caudal to tips of rays.
- R.—Dorsal fins separate, anal spines 3, second very strong and large.
CENTROPOMIDÆ.
- a.—Lateral line not in a black streak, pectorals nearly reaching tips of ventrals, scales 47 to 50, second anal spine not reaching base of caudal. *Centropomus unionensis*.
- RR.—Dorsal fin deeply notched but rarely separate, anal spines 1 or 2, the second not enlarged. *SCIÆNIDÆ*.
- a.—No mandibular barbels, preopercular spines present.
- b.—Interorbital space wide, skull excessively cavernous, spongy.
STELLIFER.
- c.—Mouth almost horizontal, inferior, the snout projecting, premaxillaries wholly below the level of the lower margin of eye, dorsal XI-I or XII-I, 22 to 25, anal II, 9 or 10. *S. fürthii*.
- cc.—Mouth strongly inclined, terminal, lower jaw projecting, premaxillaries not wholly below the level of eye, dorsal X-I, 20 to 23, anal II, 8.
S. melanocheir.
- bb.—Interorbital space not especially wide, skull not cavernous, not noticeably spongy, scales below lateral line in horizontal rows, second

dorsal spine shorter than fourth, back elevated, caudal lanceolate, at least as long as head, gillrakers 9+13, short and thick, ventral rays produced, anal rays all shorter than the longest dorsal spine, scales 5 or 5.5 to 54 or 55, preopercular margin with 4 to 6 teeth.

O. phioscion strabo.

QQ.—Lateral line not extending onto caudal.

S.—Dorsal single, lateral line interrupted under base of dorsal reappearing lower down on caudal peduncle, body deep, compressed. CICHLIDÆ.

a.—Anal fin with 3 spines.

b.—First gill arch with a lamelliform lobe above angle, snout much longer than post-orbital part of head. *Geophagus crassilabris.*

bb.—First gill arch without a lamelliform lobe above angle, snout usually shorter than post-orbital part of head. *Equidens cæruleopunctatus.*

aa.—Anal fin with 6 or 7 spines.

c.—The outer series of teeth in both jaws compressed, incisor-like.

Neotroplus panamensis.

cc.—Teeth all conical. CICHLASOMA.

d.—The outer series of teeth in the jaws somewhat enlarged, and regularly increased in size anteriorly; mouth small or moderate; the maxillary not reaching past vertical from anterior margin of eye.

e.—Lower lip narrow, its margin not free at symphysis; teeth all sharply pointed, young with cross-bars, adults with a single series of black blotches along middle of sides, scales 34 to 41, lower lateral line present on fifth row of scales below upper, anal with 6 or 7 spines.

C. tuyrense.

ee.—Lower lip abroad, continuous and free at symphysis, teeth rather blunt, young with cross bars, these less distinct in adults, sides with a large black blotch under posterior part of spinous portion of dorsal.

C. calobrense.

dd.—The anterior pair of teeth in each jaw enlarged; mouth rather large, the maxillary reaching past vertical from anterior margin of eye; sides with a dark lateral band, ending in a jet-black caudal spot.

C. umbriferum.

SS.—Dorsal double or scarcely united, lateral line incomplete or wanting, ventrals close together ventrally or united to form a sucking disc, body elongate, subcylindrical. GOBIIDÆ.

a.—Ventral fins separate.

b.—Vomerine teeth wanting, gill openings not extending forward to below eyes.

c.—Jaws anteriorly of equal length, teeth compressed at apices, gill rakers numerous, about 80 on lower limb of first arch, well developed, in two series on each arch, intestinal canal long.

Dormitator latifrons.

cc.—Lower jaw projecting, teeth all pointed, gill rakers undeveloped, intestinal canal short, a small sharp concealed spine at the lower posterior angle of preopercle. *Eleotris picta.*

bb.—Vomer with villiform teeth, gill openings extending forward to below eyes, scales 56 to 59 anal I, 10. *Philypnus maculatus.*

- aa.—Ventrals united, forming a sucking disc.
 d.—Inner edge of shoulder girdle without dermal flaps.
 e.—Dorsal VI—I, 12, anal I, 12 about 32 scales, a prominent dark spot at base of pectoral, mouth practically horizontal. *Gobius daguæ*.
 ee.—Dorsal VII—I, 16, anal I, 16, scales about 48, a short dark vertical line extending downward from anterior part of dorsal, often followed by other lighter ones, mouth nearly vertical. *Microgobius miraflorensis*.
 dd.—Inner edge of shoulder girdle with 2 or more dermal flaps projecting into the gill cavity, scales 60 to 67. *Awaous transandeanus*.
 BB.—Fish asymmetrical, both eyes on one side of head, distinct pigmentation only on eyed side.
 T.—Mouth comparatively large, with teeth; eyes well separated; margin of preopercle more or less distinct, not concealed by skin.

PLEURONECTIDÆ.

- a.—Eyes and color on left side, eyes 5 to 6 in head, scales 40 to 46, gill rakers shorter than pupil. *Citharichthys gilberti*.
 TT.—Mouth very small, twisted, with mostly rudimentary teeth, eyes close together, margin of preopercle concealed by skin. SOLEIDÆ.
 a.—Eyes and color on right side, pectoral fins absent. Dorsal 59 to 60, anal 41 to 45, scales 64. *Achirus pinnamensis*.

COMPARISON WITH OTHER DRAINAGE BASINS

THE SAMBU VALLEY.—Dr. Thomas Barbour on his expedition to Serro Sapo in 1922, west of our region, collected some fishes incidental to his main work. These specimens have been identified by Dr. Eigenmann but have not been previously recorded. Through the courtesy of Dr. Barbour I am able to list these species taken by him for comparison with the streams of the Tuyra basin draining directly into that main artery, which the present two do not.

The two streams in which the collections were made are small and drain slopes west of the Tuyra estuary. The collections were made by seine in pools between rapids above the limits of canoe navigation.

From these collections it would seem that the fishes of this drainage are identical with those of the Tuyra proper, as might be expected. There are only two differences, which are doubtless purely taxonomic and give no hint of regional differentiation. They are as follows.

The *Ancistrus centrolepis* Regan of the Rio Jesusito is doubtless the same fish as our *A. spinosus*. Although I see no reason to synonymize the two from my material, Eigenmann, 1922, suggested that they may not be differentiable. *A. centrolepis* is known only from a more southern drainage and apparently Dr. Eigenmann in identifying this material considered the two identical, which would mean a northward extension of the range of the species. However, on a regional basis it would seem

almost certain that Rio Jesuito specimens would be like those from the Tuyra basin and not like those from the Rio San Juan basin, to which *A. centrolepis* is endemic. An examination of all specimens and more material than is now in collections is apparently necessary before this point can be determined with complete satisfaction.

The *Loricaria uracantha* Kner and Steindachner of the same stream is doubtless identical with *L. altipinnis*. This identification was made in apparent confirmation of the doubted records of this form from the Pacific slope, which is otherwise known only from the Chagres basin, and before *L. altipinnis* was described and differentiated from the somewhat similar *L. uracantha*.

Whatever the true status of these two species is eventually shown to be, it is evident that the fauna of the Sambu Valley is most likely identical with that of the Tuyra. With these considerations in mind it is with little hesitation that I refer *A. centrolepis* and *L. uracantha* of the Rio Jesuito to *A. spinosus* and *L. altipinnis* respectively.

RIO JESUITO.—According to Bangs and Barbour, 1922, the Rio Jesuito "is one of a series of small streams which have their source in the highlands" of the Sapo Mountains "and flow towards the Sambu Valley but which apparently, in this case, is not tributary to the Sambu but probably empties in a marsh drained by the Rio Celorio."

<i>Lasiancistrus planiceps</i>	<i>Astyanax fasciatus</i>
<i>Ancistrus centrolepis</i>	<i>Hemibrycon dariensis</i>
<i>Loricaria uracantha</i>	<i>Gephyrocharax atricaudata</i>
<i>Curimatus magdalenæ</i>	<i>Thoracocharax maculatus</i>
<i>Compsura gorgonæ</i>	<i>Ræboides occidentalis</i>
<i>Brycon argenteus</i>	<i>Ctenolucius beani</i>
<i>Astyanax ruberrimus</i>	<i>Æquidens cæruleopunctatus</i>

QUEBRADA ESNAPE.—The Quebrada Esnape, according to Bangs and Barbour, 1922, "is said to be tributary to the Rio Taimiti."

<i>Piabucina festæ</i>	<i>Gephyrocharax atricaudata</i>
<i>Compsura gorgonæ</i>	<i>Symbranchus marmoratus</i>
<i>Astyanax ruberrimus</i>	<i>Æquidens cæruleopunctatus</i>
<i>Bryconamericus emperador</i>	

RIO BAYANO.—The Rio Bayano,¹ although not directly connected with the Tuyra-Chucunaque system dominates the continuation of this low, level, plain-like valley to the northwest, running in a northwesterly direction. The headwaters of the Chucunaque and the Bayano approach

¹The Rio Bayano is frequently referred to as the Rio Chepo in various publications. Locally, however, the latter is applied only to that portion of the river below the village of that name, a practise not uncommon in this country, although the former name is doubtless preferable for general usage.

each other closely and from observations made by Mr. Marsh from an aeroplane are separated by no transverse ridge, a simple gentle swell in the valley bottom alone determining the direction of flow. From this it would seem that these two streams would have decapitated each other repeatedly in times past and probably continue to do so today in the times of unusual terrain-modifying rain storms.

Although similar in the main, the Tuyra and Bayano basins differ decidedly in several respects, the following fresh-water forms being known from the Bayano but not from the Tuyra.

BAYANO FISHES NOT COMMON TO THE TUYRA BASIN

- Piabucina panamensis* Gill.
Hoplias microlepis (Günther).
Brachyrhaphis episcopi (Steindachner)*
Allogambusia tridentiger (Garman).
Agonomostomus monticola (Bancroft)*
Hemieleotris latifasciatus (Meek and Hildebrand)*

Species marked "*" represent genera not known from the Tuyra basin.

On the other hand, those from the Rio Tuyra proper but not known from the Bayano are as follows.

Rio Tuyra Fishes not Common to the Bayano Basin

- | | |
|----------------------------------|---------------------------------|
| <i>Ageneiosus caucanus</i> | <i>Hemibrycon dariensis</i> |
| <i>Pimelodius c. punctatus</i> | <i>Creagrutus affinis</i> |
| <i>Trachycorystis amblops</i> | * <i>Hoplias malabaricus</i> |
| <i>Arius tuyra**</i> | * <i>Piabucina festæ</i> |
| <i>Lep'oancistrus canensis**</i> | <i>Phanagoniates macrolepis</i> |
| <i>Lasiancistrus planiceps</i> | <i>Eigenmannia virescens**</i> |
| <i>Plecostomus p. panamensis</i> | <i>Sternopygus dariensis</i> |
| <i>Loricaria fimbriata</i> | <i>Sternarchus rostratus**</i> |
| <i>L. capetensis**</i> | <i>Allopecilia caucana</i> |
| <i>L. latiura**</i> | * <i>Allogambusia cana</i> |
| <i>L. variegata</i> | <i>Synbranchus marmoratus</i> |
| <i>Pygidium striatus**</i> | * <i>Cichlasoma umbriferum</i> |
| <i>Apareiodon dariensis</i> | |

Species preceded by "*" belong to genera represented in the Bayano basin by other species.

Species followed by "**" were not taken in the Chucunaque and represent similarity in absences between this stream and the Bayano. Those added to the list of fishes common to both the Bayano and Tuyra basins by the present expedition follow. They are common to the Rio Chucunaque and Bayano but unknown as yet from the Tuyra proper.

Fishes Common to the Chucunaque and Bayano

*Mollienisia sphenops**Dormitator latifrons**Eleotris picta*

These are all rather wide-ranging forms and might be expected to be found in any river system of Pacific Darien. Of course, the five forms recently described from the Chucunaque, Breder, 1925*b*, are known only from that river.

RIO CHAGRES, ATRATO AND MAGDALENA.—The Rio Chucunaque seems a far cry from the Rio Chagres, emptying into the Atlantic, but fourteen of the thirty-five species known from the Chagres are found in the former and ten species are only very slightly differentiated across the divide. Of the two forms new to the Tuyra basin, one, *Neetroplus*, is apparently identical with *N. panamensis* known only from the Chagres. The other, *Loricaria altipinnis*, is closer to *L. uracantha* of the Chagres than any other Panama form and seems to be somewhat intermediate between it and *L. magdalenæ* Steindachner of the Rio Atrato and Magdalena.

Of the numerous species identical or close to others of the Rio Atrato and Magdalena the present survey adds but one, *Characidium marshi*, which is apparently closely related to *C. phoxocephalum* Eigenmann. *Rivulus* in the Chucunaque definitely places it on the Pacific slope of Darien, where it should of course be expected, but whence it had not been previously recorded. The connection between the Tuyra, Atrato and Magdalena basins has been fully set forth by Eigenmann, 1922.

CONCLUSION

Although it is not the purpose of the present paper to discuss the ecological relationships of the various members of the fauna considered, brief mention of some of the thoughts this work has engendered and the problems it has suggested is not out of place.

For example, the many cases of parallelism to be seen in the highly differentiated characins to forms often remote both geographically and phylogenetically suggest at once that a similarity of environmental opportunities have made such possible. In some cases nearly the entire fish parallels some other distant form, e.g., *Ctenolucius* and *Lepisosteus* or *Characidium* and *Etheostoma*. In others an organ or system of organs approach that of some entirely unrelated form, e.g., *Thoracocharax* and *Halocypselus* or *Curimatus* and *Mugil*. There are comparatively few fresh-water families present in this recently populated area. They are

the Siluridæ,¹ Loricariidæ, Characidæ, Gymnotidæ, Synbranchidæ, Poeciliidæ, Cichlidæ and Gobiidæ. The fact that stands out boldly is that of these eight distinct and rather natural families there is only one, the Characidæ, which can be considered as highly differentiated within itself, at any place in its range. In the absence of evidence to the contrary, this suggests a greater plasticity on the part of this group² than of the others, all of which show considerable homogeneity of type.³

In reference to the considerable intrusion of strictly marine types, it can hardly be doubted that the tidal effect reaching so far inland is directly connected with this phenomenon. Nevertheless, the type of fresh-water fauna present must have a considerable bearing on just which forms find conditions satisfactory and which do not. In this connection it is to be borne in mind that the mixture of fresh-water and marine faunas always occurring the first mile or two from a stream's mouth in brackish water is not referred to, as the most seaward collecting site of the recent expedition was about thirty miles from the mouth of the Rio Tuyra, where that stream widens out as an estuary known as Darien Harbor. Thus, the intruding forms encountered had already traveled far inland at this point and there would very likely be a further ascent were it not for physical barriers in the form of falls and rapids. That a clash of interests exists between the two faunas is indicated by the tables of food listed under the various specific headings. For example, we have the fresh-water *Rhamdia* feeding on the marine *Achirus*, numerous fresh-water characins and the marine *Pristis* and *Centropomis* all feeding on the same kind of decapods, and *Curimatus* and the fresh-water loricariates and the marine *Mugil* feeding on the same organic ooze.⁴

A study of the tables of stomach contents of the fresh-water forms show the characins to have greater versatility in this respect than any other family. There was no food object found in the stomachs of other forms that some species of characin had not feed upon. The Siluridæ follow closely in that they are generally omnivorous, but none had fed upon organic ooze. On the other hand, this formed the sole food of the loricariates. All the others were largely carnivorous, feeding almost

¹The taxonomic families Astroblepidæ, Pygidiidæ and Callichthyidæ are omitted here, clearly being slightly modified nematognaths close to the silurid-loricariate group.

²Eigenmann, 1917, discusses the great elaboration of the characins in a broader way showing that they, above all associated families, have invariably shown the greatest amount of adaptability.

³It should be noted that all the cases of parallelism mentioned above refer to the Characidæ. None of the members of the other families depart nearly so far from their respective "central" or "generalized" type.

⁴It is to be noted in this connection that in the case of both the transient and thoroughly established marine types no great departure is to be found from their respective "stems." Thus it is evident that in cases where parallelism occurs the characins have been modified more than either the marine derivatives or the other fresh-water groups.

exclusively on fish, crustaceans and insects, with the addition of small quantities of vegetable matter, part of which was probably ingested accidentally.

It is conceivable that the above-described conditions might bring about either a stable or an unstable state of affairs, but in any event it is evident that a series of fascinating problems present themselves. Just what is the interaction of the forces that may bring about evolutionary change in the resident forms with the constant introduction of a foreign element? Why have only the characins adapted themselves to so many diverse ecological "niches?" This basin would seem to be a very promising field for the working out of such problems by the use of concrete cases, for here during the dry season, when the concentration of fish life is at its maximum, the struggle for existence is more readily observable, owing to the narrowed confines of the stage of conflict. Having witnessed some of the activities of these fishes at such a time has left me acutely sensitive to the furious form that the struggle for existence may take. May this concentration not partly account for so many of the species depositing their ova during the rainy season when the amount of water is proportionally greater, even though it would not seem to be as desirable on account of the swifter, more fluctuating and less reliable current of that season? It should be noted here that the cichlids, the only local group known to guard its eggs and young consistently, is likewise the only one which I found breeding at the height of the dry season excepting the ovoviviparous poeciliids which do not relinquish their young until they are fairly well able to take care of themselves and apparently breed continuously, being comparatively independent of the factors controlling the spawning of oviparous species.

The presence of only young *Pristis* in these fresh waters suggests another field for investigation. Is it not possible that, being of a larger size than most of the river fishes, they are less in danger of being attacked than they would be in the densely populated Bay of Panama? Countering this is the presence of a great number of crocodiles which, as we know from observation, do attack them. However, these may not be as serious a menace as the larger fish of the Bay, although their presence may account in part for the presence of no really large fish in this basin. It would seem that the great amount of life in these streams could support a considerable number of adult *Pristis*, and it may be that some factor other than food requirements prevent their continued residence in the streams. Possibly it is connected with some physiological aspect of development, such as we know to be the case with certain other species, and a return to a marine environment may be necessary.

These few suggestions may serve to indicate the richness of the possibilities to be found in attacking some of the broader problems in this region. Coupled with this are the excellent opportunities to study problems relative to zonal distribution and to add to the scant knowledge of the development and habits of these fishes. This drainage, while comparatively accessible, is at present as far from material alteration by white man as any known neo-tropical area, and for considerable sections is more convenient and safer today than many others.

While it is difficult to summarize a collection of data on a group of fishes, such as comprises the bulk of this paper, the following summary may serve to give a partial conception of the general trend, omitting, of course, the treatment of the individual species, which, nevertheless, is actually the backbone of our only too scant knowledge of the fishes of the Rio Chucunaque. As this paper and the descriptions of new species, Breder, 1925*b*, comprises the entire literature on this river it is deemed unwise to do much more than record the facts and point out possible lines of future investigation.

SUMMARY

Introduction

- 1.—This paper is the first regional report on the fishes of the Rio Chucunaque and has been made possible by the expedition financed by Mr. R. O. Marsh.
- 2.—The Rio Chucunaque and its tributaries drain virtually unbroken jungle through both the arid and humid lower tropical zones, with some of the headwaters just touching the upper tropical zone.

The Fishes of the Rio Chucunaque

- 3.—Sixty four species and one subspecies were found in these waters. Of these, twelve are marine or estuarine forms and fifty-three are fresh-water forms. Five of the latter proved to be new. *Loricaria altipinnis*, *Apareiodon compressus*, *Characidium marshi*, *Rivulus chucunayue chucunaque* and *R. c. sucubti*. In all they comprise nineteen families and fifty-six genera.
- 4.—Two genera are added to the basin, *Hoplosternum* and *Neetroplus*, both represented by species known from more northern drainages. The latter represents the southernmost record for the genus. Fifteen species not known north of the Tuyra were found in the Chucunaque.

- 5.—Fishes form an important dietary item of the various natives inhabiting the Chucunaque watershed. Their methods of fishing are various, more or less modified by direct or indirect contact with white men.

Fishes of the Tuyra Basin

- 6.—Nine fresh-water and three marine species known from the Rio Tuyra were not taken in the Chucunaque. Nine fresh-water species, one subspecies and ten marine species not known from the Tuyra were found in the Chucunaque. The latter represent six fresh-water and nine marine genera new to the Tuyra basin and the former represent six fresh-water and three marine genera not known to be represented in the Chucunaque.
- 7.—In all, seventy-six species and one subspecies are now known from the Tuyra basin, fourteen of which are marine. These represent nine orders, twenty families and sixty-five genera.
- 8.—Compared with the Bayano basin, the Tuyra contains twenty-four fresh-water species and one subspecies not known from the former and the Bayano contains six species not known from the Tuyra basin. Seven species known from the Tuyra basin are absent from the Chucunaque and Bayano. Three species not known from the Rio Tuyra are found in the Chucunaque and Bayano. Three genera of Bayano fishes are unknown from the Tuyra basin. Twenty genera of Tuyra basin fishes are unknown from the Bayano basin.
- 9.—The Tuyra basin contains fourteen species in common with the Chagres basin and ten very slightly differentiated.
- 10.—Two genera common to the Atrato and Magdalena are added to the Tuyra basin. One, *Rivulus*, is widespread and shows no especial connection, but the other, *Characidium*, probably entered the present drainage as Eigenmann, 1922, has suggested for others.

Conclusion

- 11.—The Characidæ, the dominant family of the drainage exhibit much greater differentiation than any other family associated with them.
- 12.—The breeding season is confined largely to the rainy season except in the case of the Cichlidæ which guard their eggs and young and the ovoviviparous Pœciliidæ which appear to breed continuously.

- 13.—The food of the Characidae is the most diversified of any family in this drainage, and includes all the food items of the other forms. The Siluridae second it, being chiefly omniverous. The Loricariidae subsist entirely on organic ooze, while the remaining families are chiefly carnivorous.
- 14.—The large amount of parallelism exhibited by fishes of this region to distant forms, and the conflict between the considerable number of intruding marine types and the resident fresh-water forms invites further consideration but demands more data than is at present available.

BIBLIOGRAPHY

Only the papers actually referred to in the text are listed herewith, as it is felt to be superfluous to add others in view of the Dean 'Bibliography,' 1923, and the recent work of Eigenmann, 1922.

BANGS, OUTRAM, AND BARBOUR, THOMAS.

1922. 'Birds from Darien.' *Bull. Mus. Comp. Zoöl.*, LXV, No. 6, Sept., pp. 191-229.

BREDER, C. M., JR.

- 1925a. 'Tailless Pearl Roach.' *N. Y. Zoöl. Soc. Bull.*, XXVIII, No. 3, May, pp. 72-74.
- 1925b. 'New Loricariate, Characin and Pœciliid Fishes from the Rio Chucunaque, Panama.' *Amer. Mus. Novitates*, No. 180, July, 6, pp. 1-9.
- 1925c. 'In Darien Jungles.' *Natural History*, XXV, No. 4, July-Aug., pp. 324-337.
- 1925d. 'Notes on Fishes from Three Panama Localities: Gatun Spillway, Rio Tapia and Caledonia Bay.' *Zoölogica*, IV, No. 4, Sept. 18, pp. 137-158.
1926. 'The Locomotion of Fishes.' *Zoologica*, IV, No. 5, Sept. 28, pp. 159-297.

DEAN, BASHFORD.

1916. 'A Bibliography of Fishes.' *Amer. Mus. Nat. Hist.*, Authors' Titles, A-K, I, pp. 1-718.
1917. *Idem*, Authors' Titles, L-Z, II, pp. 1-702.
1923. *Idem*, Subject Index, III, pp. 1-707.

EIGENMANN, C. H.

1917. 'The American Characidae.' *Mem. Muse. Comp. Zoöl.*, XLIII, part 1, August, pp. 1-102.
1918. *Idem*, part 2, January pp. 103-208.
1921. *Idem*, part 3, July, pp. 209-310.
1922. 'The Fishes of Western South America. Part I.' *IX*, No. 1, October, *Mem. Carnegie Mus.*, pp. 1-346.

GILBERT, C. H., AND STARKS, E. C.

1904. 'The Fishes of Panama Bay.' *Mem. Cal. Ac. Sci.*, IV, Cont. Hopkin's Seaside Lab., XXXII.

GOLDMAN, EDWARD A.

1920. 'Mammals of Panama.' *Smithsonian Misc. Coll.*, LXIX, No. 5, Pub. 2498, pp. 1-309.

MEEK, SETH E., AND HILDEBRAND, SAMUEL F.

1916. 'The Fishes of the Fresh Waters of Panama.' *Field Mus. Nat. Hist.*, Pub. 191, *Zoöl. Series*, X, No. 15, Dec. 28, pp. 217-374.

1923. 'The Marine Fishes of Panama.' *Idem*, Pub. 215, XV, Dec. 20, pp. 1-330, Part I.

1925. *Idem*, Part II, April 15, pp. 331-707.

NICHOLS, J. T.

1921. 'The Miami Aquarium.' *Nat. Hist.*, XXI, No. 4, July-Aug.

PLATES I to V

Plate I

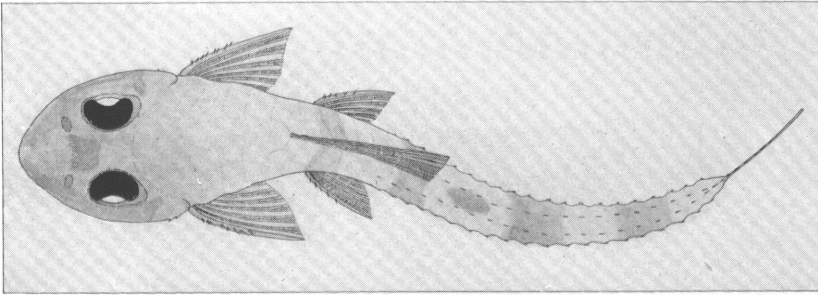
Loricaria variegata Steindachner.

A.—Post-larva of 16 mm.

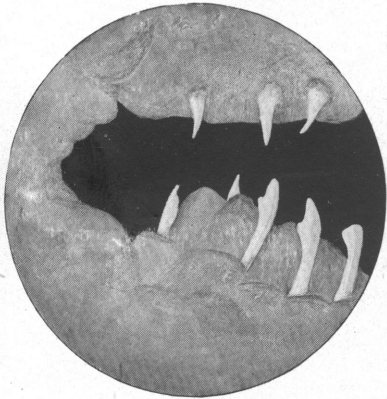
B.—Ventral view of right half of jaws of 16 mm. post-larva.

C.—Dorsal view of post-larval spines on right side of tenth lateral scute from tail of 16 mm. post-larva.

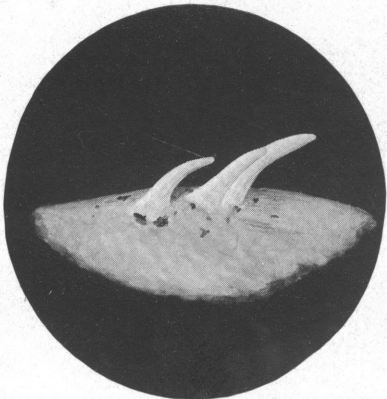
D.—Diagram of the manner in which the intestine of the adult is arranged in spiral coils. Actually the convolutions are in a greater number and closely appressed. This arrangement is characteristic of the group.



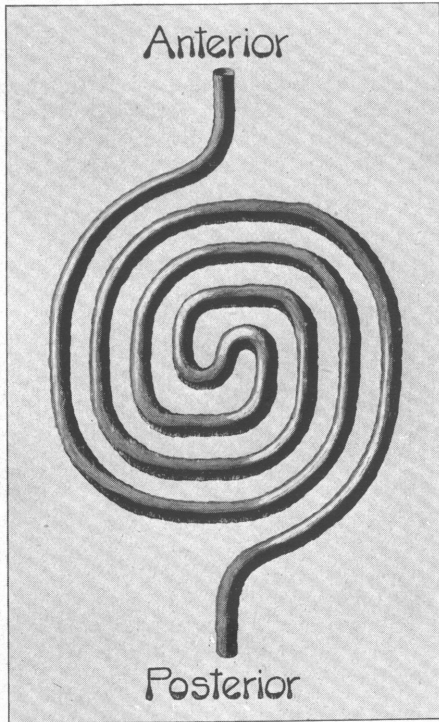
A



B



C



D

Plate II

A.—Rio Chucunaque just above Yavisa. Seining on a gravel beach. Such clean beaches are not common on the lower river.

B.—Rio Chucunaque just below Yavisa, showing the first base camp. Taken at nearly high tide with the unpleasant mud banks nearly entirely covered. Field laboratory on extreme left.



A

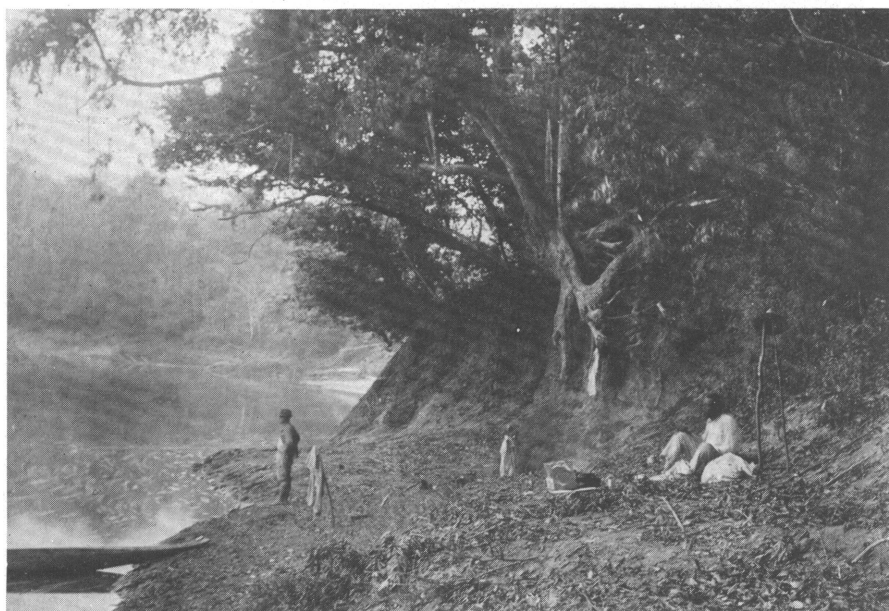


B

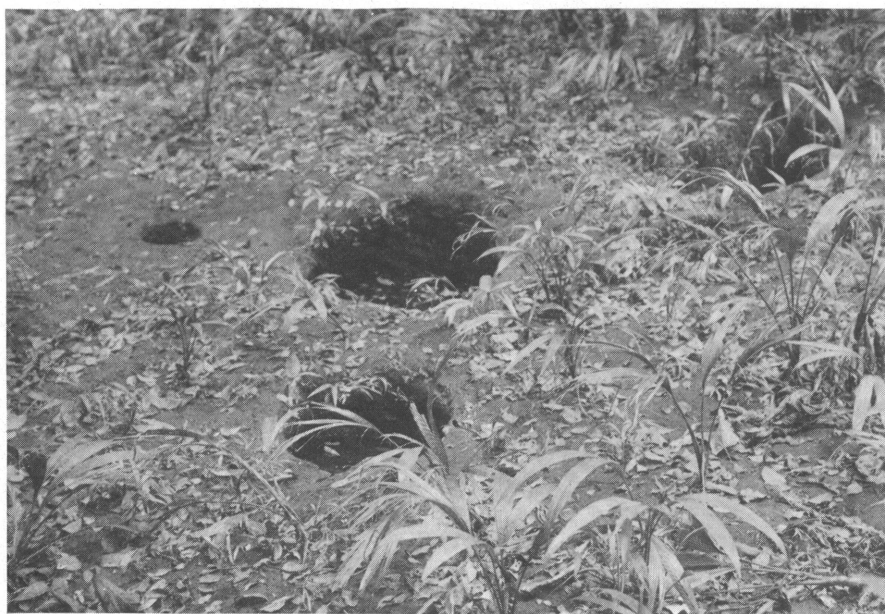
Plate III

A.—Rio Chucunaque just below the mouth of the Rio Canglon, in early morning, showing a simple overnight camp for three men. At about this point the tidal effect disappears.

B.—Habitat of *Rivulus*, during the dry season, in the bed of the creek just above the Yavisa base camp. This is above the falls in the humid lower tropical forest and is the type locality of *Rivulus chucunaque chucunaque* Breder.



A.



B.

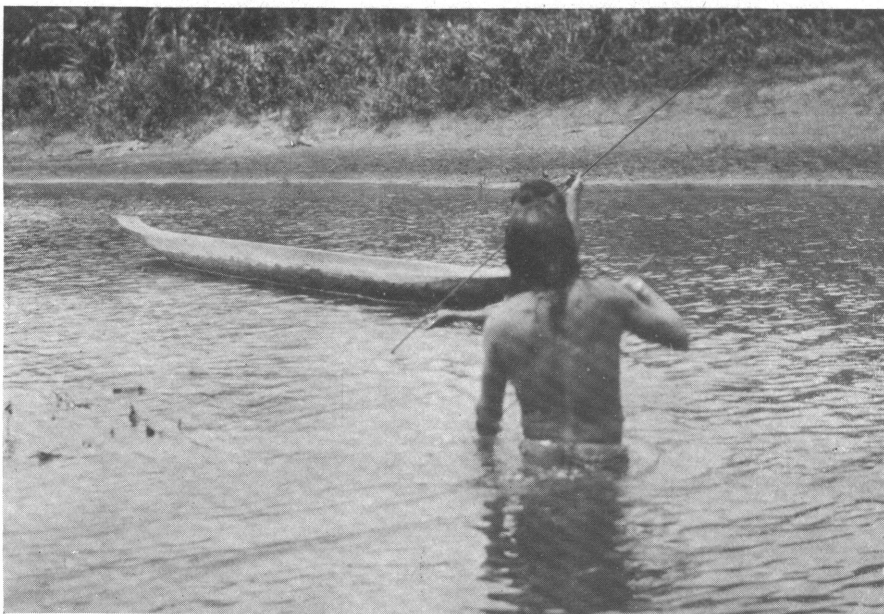
Plate IV

A.—Rio Chico at the Chocoi Indian village. Note the dugout with one of our outboard motors attached.

B.—Chocoi Indians spearing loricariates somewhat above the Rio Chico village.



A



B

Plate V

Creek on the upper Sucubti, near the Indian village. A typical habitat of *Synbranches*.



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