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Zonation of the Invertebrate Fauna in a West Indian Stream

by

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Abstract

Samples of the invertebrate fauna collected at ten points on a mountain stream in Trinidad reveal that the fauna is altitudinally zoned and that the apparent boundary between rhithron and potamon is below 30 m. This is very much lower than has previously been reported in the tropics.

Introduction

Although there have been several faunistic studies on streams in the tropics (e.g. van Someren, 1952, Marlier, 1954) few have dealt with a single watercourse along a large proportion of its length. Two of these, Malaisse (1969) on a Congo headwater and Ramanankasina (1969) on a Madagascan stream, actually present rather little data on the invertebrates that can be used to study the significance of zonation of stream fauna in the tropics. A third, which like the others is from the ethiopian region, although more thorough in terms of numbers and species lists, was a study of the effects of an insecticide which may have affected the altitudinal occurrence of some species (Hynes & Williams, 1962).

There remains therefore only the brief study of Illies (1964) on the Huallaga, an Amazon headwater. This work actually involved only 167 tabulated specimens collected from six stations distributed over 3500 m, yet its data have been used to support a fairly all-

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embracing concept on the zonal divisions of streams in the tropics (ILLIES & BOTOSANEANU, 1963).

As I had several years ago collected some information on altitudinal zonation on streams in East Africa and found, not unexpectedly, that some species were confined to cold high altitudes and were replaced lower down by others, I wondered whether the same phenomenon would be manifest over the relatively small vertical distances on much lower tropical mountains. I therefore took the opportunity of collecting a series of samples from the Arima River in Trinidad at 11° N during January 1970. Although this island is geographically one of the West Indies it is so close to the mainland that faunistically it is part of South America. Therefore the results reported here cannot be considered to be peculiarly West Indian.

THE RIVER AND METHOD OF STUDY

The Arima River flows southward from the Northern Range and is a major tributary of the Caroni River. It rises from a series of tributaries which begin between 570 to 420 metres and flows swiftly down the steep valley head and sides to the fairly steep valley floor (Fig. 1). The valley above the town of Arima is densely wooded with partly cleared forest, cocoa trees, coffee, bananas and bamboo. Below the town the country is more open, but there are many riparian trees and thickets, so much of the river bed is shaded. The town does not apparently pollute the river.

Table I.

The total number of specimens, excluding Hemiptera, collected at 10 stations on the Arima River, and the numbers of specimens of individual taxa that did not occur at all stations and of which at least 25 specimens were taken. *adults and larvae.

Station	1	2	3	4	5	6	7	8	9	10
Altitude feet	1800	1500	1200	1100	800	600	400	250	100	55
metres	550	455	365	320	245	185	120	75	30	17
Total number in collection	566	546	250	280	916	952	487	2539	2746	139
Paratelphusidae sp.	7	5	2	4	19		1	13		
Baetis (s.l.)spp.			1			29	18	39	250	72
Baetodes sp.		75	5	13	133	98	58	450		
Anacroneuria sp.		1			8	9	5	26		
Glossosomatinae sp.						3		1	46	
Chimarra sp.	25	27	12	10	59	10	9	72		
*Elsianus clypeatus Hint.						83	10	51	62	
*Hexacyloepus smithi (Grouv.)						3	3	6	189	12
*Phanocercus congener Grouv.	2	33	9	8	17		1	1		
*Heterelmis simplex codrus Hint.	2	35	10	1	40	24	14	19	1	
Psephenus sp.		2			3	114	11	171	1	
Tanytarsini	3	5	2	7	9	1	1			
Hemerodromiinae sp.	1	5	1	9	12	4	4	1		
Potamopyrgus sp.									37	6

Ten stations were chosen for study as shown in Fig. 1 and Table I. At almost all the flow was swift and the bed composed of rock, gravel and large stones. At stations 1 to 5 above 200 m there were areas of bare rock in places but the general nature of the river bed changed little from stations 1 to 9, although the width increased fairly steadily from just under a metre to 5 to 6 m at station 9. Also the deepest water increased in depth, from 10—20 cm to pools a metre or more deep in the lower reaches. Only at station 10 (17 m, and about 3 km above the confluence with the Caroni River) was

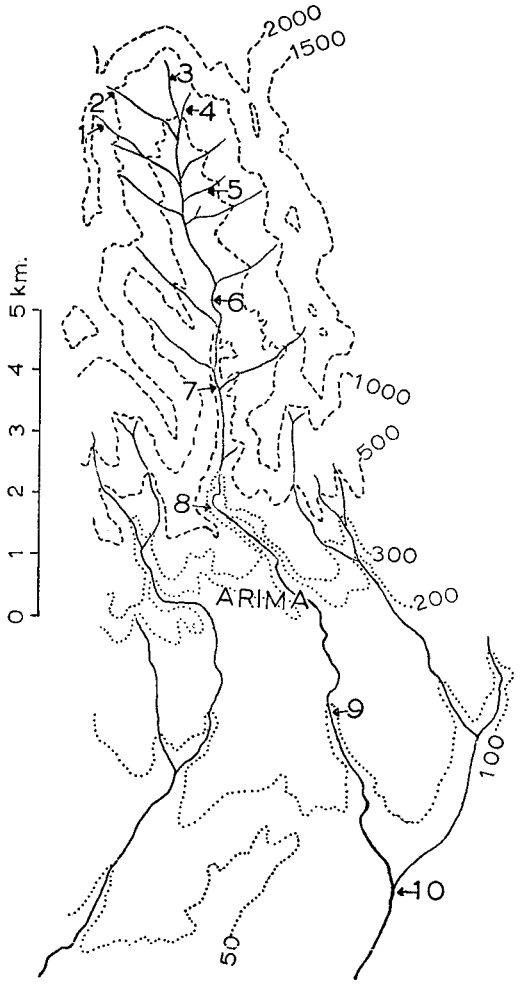

Fig. 1. Sketch map of the Arima River showing collecting stations and contours in feet.

the general appearance of the river different, in that the current was slower, the bed was without large stones and was mainly soft sandy gravel, and the shallowest midstream areas were about a metre deep. During the survey the daytime temperature of the water ranged from 23° at the upper two stations to 25° at stations 8 and 9 and 25.2° at station 10.

At each station about 20 minutes were spent collecting Gerridae and Veliidae with a hand net, and the catch was preserved in alcohol. Then, after a preliminary examination of the river bed, about 20 minutes were spent making a general collection with a triangular net with 24 meshes per cm (0.3 mm openings). Stones were rolled over upstream of the net, gravel and smaller stones were stirred with the foot and the net was emptied at intervals. In this way all the available habitats were sampled in approximate proportion to their areas, and the samples were preserved in formalin. Because this collection method does not adequately sample firmly attached animals, such as Ancylidae, these were specially sought, but no invertebrates were found that were not present in the samples. Indeed, the only sign of the Ancylidae discovered was one empty shell of *Ferissia* at station 8 (75 m).

The samples were later hand-sorted under a low power microscope in the laboratory, and the animals were picked out, identified and counted. The samples contained much allochthonous organic matter, but no aquatic plants, and in the watercourse itself the only obvious plant seen was *Hildenbrandtia*, which was abundant on large stones and rock at most stations and was very clearly restricted to densely shaded areas.

Results

The samples contained varied, but mostly large, numbers of animals (Table I), and some categories were present at all stations. These were Oligochaeta (72 specimens, in small numbers at all points but none at station 8), *Paraleptophlebia* spp. (1078 specimens), Tricorythidae (1088 specimens), *Argia* sp. (206 specimens) and Orthocladiinae (896 specimens). Only at station 1 did the last exceed 50% of the catch (51.4%). Some categories occurred in fair numbers at almost all stations except the lowest. These were *Dugesia* sp. (118 specimens), *Hetaerina* sp. (48 specimens), *Brechmoroga* sp. (277 specimens), *Smicridea* sp. (214 specimens), *Simulium* sp. (280 specimens), a vermiform Ceratopogonid (*Bezzia* sp?) (27 specimens), and Tanypodinae (149 specimens).

Many animals occurred sporadically and were represented by

less than 25 specimens. The remainder that occurred fairly regularly and in larger numbers are shown in Table I; and Table II shows the numbers of Gerridae and Veliidae collected.

Among the sporadic animals some are worthy of mention. A few specimens of *Palaemonetes*, *Atya*, *Helicopsyche* and *Cataclysta* were taken at 75 and 30 m, and *Leucotrichia*, *Paltostoma* and *Maruina* occurred in most of the samples from 320 m and above. These three, together with *Simulium* and *Baetodes*, formed the fauna of the rocky chutes which were characteristic of the upper reaches, and they could be found in similar places at lower altitudes if specially sought, even though they were not usually taken in the main samples. It is also of interest that all the samples from 185 m and above contained great numbers of empty shells of a large species (410—460 μ diameter) of *Centropyxis* somewhat resembling *C. stellatus*. MALAISSE (1969) records the occurrence of *Plagiopyxis* shells in a high-level African spring stream.

Table II

The numbers of various species of Gerridae and Veliidae collected at 10 stations on the Arima River. Numbers include both adults and nymphs, Rhagovelia sp. is not yet certainly identified, and is the species listed as "near femoralis" by Hynes (1948).

Station Altitude m.	1 550	2 455	3 365	4 320	5 245	6 185	7 120	8 75	9 30	10 17
Brachymetra unca Shaw	21	1	9	9	4					
Br. albinerva Amyot & Serv.						4	9	5	1	4
Hynesia mangroviensis China								1		2
Rhagovelia sp.	17	61	19	2						
Rh. elegans Uhler	1	2		13	17	12				
Rh. tenuipes Champion					6	347	141	21	45	2
Rh. calopa Drake & Harris										9

Although they were not fully identified it seemed that animals referred to as "sp." above and in Table I were in fact single species. At any rate, careful study of the specimens revealed no reason for believing that this was not so. Within the very abundant Ephemeroptera it was possible further to categorize the larger specimens, and to recognise, on the basis of size of ripe specimens, colour pattern and body proportions, that there were two types (? species) of *Paraleptophlebia*, three of *Baetis* (s.l.), and, within the Tricorythidae, three of each of *Tricorythodes* and *Leptohyphes*.

All these data then permit the construction of Table III showing the vertical range in the Arima River of what appear to be 38 single species.

Discussion

Table II shows, as has previously been reported for Trinidad (Hynes, 1948), that there is a very clear altitudinal zonation of species of *Rhagovelia*, and that the two species of *Brachymetra* are vicariously distributed. It also implies vicarious altitudinal zonation in *Hynesia*, as the only other species of the genus is abundant in the mangrove swamps at the mouth of the Caroni River (China, 1943). Table III shows that there is also altitudinal succession within the Elminthidae and the Ephemeropteran genera *Paraleptophlebia*, *Tricorythodes* and *Leptohyphes*. This phenomenon is, of course, well known in temperate latitudes (references in Hynes, 1970a and b), but it has not often been reported from the tropics. It was, however, observed in the River Manafwa in Uganda for Elminthidae, *Acentrella*, *Simulium* and *Potamon* (Hynes & Williams, 1962), on several other

Table III.

The vertical distribution of the 38 recognisable "species" in the Arima River. A dash denotes that species was present, an asterisk that more than 10 specimens were collected.

Station		1	2	3	4	5	6	7	8	9	10
Altitude m.		550	455	365	320	245	185	120	75	30	17
Group	"Species"										
Odonata	Argia	-	-	-	-	*	*	*	-	*	-
Tricladida	Dugesia	-	-		-	-	-		*	*	
Odonata	Brechmoroga	-	*	-	-	*	*	*	*	*	
Trichoptera	Smicridea	*	*	-	-	*	*	*	*	*	
Diptera	Simulium	*	-	*	*	*	-	-	-	-	
Diptera	Bezzia?	-	-	-	-	-	-		-	-	
Ephemeroptera	Paraleptophlebia A	-	-	-	-	*	*	*	*	*	
Ephemeroptera	Leptohyphes A	-	-	-	*	*	*	*	*	-	
Coleoptera	Heterelmis	-	*	-	-	*	*	*	*	-	
Trichoptera	Chimarra	*	*	*	-	*	-	-	*		
Coleoptera	Phanocercus	-	*	-	-	*		-	-		
Diptera	Hemerodromiinae	-	-	-	-	*	-	-	-		
Decapoda	Paratelphusidae	-	-	-	-	*		-	*		
Diptera	Tanytarsini	-	-	-	-	-	-	-			
Ephemeroptera	Tricorythodes A	-	*	-	*	*	-	-			
Hemiptera	Rhagovelia elegans	-	-		*	*	*				
Hemiptera	Brachymetra unca	*	-	-	-	-					
Hemiptera	Rhagovelia sp.	*	*	*	-						
Ephemeroptera	Baetodes		*	-	*	*	*	*	*		
Plecoptera	Anacroneuria		-			-	-	-	*		
Coleoptera	Psephenus		-			-	*	*	*	-	
Odonata	Metaerina		-	-	-	-	-	*	-	-	
Hemiptera	Rh. tenuipes			-		-	*	*	*	*	-
Ephemeroptera	Baetis A			-			-	-	*	*	*
Ephemeroptera	Leptohyphes B					-	*	*	*	*	
Coleoptera	Elsianus						*	-	*	*	
Trichoptera	Glossosomatinae						-		-	*	
Coleoptera	Hexacoellopus						-	-	-	*	*
Ephemeroptera	Paraleptophlebia B						-	-	*	*	-
Ephemeroptera	Tricorythodes B						-	*	*	*	-
Ephemeroptera	Baetis B						-	-	*	*	*
Ephemeroptera	Baetis C						*	*	*	*	-
Ephemeroptera	Leptohyphes C						-	*	*	*	-
Hemiptera	Br. albinerva						-	-	-	-	-
Hemiptera	Hynesia								-		-
Gastropoda	Potamopyrgus									*	-
Ephemeroptera	Tricorythodes C										*
Hemiptera	Rh. calopa										-

streams on Mount Elgon (WILLIAMS & HYNES, in preparation), and by ILLIES (1964) for *Baetis* and Elminthidae in an Amazon headwater. But those studies extended over thousands of metres with much greater changes of temperature. It is interesting that the present survey demonstrates the phenomenon over little more than 500 m and only 2.2°C, a temperature difference that probably varies little through the year.

Table III also shows that there is a fairly steady change in the faunal composition as the watercourse descends from 550 to 30 m. This is accomplished first by the addition of species, and then from about 320 m by the loss of rather fewer species. Only between the last two stations (30 and 17 m) there was a marked faunal change which can perhaps be equated with the major change form "rhithron" to "potamon". ILLIES (1964) claims to have observed this division, first described from Europe, at between 2500 and 3000 m in the Huallaga, an Andean tributory of the Amazon, and he suggests that in the tropics it will usually lie at high altitudes. The present study appears to place it at less than 30 m in Trinidad. It would seem that slope, and hence the nature of the stream bed, is really the important factor, and that altitude per se, which is in effect temperature, is yet another factor imposed on the stream system. To use the term potamon, even epi-potamon, for a swift mountain stream like the Arima River merely because it has warm water would seem to be a misuse of the word. The point where a marked faunal change occurs is where the hill stream meets the plain and this does not always happen at high altitudes in the tropics. Where, however, it does do so, as in the Amazon headwaters or on the East African mountains, it can be expected that the faunal change will be more marked because of the added factor of greater temperature increase.

SUMMARY

General collections of the benthos and water striders were made at 10 points from 550—17 m altitude on the Arima River, Trinidad, a swift mountain stream. It was possible to conclude that 38 of the taxa that occurred commonly in some of the samples were probably single species. These displayed marked vertical zonation of the fauna and a change in the community that can be interpreted as the rhithron-potamon boundary at less than 30 m. This markedly lower than has previously been reported from the tropics.

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