The Aquatic Fauna of Two Intermittent Streams in the Southwestern Peninsula, Trinidad

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Introduction

Local interest in freshwater ecology has not been very well developed in the past, possibly because of difficulties in identification of many of the groups of organisms. This stems from a lack of identification keys relevant to the island as well as the scattered nature of the primary literature. Recently however, studies have been initiated at the Zoology Department, U.W.I., St. Augustine aided by the availability of guides to the taxonomic literature for the aquatic fauna of the region (Hurlbert *et al* 198'1, Hurlbert & Villalobos 1982) and collaboration with taxonomic specialists abroad. This has lead to the development of local taxonomic guides, for example Michalski (1988) and Nieser & Alkins-Koo (in prep).

Published ecological studies on the freshwater fauna of Trinidad are few (Thornhill *et al* 1967, Hynes 1971, Alkins *et al* 1981, Phillip 1988) and some unpublished reports exist (Caesar 1985, Khan 1986, Ottley 1986, Maharaj 1987). Many of these deal with running waters in the Northern Range and there is little recorded on the faunas of lowland rivers or streams which make up a large proportion of the freshwater habitats of Trinidad. In addition, many small lowland streams tend to be intermittent, i.e. flow during the wet season but dry up during the season of drought, and therefore they are of some ecological interest. The present study attempts to document the fauna for such a habitat.

The Study Site

According to Ordinance Survey maps (1977), the Quarahoon River, in conjunction with its major tributaries, drains an area of approximately 16 km^2 along the Chatham Road (South) and enters the sea at two points in Erin Bay. This river has not been mapped adequately and local residents maintain that two watercourses exist: a larger more westerly one being the Carlisle River and the smaller eastern stream being the Quarahoon River. Field checks by the author and others confirm the presence of two watercourses and in this study they are named according to the local residents (Fig.1). However, they are connected in their lower reaches by a series of artificial channels and ditches and are therefore not entirely independent of each other.

The catchment area of the two rivers has a gently undulating physiography with maximum elevations not greater than 60 m. The natural vegetation is seasonal evergreen forest (Beard 1946) but areas planted with cocoa/coffee/banana or coconut exist to the east of the streams. Both the Carlisle and Quarahoon rivers are generally meandering and between one and eight metres wide with depths up to three metres in the rainy season. The banks rise steeply about two to three metres from the water's edge. Substrates are primarily composed of clay with a layer of detritus of variable thickness above. Flow is intermittent in most years, ceasing completely during the height of the dry season when shallow stretches dry up leaving isolated pools or chains of pools. Most of the upper and middle reaches of the Quarahoon dry up during severe dry seasons while only the upper half of the Carlisle does so. The latter river retains many large refuge pools throughout the dry season.

Station 1 was a shallow pool on the Carlisle River (Fig. 1) about 10 m in length and 0.65 m deep in the rainy season. It dried out completely during severe dry seasons. Station 2 was a deeper, larger pool about 25 m long and 2.4 m deep in the rainy season. It did not dry out even in the most severe dry seasons and seemed to be the most northern refuge pool on the Carlisle River. Station 3 was a fairly deep pool on the Quarahoon River immediately downstream of a road culvert. It was about 15 m long and 1.1 m deep and was used as a cattle watering hole. Station 4 was brackish, located about 300 m from the Quarahoon River mouth; maximal width was 7.3 m and depth 1.5 m. The freshwater sites studied (Stations 1 to 3) were characterised by high turbidity, slight acidity and high specific conductance in the dry season. Station 4 was subjected to tidal influence. Detailed physical and chemical analyses and seasonal variation are given in Alkins (1987).

Methods

Faunal sampling was conducted on a monthly basis from 1980 to 1982 by a variety of methods. Bottom macrofauna was sampled with an Ekman grab and samples of detritus were taken by hand as well. A 3 mm mesh two-man push seine was used for fish and other swimming species as well as some benthic macrofauna. Plankton was sampled with a hand-held plankton net of mesh size 110 µm.

Results

The groups represented most commonly in the plankton were algal groups, with desmids, some filamentous chlorophytes and cyanophytes, diatoms and euglenoids being prominent at most times (Table 1). Station 1 supported a somewhat poorer plankton community when compared with other stations. Crustaceans such as cladocerans, ostracods, copepods (mainly cyclopoid) and amphipods were restricted in distribution being most prevalent at Stations 3 and 4. Only copepods and occasionally ostracods were found at Stations 1 and 2 and even then only rarely. The colonial rotifer *Conochilus* was found mainly in the slower-flowing, deeper Stations 2 and 3. The diatoms *Coscinodiscus* and *Synedra* and the medusae of the freshwater hydroid *Craspedacusta* were found only at the brackish water Station 4.

Each station supported quite rich benthic invertebrate faunas with Station 4 having a distinct brackish water fauna. As regards numbers of taxa represented, Station 1 showed a greater diversity than the other stations, Stations 2 and 3 were roughly equivalent and Station 4 was the least diverse (Table 2). Station 1 was especially rich with respect to aquatic arthropods, particularly insects, presumably owing to more favourable flow conditions and the sandy substrate at this site.

The most commonly collected benthic invertebrates at all freshwater stations were: oligochaetes, particularly tubificid and occasionally naidid worms; the trichodactylid crab *Dilocarcinus dentatus*; aquatic insects such as the dragonfly nymphs *Perithemis mooma* and *Dythemis* spp, the water scorpion *Ranatra mixta*, the gerrid *Brachymetra albinervis*, and chironomid midge larvae; molluscs such as planorbid gastropods, *Pomacea glauca*, and sphaeriid bivalves. Ancylid limpets were common at Stations 2 and 3 but were not found at Station 1 while nematodes were always abundant at Station 3 but not elsewhere. Other invertebrate taxa were collected only occasionally.

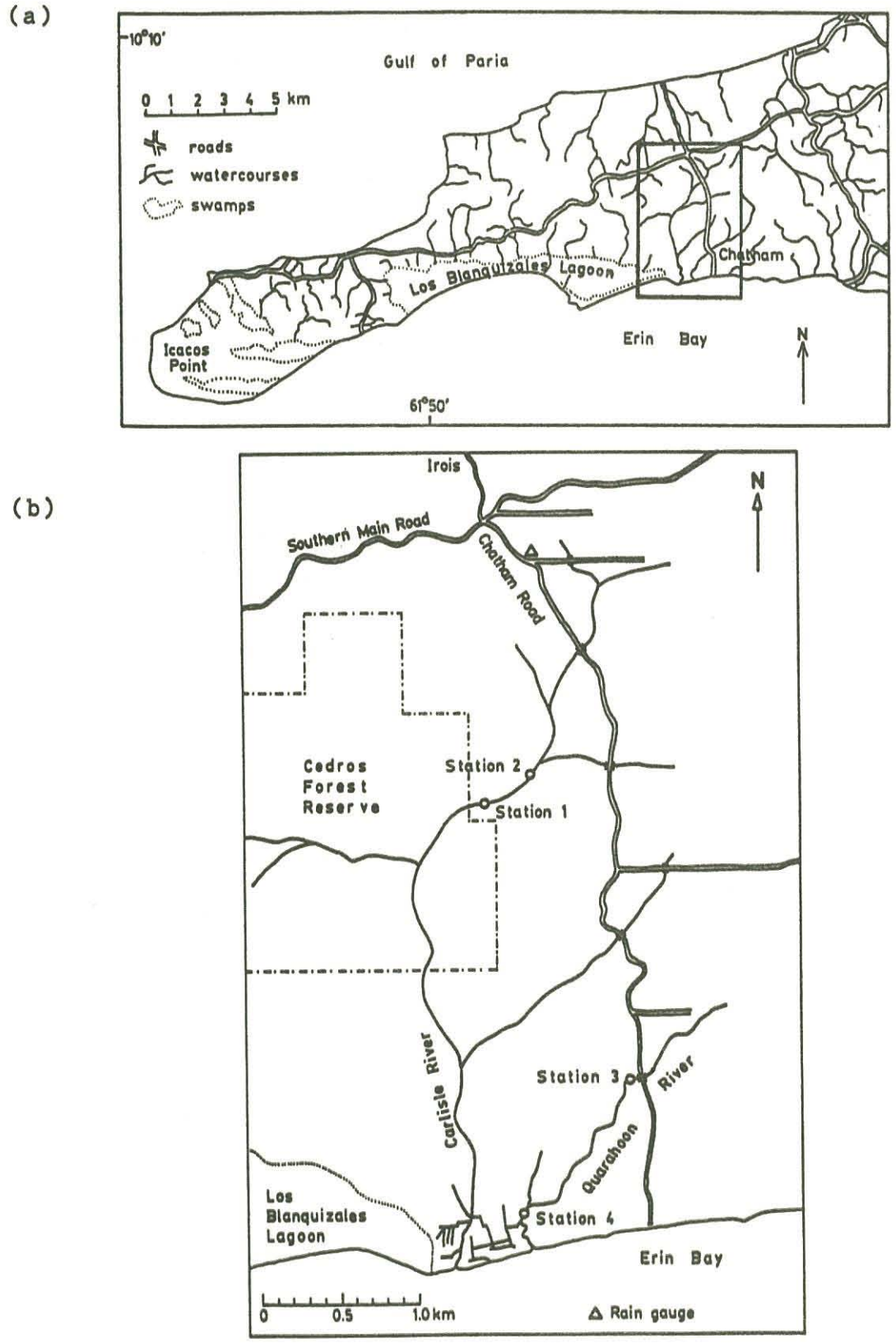

Fig. 1. Location of (a) the study site in the southwestern peninsula and (b) sampling stations 1 to 4.

TableI: Taxonomic list of phyto- and zoo-plankton collected.

Taxon	Station 1	2	3	4
CYANOPHYTA				
Myxophyceae				
Spirulina		x	x	x
Oscillatoria		x	x	x
other filamentous species		x	x	x
CHLOROPHYTA				
Chlorophyceae				
Desmidiaceae				
Closterium	x	x	x	x
Pleurotaenium	x	x	x	x
Zygnemataceae				
Spirogyra		x		x
Oedogoniaceae				
Oedogonium		x	x	
CHRYSOHYTA				
Bacillariophyceae				
Coscinodiscaceae				
Coscinodiscus				x
Melosira	x		x	x
Fragilariaceae				
Synedra				x
Naviculaceae				
Navicula	x	x	x	x
Pinnularia	x	x	x	x
Gyrosigma	x	x	x	x
PROTOZOA				
Phytomastigophorea				
Euglenidae				
Euglena	x	x	x	x
Phacus	x	x	x	x
Trachelomonas	x	x	x	x
Zoomastigophorea	x	x	x	
Rhizopoda				
Arcellidae				
Arcella	x	x		x
Difflugiidae				
Difflugia	x	x	x	x
Actinopoda				
Clathrulinidae				
Clathrulina	x	x		
Ciliata	x	x	x	
COELENTERATA				
Hydrozoa				
Petasidae				
Craspedacusta				x
ROTIFERA				
Flosculariaceae				
Conochilus		x	x	
ARTHROPODA				
Crustacea				
Cladocera			x	x
Ostracoda		x	x	x
Copepoda (Calanoida, Cyclopoida)	x	x	x	x
Amphipoda			x	x
Arachnoidea (Hydracarina)	x	x		x

Station 4 supported a brackish water faunal assemblage with groups such as nereid polychaetes, isopods, amphipods, hydrobiid gastropods and juvenile mussels being well represented (Table 2). Other crustacean fauna included penaeid and snapping shrimp and the swimming crab *Callinectes sapidus*. Terrestrial crabs on the stream banks and vegetation included *Goniopsis cruentata, Sesarma* sp, *Aratus pisonii* and *Cardisoma guanhumi*. No aquatic insects were found in this part of the stream.

Most non-teleost vertebrates were collected only occasionally (Table 3) although two turtles, *Kinosternon s. scorpioides* and *Rhinoclemmys p. punctularia* were frequently caught in seines. Caiman were noted in the lower reaches of the Quarahoon at Station 4 and even near the river mouth.

The fish caught in fresh and brackish waters belonged to nine orders, 21 families and 31 species (Table 3) of which two species were new records for Trinidad, i.e. *Brycon siebenthalae* and *Triportheus elongatus* (Alkins & de Souza 1984, Sturm & de Souza 1984). The most dominant families in terms of species represented were Characidae (six species), Poeciliidae (three species), Erythrinidae, Callichthyidae and Cichlidae (two species each). Of the 19 freshwater fish species, the characids were very common at the first three stations especially *Corynopoma riisei, Astyanax bimaculatus* and *Hemigrammus unilineatus. Poecilia reticulata* was also abundant. *Gasteropelecus sternicla* and *Corydoras aeneus* were commonly found and especially to the end of the study period the former species became quite abundant. *Hoplias malabaricus, Rivulus hartii* and the two cichlid species, *Cichlasoma bimaculatum* and *Crenicichla alta*, were caught occasionally as adults but during their respective reproductive periods juveniles were common. Other species such as *Rhamdia sebae, Gymnotus carapo* and *Synbranchus marmoratus* were only rarely caught, possibly owing to their more nocturnal habits.

Certain freshwater fish species were restricted in their distribution; for example *Moenkhausia bondi* was found only during an extensive seining effort along the middle and lower reaches of the Carlisle River, an area not regularly sampled. *G. sternicla* was collected only from the Carlisle River. *Erythrinus erythrinus* and *Callichthys callichthys* were found only at Station 3. This station was situated just beside the Chatham South Road and it is possible that they were introduced there. *E. erythrinus* was only found later in the study period. Another restricted species was *Polycentrus schomburgkii* found only at Station 2 and whose distribution was probably determined by habitat preference since this pool was one of the deeper, more extensive and permanent ones in the upper Carlisle River. Pool depth and permanence most likely influenced distribution of fish at the freshwater sites since Stations 2 and 3 each supported 15 species as compared with only 10 at the shallower less permanent Station 1.

Twelve species of fish were restricted to the brackish water Station 4. They included *Centropomus parallelus* which occurred in most of the catches and *Poecilia vivipara, Diapterus rhombeus, Citharichthys* sp and *Trinectes* sp which were only occasionally found. Other species such as *Poecilia picta, Epinephelus itajara, Pomadasys* sp, *Mugil curema, Sicydium punctatum*, atherinids and sygnathids were uncommon or rare. However, at the mouth of the Quarahoon River schools of juvenile *M. curema*, atherinids and *Anableps anableps* were seen. Many of these species were represented by juveniles only, for example *C. parallelus, D. rhombeus, Citharichthys* and *Trinectes*, and indicated the use of this estuarine area as a nursery ground for these species.

Table II: Texonomic list of invertebrate macrofauna.

Taxon	Station 1	2	3	4
NEMATODA			x	
NEMERTEA	x			
ANNELIDA				
Oligochaeta				
Tubificidae	x	x	x	
Naididae	x	x	x	
Enchytraeidae	x			x
other	x	x	x	
Hirudinea				
Glossiphonidae				
Glossiphonia	x	x	x	
Placobdella			x	
Polychaeta				
Nereidae				x
Capitellidae				x
ARTHROPODA				
Crustacea				
Cladocera		x	x	
Ostracoda			x	
Copepoda		x	x	
Isopoda				x
Amphipoda				x
Decapoda				
Penaeidae				
Penaeus notialis Perez-Farfante				x
Palaemonidae				
Palaemon pandaliformis (Stimpson)	x			
Macrobrachium jelskii (Miers)	x			
M. heterochirus (Wiegmann)			x	
Macrobrachium sp	x			
Alphaeidae				
Alphaeus sp				x
Portunidae				
Callinectes sapidus Rathbun				x
Trichodactylidae				
Dilocarcinus dentatus (Randall)	x	x	x	
Arachnoidea				
Hydracarina	x	x		
Insecta				
Ephemeroptera				
Leptophlebiidae				
Miroculis (M.) ?fittkaui Savage & Peters	x	x		
Odonata				
Coenagrionidae	x	x		
Calopterygidae				
Hetaerina caja Drury	x			
Aeshnidae				
Coryphaeschna viriditas calvert	x			
Gomphidae				
Aphylla producta (Selys)	x	x		
Phyllocycla ?anduzei Needham	x			

(Table II con't)

Taxon	Station 1	2	3	4
Libellulidae				
Dythemis multipunctata Kirby	x			
D. sterilis Hagen	x	x		
Macrothemis sp	x			
Micrathyria sp	x			
Oligoclada walkeri Geijskes	x			
Orthemis ?ferruginea Fabricius	x	x		
Perithemis mooma Kirby	x	x	x	
Hemiptera				
Belostomatidae				
Belostoma malkini Lauck		x		
B. micantulum (Stal)	x			
Nepidae				
Ranatra mixta Mont.	x	x	x	
Curicta intermedia Martin	x	x		
Hydrometridae				
Hydrometra comata Torre-Bueno	x	x		
H. guiananae Hungerford & Evans	x	x		
Notonectidae				
Buenoa rostra Truxal		x	x	
Gerridae				
Brachymetra albinervis (Amyot & Serville)	x	x	x	
Limnogonus aduncus Drake & Harris	x	x		
Telmatometra fusca Kenaga	x	x		
Veliidae				
Rhagovelia ?insularis Champion	x			
Coleoptera				
Dytiscidae				
Thermonectus sp. nov.?	x			
Laccophilus proximus Say	x			
Gyrinidae				
Gyretes ?distinguendus Reg.	x			
Hydrophilidae				
Helochares sp. nov.?			x	
Carabidae				
?Omophron	x			
Diptera				
Chironomidae	x	x	x	
Heleidae	x	x	x	
Culicoides sp	x			
MOLLUSCA				
Gastropoda				
Planorbidae	x	x	x	
Ampullariidae				
Pomacea glauca (Linnaeus)	x	x	x	
Hydrobiidae				x
Ancylidae (2 spp)		x	x	
Bivalvia				
Sphaeriidae (2 spp)	x	x	x	
Mytellidae				
Mytilopsis dominigensis Recluz				x

Discussion

Phytoplankton associations in the freshwater study sites may be classified according to Hutchinson (1967) as being a euglenophyte-dominated plankton assemblage found in very small and organically polluted bodies of water rich in nonhumic organic matter (Pennak 1978). In addition, occurrence of the diatom *Melosira* is indicative of eutrophic waters while there is a strong correlation between soft waters deficient in calcium and magnesium (as found in the freshwater sites) and the occurrence of large numbers of desmids (Hutchinson 1967). Euglenophyte-dominated communities have also been described for turbid swamps and pools and small creeks in Suriname (Leentvaar 1975, van der Heide 1976). Poorly developed zooplankton communities, such as those seen in the freshwater study sites, have been recorded for other Neotropical areas, for example in streams and swamps of Guyana (Carter 1934) and in Suriname (Leentvaar 1975).

Table III: Taxomonic list of vertebrates collected.

Taxon	Station 1	2	3	4
TELEOSTEI				
Characiformes				
Erythrinidae				
Hoplias malabaricus (Bloch)	x	x	x	
Erythrinus erythrinus (Schneider)			x	
Gasteropelecidae				
Gasteropelecus sternicla (Linnaeus)	x	x		
Characidae				
Brycon siebenthalae Eigenmann		x		
Triportheus elongatus Gunther			x	x
Corynopora riisei Gill	x	x	x	
Astyanax bimaculatus (Linnaeus)	x	x	x	
**Moenkhausia bondi* (Fowler)				
Hemigrammus unilineatus (Gill)	x	x	x	x
Siluriformes				
Pimelodidae				
Rhamdia sebae (Valenciennes)	x	x	x	
Callichthyidae				
Callichthys callichthys (Linnaeus)			x	
Corydoras aeneus (Gill)	x	x	x	
Gymnotiformes				
Gymnotidae				
Gymnotus carapo Linnaeus		x	x	
Cyprinodontiformes				
Aplocheilidae				
Rivulus hartii (Boulenger)	x	x	x	
Poeciliidae				
Poecilia reticulata Peters	x	x	x	
P. picta Regan				x
P. vivipara Bloch & Schneider				x
Atheriniformes				
Atherinidae				x
Syngnathiformes				
Syngnathidae				x
Synbranchiformes				
Synbranchidae				
Synbranchus marmoratus Bloch		x	x	
Perciformes				
Centropomidae				
Centropomus parallelus Poey				x

(Table III con't)

Taxon	Station 1	2	3	4
Serranidae				
Epinephelus itajara (Lichtenstein)				x
Gerreidae				
Diapterus rhombeus (Cuvier)				x
Haemulidae				
Pomadasys sp				x
Nandidae				
Polycentrus schomburgkii Muller & Troschel			x	
Cichlidae				
Cichlasoma bimaculatum (Linnaeus)		x	x	
Crenicichla alta Eigenmann	x	x		
Mungilidae				
Mugil curema Valenciennes				x
Gobiidae				
Sicydium punctatum Perugia				x
Pleuroneciformes				
Bothidae				
Citharichthys sp				x
Soleidae				
Trinectes sp				x
AMPHIBIA				
Bufonidae				
Bufo marinus (Linnaeus)			x	
B. granulosus beebei Gallardo			x	
Hylidae				
Hyla geographica geographica Spix		x		
Leptodactylidae				
Leptodactylus podicipinus petersi (Steindachner)		x		
REPTILIA				
Chelidae				
Phrynops (Mesoclemmys) gibbus (Schweigger)		x	x	
Emydidae				
Rhinoclemmys punctularia punctularia (Daudin)		x		
Kinosternidae				
Kinosternon scorpioides scorpioides (Linnaeus)		x	x	
Crocodylidae				
Caiman crocodilus (Linnaeus)		x	x	x

•Collected in the lower to middle reaches of the Carlisle River only.

Many planktonic taxa at Station 4 seemed to be introduced either from upstream during the rainy season, for examle *Synedra, Closterium* and *Gyrosigma,* or from the marine environment, for example *Coscinodiscus.* Dominant zooplankton taxa such as cladocerans and copepods are characteristic of oligohaline estuaries such as those of the Amazon and Maracaibo Lake (Rodriguez 1974).

The macrofaunal composition of the freshwater sites was generally comparable to that of lentic rather than lotic communities as described by Odum (1970) and Maitland (1978). In particular, many of the aquatic insect species are characteristic of either littoral, lentic or depositional lotic environments (Merritt & Cummins 1984). Overall community composition at the study site was different from that recorded for other local areas studied, for example Maracas River (Thornhill *et al* 1967, Caesar 1985, Ottley 1986), Arima River (Hynes 1971) and Shark River (Maharaj 1987) which are all fast-flowing clear-water streams with larvae of such groups as simuliids, hydropsychid and hydroptilid Trichoptera, pyralid moths and psephenid beetles present. Substrate was a major influential factor with the occurrence of such groups as tubificid worms, chironomid midge larvae, prosobranch gastropods and sphaeriid bivalves which are commonly found in the soft substrates of slow-flowing silt-laden floodplain rivers (Welcomme 1979). The fauna was also similar to that of the periodically inundated forests along the white and mixed white/black water rivers in the Amazon (Irmler 1975, 1981).

The species composition of the freshwater fish communities was dominated by primary freshwater fishes such as the Characiformes which made up almost 50% of the species recorded. Other primary freshwater families recorded were Pimelodidae, Callichthyidae, Gymnotidae and Nandidae accounting for a further 26% of the fish fauna while the remainder belonged to secondary freshwater fish families (Darlington 1957). This composition was consistent with the general pattern of distribution of freshwater fishes in Trinidad (Price 1955, Boeseman 1960, 1964).

In spite of the small drainage area and the intermittency of flow of the Chatham streams, the study area possessed a notably high fish diversity, supporting almost half of the true

freshwater species recorded for Trinidad in addition to two new species records for the island. This may have been due to intermediate levels of disturbance based on an annual flood-drought cycle as well as the presence of extensive refuge pools. A further factor that may have been contributory was the dynamic state of the local faunas in the southwestern peninsula as a result of colonisation of species from the nearby mainland. Of the nine characoid fishes recorded, three were recently established colonisers and two were new records during the study period. *G. sternicla* and *M. bondi* are reported only in a restricted number of streams in southwestern Trinidad (Price 1955, Boeseman 1960) and evidence points to their being recent colonists (Price 1955). *E. erythrinus* is not recorded by Boeseman (1960, 1964) having been caught only within recent times in a small north-flowing watercourse in a drainage immediately adjacent to the Chatham basin (Kenny pers. comm.) . While not all colonist species establish populations, at least these three relatively recent arrivals have done so and a fourth, *T. elongatus*, may be in the process of establishment. Faunal diversity trends in some North American river systems have been shown to be explained in part by the proximity of basins to rich source areas (Horowitz 1978).

With the exception of the above species which are of restricted distribution, all of the other freshwater species are widely distributed and common throughout Trinidad south of the Northern Range (Guppy 1934, 1936, Price 1955, Boeseman 1960). Some species are commonly found in ponds, ditches and slow-flowing watercourses, for example *G. carapo* and *C. callichthys*, while others are found in middle to lower course rivers, for example *R. sebae, C. aeneus* and *S. marmoratus* and the characids *A. bimaculatus, H. unilineatus* and *C. riisei*. In particular, *P. reticulata, C. riisei* and *A. bimaculatus* have been reported to be the three most common species in Trinidad in order of decreasing abundance (Nelson 1964). In addition, Nelson showed that *C. riisei* and *A. bimaculatus* were significantly associated with each other and with three other species: *H. unilineatus, C. aeneus* and the cichlid, *C. bimaculatum*. He attributed this to common exclusion from particular habitats, specifically those with high gradients or those tending to become brackish in the dry season.

Many of the fish species collected from the Chatham streams have been shown to have some ability to withstand fluctuating environmental conditions, particularly stagnation and associated hypoxia, increased predation and crowding (Carter 1935, Lowe-McConnell 1964). Air-breathing has been recorded for *E. erythrinus, Callichthys, C. aeneus* and *S. marmoratus* (Kramer 1978, Kramer & McClure 1980) and suggested for *C. bimaculatum* (Lowe-McConnell 1964). An air-breathing ability and capacity for overland movement (for example in *R. hartii, C. callichthys* and *S. marmoratus*) permits the colonisation of new habitats which may be more favourable. Use of the oxygen-rich surface water for respiration has been reported for many Neotropical fish species (Carter 1935, Lowe-McConnell 1964, Lewis 1970, Kramer & McClure 1982) including *P. reticulata* (Kramer & Mehegan 1981), and species of the genera *Hoplias, Astyanax, Rhamdia, Rivulus* and *Cichlasoma* in Panama (Kramer 1983). Myers (1947) and Kramer et al (1978) recorded the ability of *S. marmoratus* to survive in an active state without free water in burrow systems in the Amazon. Despite the capacity for many species to withstand harsh environmental conditions, species richness was greater for the deeper, more permanent pools in the streams. In addition, the larger species were found in the bigger, deeper pools comparable with other studies elsewhere (Holden 1963).

The species of the brackish water Station 4 included representatives of a euryhaline freshwater family, the Poeciliidae, while all the other species belonged to euryhaline marine families (Miller 1982). *C. parallelus* and *M. curema* have been commonly found in brackish water habitats in Trinidad (Boeseman 1960).

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