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A Survey of Freshwater Macroinvertebrates on Antigua, West Indies

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ABSTRACT

A survey of macroinvertebrates inhabiting the freshwater habitats of Antigua was conducted during June 1996. Qualitative collections were made by sweeping a dip net through the water column and by hand examination of submerged aquatic plants and debris in freshwater environments across the island. In addition, water temperature was recorded at each site. These collections yielded at least 41 species, all of which are reported for the first time from Antigua. Dominant taxa collected included gastropods, odonates, hemipterans, and coleopterans. Generally this macroinvertebrate fauna is sparse, most likely due to the oceanic origin of Antigua, the lack of freshwater habitat diversity, and disturbances to freshwater environments across the island.

INTRODUCTION

Antigua is located in the Leeward Islands of the Lesser Antilles. It is a small oceanic island comprising approximately 280 square kilometers. The south-western portion of this island is volcanic in origin, dating back at least 24 million years (Nagle *et al.* 1976) and rises to 402 m at Boggy Peak. Land to the north and east was formed as ocean sediments were thrust upward and primarily consists of limestones, marl, and calcareous sandstones. There are no permanent streams and only a few small springs exist. Many small water storage ponds having surface areas of <5 hectares were excavated in the past. Today several larger reservoirs have been constructed to supply water for domestic and agricultural uses. Much aquatic vegetation grows in shallow waters of these ponds and reservoirs. There appear to be no permanent bodies of fresh water above 150 m in elevation.

A limited amount of information regarding the freshwater invertebrates of the Lesser Antilles and other small Caribbean islands is available. Biodiversity surveys have been conducted on some islands including Barbados (Bass 2003a), St. Vincent (Harrison and Rankin 1975, 1976a, 1976b), St. Lucia (McKillop and Harrison 1980), Nevis (Bass 2000), Grenada (Flint and Sykora 1993; Bass 2004), Tobago (Nieser and Alkins-Koo 1991; Bass 2003b), and Trinidad (Hynes 1971; Alkins *et al.* 1981; Alkins-Koo 1990; Nieser and Alkins-Koo 1991), but similar published investigations are generally lacking for Antigua. While some invertebrate groups in the region have been studied, such as decapod crustaceans (Chace and Hobbs 1969; Hart 1980), odonates (Donnelly 1970), and trichopterans (Flint 1968, 1996; Botosaneanu and Alkins-Koo 1993; Flint *et al*. 1999), many others have yet to be surveyed.

The objectives of this investigation include: 1) to determine the species of aquatic macroinvertebrates inhabiting freshwater environments of Antigua; 2) to note microhabitat preferences of each species; 3) to determine the relative abundance of each species; and 4) to compare the Antiguan macroinvertebrates to those of other small Caribbean islands.

MATERIALS AND METHODS

Sixteen sampling sites were established in various freshwater habitats across Antigua during June 1996 (Fig.1). Water temperature was measured with a centigrade thermometer at each site immediately prior to collecting efforts. Several methods of collecting were employed to ensure as many species as possible were captured. Submerged debris, primarily decaying plant material, was carefully examined and inhabitants were collected using forceps. A dip net was swept through aquatic vegetation and the water column to capture macroinvertebrates occupying those microhabitats. The microhabitat where each specimen occurred was noted. These collecting methods were similar to those used in studies on other islands so comparisons of results could be made (Bass 2000, 2003a, 2003b, 2003c, 2004). Specimens were preserved in 70% ethanol and returned to the laboratory for further identification. Taxa that could not be identified to the species level were separated into morphospecies for subsequent analysis and the taxonomic name to which they could be identified was used. Sorenson's index of similarity (1948) was used to compare my collections in Antigua with similar endeavors on other small Caribbean islands.

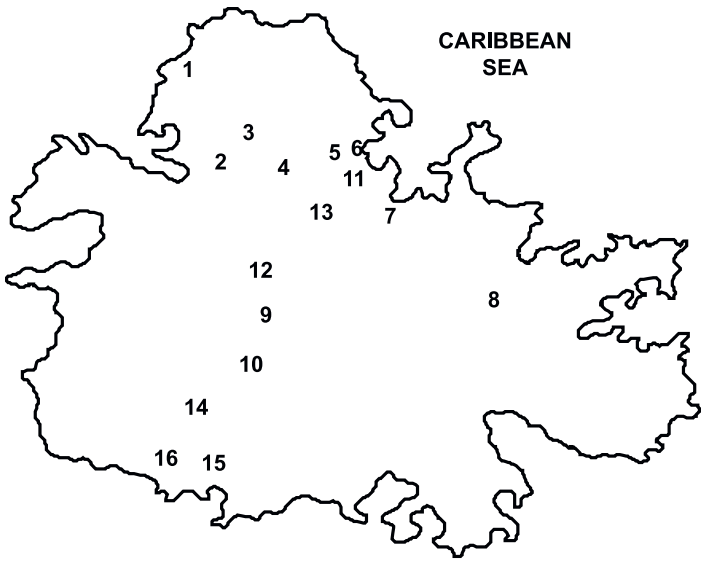

Fig. 1. Map indicating collecting sites in Antigua. Specific locations, dates, and approximate elevations of collections are listed below in Table 1.

RESULTS AND DISCUSSION

Water temperatures were warm, ranging from 27-32ºC during the sampling period. Because Antigua is a relatively low-lying island, larger temperature differences due to changing elevations, such as those recorded on the more mountainous islands of St. Vincent (Harrison and Rankin 1975), St. Lucia (McKillop and Harrison 1980), Tobago (Bass 2003b), and Grenada (Bass 2004), were not observed.

A total of at least 41 species was collected from the freshwater habitats of Antigua (Table 1). This list is important because it represents the only collections of freshwater invertebrates currently known from Antigua. However, none of the species present was considered unexpected.

Oligochaeta

Only one species of oligochaeta was collected. *Limnodrilus udekemianus* was found in the muddy sediments of Cable and Wireless Pond. This eurytolerant species has been reported from similar microhabitats in Grenada (Bass 2004).

Gastropoda

Three species of snails were collected in freshwaters of Antigua. The introduced Asiatic snail, *Melanoides tuberculata*, and the native, air-breathing pond snail, *Physella cubensis*, are widespread on Caribbean islands (Bass 2003a, 2003b; Bass 2004). A third species, *Tropicorbis albicans*, was abundant across Antigua.

Cladocera

Simocephalus acutirostratus was found in large populations in two ponds near Old Road. Both ponds are shallow and contain high densities of aquatic vascular plants. Cladocerans often are planktonic and associate with submerged portions of vascular plants (Thorp and Covich 2001).

Ostracoda

A single species of ostracod was also collected from the two heavily vegetated ponds near Old Road. This species, *Chlamydotheca hummelinc*, occurred at high density and appeared to be epibiotic with the submerged portions of plants.

Amphipoda

The eurytolerant and widespread Holarctic amphipod, *Hyalella azteca*, was collected from submerged plant detritus in one small body of water. This species is abundant in ponds on other Caribbean islands (Bass 2003a, 2004), but seems to be generally lacking from those habitats in Antigua.

Decapoda

Several individuals of *Macrobrachium* were observed among roots and submerged debris beneath ledges in Fig Tree Creek. None was collected so a species determination could not be made.

Ephemeroptera

One genus of mayfly, *Callibaetis*, was collected from several locations on Antigua, typically on submerged decomposing leaves. These specimens were very immature and it was not possible to determine the exact species. Because all nymphs appear similar, they are to be assumed to belong to the same species.

Odonata

Eight species of odonates were collected. Of these, *Ischnura ramburii*, *Erythrodiplax umbrata*, and *Erythemis vesiculosa* were found at three or more sites. *Brachymesia furcata/herbida* was also found at more than one site but, due to the immaturity of the specimens collected, it was not possible to determine whether *B. furcata* or *B. herbida* was present. Only three of the sixteen sites lacked odonates. *I. ramburii* has been reported from freshwaters throughout the Caribbean (Harrison and Rankin 1976; Bass 2003b, 2003c, 2004).

Hemiptera

Hemipterans are one of the most common groups of insects in freshwaters of Caribbean islands (Bass 2003c). Eight species of hemipterans were found in these collections from Antigua. Although *Belostoma subspinosum* and *Mesovelia mulsanti* were the most common, all species, except for one, were found at more than one location. Only two sites lacked hemipterans. As observed on other small Caribbean islands (Bass 2003c), populations of *M. mulsanti*, *Microvelia* sp., and *Pelocoris poeyi* possessed both winged and non-winged individuals. This loss of wings is a well-documented and widespread phenomenon observed among certain hemipterans occurring in isolated habitats (Schuh and Shlater 1995; Thorp and Covich 2001). It has been suggested an energy savings occurs if wings do not develop on individuals living in isolated habitats where suitable aquatic habitats are persistent (Roff 1990).

Coleoptera

Beetles are represented by 13 species and comprise the most diverse group of aquatic invertebrates in Antigua. This diversity is most likely due to the abundance of submerged aquatic vascular plants in ponds, a preferred microhabitat for many species of freshwater beetles. Of these, *Laccophilus subsignatus* and *Tropisternus lateralis* were the most frequently encountered. Coleopterans were absent at only one collecting site.

Diptera

Three taxa of freshwater dipterans were collected. The most common of these were larvae of the true midge, *Chironomus*. Members of this genus have hemoglobin in their blood that allows them to concentrate additional oxygen and occupy muddy sediments with low oxygen levels. *Chironomus* is widely distributed and its larvae have been reported from similar such habitats on other Caribbean islands (Harrison and Rankin 1976; Bass 2003a, 2003b). *Odontomyia* sp. and Tanyderidae were the two other dipteran larvae present, and both were uncommon on Antigua.

The number of macroinvertebrate species found in Antiguan freshwaters is less than half of that reported from Tobago (Bass 2003b), Grenada (Bass 2004), Barbados (Bass 2003a), and St. Vincent (Harrison and Rankin 1976b). Fewer species were expected because all four of those islands are larger than Antigua. In addition, Tobago, Grenada, and St. Vincent are mountainous and possess more aquatic microhabitats that allow more species to inhabit those islands.

It was interesting to note that trichopterans have not been found in Antigua although these aquatic insects are common on most other small Caribbean islands. As stated, Antigua is drier and has no permanently flowing water, a habitat preferred by many caddisflies species. This situation is similar to that occurring in Barbados where Flint (1993) reports only two species were present. Researchers have reported many more species are present on mountainous islands having permanent flowing waters, such as Tobago with 33 species (Flint 1996) and Grenada with 22 species (Flint and Sykora 1993; Flint *et al.* 1999; Botosaneanu 2002).

Similarity analysis indicated very little species overlap between Antigua and most of the other islands surveyed (Table 2). The highest similarity values were with Nevis (0.25) and St. Kitts (0.18). Both of these islands are relatively close to Antigua so it is not surprising that they show the greatest amount of faunal similarity. Although Barbados was much further away than most of the other islands, it had the third highest species similarity value (0.15). Again, this is most likely because the physical environments of Antigua and Barbados are somewhat alike. Most of the other islands to which Antigua is compared, except for the Caymans, are mountainous with very different physical environments resulting in different freshwater faunas (Bass 2003c). The limited species overlap between Antigua and the other islands included in this study makes it difficult to establish from where the Antiguan freshwater invertebrate fauna originated.

Much of Antigua has been impacted by both natural and

Table 1. List of freshwater macroinvertebrates, including collecting sites, life cycle stages present, relative occurrence, microhabitats, and proposed trophic relationships in Antigua during June 1996. Life cycle: A, adult; J, juvenile; L, larva; N, nymph. Occurrence: *** abundant, ** common, * uncommon.

Taxa	Collection Sites	Life Cycle	Occurrence	Microhabitat	Trophic Relationship[1]
Oligochaeta					
Limnodrilus udekemianus	3	A	*	Sediment	
Gastropoda					
Tropicorbis albicans	2, 3, 4, 7, 9, 10, 13, 14, 15	J, A	***		
Melanoides tuberculata	4, 10, 12, 13, 14	J, A	**		
Physella cubensis	4, 5, 9, 13, 14	J, A	**		
Cladocera					
Simocephalus acutirostratus	15, 16	J, A	**	Vascular hydrophyte	
Ostracoda					
Chlamydotheca hummelinc	15, 16	J, A	**	Vascular hydrophyte	
Amphipoda					
Hyalella azteca	1	A	*	Sediment	
Decapoda					
Macrobrachium sp.	14	A	*	Roots, Debris, Crevices	Predator
Baetidae					
Callibaetis sp.	5, 12, 13	N	*	Vascular hydrophyte	Collector
Odonata					
Brachymesia furcata / herbida	7, 8	N	*	Sediment	Predator
Ischnura ramburii	3, 4, 5, 7, 8, 9, 15, 16	N	***	Vascular hydrophyte	Predator
Erythrodiplax umbrata	5, 12, 15	N, A	**	Vascular hydrophyte	Predator
Erythemis vesiculosa	4, 5, 10, 14	N	**	Sediment	Predator
Lestes sp.	15	N	**	Vascular hydrophyte	Predator
Miathryria marcella / simplex	13	N	*	Vascular hydrophyte	Predator
Orthemis ferruginea	13	N	*	Sediment	Predator
Pantela flavescens	2, 3	N	*	Sediment	Predator
Hemiptera					
Belostoma sp.	2, 10, 13, 14, 15, 16	N, A	**	Vascular hydrophyte	Predator
Buenoa sp.	12, 15, 16	N, A	**	Water column	Predator
Centrocorisa nigripennis	15, 16	N	**	Water column	Predator
Hydrometra australis	4	N, A	*	Vascular hydrophyte	Predator
Limnogonus franciscanus	5, 11	N, A	**	Neuston	Predator
Mesovelia mulsanti	3, 5, 8, 9, 12, 13, 16	N, A	***	Vascular hydrophyte	Predator
Microvelia sp.	13, 15	N, A	**	Neuston	Predator
Pelocoris poeyi	4, 7, 9, 12, 16	N, A	**	Vascular hydrophyte	Predator
Coleoptera					
Berosus sp.	6, 9	A	*	Vascular hydrophyte	Herbivore, collector, shredder
Celina grossula	2	A	*	Vascular hydrophyte	Predator
Chrysomelidae	15	A	*	Vascular hydrophyte	Herbivore, shredder
Derallus rudis	2	A	*	Sediment	
Enochrus pseuduchraceus	1, 2, 14, 15	A	**	Sediment	Predator
Hydrophilus insularis	6, 8, 16	L, A	**	Sediment	
Laccophilus subsignatus	3, 5, 10, 12, 13, 15, 16	L, A	***	Vascular hydrophyte	
Mesonoterus sp.	3	A	*	Vascular hydrophyte	Predator
Pachydrus sp.	2	A	*	Vascular hydrophyte	
Paracymus confusus	4, 5, 8, 10	A	**	Sediment	
Suphisellus sp.	2, 7, 16	A	**	Vascular hydrophyte	Predator
Thermonectus basilaris	12, 15, 16	L, A	**	Vascular hydrophyte	Predator
Tropisternus lateralis	4, 5, 6, 7, 8, 10, 12, 15, 16	L, A	***	Sediment	Predator, collector, herbivore
Diptera					
Chironomus sp.	4, 5, 15, 16	L, A	**	Sediment	Collector, shredder
Odontomyia sp.	1, 15	L	*	Vascular hydrophyte	Collector
Tanyderidae ?	15	L	*	Sediment	

Trophic relationship[1] – Trophic relationships of insects taken from Merritt and Cummins (1996).

Collecting sites and approximate elevations: 1) Saline pool, Buccaneer Cove (2 m); 2) Woods Pond, Woods (15 m); 3) Cable and Wireless Pond, Woods (30 m); 4) Piggotts Creek, Piggotts (15 m); 5) Fitches Stream, Fitches (10 m); 6) Fitches Marsh, Fitches (7 m); 7) Blackmans Spring, Parham (5 m); 8) Collins Reservoir, Collins (12 m); 9) Fiennes Reservoir, Swetes (30 m); 10) Wallings Spring, Wallings (125 m); 11) Fitches Water Tank, Fitches (15 m); 12) Olivers Pond, Olivers (40 m); 13) Lightfoots Reservoir, Lightfoots (12 m); 14) Fig Tree Creek, Fig Tree Hill (12 m); 15) East Callaloo Pond, Old Road (5 m); 16) West Callaloo Pond, Old Road (5 m).

Table 2. Sorensen's Index of Similarity values comparing the freshwater macroinvertebrate fauna of Antigua to that of other small Caribbean islands, including approximate distances to those islands from Antigua and approximate island sizes. 0.00 = 0% common taxa and 1.00 = 100% common taxa.

Island	Approximate Distance (km)	Approximate Size (km²)	Similarity Value
Montserrat	44	83	0.11
Nevis	70	93	0.25
St. Kitts	93	176	0.18
Saba	150	13	0.04
Dominica	154	751	0.08
St. Lucia	334	616	0.09
Barbados	466	430	0.15
Grenada	532	346	0.08
Tobago	642	300	0.08
Cayman Brac	1910	37	0.04
Little Cayman	1932	26	0.12
Grand Cayman	2028	197	0.05
Guanaja	2121	69	0.05

anthropomorphous factors. Most of the island has been settled and developed to some degree by humans. Many of the ponds on the island were constructed for water storage sites and subsequently colonized by aquatic life. Some ponds are surrounded by commercial and residential development resulting in sedimentation and pollution via runoff flowing into those ponds. Tropical storms and hurricanes periodically pass over Antigua and release large amounts of rainfall in short periods of time across the island.

Because Antigua is an oceanic island, its freshwater macroinvertebrate fauna had to colonize the island from elsewhere. These immigrants must have suitable dispersal mechanisms and be able to tolerate unfavorable conditions encountered while crossing ocean waters (Bass 2003c). No endemic freshwater invertebrates that may have evolved in isolation on Antigua have been discovered. However, as further studies are conducted in Antigua, additional species may be found and some of these might be unique to the island.

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