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Habitat Effects on the Occurrence of Parasites Inhabiting the Sergeant Major, Abudefduf saxatilis (Linnealus), with a List of Parasites of Caribbean Damselfishes

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HABITAT EFFECTS ON THE OCCURRENCE OF PARASITES INHABITING THE SERGEANT MAJOR, *ABUDEFDUF SAXATILIS* (LINNEAUS), WITH A LIST OF PARASITES OF CARIBBEAN DAMSELFISHES

Steven E. Yeo and Richard E. Spieler

ABSTRACT

In June 1976 the parasitic faunas of sergeant majors, *Abudefduf saxatilis*, from a coral reef habitat near Akumal, Quintana Roo, Mexico and from an estuarine habitat in the adjacent caleta at Yalku were compared. The frequencies of occurrence of the nematode *Spirocamallanus*, the hemiurid trematode *Genolinea*, the haplosplanchnid trematode *Schikhobalotrema*, and the copepod *Holobomolochus nothrus*, were dependent on collection locality. The residency of the damselfish in habitats with radically different salinity regimes, as well as the associated biotic communities within these habitats, are suspected causes of the observed differences.

Damselfishes are ideal subjects for comparative studies of habitat effects on fish ecology. They are easily observable, present in a variety of marine environments, and in general possess highly restricted home ranges (Ehrlich, 1975). Because some parasite populations of marine fish are geographically distinct (Sindermann, 1961), by comparing a specific species of damselfish from various habitats the ecological, physiological, and behavioral peculiarities, which influence communities of parasites inhabiting fishes (Noble, 1966), can be examined.

As part of ongoing ecological and physiological studies of coastal marine fishes of Quintana Roo, Mexico by the Milwaukee Public Museum in cooperation with CEDAM International, we compared the parasite-mix of *Abudefduf saxatilis* from ecologically distinct habitats along the Yucatan coast.

MATERIALS AND METHODS

Twenty *A. saxatilis* were speared during daylight hours between June 6–23, 1976. Half of these were collected from coral reef areas near Akumal and half from the caleta at Yalku. The fish were of mixed sexes, and ranged in size from 67–119 mm standard length in the caleta and from 96–111 mm standard length on the coral reefs.

Description of Collecting Areas: Coral Reefs

Elkhorn coral (*Acropora palmata*) dominates the fringing reefs bordering Akumal Bay, Quintana Roo, Mexico (Fig. 1). Extensive growths of brain coral, staghorn coral, other massive and encrusting forms of stony corals, and gorgonians abound (Fig. 2) in association with the fringing reef and with nearby patch reefs (Ward and Brady, 1976). *A. saxatilis* was collected inside and beyond the fringing reef at depths from 0.5 to 15 m. Water temperature varied from 27 to 29°C and salinity varied from 30 to 35‰ in the area, as determined by a YSI temperature and salinity probe. Associated with these coral growths was the diverse community of tropical fishes and invertebrates typical of Caribbean coral reefs.

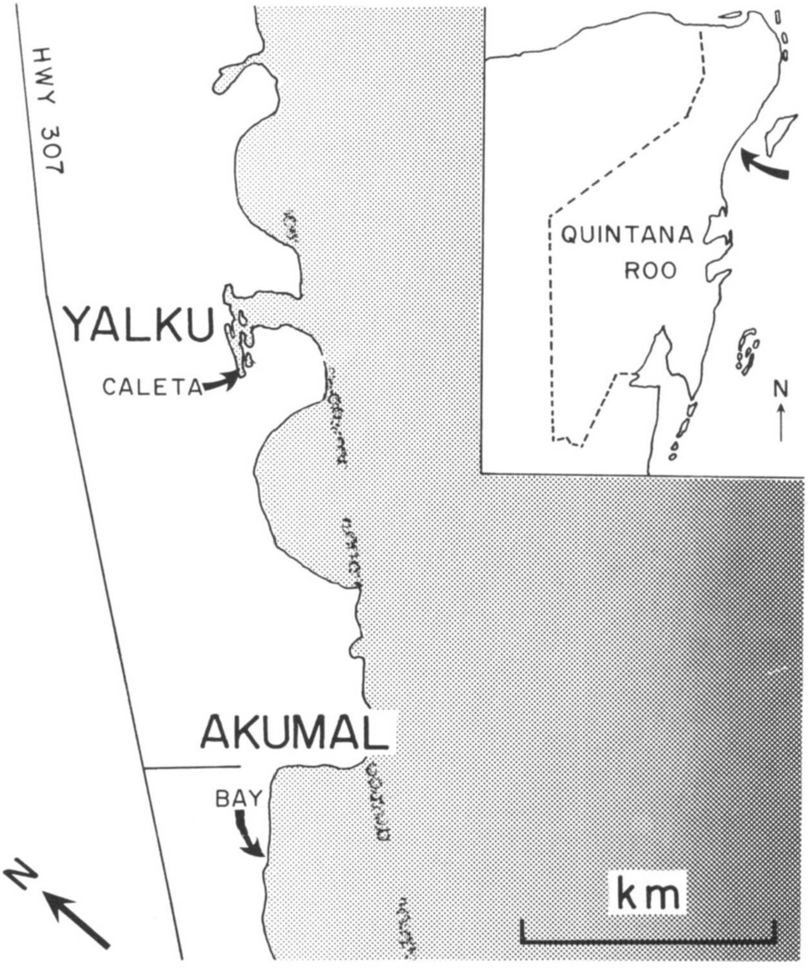

Figure 1. Map of the caleta at Yalku and the fringing reefs in the Akumal area of Quintana Roo, Mexico. (Based on map in Andrews and Andrews, 1975, and aerial photos of the area.) The arrow in the inset of Quintana Roo points to the portion of the coast shown in the main diagram.

Caleta

Approximately 2 km northeast of Akumal, at Yalku, an inlet is formed in the karst topography of the Yucatan coast (Fig. 1). The caleta (the steep-sided lateral branches of the head-waters) at the shoreward end of the inlet follows fractures in the bedrock. The caleta has a bottom of carbonate sediments and water up to several meters in depth. The seaward portion tends to be shallower than the water in the head-waters of the shoreward end where depth is difficult to determine in the narrow rock channels.

The caleta is an area of rapidly varying salinity. Relatively fresh groundwater flows into the caleta through the complex network of channels in the bedrock in a pattern generally similar to that described by Bach et al. (1976), for the Xelha caleta 12 km southwest of Yalku. In the protected inshore areas, this fresher water stratifies as a visible layer above the denser saline water. Wind and tidal action frequently disturb this stratification creating rapid variations in salinity and

Figure 2. Coral reef community at Akumal Bay.

diffusion currents that can obscure diver vision. During the collecting period salinities ranged between 18 and 32‰ and water temperatures between 26 and 31°C.

The biota of the caleta differed markedly from that of the nearby coral reefs, especially with regard to sessile organisms (Fig. 3). Coral growths larger than a few centimeters were rare. Encrusting growths of algae blanketed the rock faces bordering the caleta. Mangroves were present on the small island in the center of the caleta and along some of the shoreline. The inability of sessile organisms to avoid salinity variations apparently prevents stenohaline sessile organisms from surviving for prolonged periods in the caleta. In spite of the harsh salinity regime, a specialized community of motile invertebrates and herbivorous marine fishes dominated the caleta (Spieler and Noeske, unpublished data).

Parasite Survey Procedures

The exterior surface, oral cavity, gills, and the visceral organs of each fish were examined for parasites with a dissecting microscope. Portions of the gills were examined at 100× and 430× magnification with a compound microscope. After removal and preliminary examination, the alimentary canal and its contents were shaken vigorously in a jar partially filled with water. After settling and decanting to remove debris, helminths were recovered from the residue. Nematodes were fixed in either formalin or hot 70% ethanol and transferred to glycerin for examination. Trematodes were flattened with cover-slip pressure, fixed with formalin, stained using Lynch's precipitated borax carmine and mounted whole. Crustaceans were fixed in formalin and transferred to glycerin.

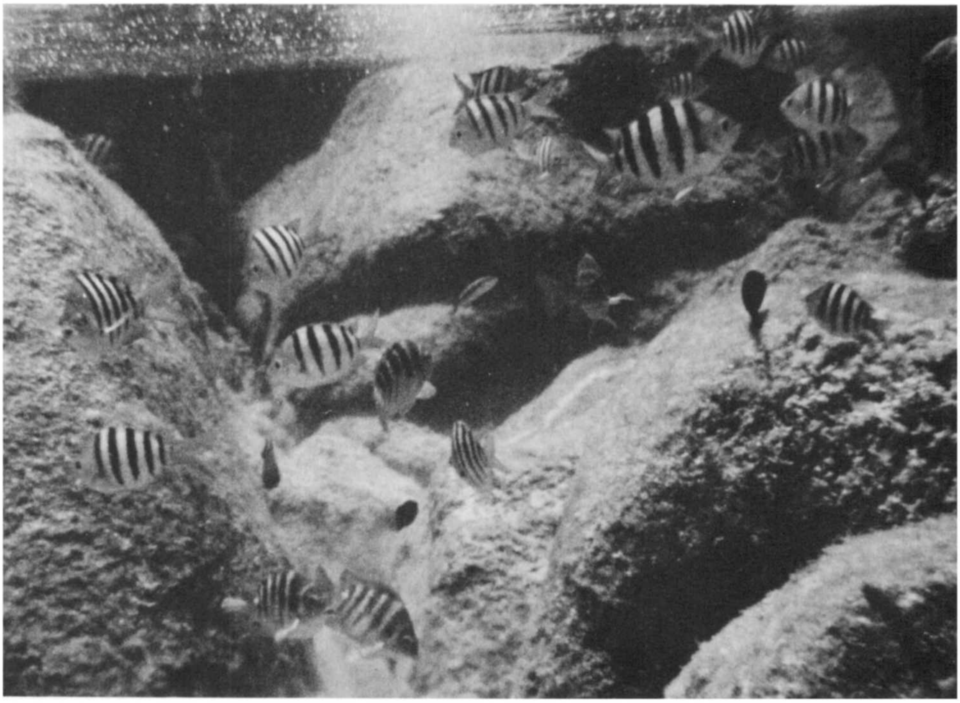

Figure 3. An aggregation of *Abudefduf saxatilis* and other fishes in the caleta at Yalku, also, showing the algal mat encrusting the rocks bordering the caleta.

Parasites were identified by using the keys of Yamaguti (1971), Schell (1970), and Skrjabin et al. (1964), and through comparison to descriptions in the literature. Yamaguti (1971) served as the standard for naming the digenetic trematodes.

Parasite incidence was recorded and tested (alpha level = 0.05) for independence from habitat type using the chi-square procedure for 2 × 2 contingency tables for each parasite (Sokal and Rohlf, 1969). Expected frequencies were calculated based on overall frequencies of occurrence regardless of habitat. In the case of the parasite with the lowest significant chi-square value, Fisher's exact test was used to verify that result.

Numbers of the larger helminths and crustaceans recovered from each habitat and the range of the number recovered per host are given as an approximate indication of the intensity of parasitism. Monogenetic trematodes, metacercaria, and protozoans were not included in these counts due to their small size and difficulties with recovery.

RESULTS

From the 20 *A. saxatilis* examined, 181 nematodes, 120 adult digenetic trematodes, 6 immature cestodes, and 13 crustacean parasites were recovered. Overall incidence of parasitism in the two habitats was similar with from one to five taxa of parasites recorded per host. Incidence of four parasite taxa inhabiting *A. saxatilis* were dependent on host-habitat; other parasites occurred either independently of habitat or too infrequently to detect dependence based on the numbers of fish examined (Table 1).

Table 1. Incidence of parasites in *Abudefduf saxatilis* hosts from the caleta at Yalku and reef areas near Akumal Bay, Quintana Roo, Mexico (co-occurrence of parasites on hosts is shown in the numbered column for each fish)

	Hosts																			
	Caleta										Reefs									
Parasites	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Protozoa																				
sporozoan cysts				X			X													
Trematoda																				
unident. monogenetic	X	X			X		X	X	X	X		X	X	X	X	X			X	
Hemiuridae																				
**Genolinea*	X							X			X	X	X	X	X	X	X	X	X	X
Lecithochirium		X																		
Haplosplanchnidae																				
**Schikhobalotrema*								X			X	X	X	X	X	X		X		
Zoogonidae																				
Deretrema fusillus									X					X						
metacercarial cysts		X					X	X					X			X		X		
Cestoda																				
plerocercoid larvae												X								
cysticercus larvae															X				X	
Nematoda																				
**Spirocamallanus*	X	X	X	X	X	X	X		X	X										
Crustacea																				
Copepods																				
**Holobomolochus nothrus*											X	X				X			X	
Isopods																				
Gnathia															X				X	X
Tanaids			X																	
Aquatic mite		X																		

* Frequency of incidence dependent on host-habitat (alpha = 0.05).

Parasite-mix of hosts from coral reefs near Akumal

The parasite-mix of *A. saxatilis* hosts from coral reefs (Table 1) consisted mainly of genera previously reported from *A. saxatilis* or from other pomacentrids collected at Caribbean and Central American marine localities (Table 2). The stomach trematode *Genolinea* and the intestinal trematode *Schikhobalotrema* occurred more frequently (Table 1) in hosts from coral reefs than in hosts from the caleta. A total of 99 specimens of these trematodes (3–27 per host) were recovered from the 10 reef hosts; only 9 specimens (0–7 per host) were recovered from 10 caleta hosts. The bomolochid copepod *Holobomolochus nothrus* was observed (0–3 specimens per host) within the oral cavity or on the gills of only hosts collected in coral reef areas. Previous reports of this copepod on *A. saxatilis* are from Jamaica (Wilson, 1913) and Curacao (Vervoort, 1969). Cestode larvae (0–3 specimens per host) and gnathid isopods (0–3 specimens per host) were observed only on coral reef hosts, but at too low incidence to detect a dependence on habitat type.

Parasite-mix of hosts from the caleta at Yalku

In contrast to the similarity of the parasite-mix of hosts inhabiting coral reefs to previous reports, the parasite-mix of *A. saxatilis* inhabiting the caleta was dominated by the nematode *Spirocamallanus*. Previously unreported from damselfishes, *Spirocamallanus* occurred in the alimentary canal of 9 out of 10 *A. saxatilis* from the caleta, and was not observed in hosts inhabiting coral reefs (Table 1). The occurrence of *Spirocamallanus* in *A. saxatilis* is not surprising considering previous reports of its occurrence in a wide variety of estuarine and marine teleosts from the American Atlantic and Pacific (Annereaux, 1946; Sogandares-Bernal, 1955; Noble and King, 1960; Joy, 1971; 1974; Vicente and Santo, 1972; Fusco and Overstreet, 1978). The closest previous locality records to Yalku are Winter's (1953) reports on the genus, based solely on females of *S. spiralas* from Boca del Rio, Veracruz, and Salina Cruz, Oazaca, Mexico. Hosts from the caleta contained a total of 181 nematodes and from 0 to 105 individuals of *Spirocamallanus* per host. Some of these nematodes were over 2 cm in length.

Several specimens of the stomach trematode *Lecithochirium* (12 recovered from a single host) and sporozoan cysts (approximately 1 mm in diameter) were present in the alimentary canal of fish from the caleta, but they occurred too infrequently to show dependence on host-habitat. Tanaids and an aquatic mite were found on the external surface of single hosts from the caleta.

Occurrences of parasites independent of host-habitat

In addition to the parasites found too infrequently on hosts from a single habitat to demonstrate habitat dependence, the gall bladder trematode *Deretrema fusillus* (2 specimens), metacercarial cysts, and monogenetic trematodes occurred with about equal incidence on *A. saxatilis* from both habitats. This similarity, however, may be an artifact of not identifying the monogenetics and metacercaria to species-level due to difficulties with recovery and preparation.

DISCUSSION

Previous studies of parasitism in Caribbean and Central American pomacentrids are principally systematic in nature with parasite-descriptions, host-species lists, and some comparison of geographically distant faunas (Table 2). We are unaware of any previous observations of distinct differences in occurrence of

Table 2. Summary of previous reports of parasites from *Abudefduf saxatilis* and from other Caribbean damselfishes. Host binomials are those of the cited authors except when inclusions were made, as indicated

Host/Parasite	Locality	Reference
*Abudefduf saxatilis**		
Trematoda		
Deretrema fusillus	Dry Tortugas, Florida	Linton, 1910
Deretrema fusillus	Dry Tortugas, Florida	Manter, 1947
Genolinea gravida syn. *Theletrum gravidum*	Socorro and Clarion Is., Mexican Pacific	Manter, 1940
Genolinea magnasaccus syn. *Theletrum m.*	Atlantic coast, Panama	Sogandares-Bernal and Sogandares, 1961
Genolinea noblei	Curacao	Nahhas and Cable, 1964
Lecithochirium monticellii syn. *Sterrhurus monticelli*	Dry Tortugas, Florida	Linton, 1910
L. floridensis syn. *Sterrhurus f.*	Bimini, Bahamas	Sogandares-Bernal, 1959
L. parvum	Jamaica	Nahhas and Cable, 1964
Opecoelus acutus	Socorro Is., Mexican Pacific	Manter, 1940
Parahemiurus merus	Dry Tortugas, Florida	Manter, 1947
Parahemiurus merus	Jamaica	Nahhas and Cable, 1964
Schikhobalotrema acutus syn. *Haplosplanchnus acutus*	Galeta Point, Panama	Sogandares-Bernal and Sogandares, 1961
S. adacutus syn. *Halosplanchnus adacutus*	Dry Tortugas, Florida	Manter, 1947
S. adacutus	Jamaica	Nahhas and Cable, 1964
S. bivesculum	Jamaica	Nahhas and Cable, 1964
Copepoda		
Holobomolochus nothrus syn. *Bomolochus n.*	Jamaica	Wilson, 1913
Holobomolochus nothrus	Curacao	Vervoort, 1969
Orbitacolox oniscoides	Curacao	Vervoort, 1969
Isopoda		
Anilocra laticauda	Panama	Boone, 1921
Negative records:		Siddiqi and Cable, 1960 Sparks, 1957 Overstreet, 1969
Chromis multilineata (including *C. marginatus*)		
Acantocephala		
Rhadenorhynchoides chromitides syn. *Cavisoma c.*	Puerto Rico	Cable and Quick, 1954
Negative record:		Nahhas and Cable, 1964

Table 2. Continued

Host/Parasite	Locality	Reference
Chromis enchrysurus		
Negative record:		Manter, 1934
Microspathodon chrysurus		
Trematoda		
Schikhobalotrema pomacentri	Curacao and Jamaica	Nahhas and Cable, 1964
Pomacentrus analis		
Trematoda		
Schikhobalotrema pomacentri	Curacao	Nahhas and Cable, 1964
Pomacentrus fuscus (including *Eupomacentrus f.*)		
Trematoda		
Schikhobalotrema pomacentri	Curacao and Jamaica	Nahhas and Cable, 1964
unident. adult trematode	Bimini, Bahamas	Blankespoor, 1976
Negative record:	Biscayne Bay, Florida	Overstreet, 1969
Pomacentrus leucostictus (including *Eupomacentrus l.*)		
Trematoda		
Diphtherostomum americanum	Biscayne Bay, Florida	Overstreet, 1969
Helicometrina nimia	Dry Tortugas, Florida	Manter, 1947
Genolinea pomacentri syn. *Theletrum p.*	Jamaica	Nahhas and Cable, 1964
Schikhobalotrema pomacentri syn. *Haplosplanchus p.*	Dry Tortugas, Florida	Manter, 1947
Schikhobalotrema pomacentri	Panama	Sogandares-Bernal and Sogandares, 1961
Schikhobalotrema pomacentri	Curacao	Nahhas and Cable, 1964
Negative record:	Bimini, Bahamas	Sogandares-Bernal, 1959
Pomacentrus ovalis		
Negative record:	Bimini, Bahamas	Sogandares-Bernal, 1959
Pomacentrus planifrons (including *Eupomacentrus p.*)		
Trematoda		
Schikhobalotrema pomacentri syn. *Haplosplanchnus p.*	Panama	Sogandares-Bernal and Sogandares, 1961
Copepoda		
Acanthochondria crassicornis	Dry Tortugas, Florida	Wilson, 1935

Table 2. Continued

Host/Parasite	Locality	Reference
Negative record:	Dry Tortugas, Florida	Manter, 1947
Pomacentrus variabilis (including *Eupomacentrus v.*)		
Negative record:	Biscayne Bay, Florida	Overstreet, 1969
Pomacentrus xanthurus		
Trematoda		
Schikhobalotrema pomacentri syn. *Haplosplanchnus p.*	Dry Tortugas, Florida	Manter, 1947

* *Abudefduf* from the Pacific and Red Sea are not considered *A. saxatilis* by some investigators.

pomacentrid parasites from such relatively adjacent collecting localities as exist between the parasite-mixes of *A. saxatilis* from the caleta at Yalku and the coral reefs near Akumal. We believe the observed differences in the parasite-mixes of *A. saxatilis* were the result of the combined effect of the ecological distinctness of the two habitats and the tendency of individual damselfish to maintain a limited home range.

Since differences in the salinity regimes of the two habitats appeared to be important in maintaining the biotic distinctness of each of these areas, the direct or indirect effect of salinity variations are suspected of also influencing the parasite-faunas. External parasites are directly subjected to the salinity variations of the habitat selected by their host. Intolerance of variable salinities may explain the apparent absence of *H. nothrus* and gnathid isopods from *A. saxatilis* inhabiting the caleta. The presence of monogenetic trematodes on hosts from both the caleta and the reef areas may be indicative of their greater tolerance to salinity variations. However, undetected species-level differences in tolerance might be present that could only be detected by further investigation.

The absence of *Spirocamallanus* from *A. saxatilis* residing in the coral reefs cannot be easily explained by the direct effect of salinity variations. Noble and King (1960) found that *S. pereirai,* the closely related nematode parasitizing *Gillichthys mirabilis,* showed a remarkable tolerance to changes in salinity. On this basis the nematode would be expected to parasitize hosts from both the caleta and the coral reefs. Joy (1974) attributed differences in the incidence of *S. pereirai* in various size classes of *Micropogon undulatus* to varying consumption of copepods containing infective larvae. Fusco and Overstreet (1978) considered the records of *S. pereirai* reported by Joy (1971; 1974) and Sogandares-Bernal (1955) to be *S. cricotus,* which they described as an Atlantic species morphologically distinct from the closely related Pacific species *S. pereirai* and from the Brazilian species *S. macaensis* (Vicente and Santo, 1972). The estuarine collection localities and hosts of *Spirocamallanus cricotus* and *S. pereirai* in previous reports suggest that the crustacean intermediates of these nematodes are adapted to estuarine habitats. Thus, the scarcity of intermediate hosts in areas of more constant salinity may explain the absence of *Spirocamallanus* in *A. saxatilis* from the coral reef habitats.

Noble (1966) considered the diet of fishes as the most important biotic feature in determining the nature of their parasite fauna. Randall (1967) found that the diet of *A. saxatilis* varied markedly with the environment from which it was collected. Differences in the biotic communities of the reef and the caleta thus may have affected the diet of *A. saxatilis,* thereby creating the differences in the frequencies of occurrence of its internal parasites. Information is unavailable, however, concerning possible dietary routes of infection for *Genolinea* and *Schikhobalotrema,* other than the observations that the cercaria of *S. acuta* encyst in the open on vegetation (Cable, 1954) and that benthic algae, sessile animals, and individual zooplankters are important items in the diet of *A. saxatilis* (Randall, 1967).

The differences in the salinity regimes of the caleta and the reef areas could influence internal parasites indirectly through alterations in the physiology of the host. Osmoregulatory stress could alter the internal environment of the fish to such an extent that certain parasites encounter more favorable conditions in hosts from a particular habitat. Interspecific competition for limited resources, such as preferred sites within the hosts might also affect parasite occurrence. Sogandares-Bernal (1959) has discussed how factors, such as pH, affect the exact site location of parasites within their hosts. The trematodes of *A. saxatilis* exhibited site preferences: *Genolinea* and *Lecithochirium* were observed in the stomach, *Schikhobalotrema* occurred in the intestine, and *Deretrema* was present in the gall bladder. The abundance and physical size of *Spirocamallanus* in the alimentary canal of the caleta hosts may have decreased the sites available to *Schikhobalotrema* or *Genolinea*. Interestingly, in the single host from the caleta not parasitized by *Spirocamallanus*, *Schikhobalotrema* was present and, in the only host parasitized by *Lecithochirium*, *Genolinea* was absent. Although these observations are too limited to draw definite conclusions, they suggest interspecific competition among parasites.

The size and permanence of host residence are of interest in establishment of habitat-related differences in parasitism. The existence of differences between the parasite-mix of *A. saxatilis* from the caleta and that of the coral reef hosts seems to confirm previous observations of the restricted size of damselfish residences (Bardach, 1959; Fishelson, 1970). Joy's (1974) observation of seasonal variations in the incidence of *S. pereirai* and the 30 to 50 day periods of residence observed by Bardach (1959) for *A. saxatilis,* suggest that similar periods of residency would be sufficient to establish a parasite fauna reflecting host-habitat differences.

Although the short duration of this study precluded more definite statements concerning the dynamics of damselfish host-parasite relationships, the existence of parasite-mix differences in *A. saxatilis* from adjacent but ecologically distinct habitats provides a unique opportunity for further investigation of the ecological relationships of marine fishes.

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