

5. THE LITTORAL FISHES OF LITTLE CAYMAN (WEST INDIES)

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Abstract

A brief survey of the littoral marine fish of Little Cayman is described together with notes of their habitat preferences.

The classification of littoral fish faunas in the Caribbean is discussed and an alternative scheme is suggested in the light of the present work. The fauna elements are typical of the area and support the theory that the Caribbean is an integrated zoogeographic unit.

Introduction

During the summer of 1975 the Royal Society and Cayman Island Government supported an expedition to Little Cayman where the opportunity was taken to study different aspects of the ecology of the island. The present paper examines the littoral marine fishes from two rocky shore areas, Jackson's Bay and the West End rocks from Little Cayman and describes their distribution and habitat preferences.

The distribution of littoral invertebrates has been well covered and is discussed and reviewed in special relation to Little Cayman by Potts (1979). By comparison the littoral fishes of the West Indies have not been examined in great detail apart from a few early papers by Breder (1948, 1954), and other works on single species such as those by Tavalga (1950a and b) and Aronson (1951, 1971) and others. For more general accounts of the shallow water fishes of the Caribbean it is necessary to examine the work by Longley and Hildebrand (1941) from the Tortugas, Florida with many useful ecological notes and the books by Beebe and Tee-van (1933), Randall (1968), and Bohlke and Chaplin (1968). The latter is especially useful in having a full bibliography of papers covering the taxonomy of fishes of the region. The Pacific coast of America and the islands of the tropical Pacific have been examined by Hiatt and Strasburg (1960), Gosline (1965),

Thompson and Lehner (1976) and others and offer many useful ecological parallels and comparisons that will be discussed later.

Classification of Littoral Fishes

The littoral region of Little Cayman is described by Potts (1979) in a paper on the distribution and zonation of the common species of mollusc and crustacean. Potts also includes tidal data which show clearly that the low tidal range is less likely to have an effect on the distribution on littoral species than the surge and spray from wave action. While for the distribution of littoral invertebrates it has been convenient to adopt the classification and terminology outlined by Stephenson and Stephenson (1952) and which is summarised by Doty (1957), for the littoral fish it is more appropriate to use the classification of Gosline (1965) and Hiatt and Strasburg (1960). Gosline divides the littoral region into two; the "surge zone" which represents the true littoral region or midlittoral of Stephenson and Stephenson (1952) and which is washed by the surge action of waves as well as the normal rise and fall of sea level during the tidal cycle, and secondly the "splash zone" which is comparable with the supralittoral fringe and which is wetted only by spray from the action of wind and waves. Hiatt and Strasburg (1960) call these the 'intertidal' and 'supratidal' zones respectively.

This classification identifies the littoral region in terms of the influence of wave and tidal action on the shore. Within this framework the fish population has been considered under a further classification based upon the biological adaptation and permanence of the fish fauna to the region.

Breder (1948) described the littoral fish as either typical, casual or accidental, but these categories are not always easy to apply and it is perhaps somewhat easier to use Gibson's (1969) broader classification. In this, Breder's 'casual' and 'accidental' categories are grouped as 'partial residents', but in addition temporal variations are allowed for by the categories of 'tidal' and 'seasonal' visitors. In actual fact the partial residents could be either tidal or seasonal and it would seem more useful to define the fish as either residential or transient, and to subdivide the transient groups as either tidal or seasonal. This in fact covers most problems associated with the earlier classification, but leaves unresolved the need for a group to cover those species that may only occur in the littoral region at a certain stage of their ontogeny. To some extent this is covered by the heading of seasonal visitors, but this might better be divided into two to describe seasonal visitors that represent adult migrants and those which are present as part of their essential ontogeny. The revised classification recommended for littoral fish is briefly summarised in Table 5 and it is this classification that is adopted in the present work.

While this classification may assist to identify the relevance of a fish in the littoral zone it can only be used as a rough guide in the categorisation of spatial and temporal factors controlling littoral fish

populations. Variability in dependence upon the littoral environment will be species specific and a classification of this kind can only be of advantage in comparing between species at the broadest level.

Table 5. Classification of littoral fishes

I Residential Species

- II Transient Species (a) Accidental visitors
 (b) Tidal visitors
 (c) Seasonal visitors (i) Adult migrants
 (ii) Juveniles
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Methods

The areas chosen for examination were at West End rocks in the west and at Jackson's Bay in the North of Little Cayman. The more exposed rock outcrops at the East End and bluff end of the island only contained relatively small pools on a steep shore and contained rather few species of littoral fish. For this reason it was decided to concentrate on the pools on the more sheltered sides of the island. Before pools were subjected to disturbance observations were made of the habits of the fish species present. This was then followed by a survey of the extent and depth of the pool.

Littoral fish were collected at low water by using the fish anaesthetic Quinaldine in the manner suggested by Gibson (1967). Firstly the rocks and larger stones were moved from the pool and then a mixture of Quinaldine mixed one to four with acetone was squirted into the pool from a plastic wash bottle. The mixture was directed into crevices in the rock where many of the smaller littoral species hide and the water was agitated thoroughly. As soon as fish showed signs of anaesthesia they were dipped out of the pool with a net and transferred to a bucket of clean sea water where they revived. It is interesting to note that as well as fish the stomatopods, *Pseudosquilla* sp. and *Gonodactylus* sp. were also affected by the Quinaldine and could be easily collected. The fish were then examined and provisional identifications made of the living specimens before they were narcotised and preserved in 10% Formalin. Figure 20 represents diagrammatically the fish faunas of the splash and surge level pools.

Results

A summary of the littoral fish collected on Little Cayman is given in Table 6 together with details of the mean size, sample size, zonal

Table 6. Table indicating the mean size, sample size and habitat preference of the fishes found occupying six littoral rock pools.

SPECIES	mean size (mm)	number of specimens	maturity	Habitat preference			Zonal level		residential sp.	transient sp.
				midwater	benthic	crevice	spash zone	surge zone		
Holocentridae <i>Adioryx vexillarius</i> (Poey)	53	13	A			*	*	*	*	
Gobiidae <i>Bathygobius soporator</i> (Cuv. and Val.)	43	39	J-A		*	*	*	*	*	
Pomacentridae <i>Abudefduf taurus</i> (Müll. and Tros)	19	5	J	*			*		*	
<i>A. saxatilis</i> (L)	24	17	J	*			*	*	*	
<i>Eupomacentrus leucostictus</i> (Müll. and Tros)	31	1	J	*			*	*	*	
Lutjanidae <i>Lutjanus apodus</i> (Walbaum)	29	5	J	*			*		*	
Gerridae <i>Gerres cinereus</i> (Walbaum)	40	2	J	*			*		*	
<i>Eucinostomus argenteus</i> (Baird & Girard)	28	4	J	*			*		*	
Gobiescoideae <i>Tomicodon fasciatus</i> (Peters)	22	6	A		*	*	*	*	*	
Tetradontidae <i>Canthigaster rostrata</i> (Bloch)	25	1	A	*	*		*		*	

Chaetodontidae									
<i>Pomacanthus paru</i> (Bloch)	19	2	J	*				*	*
Muraenidae									
<i>Echidna catenata</i> (Block)	132	1	J		*	*		*	*
<i>Enchelycore</i> sp.	50	1	J		*	*		*	*
Labridae									
<i>Thalassoma bifasciatum</i> (Bloch)	19	22	J	*		*		*	*
Acanthuridae									
<i>Acanthurus</i> sp. (? <i>chirurgus</i>)	32	1	J	*				*	*

A = Adult

J = Juvenile

level and habitat preferences. The fish of the splash zone will include ones collected from the supralittoral fringe and upper part of the midlittoral zone while those of the surge zone are completely littoral and were found in pools down to the infralittoral fringe. Provisional field identification were made from the book by Chaplin and Scott (1972) and these were subsequently checked with the important reference books of Randall (1968) and Bohlke and Chaplin (1968).

Of the 15 species caught from 12 families, it is striking that only three species were found to occupy both the splash zone and the surge zone, *Bathygobius soporator*, *Abudefduf saxatilis* and *Tomicodon fasciatus*. It must be assumed that some species of the upper splash zone might normally be found in the surge zone pools since all but one are considered transient littoral species which at some stage will spend time offshore in the sublittoral region. By comparison none of the surge level species could be considered residential littoral species most of which are more commonly found on the fore-reef terrace and only the juveniles of *Thalassoma bifasciatum* were found with any regularity in littoral pools. Only *B. soporator* was confined to the littoral region and not seen below tide marks.

The habitat preferences of the species indicate that under undisturbed conditions they can be broadly grouped into those that swim in mid-water, benthic species that keep close to the rock often with the aid of anatomical adaptations such as modified fins, and those that tend to remain in crevices. There is some overlap between these groups as some benthic species may also use crevices and mid-water species may adopt them when disturbed, or at certain times of the day. There may also be ontogenetic differences not recognised during the present work. On the whole the crevice dwellers, e.g. Muraenidae, tend to be crepuscular or nocturnal in their habits.

The majority of species were immature and only *B. soporator*, *A. vexillarius*, *Tomicodon fasciatus* and *Canthigaster rostrata* were represented by adult specimens although even these were smaller than the adults shown in Randall (1958) and Bohlke and Chaplin (1968).

In addition to the species listed in Table 6 one other fish species was collected from West End rocks, *Diodon holacanthus*. This single mature specimen (315 mm) must be considered a transient pool species, as while not uncommon on the shallow upper reef terrace together with *D. hystrix*, it does not normally tolerate the unstable pool environment. This specimen was found beneath a very large flat boulder which must have provided the shelter necessary for this relatively weak swimmer. Another species, the Hardhead silverside *Atherinomorus stipes* (mean total length 67 mm, ST = 8.1, n = 37) were found in a group of two or three hundred individuals in an inlet at West End rocks where they kept close to the waters edge on the rising tide. It is probable that this species may also be trapped in low level pools on the falling tide.

Quinaldine as well as narcotising the littoral fish also affected the stomatopods that were common in the littoral and sublittoral region. Two genera were collected, *Gonodactylus* sp. that was found in

splash and surge level pools and *Pseudosquilla* sp. found only in the lower surge pools.

Discussion

In temperate regions where the tidal range is often large, the littoral region may provide an extensive platform with large and permanent rock pools in which many species of fish are able to establish themselves. The fish fauna is further assisted by the development of a considerable algal canopy which offers a diverse habitat in which littoral fishes can live together with a large range of potential food organisms. By contrast the littoral region of tropical islands is often poorly developed with a small tidal range and relatively inconspicuous flora. Over much of the tropics the tidal range is less than one metre and the nature and extent of the shore and its associated fauna and flora are determined by the degree of wave action rather than by tidal factors (Doty, 1957; Hiatt and Strasburg, 1960 and Gosline, 1965). In addition, the physical environment necessitates that littoral fish are tolerant of temperature extremes and emersion, together with the related problems of oxygen tension, pH, salinity, and desiccation. These factors and other aspects of the adaptations shown by littoral fishes to life on shore are reviewed by Gibson (1969).

Apart from the early work of Breder (1948, 1954) most work on littoral fish faunas from the Caribbean has been done on specific aspects of the biology of single species. On Little Cayman the only permanent littoral resident was the Frillfin goby *Bathygobius soporator*, occurring at all tidal levels in rock pools. This fish has been subjected to more research than any other Caribbean species with important work on its locomotion and orientation by Aronson (1951, 1971), and upon other aspects of its life cycle and sensory biology by Tavalga (1950a and b). No large scale survey on the ecological relations of the fish fauna of the Caribbean has been published, of the kind carried out by Hiatt and Strasburg (1960) for the Marshall Islands, but none-the-less the books of Randall (1968) and Bohlke and Chaplin (1968) do provide much useful ecological information on individual species, together with descriptions of their known geographic ranges.

The Cayman group of islands lie in the deep water of the Cayman Trench between Jamaica and Cuba. For this reason the littoral fish fauna is particularly interesting as the problems associated with their dispersal across deep water are considerable and it might be expected that some form of endemism might occur among fish restricted to shallow water. In fact no unusual faunal elements were found among the shore fishes all of which are recorded from Cuba (Duarte-Bello and Buesa, 1973), and which confirms the view that the Caribbean can be regarded as an integrated zoogeographic unit with relatively free mixing among the fish population of the region. Despite this, Little Cayman had only four littoral fish common to those listed by Breder (1948) from Bimini in the Bahamas. These were the ubiquitous species *B. soporator*, *T. bifasciatum*, *E. leucostictus* and *Abudefduf saxatilis*. The remaining species were different, but represented similar families that are typical of the littoral region, both within the Caribbean area

and the tropical Pacific (Hiatt and Strasburg, 1960; Gosline, 1965 and Thompson and Lehner, 1976) and also to some extent the littoral zone from temperate regions (Gibson 1969). It seems that the colonisation of the turbulent and unstable littoral region has only been possible by relatively few families of fish which have been able to develop behavioural, anatomical and physiological adaptations appropriate to the littoral environment. Many of these adaptations are described and discussed in the papers mentioned above to which should be added the work of Fishelson (1963), Gibson (1967a and b) and Williams (1957).

While the littoral fish of Little Cayman are confined to a relatively restricted environment it can be seen by examining Table 6 that rather few are likely to be in competition for space or food as not only do they show different spacial and temporal activity patterns, but also differences in feeding habits. With the predominance of carnivorous species the situation is essentially similar to that of Californian tide pools described by Mitchell (1953).

On Little Cayman four species were identified as being residential in the littoral region. The others are typical of several groups of shallow water tropical fish which are widely distributed over the upper reef terraces and back reef including at times the littoral region. Other species formed a more transient element and were mostly represented by juvenile individuals of shallow sublittoral species. Some, such as *Abudefduf saxatilis*, *A. taurus*, *Lutjanus apodus* and *Tomicodon fasciatus* were relatively common in rock pools and it must be supposed that the young of these and other species of fish may remain in the shallow beach zone. In this region they would be protected from the predatory species that frequent the reef platform. Other species are widespread as the Holocentrid, *Adioryx vexillarius* which is common beneath boulders in rock pools and may also be found down to a depth of 20 m on the lower fore-reef terrace. Gibson (1969) also described a group of littoral fishes, the "seasonal visitors", which are represented only at specific times of the year, often associated with spawning migrations. Unfortunately, the brief period on Little Cayman did not permit a full examination of these species.

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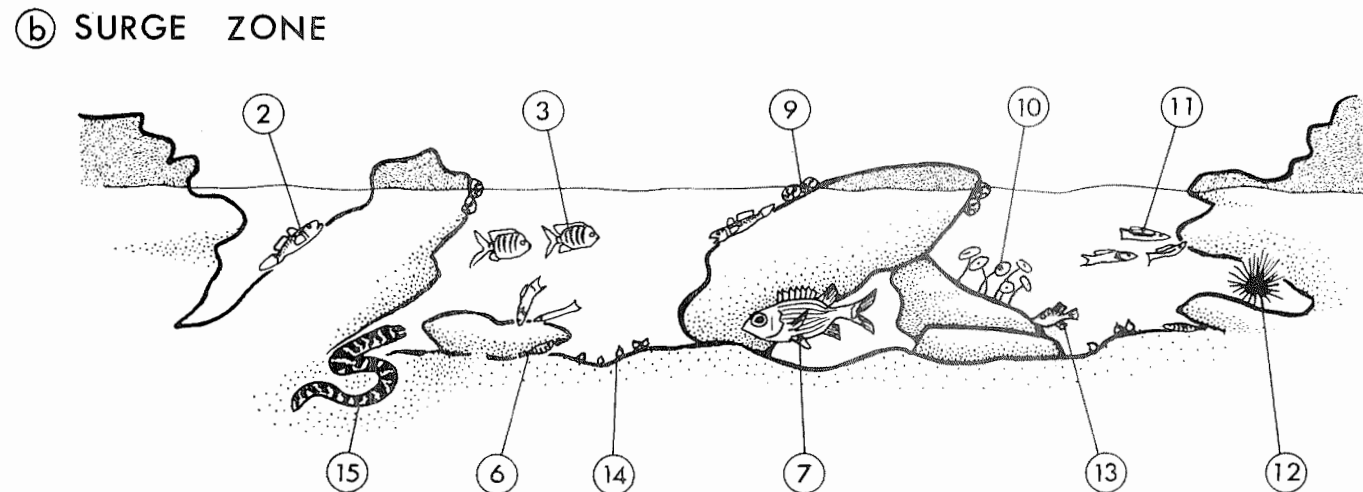
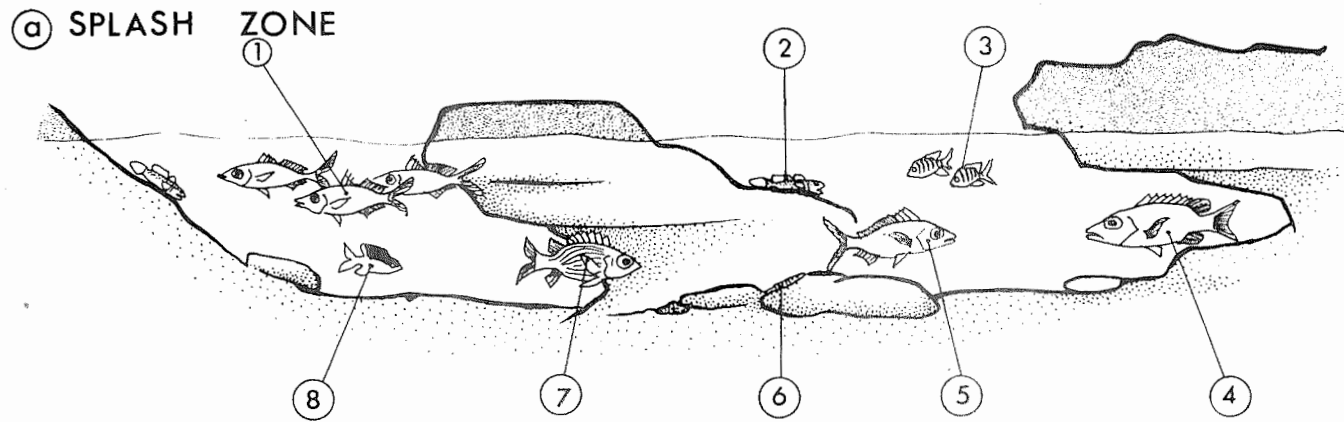


Figure 20. Diagram of (a) Splash Zone and (b) Surge Zone pools with their typical inhabitants: 1. *Eucinostomus argenteus*; 2. *Bathygobius soporator*; 3. *Abudefduf saxatilis*; 4. *Lutjanus apodus*; 5. *Gerres cinereus*; 6. *Tomicodon fasciatus*; 7. *Adioryx vexillarius*; 8. *Eupomacentrus leucostictus*; 9. *Puperita* pupa; 10. *Acetabularia sanctae-crucis*; 11. *Thalassoma bifasciatum*; 12. *Diadema antillarum*; 13. *Canthigaster rostrata*; 14. *Littorina mespillum*; 15. *Echidna catenata*