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Community organization of coral reef fishes in the rubble sub-habitat of Kavaratti Atoll, Lakshadweep, India

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Abstract

A visual census of the coral reef fishes, conducted during January 1991 to June 1992, indicated the occurrence of 64 species belonging to fifteen families in the rubble sub-habitat of Kavaratti Atoll (Lat. 10°33'N; Long. 72°38'E) in Lakshadweep. The community diversity for families and species was 2.68 and 3.58 respectively. Family assemblages were not stable during different seasons. Labridae and pomacentridae made use of the rubble zone efficiently. Pomacentrids were characteristically site attached but varied in relative abundance. *Rhinecanthus aculeatus* among balistids depended on rubble for food and nesting sites. The occurrence of chaetodontids was due to their flexible feeding habits, in the absence of coral cover. Availability of food strongly determined the distribution of the surgeonfish, *Acanthurus triostegus*. The abundant turf algae harbored by rubble attracted schools of sub-adult herbivores resulting in variations.

Key words: Kavaratti Atoll, Lakshadweep, coral reef fishes, diversity index

Introduction

Sedentary and non-migratory nature and association with specific habitats are striking characters of coral reef fishes. A variety of habitats found in coral reef areas may be rich or poor in species within the habitat or between habitats, supporting markedly different fish communities of which some may be cosmopolitan. Many workers at present are actively carrying out studies on the reef fishes in the tropical western Atlantic and Caribbean, the Gulf of California, several centres in the Indo-West Pacific, and in the Red Sea (Sale, 1980 a). In India, habitat distribution and species diversity of coral reef fishes in the reef slope of the Kavaratti Atoll in Lakshadweep has been reported recently by Vijay Anand and Pillai (2003). The present account is on the community organisation of coral reef fishes in the rubble sub-habitat of the above atoll.

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Material and methods

Fish species enumeration and their distribution in the sub-habitats of Kavaratti

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Atoll, were studied using the visual census technique reported earlier by Vijay Anand and Pillai (2003). Data collected from each census were grouped by species. These were transformed into a data matrix for the sub-habitat. Results obtained from the data matrix were used to study the community parameters and seasonal variation in community parameters. Results of all censuses were combined to obtain the following aspects: a) species composition of the particular region listed in the order of frequency of occurrence, b) frequency of occurrence, c) total abundance, d) percentage abundance and e) Shannon-Weiner diversity index (H^i).

Results of all censuses were treated separately and were grouped into three distinct seasons prevailing in Lakshadweep region, namely, pre-monsoon (January to April), monsoon (May to August) and post-monsoon (September to December). The following aspects were studied: a) total number of individuals, b) total number of species, c) Shannon-Weiner diversity index (H^i) (Shannon and Weiner, 1949) and d) Evenness index (J^i) (Pielou, 1966).

Results

Community parameters: Table 1 depicts community parameters of 46 species recorded from the habitat. Of the five acanthurids found on rubble, *Acanthurus triostegus* was dominant contributing to 4.4% with a diversity of 3.6, followed by *Acanthurus* spp. Other species, however, were rare. Balistids like *Rhinecanthus*

Table 1. *Frequency of occurrence (FO), total abundance (TA), percentage abundance (%) and diversity index (H^i) for each species recorded in the rubble sub-habitat of Kavaratti Atoll*

Species	FO	TA	%	H^i
ACANTHURIDAE				
Acanthurus triostegus	15	132	4.4	3.68
Acanthurus spp.	5	43	1.4	2.04
A. lineatus	3	10	0.3	1.48
Naso lituratus	2	2	0.2	0.92
N. unicornis	2	4	0.1	1.00
APOGONIDAE				
Apogon fraenatus	1	6	0.2	0.00
BALISTIDAE				
Rhinecanthus aculeatus	21	116	3.9	4.18
Melichthys indicus	5	13	0.4	2.16
Rhinecanthus rectangulus	5	12	0.4	2.19
CHAETODONTIDAE				
Chaetodon citrinellus	8	30	1.0	2.54
C. auriga	1	2	0.1	0.00
FISTULARIDAE				
Fistularia petimba	3	6	0.2	1.46
GOBIIDAE				
Gobids	9	111	3.7	3.11
HAEMULIDAE				
Plectorhinchus orientalis	3	3	0.1	0.92
LABRIDAE				
Halichoeres scapularis	24	384	12.9	4.45
Cheilinus trilobatus	6	16	0.5	2.48
H. centiquadrus	6	41	1.4	2.21
Labroides dimidiatus	5	17	0.6	2.11
Stethojulis albovittata	5	49	1.6	2.21
C. undulatus	4	10	0.3	1.84
Halichoeres nebulosus	4	37	1.2	1.95
Coris gaimard	2	3	0.1	0.92
H. marginatus	2	8	0.3	0.95
Hologymnosus doliatus	2	3	0.1	0.92
Thalassoma herbraicum	2	2	0.1	1.00
T. purpureum	2	2	0.1	1.00
Stethojulis strigiventer	1	4	0.1	0.00
MULLIDAE				
Parupeneus barberinus	10	66	2.2	3.19

P. bifasciatus	8	38	1.3	2.68
Mulloides flavolineatus	5	20	0.7	2.19
P. pleurostigma	3	8	0.3	1.30
MURAENIDAE				
Gymnothorax undulatus	8	11	0.4	2.82
NEMIPTERIDAE				
Scolopsis bilineatus	7	26	0.9	2.22
PLESIOPIDAE				
Plesiops coeruleolineatus	4	31	1.0	1.84
POMACENTRIDAE				
Pomacentrus trilineatus	24	202	6.8	4.38
Chrysiptera biocellata	22	305	10.2	4.09
P. pavo	19	285	9.6	4.12
P. sulfureus	19	117	3.9	4.09
Plectroglyphidodon phoenixensis	12	109	3.7	3.49
Stegastes nigricans	3	25	0.8	1.32
Pomacentrus spp.	2	15	0.5	0.99
Abudefduf sexlineatus	1	3	0.1	0.00
Dascyllus aruanus	1	4	0.1	0.00
Stegastes lividus	1	4	0.1	0.00
SCARIDAE				
Scarus spp.	8	620	20.8	2.72
SERRANIDAE				
Epinephelus spp.	3	19	0.6	1.40

aculeatus occurred commonly with a diversity of 4.18. Other two species were *Melichthys indicus* and *Rhinecanthus rectangulus*. Of the two chaetodontid species, *Chaetodon citrinellus* dominated followed by *C. auriga*. The gobiids were dominant on rubble. Among the 13 labrid species *Halichoeres scapularis* dominated followed by *Stethojulis albovittata, H. nebulosus, H. centiquadrus, Labroides dimidiatus* and *Cheilinus trilobatus*. Among goatfishes *Parupeneus barberinus* and *P. bifasciatus* were common. The former contributed to 2.2% of the fishes with a diversity of 3.2. Other species constituted less than 0.7%. *Gymnothorax undulatus, Scolopsis bilineatus* and *Plesiops coeruleolineatus* were the sole representatives of the families Muraenidae and Plesiopidae.

Among Pomacentrids *Chrysiptera biocellata, Pomacentrus pavo* and *P. trilineatus* were represented on rubble with high diversity index. *P. sulfureus* and *Plectroglyphidodon phoenixensis* were next in importance. Occurrence of *Stegastes nigricans, Abudefduf sexlineatus, Dascyllus aruanus* and *Stegastes lividus* were found to be low. *Scarus* spp. accounted for the highest abundance (20.8%). A single serranid, *Epinephelus* spp. recorded 19 counts.

Seasonal variation in community parameters

Variation in the total counts of fishes from the sub-habitat was lower (79 to 157) during pre-monsoon of '91 as compared to same period in '92. (Table 2). In the same year low counts were registered in February and April. A fluctuating pattern (53 to 161) was evident during post-monsoon. Total number of species generally varied between 9 and 12. Highest occurred during pre-monsoon of 1991. During monsoon, 9 to 12 species were regularly observed except in May and August where it was relatively high. Total number of species occurring in post-monsoon was stable except in November.

Species diversity in pre-monsoon ('91) was generally above 3.0 in all samples with January and March accounting for high diversity. In the pre-monsoon of '92, diversity values were generally low except in February and April where 3.15

Table 2. *Total number of individuals (I), number of species (S), diversity index (H^i) and evenness (J^i) for each census in different seasons on the rubble sub-habitat of Kavaratti Atoll*

	Pre-Monsoon 1991						
	Jan.	Feb.	Feb.	Mar.	Mar.	Apr.	Apr.
I	157	89	99	145	79	103	97
S	16	12	12	17	9	11	12
H^i	3.6	3.1	3.2	3.6	2.8	3.2	3.1
J^i	0.9	0.8	0.8	0.7	0.8	0.9	0.8
	Monsoon 1991						
	May	May	Jun.	Jul.	Aug.		
I	132	93	122	100	132		
S	14	12	11	9	13		
H^i	3.5	3.2	3.0	2.8	3.4		
J^i	0.9	0.9	0.8	0.9	0.9		
	Post- monsoon 1991						
	Sep.	Sep.	Oct.	Oct.	Nov.	Nov.	Dec.
I	121	80	141	53	57	78	161
S	12	12	10	10	9	13	9
H^i	3.1	3.1	1.7	3.0	2.8	3.3	1.9
J^i	0.8	0.8	0.5	0.9	0.8	0.9	0.6
	Pre-monsoon 1992						
	Jan.	Feb.	Mar.	Mar.	Apr.	Apr.	
I	160	77	167	39	166	66	
S	10	13	11	6	11	10	
H^i	2.1	3.1	2.1	2.1	2.1	3.0	
J^i	0.6	0.8	0.6	0.8	0.6	0.9	
	Monsoon 1992						
	May	Jun.					
I	177	87					
S	11	11					
H^i	2.2	3.2					
J^i	0.6	0.9					

and 3.08 were recorded respectively. The monsoon time also showed a relatively high diversity except in July 1991 and May '92. Variation in species diversity was high in the post-monsoon. Four samples accounted for diversities above 3.0.

During the pre-monsoon of '91, species distribution was relatively even and stable (0.85 to 0.93) compared to 1992. All samples taken during monsoon had even distribution except in May'92. Highest variation in species distribution was observed in post-monsoon. Samples in October and December accounted for low evenness, while the trend in other samples generally remained stable.

Discussion

Labridae and Pomacentridae were the most species rich families represented in the rubble zones. Among labrids, only *H.scapularis* represented the zone in good numbers regularly. As discussed earlier, adults of certain species (*Cheilinus trilobatus* and *C. undulatus*) observed in deeper waters might be temporary visitors of this zone. *C. trilobatus* and *H. centiquadrus* were considered as generalists (Galzin, 1987 a) but such a distributional pattern was not observed in the present study probably due to variations in ecological factors at a different geographic region. *Stethojulis albovittata* and *S. strigiventer* were occasionally recorded on rubble, as they preferred small invertebrates for food. The surge wrasse, *T. purpureum*, *T. herbraicum* and *Hologymnosus doliatus* were observed on the edge of the reef flat where turbulence is high and their occurrence on the rubble zone could be due to proximity of the two regions. The pomacentrids were characteristically site-attached but varied in relative abundance. *Dascyllus aruanus*, normally associated with ramose was found on rubble, while *Abudefduf sexlineatus* normally occurred in high patch reefs. Their presence on non-conventional habitats (rubble) could be due to chance colonization and not of systematic partitioning of living space (Sale and Dybdahl, 1975). Due to the cryptic nature of these species, certain element of bias during censuses could also alter the relative abundance. Constraints in sampling were also applicable to gobiids, apogonids, *Epinephelus* spp., *Plesiops coeruleolineatus* and *Gymnothorax undulatus* due to their hiding behaviour or in certain cases a nocturnal behaviour, but were found to be abundant otherwise. Randall (1983) found *Scolopsis bilineatus* common along the reef edge and seemed to prefer deeper waters and its presence on rubble zones at Kavaratti could be explained due to proximity of the two regions. *Parupeneus barberinus* weighed significantly in all censuses (H^{i} = 3.19); and it was found on rubble/sand by Grovhoug and Talbot (1976) and Randall (1983). According to Hobson (1974), certain species are nocturnal and this could affect censuses. *P. bifasciatus*, *P. plerurostigma* and *Mulloides flavolineatus* seem to prefer sandy regions and hence their low counts on rubble.

Among balistids, *R. aculeatus* depended on rubble for food and nesting sites (Hiatt and Strasburg, 1960; Grovhoug and Talbot, 1976). *Melichthys indicus* is non-typical of this zone but inhabits the adjacent reef slope. *R. rectangulus* showed similar preferences like that of *R. aculeatus* but does not forage far from nearby coral shelter and surge zone and thus the low counts on rubble. *Chaetodon citrinellus* is a non-coral feeder (Galzin, 1987b) while *C. auriga* feeds on polychaete tentacles or filamentous algae (Vijay Anand 1990). Their presence on rubble could be explained owing to a flexible feeding habit. The richness of Chaetodontid species was observed to increase with coral cover.

Only *Acanthurus triostegus* formed the bulk among acanthurids. According to Hiatt and Strasburg (1960), this species feeds on filamentous algae and was observed to be abundant in shallow rubble zones. Therefore, food strongly determined the distribution of this species. Compared to massive coral zones, rubble zones are shallow habitats and are close to the reef flat/reef slope. A low variation in the community parameters during monsoon is perhaps due to rough conditions. The very fact that it is storm cast rubble substantiates the fact. The unstable nature of this habitat strongly influenced seasonal fish assemblages. Lassig (1983) observed that a cyclonic storm caused high juvenile mortality and redistribution of sub-adult fishes while adult fishes remained unaffected. Walsh (1983) pronounced local change in habitat features. In the present study, as most of the species observed were small territorial pomacentrids, physical disturbance to the habitat would certainly have altered their assemblage structure, which in turn varied the counts. The larger species capable of migrating would have shifted to the reef slope area. A higher variation in community parameters during pre-monsoon and post-monsoon could be due to recolonisation of resident species and frequent visitors from the adjacent reef slope. Rubble harbored abundant turf algae, which attracted schools of sub-adult herbivores resulting in variations.

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