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Habitat distribution and species diversity of coral reef fishes in the reefslope of the Kavaratti atoll, Lakshadweep, India

P.E. Vijay Anand* and N.G.K. Pillai

Central Marine Fisheries Research Institute, Cochin-682 014, India

Abstract

Habitat distribution and species diversity of coral reef fishes in the reef slope of Kavaratti atoll was studied by the visual census method during January 1991 to June 1992. Twenty seven families represented by 121 species, the highest for any sub-habitat of the atoll were recorded. The community diversity, also the highest both for families and species was 3.32 and 4.45 respectively. Family assemblages were not stable between censuses and pre-monsoon, monsoon and post-monsoon seasons. Labridae, Chaetodontidae, Balistidae, Pomacentridae and Acanthuridae were the most specious families. Low abundance of coral feeders indicated unhealthy reef condition. While dominance of some surgeonfish indicated availability of algal food, balistids provided clues for topographic complexity.

Introduction

Discrete populations, small breeding pools, 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 in each habitat or between differing habitats, supporting markedly different fish communities of which some may be cosmopolitan. Dependence on a particular food item, behavioural interactions and depths across reefs are other factors known to limit reef fish distribution.

Although the interest in the ecology of reef fishes is relatively recent, it is developing rapidly, with many workers at present active in the tropical western Atlantic and Caribbean, the Gulf of California, several centres in the vast Indo-West Pacific and in the Red Sea (Sale, 1980). However, there is an overall paucity of knowledge on this subject from the Indian region, leaving gaps in the works or reviews of workers who attempted to summarize a global picture on reef fish community organization.

The present account is on coral reef fish community organization, numerical densities, species richness and species composition in the reef slope of Kavaratti atoll (Lat. 10°33′ N, Long. 72°38′E) in Lakshadweep.

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* Present address: Aquacare, Division of Tetragon Chemie Pvt. Ltd., IS-40, KHB Ind. Area, Yelahanka New Town, Bangalore-560 064.

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Material and methods

Fish species enumeration and their distribution in the sub-habitats at Kavaratti atoll were studied using the visual census technique (Sale, 1980).

Owing to limited facilities, a combination of/or modifications of existing methods have been used to suit the sub-habitats. Belt transects of 30 m length were used to record all visible fish species and numbers from 2 m on either sides of a prelaid line. Transect width was estimated visually. Due to shallow depth and absence of SCUBA facility, the fishes were observed using a mask and snorkel apparatus with three intervals to record the observations. The approximate area covered by a single census unit is 120 sq.m. for each sub-habitat. Censuses were conducted fortnightly for 18 months, for each subhabitat. The period of study was from January 1991 to June 1992.

Fish species from the outer reef slope were recorded using a 100 m belt transect running parallel to the reef crest, the total width of the transect being approximately 6 m visually estimated. Depths in the region varied between 4 to 6 m. The length of the transect was marked on the adjacent reef crest using two small anchored floats. A glass bottomed boat driven slowly along the transect (aligning with reef crest flags and floats in the water) by an assistant was used to record visible fish species continuously by the senior investigator. Use of glass bottomed boat permitted easy counting and rapid recording. Sampling in this region was avoided, during rough monsoon conditions, thus 22 censuses could be carried out from the reef slope.

The vagile species encountered in large schools were eliminated to avoid over emphasis of a particular group. While vagile species that occur singly were included, certain typical, reef associated species like caesionids, juvenile and subadult scarids, etc. which occur in schools were counted in 10's, 50's or 100's. In most cases, fish species were identified upto species level except those that were difficult to distinguish quickly underwater and such species were treated as single group.

To minimize the recognized tendency of census to underestimate the numbers of fish present, a combination of successive census results as recommended by Russell *et al.* (1978) has been used in the present investigation. Fish species counts that are likely to be influenced by environmental conditions, behavioural activities, secretive/cryptic nature were expected to be included in successive visual records. Further, several transient fishes which may not use a particular sub-habitat intensively are also likely to be included, resulting in building up lists of species (species composition) characteristic to the five sub-habitats and the reef slope.

Data collected from each census were grouped by species. These were transformed into a data matrix for respective sub-habitats and the reef slope. Results obtained from the data-matrix were used to study the following four aspects of the community organization of coral reef fishes on the five sub-habitats and reef slope.

Community parameters: Results of all census were combined to obtain the information mentioned below:

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') (Shannon and Weiner, 1949).

The evenness index of Pielou (1966) was used to determine equitability of distribution of species or number of families in each census in the three seasons in Lakshadweep and between the sub-habitats.

Results

Community parameters : Table 1 depicts the community parameters of 121 species recorded from this region. Of the 9 species of acanthurids recorded, *Acanthurus* spp. (411 nos.) formed 6.50% of fishes recorded with a diversity of 4.00. On 3 occasions a total of 76 apogonids were recorded. 11 species of balistids were found on the reef slope region. *Melichthys indicus* (168 nos). *Odonus niger* (131 nos) and *Rhinecanthus aculeatus* (72 nos.) commonly occurred 11 to 13 times. *M. indicus* showed a diversity of 4.52 while *O. niger* and *R. aculeatus* registered values of 3.34 and 3.27 respectively. Other species were rare in occurrence (1 to 7 times) accounting for percentages less than 1. Of these, *Balistapus undulatus* (22 nos.) and *Balistoides viridescens* (33 nos.) were relatively more in number.

A total of 159 casesionids and a single species of carangid, *Elagatis pinnulata* (6 nos.) were recorded 5 times. Chaetodontids (18 species) were found on the reef slope. In terms of numerical abundance, *Chaetodon collare* (148 nos). *Hemitaurichthys zoster* (134 nos.) and *Chaetodon auriga* (103 nos.) ranked relatively high and occurred 13.7 and 17 times with percentages of 2.34, 2.12 and 1.63 respectively. High diversities were recorded by *C. auriga* (3.78), *C. collare* (3.52) and *Forcipiger* spp. (3.02), though the latter recorded only 17 individuals occurring 10 times. Of the 24 species of labrids recorded, *Halichoeres scapularis* (299 nos.) was abundant occurring 17 times, forming 4.73% of fishes recorded with diversity of 3.55. Among the 6 mullid species, *Parupeneus barberinus* (101 nos.) and *P. bifasciatus* (80 nos.) were occurring relatively more.

10 species of pomacentrids were found. *Chrysipetra biocellata* occurred more frequently (11 times) followed by *Abudefduf sexfasciatus* (9 times) and *Chromis caerulea* (8 times) forming 3.97, 1.27 and 6.41% respectively. In terms of numerical density *C. caerulea* accounted for 405 individuals followed by 251 in *Chrysiptera biocellata*, 189 in *Dascyllus aruanus* and 112 in *D. reticulatus*. *Scarus* spp. contributed to the

Table 1. *Frequency of occurrence (FO), Total abundance (TA), Percentage abundance (%) and diversity index (H') for each fish species recorded on the reef slope.*

SPECIES	FO	TA	%	H'
ACANTHURIDAE				
Acanthurus spp.	19	411	6.50	4.00
A. leucosternon	17	299	4.73	3.55
A. lineatus	14	210	3.32	3.48
N. unicornis	13	163	2.58	3.35
Zebrasoma veliferum	8	21	0.33	2.41
N. lituratus	7	21	0.33	2.45
Acanthurus triostegus	6	28	0.44	1.99
Naso vlamingii	3	34	0.54	1.38
Naso brevirostris	2	19	0.30	0.63
APOGONIDAE				
Apogon spp.	3	76	1.20	1.26
BALISTIDAE				
Melichthys indicus	13	168	2.66	4.52
Odonus niger	11	131	2.07	3.34
Rhinecanthus aculeatus	11	72	1.14	3.27
Balistapus undulatus	7	22	0.35	2.69
Rhinecanthus rectangulus	5	10	0.16	2.11
Sufflamen bursa	5	12	0.19	2.25
Balistoides viridescens	4	33	0.52	1.43
B. conspiculum	4	4	0.06	2.00
Sufflamen fraenatus	4	9	0.14	1.75
Balistes ringens	3	6	0.09	1.59
Pseudobalistes flavimarginatus	1	1	0.02	0.00
CAESIONIDAE				
Caesio spp.	5	159	2.52	2.10
CARANGIDAE				
Elagatis pinnulata	5	6	0.09	2.25
CHAETODONTIDAE				
Chaetodon auriga	17	103	1.63	3.78
C. collare	13	148	2.34	3.52

SPECIES	FO	TA	%	H'
Forcipiger spp.	10	17	0.27	3.02
C. trifasciatus	8	25	0.40	2.84
C. marleyi	7	12	0.19	2.75
Hemitaurichthys zoster	7	134	2.12	2.64
C. trifascialis	6	14	0.22	2.47
C. xanthocephalus	6	24	0.38	2.24
C. falcula	5	9	0.14	2.19
Heniochus acuminatus	5	46	0.73	2.18
C. citrinellus	4	17	0.27	1.87
C. bennetti	3	10	0.16	0.72
C. vagabundus	3	5	0.08	1.52
C. plebeius	2	4	0.06	1.00
C. lunula	2	2	0.03	1.00
C. triangulum	2	4	0.06	0.00
Heniochus monoceros	2	6	0.09	0.92
C. melannotus	1	4	0.06	0.00
CIRRHITIDAE				
Paracirrhites forsteri	10	53	0.84	2.91
Cirrhitus pinnulatus	2	4	0.06	1.00
DIODONTIDAE				
Diodon hystrix	2	3	0.05	0.92
GRAMMISTIDAE				
Grammistes sexlineatus	6	9	0.14	2.27
HAEMULIDAE				
Plectorhinchus orientalis	9	14	0.22	3.03
P. gibbosus	5	83	1.31	2.24
HOLOCENTRIDAE				
Sargocentron spp.	4	14	0.22	1.84
Myripristis murdjan	3	11	0.17	1.32
M. adustus	2	5	0.08	0.97

SPECIES	FO	TA	%	H'
LABRIDAE				
Halichoeres scapularis	17	299	4.73	3.55
Thalassoma hardwicki	14	142	2.25	3.68
T. lunare	14	88	1.39	3.24
Halichoeres centriquadrus	11	162	2.56	3.32
Cheilinus undulatus	10	50	0.79	3.07
Gomphosus varius	7	24	0.38	2.60
G. coeruleus	6	14	0.22	2.35
Labroides dimidiatus	6	46	0.73	2.43
Thalassoma hebraicum	6	14	0.22	2.11
Cheilinus trilobatus	5	35	0.55	2.16
Coris gaimard	4	7	0.11	0.98
Halichoeres nebulosus	4	19	0.30	1.89
H. marginatus	4	17	0.27	1.78
Novaculichthys taeniourus	4	14	0.22	1.93
Bodianus axillaris	2	5	0.08	0.72
Hemigymnus fasciatus	2	3	0.05	0.92
H. doliatus	2	3	0.05	0.92
Labroides bicolor	2	3	0.05	0.92
Stethojulis albovittata	2	7	0.11	0.98
Anampses caeruleopunctatus	1	1	0.02	0.00
Cheilinus chlorurus	1	2	0.03	0.00
Coris formosa	1	4	0.06	1.20
Thalassoma amblycephalum	1	3	0.05	0.00
T. purpureum	1	2	0.03	1.00
LETHRINIDAE				
Monotaxis grandoculis	3	5	0.08	1.52
Gnathodentex aureolineatus	1	6	0.09	0.00
LOBOTIDAE				
Lobotes surinamensis	1	1	0.02	0.00
LUTJANIDAE				
Aprion virescens	2	3	0.05	0.92

SPECIES	FO	TA	%	H'
MALACANTHIDAE				
Malacanthus latovittatus	2	2	0.03	1.00
MONOCANTHIDAE				
Cantherines paradalis	3	7	0.11	1.72
Alutera scripta	1	1	0.02	0.00
MUGILOIDIDAE				
Parapercis hexophthalma	6	35	0.55	2.38
MULLIDAE				
Parupeneus barberinus	12	101	1.60	3.33
P. bifasciatus	11	80	1.27	3.31
Mulloides flavolineatus	4	33	0.52	1.95
P. macronema	4	20	0.32	1.61
P. pleurostigma	3	27	0.43	2.35
P. cyclostomus	2	6	0.09	0.92
MURAENIDAE				
Echidna zebra	2	2	0.03	1.00
Gymnothorax undulatus	1	1	0.02	0.00
Gymnothorax spp.	1	1	0.02	0.00
NEMIPTERIDAE				
Scolopsis bilineatus	2	8	0.13	1.00
Ostracion meleagris	4	6	0.09	1.79
Lactoria cornuta	3	8	0.13	1.50
PLATACIDAE				
Platax orbicularis	4	12	0.19	1.92
POMACANTHIDAE				
Pomacanthus imperator	4	7	0.11	2.24
Centropyge multispinis	2	8	0.13	0.81
Pomacanthus semicirculatus	1	4	0.06	0.00
Pygoplites diacanthus	1	1	0.02	0.00
POMACENTRIDAE				
Chrysiptera biocellata	*11*	*251*	*3.97*	*3.20*
Abudefduf sexfasciatus	9	80	1.27	3.03

SPECIES	FO	TA	%	H'
Chromis caerulea	8	405	6.41	2.87
Dascyllus aruanus	7	189	2.99	2.53
D. trimaculatus	5	33	0.52	2.06
Pomacentrus spp.	5	92	1.46	2.32
Dascyllus reticulatus	4	112	1.77	1.81
Amphiprion nigripes	2	10	0.16	0.72
Chromis dimidiata	1	4	0.06	0.00
Plectroglyphidodon phoenixensis	1	8	0.13	0.00
SCARIDAE				
Scarus spp.	15	525	8.31	3.30
SCORPAENIDAE				
Pterois miles	5	11	0.17	2.23
SERRANIDAE				
Epinephelus spp.	14	84	1.33	3.27
Cephalopholis argus	6	27	0.43	1.90
Anthias squamipinnis	3	250	3.96	1.52
Cephalopholis spp.	3	5	0.08	1.52
Variola louti	1	1	0.02	0.00
TETRAODONTIDAE				
Canthigaster margaritata	6	23	0.36	2.36
Tetraodon nigropunctatus	5	8	0.13	2.02
Canthigaster valentini	3	6	0.09	1.59
ZANCLIDAE				
Zanclus canescens	10	50	0.79	2.90

highest density (525 nos) of fishes recorded from the region contributing to 8.31% and a diversity of 3.30. *Pterois miles* occurred only 5 times. Of the five species of serranids recorded, *Epinephelus* spp. was frequent (14 times) while others occurred 3 to 6 times excepting *Variola louti* that was found only once. In terms of numerical density *Anthias sqamipinnis* (250 nos.) was abundant, followed by *Epinephelus* spp. (84 nos.).

Generally tetraodontidae were rare with only two species being recorded, *Canthigaster margaritata* accounted for 23 nos. A total of 50 individuals of *Zanclus canescens* were recorded on 10 samples.

Seasonal variation in community parameters: Highest total counts of fishes (411 nos.) were recorded in April 7 (1991) during pre-monsoon (Table 2 A). This was followed by 388, 371 and 341 individuals observed in January 1 and February 2 and 3 (Table 2 A). In March 3 ('92) a minimum of 169 individuals were recorded while February 2 (386 nos.) recorded a relatively high count (Table 2 D). During monsoon ('91) May 1 and 2 accounted for 340 and 304 counts respectively while August 3 recorded 251 counts. A low count was observed in May 1, '92 (Table 2 E). Total counts varied between 199 (October 3) and 387 (September 1) during post-monsoon.

Number of species recorded in pre-monsoon ('91) was generally stable between 35 and 45 species except in March 4 where it was 30. Variation was high (14 to 32 species) in '92. During monsoon, 39 species were recorded in May 2, while two other samples taken in the same season accounted for 31 and 32 respectively (Table 2 B). Least count (25 nos.) was in May, '92 (Table 2 E). Species number recorded in post-monsoon was generally low (21 to 27 nos.) except in October 4 where it was 31 species (Table 2 C).

Species diversity was generally between 4.28 and 4.61 in pre-monsoon ('91) except in April 7 which recorded 3.96 (Table 2 A). A majority of samples in the pre-monsoon of '92 has a species diversity between 3.72 and 3.77 (Table 2 B). The trend in post-monsoon was relatively low (3.09 to 3.94), but for a high value of 4.06 recorded in October 4 (Table 2 C).

Evenness of distribution of species during pre-monsoon of '91 was most even (0.93) in April (Table 2 A). An even distribution (0.77) was observed in April 7. A relatively uneven distribution (Table 2 D) was found in pre-monsoon of '92 (0.74 to 0.76). During monsoon ('91) a stable distribution (0.80 to 0.87) was observed, while a single sample taken in May ('92) was found to be even, accounting for a value of 0.92 (Table 2 E).

Discussion

Labridae, Chaetodontidae, Balistidae, Pomacentridae and Acanthuridae were the most specious families.

Among the labrids, five species, distinctly outweighed others (H' above 3.00), *Halichoeres scapularis, H. centriquadrus* and *Thalassoma hardwicki* were numerically dominant and this could be due to non-specificity of ecological niches required by them. Among the genus *Cheilinus, C. undulatus* was common. The rare occurrence of *Bodianus axillaris* could be related to their preference to greater depth regime and absence of relatively shallow reef slopes. A variety of other species inhabited the reef slop as the larger adults required greater depths and foraging area. The reef slope in this case has sufficient complexity and perhaps hoards abundant food resources.

H' values have separated *Chaetodon auriga* (H' = 3.78) and *C. collare* (H' = 3.52) as species that were regularly encountered on the reef slope. A comparable H' value of 3.02 in *Forcipiger* spp. could have resulted to dubbing of two species that were found to coexist in the reef slope of Kavaratti atoll (*Forcipiger longirostris* and *F. flavissimus*). Low occurrence of the obligate coral feeders, *Chaetodon trifasciatus, C. trifascialis, C.vagabundus* and *C. triangulum* could be related to the over all paucity of rich coral cover in the reef slope, while in contrast, facultative/non-coralline feeders dominated the zone, including *C. citrinellus*.

Greatest numbers of balistid species were found on the reef-slope as compared to other sub-habitats. Two important factors that probably determined this patterns were the behaviour of certain balistids which required deeper waters and topographic complexity of the reef slope. This is supported by a clear dominance of *Melichthys indicus* (H' = 4.52) and *Odonus niger* (H' = 3.34) and to an extent by *Balistapus undulatus, Balistoides conspiculum, Balistes ringens, Sufflamen bursa* and *S. fraenatus*. They seemed to prefer relatively greater depths.

The pomacentrid community was generally dominated by planktivores in contrast to that observed on rubble zones with carnivores/herbivores. Diurnal planktovores such as *Chromis caerulea, Dascyllus aruanus* and *D. reticulatus* concentrate along the reef edge and feed mainly on transient zooplankters from open waters. The

Table 2 *Total number of individuals (I) number of species (S) diversity index (H′) and evenness index (J′) for each of the census conducted during pre-monsoon and post-monsoon seasons on the reef slope (January 1991 to April 1992).*

REEF SLOPE

Sample No.		1	2	3	4	5	6	7
A. PRE-MONSOON 1991								
		Jan.	Feb.	Feb.	Mar.	Mar.	Apr.	Apr.
	I	388	371	341	228	237	253	414
	S	39	36	39	30	45	34	36
	H′	4.40	4.28	4.54	4.37	4.61	4.59	3.96
	J′	0.83	0.83	0.86	0.89	0.84	0.93	0.77
B. MONSOON								
		May	May	Aug.				
	I	340	304	251				
	S	31	39	32				
	H′	3.94	4.58	4.35				
	J′	0.80	0.87	0.87				
C. POST-MONSOON								
		Sep.	Sep.	Oct.	Oct.	Nov.	Dec.	
	I	387	270	199	260	307	219	
	S	29	27	24	31	21	24	
	H′	3.80	3.76	3.94	4.06	3.09	3.64	
	J′	0.78	0.79	0.86	0.82	0.70	0.79	
D. PRE-MONSOON 1992								
		Jan.	Feb.	Mar.	Apr.	Apr.		
	I	256	386	169	290	300		
	S	14	32	18	31	23		
	H′	2.86	4.11	3.72	3.75	3.77		
	J′	0.75	0.82	0.74	0.76	0.83		

dominance of *Chrysiptera biocellata* could be explained by their omnivorous feeding habit which permits non-localized distribution. Feeding adults of *Abudefduf sexfasciatus* occurred on reef tops with little surge.

Acanthurus spp. (H′ = 4.00) dominated the reef slope scenario. The species is possibly *A. dussumieri* but due to occurrence of similar species such as *A. mata*, it was considered only upto generic level. Conspicuous dominance of three other species (*A. leucosternon*, *A. lineatus* and *Naso unicornis*) is perhaps related to the presence of desired algal food on the reef slope or the nearby reef flat. Depth distribution of herbivores are ultimately constrained by their algal food supply which are light dependent organisms and, therefore, acanthurids predominate shallow habitats (Bouchon-Navaro and Harmelin-Vivien, 1981). *Acanthurus lineatus* is usually restricted to the flats and adjacent reef fronts and its occurrence on the reef slope is perhaps justified in the present study as it probably feeds on the reef flats where algal food was observed to be abundant. In the present study, *A. leucosternon* and *A. lineatus* co-occurred but the former was more abundant; this could be due to a greater feeding flexibility observed in *A. leucosternon*. Poor representation of *A. triostegus* implies its preference towards shallower lagoonal habitats.

As *Paracirrhites forsteri* was always found on *Acropora humilis* head, they perhaps are specific to the particular species of coral. Their greater representation could also be related to their preference of the surge zone. *Plectorhinchus orientalis* was represented regularly on the reef slope (H' = 3.03) but lower numerical status is due to solitary occurrence as compared to the schooling behaviour of *P. gibbosus*. However, Haemulidae had a poor representation in Lakshadweep. A variety of nocturnal species were perhaps not spotted or were underestimated in the present study. Such groups included apogonids, holocentrids and muraenids, which were found to be otherwise abundant in fish catches at night. Similarly, schooling lutjanids and some lethrinids, as mentioned earlier, were deleted to avoid overemphasis but these two groups were very dominant in all habitats, particularly on the reef slope. *Gnathodentex aureolineatus* seemed to prefer shallower habitats while *Monotaxis grandoculis* was solitary. Low numbers could be attributed to its nocturnal behaviour as observed by Hobson (1974). Hiatt and Strasburg (1960) observed *G. aurolineatus* among deep lagoonal reefs and surge zones and *M. grandoculis* around coral mounds.

Monocanthids had poor representation. Their presence could be due to certain species that fed on coral tips and coralline algae (Hiatt and Strasburg, 1960). A similar explanation also holds good for *Tetraodon nigropunctatus* (Tetraodontidae). Normally, reef slopes haboured few sand associated communities like mullids and mugiloidids. *Parupeneus barberinus* and *P. bifasciatus* consistently occurred among patch and pockets in protected areas. Randall (1983) observed certain mullid species to inhabit reef sand areas and Hobson (1974) stated that they had wide foraging ranges. Hiatt and Strasburg (1960) recorded *P. cyclostomus* as solitary individuals. Considering observations of certain authors, it is evident that mullids prefer a homogeneous, uninterrupted foraging expanse which the reef slope does not offer. This could also determine their assemblages.

Pomacanthids in general were rare except *Centropyge multispinis* that was abundant on lagoonal patch reefs, other species seemed to prefer deeper waters. Randlall and Hartman (1968) observed pomacanthids and chaetodontids to feed on sessile invertebrates like sponges and these were perhaps existing in good quantities on the reef slope. A similar reasoning holds good for *Zanclus canescens*. Hobson (1974) observed this to feed on sponges. Numerical dominance of *Anthias squamipinnis* is due to their schooling behaviour. Epinephelids were abundant where coral shelter was more while *Variola louti* and *Cephalopholis argus* were common on the reef slope. Possibly due to the occurrence of certain species of the genera *Cephalopholis* and *Variola* at greater depths (Randall and Brock, 1960), they were not encountered on the relatively shallow reef slope. A similar reason may hold good for scarids. Adult scarids were observed as solitary individuals on the reef slope in contrast to schooling sub-adults in the Pagoon. Choat (1993) found that depth distribution in scarids interacted with features of reef structure. Bouchon-Navaro and Harmelin-Vivien (1981) observed scarids to predominate deeper waters. Due to preference of deeper waters and solitary behaviour, only few scarids were recorded on the reef slope. Hiatt and Strasburg (1960) recorded *Canthigaster valentini* on shallow seaward reefs. In the present study, *C. valentini* was recorded only from the reef slope while *C. margaritata* was a generalist on all sheltered areas. Apart from what was obtained through visual censuses, many other rare species were observed or fished during the course of study. This species richness undoubtedly makes the reef slope and the adjacent physiographic zones on the windward reef, the zones with greatest fish species diversity.

This zone pictured a different trend with greatest seasonal variation during pre-monsoon. H′ and J′ values supported the patterns observed. As mentioned earlier, one reason could be due to new recruits while the other is perhaps due to certain spawning aggregations that might have been included in the censuses. Such aggregations were reported by Warner (1982) for wrasses, Colin and Chivijio (1978) for goatfish, Colin (1978) for parrotfish, and Colin (1982) for groupers and other reef fish in general. Monsoon data cannot be interpreted due to incomplete sampling during rough sea conditions. H′ for the few available samples was high, indicating a stable nature. The shallowest parts of the reef comprise stressful environment in which to live (Sheppard *et al*., 1992) and this could be pronounced during monsoons (on shallow sub-habitats) in Lakshadweep resulting in a habitat shift for larger fishes. Walsh (1983) observed the shallow reef flat devoid of fish, while deeper areas had more fish due to habitat shift that substantially reduced immediate impact of storms. Relatively lower community parameters during post-monsoon could be attributed to a reverse process which involves fish migrations to shallow habitat primarily for feeding.

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