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STUDIES ON *OCTOLASMIS* GRAY 1825 (CIRRIPEDIA : PEDUNCULATA) THE GILL INFESTING BARNACLES OF CRABS OF PORTO NOVO

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ABSTRACT

Of the four species of *Octolasmis*, *O. cor* occurred only in *Scylla serrata*. *Octolasmis stella* and *O. tridens* preferred invariably *Charybdis cruciata*, *C. natator* and *Podophthalmus vigil*. Medium and larger sized crabs harboured more number of epizoites except in few cases where the reverse was encountered. Moulting, growth and the subsequent increase in the size of the gill area of the hosts appear to influence the abundance of barnacles. No significance was observed between the variations in the numbers of epizoic barnacles and right and left side gills of the host crabs.

Ventral face of the gills were infested heavily with the epizoic barnacles than the dorsal, anterior and posterior faces. Gills 2-6 showed concentration of barnacles, particularly gills 3-5.

INTRODUCTION

EARLIER studies on gill-infesting cirripeds, generally dealt with their occurrence and systematics (Annandale, 1909 ; Nilsson-Cantell, 1938 ; Daniel, 1955 ; Newman, 1961 a, b). Information on their nature of settlement in relation to their hosts is scanty. The mode of distribution and specific orientation of the cirriped *Octolasmis stella* (Annandale) infesting the gills of the lobster *Puerulus sewelli* Ramadan, collected from the Kerala Coast (Dinamani and Kurian, 1961 ; Dinamani, 1964) and detailed studies on the relationship existing between *O. cor* and its specific host crab *Scylla serrata*, by Bullock (1964), Hashmi and Zaidi (1965), Arudpragasam (1967) and Venkateshwaran and Fernando (1982) respectively from the Malaysian, Pakistani, Sri Lankan and Indian waters are the only studies available from the Indian Ocean region.

MATERIAL AND METHODS

The present study conducted between January and December (1982) is based on samples of crabs obtained from Porto Novo waters.

For the analysis of barnacle distribution on the gills, the method described by Arudpragasam (1967) has been followed with minor modifications.

Each gill of both right and left sides was carefully examined for the presence of barnacles on its different faces (dorsal, ventral, anterior and posterior) and recorded as to the species and their relative numbers.

Analyses of variance were made to test the significant variations between right and left sides, and the size groups of each species of crabs.

Results

The number of barnacles (Table 1) in most of the crabs showed proportionate increase with increase in the size of the hosts except *P. sanquinolentus* and *C. natator* where the reverse was observed.

stically significant variation. The absence of significance of the numbers of barnacles in the other species of crabs indicated that the size of the hosts did not affect settlement. No marked difference in the barnacle numbers between the right and left sides was observed (Table 2).

Table 1. *Number of barnacles in relation to the size (in mm) of the individual crab species*

S. serrata					
Size of the crab	..	80-99	100-119	120-139	140
No. of barnacles	..	128	174	450	887
P. pelagicus					
Size of the crab	..	110-129	130-149	150	
No. of barnacles	..	39	17	218	
P. sanguinolentus					
Size of the crab	..	80-99	100-119	120-139	140
No. of barnacles	..	348	191	171	174
C. cruciata					
Size of the crab	..	70-89	90-109	110-129	
No. of barnacles	..	147	201	119	
C. natator					
Size of the crab	..	60-69	70-79	80-89	
No. of barnacles	..	141	94	123	
C. luctfera					
Size of the crab	..	70-89	90-109		
No. of barnacles	..	29	58		
P. vigil					
Size of the crab	..	60-79	80-99	100-129	
No. of barnacles	..	97	166	302	
G. bispinosa					
Size of the crab	..	50-59	60-69	70-79	
No. of barnacles	..	5	8	44	

The number of barnacles infesting the different size groups of each crab was tested for significance by ANOVA. The numbers of barnacles settling on the different size groups of the crabs *S. serrata* and *P. pelagicus* alone showed stati-

Maximum number of barnacles was observed on the ventral face (87.5 and 87.7% respectively on the right and left sides) followed by dorsal face (11.5 and 11.6%). Anterior face of the right (0.82%) and left (0.52%) and posterior

TABLE 2. *Number of barnacle species occurring on the gills of the right and left sides of host crabs*

Barnacle species	Host crab		Barnacle numbers		
			Right Gill	Left Gill	Grand Total
O. cor a		..	427	375	
O. cor b	S. *serrata*	..	558	511	
O. cor c		..	1162	1245	
	Total	..	2147	2131	4278
O. angulata	*P. pelagicus*	..	320	281	
	P. sanguinolentus	..	1085	1028	
	C. cruciata	..	248	199	
	C. natator	..	107	87	
	C. lucifera	..	87	77	
	P. vigil	..	420	471	
	G. bispinosa	..	33	41	
	Total	..	2300	2184	4484
O. stella	*P. pelagicus*	..	47	16	
	P. sanguinolentus	..	92	110	
	C. cruciata	..	99	78	
	C. natator	..	194	210	
	C. lucifera	..	1	1	
	P. vigil	..	233	213	
	G. bispinosa	..	0	0	
	Total	..	666	628	1294
O. tridens	*P. pelagicus*	..	0	0	
	P. sanguinolentus	..	13	11	
	C. cruciata	..	531	506	
	C. natator	..	13	9	
	C. lucifera	..	0	0	
	P. vigil	..	498	483	
	G. bispinosa	..	0	0	
	Total	..	1055	1009	2064

face of the right (0.4%) and left (0.13%) sides were infested with negligible numbers (Table 3).

The percentage of abundance from gill 1 to 8 in all the crabs together ranged between 3.5 and 20.81 on the right and 3.27 and 21.30 on the left and the maximum and minimum of total average numbers fell respectively on the 4th and 7th gills on either side. On the other hand, when individual species of barnacles were considered mostly all of them preferred the 5th gill on both the sides while *O. tridens* on the left and *O. cor* on both the sides recorded more numbers on 4th gill. On the posterior side, the 7th gill had more barnacles than the 8th. Progressive decrease in the total numbers of each barnacle species was observed on either side of the middle gills (4 and 5). In general barnacle abundance progressively decreased towards the anterior gills (5 to 8), while on the posterior gills (4 to 1) although the numbers progressively decreased upto the 7th, the 8th gill recorded slightly more barnacles than the later.

Discussion

Growth in crabs particularly in fast moving portunids, lead to larger branchial cavity and respiratory surface area in consequence to the increased metabolic activity (Williams and Needham, 1941 ; Gray, 1957). In the present study although a corresponding increase could naturally be expected in the number of barnacles settling on the increased gill area, only in five out of eight species of crabs such increase was observed. Presently, young crabs of *P. sanguinolentus* and *C. natator* and the medium sized crabs of *C. cruciata* hosted an appreciably large number of barnacles on their gills.

There appears to be no previous information regarding the relationship between the size of the crab and the number of barnacles except for the study of Walker (1974) who reported that older crabs of *Callinectes sapidus* were found to be heavily infested than the juveniles. This is in agreement with the present study where older crabs of *S. serrata*, *P. pelagicus*, *C. lucifera*, *P. vigil* and *G. bispinosa* had larger number of barnacles than the juveniles.

It is certainly possible for the barnacles to settle in young crabs, but as Lang (per. comm.) suggested the frequency of moulting in juvenile crabs being high and along with the exuvia the attached barnacles are also shed and the net effect will be a very low incidence in them. Deshmukh (1964) also observed that in west coast of India, young lobsters (*Panulirus polyphagus*) were free from any epizoite and suggested that this is obviously due to higher ecdysis frequency.

The greater number of barnacles observed in larger crabs may be due to increase in the available surface area of the gill. It may also be due to the fact that the intermoulting period being longer, the barnacles could possibly reach sexual maturity and propagate within this time. Conversely, the reason for the high numbers of barnacles in the juvenile crabs of *P. sanguinolentus* and *C. natator* observed in the present study could not be accounted for. Since a definite correlation exists between the size of the gill area, and the degree of activity and the habits of the crab concerned (Gray, 1957) further studies on these two crabs with reference to the gill area might throw light on the reason for the apparent abundance of barnacles in the young crabs.

Little information is available regarding settlement of barnacles in the right and the left gills of the crabs.

There were instances when barnacles were more either on the right or left gill or otherwise in almost equal numbers (Venkateshwaran and Fernando, 1982). The possible variations in numbers could only be attributed as a result of the response of both the epizoic and the host crab to the various environmental stimulii as well as the behaviour of the organisms

TABLE 3. *Number and percentage (in parenthesis) of each species of barnacle occurring on the different faces of the right and left gills of each crab*

Host	Barnacles	Right				Left			
		Dorsal	Ventral	Anterior	Posterior	Dorsal	Ventral	Anterior	Posterior
Scylla serrata	*O. cor. a*	0 (0)	426 (100)	1 (0)	0 (0)	0 (0)	375 (100)	0 (0)	0 (0)
	O. cor b ..	0 (0)	558 (100)	0 (0)	0 (0)	0 (0)	506 (99)	5 (1)	0 (0)
	O. cor c ..	343 (29)	773 (66)	39 (4)	7 (1)	361 (29)	851 (68)	25 (2)	8 (1)
Portunus pelagicus	*O. angulata* ..	75 (23)	243 (76)	2 (1)	0 (0)	54 (19)	227 (81)	0 (0)	0 (0)
	O. stella ..	6 (13)	38 (81)	1 (2)	2 (4)	1 (6)	15 (94)	0 (0)	0 (0)
	O. tridens ..	0	0	0	0	0	0	0	0
Portunus sanguinolentus	*O. angulata* ..	71 (7)	1013 (93)	1 (0)	0 (0)	87 (8)	941 (92)	0 (0)	0 (0)
	O. stella ..	3 (3)	89 (97)	0 (0)	0 (0)	1 (1)	109 (99)	0 (0)	0 (0)
	O. tridens ..	0 (0)	13 (100)	0 (0)	0 (0)	0 (0)	11 (100)	0 (0)	0 (0)
Charybdis cruciata	*O. angulata* ..	98 (40)	150 (60)	0 (0)	0 (0)	73 (37)	126 (63)	0 (0)	0 (0)
	O. stella ..	5 (5)	93 (94)	1 (1)	0 (0)	5 (7)	72 (92)	1 (1)	0 (0)
	O. tridens ..	12 (2)	516 (97)	3 (1)	0 (0)	3 (1)	503 (99)	0 (0)	0 (0)
Charybdis natator	*O. angulata* ..	5 (5)	102 (95)	0 (0)	0 (0)	5 (6)	82 (94)	0 (0)	0 (0)
	O. stella ..	9 (5)	185 (95)	0 (0)	0 (0)	6 (3)	204 (97)	0 (0)	0 (0)
	O. tridens ..	0 (0)	13 (100)	0 (0)	0 (0)	0 (0)	9 (100)	0 (0)	0 (0)
Charybdis lucifera	*O. angulata* ..	3 (3)	84 (97)	0 (0)	0 (0)	2 (3)	75 (97)	0 (0)	0 (0)
	O. stella ..	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)
	O. tridens ..	0	0	0	0	0	0	0	0
Podophthalmus vigil	*O. angulata* ..	68 (16)	349 (83)	3 (1)	0 (0)	80 (17)	391 (83)	0 (0)	0 (0)
	O. stella ..	9 (4)	224 (96)	0 (0)	0 (0)	11 (5)	202 (95)	0 (0)	0 (0)
	O. tridens ..	3 (1)	495 (99)	0 (0)	0 (0)	2 (0)	481 (100)	0 (0)	0 (0)
Galene bispinosa	*O. angulata* ..	1 (3)	32 (97)	0 (0)	0 (0)	2 (5)	39 (95)	0 (0)	0 (0)
	O. stella ..	0	0	0	0	0	0	0	0
	O. tridens ..	0	0	0	0	0	0	0	0
	Total ..	711 (11.52)	5397 (87.49)	51 (0.826)	9 (0.4)	693 (11.64)	5220 (87.7)	31 (0.52)	8 (0.13)

themselves. Other factors for the variations are parasitization, clogging of the gills and blocking of any one of the main inhalent opening, preventing the free entry of the cypris larva.

Presently, as that of the earlier studies (Jeffries *et al.*, 1982) various species of *Octolasmis* preferred to settle on the ventral faces of the gills of the respective host crabs.

The factors responsible for the barnacles to concentrate on the ventral faces of the gills were considered to be both ecological and biological, since the ventral face of the gill region is presumed to be ecologically favourable for they benefit much from the water current bringing the food.

Although, the ventral faces of the gills are the preferred sites of attachment for barnacles, few of the crabs such as *S. serrata*, *P. pelagicus*, *C. cruciata*, *P. vigil* were observed to habour (besides the ventral) considerable percentage of epizoic barnacles on their dorsal side of the gills in some instances.

Many crabs are known to resort to a periodic reversal of the respiratory current to clean the respiratory chamber of debris accumulated during the normal respiratory flow (Lockwood, 1968). It is possible that as the barnacle population on the ventral side of the gill increases and forms clusters, the cleaning appendages are unable to work effectively and debris accumulates. The host therefore reverses the respiratory current more frequently in order to remove the accumulated debris and in doing this could have taken more cyprids into the dorsal side of the branchial chamber.

Very little is known regarding the relative abundance of barnacles infesting the individual gill of the crabs, Bullock (1964), Hashmi and Zaidi (1965), Arudpragasam (1967) and Venkateshwaran and Fernando (1982) reported that the infestation of *O. cor* was heavy on gills 2-6 with maximum numbers either on the 4th or 5th gill of its host crab *S. serrata*. Walker (1974) observed a similar trend in *O. mulleri* of *C. sapidus* with maximum infestation on gill 6.

The concentration of barnacles on gills 2-6 obviously indicates that the settlement of the barnacles is not random, for it is in correspondence to the location of the middle gills that are washed by the full force of the strong respiratory current of the host (Arudpragasam and Naylor, 1964 ; Hughes *et al.*, 1969).

Lockwood (1968) generalised that in all the crabs 80% of the respiratory water enters through the Milne Edwards' opening and irrigates gills 1-6 (8 to 3 in the present study). The remaining gills are washed by a much smaller volume of mild current entering at the more posterior limb bases. Thus in the present study the highest concentration of barnacles in gills 4 and 5, and the lowest in gills 1, 7 and 8 are in correspondence respectively with the strong and mild currents of the host crabs.

The presence of more barnacles in gill 8 compared to gill 7 could be due to the fact that not only the former is larger than the latter, but it lies antero-posteriorly close to the bases of the gills 7-5. Thus it exposes itself to the favourably strong inhalent stream of the host crabs.

On the whole, it is evident from the present study that the barnacles infest the gills in response to the hosts respiratory current that aids in feeding and larval spawning.

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