

Seasonal variations in the distribution of pedunculate barnacle *Octolasmis* spp. on *Scylla serrata* (Forskal, 1775) from the Ayiramthengu mangroves, Kerala

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Present study is to understand the seasonal distribution and infestation rate of pedunculate barnacles *Octolasmis* spp., in *S. serrata*. Altogether 103 crabs were analysed and a total of 2070 barnacles were obtained from 87 infested crabs. Barnacle infestation was more prevalent on the gills and was found to differ significantly by season, size and sex. They are more abundant during the premonsoon months when salinity is higher in the estuarine waters. The mean intensity of infestation was less in monsoon compared to pre-monsoon and post-monsoon, which registered a very high incidence of 18.33 and 40.21 respectively. Larger crabs host more barnacles than younger ones. The less active, bottom seeking females are more vulnerable to the infestation and the barnacle load was higher in them. Barnacles cause respiratory obstruction in the host and heavy infestation leads to high mortality.

[Key words : Mud crab, *Scylla serrata*, barnacle, *Octolasmis* spp., Ayiramthengu mangrove]

Introduction

Mud crabs are the most valuable crab species in the world, with the bulk of their commercial production sent live to market¹. Both *Scylla serrata* and *Scylla tranquebarica* are valued for their delicious meat and export potential². Live crabs are mainly exported to the South-East Asian countries as they are highly palatable and having nutritive quality³. They are a very good alternative for shrimp in brackishwater aquaculture. Their culture in the coastal areas of India especially among the weaker sections of the society strengthens the production base of this species for export in live and value added products⁴. Several studies have been reported on their distribution from portunid crabs around the world⁵⁻⁹. Presence of large number of these barnacles in their gill chambers severely impair host respiration^{1,10} and heavy infestation leads to physiological stress and mortality¹¹. Rhizocephalan barnacles are reported to induce sterilisation in portunids and other brachyurans^{12,13} and thus have a detrimental impact on its production and fishery. Information on the relation between barnacle and host (prevalence, seasonality etc.) is therefore a prerequisite to any predictions on the effect on aquaculture yields and to counter measures against barnacle epibiosis that might be set to work. The present study was based on the seasonal variations in the infestation of *Octolasmis* spp. in

S.serrata collected from the Ayiramthengu mangrove region of the Kayamkulam estuary.

Material and Methods

Monthly samples of *S.serrata* were collected with the help of traps from the Ayiramthengu mangrove region of the Kayamkulam Lake, an estuarine system dotting the coast of Kerala (9° 09' - 9°15' N and 76° 02' - 76° 28' E), during 2010-2011 and were brought to the laboratory in live condition for analyzing the infestation of barnacles. Samples were taken at random. A total of 103 crabs were examined and their body dimensions including carapace width (C_W , greatest width between the epibranchial spines), total weight (W_T) and sex were assayed. The carapace was then cut opened using scissors. The dorsal and ventral body surfaces, wall of branchial chamber and gills in each chamber were carefully examined to record the attachment site of the barnacles when present^{14,15}. Only barnacles settled in the inner wall of the gill chamber and gill surfaces were included in the study. The exact site of barnacle attachment with respect to gill chamber, inside (hypobranchial) or outside (epibranchial) gill surface, proximal or distal gill region were recorded¹⁰. Hand lenses and dissecting microscopes were used for this. Barnacles present on the gills and adjacent areas were removed and preserved in alcohol, separately for making the

identification easier. Then, prevalence (number of hosts infested with the epizoid barnacle/number of hosts examined, expressed as a percentage) and mean intensity (total number of barnacles in a sample/total number of infested hosts) were also calculated⁹. Interaction amongst the variables a) season b) sex c) maturity and d) frequency of infestation were examined.

Physicochemical parameters such as salinity(ppt.), temperature(°C), pH and dissolved oxygen(mg.L⁻¹) of the two selected locations of the lake (site I – freshwater area, site II – estuary) were measured using standard procedures¹⁶. Seasons were divided into pre-monsoon (PRM, February to May), monsoon (MS, June to September) and post-monsoon (PTM, October to January). Rate of infestation during different seasons were analysed and compared with the physicochemical parameters prevailing at that time.

Results

A total of 103 crabs (size range: 6.4-13.4cm) were examined, of which 49 were males and 54 were females. Their C_W and W_T ranges 6.5 cm - 13.4 cm and 58g - 590g respectively (Table 1). Among them 87 crabs (46% males and 54% females) were found to

bear pedunculate barnacles of *Octolasmis* spp. in the branchial chamber. They were frequently found attached on the gills (Fig. 1a,b). Crabs exhibited an overall prevalence of 84.5% during the study period and mean intensity of infestation was 23.8. Prevalence of infestation varied significantly with season, size and sex.

Even though infestation was found in all months, two distinct period of occurrence were discernible. The percentage of infestation showed a gradual decrease from pre-monsoon to monsoon (Fig.2) in correlation with the salinity of the lake. Seasonal variations in physico-chemical parameters of the lake were recorded in table 2. It shows a remarkable variation in salinity, temperature, pH and Dissolved Oxygen (DO) of the two sites during different seasons. Salinity and temperature were low during monsoon. There was a marked reduction in the barnacle distribution during this time. The mean intensity of infestation during monsoon, was much less (7.11) when compared to pre-monsoon and post-monsoon, which registered a very high incidence of 18.33 and 40.21 respectively.

In the collected samples, even though *Octolasmis* spp. was attached on the gills and anterior wall of the

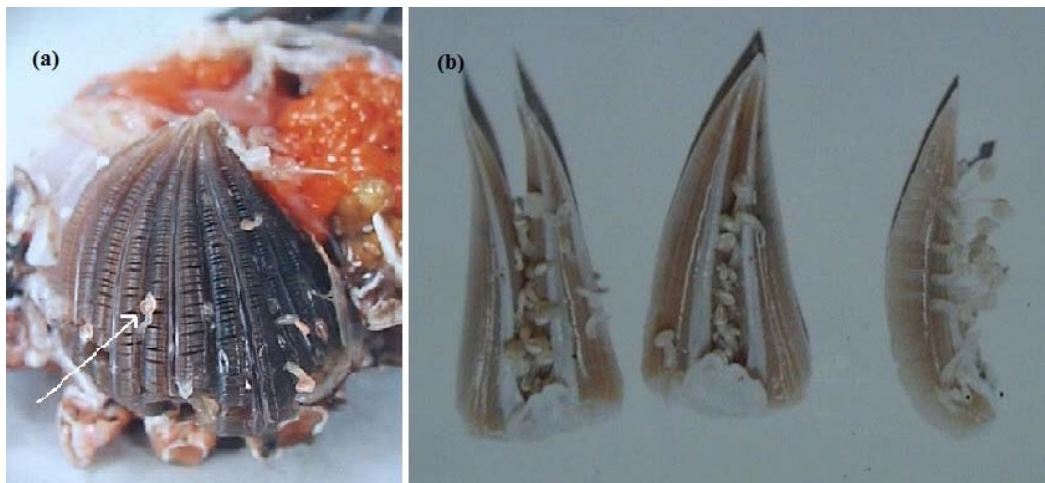


Fig. 1 — Infestation of *Octolasmis* spp. on the (a) epibranchial and (b) hypobranchial surface of gills in *Scylla serrata*

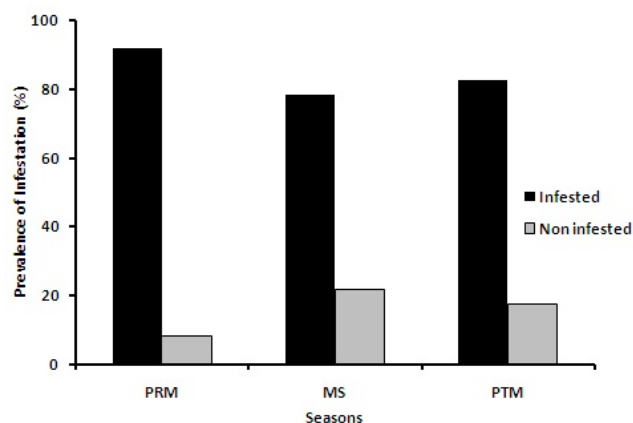
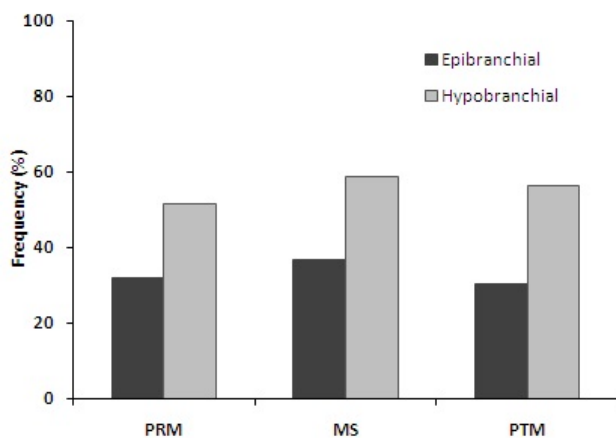
Table 1 — Details of *Scylla serrata* and associated barnacles studied during different seasons

Season	N*	Male: Female	Details of host crab				Number of barnacles		
			CW (cm)		W _T (g)		n*	Range	Mean±SD
			Range	Mean±SD	Range	Mean±SD			
PRM	37	18:19	7.0-13.4	9.14±1.37	58.0-590.0	139.14±99.35	1367	1-200	36.95±49.44
MS	37	17:20	7.0-12.7	9.14±1.36	50.0-250.0	117.28±48.12	263	1-36	7.11±9.02
PTM	29	14:15	6.5-10.7	8.52±1.06	60.0-210.0	101.49±36.71	440	1-74	15.17±20.26

*N: total number of crabs; n: total number of barnacles

Table. 2 — Hydrography of the study area

Parameters	Site I			Site II		
	PRM	MS	PTM	PRM	MS	PTM
Water Temperature (°C)	30	26	28	32	28	30
Water pH	8	7.8	7.2	5.3	9	8
DO (mg.L ⁻¹)	3.2	4	3.5	6	7	6.8
Salinity (ppt)	2.8	1.2	2.2	30	12.8	18.5

Fig. 2 — Seasonal variation in the distribution of octolasmis spp. in *Scylla serrata* (N=103)Fig. 3 — Distribution of barnacles (n=2070) in the gills of *S.serrata*

branchial chambers, their number was more on the hypobranchial surface of the gills rather than the epibranchial (Fig. 3). Only 11% were found in the branchial chambers. The proximal surface of the gills displayed higher prevalence of *Octolasmis*. A total of 2070 *Octolasmis* were found inside the branchial chambers of the sampled crabs. Heavily infested crabs contain barnacles of different size groups. Maximum number of *Octolasmis* found in the gill chamber of a single crab was 200.

There was a positive correlation between prevalence and C_w . High prevalence and mean intensity of infestation observed with host size in the range 8.5 - 10.5cm carapace width (Fig.4a). Infestation was comparatively higher in larger size groups where as in the younger ones it was negligible. Intensity of infestation in larger crabs of size between 12-14cm were only few in number and 50% of them were collected in monsoon. No relationship was observed between body weight and prevalence (Fig.4b). Barnacles obtained during June- July were mostly juveniles. Two molted female crabs (8.5cm and 13.4cm) harbors barnacles (n= 7 and 70 respectively) of size less than 2mm. Intensity of infestation shows a remarkable variation in the two sexes during different seasons (Fig. 5, Table 3). Females sampled in pre-monsoon displayed significantly higher infestation rate (95%) compared to male (89%). Mean intensity of infestation was also higher in females (29.1) than males (17.6).

Discussion

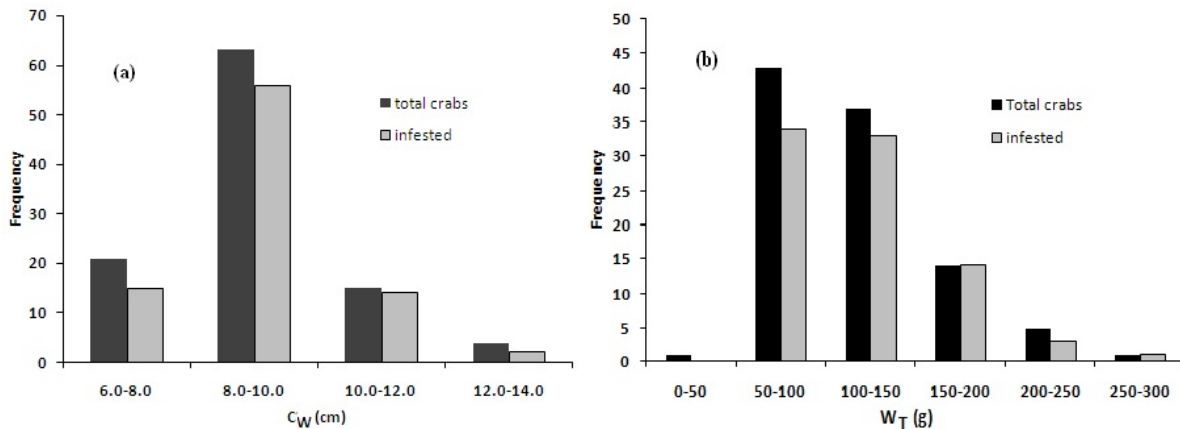
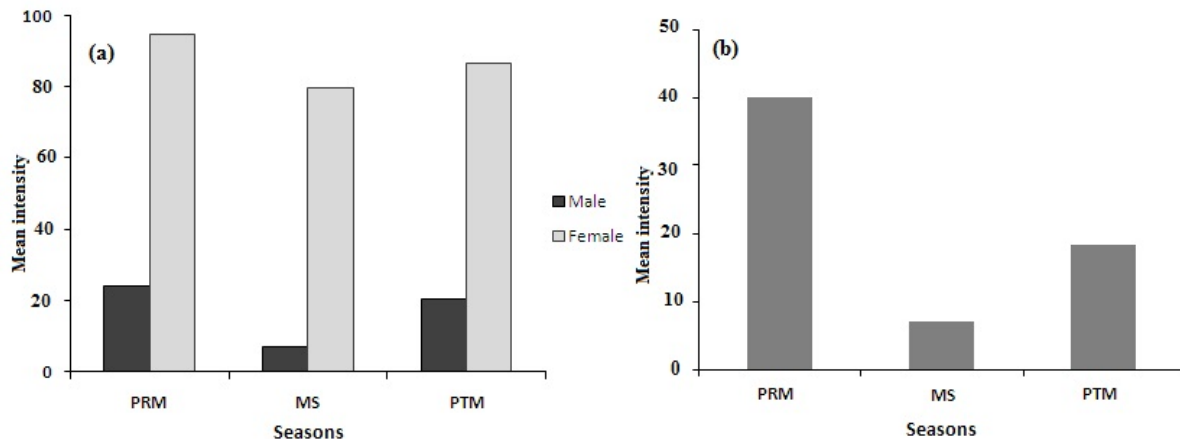
Earlier studies on these epibionts on *S.serrata* generally deals with their association, occurrence and systematics^{17,18}. Salinity, temperature, suspended matter and the amount of pollutants affect the distribution and abundance of these organisms at a particular locality¹⁹. In addition, host factors like moult stage, size and maturity status contribute significantly to their infestation dynamics²⁰.

Their distribution pattern varied significantly during different months and different exposure periods. Infestation in all months reveals the nature of the species. The increased intensity during December - May can well be related to the environmental factors mainly salinity and temperature, which would be normally high during pre-monsoon months. Salinity act as a master factor in the settlement and successful survival of the barnacles. The high prevalence of infestation noticed in the present investigation suggests the greater susceptibility of the host during this period. Similar to the present observation several marine parasites and symbionts are limited by low salinities^{14,21} and low temperatures¹². Seasonal analysis helps to evaluate the interaction between host and epibionts²². Many barnacles are killed and sloughed off due to the low salinity prevailing at that time²³. The surface salinity and temperature of the Kayamkulam lake was reported to vary from 3.22 ppt to 35ppt and 28°C to 35°C respectively²⁴. Regular freshwater treatment in the aquaculture system assists

Table. 3 — Seasonal variations in prevalence and mean intensity of infestation by *Octolasmis* spp. in *Scylla serrata*

Season	Male				Female			
	N*	n*	Prevalence (%)	Mean intensity	N*	n*	Prevalence (%)	Mean intensity
PRM	16	386	88.89	24.13	18	981	94.74	54.50
MS	13	92	76.47	7.07	16	171	80.00	10.69
PTM	11	225	78.57	20.45	13	215	86.67	16.54

N*: Total number of infested crabs; *n: No. of barnacles


 Fig. 4 — Infestation in different size groups of *S. serrata* (a) in relation to length and (b) body weight (N=103)

 Fig. 5 — Seasonal variation in the mean intensity of infestation (a) on male and female *S. serrata* and (b) on total crabs

in the eradication of barnacles without deleterious effect on the crabs. The cypris larvae cannot survive or grow below certain salinity.

Barnacles of *Octolasmis* spp. are frequently found attached to the gills of *S. serrata*. Three species of these sessile barnacles viz., *Octolasmis angulata*, *O. lowei* and *O. cor* were reported from the gills of *S. serrata*^{17,25-27}. Infestation by more than one barnacle per gill was common among adult crabs and they are lost at each time the host moults. They were found more on the hypobranchial side than the gill surface⁹ and diminishes the area available for gas exchange

and take advantage of the respiratory currents to bring in planktonic food. The broader lateral margin of the gill offers sufficient space for cementing its peduncle. The intensity of infestation increased with crab's size^{17,28} and immature crabs are unsuitable host for barnacles due to their short intermoult period. More number of epizoic barnacles in the adult crabs are attributed to correspondingly larger gill area and longer inter molting period²⁶. It get attached to the host, metamorphosed, and then grows into the filter feeding adult. This is due to the facilitated nutrient acquisition and the protection provided by the

branchial chamber of the host crabs²². Hurley²⁹ reported that the barnacles, that colonise an unstable habitat reach early maturity than that of the same species occupying a stable habitat. In *S.serrata* individuals having less than 12 instars were unsuitable hosts for *Octolasmis* because the short inter-moult period does not allow barnacle reproduction. The epibionts are not able to settle and develop quickly enough to complete their life cycle on juvenile crabs³⁰. Significantly higher abundance of juvenile barnacles attached to the gills during June – July months indicated either the crab is a post moult one or the low saline environment affects the growth of the barnacle.

The mud crabs are commonly found buried in mud and feeds mainly on detritus, molluscs and worms. The reason for higher prevalence of these barnacles in female population might be due to the availability of more number of females in the environment and it also suggests the susceptibility of the females to infestation. Berried females become inactive and dwelling at the bottom for longer time than males. *Octolasmis* species is a continuous breeder and the cypris larvae easily enter in to the branchial chamber of the inactive female crabs than that of males. In some species of crabs the female usually migrates to high saline off-shore regions where she releases her eggs and larvae³¹ and the larvae become infested with epizoids.

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References

- Shelley, C. & Lovatelli, A., Mud crab aquaculture- A practical manual. FAO Fisheries and aquaculture technical paper-567. FAO Rome (2011) 78pp.
- Kathirvel, M., Srinivasagam, S. & Kulasekharapandian, S., Mud crab hatchery seed production: Recent Advances, *Fish. Chim.*, 19(2000) 83-93.
- Babu, D.E., Rao, K.R., Raju, D.V.S.N., Kumar, B.J. & Raju, M.R., Mud crab hatchery technology: Outlines, *Fish. Chim.*, 19(2000) 109-111.
- Sathiadhas, R. & Najmudeen, T.M., Economic evaluation of mud crab farming under different production systems in India, *Aquacult. Econ. Manage.*, 8(2004) 99-110. doi:10.1080/13657300409380355
- Gannon, A.T., Distribution of *Octolasmis mulleri*, an ectocommensal gill barnacle on the blue crab, *Bull.Mar.Sci.*, 46(1990):55-61.
- Walker, G., Some observations on the epizoid barnacle *Octolasmis angulata* within the branchial chambers of an Australian swimming crab, *J. Crust.Biol.*, 21(2001) 450-455.
- Shields, J.D. & Overstreet, R.M., Diseases, parasites and other symbionts, in: *The Blue Crab, Callinectes sapidus*, edited by V. S. Kennedy and L.E. Cronin. (Maryland Sea Grant College. University of Maryland, College Park, Maryland, U.S.A) 2003.
- Mantelatto, F.L., O'Brien, J.J. & Biagi, R., Parasites and Symbionts of Crabs from Ubatuba Bay, Sa˜o Paulo State, Brazil, *Comp. Parasitol.*, 70(2003) 211-214.
- Yan, Y., Huang, L. & Miao, S., Occurrence of the epizoid *Octolasmis angulata* on the crab *Charybdis feriatus* from Daya bay, *J Mar. Biol. Assoc.UK.*, 84 (2004) 619-620.
- Jeffries, W.B. & Voris, H.K., The distribution, size and reproduction of the pedunculate barnacle *Octolasmis mulleri*(Coker 1902) on the blue crab *Callinectes sapidus* (Rathbun 1896), *Fieldiana Zool.*, 16(1983) 1-10.
- Gaddes, S.W. & Sumpton, W.D., Distribution of barnacle epizoids of the crab *Portunus pelagicus* in the Moreton bay region, eastern Australia, *Mar. Freshwater Res.*, 55(2004) 241-248
- Shields, J.D. & Wood F.E., Impact of parasites on the reproduction and fecundity of the blue sand crab *Portunus pelagicus* from Moreton Bay, Australia, *Mar. Biol. Prog. Ser.*, 92 (1993) 159-170.
- O'Brien, J.J., Parasites and reproduction, in: *Encyclopedia of Reproduction*, edited by J. Pearse. Vol. 3. (Academic Press, San Diego, California) 1999, pp. 638-646.
- Walker, G., The occurrence, distribution and attachment of the pedunculate barnacle *Octolasmis mulleri* (Coker) on the gills of crabs, particularly the blue crab, *Callinectes sapidus* Rathbun, *Biol. Bull.*, 147 (1974) 678-689.
- Jeffries, W.B., Voris, H.K. & Yang, C.M., Diversity and distribution of the pedunculate barnacle *Octolasmis* in the seas adjacent to Singapore, *J. Crust.Biol.*, 2(1982) 562-569.
- APHA, Standard methods for examination of water and waste water, edited by A.D.Eaton, L.S.Clescenri, A.E.Greenberg. (American Public Health Association, Washington DC, USA) 1995.
- Jeffries, W.B., Voris, H.K. & Poovachiranon, S., Age of the Mangrove Crab *Scylla serrata* at colonization by Stalked Barnacles of the Genus *Octolasmis*, *Biol. Bull.*, 182(1992) 188-194.
- Voris, H.K., Jeffries, W.B. & Poovachiranon S., Size and location relationships of stalked barnacles of the genus *Octolasmis* on the mangrove crab *Scylla serrata*, *J. Crust.Biol.*, 20(2000) 483-494.
- Crisp, D.J. & Southward, A.J., The distribution of intertidal organisms along the coast of the English Channel, *J Mar. Biol. Assoc.UK.*, 37(1958)157-208.
- Shields, J.D., Parasites and symbionts of the crab *Portunus pelagicus* from Moreton Bay, eastern Australia, *J. Crust.Biol.*, 12(1992) 94-100.
- Tindle, S., Boone, E., O'Brien, J. & Boettcher, A., Effects of salinity on larval stages of the rhizocephalan barnacle *Loxothylacus texanus*: survival and metamorphosis in response to the host, *Callinectes sapidus*, *J. Exp.Mar.Biol.Ecol.*, 302(2004) 165-176.

- 22 Costa, T.M., Christofolletti, R.A. & Pinheiro, M.A.A., Epibionts on *Arenaeus cribrarius* (Brachyura:Portunidae) from Brazil, *Zoologia*, 3(2010):387-394. doi:10.1590/S1984-4670201000030010
- 23 Meenakumari, B., Ecology of Indian barnacles, in: *Barnacles, the biofoulers*, edited by M.F.Thompson and R. Nagabhushanam. (Regency Publications, New Delhi) 1992, pp.1-20.
- 24 Natarajan, P. & Aziz, P.K.A., Studies on the impact of the Kayamkulam Super thermal Power Project on the Kayamkulam kayal and adjacent area with special reference to living resources and their thermal endurance in ecosystem—Project Report. (Department of Aquatic Biology and Fisheries, University of Kerala. Thiruvananthapuram, India) 1992, 61pp
- 25 Venkateswaran, K. & Fernando, A.S., Distribution and variation in form of the epizoic cirriped, *Octolasmis cor* (Aurivillius, 1983), *Indian J. Mar.Sci.*, 11(1982) 243-246.
- 26 Sudhakaran, E., Studies on *Octolasmis* Gray, 1985 (Cirripedia: Pedunculata) The gill infesting barnacles of edible crabs of Porto Novo. M.Phil Thesis, (Annamalai University, Tamil Nadu. India) 1983, 50 pp.
- 27 Kumaravel, K., Ravichandran, S. & Rameshkumar, G., Distribution of barnacle octolasmis on the gill region of some edible crabs, *Academic Journal of Entomology*, 2(2009) 36-39.
- 28 Santos, C. & Bueno, S.L.S., Infestation by *Octolasmis lowei* (Cirripedia: Poecilasmatidae) in *Callinectes danae* and *Callinectes ornatus* (Decapoda: Portunidae) from Sao Sebastiao, *J. Crust.Biol.*, 22(2002) 241–248.
- 29 Hurley, A.C., Fecundity of the acorn barnacle *Balanus pacificus* Pilsbury: A fugitive species, *Limnol.Oceanogr.*, 18(1973):386-393.
- 30 Abello', P., Villanueva, R. & Gili JM., Epibiosis in deep sea crab populations as indicator of biological and behavioral characteristics of the host, *J Mar. Biol. Assoc.UK.*, 70 (1990):687–695.
- 31 Overstreet, R.M., Metazoan symbionts of crustaceans, in: *The Biology of Crustacea*, edited by A.J. Provenzano, Jr., Vol. 6, (Academic Press, Inc. New York) 1983, pp155-250.