

GRAZING INTERACTION BETWEEN SOME SELECTED GASTROPODS AND SEAWEEDS AT ALIBAG AND SRIVARDHAN COAST, MAHARASHTRA

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ABSTRACT : Grazing interaction between gastropods and seaweeds eventually form a key component of intensified grazing ecosystem in rocky intertidal area. Grazing gastropods suppresses the abundance of canopy forming algal species, thus lead to a reduced algal diversity in the long term. We conducted feeding trials with single and mixed diet during a 28-Days indoor experiment to examine the grazing intensity among green, red and brown algae namely *Ulva lactuta*, *Enteromorpha flexuosa* and *Sargassum cinerium* following a comparative analysis of gut content of both *Euchelus* sp. and *Nerita* sp. show the occurrence of semidigested seaweed diet in their gut. About 70% of *Euchelus* sp. consumes *Enteromorpha* sp. 40% feeds on *Ulva* and 20% on *Sargassum* sp. whereas about 13% *Nerita* sp. consumes *Ulva* sp. and *Enteromorpha* sp. equally during the study period. Maximum numbers of *Euchelus* sp. are recorded with semidigested seaweed feed in gut compared to *Nerita* sp. Nonselective feeding habit of *Euchelus* sp. may pose a threat to nature in terms of reduction of biodiversity and ecological balance. This pioneer work on intertidal grazing relationship in India may help in deciding the feeding strategy in molluscan culture and taking some preventive measure in seaweed culture.

Key words : Grazer, Gastropods, seaweed.

INTRODUCTION

Indian coast harbours around 844 seaweeds species belonging to Chlorophyta, Phaeophyta and Rhodophyta, out of them nearly 60 species are commercially important and can be utilized as raw material for agar, algin and carrageenan and for food, manure and pharmaceuticals (Oza and Zaidi, 2000). Seaweeds have been used since ancient times as food, fodder, fertilizer and as a source of medicine. About 8 million tons wet seaweed are harvested annually worldwide and drifted seaweed on the beach constitute a considerable part of it (McHugh, 2003). India presently harvests only about 2,60,876 tonnes of seaweed annually compared to a potential harvest of 870,000 tonnes, a mere 29.9%.

Being the primary producers in the intertidal areas, it is grazed by several marine fauna; particularly molluscs and crustaceans. Grazers have been shown to contribute to the reduction of seaweed succession and abundance. Seaweed morphology and structure are directly affected by grazer community. The filamentous seaweed seldom has grazers while fleshy thalli showed diversified faunal species grazing upon them.

In view of the importance of the relation between the grazer community, seaweed biomass and its ecological balance, it is necessary to understand the grazing benthic community structure and its possible effect on the other community. Hence, the present investigation has been conducted to examine the Effect of grazing on the seaweed community-diversity and biomass.

MATERIALS AND METHODS

Monthly water samples, seaweed and grazers were collected for seven months (October 2014 - April 2015) from nine stations each from Srivardhan and Alibaug beach. However, the samples could not be collected in the month of February. Common grazers namely *Nerita oryzarum* (Recluz) and *Euchelus tricarinata* were chosen to conduct laboratory measurement of rates of grazing and seaweed consumption in single diet and choice experiment. Feeding experiments was conducted using *Ulva lactuta*, *Enteromorpha flexuosa* and *Sargassum cinerium* which are occurred in abundance in the intertidal zone along Shrivardhan and Alibaug coast. The fauna were collected from Shrivardhan as well as Alibaug coast.

The animal were starved and acclimated for 24 h in filtered seawater at temperature 25°C and at 30-32‰ salinity. These conditions were similar for both the experiment during which time the invertebrates and seaweed were collected. The experimental organisms and seaweed were collected from sampling sites (Shrivardhan and Alibaug), due to abundance of their biomass in the intertidal zone. A group of 10 organisms (consisting 5 *Nerita* and 5 *Euchelus*) was placed in the plastic tub filled with 10-liter filtered seawater. Four sets of experiments were set for both the species; one with *Ulva* sp. as feed, second with *Enteromorpha* sp. and the third with *Sargassum* as feed. The fourth; choice experiment was with all three seaweed together in one tub where same number of both the organism varieties were maintained. Controlled treatments lacked Seaweed. Rate of grazing in 7-days interval were calculated by loss of seaweed fresh weight in plastic tubs compared to control treatment. Within each treatment weight of the Seaweed and animal (fresh weight and dry weight) were taken. Gastropods were dissected after 24h interval of grazing to examine the gut content.

The experimental organisms (*Euchelus tricarinata* and *Nerita oryzaarum*) were dissected in laboratory and their gut content had been examined for the availability of seaweed fragments using stereoscope and compound microscope (Hund, Germany) and images were taken using digital camera. The analysis was carried out using Excel 2010.

RESULTS AND DISCUSSION

Grazing experiment

Feeding experiment was conducted for 28-days to estimate the feeding preference of the experimental grazers, loss of individual seaweed weight was noted down with an interval of 7 days in single diet and choice feeding experiment loss of seaweed weight have shown to find out rate of grazing. The table interpreted that *Enteromorpha* sp. was being grazed much faster than the other three seaweed as it lose much weight within similar period of time. The overall rate of grazing displayed a higher grazing rate in *Enteromorpha* sp. rather than mix diet, *Ulva* sp. and *Sargassum* sp. (Tables 1, 4).

The result of the single and choice feeding experiment are presented in terms of loss of seaweed fresh weight varied among experiments related to the studies of Hambrook and Sheath (1987). Grazing rate calculated from single diet feeding experiment concluded greater rate of grazing observed when each seaweed treatment offered individually in the recent study. Similar observation

Table 1 : Seaweed preferences of *Euchelus tricarinata*.

Preference Ranking	Chlorophyceae	Phaeophyceae
High	<i>Enteromorpha</i> sp.	
Medium	<i>Ulva</i> sp.	
Low		<i>Sargassum</i> sp.

was noticed by Nicotri (1980), where he studied the comparative attractiveness of seaweed species against artificial plants towards isopods and amphipods by Lawrence (1975) for sea urchin grazing. Other studies have merged together with the present study where seaweed offered singly is consumed faster than in combination (Leighton, 1971; Vadas, 1977).

Gut content analysis

To study grazing activity of Intertidal organism in natural environment a handful organism was taken to laboratory and their gut contents were inspected in the microscope. On the basis of presence-absence, they have been marked. The result has been shown in Table 3.

The experimental organisms were dissected after 7 days of grazing and gut content were observed under microscope for presence of seaweed fronds. The analysis has shown that semi digested *Enteromorpha* sp. was found frequently during the study period. The column diagram shows that they prefer *Enteromorpha* sp. as it found in the gut of maximum number of *Euchelus* sp. while dissection. They consumes more than 70% of *Enteromorpha* sp., 40% *Ulva* sp. and about 20% *Sargassum*. Their food preference lies in the following form *Enteromorpha* sp. > *Ulva* sp.> *Sargassum* sp. as per the study period. *Nerita* sp. consumes more than 13% of both *Ulva* sp. and *Enteromorpha* sp. during single diet experiment. Gut content of *Nerita* sp. was found to be empty maximum time. They mostly prefer *Ulva* sp. than other seaweed.

Total 15 gastropods (*Euchelus asper* and *Nerita oryzaarum*) from each of 3 are of single diet (T1-*Ulva* sp., T2-*Enteromorpha* sp. and T3-*Sargassum*) treatment were dissected. Maximum semidigested seaweed fragments were observed in the gut of *Euchelus tricarinata* compared to *Nerita oryzaarum*.

During choice feeding experiment (combination of all 3 seaweed), total of 80 (40 *Euchelus* and 40 *Nerita*) were dissected which place *Euchelus* in higher level of preferring seaweed in compared to *Nerita* sp. Maximum number of *Euchelus* sp. was examined with mixed diet of *Ulva* sp. + *Enteromorpha* sp., semidigested *Enteromorpha* sp., *Enteromorpha* sp. + *Sargassum* sp. and combination of all 3 diet in their gut. Infact it stretches out its preference towards all experimental diet whereas *Nerita* sp. confines its preference towards *Ulva* sp. to a

Table 2 : Grazers with occurrence of seaweed fragments in their gut analysis.**A) Laboratory Experiment**

Gastropod	Seaweed		
	<i>Ulva</i> sp.	<i>Enteromorpha</i> sp.	<i>Sargassum</i>
<i>E. asper</i>	+	+	+
<i>N. oryzaeum</i>	+	-	-

B) Field Experiment

Gastropod	Seaweed					
	<i>Ulva</i> sp.		<i>Enteromorpha</i> sp.		<i>Sargassum</i> sp.	
	Shrivardhan	Alibag	Shrivardhan	Alibag	Shrivardhan	Alibag
<i>Astrea stellata</i>	-	-	-	-	-	-
<i>Bursa tuberculata</i>	-	-	+	-	-	-
<i>Cellana radiata</i>	-	-	-	-	-	-
<i>Cerithium morus</i>	-	-	-	-	-	-
<i>Clanculus</i>	-	-	+	-	+	-
<i>Euchelus asper</i>	-	-	+	-	-	-
<i>E. tricarinata</i>	-	-	+	+	-	-
<i>Nerita oryzaeum</i>	-	-	-	-	-	-
<i>Planaxis sulcatus</i>	+	-	+	-	-	-
<i>Planaxis Similis</i>	+	-	-	+	+	-
<i>Trochus radiata</i>	-	+	-	+	-	-

Table 3 : Occurrence of seaweed fragments in the gut of experimental organism.

Treatment	No. of <i>N. oryzaeum</i>			No. of <i>E. tricherinata</i>		
	Sem. Digt	Digested	Empty	Sem. Digt	Digested	Empty
T-1 (<i>Ulva</i> sp.)	5	3	12	10	2	8
T-2 (<i>Enteromorpha</i> sp.)	5	0	15	15	0	5
T-3 (<i>Sargassum</i>)	3	2	15	6	0	14
T-4 (<i>Ulva</i> sp.+Ent+Sarg)	7	0	13	16	0	4

Sem. Digt-Semi digested, Ent- *Enteromorpha* sp., Sarg-*Sargassum* sp.

Table 4 : Loss of seaweed weight during grazing experiment.

Seaweed species	Weight loss of seaweed (g)				
	7 Days	14 Days	21 Days	28 Days	35 Days
<i>Ulva</i> sp.	2.184	2.734	2.658	2.479	2.139
<i>Enteromorpha</i> sp.	2.347	2.483	2.326	1.937	1.627
<i>Sargassum</i> sp.	2.259	2.891	2.704	2.582	2.206
<i>Ulva</i> sp. + Ent + Sarg	2.305	2.647	2.511	2.391	1.849

Sem. Digt-Semi digested, Ent- *Enteromorpha* sp., Sar-*Sargassum*.

greater extends rather than *Enteromorpha* sp. and rest other combined diet. Several times they have been found with empty gut. But in field they may have other choice. During choice feeding experiments, it is found that grazer *Euchelus tricarinata* have high preferences towards the green seaweed *Enteromorpha* sp. While, it have medium and lower preferences towards *Ulva* sp. and *Sargassum*, respectively (Table 4).

Comparative analysis of gut content of both *Euchelus tricarinata* and *Nerita oryzaeum* show the occurrence of semidigested seaweed diet in their gut. Result of 4 seaweeds treatment that compares occurrence of seaweed fragments in *Euchelus tricarinata* and *Nerita oryzaeum* shows that T1 (*Enteromorpha* sp.) differs in greater significance than T2 (*Ulva* sp.) and T3 (*Sargassum* sp.) in single diet experiment. In graphical representation, *Euchelus tricarinata* pulls out maximum

preference towards *Enteromorpha* sp. which may consider to be highly preferred seaweeds feed for *Euchelus tricarinata* followed by *Ulva* sp. and *Sargassum* sp. and they fed on the mix diet to a greater extent.

The seaweed treatment studied here over laboratory grazing experiment of 28 days showed that the experimental organisms preferred higher percentage of green seaweed rather than brown seaweed *i.e.* *Sargassum*. Hambrook and Sheath (1987), demonstrated red seaweed as the chief foods preference of herbivorous and omnivorous invertebrates. However, in present study, diatom was the most frequently found gut material. Similar results had been shown by Jonne *et al* (2006). In present feeding experiment, the herbivores preferred more green seaweed. This may be due to absence of grazers prefer much of green seaweed. Das *et al* (2014) had worked on grazing of selected genera of green, red and brown seaweed along the Maharashtra coast, which Showed similar result on present study.

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