

Ecological studies on the Fauna Associated with Economic Seaweeds of South India-3.

Food preferences of selected Algivorous Gastropods

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Introduction

The importance of algivorous animals in the ecology of economic seaweeds has been recognised by many workers (Tilden, 1927; Leighton, 1960; Chapman, 1962; North, 1962, 1963; Boney, 1966). In recent years many studies have been made to ascertain the food and feeding habits of major algivores, the important among which are by Barkman (1955), van Dongen (1956), Bakker (1959), Satio and Nakamura (1961), Leighton and Boolootian (1963), Leighton (1966), Paine (1963) and Paine and Vadas (1969). In order to study the role of algivores in the ecology of cultivatable marine algae and to ascertain the nature of discrimination in the choice of algal food by them, a study was undertaken during 1968-'71 at the Marine Algal Research Station, Mandapam. This paper presents the findings pertaining to the chief algivorous gastropods in the Gulf of Mannar and Palk Bay region.

Materials and Methods

The usual methods of the study of food and feeding habits by the analysis of gut contents could not be used because—(i) gut contents provided unreliable clues to food habits in algivorous animals, and (ii) the identity of the food and estimation of the quantity consumed were difficult. Hence, a method modified after that of Leighton (1966) was followed. Individuals (usually ten in number) collected from a variety of habitats were conditioned in the aquarium for 3 to 4 days. They were starved for 48 hours prior to the commencement of the experiments and offered equal weights of ten species of algae. Amounts ingested were determined by measuring the loss in weight of algae after a feeding period of 24 hours. The individuals used in the experiments were adults of more or less equal size. Freshly collected algae were used as food and the components of the food were thoroughly mixed several times during each experiment. A control with algae alone was kept to determine possible deterioration of the algae during the 24 hr. period. All experimental vessels were constantly aerated. The following are the species of algae and gastropods employed.

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Algae

Ulva lactuca Linn.
Enteromorpha compressa (Linn.) Grev.
Padina gymnospora (Kuetz.) Vickers
Sargassum wightii Greville
Stoechospermum maculatum J. Ag.
Gracilaria edulis (Gmel.) Silva
Gracilaria corticata J. Ag.
Gracilaria verrucosa (Hunds) Papenfuss
Hypnea musciformis (Wulf.) Lomour
Gelidiella acerosa (Forsk.) Feldman et Hamel

Gastropods

Pyrene versicolor Sowerby
Pyrene zebra Gray
Trochus radiatus Gmelin
Turbo intercostalis Menker
Aplysia lineolata Adams and Reeve

At the end of the 24 hr. feeding period all remaining algal fragments were removed from each tank, sorted into species, blotted free of water and weights determined. Weight losses, corrected for changes in the controls were taken as seaweed consumed by grazers. Data were tested statistically for consistency of ranks and for significant differences in means of consumption values.

Results

The means and range of consumption values by *Pyrene versicolor*, *P. zebra* and *Trochus radiatus* are given in Fig. 1. Similarly, values for *Turbo intercostalis* and *Aplysia lineolata* are presented in Fig. 2. To test the agreement of results, a ranking method described by Kendall (1970) was employed. In each experiment, the algae were assigned ranks 1 to 10 in the order of decreasing quantities consumed. The various species of algae are ranked according to the sums of ranks allotted to the individuals in each set of experiments with a given species of gastropod (Table 1 to 5). Values of W, the coefficient of concordance, (see Kendall, 1970) ranged from 0.858 to 0.935 indicating that the preferences of food were not at random. In all the experiments, values of W were significant at 1% level. The order of preference of each grazing species therefore, can be regarded as consistent and the mean values for consumption afford the best estimate of the relative degree of attractiveness of the grazing species to the algae.

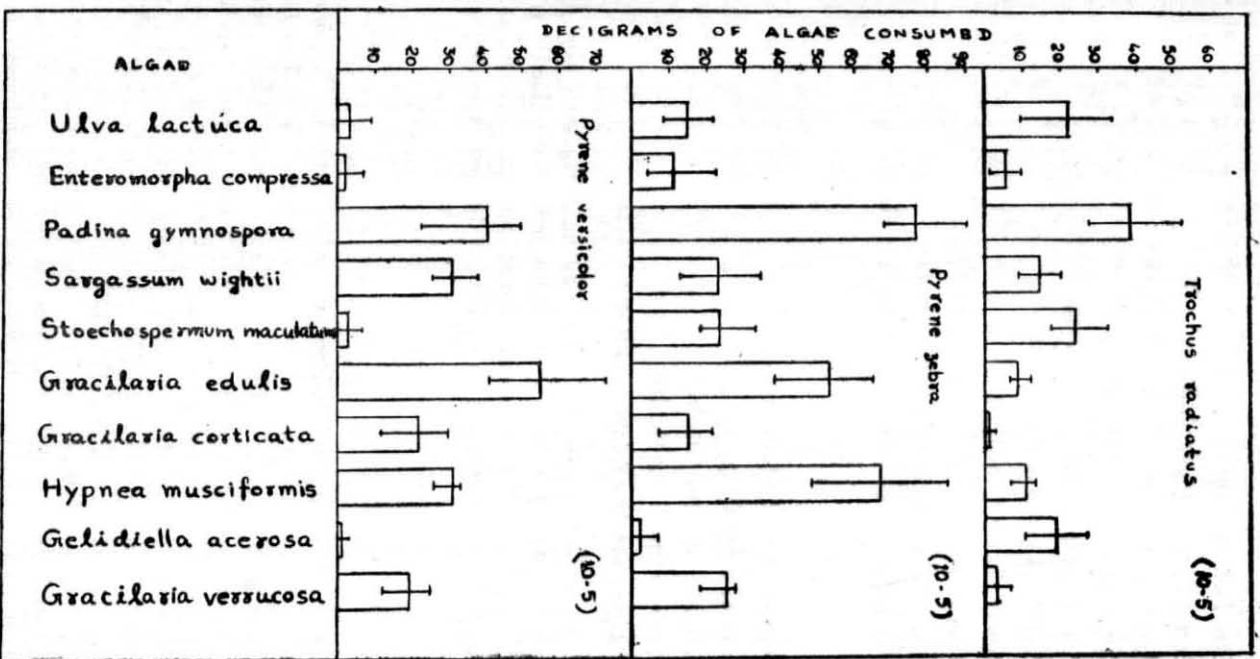


FIG. 1

Legend

Fig. 1 Means of algae consumption values of *Pyrene versicolor*, *P. zebra* and *Trochus radiatus* shown by histograms. Vertical lines indicate the ranges. The numbers of individuals employed and numbers of experiments are given in that order hyphenated in brackets.

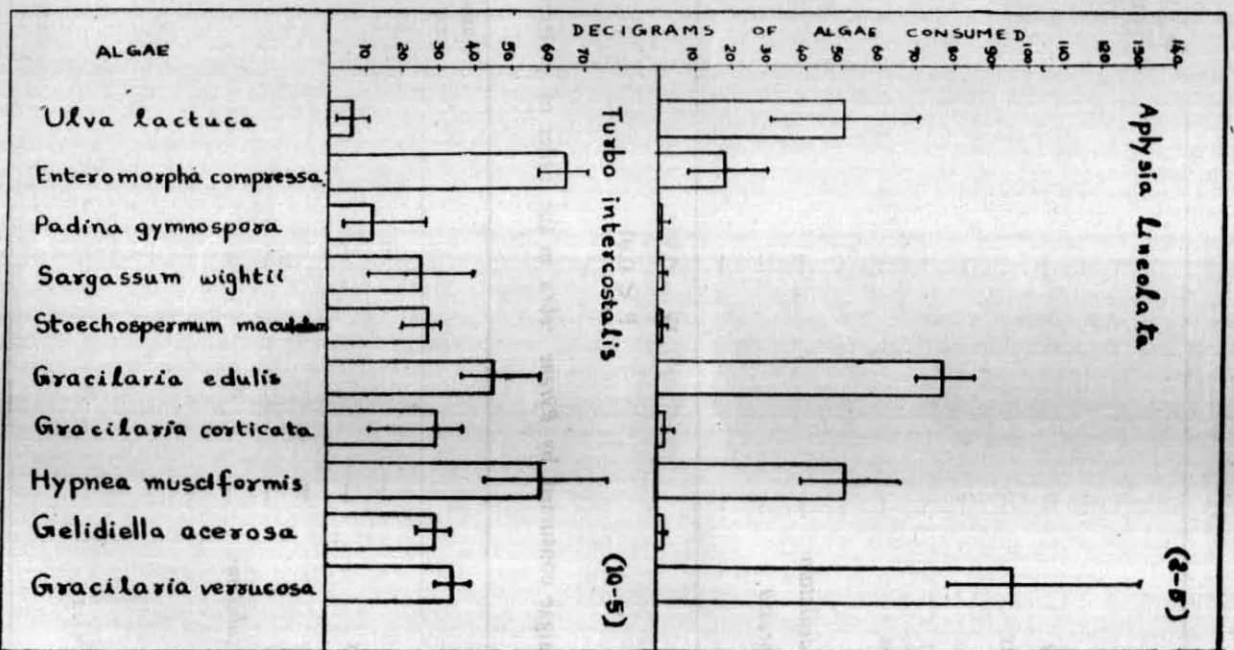


Fig. 2 Means of algae consumption values of *Turbo intercostalis* and *Aplysia lineolata* shown by histograms. Details as in Fig. 1.

FIG. 2

Table 1. Species of algae consumed by *Pyrene versicolor* in the order of preference (top to bottom).

spp. of algae			Rank totals for 5 experiments
<i>Gracilaria edulis</i>	...	....	5.0
<i>Padina gymnospora</i>	...	...	10.0
<i>Hypnea musciformis</i>	...	...	17.0
<i>Sargassum wightii</i>	...	....	19.0
<i>Gracilaria corticata</i>	...	...	25.5
<i>Gracilaria verrucosa</i>	....	...	28.5
<i>Ulva lactuca</i>	...	...	41.0
<i>Stoechospermum maculatum</i>	....	....	41.5
<i>Enteromorpha compressa</i>	...	...	43.0
<i>Gelidiella acerosa</i>	...	....	44.5

$$W = 0.935$$

$$P < 0.01$$

Table 2. Species of algae consumed by *Pyrene zebra* in the order of preference (top to bottom).

Spp. of algae			Rank totals for 5 experiments
<i>Padina gymnospora</i>	...	...	6.0
<i>Hypnea musciformis</i>	...	....	9.0
<i>Gracilaria edulis</i>	....	...	15.0
<i>Gracilaria verrucosa</i>	....	...	24.5
<i>Stoechospermum maculatum</i>	....	...	27.0
<i>Sargassum wightii</i>	...	...	28.5
<i>Gracilaria corticata</i>	...	...	36.5
<i>Ulva lactuca</i>	...	...	37.0
<i>Enteromorpha compressa</i>	...	...	41.5
<i>Gelidiella acerosa</i>	...	....	50.0

$$W = 0.897$$

$$P < 0.01$$

Table 3. Species of algae consumed by *Trochus radiatus* in the order of preference (top to bottom).

Spp. of algae		Rank totals for 5 experiments
<i>Padina gymnospora</i>	....	7.0
<i>Stoechospermum maculatum</i>	...	14.0
<i>Ulva lactuca</i>	....	16.0
<i>Gelidiella acerosa</i>	....	18.0
<i>Sargassum wightii</i>	....	23.0
<i>Hypnea musciformis</i>	...	31.0
<i>Gracilaria edulis</i>	....	34.5
<i>Enteromorpha compressa</i>	....	38.0
<i>Gracilaria verrucosa</i>	...	46.0
<i>Gracilaria corticata</i>	....	47.5

W=0.858

P<0.01

Table 4. Species of algae consumed by *Turbo intercostalis* in the order of preference (top to bottom).

spp. of algae		Rank totals for 5 experiments
<i>Enteromorpha compressa</i> and <i>Hypnea musciformis</i>	} ...	9.0
<i>Gracilaria edulis</i>	...	14.0
<i>Gracilaria verrucosa</i>	...	24.0
<i>Gracilaria corticata</i>	....	26.5
<i>Gelidiella acerosa</i>	....	30.5
<i>Stoechospermum maculatum</i>	...	32.5
<i>Sargassum wightii</i>	...	34.5
<i>Padina gymnospora</i>	...	45.5
<i>Ulva lactuca</i>	....	49.5

W = 0.862

P < 0.01

Table 5. Species of algae consumed by *Aplysia lineolata* in the order of preference (top to bottom).

Spp. of algae		Rank totals for 5 experiments
<i>Gracilaria verrucosa</i>	...	7.0
<i>Gracilaria edulis</i>	....	8.0
<i>Hypnea musciformis</i>	...	16.0
<i>Ulva lactuca</i>	....	19.0
<i>Enteromorpha compressa</i>	....	25.0
<i>Gracilaria corticata</i>	...	34.0
<i>Padina gymnospora</i>	...	40.0
<i>Stoechospermum maculatum</i>	...	41.5
<i>Gelidiella acerosa</i>	....	42.0
<i>Sargassum wightii</i>	...	42.5

W=0.913

P<0.01

Table 6. Synopsis of preference order rankings.

Sp. of algae →	<i>Hypnea musciformis</i>	<i>Gracilaria edulis</i>	<i>Padina gymnospora</i>	<i>Gracilaria verrucosa</i>	<i>Stoechospermum maculatum</i>	<i>Ulva lactuca</i>	<i>Enteromorpha compressa</i>	<i>Gracilaria corticata</i>	<i>Sargassum wightii</i>	<i>Gelidiella acerosa</i>
Sp. of animal ↓										
<i>Pyrene versicolor</i>	3	1	2	6	8	7	9	5	4	10
<i>Pyrene zebra</i>	2	3	1	5	4	8	9	7	6	10
<i>Trochus radiatus</i>	6	7	1	9	2	3	8	10	5	4
<i>Turbo intercostalis</i>	1.5	3	9	4	7	10	1.5	5	8	6
<i>Aplysia lineolata</i>	3	2	7	1	9	4	5	6	10	8
Rank total	15.5	16	20	25	30	32	32.5	33	33	38
Average of Rank Total 27.5										

The preference order rankings are summarised in Table 6. The most highly preferred algae are *Hypnea musciformis* (rank total 15.5) and *Gracilaria edulis* (rank total 16). These are followed by *Padina gymnospora* (rank total 20), and *Gracilaria verrucosa* (rank total 25). The remaining six species of algae falling above the average of rank total of 27.5 do not seem to be preferred by the five species of grazers.

Discussion

Several species of red algae were consistently consumed in greater relative quantities by all grazers. Species of *Hypnea* and *Gracilaria* were generally preferred to other red, brown or green algae. Interestingly the least preferred by all grazers investigated is *Gelidiella acerosa*, a red alga. Another red alga *Gracilaria corticata* and a brown alga *Sargassum wightii* are also at a lower level of preference. Leighton (1966) stated that in Southern Californian kelp beds, algivorous invertebrates revealed stronger preferences for the brown alga *Macrocystis pyrifera*, *Laminaria farlowii* and *Pterygophora californica*. Red algae were preferred only by deep water herbivores. In the light of these observations, the present data appear interesting in that the order of preference is reversed, the red alga being preferred to brown and green algae.

The fact that closely allied species like *Pyrene versicolor* and *P. zebra* equipped with similar chewing, biting or rasping organs exhibited divergent preference indicates that the toughness of algae alone is not the basis of food selection. A more probable explanation may be the selectivity of algal diet on the basis of chemical perception. Paine and Vadas (1969) showed that food preferences of invertebrate herbivores seem to have evolved in response to availability rather than to absolute food value.

Physical properties like toughness may determine the quantity of food eaten and sometimes food preferences as smooth, juicy or fleshy food may attract, incite or stimulate feeding (Paine, 1963). In the present study, the best preferred species of algae (*H. musciformis*, *G. edulis*, *P. gymnospora* and *G. verrucosa*) are relatively softer or more fleshy than the least preferred one *G. acerosa*, *S. wightii* and *G. corticata* which are tougher.

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Summary

Discrimination in the selection of algal food from ten species of marine algae was studied in five common gastropods of the Gulf of Mannar and Palk Bay region. Species of *Pyrene* preferred *Gracilaria edulis*, *Padina gymnospora*, *Hypnea musciformis* to other spp. of algae, while in *Trochus radiatus* the preference order was: *Padina gymnospora*, *Stoechospermum maculatum*, *Ulva lactuca* etc. *Turbo intercostalis* exhibited preference to a diet of *Enteromorpha compressa* and *Hypnea musciformis*. Red algae (*G. verrucosa*, *G. edulis*,

H. musciformis) and green algae (*U. lactuca*, *E. compressa*) were best preferred by *Aplysia lineolata*. An order of preference for the ten species of algae by the five species of gastropods is given.

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