

A correlation study of algal diversity with reef characteristics of Akurala reef in the Southwest coast of Sri Lanka

M.U. Mallikarachchi^{1,2} and M.P. de Silva²

¹presently Coastal Resources Management Project, 415/1, T.C.P. Fernando Mw, Patabedimulla, Ambalangoda.

²Department of Botany, Faculty of Science, University of Ruhuna, Matara, Sri Lanka.

Abstract

*Akurala (N 06°.11'-E 80°.04') reef is located approximately 90.5 km south of Colombo. The reef forms part of a fringe of sandstone. It is about 35 m wide and does not slope gently from land to sea. The seaward face of this platform is practically vertical. Even little wave action can cover the entire reef. However, waves break with fair regularity on the seaward edge and then the water washes over most of the platform. The reef can be recognized into 3 distinct zones described as Zone 1 - which is a Patchy Seaweed Zone in the inner part of the reef flat, which is dug into a shallow basin and covered by a thin sheet of water at low tide, Zone 2, which is the Corallinaceae Zone consisting of calcareous elements with a flat leveled top and Zone 3, where the Reef Glacis is slightly inclined seawards and exposed at low water of springtide. A quantitative and a qualitative survey of marine algae present on the reef was carried out at monthly intervals. A total of 44 macroalgal taxa belonging to 25 genera and 19 families were recorded. Of them, 18 taxa belonged to the Chlorophyta, 5 to the Phaeophyta and 21 to the Rhodophyta. *Ulva fasciata*, *Cheilosporum cultratum* and *Gracilaria hikkaduensis* were the most abundant species. An observed feature was the seasonal variation of the number of species on the 3 biotopes.*

*The green algal diversity was high in zone 1 during the monsoons with species such as *Ulva fenestrata*, *U. fasciata* and *U. lactuca* being the dominants. Generally, the diversity among the greens decreased from landwards to seawards. Very interestingly, an inversed trend was observed for the red algae. Reds such as *Pterocladia heteroplotos*, *Gracilaria hikkaduensis*, *Ahnfeltiopsis vermicularis* and *Cheilosporum cultratum* dominated zone 3 while *Cheilosporum cultratum*, *Pterocladia heteroplotos* and *Ahnfeltiopsis vermicularis* were the dominants at zone 2. The trend in the variations of the brown algae landwards to seawards was similar to that of green algae, though their diversity was considerably lower.*

All results clearly indicated a very specific algal zonation at the biotopes, which is apparently influenced by the interactions of many physical and environmental factors, as governed by many of the reef's physical characteristics that may determine the intensity and duration of submergence of the biotopes.

Keywords: Akurala, biotopes, diversity, microbial taxa, zones

Introduction

The macrophytic marine algae form an important natural resource of Sri Lanka. The marine algae are abundantly found in the littoral as well as in the sunlit sub-littoral regions of coastal areas (Coppejans *et al* 1997). Sri Lanka has a coastline extending to about 1585 kilometers along which are the coastal wetlands of Sri Lanka. These include extensive lagoons and estuaries, mangrove forests, coastal marshes, dunes, and those found seawards to the coastline, which are the reefs of coral sandstone, algal communities and shallow beds of coastal and estuarine seagrasses (Baldwin, 1991).

Objective of this study

Only scant data are available on the ecology of the macrophytic algae of Sri Lanka. (de Silva et al. 2004) Furthermore, complete data on the algal flora of this area were not available. The major objectives of this study were therefore to study both the algal diversity in the Akurala reef, and to establish relationships of algal diversity and abundance to reef characters. Preliminary surveys indicated the richness of the reef with reference to marine algae.

Materials and Methods

Study site

Akurala (N 06° 11' -E 80° 04') is located approximately 90.5 km south of Colombo. The reef is part of a fringe of sandstone which is attached to the shore and partly covered by sand. The reef forms a platform of about 35 m width and does not slope gently from land to sea. The seaward face of this platform is practically vertical. Even little wave action can cover the entire reef. However, waves break with fair regularity on the seaward edges and then the water washes over covering the greater part of the platform.

Sampling

The study period was from January 2000 to February 2002. The quantitative survey was done at monthly intervals by placing quadrates (20 cm × 20 cm) at 1.5 m intervals along line transects that extended from the landwards to the seawards edge of the platform. A qualitative survey of marine algae present was concurrently carried out during the transect study. Samples were also collected outside transects for the diversity assessments.

Analysis of the samples

All samples were collected either manually or through scrapings with hammer and chisel, preserved in a 4-5% formalin/sea water solution and conserved as wet samples and dried herbarium specimens. (The specimens now form part of the algal collection at the National Herbarium of Sri Lanka). All identifications were confirmed using keys, herbarium specimens or with the assistance of two foreign experts attached to algal taxonomic laboratories in India and Belgium. We followed Silva *et al.* (1996) for the nomenclature and the ordination into divisions, classes, orders, families and genera.

Results and Discussion

Three biotopes were identified on the reef from landwards to seawards viz a patchy weeds zone (1), a Corallinaceae zone (2) and a reef glaucis (3). These biotopes were identified on the basis of dominant algal species, reef slope, nature of the substratum, effect of tides and nature and duration of wave exposure. (Fig. 1).

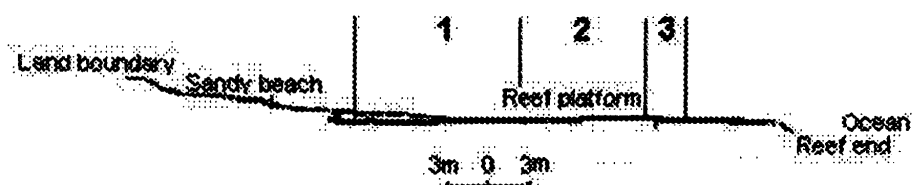


Fig. 1: Profile and the three biotopes of the reef

- Zone 1 -** Patchy Seaweed Zone in the inner part of the reef flat, which is dug into a shallow basin. This area remains covered by a thin sheet of water at low tide. The landward part of this region is covered by sand.
- Zone 2 -** The Corallinaceae Zone consists of calcareous elements with a flat leveled top. This area is somewhat higher than the other two regions.
- Zone 3 -** The reef glacis is slightly inclined seawards. At low water of springtide, this area is exposed. Various seaweeds can be observed here.

A total of 44 macroalgal taxa belonging to 25 genera and 19 families were recorded. Of them, 18 taxa belonged to the Chlorophyta, 5 to the Phaeophyta and 21 to the Rhodophyta. *Ulva fasciata*, *Cheilosporum cultratum* and *Gracilaria hikkaduensis* were the most abundant species of the entire reef. An observed feature was the seasonal variation of the number of species on the 3 biotopes. Species of macroalgae found within the three zones of the reef are given in Annex 1.

The highest diversity was shown by the red algae at the site during the entire study period, the lowest diversity was exhibited by the brown algae while greens had an intermediate position with reference to diversity. Fig. 2 illustrates the diversity pattern among the 3 groups of algae for the entire study period. Fig. 3 illustrates how the number of species (indicated here as percentages) vary seasonally on the biotopes.

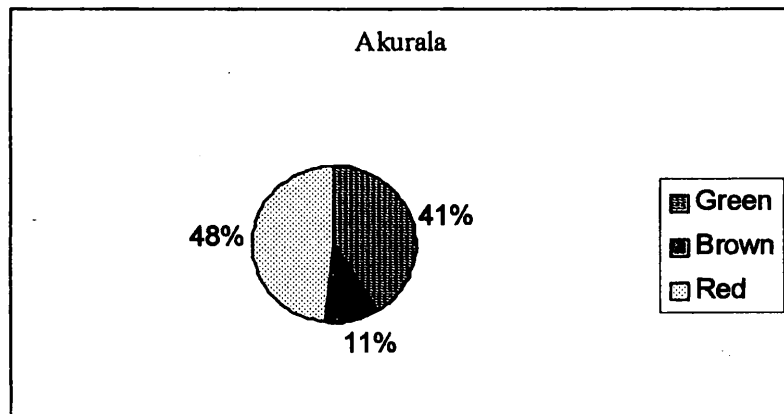


Fig. 2: Number of macroalgal species (expressed as percentages of the total number of species) recorded from Akurala reef

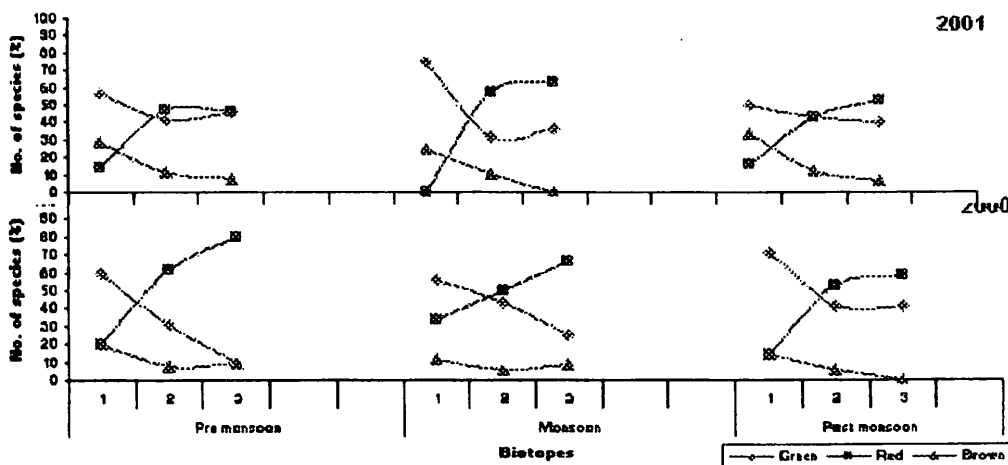


Fig. 3: Seasonal variation in the number of species (%) in the biotopes at the Site

The variations in growth patterns of the 3 macroalgal systematic groups on the reef are governed by many of the reef's physical characteristics that may determine the intensity and duration of submergence of the biotopes. In the case of this site, green algal diversity was high in zone 1 during the monsoons with species such as *Ulva fenestrata*, *U. fasciata* and *U. lactuca* being the dominants. Generally, the diversity among the greens decreased from landwards to seawards. Very interestingly, an inverse trend was observed for the red algae. Reds such as *Pterocladia heteroplotos*, *Gracilaria hikkaduwendensis*, *Ahnfeltiopsis vermicularis* and *Cheilosporum cultratum* dominated zone 3 while *Cheilosporum cultratum*, *Pterocladia heteroplotos* and *Ahnfeltiopsis vermicularis* were the dominants at zone 2. The green alga *Ulva fasciata* was also abundantly found in zone 2. The trend in the variations of the brown algae landwards to seawards was similar to that of green algae, though their diversity was considerably lower.

Ulva fasciata, *Cheilosporum cultratum*, *Gracilaria hikkaduwendensis*, and *Dictyota ceylanica* were found in all three zones, while certain species such as *Ulva fenestrata* and *Chaetomorpha gracilis* were confined to zone 1. *Chaetomorpha gracilis*, *Amphiroa fragilissima* and *Hypnea hamulosa* were present only at zone 2. *Hypnea pannosa* and *Gelidium* sp. were found only at zone 3 while *Ulva lactuca* and *U. rigida* were only at zones 1 and 2. *Pterocladia heteroplotos*, *Ahnfeltiopsis vermicularis*, *Caulerpa racemosa* var. *turbinata* ect. were present only at zones 2 and 3. Our observations also showed that species such as *Chaetomorpha gracilis*, *Chondracanthus acicularis*, *Hypnea hamulosa* and *Halimeda discoidea* etc. were found only during the southwest monsoon period. All these results clearly indicate a very specific zonation at the biotopes, which is apparently influenced by the interactions of many physical and environmental factors.

Fig. 4 – indicates the spatial (in biotopes) and temporal (seasonal) biomass variations from landwards to seawards along the transect at the Site. The presence of the red alga *Cheilosporum cultratum* in large numbers in biotope 2 had a significant effect for this red algal biomass decrease during the study period.

Throughout the study period, red algal biomasses were the highest, while greens were intermediate and brown algae had the lowest. The red algal biomass gradually decreased throughout the study period without showing any monsoonal effects. The biomass of greens increased during the monsoon in zone 1. Disappearance of *Cheilosporum* spp. observed during our survey at the Site was established as due to sand deposition.

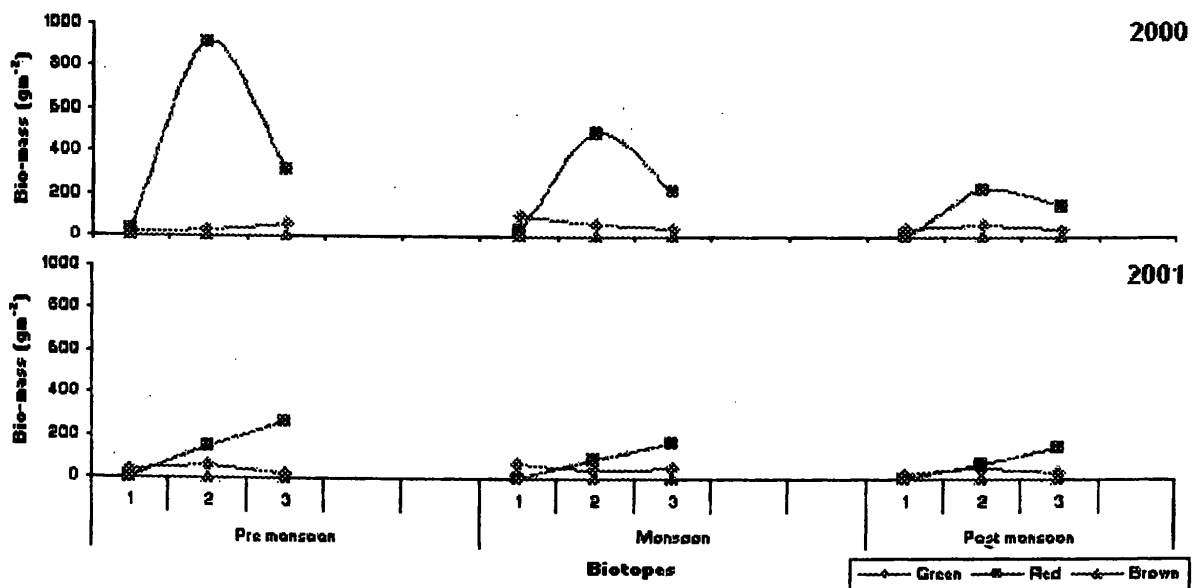


Fig. 4: Seasonal variation of biomass in the biotopes at the Site

Conclusion

The presence of 44 species of macrophytic marine algae within a small reef area is noteworthy and is indicative of the high diversity for this group of lower plants in Sri Lanka as well as the richness of this reef with reference to marine algae. The dominance of the red algae at the site was a general observation for the 78km region of the southwestern coast (including Akurala) in our major study. A very clear zonation of algae at each biotope was identified and furthermore their seasonal oscillations were found to be governed mainly by monsoonal effects and the reef characters. The reef characters influence wave force intensities , cover and uncover periods as well as duration of exposure of seaweeds to dry conditions. The results are indicative of the fact that the abilities of the algal flora to withstand these conditions are highly variable.

Acknowledgements

This work is part of the project RG/99/B/08 funded by the National Science Foundation of Sri Lanka.

References

- Baldwin, M.F. (ed.) (1991). Natural Recourses of Sri Lanka: conditions and trends. *Keels Business Systems Ltd.* Sri Lanka.
- Silva, P.C., Basson, P.W. and Moe, R.L., (1996). Catalogue of Indian Ocean Algae. *University of California Publications in Botany* 79: 1259p.
- Coppejans, E., Richmond, M.D. de Clerck, O. and Rabesandratana, R., (1997). Marine macroalgae. In M.D. Richmond (ed.). *Seaweeds, A guide to the seashores of eastern Africa and the western Indian Ocean* islands (pp.70 – 101). Sida/Department for Research Cooperation, SAREC.
- De Silva, M.P., Mallikarachchi, M.A.U., (2003). Historical survey of marine algal exploration in Sri Lanka and new perspectives, First Academic Sessions of the University of Ruhuna, July,2003.