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Marine macrophytes: Macroalgae species and life forms from Golden Beach, Similajau National Park, Bintulu, Sarawak, Malaysia

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Abstract — A study on macroalgae was carried out around Golden Beach, Similajau National Park during the month of April 2005. Collections and recordings of macroalgae species and life forms were conducted during low tide period. A total of 35 macroalgae were identified belonging to 27 genera comprising of 10 species (28.6%) Chlorophyta, 6 species (17.1%) Phaeophyta and 19 species (54.3%) Rhodophyta. *Sargassum paniculatum*, the common species inhabited the sand and rock substrates. *Enteromorpha intestinalis*, *Hypnea cervicornis* and *Laurencia corymbosa* encountered in this survey are in association with a bivalve, *Perna* sp. growing on sand substrate. *Leveillea jungermannioides* and *Cladophora fuliginosa* were observed attached to other macroalgae *Cheilosporum jungermannioides* and *Hypnea cervicornis* respectively. *Caulerpa sertularioides* was observed on sand substrate and among live corals. This is attributed to their rhizomaceous mode of growth enabling them to expand in this environment by vegetative means. Based on mode of attachment on substrate types, macroalgae life form categories are epilithic, epiphytic and rhizophytic. Epilithic macroalgae represents a big group compared to epiphytic and rhizophytic macroalgae. The epilithic category was represented in the three divisions of Chlorophyta, Phaeophyta and Rhodophyta.

Key words: seaweeds, life forms, diversity, Golden Beach, Similajau National Park, Bintulu, Sarawak

Introduction

Macroalgae are large multicellular plants that resemble vascular plants but lack the complex array of tissues used for reproduction and water transport. Macroalgae typically grow attached to hard substrates such as rocks, shells and coral skeletons. They are important elements of shallow coastal and are divided into the three groupings; green algae-Division Chlorophyta, brown algae-Phaeophyta and red algae-Rhodophyta. Their life forms category (Taylor 1957; Bold and Wynne 1978, den Hartog 1979, Brouns and Heijs 1991) can be divided into: (1) rhizophytic/epipelic-those macroalgae attached to mud and sand, (2) lithophytic/epilithic-macroalgae living on stones, rocks, boulders or dead corals, (3) epiphytic-macroalgae attached to seagrass leaves, stems, rhizomes and other macroalgae, (4) epizoic-macroalgae attached to mollusc shells or polychaete tubes and (5) loose-lying or drift or floating macroalgae.

Studies on macroalgae at coral reef flats or seagrass bed had been conducted in several parts of the world, such as Enewetak Atoll lagoon, Marshall Island (Cohn 1986); South Singapore (Goh and Chou 1992); Ischia, Gulf of Naples (Mazzella et al. 1989), Kaneohe Bay (Hawaii). Discovery Bay (Jamaica), La Saline reef (Reunion), Moorea, (French Polynesia) and Great Barrier Reef (Done 1992), Gazi Bay, Kenya (Copejans et al. 1992) and Seribu Island, Indonesia (Suharsono 1992). In Malaysia, studies pertaining to macroalgae have been conducted by Green (1978), Ghazally (1987), Khew (1978), Phang (1984, 1994) and Ahmad (1995). This present study on macroalgal resources formed the extension of such studies and the objective is to collect information on general distribution of macroalgae and species diversity in association with corals at Golden Beach, Similajau National Park.

Materials and Methods

Description of the study area and field survey

The study was conducted at Golden Beach (latitudes 3° 24′ 57.7″ N, and longitudes 113° 11′ 36.0″ E, Fig. 1) in Simi-

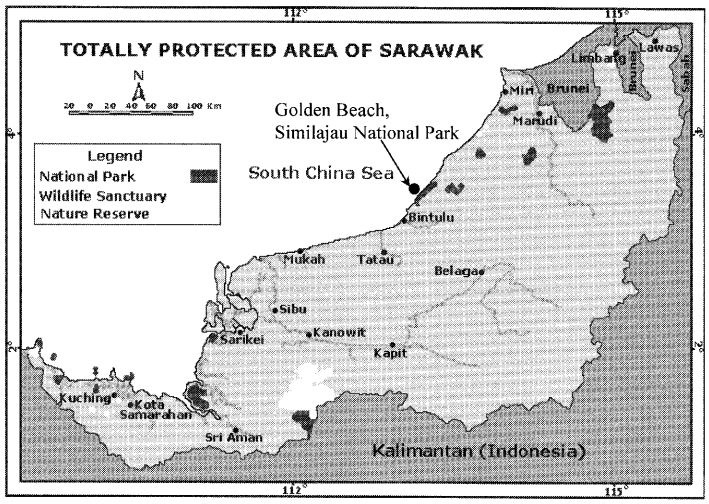

Fig. 1. Location map of Golden Beach, Similajau National Parks.

lajau National Park (Fig. 1), situated in Bintulu Division about 30 km from Bintulu Town. It is one of the coastal areas in Malaysia with miles of unspoiled sand and rocky beaches facing the South China Sea. General observations indicated that macroalgae could only be found 10 to 60 m from the shoreline to the seaward direction associated particularly with corals. Collection of macroalgae was conducted in April 2005 along the coastal areas of Golden Beach by SCUBA diving. Macroalgae encountered were recorded and preserved in 7% saline formalin solution kept in labelled plastic containers for identification in the laboratory. Identification of macroalgae in the laboratory was conducted by referring to several standard references such as Crane (1981), Lu and Tseng (1984), Taylor (1960), Toe and Wee (1983) and Trono Jr. (1971, 1986). In addition, macroalgae attached substrates e.g. rocks, sand, live corals, dead corals, coral rubbles and the approximate horizontal distance from shoreline were recorded in situ.

Observations and discussion

Macroalgae from the three divisions (Chlorophyta, Phaeophyta and Rhodophyta) did not show any distinct zonation and have an overlapping distribution. A total of 35 macroalgae species has been recorded with Rhodophyta showed the highest diversity of macroalgae with 9 family, 13 genus and 19 species. This is followed by Chlorophyta with 8 family, 9 genus and 10 species while Phaeophyta has few species with 2 family, 5 genus and 6 species (Table 1). From the records, Phaeophyta especially *Sargassum paniculatum* is the most common species as it can adapt to the rough and hash environment (Campbell 1996). In similar coral areas of Pulau Redang, Terengganu, Penisular Malaysia, 57 species of macroalgae have been reported by Green (1978). By comparison, the Caribbean Sea supports nearly 500 species of macroalgae (Chapman 1961). The apparent low species number at Golden Beach is attributed to the presence of relatively healthy coral population. Live corals provide poor substrate for colonization by macroalgae and their sporeling. However, macroalgae such as *C. sertularioides* encountered in this study is found growing among live corals. This is attributed to their rhizomaceous mode of growth enabling them to expand by the vegetative means in this environment.

Macroalgae recorded from Golden Beach area are growing on sand, rocks and coral substrates. Based on their mode of attachment in relation to substrate types, life form categories are (1) epilithic, (2) epiphytic, (3) rhizophytic, (4) epizoic and (5) drift macroalgae (Table 1). The epilithic and rhizophytic categories are represented by the three divisions of Rhodophyta, Chlorophyta and Phaeophyta. Macroalgae such as *S. paniculatum*, *Padina* sp. are both epilithic and rhizophytic as they inhabit sand and rock substrates. *Anadyomene plicata* and *Lobophora variegata* are epilithic. Similar observation was also obtained by Copejans et al. (1992), who reported that most of the macroalgae at Gazi Bay, Kenya are epilithic since they are attached to the hard substrates such as rocks and corals. The high percentage representation in the epilithic and rhizophytic macroalgae at Golden Beach reflects the bottom topography comprising sand, coral and rock substrates present in the area. Macroalgae are not only attached to some fixed substrate, e.g. rocks and corals but also to marine plants (Japar Sidik et al. 1996). Attachment is by way of a simple modified portion of the plant body or holdfast. Epiphytic macroalgae such as *Leveillea jungermannioides* and *Cladophora fuliginosa* represents a small group and are found attached on seaweed *Cheilosporum jungermannioides* and *Hypnea cervicornis* respectively. The attachments shown are mainly dependent on macroalgae species with some forms of rhizoidal mode of growth. For example, the presence of numerous rhizoids in *C. sertularioides* enabled the species to affix and expand by vegetative means in sand environment. *Hypnea cervicornis* and *Laurencia corymbosa* are epizoic, usually attached to the shells of live bi-

Table 1. Macroalgae recorded at Golden Beach, Similajau National Park, Bintulu, Sarawak. Life form: Epl-epilithic, Epp-epiphytic, E-epizoic, Rp-rhizophytic and D-drift.

No.	Division/Family Chlorophyta	Species	Substrate	Life form
1.	Anadyomenaceae	*Anadyomene plicata* C. Agardh	Rock and live coral	Epl
2.	Bryopsidaceae	*Bryopsis indica* A. Gepp & E. Gepp	Sand, rocks and seaweed	Epl/Epp
3.	Caulerpaceae	*Caulerpa sertularioides* (Gmelin) Howe	Sand and live coral	Rp/Epl
4.		*Cladophora fuliginosa* Kutzing	Seaweed	Epp
5.	Codiaceae	*Codium* sp.	Rocks	Epl
6.	Polyphysaceae	*Acetabularia parvula* Solm-Laubach	Sand and rocks	Rp/Epl
7.	Udoteaceae	*Udotea javensis* (Montagne) A. Gepp and E.S. Gepp	Rocks	Epl
8.	Ulvaceae	*Enteromorpha intestinalis* (Linnaeus) Nees	Sand and rocks	Rp/Epl
9.	Valoniaceae	*Velonia aegagropila* C. Agardh	Sand and rocks	Rp/Epl
10.		*V. utricularis* (Roth) C. Agardh	Sand and rocks	Rp/Epl
	Phaeophyta			
11.	Dictyotaceae	*Dictyopteris delicatula* Lamouroux	Rocks and coral rubbles	Epl
12.		*Dictyota dichotoma* (Hudson) Lamouroux	Rocks and coral rubbles	Epl
13.		*Lobophora variegata* (Lamouroux) Womersley	Live coral, coral rubbles and rocks	Epl
14.		*Padina australis* Hauck	Sand and rocks	Rp/Epl
15.		*Padina* sp.	Sand and rocks	Rp/Epl
16.	Sargassaceae	*Sargassum paniculatum* J.G. Agardh	Rocks and sand	Epl/Rp
	Rhodophyta			
17.	Ceramiaceae	Ceramium *affine*	Coral rubbles, rocks and seaweed	Epl/Epp
18.		*C. gracillimum* (Kutzing) Zanardini	Coral rubbles, rocks and seaweed	Epl/Epp
19.	Champiaceae	*Champia compressa* Harvey	Coral rubbles and sand	Epl/Rp
20.	Corallinaceae	*Amphiroa fragilissima* (Linnaeus) Lamouroux	Sand and rocks	D/Epl
21.		*Cheilosporum jungermannioides* Ruprecht	Rocks and coral rubbles	Epl
22.		*Jania decussato-dichotoma* (Yendo) Yendo	Sand and rocks	Rp/Epl
23.	Cryptonemiaceae	*Halymenia dilatata* Zanardini	Coral rubbles and sand	Epl/Rp
24.		*H. floresia* (Clemente y Rubio) C. Agardh	Coral rubbles and sand	Epl/Rp
25.	Galaxauraceae	*Galaxaura oblongata* Ellis & Solander) Lamouroux	Sand and rocks	Rp/Epl
26.	Gelidiaceae	*Gelidiella acerosa* (Forsskal) Feldmann & Hamel	Sand and live coral	Rp/Epl
27.	Gracilariaceae	*Gracilaria* sp.	Sand and rocks	Rp/Epl
28.	Hypneaceae	*Hypnea cervicornis* J. Agardh	Sand and rocks	E/Epl
29.		*H. pannosa* J. Agardh	Sand and rocks	Rp/Epl
30.		*H. spinella* (C. Agardh) Kutzing	Sand and rocks	Rp/Epl
31.	Rhodomelaceae	*Acanthophora specifera* (Vahl) Borgesen	Sand and rocks	Rp/Epl
32.		*Laurencia corymbosa* J. Agardh	Sand and rocks	E/Epl
33.		*L. perforate* Montagne	Sand and rocks	Rp/Epl
34.		*Laurencia* sp.	Sand and rocks	Rp/Epl
35.		*Leveillea jungermannioides* (Hering and Martens) Harvey	Seaweed	Epp

Total no. of species=35

valve, *Perna* sp. Drift macroalgae (e.g. *Amphiroa fragilissima*) represents a group that is not attached to any substrates but entangled among live corals, dead corals and coral rubbles. Their presence in the area may be attributed to storm event or other kind of disturbances, which sent them adrift to the area. Such macroalgae are not even attaching to any sub-

stratum but remain free and still can survive in the environment. The reasons are that the plants did not feed from the substrate but mainly through the nutrient obtained direct from the water column and also depending on the photosynthesis processes (Chapman, 1979).

In summary, the Golden Beach area has a sizeable diversity of macroalgae represented by the three divisions; Chlorophyta, Pheophyta and Rhodophyta. The macroalgae are able to colonize the area due to availability of soft and hard substrates such as rocks, coral rubbles, dead corals and even to a certain extent live corals.

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