

DIVERSITY ASSESSMENT ON MALAYSIAN BENTHIC MACROALGAE IN TIOMAN ISLAND AND TULAI CANDANG ISLAND, PAHANG

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Abstract- Pulau Tioman is one of the popular tourism island in Malaysia and was gazetted as Marine Park in 1995 to protect the valuable marine resources. Nowadays, species compositions of seaweed are decreasing gradually due to the major environmental disturbance. Thus, due to the concerning on the availability of the seaweeds, the assessment was employed from October 2011 until April 2016 in order to observe the changes in terms of density and richness of the marine algae. The methodology were specimen collection, preservation of the sample, preparation of digital images, specimen identification and herbarium specimen preparation. The herbarium specimens were deposited to Algae Herbarium, Universiti Kebangsaan Malaysia. The outcomes of the study have recorded 76 taxa out of 1176 collected specimens. The recorded taxa were from division of Chlorophyta, Rhodophyta, Phaeophyta and Cyanophyta. Chlorophyta is reported having the highest number of taxa for every assessment, followed by Rhodophyta, Phaeophyta and the least number of taxa is Cyanophyta. Over six years assessment, started from 2011, the species density were gradually change, then it was reduced suddenly in 2013. The reduction in species density were twofold, later the species density getting lower and constant until now. There were several species noticed as new record in Pulau Tioman and Pulau Tulai which are *Acetabularia clavata*, *Anadyomene plicata*, *Caulerpa cupressoides*, *Chaetomorpha ligustica*, *Dictyosphaeria versluysii*, *Gelidiella trinitatis* and *Padina pavonica*. The work has successfully observed the changes in terms of density of the seaweed species throughout six years assessment.

Index Terms- Benthic algae, diversity, seaweeds, Pulau Tioman, Pulau Tulai Candang.

I. INTRODUCTION

Pulau Tioman was popularly known as the tourism hotspot by the sea lovers due to its crystal clear blue seawater, pearl white sandy beach and inhabiting by abundance of marine organism such as coral fishes, echinoderms, colourful hard and soft corals seaweeds and others. The island located almost 56 kilometres to the eastern coast of Peninsular Malaysia.

The size is approximately 38 kilometres length and 19 kilometres wide. The island has a tropical climate with 28°C of water temperature. Historically, Pulau Tioman was the biggest and largest volcanoes mountain, later forming an island and currently now were established as Tioman Marine Park. The island and its vicinities were gazetted as Marine Park in 1995 with an aim to protect the valuable marine resources. A lot of corals inhabiting Pulau Tioman coastline, the habitat of marine life such as seaweeds, sea grasses and varieties of fish species.

The word 'algae' was first introduced by Linnaeus in 1774 and comes from Latin word which means seaweed [1]. There were some definition made by previous researcher [2], which defined algae as a group of organism which is non-vascular plant that cannot be differentiated into true leaf, stem and root. Main structure of algae body are holdfast, stipe and blades [3][4]. Taxonomist identified seaweed accurately based on its pigmentation, photosynthesis storage, motility and composition of cell wall. Chlorophyta, Rhodophyta and Phaeophyta are the

dominant division of marine algae that had always been collected and recorded by phycologist [5][6][7]. Vertical distributions of algae can be divided according to coastal zones which are supralittoral, littoral and sublittoral zone [8].

Supralittoral zone is the upper zone from the shoreline which have minimal waves activity. Algae that live in this zone always exposed to the extreme condition such as wind and air. Thus, the action of waves are important in giving moisturization to the algae. Littoral zone is also known as intertidal zone. The zone is located 200 m from the shore which is exposed to the atmosphere during low tide. This extreme condition will cause dehydration to the algae. Only survived algae can live in this zone. Sublittoral zone is the third zone of coastal zone. Light is the limiting factor that control the growth of algae. Most of rhodophytes can be found in the deeper water [9][10]

II. MATERIALS AND METHOD

A. Study area

Research was carried out at Salang Bay, Berus Dalam Bay, Air Batang Village, Tekek Bay, Lalang Bay, Paya Bay and Genting Bay of Tioman Island and Pasir Panjang Beach, Tulai Island (Fig. 1).



Fig. 1 The map shows the location of sampling sites are marked as round line. Starting from the north of the island; Pasir Panjang Beach, Salang Bay, Berus Dalam Bay, Air Batang Village, Tekek Bay, Lalang Bay, Paya Bay and Genting Bay.

B. Specimen collection

The collection of specimen was made by snorkeling and SCUBA which is by referring to the tide table. The exploration was focused on the specific habitat of seaweeds such as water puddle, rocky and sandy and corals.

C. Specimen preparation

The collected specimen was cleaned from its impurities and preserved by using 4% formalin solution. The fresh specimens were photographed for the purpose of description and identification. The herbarium specimen were prepared and deposited in Algae Herbarium of Universiti Kebangsaan Malaysia.

D. Environmental parameters

The environmental data such as temperature, pH, salinity and dissolved oxygen were recorded in-situ by using YSI multiparameter, while the nitrogen and phosphate content of the seawater was tested by using Hach kit model DR 2000.

III. RESULTS AND DISCUSSION

A total of 76 taxa were successfully recorded from 1176 specimen collected during the six year assessment. Chlorophyta, the green algae are the dominant for every assessment with the highest diversity which is 30 taxa (Fig.2). This is followed by Rhodophyta (25 taxa) and Phaeophyta (15 taxa). Among these, Genting Bay and Tulai Island were having the highest diversity with 40 and 39 species respectively. It is followed by Salang Bay (27 species), Tekek Bay (20 species), Air Batang Village (18 species), Paya Bay (16 species), Berus Dalam Bay (14 species) and the lowest diversity is Lalang Bay (12 species). There were several species noted as new record in Pulau Tioman and Pulau Tulai, they are *Acetabularia clavata*, *Anadyomene plicata*, *Caulerpa cupressoides*, *Chaetomorpha* *ligustica*,

Dictyosphaeria versluysii, *Gelidiella trinitatis* and *Padina pavonica*.

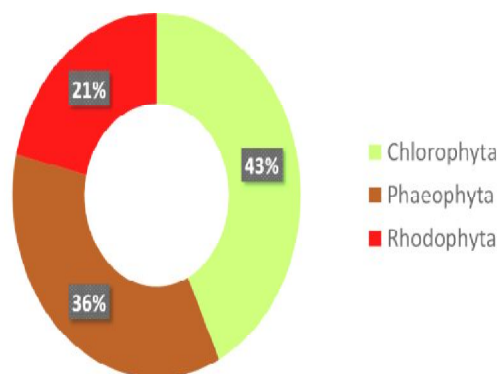


Fig. 2 This pie chart illustrates the approximate percentage of the collected marine algae according to their division. The largest percentage recorded by the green algae, Chlorophyta.

Over six years assessment, the collection on 2011 were the highest compared to the other year. Year by year, the species density was reduced gradually, but in 2013 the reduction in species density was doubled to only 9 species collected. Then, the density becomes constant from year 2014 until now (Fig. 3). The construction of chalet and motel near to the seaside are probably leads to habitat destruction. Besides, the sedimentation from the nearest construction site is changing the turbidity and clarity of the water. During collection of samples, most of the samples were covered by silt and mud and this have proved the sedimentation causing the diversity of seaweed to reduce. The environmental sensitive species are unable to survive prior to the instant environmental changing [11][12].

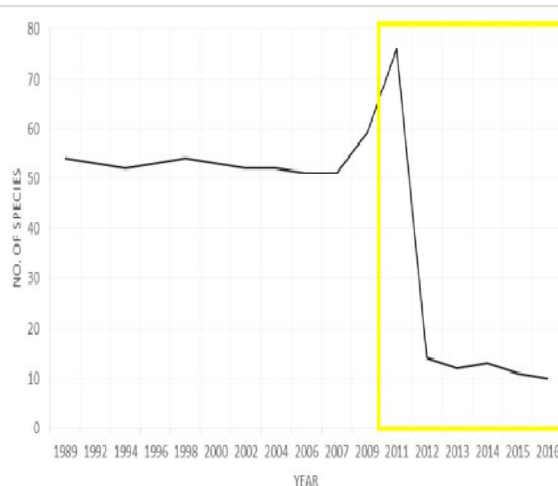


Fig. 3 This line graph shows the changes in number of species from the previous research until 2016. The yellow box indicates the latest assessment. The highest diversity occurs in once in 2011, the number of species dropped suddenly in 2012 and getting constant until 2016.

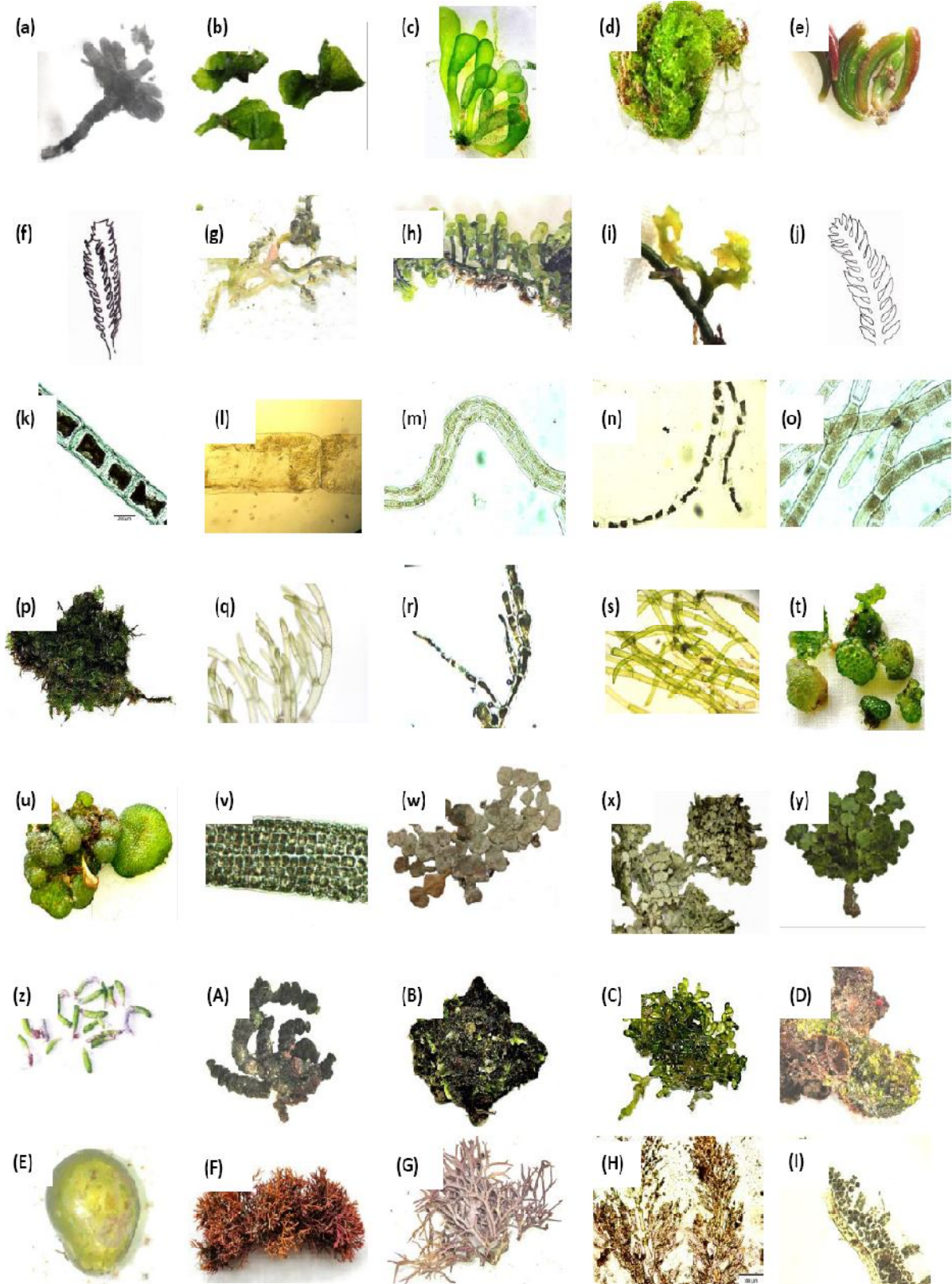


Fig 4. The picture above shows the species of division Chlorophyta [(a)-(E)] and Rhodophyta [(F)-(I)]. (a) *Acetabularia clavata*. (b) *Anadyomene plicata*. (c) *Boergesenia forbesii*. (d) *Boodlea composita*. (e) *Bornetella nitida*. (f) *Caulerpa cupressoides*. (g) *Caulerpa peltata*. (h) *Caulerpa racemosa*. (i) *Caulerpa serrulata*. (j) *Caulerpa taxifolia*. (k) *Chaetomorpha aerea*. (l) *Chaetomorpha ligustica*. (m) *Chaetomorpha linum*. (n) *Chaetomorpha minima*. (o) *Cladophora sericea*. (p) *Cladophora* sp. (q) *Cladophora stimpsonii*. (r) *Cladophora vagabunda*. (s) *Cladophoropsis membranacea*. (t) *Dictyosphaeria cavernosa*. (u) *Dictyosphaeria versluysii*. (v) *Enteromorpha clathrata*. (w) *Halimeda discoidea*. (x) *Halimeda opuntia*. (y) *Halimeda simulans*. (z) *Neomeris annulata*. (A) *Tydemania expeditionis*. (B) *Udotea javensis*. (C) *Valonia aegagropila*. (D) *Valonia fastigiata*. (E) *Valonia ventricosa*. (F) *Actinotrichia fragilis*. (G) *Amphiroa fragilissima*. (H) *Antithamnionella* sp. (I) *Ceramium gracillimum*.

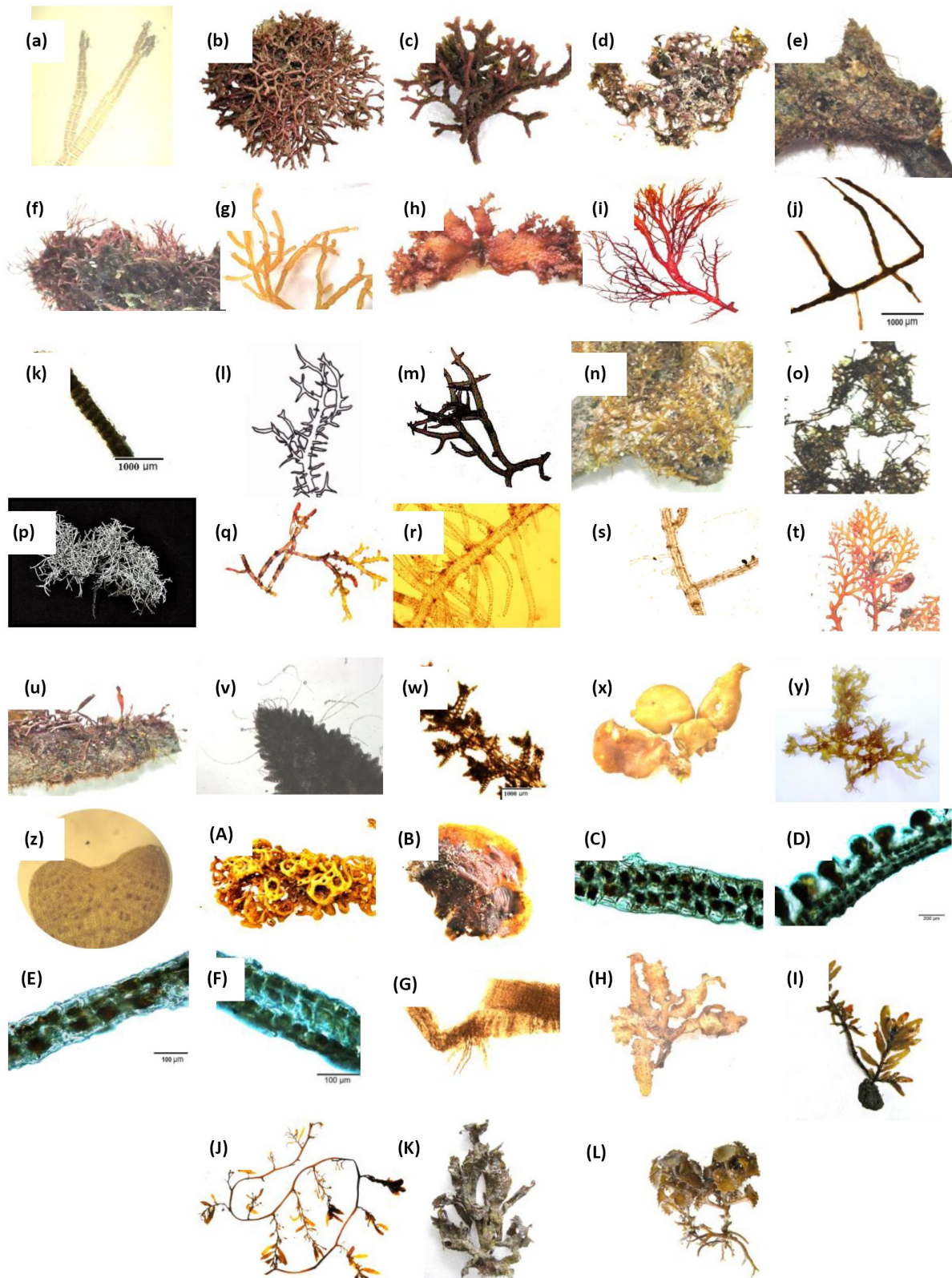


Fig 5. The picture above shows the species of division Rhodophyta [(a)-(W)] and Phaeophyta [(X)-(L)]. (a) *Ceramium tenuissimum*. (b) *Galaxaura oblongata*. (c) *Galaxaura rugosa*. (d) *Gelidiella acerosa*. (e) *Gelidiella trinitatis*. (f) *Gelidiopsis intricata*. (g) *Gracilaria salicornia*. (h) *Halymenia dilatata*. (i) *Halymenia floresia*. (j) *Herposiphonia pacifica*. (k) *Herposiphonia tenella*. (l) *Hypnea cervicornis*. (m) *Hypnea pannosa*. (n) *Hypnea spinella*. (o) *Hypnea valentiae*. (p) *Jania-decussato dichotoma*. (q) *Laurencia parvipapillata*. (r) *Murrayellopsis dawsonii*. (s) *Polysiphonia coacta*. (t) *Porteria hornemannii*. (u) *Pterocladia caloglossoides*. (v) *Tolypocladia calodictyon*. (w) *Tolypocladia glomerulata*. (x) *Colpomenia sinuosa*. (y) *Dictyota cervicornis*. (z) *Dictyota dichotoma*. (A) *Hydroclathrus clathratus*. (B) *Lobophora variegata*. (C) *Padina australis*. (D) *Padina boergesenii*. (E) *Padina minor*. (F) *Padina pavonica*. (G) *Padina tetrastromatica*. (H) *Sargassum ilicifolium*. (I) *Sargassum polycystum*. (J) *Sargassum* sp. (K) *Spatoglossum* sp. (L) *Turbinaria ornata*.

CONCLUSION

To date there is no extensive assessment on the diversity of seaweeds have been done in the study area. The described species were able to update and recorded the species found in the island. Some of the commercially important as well as scientifically interesting species have been analysed. To make the status of marine algae feasible, more comprehensive research on seaweed and its application have to be conducted.

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