Faculty of Resource Science and Technology

EPIPHYTIC MACRO-ALGAE (SEAWEED) IN MANGROVE OF SADONGJAYA, ASAJAYA AND KUCHING, SARAWAK

Nasuha A'didah binti Marzuki

Bachelor of Science with Honours

(Aquatic Resource Science and Management)

2015

UNIVERSITI MALAYSIA SARAWAK

Grade: ____________

Please tick (√)

Final Year Project Report ☑

Masters ☐

PhD ☐

DECLARATION OF ORIGINAL WORK

This declaration is made on the ....25.......day of....JUNE......2015.

Student's Declaration:

I NASUHA ÀDIDAH BINTI MARZUKI, 37440 (PLEASE INDICATE STUDENT'S NAME, MATRIC NO. AND FACULTY) hereby declare that the work entitled EPIPHYTIC MACRO-ALGAE (SEAWEED) IN MANGROVE OF SADONGJAYA, ASAJAYA AND KUCHING SARAWAK is my original work. I have not copied from any other students' work or from any other sources except where due reference or acknowledgement is made explicitly in the text, nor has any part been written for me by another person.

25 JUNE 2015
Date submitted

NASUHA ÀDIDAH BT MARZUKI
Name of the student (Matric No.)

Supervisor's Declaration:

I Dr. OTHMAN B. BOJO (SUPERVISOR'S NAME) hereby certifies that the work entitled EPIPHYTIC MACRO-ALGAE (SEAWEED) IN MANGROVE OF SADONGJAY, ASAJAYA AND KUCHING, SARAWAK (TITLE) was prepared by the above named student, and was submitted to the "FACULTY" as a * partial/full fulfillment for the conferment of ------------------------------------ (PLEASE INDICATE THE DEGREE), and the aforementioned work, to the best of my knowledge, is the said student's work.

Received for examination by: ____________ Date: 25.06.2015

(Name of the supervisor)

Dr. Othman Bojo
Profesor Madya
Jabatan Sains Akuatik
Fakulti Sains dan Teknologi Sumber
UNIVERSITI MALAYSIA SARAWAK
94300 Kota Samarahan

I declare that Project/Thesis is classified as (Please tick (√)):

☐ **CONFIDENTIAL** (Contains confidential information under the Official Secret Act 1972)*
☐ **RESTRICTED** (Contains restricted information as specified by the organisation where research was done)*
☑ **OPEN ACCESS**

Validation of Project/Thesis

I therefore duly affirm with free consent and willingly declare that this said Project/Thesis shall be placed officially in the Centre for Academic Information Services with the abiding interest and rights as follows:

- This Project/Thesis is the sole legal property of Universiti Malaysia Sarawak (UNIMAS).
- The Centre for Academic Information Services has the lawful right to make copies for the purpose of academic and research only and not for other purpose.
- The Centre for Academic Information Services has the lawful right to digitalise the content for the Local Content Database.
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis for academic exchange between Higher Learning Institute.
- No dispute or any claim shall arise from the student itself neither third party on this Project/Thesis once it becomes the sole property of UNIMAS.
- This Project/Thesis or any material, data and information related to it shall not be distributed, published or disclosed to any party by the student except with UNIMAS permission.

Student signature ______________ (Date) 25/JUNE/2015

Supervisor signature: ______________ (Date) 25.06.2015

Current Address:
NO. 14 KANGANGAN BELIA, SEBERANG PERAK,
36000, TELUK INTAN, PERAK.

Notes: * If the Project/Thesis is **CONFIDENTIAL** or **RESTRICTED**, please attach together as annexure a letter from the organisation with the period and reasons of confidentiality and restriction.

[The instrument is duly prepared by The Centre for Academic Information Services]

Acknowledgement

By the grace of Allah the Beneficent, the Merciful and The Compassion, I am able to complete this thesis “Epiphytic Macro-algae (seaweeds) in Mangrove of Western coastal water in Sarawak: Asajaya, Sadongjaya and Kuching Wetland. A million thanks to my supervisor, Assc. Prof. Dr. Othman b. Bojo, who never give up on providing me a guide to finished my final year project. A special thanks and appreciation goes to my parents Marzuki b. Shaari and A’ashitun binti Wan Nayan for their limitless moral and financial support. They also helping me to survive all the stress from this year and not letting me give up. Thanks you very much to all FRST staffs that invoved directly and indirectly in this study. Not forgotten to all my friends especially Siti Nabila binti Mohd Sharif, Siti Sarah binti Jamil, Fatin Ameera binti Mohd Izam and Mohd Effy Izran bin Mazlan for your assistance and suggestion throughout my project.

Declaration

I hereby declare that no portion of work referred to this dissertation has been submitted in support for another degree of qualification or another university or institution of higher learning.

NASUHA A'DIDAH BINTI MARZUKI

Department of Aquatic Science

Faculty of Resource Science and Technology

University Malaysia Sarawak

Table of Contents

List of Figures and Tables

Epiphytic Macro-algae (seaweeds) in Mangrove of Asajaya, Sadongjaya and Kuching, Sarawak

Aquatic Resource and Management Programme

Faculty of Science and Technology

University Malaysia Sarawak

ABSTRACT

An assessment of seaweeds composition in Asajaya, Sadongjaya and Kuching Wetland mangrove was done. Seaweeds sample was collected within 100m² of the sampling site at these there location. Seven genera namely *Enteromorpha, Cladophoropsis, Bryopsis, Gracilaria, Hypnea, Jania and Spatoglossum* were identified based on morphological characters. Based on the total number of species, division Rhodophyta shows the highest percentage during the entire period of study. The density and frequency for each species were calculated. *Gracilaria* sp show the highest density and frequency for those the sampling site. Division Phaeophyta was the least species that was found at those sampling site.

Key words: seaweed, mangrove, Asajaya, Sadongjaya, Kuching

ABSTRAK

Satu penilaian komposisi rumpai laut di kawasan paya bakau Asajaya, Sadongjaya dan Kuching Wetland telah dilakukan. Sampel rumpai laut telah dikutip dalam 100m² laman pensampelan di ketiga-tiga lokasi tersebut. Tujuh genera telah dikenal pasti iaitu Enteromorpha, Cladophoropsis, Bryopsis, Gracilaria, Hypnea, Jania dan Spatoglossum telah berdasarkan kepada aksara morfologi. Berdasarkan jumlah bilangan spesies,kumpulan Rhodophyta menunjukkan peratusan tertinggi dalam tempoh keseluruhan kajian. Densiti dan frekuensi setiap spesis juga dikira dan Gracila sp menunjukkan nilai paling tinggi di ketiga-tiga tempat pensampelan. Divisi Phaeophyta adalah species yang paling sedikit ditemui di tapak pensampelan.

Kata kunci: Rumpai laut, paya bakau, Asajaya, Sadongjaya, Kuching

1.0 Introduction

Seaweed can be defined as macroscopic marine algae from division of chlorophyta (green algae), Rhodophyta (red algae) and Phaeophyta (brown algae) (Ahmad, 1995). It is also one of the photosynthetic organisms occurring in most habitats. It's possessing different type of pigment such as chlorophylls, carotenoids, and other accessory pigment which enable them to synthesize organic compound from simple compound such as water and carbon dioxide in the presence of light as source of energy. The most usual habitat of seaweeds are in any bodies of water, but they also common in terrestrial environments and also found in unusual places such as on snow and on ice. According to Abott and Dawson, 1978, the seaweeds inhabit the benthic division or the sea floor and also called as attached algae. The attachment of seaweed is by structure called holdfast, a simple modified portion of plant body (Teo & Wee, 1983)

Growing in saline coastal sediment habitats in the tropics and subtropics, mangroves are various types of trees up to medium height and shrubs. Mangrove forest that usually found near the coastal water, estuaries and around the island is a group of plant that have several unique characteristic that combined the characteristic of plant that live in the land and sea (Kanthaswamy *et al*., 1994). Mangrove is usually located at estuary the place where seawater and freshwater meet. The mangrove area is distinguished by the harsh condition and to be able to survive within this condition, organism may have to withstand the exposure to desiccation, temperature stress, osmotic stress and ultra violet radiation (Rawlings, 1999). The mangrove plants also require a number of physiological adaptations. They also play many important roles in ecology such as mangrove swamps protect coastal areas from erosion, storm surges, and tsunamis, wave energy can be dissipated efficiently by the mangrove root sytems, and the deposition of the sediments as the tide comes in can be slow down enough to leave all except fine particles when the tide ebbs.

Often referred to as the “bostrychietum” (Post, 1936), mangrove-associated algae represent a specialized group of plants occurring as epiphytes on the stems and roots of mangrove trees or growing on other substrata within the mangrove ecosystems. They are the main food source for a variety of fishes and invertebrates, such as crabs (Wada and Wowor, 1989). An understanding of their diversity and biomass on certain habitats may indicate the health of mangroves (Chihara and Tanaka, 1988). By building and trapping sediments and or in carbonate precipitation, algal mats that consist largely of Rhodophyta, Phaeophyta, and Chlorophyta associated with mangrove habitats play an important role. Furthermore, the coastal waters are enrich with a highly diverse flora and fauna including some species of seeweed (Fisheries Resource Institute, 1998). There are some previous studies done by several scientists about the epiphytic macroalgae on the mangrove ecosystem. One of the studies was done by Gallin *et al*., (1989) on the mangrove vegetation of Gazi bay, Kenya. Another study was done by Fortes and Sci (1987) on the structure of algal communities.

1.1 Objectives

1. To determine the dominant species of epiphytic macro algae in mangrove forest of Sadong Jaya, Asajaya and Kuching Wetland.
2. To evaluate the quantitative assessment of abaundance of seaweeds from these three location.

2.0 Literature review

2.1 What are seaweeds?

Seaweed or macro-algae are defined as a group of simple organism which contains chlorophyll so it can manufacture their own food through photosynthesis process and can be found in the aquatic habitats and moist places or land (Ariffin, 2006). Seaweeds also are the macroscopic algae that can be found attached on the seafloor of shallow waters (Ananthamaran and Kannan, 2009). Meanwhile, seaweed can be distinguished by their pigments (Guiry and Guiry, 2011). They require an environment where water is present at all times, so they can live up as far as the flash zone in the seashore and down to 30 m depth in the sea, where they can get enough light for photosynthesis (Mine, 2008) (Figure 1). According to Phang *et al*. (2008), seaweeds form an important component of the coastal and marine ecosystem by providing feeding, breeding and nursery ground for some of marine life.

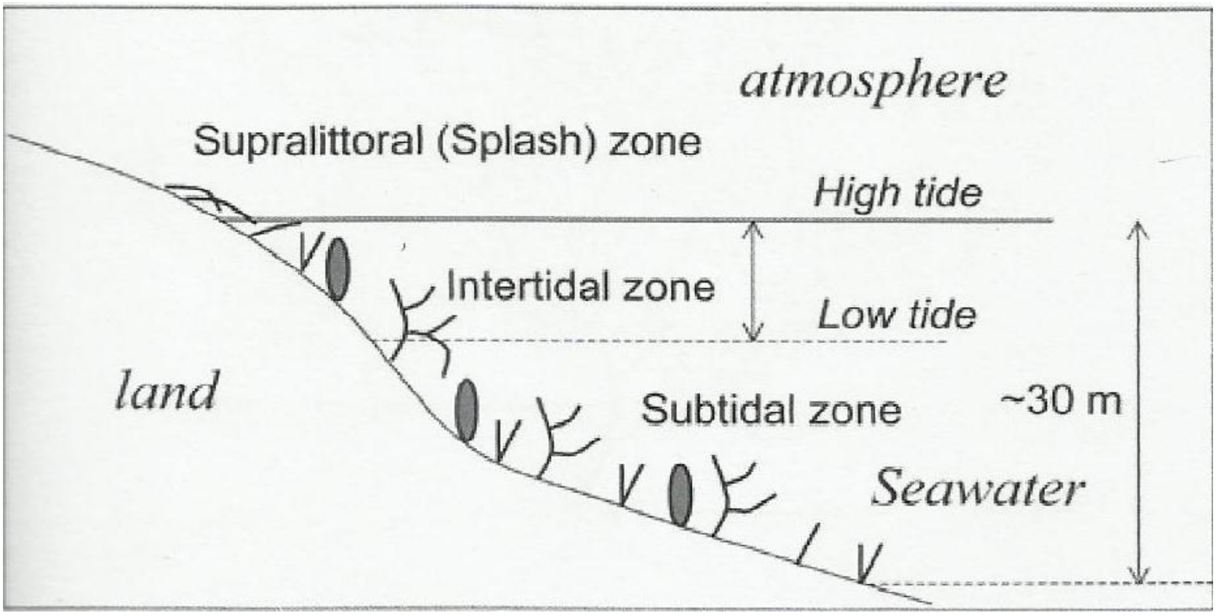

Figure 1: Distribution of seaweeds along the seashore (Adapted from mine, 2008)

2.2 Morphological of Seaweed

All seaweeds at some stage in their life cycles are unicellular, as spores or zygotes, and may be temporarily planktonic (Lobban, 1994). The forms usually composed of a recognizable blade, a stem-like stipe and root-like simple rhizoids or more complex holdfasts (Hodgkiss & Lee, 1983). They do not have true roots, stem or leaves (Dhargalkar and Kavlekat, 2004). Attachment of seaweeds is by way of a holdfast, a simple modified portion of plant body (Teo & Wee, 1983). Figure 2 shows the whole body of the algae called thallus that consist of holdfast, blade and stipe. Blade has variable in shape and contains photosynthesis pigment meanwhile a stipe is the structure for support their body. Most of they are macroscopic in size, so that they are easily seen by naked eye or the most with help of low-power hand lens of x10 magnification (Teo and Wee, 1983)

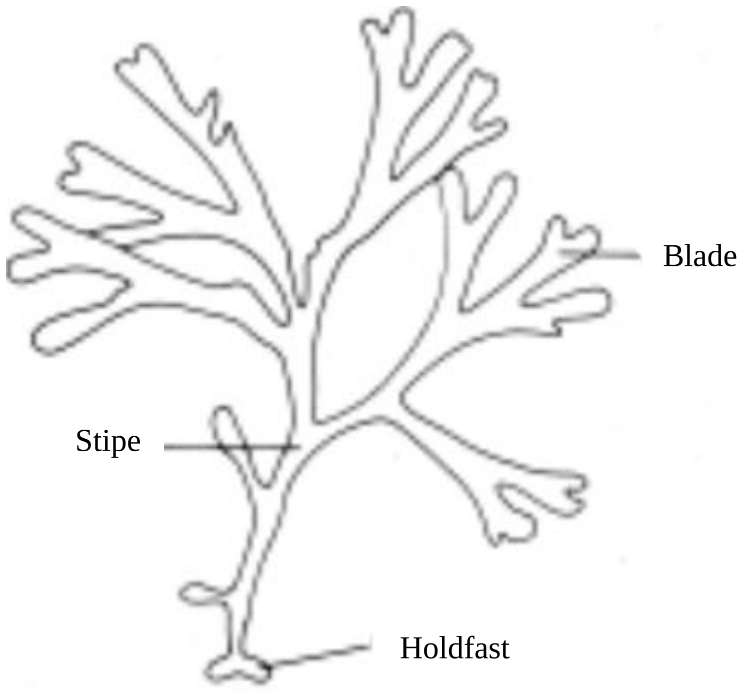

Figure 2: Parts of a thallus (Adapted from Dhargalkar & Kalvekar, 2004)

2.3 Reproduction of the seaweeds

Reproduction of seaweeds can be sexual or asexual. In sexual reproduction a male and female cell, either of which is termed gamete, fuse to form a zygote following (Ariffin, 2006). The gametes are usually motile, big provided with flagella for the purpose (Teo and Wee, 1983). There is no fusion of gametes in asexual reproduction. The simplest form is fragmentation, where by the plant body breaks up as a result of tidal action or grazing by marine animals and each portion eventually regenerates into a separate plant (Teo and Wee, 1983).

2.4 Classification of seaweeds

Seaweeds are evolutionarily quite diverse (Lobban, 1994). According to Abbott and Dawson (1978), green algae (Chlorophyta), brown algae (Phaeophyta) and red algae (Rhodophyta) are three groups of algae which make up the vast majority of seaweeds are namely because of the main colors which their members commonly assume, and are technically distinguished by the chemistry of their pigment. This statement support by Litter *et al*. (1989), which stated that the green, brown and red algae are named after the color of the dominant photosynthetic pigments. Most seaweed is multicellular most of the time. Multicellular algae often grow vertically away from the substraturn. This habit brings them closer to the light, enables them to grow large without extreme competition for space, and allows them to harvest nutrients from a greater volume of water.

2.4.1 Chlorophyta

Chlorophyta or green algae include a range of morphological type from unicells to variously complex multicellular structures. According to Wells (2010), the green algae tend to be delicate in its morphology and the turn brown when decomposition takes place. The colour of these plant are tipically green because the pigment are characteries same as other plant. Members of the division are found in variety of habitats including terrestrial, freshwaters and marine (Teo & Wee, 1983) Chloropytes contain pigments of chlorophyll a, chlorophyll b, and xanthophylls (Ahmad, 1995). Their thalli may be fairly or highly calcified, appearing in diverse form – fan shaped segments, feather like or star-shaped brances (Dhargalkar & Kavlekar, 2004). These divisions consist of five oders, 11 families, 20 genera, 48 species and three varieties (Ahmad, 1995). Starch is their photosysthetic product and the reproduction for this group is both asexual and sexual (Trono, 1997).

2.4.2 Rhodophyta

There are over 10, 000 described species of red algae. Division Rhodophyta or red algae have distinct redness as a result of phycoerythrins and phytcocyanins that mask the chlorophy a and carotenoids (Teo & Wee. 1983). According to Abbott and Dawson, (1978) it’s not easy to recognise this division of algae because many of them are not really red in color, but green, brown, purple or even black in nature. They inhabit intertidal to subtidal to deeper waters (Dhalkar & Kavlekar, 2004). This plant have pigments of chlorophyll *a*, chlorophyll *b*, chlorophyll *c*, phycoerythrins, phycocyanins, α & β carotene (Ahmad, 1995).

2.4.3 Phaeophyta

Members of the Phaeophyta or brown algae are mostly macroscopic seaweeds. They show a complex morphology compared to other algae (Moris, 1988). Members of the Phaeophyta are distinguished by a brown or yellow brown color, which result from the carotenoid pigment, fucoxanthin. Major photosynthetic pigments are chlorophylls *a*, chlorophyll *c*, β-carotene, violaxanthin, and diatoxanthin. Cell walls are composed of cellulose, alginic acid and sulphated polysaccharides relatives proportion vary among species and environmental conditions (Mackie & Preston, 1974).

Of all species, less than 1% are known from freshwater habitats. Several species colonizing estuarine and saltmarsh environments. Nearly all freshwater species may be recognized by possesing large unilocular sporangia or clusters of plurilocular sporangia following (John, 2002). Phaoephyta represented by four orders which consists of five families, 12 genera and 27 species overall (Ahmad, 1995)

Table 1: Diagnosis features of seaweeds.

Division	Pigment (s)	Plastid (s)	Storage (s)	Cell wall
Chlorophytes	Chorophyll *a*, Chlorophyll *b*, xanthophylls	2-6 thylakoids	Starch	Cellulose
Phaeophytes	Chlorophyll *a*, Chlorophyll *b*, β carotene, xanthophylls, fucoxanthin	3 thylakoids	Laminarin and mannitol	Cellulose & arginic acid
Rhodophytes	Chlorophyll *a*, Chlorophyll *b*, Chlorophyll *c*, Phycoerythrin, Phycocyanin, α & β carotene	Unstacked thylakoids	Floridean starch	Cellulose, xylan & pectin

Source: Ahmad, 1995

2.5 Growth and tolerance in intertidal seaweeds

Water movement in intertidal zone has intense influence on yhe ecology and physiology of seaweeds (Barr *et al*., 2008). In addition, the negative effect of extreme water movement can be seen in the detachment or destruction of seaweeds (Lobban & Harrison, 1994). However, low levels of water movement can limit growth by restriction of supply of macronutrient such as phosphorus and nitrogen (Hurd, 2000). Intertidal seaweeds tend to inhabit environment where there is less water movement over a significant period of time (Pearson *et al*., 1998).

2.5 Uses of seaweeds

In the last three decades the discovery of metabolites with biological activities from macroalgae has increased significantly (Smit, 2004). Seaweed have various uses for human and animal food, soil fertilizer, colloid production, cosmetics and pharmaceuticals (Krishnaih *et al*., 2008). Global utilisation of macroalgae is a multi-billion dollar industry based on farming of edible species or on the production of agar, carrageenan and alginate. They have attained commercial significance through their use in various industries which exploit their physical properties such as gelling, water-retention and their ability to emulsify (Renn, 1997). Little commercial exploitation of products extracted from seaweeds occurs outside the hydrocolloid industry. Substances that currently receive most attention from pharmaceutical companies for use in drug development, or from researches in the field of medicine-related research include sulphated polysaccharides as antiviral substances, halogenated furanones from *Delisea pulchra* as antifouling compound, and kahalalide F from a species of *Bryopsis* as a possible treatment of lung cancer, tumours and AIDS following (Smit, 2004). Prior to the 1950s, the medicional properties of seaweeds were restricted to traditional and folk medicines (Lincoln *et al.,* 1991). Research into the active ingredients of seaweeds used in folk remedies underlies another area of drug discovery. Seaweeds are traditionall used in human and animal nutrition (Fleurence, 1999).

Seaweeds have been traditionally used by the Western food industry for their polysachharide extractives- alginate, carrageenan and agar- also contain compouds with potential nutritional benefits. Recently, seaweeds have been approved in France for human consumption (as vegetables and condiments), thus opening new opportunities for the food industry following Mabeau and Fleurence (1993).

Their abundance and diversity have made them prime material for human use. Even though the new ways of using them are constantly being researched and developed, many of the old ways of using them are still practised.

2.6.1 Food

In ancient times, seaweeds are eaten for their food values, flavours, colours, and textures and are typically combined with other types of food. Seaweeds often have been eaten by coastal inhabitants to ward off stravation during times of famine due to failure or destruction. Through analyses of certain edible seaweeds, many contains significant amounts of protein, vitamins and minerals essential for human nutrition; they also contain large amounts of polysaccharides that are usually not digestible by humans.

2.6.2 Fodder

Deer, rabbits, arctic foxes and polar bears have been observed eating seaweeds. Livestocks such as cattle, sheep, horses, goats, pigs, and poultry have regularly been fed by seaweeds in areas where they are conveniently and abundantly available. A period of habituation has been indicated for animals to achieve good digestibility of the seaweeds in some cases.

2.6.3 Fertilizer

For agricultural use, seaweeds are collected from beach drift or harvested. The method of application ranges from whole and chopped plants applied wet or dry to composted, liquified, supplemented, and extracted preparations. Ashes or 'kelp' from burn seaweeds have also been applied to improve the soil. Seaweeds have ample amounts of nitrogen and potassium but low in phosphate for use in most crops as a fertilizer. Compared to 'average' barnyard manure, seaweeds have similar nitrogen values, about one-third as much phosphate and about three times as much potassium (Chapman, 1970). The high organic matter content is similar and is binificial in improving water retention and mechanical properties of the soil. An advantage of seaweed as fertilizer is that it is free of weed seeds and spores of fungi that harm terrestrial crops. The auxin, cytokinin, and gibberellin associated with seaweed regulate crop growth and ripening and because they may inhibit certain pathogens, including virus-carrying aphids and some fungi.

2.6.4 Biofiltration

Seaweeds also can be used as an alternative biofilters for maintenance of water quality in land based mariculture (Neori *et al*., 1996). Seaweed filtration improve the efficiency and productivity of aquaculture by enhancing culture conditions (Cahill *et al*., 2010). Othe than that, seaweed are used or designated as biomonitors to study the environment contamination (Caliceti *et al*., 2002). Biosorption using seaweeds for agricultural fisheries industry have shown a remarkable potential to be used as treatment for wastewater treatment contaiminated with heavy metal (Ghimire *et al*., 2007). According to Senthilkumar *et al*., (2007) brown seaweeds have the potential to be used as heavy metal biosorption because it contained polysaccharide that has excellent binding metal capacity.

3.0 Materials and methods

3.1 Study area

The study has been carried out at mangrove Sadong jaya mangrove (N 01º 50.684', E 111º 49' 43.7"), Kuching Wetland (N 01º 76.154', E 110º 33' 38.1"), and Asajaya mangrove (N 01º 49.92', E 110º 49' 16.26") (Figure 3).

Figure 3: Study site (Google maps, 2014)

3.2 Algae sampling

The algae sampling was carried out in all selected mangrove forest during low tide from November, 2014 to March, 2015. 100 m^2 of sampling site were marked. The sample was collected within this area. Knife has been used to collect the samples. The whole thallus of seaweeds must be pulled out from it substrate for identification. In mangrove area, seaweed could be found attach to mangrove roots (Ahmad, 1995). Other information about the sample like location, physical features of seaweeds, temperature, salinity and pH has been recorded.

3.2.1 Photograph

Taking a photo were one of the best ways to identify the seaweed if incase the samples collected were broken. Photograph will be used for identification.

3.2.2 Preservation

10 % of ethanol and sea water was used to preserve the samples. The solution was poured into the whirl park. This process was done in the field to avoid the samples become spoiled. The location, date, substrate, colour of the specimen has been recorded.

3.3 Identification and documentation

The non-diatom samples were viewed under a compound microscope for taxonomic identification following Abbot and Hollenberg (1976). Related book was used for identify the sample. Identification of the specimen obtained by using keys from Ahmad (1995), Dhargalkar and Kavlekar (2004) and Nurridan (2007). The significant characters for identification were based on the morphology of size, form, branch of thallus and type of holdfast. For documented process, photo of the sample has been used.

3.4 Quantitative assessment of abundance

Quantitative assessment of abundance was a statistical consideration, which includes density, frequency, species richness and species diversity (Dhargalkar & Kavlekar , 2004). The using of statistical consideration was for the more realistic picture of dynamics and structure of seaweeds.

3.4.1 Density

Density was the count of number of individual of the species and the total area sampled. The uses formula for the calculation was stated by Dhargalkar & Kavlekar (2004).

$$D = n/A$$

Where D = density

n = total number of individual of the species

A = total area sampled

3.4.2 Frequency

Frequency was the number of the sample in which species occur and total number of samples taken (Dhargalkar & Kavlekar, 2004).

$$F = j/k$$

Where F = frequency

j = number of samples in which species occur

K = total number of samples