

FISH DIVERSITY IN ARTIFICIAL SEAGRASS AREA

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UNIVERSITI MALAYSIA SABAH

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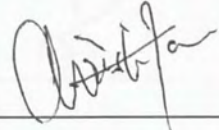
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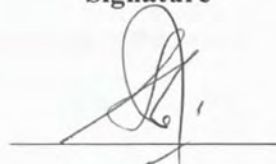


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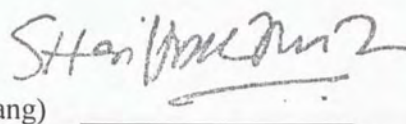
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ABSTRACT

A field experiment was designed to assess the attraction of artificial seagrass on fishes. Artificial seagrass units were tied with 6 square metal mats, 1m x 3m, and were submerged on a plain area that only contain silt and sand nearby jetty of UMS, Sepanggar Bay. The fish identification was made up to genus level and fish abundances were recorded with the aid of photos. The characteristics of every fish were also observed during dives.

Two tests were applied by using Shannon Weaver Index and Pielou Evenness Index to know the fish diversity in the area. As the result the diversity of fish in the area was high but had decreased compared to the study in the previous year.

The interpretation of these data is that artificial seagrass successfully attracts various fishes, with the most occurrences was *Caesio sp.*. However the numbers of fishes in the area decreased based the data in previous study in this area, with some of the factors such as the condition of the artificial seagrass units in the area such as all the seagrass blades were lying on the seabed and the environmental problem such as algae bloom.



ABSTRAK

Kajian telah dijalankan ke atas rumput laut tiruan untuk mengetahui sejauh manakah kawasan rumput tiruan ini dapat menarik ikan-ikan dari kawasan lain. Unit rumput laut tiruan ini terdiri daripada 6 petak besi sebesar 1m x 3m, ditaburkan di satu kawasan kosong yang hanya mengandungi pasir berdekatan dengan jeti Universiti Malaysia Sabah di Teluk Sepanggar. Identifikasi ikan sehingga ke genus telah dijalankan di kawasan tersebut dengan mengambil gambar foto ikan dan dicatatkan juga dengan bilangan ikan dengan menggunakan kertas berkalis air semasa menyelam.

Data-data ikan termasuk bilangan dan rupa bentuk amat diperlukan supaya kepelbagaian ikan di kawasan rumput laut tiruan dapat diketahui dengan menggunakan Index Shannon Weaver dan Index Kesamarataan Pielou. Keputusannya telah menunjukkan kepelbagaian ikan dalam kawasan tersebut adalah agak tinggi namunnya telah menurun berbanding dengan kajian sebelum ini.

Sebagai keputusan, rumput laut tiruan ini telah berjaya menarik sebilangan ikan yang berbilang spesies ke kawasan ini, di antara genus ikan yang paling banyak ialah *Caesio sp.*. Walaubagaimanapun kutipan data pada kajian sebelum ini telah menunjukkan bahawa bilangan ikan di kawasan ini telah berkurangan. Ini boleh disebabkan keadaan rumput laut tiruan itu iaitu rumput laut telah terdampar di dasar laut dan keadaan air laut di lokasi kajian seperti Pasang Surut Merah.



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LIST OF ABBREVIATION, SYMBOL AND UNIT

$\sum_{i=1}^S$	Sum of the number of species S started from the first species.
&	And
ADW	Ash-free dry weight
cm	Centimeter
DW	Dry weight
e.g.	Exempli gratia (Latin)
E_H'	Pielou Evenness Index
etc.	et cetera
H'	Shannon Weaver Index
ln	Natural logarithm
m	Meter
p_i	The relative abundance of each species, calculated as the proportion of individuals of a given species to the total number of individuals in the community.
S	Number of species
$sp.$	Species



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CHAPTER 1

INTRODUCTION

1.1 Introduction

1.1.1 Seagrass History

The earliest taxonomic studies on seagrasses were carried out in Europe by psychologists primarily interested in the abundant algal epiphytes on seagrasses and aquatic plants. The group was known as Helobiae. Systematic survey of the Helobiae, including seagrasses were carried out by Ascherson and Gürke (1889), who had studied incorporated and morphological and anatomical observations. The framework established in this study formed the basis of the groupings adopted by den Hartog (1970) in his comprehensive treatment of these plants.



1.1.2 Ecology of Seagrass

Seagrasses are a kind of plant that lives beneath the ocean. Usually they can be found in most of the shallow coastal areas. They are present as colonies, but not individually.

In tropical areas, most of the seagrass colonies appear nearby mangroves at the coastal area. In order to grow faster and healthier, sufficient intake of nutrients is a must for seagrass. Mangrove area is the main source of nutrients due to the ability of mangroves to trap the sediments. The sediments will settle down in the area because the movement of the current in mangrove area is zero. The settlements will be fixed by microorganisms or detritus and produced as nutrients that are needed by marine flora, including seagrass, during high tide as nutrients outflow. Basically, there are certain composition of nutrients that are needed by seagrass; which are nitrate (Boon *et al.*, 1986) and phosphorus (Carignan & Kalff, 1982). Those nutrients can be attained either from the nutrients outflow of mangrove area, seabed and nutrients fixation by bacteria. Other than the organic matters and sun light, carbon dioxide is also required by seagrass in order to do the photosynthesis for food construction.

1.1.3 Seagrass Community

Seagrass meadows in many parts of the world support large numbers of juvenile fishes and provide a nursery habitat for many commercially important species (Pollard, 1984). Seagrass can provide protection for small fishes to prevent predation from other fishes. Besides, seagrass area can also provide food for juveniles and small fishes whether they are grazer or carnivores. Within seagrass area there are many



invertebrates living in. Most of them are mobile such as gastropods, bivalves and cephalopods. For grazers, they will seek algae that grow on the seagrass leaves. Even the seagrass themselves can be the source of food for herbivores. As a result, seagrass can provide food for fishes, whether it is directly or indirectly.

1.1.4 Artificial Seagrass

Artificial seagrass is actually the mimic of natural seagrass. It has some of the functions and ability of natural seagrass. For example, it can provide nursery ground for juveniles, provide habitat for small fishes and arthropods, provide food for grazers, provide hiding place for small fishes to prevent predation of bigger fishes and prevent coastal erosion (Larkum & West, 1983).

Nevertheless, some of the functions of natural seagrass cannot be established by artificial seagrass. Artificial seagrass cannot produce gases to increase the gas regulation in the water. The leaf blade of natural seagrass can be the source of food for herbivores but not for artificial seagrass. Artificial seagrass does not have real roots as natural seagrass has for absorbing the nutrients and consolidate the sand structure to prevent coastal erosion. The details of the pros and cons between the natural seagrass and artificial seagrass will be discussed in the next chapter.



1.2 Objective

- i. To identify the genus of the fishes in the study site.
- ii. To know the fish diversity by Shannon's diversity index in the artificial seagrass area.
- iii. To compare the diversity of fish in the current and previous studies.

1.3 Significance of Study

The successiveness of seagrass attracting fish inhabits inside of it can be the main tool to increase the fish population in the area. Among the fishes there is probability that commercial fish also inhabits in the seagrass meadow area, indirectly increase the local fishery economics.

This artificial seagrass project expects that fishes can be attracted to this area under several factors such as food seeking, nursery ground, hiding from predators, or as the fishes' home. The attraction factors can be the reason on the build up of artificial seagrass communities in more areas to increase the productivity of fish and fisheries.

The identified fish genus can be important reference in the future. The data obtained can be the reference for any studies on seagrass or artificial seagrass. If there is any new genus or species of fish under the area of artificial seagrass area, it could be one of the contribution to the fish data base.



CHAPTER 2

LITERATURE REVIEW

2.1 Artificial Seagrass = The Mimic of Natural Seagrass

The artificial seagrass is constructed based on the structures of real seagrass. The only differences are the real seagrass is running metabolism activities and doing photosynthesis during day time. The rest of the functions are the same with natural seagrass which will be described further in the following subchapters.

2.2 Shelter

Seagrass beds serve as nursery ground for juveniles of a variety of finfish and shellfish of commercial and sportfishing importance (Zieman, 1982).

Seagrass beds are spatially positioned between the inshore mangroves and marshes and the offshore coral reefs. Thus, a great variety of animals are permanent residents or finds temporary shelter within the leaf canopy at some stage of their life cycle. In the tropics, a number of fish and sea urchin species undertake a temporal migration from their daylight abode on the coral reef to a night-time feeding residence on the adjacent seagrasses. There are seasonal finfish and shellfish that shelter and



feed within the seagrasses during their migratory movements. There are a great number of juvenile fish species which migrate offshore from the mangrove or marsh habitats and find refuge in the seagrass meadows before migrating offshore (Thayer *et al.*, 1978; Philips, 1984).

The previous study conducted by Bell *et al.* in 1987 determined that fish larvae were discriminating significantly between seagrass meadows and bare sandy substratum. In the study, Bell compared the fish abundances in between the artificial seagrass area, cages and bare sand. He had discussed that larger habitats (the cages) will receive more individuals than smaller habitats of the same shape (artificial seagrass units), provided there is equal availability of larvae. However, in practice, habitat shape may be even more important than habitat size. Their result showed that there is significant difference between the artificial seagrass area with bare sand area.

Kikuchi (1980) enumerated four reasons for this sheltering function: (1) Seagrass form a dense submerged meadow and increase the available substrate surface for epiphytic algae and fauna; (2) Dense vegetation reduces the water movement resulting from currents and waves and offers calm underwater space within it; (3) Because of the less disturbed water, mineral and organic particles sink to the bottom, creating relatively clear water; (4) The leaf mass reduces excessive illumination in the dynamic which facilitates the refuge effect for the prey species.



2.3 Predation

Generally, the denser the seagrass bed, the greater the protection that is offered to macrofaunal species. Seagrass species with complex structure or a large biomass of associated epiphytes have high numbers of associated animals because they restrict the access of epibenthic predators. Experimental manipulations of seagrass density and predator abundance have indicated that both an active choice of dense patches of seagrass by most species and higher rates of predation in sparse patches are responsible for this relationship (Stoner, 1980; Bell & Westoby, 1986).

Research on both fresh water and marine predator-prey interactions has shown that structural complexity has an inhibitory effect on predator success (Orth, 1977; Nelson, 1979). Submerged vegetation is one structure that may influence predator efficiency by inhibiting the movement of predator or by reducing the visibility of prey (Stoner, 1980; Orth *et al.*, 1984). Seagrass provides a visual barrier between predator and prey which may reduce predator detection of prey and prey detection of predator.

Some predators can feed successfully in submerged structures such as seahorse because of its physical structures. The species *Hippocampus erectus* of seahorse relies on the dorsal fin for propulsion and paired pectoral fins for precise movements within structure. The caudal fin has been replaced by a prehensile tail which also aids in manoeuvrability. The prehensile tail is also used to grasp blades and pull them aside, which facilitates passage (James & Heck, 1993).



However, visual predation in aquatic environment is strongly correlated with ambient lights levels (James & Heck, 1993). Most animals feed during either the day, night or “twilight” hours depending on their adaptations to the influence of light on their environment. In seagrass beds, the leaf mass reduces illumination in the daytime, offering a shaded environment for living animals (Kikuchi, 1980).

As the result, seagrass beds can provide hiding place for preys to avoid predators by the blades density and shading areas that the light is blocked by the seagrass community.

2.4 Nursery Ground

Seagrass provides shelter and food during the early life history stages when individuals are susceptible to predation. This has led to the view that seagrasses are important nursery areas for fish, including species of commercial and recreational value (Kikuchi, 1974; Adams, 1976; Weinstein and Heck, 1979; Beckley, 1983; Pollard, 1984). Few species of fish actually spawn among seagrasses (Kikuchi, 1966). Instead, most of the species usually spawn at the area away from seagrass habitat such as estuaries or bays.

In Australia, Dybdahl (1979) found that 65% of all individuals were juveniles and that of 73 of the 144 species of fishes and invertebrates present were of economic value. 86 of the 88 species collected by Ramm (1986) were represented by juveniles and 18 species were of economic value. Robertson & Mann (1982) described in detail



how juveniles of 2 species, *Sillaginodes punctatus* and *Arripis trutta*, use seagrass as their growing area.

A common pattern of seagrass habitat is for juveniles to utilize seagrass beds but for adults to inhabit a variety of different inshore habitats. Examples of sequential use of habitats by different life history stages of fish are given by Robertson & Lenanton, (1984) and Middleton *et al.* (1984). Collectively, fish occurring in estuaries as juveniles make up a substantial proportion of the total commercial fish catch (Pollard, 1984).

Actually, seagrass provides nursery areas for a resource of much greater economic value than fish, which is the penaeid prawns. As juveniles, the two most important species in fishery, the tiger prawns *Penaeus esculentus* and *Penaeus semisulcatus* are found predominantly in seagrass beds (Coles *et al.*, 1987). In southern Queensland, juvenile king prawn *Penaeus plebejus* is also commonly associated with seagrass (Young, 1978).

Other decapod species of economic value, including the western rock lobster *Panulirus cygnus* and the blue swimmer crab *Portunus pelagicus*, also occur in seagrass as juveniles. Larger juveniles shelter on reefs during the day but forage over adjacent beds of *Heterozostera* and *Halophila* at night (Jernakoff, 1987). Blue swimmer crabs settle from the plankton into seagrass beds near the mouths of estuaries (Bell & Westoby, 1986), and small juveniles are common in intertidal seagrass. Cockles (*Anadara trapezium*) are another exploited species that settles into



seagrass beds from the plankton. They are different from other species discussed before because they remain there permanently.

Some juvenile fish are not dependent on seagrass bed, but shelter it provides. Bell *et al.* (1987) found that several species are believed to use only seagrass as nursery area, settled and survived as small juveniles equally well on artificial shelter. The results of Bell *et al.* (1987) help put the role of seagrass beds as nursery areas into perspective. Even though seagrass may not be essential to some of the juvenile fishes, seagrass do provide the bulk of the shelter available in many estuaries. Without seagrasses, shelter will be lacking or greatly reduced. Without shelter, the settlement success of juvenile fish will be reduced.

2.5 Seagrass Epiphytes

Epiphytic organisms are important primary producers and potentially significant food sources. The skeletal remains of epiphytic crustose algae are also important as sources of CaCO_3 for sediments (Land, 1971). These algae are ubiquitous in their occurrence on seagrasses, and larger erect coralline algae such as *Metagoniolithon* spp. and *Jania* spp. are commonly found on some species of seagrass. In south-western Australia, up to 200 tonnes km^{-2} of calcium carbonate occur on the stems and leaves of *Amphibolis antarctica*. Their skeletal remains are estimated to increase the depth of sediment by $0.5 \text{ mm m}^{-2} \text{ year}^{-1}$ (Walker & Woelkerling, 1988).

Surface of seagrass leaves typically carry a complex layer of periphyton comprising of diatoms, macroalgae, encrusting algae, bacteria, fungi and settling



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