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Community Structure of Fish Larvae in Mangroves with Different Root Types in Labuhan Coastal Area, Sepulu – Madura

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Abstract. Mangrove root complexity and shading are well known to give positive correlation for both juveniles and adult fishes. However, it is remain unclear whether that complexity would affect the community of fish larvae (ichthyoplankton). This study aimed to address the question, especially in mangrove area in coastal area of Sepulu, Madura which projected as a mangrove protection area. Sampling periods were from March to May, 2016. The samples of fish larvae were collected by plankton net (mesh-size 0.150 and 0.265 mm) from six different locations representing different root types (stilt root, pneumatophore, combination of stilt root-pneumatophore and unvegetated area). As the results, 6 families were identified, namely Gobiidae, Blennidae, Pomacentridae, Carangidae, Engraulidae and Ambassidae, respectively. Gobiidae seems to be the most abundant and widely dispersed in the area. Results of two-way AnovadanTukey HSD (both at p = 0.05) indicate that there were significant difference in the larval abundance regarding locations, sampling periods and interaction of both factors. As for number of taxa, significant difference occurred only from factors of locations and sampling periods, but not for interaction of both factors. Highest larval abundance and number of taxa occurred in *Rhizophora*spp (with stilt root), indicating that root complexity would affect the community of fish larvae. Ordination by canonical analysis shows that different taxa of the fish larvae are tend to be distributed on different locations.

Keywords: community structure, fish larvae, mangrove root, Labuhan coastal area

INTRODUCTION

The term 'mangrove' is used to define both the plants that occur in tidal forests, and to describe the community itself [1]. Mangroves can be broadly defined as woody vegetation types occurring in marine and brackish environments. They are generally restricted to the tidal zone [2].Mangroves are unique ecosystems. As a source of renewable resources, they are second to none in terms of its natural productivity and the wide range of goods and services they provide on a continuing basis, i.e. for estuarine and near-shore fisheries [3]. Mangroves is widely recognized as one of coastal ecosystem that support high abundance fish diversity and high numbers of individuals, some of which have great commercial importance [4] [5] [6] [7] [8] and most of mangrove areas are protected worldwide as a nursery ground of fishes [9] [10].

There are two hypotheses that proposed to explain why mangroves are so attractive for fishes: first; the predator refuge hypothesis, which stresses that the structural complexity of mangrove pneumatophores and prop roots provides excellent shelter from predators for juvenile and small fishes by migrating into vegetated areas of mangroves particularly when the trees are inundated by water [7] [11] [12] [13]. Second, the feeding hypothesis, which explained that there is a greater abundance of food within mangroves due to high productivity and the associated abundance of benthic fauna [10] [11].

Most of studies on effect of canopy and root structure complexities of mangrove focused to juveniles and small fishes, as exampled by [10] [12] [14] [15] or on mature fishes [7] [13]. However, those effects on fish larvae or

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ichthyoplankton are still poorly understood, with only several studies recorded from Southeast Asia, i.e. from Thailand [15]and Malaysia [16] or Indonesia [17].

Mangrove area of Labuhan, Bangkalan – Madura representing a moderate to good condition, thus projected as a mangrove conservation and education area by local community, with aid from a national oil and gas company. At least 12 species of true mangrove and more than 25 species of associate mangrove occurred in the area. The diversity of mangroves in the area are moderately high. Some of them with pneumatophore root type (*Avicenniamarina* and *Sonneratiaalba*) and the other with stilt root type (*Rhizophora*spp and *Bruguiera*spp) [18]. Mangrove's root complexity in the area assumed to give an effect for planktonic fish larvae communities. Sampling of estuarine and coastal fishes at 2015 shows that more fishes collected from mangroves than from unvegetated area. However, a study concerning correlation of mangrove and fish larvae in the area had not been conducted.

Based on those facts, it is a clear need to conduct a study in order to access the effects of mangrove root complexity on community structure of fish larvae. Data obtained from this study could be used as baseline for mangrove management in the area.

MATERIALS AND METHOD

Study Sites and Sampling Periods

Six sampling stations representing mangrove vegetated areas and one unvegetated sampling station established along coastline of Labuhan, Sepulu – Madura, as shown in Figure 1. The RR (Station 1) as a location that dominated by mangrove *Rhizophora* spp with stilt and prop roots; SS (Station 2) as a location that dominated by mangrove *Sonneratia alba* with pneumatophore while CM (Station 3 and 4) as locationswith mixed species of mangrove, namely*Rhizophora*, *Sonneratia* and *Avicennia*. The last are TM (Station 5 and 6) as location without mangrove vegetation. Samples collections were conducted monthly from March to May 2016.

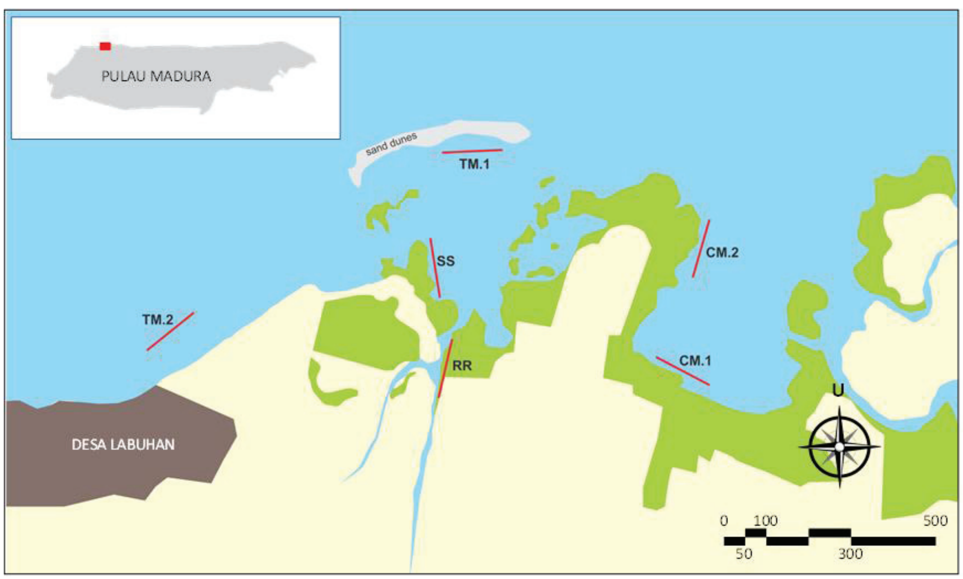

FIGURE 1. Fish larvae sampling locations in Sepulu coastal area

Fish Larvae Collection

The fish larvae samples were collected by plankton net with mesh size 0.150 and 0.265 mm. The net towed subsurface in proximity of mangrove. Towing path is 100 meter long and duplicate samples were obtained from each location. Collected samples immediately preserved in 10% buffered-formaldehyde. Ambient parameters measured including salinity, water temperature, alkalinity or pH, level of dissolved oxygen (DO), turbidity and surface current.

Sample Processing and Analysis

In the laboratory, fish larvae were sorted and separated from other zooplankton taxa with help of a stereo microscope. Fish larvae identified to the family level using available information from [19] [20] and [21]. The number of individuals per taxon was counted from the entire sample and fish larvae density was calculated based on a standard volume of 100 m^3[16] [22].

Data Analysis

Two-way analysis of variance (Anova)[16], followed by a Tukey's HSD test (both at p = 0.05) were used to compare the differences in larval abundance and richness among locations and sampling periods. RDA triplot performed to determine the relationship between the abundance of fish larvae and environmental variables among locations.

RESULT AND DISCUSSION

Environmental Variables

The average of water temperature in the study area was 31.64±1.88°C, which still in the range of marine water quality standard for marine life at 28-32°C [17]. The average salinity was 29±3.03‰while the salinity tolerance of marine life ranging from 18-32‰ [23]. Salinity value in study area also still in the range of marine water quality standard for marine life [17].Averaged value for pH was 7.12±0.21 and DO was 6.77±1.026 mg/L, respectively; whilst standard quality for marine life are 7-8.5 for pH and >5.00 mg/L [17]. In the study area, turbidity ranged from 0.73 to 144 NTU. Highest turbidity recorded is study area was due to high input of detrital particulate and resuspended sediment particles. Surface current in the study sites was very slow, with a value of <0.01 m/s [24].

Fish Larvae Composition and Abundance

In general, from three sampling periods at six sampling locations we identified six families of fish larvae, namely Ambassidae, Apogonidae, Blenniidae, Carangidae, Gobiidae and Pomacentridae. All families in this study comprises common taxa found in estuary [16] [22] [25] [26].

Gobiidae is the family with highest abundance found in all observation stations, make up 70% of total individual abundance of fish larvae. This family is well known to have a good adaptability to the estuarine environment [27], therefore most abundant in estuaries and the sea [28] and has a relatively long larval phase, approximately to 40 days [29]. Because of these reasons, Gobiidae would be found in high abundance in estuarine water [15] [16].Family with the second highest abundance is Blenniidae (21% of total population of fish larvae); followed by Pomacentridae, Ambassidae, Carangidae and Apogonidae. As same as Gobiidae, Blennidae is one family of fish which are also commonly found in large quantities in the estuary [16] [25].

Among locations, RR station have highest fish larvae abundance, with to total number is 188.33 individual/100m^3, and comprised from five families, excluding Apogonidae, respectively. The lowest abundance of fish larvae occurred in SS station, with only 13.33 individual/100m^3. In this study, locations without mangrove (TM.1 and TM.2) have a relatively higher number of individual (73.33 and 35 individual/100m^3) compared to SS station. Based on [10], richness and abundance of fish in Dongzhaigang Bay (China) are possibly lower in the mangrove area than in mudflat. The similar findings also occurred in Barwon River Estuary (Australia) [10].

Result of two way Anova and Tukey's HSD test (both at p=0.05) indicate that there were significant difference in larval abundance regarding locations, sampling periods and interaction of both factors, with the highest abundance occurred in RR. As for number of taxa, significant difference occured only from factors of locations and sampling periods, but not for interaction of both factors.

Highest richness and abundance of fish larvae occurred in RR. This is possibly correlated with mangrove root type in the station, which dominated by dense stilt and prop root of *Rhizophora*. Study of [17] stating that highest abundance of fish larvae occurred in mature *Rhizophora* vegetation with more complex root structure which providing shelter for the larvae. In study by [12], which using artificial mangrove unit (AMU) to mimicking the root of mangrove, reported that abundance and diversity of fish will be highest in location with more complex root system and more dense canopy.

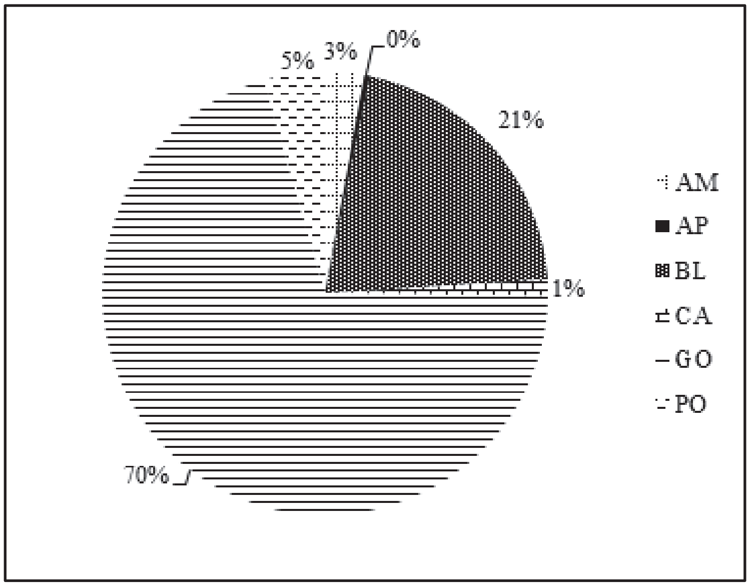

FIGURE 2. Composition and relative abundance of fish larvae

Correlation of Fish Larvae and Environmental Variables

The distribution of fish larvae in the study area, in correlation with environmental variables (temperature, pH, salinity, DO, turbidity and surface current) was accessed by a RDA diagram; as shown in Figure 3.

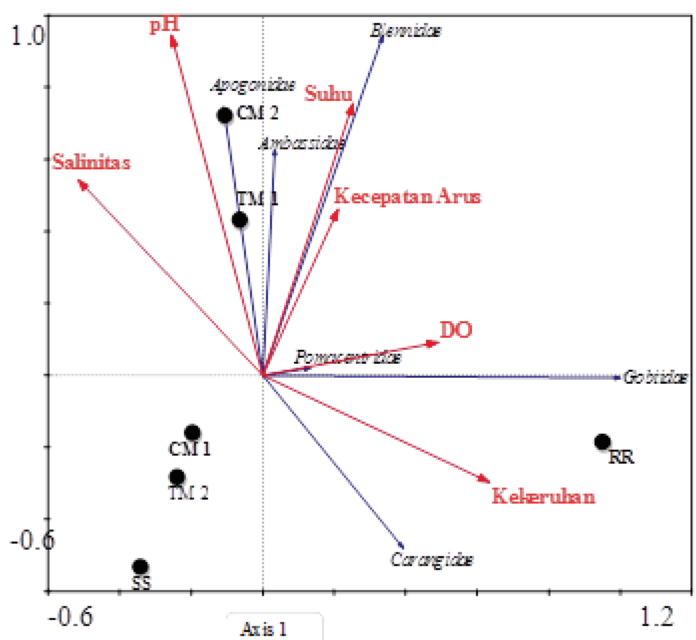

FIGURE 3. RDA triplot relationship of fish larvae and environmental variables at each location

Based on the diagram, some families of fish larvae tend to clustered in certain locations. Pomacentridae and Gobiidae more likely to be concentrated at RR station whilst Apogonidae only at CM.2 station. Ambassidae and Blenniidae tend to be found at CM.2 and TM.1. Based on the results of the diagram, environmental factors affecting the distribution of fish larvae in RR station.These finding correspond with the results of measurements of environmental variables which indicating that turbidity and DO have greatest value and always consistent in that location. pH and water temperature appear to affect the distribution of fish larvae in CM.2, as those variables have greatest value and always consistent in that location. However, Monte-Carlo Permutation Test resulting that there are no single environmental variable responsible for distribution of fish larvae in study area (p value of environmental variables is <0.05). In other words, each environmental variable is interacting with each other to influence the distribution of fish larvae. Based on this, mangrove roots structure seems to be the main cause of differences in the abundance and distribution of fish larvae.

According to [11], structural heterogeneity of mangrove habitat are attractive to juvenile fish. The structural complexity provided by the above-ground portion of the mangrove can reduce the efficiency of predatory by inhibiting or restricting the predator's vision. Many studies have proven that juvenile fish are more interested in the structure complexity of mangrove root to reduce the risk of encounter with predator [11] [13] [16] [30].

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