

Fish Larva Distribution and Profusion in Mangunharjo and Timbulsloko Mangrove Ecosystem

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Fish larva distribution and profusion in Mangunharjo and Timbulsloko mangrove ecosystem

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Abstract. Mangrove area as nursery grounds for the fish larvae in Semarang and Demak. Fish larvae were collected during August - February representing dry and rainy seasons from three mangrove station swamps by a beach seine net. The net was dragged on the bottom for 100 m three times. A total of 291 fish larvae were collected, representing 5 families. The most abundant species formed about 76 % of all collected fishes. Two fish larvae family were collected for the first time from mangrove areas in the Timbulsloko. Most of the collected fishes are economically important fishes. Moreover five families were belonging to demersal fishes. The highest species richness value was recorded in Timbulsloko mangroves at night in the river. This Finding showed that mangroves could support the life history of many demersal and pelagic fish.

I. Introduction

About one hundred of fish larvae species included in 18 families live on mangrove areas. The vast majority of demersal fishes have demersal larva that spent in the water column away from adult habitat on the ocean [1]. Larva Phase is potentially much more dispersive than the relatively sedentary adult stage, many aquatic biota have complex life histories [2]. Marine fishes need spawn and nursery habitats are the same habitats as their adult, but for most species nursery habitats are distinct [3].

Most marine organisms phase hatch into larvae that drift in ocean currents for 1 week to several months before transforming into juveniles [3]. Explained that the main cause of the decline in fish stocks in artisanal fishing areas to below the current catchment threshold Destructive and poisonous fishing activities occurred in the mangrove area in Mangunharjo Semarang. It has been proved that high number of fishes and marine invertebrates depends to a large extent on mangrove habitats during the juvenile phase of their life cycles, where the mangrove prop-roots create a special underwater habitat, especially during the breeding and juvenile stages [4].

The availability of mangrove nursery habitat had a striking impact on the community structure and biomass of reef fish in their adult, coral reef habitat. The biomass of several species was more than doubled when the reefs were connected to rich mangrove resources [4].

Despite the importance of mangroves as nursery area for life history of fishes, researches on the early stages of fishes and the biology and ecology in the Timbulsloko and Mangunharjo sea are very rare. Moreover, information on the distribution of fish larvae of the ocean is almost lacking. However [5] studied the distribution, growth, feeding, species composition and abundance of the fish larvae in the mangrove area. Therefore, this study aims to determine the composition of fish larvae communities inhabiting mangrove swamps in the Timbulsloko and Mangunharjo sea, to evaluate the importance of



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these swamps as nursery areas for the economically important fishes and how mangroves could support the life history of reef fishes.

This study aims to determine the relationship between mangrove that can affect environmental conditions so that it becomes a barometer of the abundance of fish larvae in the mangrove area of Timbulloko Demak and Mangunharjo Villages, Semarang City. The expected benefit of this research activity is that it can become the basis of fish resource management based on the success of the recruitment process from an upbringing area where the fish larvae are developed to recruit sustainable stocks and zoning to be carried out in accordance with the conservation concept.

2. Research methods

The material used in the study of mangrove density analysis on the abundance of fish larvae in Semarang and Demak was a sample of fish larvae caught using Scoope Net fishing equipment and phytoplacton and zooplankton test results from the Mangrove area in Mangunharjo Semarang and Timbulloko Demak. Most of the coast of Timbulloko is formed of medium to coarse sand while the northern part is characterized by grit stone. The tidal flat is wide, nearly horizontal and extends smoothly with a very gentle slope seaward. Its bottom floor is rocky mainly from the dead coralline limestone covered with thin layer of fine sand and mud inhabited with mangrove trees. This area is very shallow and the mangrove trees were situated along the beach zone, also the area has narrow rocky tidal flat. Mangunharjo is shallow with a narrow coastal area that is inhabited by mangrove trees located at 9°32'–9°55' LS and 108°33' - 102°36' BT.

The tidal flat is narrow in the middle and southern parts while the northern part is sandy and inhabited with dense seagrasses cover. It extends smoothly with very gentle slope seaward. Timbulloko at 5°50'–5°52' LS dan 106°34' - 106°36' BT in the north coast is about 70 km south of Demak (Fig. 1). It contains the best-developed stands of mangrove on the entire coast. This stand has a crescent shape, with two sandy protected shallow lagoons with muddy bottom. The lagoons are sheltered and nearly isolated from the sea.

2.1. Study site

The tool used in the field research is the Global Positioning System (GPS) to determine the location of the research location, Scoope Net with a mesh size of 0.5 mm to capture fish larvae, sample bottles as caught larvae and water containers, digital cameras for documentation, thermometers measurement of air temperature and water temperature, flow meter for measuring current velocity, hand refractometer for accurate measurement of salinity, secchi disk for measuring brightness and depth, universal pH Digital for measuring pH (acidity degree), stationery for recording results. The tools used in the laboratory for identification of larvae are stereo microscopes, tweezers, petri dishes, writing instruments for recording results, digital cameras for documentation, and identification books as references in comparing the morphology of fish larvae.

This research was carried out in the villages of Mangunharjo, Semarang and Timbulloko, Demak. Primary data is obtained by conducting direct observations in the field during the months of August-February. Data collection of fish larvae is carried out every day and night during day and night, in the mangrove forest area in the waters of Mangunharjo and Timbulloko using 3 types of fish larvae, namely: 1 scoope net for data collection in the mangrove area, 2. fish larvae nets with a mesh size of 0.5 mm for data collection in deep-water mangrove areas and fish trap net larvae with 0.5 mm mesh size temporarily placed in the area mangrove channel. The operation of the drag net is dragged when the net has reached the bottom of the water at the specified station, while the scoope net and trap net larvae are used in the water surface area. Secondary data used in this study were obtained from previous research and related agencies in the villages of Mangunharjo, Semarang and Timbulloko, Demak. Secondary data includes phytoplankton, zooplankton, pH, temperature, salinity and tidal pattern data. Other secondary data including satellite imagery as a tool for processing GIS, and questionnaire data on catches in each season in the form of fishing area questions, estimated number of catches and types fish obtained.

Physico-chemical parameters of temperature and salinity, were measured by the Hydro-lab. Juvenile fishes were collected from the mangroves of Timbulloko and Mangunharjo in rain and dry

season. Fishes were collected by a small beach seine that was towed horizontally creeping on the bottom for a distance of approximately 10 m [4]. Fishes were removed and then frozen for further investigation. Sizes of the fish larvae fishes were measured to the nearest 0.1 cm.



Figure 1. Location of the Mangunharjo and Timbulsloko sea showing the sampling mangrove site.

2.2. Data analysis

The abundance of fish larvae defined as the number of fish larvae united in water volume is calculated using the formula [12]:

$$N = n/Vtstr$$

N = abundance of fish larvae (ind / m³)

n = number of enumerated larvae (ind)

$Vtstr$ = volume of filtered water ($Vtstr = l \times t \times v$)

l = the width of the larvae mouth opening

t = towing time (minutes)

v = speed of withdrawal time (towing speed) (meters / minute)

The diversity index of the types of fish larvae caught is used to determine the presence of individuals between genera in a community. This value is calculated using the Shannon-Wiener index [24]. Shannon-Wiener Diversity Index formulation is based on the equation as follows:

$$H' = - \sum_{i=1}^s p_i \ln p_i \quad (11)$$

H' = Shannon-Wiener Diversity Index

N = total number of individuals in the community (n_i)

n_i = number of individual species or species i

p_i = proportion of the second individual species (n_i / N)

$i = 1, 2, 3, \dots, s$

s = number of genus / species

Data analysis is a method used to process and analyze research data to obtain a conclusion so that it can be read and interpreted. The analytical method used in this study is the product moment correlation method with the SPSS version 23.0 computer statistical analysis program. Normality test is used to test whether the subject's score in the group is an estimation of the score of the subject in the population [21] and that the score of the subject in the population is normally distributed [2]. The normality test was tested using the Kolmogorov-Smirnov test technique [12]. G-test of the Fit Test with the help of the SPSS version 23.0 program. to determine differences in the number of individuals and number of species between months and sites

Linearity test is a procedure that is used to determine whether or not the linear attainment of a research data distribution. Linearity test is done by using the F test, it is expected that the F empirical price is smaller than the theoretical F, which means that the distribution of the data studied has a linear form [23].

3. Result and discussion

Mangroves in Timbulsloko and Mangunharjo were highly exposed during the low tide with a water depth of less than 10 cm. The average value of water temperature ranges from 27 - 31.2 ° C, the average value of water salinity obtained is 28 - 32.2 ‰, the average value of water brightness ranges from 0 - 97, the average value of water depth ranged from 52 - 187.6 cm, the average value of aquatic pH ranged from 7.16-8.46, the mean value of aquatic DO ranged from 7.0 to 8.3 and the average velocity of water currents ranged from 0.1 - 1.5m / s.

Table 1. Average results of 3 repetitions of aquatic physico -chemistry parameter measurement.

Site Sample	Parameter						
	Temperature (°C)	Salinity (ppt)	Brightness (m)	Depth (cm)	pH	DO (mg/l)	Current (m/s)
TSS	27	28.1	34	105	7.23	8.3	1.2
TSM	29	29	17.7	96	7.53	7.9	1.5
TSP	30	32.1	0	52	8.22	7.0	0.2
TMS	27	29	77.2	187.6	7,16	7.4	1.3
TMM	29,7	30	39	100	7.33	7.3	1.2
TMP	30,7	32.2	21	97	8.46	7.9	1.5
MSS	27,5	29	61.5	142	7.91	7.8	1.4
MSM	29,5	30	41.6	97	8.15	7.6	0.1
MSP	31,2	31.6	20	78	8.37	7.4	0.2
MMS	28	28	97	134	7.28	7.6	0.5
MMM	29,7	30	28	79	7.45	7.9	0.4
MMP	31,7	31.7	12	66	8.46	7.1	0.2

A total of 291 fish larvae, representing 5 families were collected throughout the period of study (Table. 2). The most abundant *Gobidae* and *Mugilidae* with 3 families other. The analysis of the diversity indices showed that TMS mangrove site had the highest diversity index. Where as MSP site has lowest value of diversity index. The number of species was also much hinger in MMS site than both MMM and TMM as indicated by the richness value. The analysis of variance (Annova) showed that there was asignificant difference between the three site mangrove area (F=4.12, P<0.05). Regarding the spatial distribution of fish larvae. TMS site mangrove harbored the highest number of fishes larvae where 291 fish larvae representing 5 families. The highest number of fish larvae was collected in november, whereas the lowest number was recorder in december (Table 3 and figure 6). The highest number of species was found in november where 51 fish larvae species were collected. Whereas, the lowest number 30 was recorded in december.

The size frequency distribution of the four abundant species was analyzed. Size of the collected fishes throughout the present study ranged from 0.11 cm 0.81 cm. The seasonal variation in the size indicated that the largest fishes (0.81) occurred in autumn. *Mugilidae* had the largest fishes in november and smallest in February. Many studies in various parts of the world have recognized the importance of mangroves as habitats for fish [7]. It has been known to contain a high diversity and abundance of coral reef fishes in the Caribbean [23], in the Indian Ocean [16]. The present study showed the importance of mangroves as nursery for commercial reef fish species along the Mangunharjo coast. Several hypotheses have been proposed to explain the high abundance of juvenile

fishes in mangroves. These hypotheses are based on avoidance of predators and the abundance of food [4] [18].

When fishes become too large to be protected by mangrove prop-roots they often migrate to the open. This migration pattern has largely been described qualitatively for a few species (Rooker and Dennis, 1991). In the present study, most juveniles leave the mangrove as they grow. These species may be dependent on mangroves for longer periods than other species. Most of the studied species use the shallow water (mangroves) as nurseries during their larvae stage, but migrate permanently to the deeper (coral reef) when reaching a specific size class. However, *Chanidae* and *Mugilidae* reach large size in mangrove of Timbulsloko in TMS site. Of the species recorded in the present study, two are found in other habitats than mangrove.

Table 2. Density of fish larvae inhabiting mangrove swamps in different sites.

Family	August	September	October	November	December	January	February
Gobiidae	24	21	17	37	15	23	32
Mugilidae	16	14	12	13	10	15	13
Chanidae	1	3	1	1	1	3	3
Apogonidae	2	-	2	-	3	1	-
Scatophagidae	1	-	2	-	1	4	-
Total	44	38	34	51	30	46	48

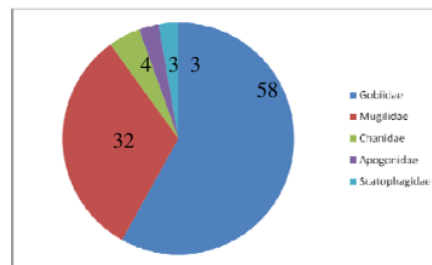


Figure 2. The percentage contribution of the most abundant species.

Very limited work has been carried out on the fish larvae stages of ocean [4]. Five Families were collected during the present study where they were absent from the previous surveys. These were *Mugilidae*, *Gobiidae*, *Chanidae*, *Apogonidae*, *Scatophagidae*. Two of these species were collected from Mangunharjo. Two species (*Apogonidae* and *Scatophagidae*) were collected from TMS site and one species (*Chanidae*) was collected from MMS site, *Gobiidae* was collected from both TMS and MMS site (Table 2). The substrate of both TSM and MMS site with a lot of prop-roots that may suit the existence of this species which avoids the muddy substrate in Timbulsloko. It was recorded that two fish larvae family; *Gobiidae* and *Mugilidae* were collected from TSS. This may be due to that the area in TMS site is frequently exposed. Mangroves of the Timbulsloko and Mangunharjo are now protected by law because of their environmental and economical importance. However, data on the utilization of these areas by early stages of reef fishes as feeding and nursery areas is very scarce. This is the first comprehensive study in the Timbulsloko and Mangunharjo proper that focuses on the importance of mangrove areas to fish larvae of the ocean as a nursery ground.

However [4] studied the species composition, abundance and some biological aspects of fish larvae in the Timbulsloko and Mangunharjo Mangrove. Collected 5 families. Only 3 were collected from mangrove TMM. The most abundant families *Mugilidae*, *Chanidae* and *Gobiidae* that formed about 82% of all recorded fish larvae. On the other hand, juveniles of 9 fish species that were not recorded

by [4] from Wadi Kid mangroves occurred in mangroves in the present study. A recent study from the Caribbean found that the availability of mangrove nursery habitat had a striking impact on the community structure and biomass of reef fish in their adult, coral reef habitat [13]. Coral reefs adjacent to mangrove nursery areas might be expected to harbor higher densities of adults of nursery species than reefs located at greater distance to these nursery areas.

It has been shown on various islands that a reduced density of several of coral reef fish species is related to the absence of seagrass beds and mangroves [15]. Why juvenile fishes utilize mangroves was deeply discussed by [11] and they concluded that Fish larvae are utilizing mangroves for shelter and food. As the complexity and structures such as prop-roots increase the number of fish larvae increases. Most fish species do not spawn in mangrove swamps as evidenced by low densities of fish eggs and larvae in mangrove plankton samples [8]. Fish larvae enter the nursery habitats after metamorphosis, having been spawned in the open sea, and spend some time, not more than a year, in the nursery area before returning to their natal reef habitat and entering the adult population, thus adding to the recruitment. This pattern of habitat utilization ensures protection and food supply for the young fish [6]. [3] found that mangroves were the second most frequently used ecosystem by juveniles as a nursery area after the coral reefs, where 10 species forming 32% of the species used mangroves for settlement.

Differences in size class of fish larvae among different seasons may be used to determine the growth rate of some species and indicate the recruitment of the population. For *chanidae*, it is obvious that the fish increases in length from august (average: 0.1 cm) to february (0.8 cm). About 72% of fish larvae collected are of ocean indicating the very complex dispersal of the coral reef fishes. About 85% of the collected fishes are of economic importance.

Mugil, milkfish, goatfish, barracuda and rabbit fish are of high commercial value. Others like silversides and halfbeaks have minor importance as food but are considered the main diet of most predator fishes such as snappers, barracudas and jacks and can also be used as bait [17].

The fish larvae caught in the Mangrove Conservation Area were 521,172 ind / 125m³ consisting of 5 families. The composition of the types of fish larvae caught are *Mugilidae*, *Gobiidae*, *Chanidae*, *Apogonidae*, *Scatophagidae*. The most common types of fish larvae are *Gobiidae* fish larvae, which are 134 in January 2019 while the least caught are *Apogonidae* and *Scatophagidae* fish larvae in September and November. The percentage of fish larvae that appear frequently is *Mugilidae*, *Gobiidae*, *Chanidae*. The *Gobiidae* family was caught at each point with a 53.75% appearance percentage. The least common fish larvae are the *Apogonidae* and *Scatophagidae* families with an emergence percentage of only 2.11%.

The caught fish larvae consisted of 5 families. The composition of the types of fish larvae caught are *Mugilidae*, *Gobiidae*, *Scatophagidae*, *Chanidae*, *Apogonidae*. Identification of caught fish larvae is carried out to the family stage because the ability and tools used cannot exceed the family stage. There are enough numbers of fish larvae found in the waters of Timbulloko Village because the mangrove area is a spawning area, care area, as well as a place to find food for some aquatic biota. Family composition and abundance of fish larvae obtained at each point showed differences.

[20] differences in the composition of fish larvae associated with fish migration look for environmental conditions that are in accordance with food requirements for growth. The most caught types of fish larvae in each repetition are *Gobiidae* fish larvae. The family that most dominates the research location is the family of *Gobiidae* found at each point. *Ambassidae* is a family that lives around coral reef ecosystems, and can live in various other habitats [10]. *Gobiidae* likes the sand and mud substrate so that it looks evenly abundant in the mangrove ecosystem.

The *Apogonidae* family is a type of reef fish that migrates to the beach when it starts to mature. However, by looking at the mangroves that are used by many fish species for the nursery or protection and care areas, it is possible if *Ambassidae* is found a lot [6]. If the number of species and variations in the number of individuals per species are relatively small, it means that there is an imbalance in the ecosystem caused by disturbance or pressure from the environment, this explains that only certain species can survive. This uneven number of individuals is related to the pattern of adaptation of each species, such as the availability of food and the biological, physical, and chemical conditions of the surrounding environment waters [13]. Most of the fish larvae caught at the time of the study were in

the post-flexion phase, where in this phase the body parts and internal organs had been formed more perfectly than the flexion phase and approached the juvenile phase which had body parts that resembled adult fish. In this phase fish larvae are also able to move because the fin has formed almost perfectly. Fish larvae in the *flexion* phase were also found at the study site, where in this phase the larvae had a more perfect form than the *pre-flexion* phase. [16], fish larvae in the flexion phase will move to more shallow waters such as coral reefs, seagrasses and mangroves to grow and grow.

Based on the results of data processing obtained several variables related to other variables, both those that are directly proportional (positive correlation) and opposite (negative correlation). The correlation matrix in the picture above shows a negative correlation between the abundance of larvae with phytoplankton and zooplankton in Semarang and Demak as the main factors or critical factors also closely related to the age of old mangroves [20] the presence of mangroves that have ended older resulted in higher fertility.

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