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Zooplankton Diversity and Abundance in Shrimp Pond Ecosystem in the Presence of *Sargassum plagyophyllum* and *Gracilaria verrucosa*

Munifatul Izzati
Lecturer in Department of Biology, Faculty of Mathematics and Natural Sciences

ABSTRACT

We studied zooplankton community structure in defferent ecosystem type where different species of aquatic plants are presented. The different in zooplankton community structure can be attributed to different aquatic plant species. We used two different species of aquatic plants, *Sargassum plagyophyllum* and *Gracilaria verrucosa* in shrimp pond ecosystem. Every aquatic plant species were replicated three times, and three enclosures without aquatic plant were used as controls. The different in morphological complexity of aquatic plant may affect zooplankton community structure. Our results indicated that the presence of aquatic plant differ in affecting zooplankton community structure. In general, pond with aquatic plant indicate more abundant and diverse of zooplankton. In the presence of *Sargassum* zooplankton was more abundant compared to the presence of *Gracilaria*. Whereas with *Gracilaria*, zooplankton biodiversity index were higher than with *Sargassum*.

Keywords: zooplankton, sargassum plagyophyllum, Gracilaria verrucosa.

INTRODUCTION

Zooplankton is important component of food web in shrimp pond ecosystem. This organism act as feed for small animal and shrimp larvae. Shrimp is an important export commodity for Indonesia. Recently, there is a big problem in shrimp farming indicated by mass mortality. The main problem in shrimp culture in Indonesia is the sudden mass mortality of shrimp at the age of 2 months. This occurrence is usually caused by the low quality of water (Nurjana dkk. 1994). According to Hamid and Pudjianto (1994), this symptom has started since 1990. This evidence commonly happen in shrimp pond that has been used for 4 tahun (Kokarkin, 1994).

Shrimp farming is usually applied by high stock density and feeding rate. According to Jones (1995), almost 80% of feed is left uncosumed. As consequences, organic material such as carbohydrate, protein and fat are accumulated in the sediment (Conell and Miller, 1995). Accumulation and deterioration of the organic material has led to drastic reduction of water quality, as indicated by low dissolved oxygen and high ammonia and nitrite content. Ammonia and nitrite is toxic to shrimp. This extreme situation can be resulted in shrimp mass mortality. It is hypothesized that addition of aquatic plant would be expected to reduce the negative impact in the shrimp ecosystem by supplying oxygen and removing ammonia and nitrite. In this study we investigate the effect of aquatic plant species presence on zooplankton community structure.

RESEARCH METHODS

Preparation of enclosures:

This research was done in 12 m x 16 shrimp pond that belongs to LPWP, Diponegoro University in Jepara, Central Java. The seawater was pump into the pond, at level of 1m depth. The pond was divided into 12 of 1m x 1m x 1.2m of polyethylene enclosures. All enclosure was set up inside the pond and filled with $1m^3$ of seawater. The enclosure was hung on a rope that tightens by wire and attached to the stick. The sticks were than anchored in every side of the shrimp pond.

Gracilaria cultivation method:

Gracilaria is cultivated by hanging on a rope. This method is the most suitable to conduct seaweed cultivation in shrimp pond. This technique was applied to avoid the sink of *Gracilaria* into the bottom. Beside that, *Gracilaria* that cultivated by hanging on a rope will grow more rapidly.

Gracilaria that grow in the bottom will get smaller sunlight.

Research implementation and treatment:
This research was done using *Gracilaria* at different density. There were three different of *Gracilaria* density; it was 1 a/m^3, 2 kg/m^3, and 3 kg/m^3. *Gracillaria* was divided at small bunch. Each bunch was weighing at average of 50 gram. Into each enclosure, 50 of ± 0.06 gram and ± 1.4 cm shrimp were stocked. Each treatment was replicated 3 times. Three enclosures without *Gracilaria* were served as controls.
Zooplankton community structure is then observed weekly by sampling shrimp pond water. Samples were taken in triplicate. The 10 liter of samples were concentrated using a 65-µm mass of plankton net and fixed with 4% formalin. Zooplankton composition was determined with light microscope and its abundance was counted using the sedwige rafter counter. The anova single factor was used for statistical analysis to evaluate the differences in diversity and abundance of zooplankton at different aquatic plant presence existence.

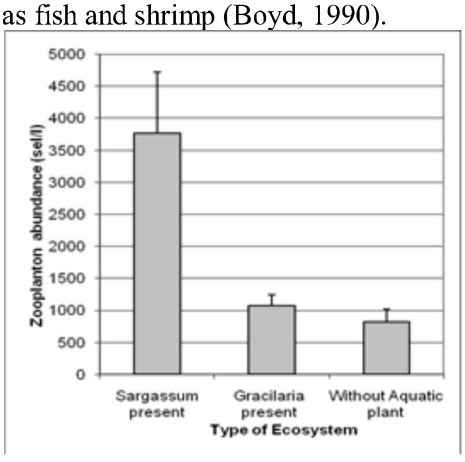
RESULTS AND DISCUSSION

Zooplankton composition

In this research, only 5 zooplankton were found, including Copepods, Calanus spp., Oligochaeta larvae, Nauplius and Protozoa. The most zooplankton found was Copepods. The total species of zooplankton found in the pond was probably due to the isolated and limited volume of water designed by this research. The 1m^3 water enclosures made from waterprooved plastic tank were probably the main cause that explain the low number of zooplankton species found in the water. Zooplankton is the consumer of small size primary production and food source of higher trophic level organism (Kovalev, et al, 1999). Zooplankton are essential as protein rich natural feed for juvenile and even adults of fish, prawn and shrimp.

Zooplankton abundance

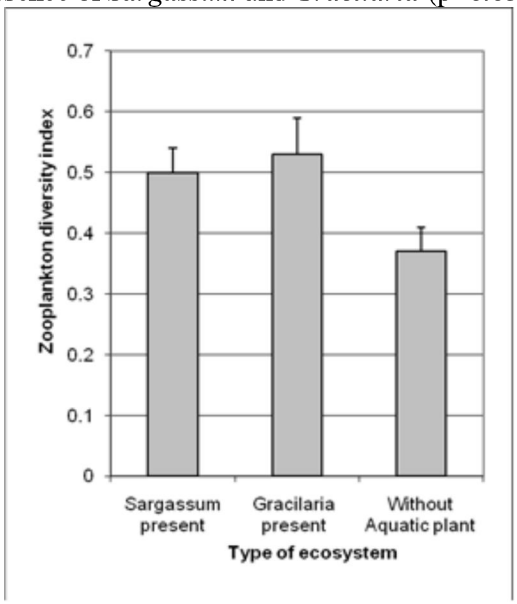
The number of zooplankton was range between 508 to 4826 individu per liter (cell/l). In the controls, the number of zooplankton was ranged between 593 to 2370 celld/l. in the presence of *Sargassum*, the number of zooplankton found was ranged between 2794 to 3973 cell/l. Zooplankton abundance in the presence of *Gracilaria* was ranged between 762 to 1185 cell/l. Statistical analyzes using anova single factor indicated no significant different zooplankton abundance between the presence of *Gracilaria* and *Sargassum* ($p>0,05$). However, there was a trend that the presence of aquatic plants tend to increase zooplankton abundant. The presence of *Sargassum* tend to increase more zooplankton abundant compared to dengan *Gracillaria*.
In general, this research showed that the presence of aquatic plant will increase the number of zooplankton in shrimp pond ecosystem. According to Moss (1990), the presence of aquatic plant tend to increased zooplankton abundant since aquatic plant can function as shelter for small animal from predators (Moss, 1990; Edgar, 1991; Cry dan Downing, 1988). The presence of *Sargassum* tend to increase zooplankton number more than the presence of *Gracillaria*. According to Cry and Downing (1988), the aquatic plant species will affect the abundant of invertebrate. Aquatic plant with more complex leave morphology will have more invertebrate, such as *Cladocera* and *Gastropoda*.
The high number of zooplankton in the presence of *Sargassum*, probably was caused by the more complex morphological performance of this plant compared to *Gracillaria*.
Zooplankton community has a significant role in shrimp pond ecosystem, particularly as a component in natural food web. Zooplankton is heterotrophic organism, a small planktonic creature that feed on phytoplankton and detritus. Zooplankton also act as natural feed for small animal such as insects. The small insect then has important role as a food for bigger size animal such as fish and shrimp (Boyd, 1990).



Observation on zooplankton abundant indicated that there was an increased in zooplankton abundant along with increasing time. The most abundant zooplankton was found in ecosystem that *Sargassum* was present. In the presence of *Gracilaria*, that abundant of zooplankton was also higher compared to controls (without aquatic plants). The number of zooplankton in controls was always smaller compared to other ecosystem where aquatic plant was present. It can be concluded from this research that the presence of aquatic plant in shrimp pond ecosystem will increase zooplankton abundant. It is indicated that the more complex food web was form by the presence of aquatic plants. The more complex morphological performance of aquatic plant, the abundant of zooplankton will also increased and more complex food web is then formed.

Zooplankton diversity:

Biodiversity index of a community indicate the balance between abundant and distribution between species (Cole, 1983). Biodiversity index of zooplankton in this research was ranged 0.24 to 0.51. In ecosystem where *Sargassum* is present, the zooplankton diversity index was ranged between 0.32 to 0.43, while in the present of *Gracillaria* was ranged between 0.49 hingga 0.53. However, statistical analyzes using anova single factor indicated that there is no significant different of zooplankton diversity between the presence of *Sargassum* and *Gracilaria* ($p>0.05$).



It can be concluded that the presence of aquatic plant tend to increase zooplankton diversity.

In the presence of *Gracilaria*, zooplankton diversity was higher. Therefore, in this type of ecosystem the zooplankton composition was distributed and more species were present. Zooplankton diversity index can also be used to indicate the pollution level in the water. The more higher the zooplankton diversity index, the level of pollution is lower (Dahuri et al, 1993). The high zooplankton index in the ecosystem where *Gracilaria* was present may related to the lower pollution level in this type of ecosystem.

CONCLUSION

The species of aqutic plant that present in shrimp pond ecosystem tend to increase water quality as indicated by more abundant and higher diversity index of zooplankton. The presence of *Sargassum* will perform more complex community structure of zooplankton compared to the presence of *Gracillaria*. With *Sargassum*, zooplankton abundance was increased by 4.62 time, while zooplankton index increased by 35%. In the presence of *Gracilaria*, zooplankton abundance was increased by 32.39%, while diversity index was increased by 43.24%. It can be concluded that, the presence of aquatic plant can change zooplankton community structure and perform more complex food web in the ecosystem.

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