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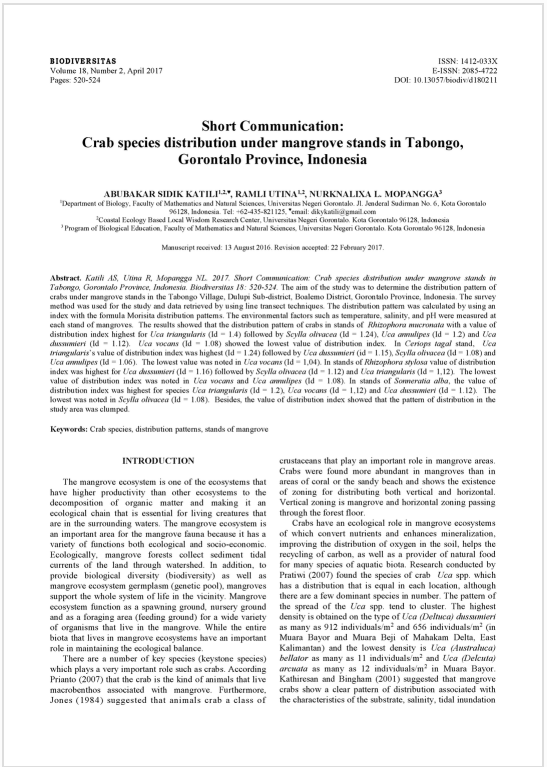

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Short Communication:
Crab species distribution under mangrove stands in Tabongo, Gorontalo Province, Indonesia

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Keywords: Crab species, distribution patterns, stands of mangrove

INTRODUCTION

The mangrove ecosystem is one of the ecosystems that have higher productivity than other ecosystems to the decomposition of organic matter and making it an ecological chain that is essential for living creatures that are in the surrounding waters. The mangrove ecosystem is an important area for the mangrove fauna because it has a variety of functions both ecological and socio-economic. Ecologically, mangrove forests collect sediment tidal currents of the land through watershed. In addition, to provide biological diversity (biodiversity) as well as mangrove ecosystem germplasm (genetic pool), mangroves support the whole system of life in the vicinity. Mangrove ecosystem function as a spawning ground, nursery ground and as a foraging area (feeding ground) for a wide variety of organisms that live in the mangrove. While the entire biota that lives in mangrove ecosystems have an important role in maintaining the ecological balance.

There are a number of key species (keystone species) which plays a very important role such as crabs. According Prianto (2007) that the crab is the kind of animals that live macrobenthos associated with mangrove. Furthermore, Jones (1984) suggested that animals crab a class of crustaceans that play an important role in mangrove areas. Crabs were found more abundant in mangroves than in areas of coral or the sandy beach and shows the existence of zoning for distributing both vertical and horizontal. Vertical zoning is mangrove and horizontal zoning passing through the forest floor.

Crabs have an ecological role in mangrove ecosystems of which convert nutrients and enhances mineralization, improving the distribution of oxygen in the soil, helps the recycling of carbon, as well as a provider of natural food for many species of aquatic biota. Research conducted by Pratiwi (2007) found the species of crab *Uca* spp. which has a distribution that is equal in each location, although there are a few dominant species in number. The pattern of the spread of the *Uca* spp. tend to cluster. The highest density is obtained on the type of *Uca (Deltuca) dussumieri* as many as 912 individuals/m^2 and 656 individuals/m^2 (in Muara Bayor and Muara Beji of Mahakam Delta, East Kalimantan) and the lowest density is *Uca (Australuca) bellator* as many as 11 individuals/m^2 and *Uca (Deltuca) arcuata* as many as 12 individuals/m^2 in Muara Bayor. Kathiresan and Bingham (2001) suggested that mangrove crabs show a clear pattern of distribution associated with the characteristics of the substrate, salinity, tidal inundation

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levels and waves.

The aim of the study was to determine the distribution pattern of crabs under mangrove stands in the Tabongo Village, Dulupi Sub-district, Boalemo District, Gorontalo Province, Indonesia.

MATERIALS AND METHODS

Study area

This study was conducted in the mangrove region of Tabongo Village, Sub-district of Dulupi, District of Boalemo, Gorontalo Province, Indonesia (Figure 1). The area of study divided into four mangrove stands. Based on observations there were four species as the mangrove stands, namely *Rhizophora mucronata*, *Rhizophora stylosa*, *Ceriops tagal*, and *Sonneratia alba*.

Procedures

Determination of location study based on mangrove stands. As for sampling at each mangrove stand, crabs were enumerated along line transect laid from land to seaward edge of the mangrove forest, perpendicular to the shoreline. Line transects were approximately 150 m long depending on location, five transects per location. Along each transect plot measuring 20 x 20 m^2 were demarcated every10 m and alternately to the left and right of the transect. Line transect is placed perpendicular to the shoreline towards the land (Figure 2).

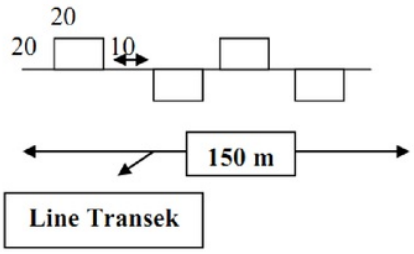

Figure 2. The laying of line transects in the study area.

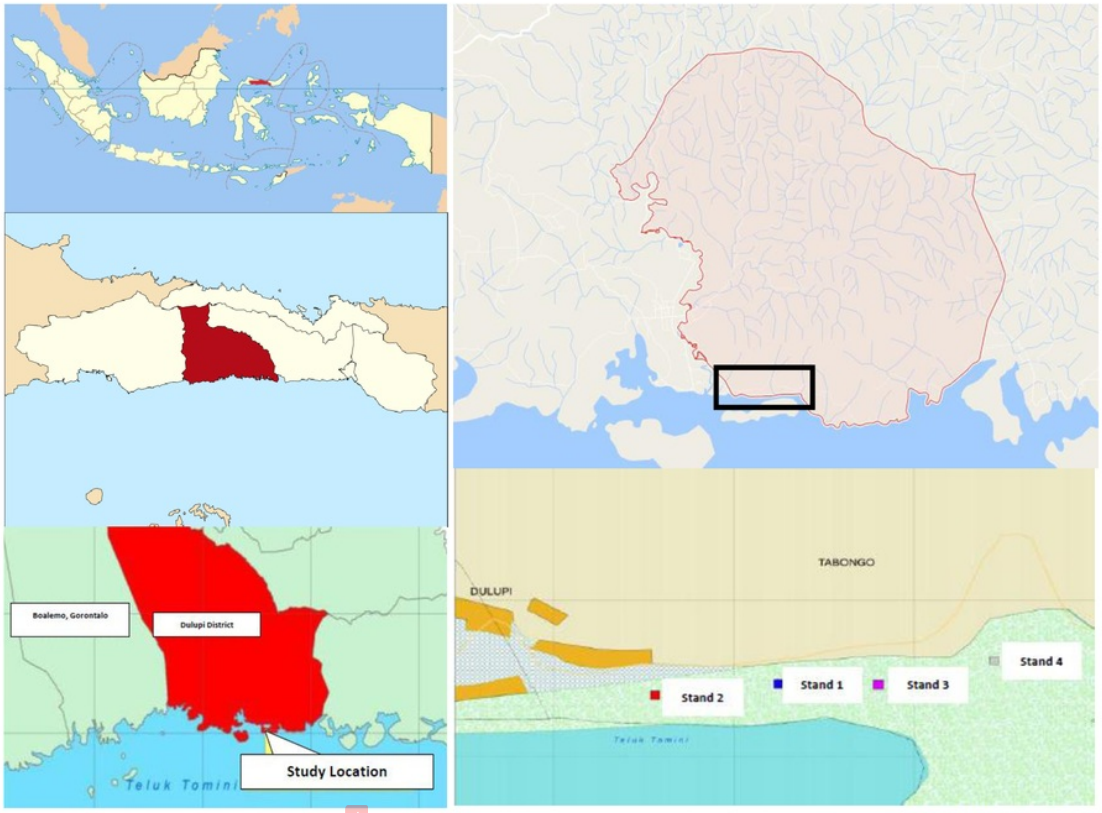

Figure 1. Study site of mangrove stands in Tabongo Village, Dulupi Sub-district, Boalemo District, Gorontalo Province, Indonesia. Stand 1 (00º30'21 "N, 122°27'70" E), stand 2 (00º30'23 "N, 122°28'00" E), stand 3 (00°30'22 "N , 122°28'10 "E), stand 4 (00°30'26 "N, 122°28'15" E)

Data collection was performed by counting the number of crab holes contained in each plot. It is known that any holes that become crab nest inhabited by the crabs indicated the number of crabs contained in a single plot (Kathiresan et al. 2016). A collection of crab done at low tide so as to facilitate its acquisition. Sampling was done bycatch the crabs on each mangrove stands that are above and below the substrate. Sampling crab on the surface of the substrate and in the hole is taken by chase all the crabs. The crab samples were then put into a container and preserved with 70% alcohol. Identification of the Crab sample done by using the key for Family Ocypodidae (Crane 1975). Measurements of environmental variables such as substrate temperature, pH, and salinity were measured in each plot when was this study undertaken.

Data analysis

Data were analyzed by descriptive quantitative. To determine the pattern of distribution were used index analysis Morisita with the formula (Krebs 1989):

$$I_d = n\left(\frac{\sum x^2 - \sum x}{(\sum x)^2 - \sum x}\right)$$

Where:
I_d = Morisita's index of dispersion
n = Sample size
$\sum x$ = Sum of the quadrate counts = $x_1 + x_2 + x_3 + \ldots$
$\sum x^2$=Sum of quadrate counts squared = $x_1^2 + x_2^2 + x_3^2 + \ldots$

Criteria for distribution patterns, as follows:
Id <1: uniform pattern
Id = 1: random pattern
Id> 1 : groups pattern

To examine further whether the distribution of random or not it should be tested by calculating two important points to the index Morisita with the formula:

$$Uniform\ Indeks = Mu = \frac{x^2.975 - n + \sum x}{(\sum x) - 1}$$

Where, x = chi-square value of the table with n - 1 of the freedom that has 97.5% of the area to the right, x = the number of organisms in the squares, n = number of plots

$$Clumped\ indeks = Mc = \frac{x^2.025 - n + \sum x}{(\sum x) - 1}$$

Where, $x^2_{.025}$ = chi-square value of the table with n - 1 of the freedom that has 97.5% of the area to the right.

Calculating the standard Morisita index:

$$I^p = 0.5 + 0.5\frac{id - Mc}{n - Mc}$$

Morisita standard index of distribution ranges from -1.0 to 1.0 with 95% confidence limits at 0.5 and - 0.5. Random pattern if $I^p = 0$, clumped patterns $I^p > 0$, uniform pattern $I^p < 0$.

RESULTS AND DISCUSSION

The crab species diversity

Uca annulipes

The crabs have a morphological characteristic, namely, shell speckled white and black, orange-white claws, feet are black with a pattern of white striped. Forms contain solid claws, jagged and there are two stands out and tapered (Figure 3.A).

Uca dussumieri

The crabs have a morphological characteristic, namely, black carapace with blue spots along. Claws color on the top and bottom of the little red and white tapered section, the small claws are black, jagged edges of claw shape resembling a saw, a body length of 3 cm for male, and female 3 cm. The male body width of 5 cm, and female 5 cm (Figure 3.B).

Uca triangularis

Uca triangularis have a carapace color that dominates the white-mottled pattern cream with black spots and black on the bottom. *Uca triangularis* foot in black with a pattern of white stripes. Cream-colored claws with a mottled pattern of black-spots and a plain white color at the edges, tiny claws are black with mottled pattern-spots, jagged like a saw and there are 2 pieces that stand out, and the tip is shaped like a hook (Figure 3.C).

Uca vocans

Uca vocans has a characteristic morphology that is the color of the carapace is dark brown, off-white on the belly. The form of claws that are not too long, flat, pointed and at the end of pick the gears and there are two pieces that stand out. Claws color white at the top while the bottom is orange. Small claws brown slightly orange (Figure 3.D).

Scylla olivacea

The crabs have a characteristic morphology that is blackish brown carapace, from left-right of her mouth, each has a row of spines that totaled nine pieces, claws brown, serrated and tapered (Figure 3.E).

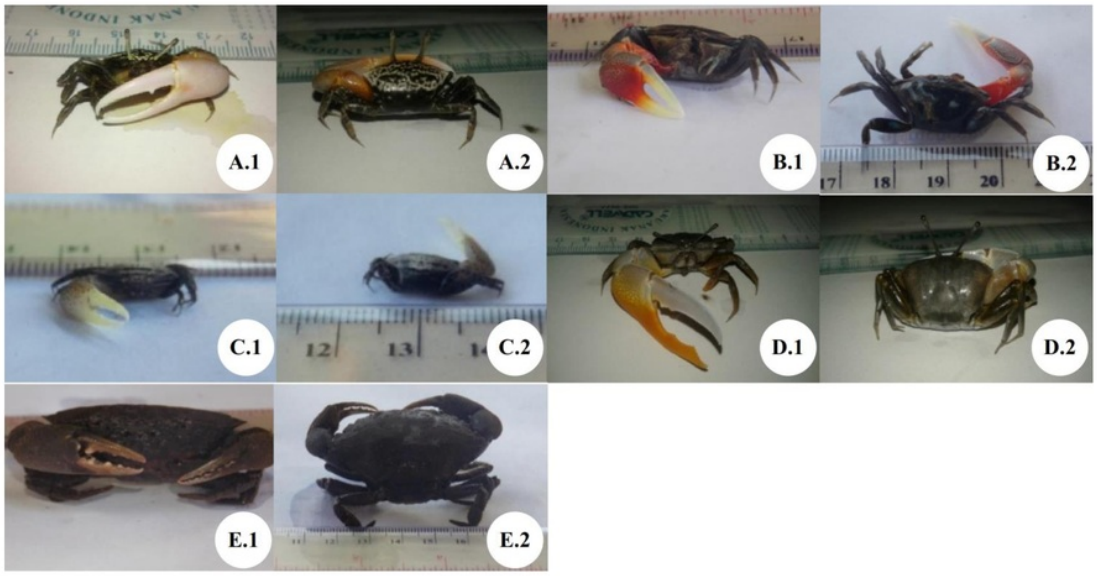

Figure 3. A. *Uca annulipes,* B. *Uca dussumieri,* C. *Uca triangularis,* D. *Uca vocans*, E. *Scylla olivacea*

Distribution of crabs within mangrove stands

Based on calculations using Morisita index showed that the distribution of crabs on the stands fourth in the study area has a clustered pattern. Where index distribution at stands of *Rhizophora mucronata* the highest found species of crab *Uca triangularis* with Id = 1.4 and the value Ip = 0.125, while the index was lowest for the distribution of species of crab *Uca vocans* with Id = 1.08 and the value Ip = 0.014. The value of distribution index at the stand of *Ceriops tagal* the highest were *Uca triangularis* with Id = 1.24 and the value of Morisita distribution index Ip = 0:07 and the lowest value of distribution index were *Uca vocans* with Id = 1:04 and value Ip = 0.003. On the stand of *Rhizophora stylosa* distribution index value is highest on the *Uca dussumieri* with Id = 1.16 and the index value was lowest for the distribution of *Uca vocans* and *Uca annulipes* with Id = 1.08 and the value Ip = Ip = 1:14 and 0:02. Then, in the stand of *Sonneratia alba* value of distribution index is highest on the *Uca triangularis* with Id = 1.2 and the value Ip = 0.05 and the value of distribution index was lowest for the *Scylla olivacea* with Id = 1.08 and the value Ip = 0.014.

Discussion

The existence of the facts found in this study that the shape of the distribution of the crabs in all stands of mangrove is clustered. According Gillikin and Verheyden (2005) that the crab has clumped due to the nature of its prey (feeding habit) the same form of benthic algae or detritus mangrove leaves or other small animals. Clumped distribution pattern is the pattern of the organism or organisms in a habitat that lives in groups in a certain amount.

The typical distribution pattern occurs in each species and habitat types. Sari (2004) suggests that the distribution of species in a community reflects the wealth of information on a species. While according to Odum (1971) clumped patterns occur as a result of their different responses to habitat locally. On the other hand, Werdiningsih (2005) research on community structure of crab in the habitat mangrove Tanjung Pasir, Tangerang, Banten, Indonesia argued, that the distribution patterns grouped by level of grouping assortment is a form of the spread of the most common for individuals in the population tend to form groups in various sizes.

To test whether the result is clustered, random and uniform then further testing should be performed (Soegianto 1994). At the time of data processing researchers who conducted a further test with Morisita index. Based on the calculation, that the pattern of distribution of the crab in the study area is real to have clustered patterns. These facts reinforce the statement that the distribution pattern that often occurs in nature are clustered distribution patterns. This is in line with that proposed by Odum (1971), that individuals who are in the population have spread in their habitat to follow one of the three distribution pattern called internal distribution pattern.

Three internal distribution pattern include a random distribution pattern, the uniform distribution and clustered distribution/grouping (clumped). Further Odum (1971) suggests that the distribution of the population is clustered in a common distribution occurs in nature, both animals and plants. Distribution clustered occur for various of season including soil and climatic conditions of an area, it will make a difference in habitat that is essential for every organism. The organisms will be present in an area that

provided ecological factors and in accordance with his life. Based on this fact, the clustered pattern also applies to the species of crabs that live in the other mangrove area. In addition, also found that, although living under different mangrove stands, but the distribution pattern of crabs in the study area belong to the clustered distribution patterns. Thus the facts and theories that have been mentioned above, can generally that the clustered distribution patterns of crabs also apply to the mangrove areas in the region apart from the area, the distribution pattern of the crab is clustered.

In conclusion, crab distribution patterns under the four stands of mangrove namely *Rhizophora mucronata, Ceriops tagal, Rhizophora stylosa, Sonneratia alba* has a clustered distribution patterns. This can be evidenced by the calculation of the distribution (Id) obtained, that each species of crab on each stand of mangroves have value Id > 1 and the distribution standard of index Morisita have Ip above 0 which is distribution is clustered.

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