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Association of Skinks with Crabs in the Mangrove Ecosystem of Tabongo Village, Dulupi Sub-District, Boalemo District

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ABSTRACT
Mangroves are plants that grow along the coast and have supporting roots. Mangrove ecosystems in addition to protecting the coast from waves and wind are also suitable areas for marine fauna life. One of the faunas found in mangrove ecosystems is the spadefish. Skinks often shelter near the bodies of crabs in order to make it easier for the fish to find food and stay protected from predators. The attachment relationship between these two species growing in the same environment is called association. This study aims to determine the association of silverfish with crabs in the mangrove ecosystem of Tabongo Village, Dulupi District, Boalemo Regency. The study showed that there were 2 species of silverfish and 3 species of crabs, namely *Periopthalmus argentilineatus*, *Periopthalmus malaccensis*, *Scylla paramamosain*, *Uca perplexa*, and *Uca sp*. There are 2 types of associations, namely positive associations and negative associations. Positive association with the highest value was found in the pair *Periopthalmus argentilineatus* with *Uca perplexa* with a value of 0.37. While the negative association with the lowest value is found in the pair *Peripthalmus malaccensis* with *Uca sp*.

Keyword: association, skipjack, crab

1. INTRODUCTION

On the coast of Tomini Bay in Gorontalo Province, there is an area that has a mangrove ecosystem area. The mangrove ecosystem area in question is Labuan Timur Village, Dulupi District, Boalemo Regency. Mangrove is a complex ecosystem consisting of coastal flora and fauna, living at the same time in the habitat of land and sea water, between the limits of tide and ebb. One of the faunas found in mangrove ecosystems is gelodok fish. The local name of this fish is different in each region, such as gelodok or glodok, belodok or blodok, belodog or blodog, then tembakul, tempakul, timpul or belaca, sea cork and lunjat. Gelodok (Family: *Gobiidae*) is a large family of mostly benthic fishes, inhabiting a wide range of habitats from deep-sea environments to freshwater streams (Patzner, et. al., 2011). Gelodok fish are animals that live in tropical to sub¬tropical areas, and are distributed throughout the coastal region (Elviana et al., 2019).

Gobies are usually relatively small in sizes and often build nests in the form of hidey holes around mangroves. In addition, gobies often shelter near the bodies of crabs to make it easier for the fish to find food and stay protected from predators. This relationship of attachment between the two species growing in the same environment is called association. An association is a relationship between two or more individuals that depend on each other in a particular environment. The association of silverfish with crabs occurs because the two species utilize each other's resources in

the environment. Thus, the association between silverfish and crabs in mangrove ecosystems can help maintain ecosystem balance and increase water productivity

2. RESEARCH METHOD

This research was conducted in the mangrove ecosystem, Tabongo Village, Dulupi District, Boalemo Regency. Geographically, this research location is located at the coordinates LU 0.507142 ° and BT 122.465093 °.

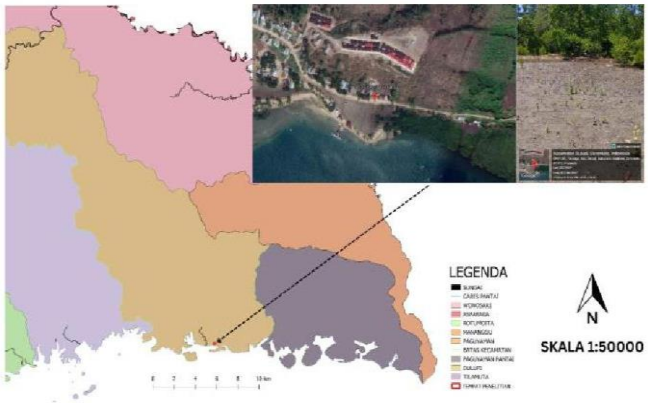

Figure 1. Research location map

This study used the transect method. Before sampling, a 100 m^2 line transect was first installed. Line transects were made into plots with a size of 10 x 10 m^2 (Ernanto et al. 2010). Sampling of skinks was conducted in the morning until late afternoon at low tide. Each plot was observed for crabs associated with silverfish. Each species found in the plot was collected using a fishing net. After catching, the species were put into plastic samples and will be observed directly at the research site. Furthermore, association analysis can be done using 2×2 Contingency Table.

3. RESULTS AND ANALYSIS

Association analysis can be done using a 2×2 Contingency Table (Kurniawan, 2008). The form of the 2x2 Contingency Table can be seen in Table 1.

Table 1. A 2×2 Contingency Table

		Type A		
		There is	None	Total
Type B	There is	a	b	a + b
	None	C	d	c + d
	Total	a+c	b+d	N = a + b + c + d

Description:
a = the number of plots where species A and species B were found,
b = number of plots where species A only was found
c = number of plots where species B was found only
d = number of plots where species A and species B were not found
N = number of plots
to calculate the point correlation coefficient based on the 2×2 contingency table, the following formula is used:

$$\frac{d - bc)}{J\,(a + b)\,(a + c)\,(c + d)\,(b + d)}$$

Description:
Type a : both species present in the sample
Types b and c : one of the species is present while the other is absent
Species d : both species are not present in the sample (Michael, 2004).
The closer the association index value is to 1, the more the association will be maximum. Conversely, the association index value that is closer to 0, the association will be minimum or even no relationship. Determining the association index value is needed to strengthen the results of the association calculation from the contingency table.

Table 2. Association value and type of Gelodok Fish with Crabs at Station I

Subplots	Species Name		Association Value	Association Type
1	*Periopthalmus argentilineatus*	*Lica perplexa*	-0,25	-
2	*Periopthalmus argentilineatus*	*Lica perplexa*	-0,11	-
3	*Periopthalmus argentilineatus*	*Lica perplexa*	-0,08	-
4	*Periopthalmus argentilineatus*	*Lica perplexa*	0,26	+
5	*Periopthalmus malaccensis*	*Uca perplexa*	0,09	+
6	*Periopthalmus argentilineatus*	*Uca* sp	0,23	+
7	*Periopthalmus argentilineatus*	*Uca perplexa*	-0,34	-
8	*Periopthalmus argentilineatus*	*Scylla paramamosain*	0,16	+
9	*Periopthalmus argentilineatus*	*Uca* sp	0,25	+
10	*Periopthalmus argentilineatus*	*Uca perplexa*	-0,31	-
11	*Periopthalmus malaccensis*	*Uca* sp	0,11	+
12	*Periopthalmus malaccensis*	*Uca* sp	0,31	+
13	*Periopthalmus argentilineatus*	*Uca perplexa*	-0,33	-
14	*Periopthalmus malaccensis*	*Uca perplexa*	-0,31	-
15	*Periopthalmus malaccensis*	*Uca* sp	0,16	+
16	*Periopthalmus malaccensis*	*Uca perplexa*	0,21	+
17	*Periopthalmus malaccensis*	*Scylla paramamosain*	0,09	+
18	*Periopthalmus argentilineatus*	*Uca perplexa*	-0,33	-
19	*Periopthalmus argentilineatus*	*Uca perplexa*	0,25	+
20	*Periopthalmus argentilineatus*	*Uca perplexa*	0,09	+

Based on the Table above, it shows that 2 species of silverfish and 3 species of crabs have been found, namely Periopthalmus argentilineatus, Periopthalmus malaccensis, Scylla paramamosain, Uca perplexa and Uca sp. The association type of station I has two types of association, namely positive association and negative association. Positive association with the highest value is found in the pair Periopthalmus argentilineatus with Uca perplexa with a value of 0.25. While the negative association with the lowest value is found in the pair Periopthalmus argentilineatus with Uca perplexa with a value of -0.11.

Table 3. Association value and type of Gelodok Fish with Crabs at Station II

Subplots	Species Name		Association Value	Association Type
1	*Periopthalmus argentilineatus*	*Uca perplexa*	0,37	+
2	*Periopthalmus argentilineatus*	*Uca perplexa*	0,37	+
3	*Periopthalmus argentilineatus*	*Uca* sp	-0,11	-

Subplots	Species Name		Association Value	Association Type
4	*Periopthalmus malaccensis*	*Uca perplexa*	-0,03	-
5	*Periopthalmus malaccensis*	*Uca perplexa*	0,16	+
6	*Periopthalmus malaccensis*	*Uca* sp	-0,31	-
7	*Periopthalmus argentilineatus*	*Uca perplexa*	-0,31	-
8	*Periopthalmus malaccensis*	*Uca* sp	0,11	+
9	*Periopthalmus argentilineatus*	*Uca* sp	-0,31	-
10	*Periopthalmus malaccensis*	*Uca perplexa*	0,33	+
11	*Periopthalmus malaccensis*	*Uca perplexa*	0,11	+
12	*Periopthalmus argentilineatus*	*Uca perplexa*	0,21	+
13	*Periopthalmus malaccensis*	*Uca perplexa*	-0,33	-
14	*Periopthalmus malaccensis*	*Uca* sp	0,35	+
15	*Periopthalmus malaccensis*	*Uca* sp	0,09	+

Based on the Table above, it shows that at station II 2 species of skinks have been found with 2 species of crabs, namely Periopthalmus argentilineatus, Periopthalmus malaccensis, Uca perplexa and Uca sp. The association type of station II has two types of associations, namely positive associations and negative associations. The positive association with the highest value is found in the pair Periopthalmus argentilineatus with Uca perplexa with a value of 0.37. While the negative association with the lowest value is found in the pair Periopthalmus malaccensis with Uca perplexa with a value of -0.03.

Table 4. Environmental Factors in the Mangrove Ecosystem of Tabongo Village, Dulupi District, Boalemo Regency

Station	Environmental Factors		
	Temperature (°C)	Soil pH	pH of Water
I	28°C	7	7,6
II	30°C	7	7,6

Based on the table above, it can be seen that the measurement of environmental factors in the mangrove ecosystem of Tabongo Village, Dulupi District, Boalemo Regency, there are 2 stations where environmental factors are measured. Environmental factors at station I show a temperature of 28 ° C, soil pH 7, and water pH 7.6. While at station II shows a temperature of 30 ° C, soil pH 7, and water pH 7.6.

4. CONCLUSION

Based on the research that has been carried out, it can be concluded that the results of the association of silverfish with crabs in the mangrove ecosystem of Tabongo Village, Dulupi District, Boalemo Regency have 2 types of associations, namely positive associations and negative associations. Positive association with the highest value is found in the pair Periopthalmus argentilineatus with Uca perplexa with a value of 0.37. While the negative association with the lowest value is found in the pair Peripthalmus malaccensis with Uca perplexa with a value of -0.03.

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