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The Analysis of the Interaction Pattern of Mangrove Vegetation-Generating Ephyfite Plant at Southern Part of Bunaken National Park in North Sulawesi

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Abstract

Mangrove forest in Bunaken National Park is the vegetative distribution pattern, or meaning that the plant community is not stand alone. In other word, unlimited interspecies interaction may be developed comprehensively from plants and animals. The objective of research is to analyze the interaction pattern of orchid ephyfite plant and mangrove vegetation-generating fern plant. Field survey is used as research method by taking a sample of substrate, leaf, and sea water. Data analysis tool is vegetation analysis and laboratory analysis.

Result of analysis on the data of *Sonaratia* with pigeon orchid indicates the coefficient rate of (0.707), meaning that strong association is made. *Rhizophora* with pigeon orchid shows weak association with coefficient rate of (0.243). *Rhizophora* and pigeon orchid has also very weak association with coefficient rate of (0.186). *Rhizophora* and moon orchid has moderate association with coefficient rate of (0.552). *Bruguiera* and pigeon orchid has moderate association with coefficient rate of (0.447). *Bruguiera* and moon orchid shows very weak category by coefficient rate of (0.124). The interaction of while orchid with coefficient rate of (0.908) is in the strong association. Such interaction may include in the Protocooperation type (++), while fern with coefficient rate of (0.870) can be in strong association, and included within Mutualism interaction type (++).

Keywords: Interaction, Mangrove, Orchid, Fern

1. Introduction

Indonesia is the largest archipelago located in the tropical regions with extensive mangrove area that consists of 17,508 islands, a coastline about 81,000 km (Sugiarto and Willy, 1996). In 1982, the total area of mangrove forests in Indonesia is about 5,209,543 ha while in 1993, it is about 2,496,185 million ha, so the decrease of mangrove forest area is about 47.92% (Dahuri *et al.* 2001). Mangrove forest ecosystem is an intermediary between land and sea zones. According to Odum (1983), ecosystem in terms of functional side can be studied and analyzed in several ways, e.g.: (1) the energy flow, (2) food chains (3) the patterns of diversity, (4) material cycles (chemistry materials), (5) the development and evolution, and (6) the balance control (cybernetics). An ecosystem is a functional unit of environment, because ecosystem includes both living things and the physical-chemical environment, both of them influence each other and are necessary to maintain the continuity of life. Therefore, it should receive major attention.

Mangrove forests are tropical coastal vegetation communities, which are dominated by some mangrove tree species that can grow and flourish in coastal muddy tidal areas (Bengen 2001). Mangrove vegetation commonly grows forming ranging from the coastal zone to a few meters inland. Mangrove forest zoning is eco-physiologic response of plants to environmental gradation. Mangrove forest is a formation of typical littoral areas plants in coastal tropical and sub-tropical areas that are protected and an intermediary ecosystem between land and sea zones. In addition, higher level plants produce habitats for the protection of young animals and its surface is useful as a adhesion substrate and growth of many epiphytic organisms (Nybakken,1993).

Mangroves have a tendency to form the density and diversity of stand structure that plays an important role as a sediment trap and protection against coastal erosion. In addition, higher level plants produce habitats for the protection of young animals useful as a substrate and surface adhesion and growth of many epiphytic organisms (Nybakken, 1986). Epiphytic ferns and orchids in nature generally ride and do not interfere the host plants, but it depends on the safety of the plant, because if the host plant is cut down, epiphytic ferns would also dead. Epiphytes are able to perform photosynthesis for his growth, so he is not a parasite. The existence of epiphytes is very important in forest ecosystems because sometimes epiphytic plants are able to provide a place for the tree ants to grow. Epiphytic ferns typically live in poor-nutrient environment, the roots generally do not have hair roots and often contain chloroplasts so they can photosynthesize (Zubaidah, 2001).

Mangrove forest in Bunaken National Park is the distribution pattern of vegetation or plant communities that do not stand alone. Growing vegetation between plants and between organisms in nature can be an interaction between individuals of different species, interactions between species are not limited, but occurs as a whole, including in plants and animals. This area is designated as a national park because it has a type of tropical coastal marine ecosystems and the complete habitat of coral reef, seagrass beds, and mangrove forests with high biodiversity (Eidman *et al,* 1999).

2. Research Methods

The field research is conducted in three location, i.e.: Teling, Sondaken and Popareng. Laboratory research is conducted in Laboratory of BALITRI SULUT, Laboratorium PAU IPB Bogor and Soil Chemistry Laboratory Brawijaya University.

2.1 Materials and Methods

The used research materials in this research are: maps, secondary data, MPIX Photo Camera with 8 Mega Pixel resolution and 3x optical zoom, Stakes and Ropes, GPS (Global Positioning System), Soil pH Tester, to measure the pH of the soil substrate. Identification of epiphytic plants that stick in each mangrove vegetation.

Association between Species

Association between two species is determined based on Chi-Square formula as the following:

$$X^2 = \frac{n(|ad - bc| - 0{,}5n)^2}{(a+c)\,(b+d)\,(a+b)}$$

To determine the closeness of association (degree of association), it needs to conduct further test by determining the association coefficient (C) with by the formula:

$$C = \frac{(ad - bc)}{\sqrt{(a+c)\,(b+d)(c+d)(a+b)}}$$

2.2 Results

***Sonaratia* Association with Pigeon Orchid (*Dendrobium crumenatum*)**

Based on the results of contingency value (the second table in appendix), the obtained Association of Contingency coefficient value is 0.707 and the X^2_{count} value is 9.00. Because X^2_{count} value (9.00) > X^2_{table} (3.84), it can be concluded that there is a significant association between Sonaratia with Pigeon Orchid. Association coefficient of 0.707 indicates that there are attachment / strong association on the presence of orchids, that is the epiphytic plants Pigeons on Sonaratia. Figure I Graph between Sonaratia and Pigeon Orchid as follows:

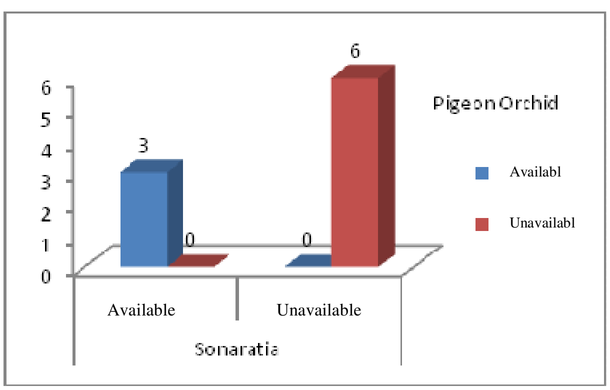

Figure 1. *Sonaratia* Association with Pigeon Orchids

Based on the graph above, it can be seen that among 9 observations (in three stations and three types of transects), if there is *Sonaratia* then there is also a Pigeon Orchids (there are three observations, i.e. the teling transect 2, teling transect 3, and transect Popareng 3). Whereas if there is no Sonaratia, then there is no pigeon orchid also (there are 6 observations, i.e. at teling transect 1, sondaken transects 1, 2 sondaken transects,

transects sondaken 3, Popareng transect 1 and Popareng transect 2). This suggests that there is an interdependence between the presence Sonaratia and the pigeon orchid.

Sonaratia **Association with Moth Orchid (*Phalaenopsis amabilis*)**

Based on the results, the Association Contingency coefficient value is 0.243 and X^2_{count} value is 0.563. Because X^2_{count} value (0.563) < X^2_{tabel} (3.84), it can be concluded that there is no significant associations between Sonaratia and Moth Orchid. The association coefficient is 0.243, this indicates that there is weak attachment / association with the existence of epiphytic plants, that is Moth Orchid on *Sonaratia*. Figure 2 the graph of association between Moth Orchid on Sonaratia as follows:

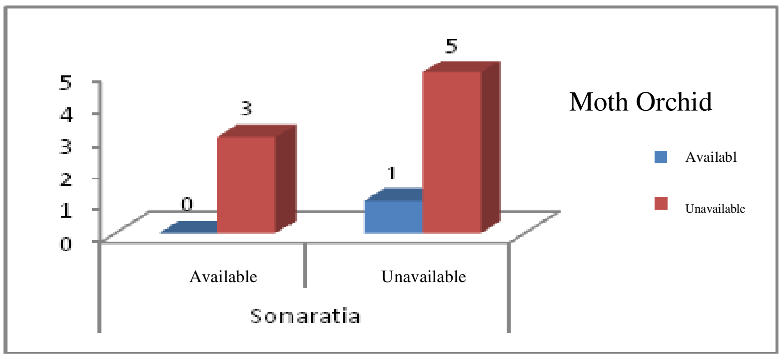

Figure 2. *Sonaratia* Association with Moth Orchids

Based on the graph above it can be seen that among 9 observations (in three stations and three kinds of transect), it is seen that in the three location where the *Sonaratia* is found, there is no Moth Orchid. Whereas among six other locations where there is no *Sonaratia*, Moth Orchid is not found in five locations. This shows that weak interdependence between the presence of *sonaratia* and moth orchid.

Rhizophora **Association with Pigeon Orchid**

Based on the result, the Association Contingency Coefficient value is 0.186 and X^2_{count} is 0.321. Because X^2_{count} (0.321) > X^2_{table} (3.84), then it can be concluded that there is insignificant association between *Rhizophora* and Pigeon Orchid. Association coefficient is 0.186, this indicates that there is very weak attachment / association on the presence of epiphytic plants, that is Pigeon Orchid on *Rhizophora*. Figure 3 the graph of *Rhizopora* association with pigeon orchid as the following:

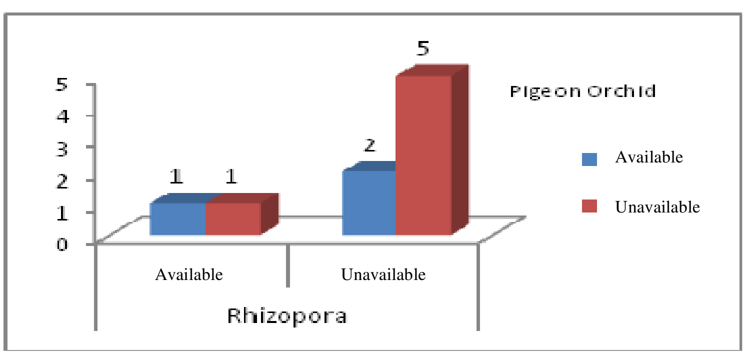

Figure 3. *Rhizopora* Association with Pigeon Orchid

Based in the graph above, it is seen that among 9 observations (in three stations and three types of transects), it appears that among two locations where there is Rhizopora (sondaken transect 2, and Popareng transect 3), there is only one location (Popareng transect 3) has Pigeon Orchid. While of seven locations where there is no Rhizopora, there are 2 pigeon orchids (at teling transect location 2 and 3). It shows less dependence between the existence Rhizopora with pigeon orchid.

Rhizophora Association with Moth Orchid

Based on the result, the Association Contingency Coefficient is 0.552 and X^2_{count} is 3.928. Because the X^2_{count} (3.928) < X^2_{table} (3.84), it can be concluded that there is a significant association between *Rhizophora* with Moth Orchid Month. The coefficient of association is 0.552, this indicates that there are strong attachment / association enough on the presence of epiphytic plants, that is Moth Orchid on *Rhizophora*. Figure 4 graphs of *Rhizophora* association with Moth Orchids month as follows:

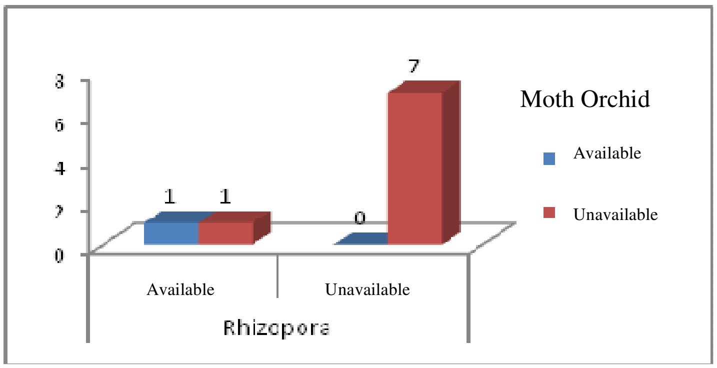

Figure 4. *Rhizopora* Association with Moth Orchid

The graph above shows that among 9 observations (in three stations and three types of transects), it appears that among two locations where there is Rhizopora (sondaken transect 2, and Popareng transect 3) there is only one location (sondaken transect 2) where Moth Orchids exist. While among seven locations where Rhizopora does not exist, there is no Moth Orchid. It shows less dependence between the existence of Rhizopora and Moth Orchids.

Brugueira Association with Pigeon Orchid

Based on the results, the Association Contingency Coefficient is 0.447 and X^2_{hitung} is 2.250. Because the X^2_{hitung} (2.250) > X^2_{table} (3.84), it can be concluded that there were no significant associations between Bruguiera with pigeon orchid. The number of Association coefficient that is 0.447 indicates that there is strong attachment / association enough between the existence of epiphytic plants, that is Pigeon Orchid and Bruguiera. Figure 5 graphs of the association between Brugueira and the pigeon orchid as follows:

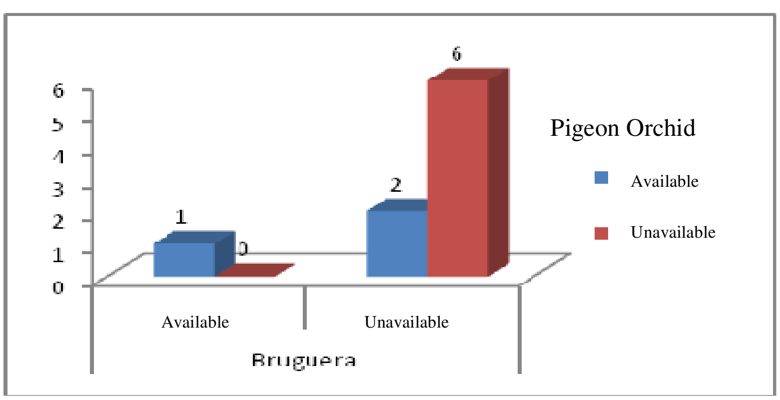

Figure 5. *Bruguiera* Association with Pigeon Orchid

The graph above shows that among 9 observations (in three stations and three types of transects), it appears that in a location where there is *Bruguiera* (Popareng transect 3), there is also pigeon orchid. While in the other location where there is no Bruguiera, there is no pigeon orchid also. This shows the dependence between the existence of Bruguiera and the pigeon orchid.

***Brugueira* Association with Moth Orchid**

Based on the results, the Association of Contingency coefficient is 0.124 and X^2_{count} is 0.141. Because X^2_{count} (0.141) < X^2_{table} (3.84), it can be concluded that there were no significant associations between *Bruguiera* and Moth orchid. Association coefficient that is 0.124 indicates that there is very weak attachment / association on the existence of epiphytic plants, that is Moth Orchid on *Bruguiera*. Figure 6 graphs of the association *Brugueira* and moth orchids as follows:

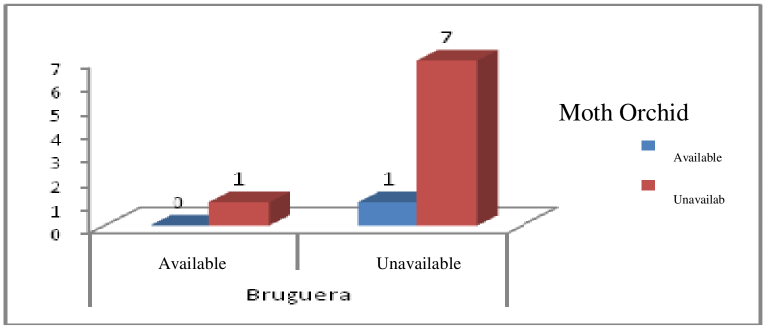

Figure 6. *Bruguiera* Association with Moth Orchid

The graph above shows that among 9 observations (in three stations and three types of transects), it appears that in the single location where there is *Bruguera* (Popareng transect 3), there is no moth orchid. While in the other eight locations where there is no *Bruguera*, there is one moth orchid (at the location of the sondaken transect 2). This shows the dependence between the existence *Bruguera* and moth orchids.

***Sonaratia* Association with Ferns**

significant associations between *Sonaratia* and ferns. The association coefficient that is 0.535 indicates that there is quite strong attachment / association between the presence of epiphytic plant, that is ferns, on *Sonaratia*. Figure 7 graph of the association between *Sonaratia* and ferns as follows:

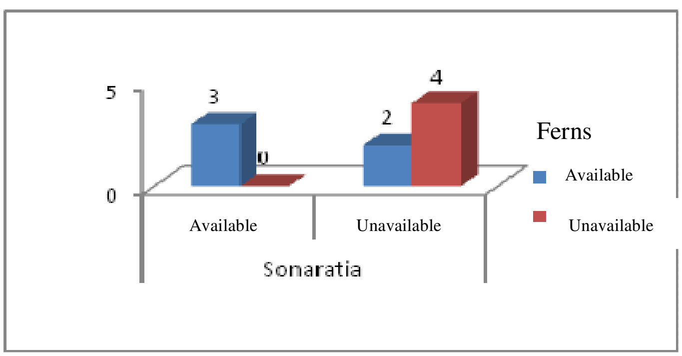

Figure 7. *Sonaratia* Association with Ferns

The graph above shows that among 9 observations (in three stations and three types of transects), it appears that if there is *Sonaratia* then there is also ferns (there are three observations, i.e. on teling transect 2, teling transects 3, and Popareng transect 3). While in the other six location, there are 4 locations where there is no ferns (Sondaken transect 3, Popareng transects 1 and 2, and teling transect 1). This shows a fairly strong dependence between the existence of *Sonaratia* and nails.

***Rhizopora* Association with Ferns**

Based on the results, the Association of Contingency coefficient is 0.431 and X^2_{count} is 2.057. Because the X^2_{count} (2.057) < X^2_{table} (3.84), it can be concluded that there is no significant associations between *Rhizopora* and ferns. Association coefficient that is 0.431 indicates that there is quite strong attachment / association between the presence of epiphytic plants, that is ferns, on *Rhizopora*. Figure 8 graph of *Rhizophora* association with ferns as follows:

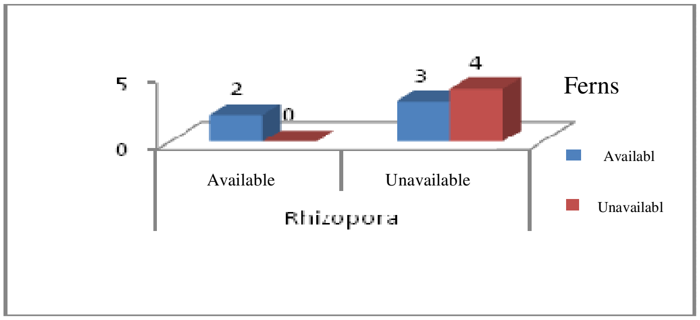

Figure 8. *Rhizopora* Association with Ferns

The graph above shows that among 9 observations (in three stations and three types of transects), it appears that if there is Rhizopora then there is also ferns (there are two observations, i.e. in sondaken transect 2 and Popareng transects 3). While in the other seven location where there is no Rhizopora, there are 4 locations where there is no ferns also (Sondaken transect 3, Popareng transects 1 and 2, and teling transect 1). This shows a fairly strong dependence between the existence of Rhizopora and nails.

***Bruguiera* Association with Ferns**

Based on the result, the Association of Contingency coefficient is 0.302 and X^2_{count} is 0.900. Because X^2_{count} (0.900) < X^2_{table} (3.84), it can be concluded that there is no significant associations between *Bruguiera* and ferns. The association coefficient that is 0.302 indicates that there is low attachment / association between the presence of epiphytic plants that is ferns on *Bruguiera*. Figure 9 graphs of *Bruguiera* and nails as follows:

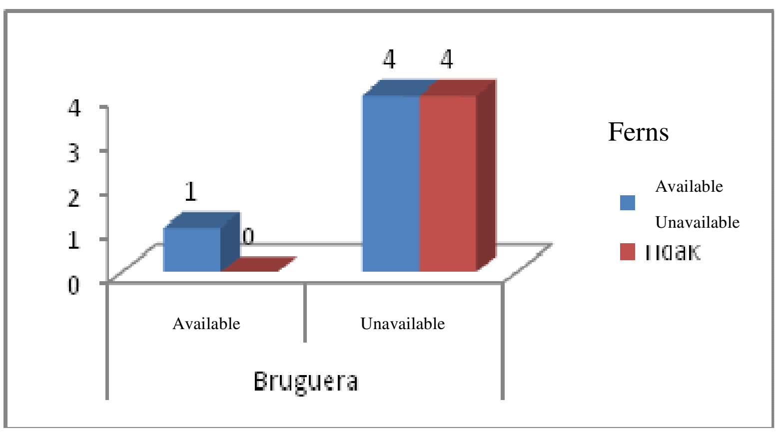

Figure 9. *Bruguiera* Association with Ferns

The graph above shows that among 9 observations (in three stations and three types of transects), it appears that if there is *Bruguiera* in Popareng transect 3, then there is also ferns. While in the other eight locations where there is no *Bruguiera*, there are 4 locations where the ferns appear (Teling transects 2 and 3, Sondaken transects 1 and 2), although in the 4 remaining locations, there is no ferns (Teling transect 1, Sondaken Transect 3, and Popareng transect 1 and 2). This shows a low dependence between the existence of *Bruguiera* and ferns.

Relationship between Molecular Weight of Mangrove and Epiphytic Plants

In obtaining the relationship between molecular weight of mangrove and epiphytic plants, Correlation Formula is used to indicate the closeness level / size of the linear relationship between two variables in the data sample. Data is obtained from the analysis of protein molecular weight using SDS-PAGE electrophoresis.

Table 1. Results of Protein Analysis by SDS-PAGE ELECTROPHORESIS

SLEB 2	22/12/2010	Samples were precipitated with acetone						
	Marker	rf Marker	BM Marker	log BM	**Orchid Sample**	rf sample	log BM	BM
Ribbon 1 Distance	0.3	0.0555556	116	2.064458	0.80	0.14	1.91	81.17
2	1.1	0.2037037	66.2	1.820858	1.00	0.17	1.87	74.77
3	1.8	0.3333333	45	1.6532125				
4	2.4	0.4444444	35	1.544068				
5	3.5	0.6481481	25	1.39794				
6	4.3	0.7962963	18.4	1.2648178				

Distance of CBB 5.8

Mangrove Sample	rf Sample	log BM	BM	**Ferns Sample**	rf Sample	log BM	BM
2.60	0.45	1.59	38.75	3.70	0.64	1.39	24.67
3.10	0.53	1.50	31.56	4.00	0.69	1.34	21.81
3.30	0.57	1.46	29.07	4.30	0.74	1.29	19.28
3.40	0.59	1.45	27.90				
3.50	0.60	1.43	26.78				
3.8	0.66	1.37	23.67				
4	0.69	1.34	21.81				
4.2	0.72	1.30	20.09				

Correlation of Molecular Weight of Mangrove and Molecular Weight of Orchid

Based on the calculation of the correlation coefficient, the obtained correlation value is 0.908, where t_{count} is 7.920 and the significance is 0.001 (Appendix). Since the significance (0.001) > 0.05, the H_0 is rejected, which means that there is a relationship between the Mangrove Molecular Weight and Orchid Molecular Weight. Correlation value of 0.908 indicates that the relationship between the Mangrove Molecular Weight and Orchid Molecular Weight is very strong, and is categorized in the type of Protocooperation interaction. Graphically, it can be seen as follows:

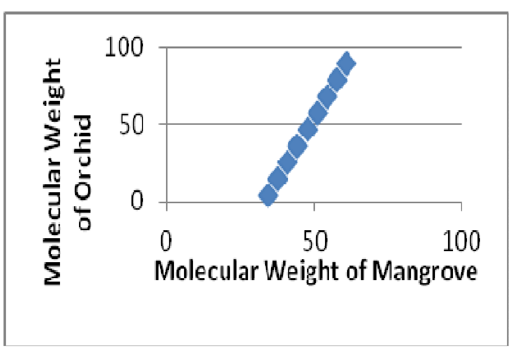

Figure 10. Graphic relationship between the Mangrove Molecular Weight and Orchid Molecular Weight

The graph above shows the higher the molecular weight of Mangrove (ranging from 35 to 90), the higher the molecular weight of orchids is (ranging from 5 to 90).

Correlation of Molecular Weight of Mangrove with Molecular Weight of Ferns

Based on the calculation of the correlation coefficient, the obtain correlation value is 0.870, where t_{count} is 6.401 and the significance is 0.002 (Appendix). Since the significance (0.002) < 0.05, then H_0 is rejected, which means that there is a relationship between the Molecular Weight of Mangrove and Molecular Weight of Ferns. Correlation value of 0.870 indicates that the relationship between the Mangrove Molecular Weight and Ferns Molecular Weight is so strong. Mutuality interaction type categories (+ +). Graphically it looks as follows:

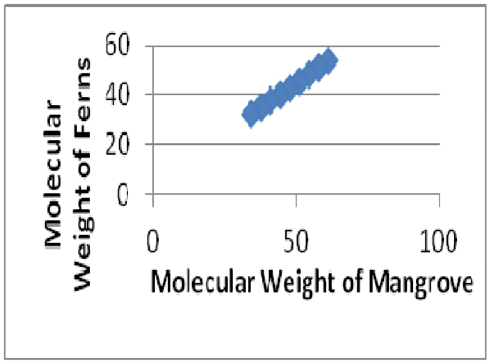

Figure 10. Graphic relationship between the Mangrove Molecular Weight and Ferns Molecular

Based on the graph above, it can be seen that the higher the molecular weight of Mangrove (ranging from 35 to 90), the higher the molecular weight of ferns is (ranging from 30 to 90).

3. Conclusion

1. The research result shows that *Sonaratia* and pigeon orchid are strongly associated based on coefficient value (0.707), *Rhizhopora* and pigeon orchid are categorized as weakly associated based on the coefficient value (0.243), R*hizhopora* and pigeon orchid are very weakly associated based on the coefficient value (0.186), *Rhizophora* and moth orchid are moderately associated based on coefficient value (0.552), *Bruguiera* and pigeon orchid are moderately associated based on the coefficient result (0.447) and *Bruguiera* and moth orchid are very weakly associated because their coefficient is the lowest (0.124).
2. The relationship between molecular weight of mangrove and molecular weight of orchid is very strong with the correlation value (0.908), this interaction is categorized in Protocooperation type (++), while the molecular weight of mangrove and molecular weight of ferns (0.870) is categorized as very strong and this interaction is categorized in Mutualism type (+ +).

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Appendix

I. Inter- Species Interaction

Table 1. *Avicennia* and Dove Orchid Interaction

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Squ	9.000[b]	1	.003		
Continuity Corre[a]	5.063	1	.024		
Likelihood Ratio	11.457	1	.001		
Fisher's Exact Te				.012	.012
Linear-by-Linear Association	8.000	1	.005		
N of Valid Cases	9				

a. Computed only for a 2x2 table

b. 4 cells (100.0%) have expected count less than 5. The minimum e› 1.00.

Symmetric Measures

		Value	pprox. Sig
Nominal by No	Contingency Coe	.707	.003
N of Valid Cases		9	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming t

Table 2. *Avicennia* and Moon Orchid Interaction

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Sq	.563[b]	1	.453		
Continuity Corre	.000	1	1.000		
Likelihood Ratio	.872	1	.350		
Fisher's Exact T				1.000	.667
Linear-by-Linear Association	.500	1	.480		
N of Valid Cases	9				

a. Computed only for a 2x2 table

b. 3 cells (75.0%) have expected count less than 5. The minimum 33.

Symmetric Measures

		Value	pprox. Sig
Nominal by N	Contingency Co	.243	.453
N of Valid Cases		9	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assumir

Table 3. *Rhizophora* and Dove Orchid Interaction

Chi-Square Tests

	Value	df	symp. Sig (2-sided)	xact Sig (2-sided)	xact Sig (1-sided)
Pearson Chi-S	.321[b]	1	.571		
Continuity Cor[a]	.000	1	1.000		
Likelihood Rati	.309	1	.578		
Fisher's Exact				1.000	.583
Linear-by-Linea Association	.286	1	.593		
N of Valid Case	9				

a. Computed only for a 2x2 table

b. 4 cells (100.0%) have expected count less than 5. The mi 67.

Symmetric Measures

		Value	pprox. Si
Nominal by N	Contingency C	.186	.571
N of Valid Cases		9	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assu

Table 4. *Rhizophora* and Moon Orchid Interaction

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Sq	3.938[b]	1	.047		
Continuity Corre[a]	.502	1	.479		
Likelihood Ratio	3.506	1	.061		
Fisher's Exact T				.222	.222
Linear-by-Linear Association	3.500	1	.061		
N of Valid Cases	9				

a. Computed only for a 2x2 table

b. 3 cells (75.0%) have expected count less than 5. The minimu 22.

Symmetric Measures

	Value	pprox. Si
Nominal by N Contingency C	.552	.047
N of Valid Cases	9	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assum

Table 5. *Bruguiera* and Dove Orchid Interaction

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Squar	2.250[b]	1	.134		
Continuity Correctio[a]	.141	1	.708		
Likelihood Ratio	2.460	1	.117		
Fisher's Exact Test				.333	.333
Linear-by-Linear Association	2.000	1	.157		
N of Valid Cases	9				

a. Computed only for a 2x2 table

b. 3 cells (75.0%) have expected count less than 5. The minimum expected 33.

Symmetric Measures

	Value	pprox. Si
Nominal by N Contingency C	.447	.134
N of Valid Cases	9	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assum

Table 6. *Bruguiera* with and Orchid Interaction

Chi-Square Tests

	Value	df	Asymp. Sig (2-sided)	Exact Sig (2-sided)	Exact Sig (1-sided)
Pearson Chi-S	.141[b]	1	.708		
Continuity Co[a]	.000	1	1.000		
Likelihood Rat	.251	1	.617		
Fisher's Exact				1.000	.889
Linear-by-Line Association	.125	1	.724		
N of Valid Cas	9				

Bruguiera

a. Computed only for a 2x2 table

b. 3 cells (75.0%) have expected count less than 5. The 11.

Symmetric Measures

	Value	pprox. Si
Nominal by N Contingency C	.124	.708
N of Valid Cases	9	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assum

Table 7. *Avicennia* and Ferns Interaction

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-S	3.600[b]	1	.058		
Continuity Cor[a]	1.406	1	.236		
Likelihood Rat	4.727	1	.030		
Fisher's Exact				.167	.119
Linear-by-Line Association	3.200	1	.074		
N of Valid Cas	9				

a. Computed only for a 2x2 table

b. 4 cells (100.0%) have expected count less than 5. The 1.33.

Symmetric Measures

		Value	Approx. Sig
Nominal by N	Contingency C	.535	.058
N of Valid Cases		9	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assum

Table 8 *Rhizophora* and Ferns Interaction

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.057[b]	1	.151		
Continuity Correction[a]	.394	1	.530		
Likelihood Ratio	2.805	1	.094		
Fisher's Exact Test				.444	.278
Linear-by-Linear Association	1.829	1	.176		
N of Valid Cases	9				

a. Computed only for a 2x2 table

b. 4 cells (100.0%) have expected count less than 5. The minimum expected count 89.

Symmetric Measures

		Value	Approx. Si
Nominal by N	Contingency C	.431	.151
N of Valid Cases		9	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error ass

Table 9. *Brugueira and* Ferns Interaction

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Sq	.900[b]	1	.343		
Continuity Corre[a]	.000	1	1.000		
Likelihood Ratio	1.275	1	.259		
Fisher's Exact T				1.000	.556
Linear-by-Linear Association	.800	1	.371		
N of Valid Cases	9				

a. Computed only for a 2x2 table

b. 4 cells (100.0%) have expected count less than 5. The minim 44.

Symmetric Measures

		Value	Approx. Sig
Nominal by Nom	Contingency Coeff	.302	.343
N of Valid Cases		9	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the nu

II. Calculation of Correlation Coefficient

1. Calculation of the correlation coefficient molecular weight proteins mangrove and weight proteins orchids.

Correlation Coefficient = $r_{xy} = \dfrac{\sum\left(X_i - \overline{X}\right)\left(Y_i - \overline{Y}\right)}{\sqrt{\sum\left(X_i - \overline{X}\right)^2 \sum\left(Y_i - \overline{Y}\right)^2}}$

$r_{xy} = \dfrac{2145.63}{\sqrt{(674.37)(6826.67)}}$ = $r_{xy} = \dfrac{2145.63}{2310.45}$ = $r_{xy} = 0.908$

Subsequently computed t value for a decision, whether the value of r_{xy} significant or insignificant.

T_{count} = $t_{count} = \dfrac{r_{XY}\sqrt{n-2}}{\sqrt{1-r_{xy}^2}}$ = $t_{count} = \dfrac{0.908\sqrt{9-2}}{\sqrt{1-0.908}}$ = $t_{count} = \dfrac{2.402}{0.303}$ $t_{count} = 7.920$

2. **The correlation coefficient calculation molecular weight proteins mangrove and molecular weight proteins Ferns**

Correlation Coefficient = $r_{xy} = \dfrac{\sum\left(X_i - \overline{X}\right)\left(Y_i - \overline{Y}\right)}{\sqrt{\sum\left(X_i - \overline{X}\right)^2 \sum\left(Y_i - \overline{Y}\right)^2}}$

$r_{xy} = \dfrac{630.85}{\sqrt{(684.33)(767.35)}}$ = $r_{xy} = \dfrac{630.85}{724.656}$ = $r_{xy} = 0.870$

Subsequently computed t value for a decision, whether the value of r_{xy} significant or insignificant.

T_{count} = $t_{count} = \dfrac{r_{XY}\sqrt{n-2}}{\sqrt{1-r_{xy}^2}}$ = $t_{count} = \dfrac{0.870\sqrt{9-2}}{\sqrt{1-0.870}}$ = $t_{count} = \dfrac{2.303}{0.359}$

$t_{count} = 6.401$