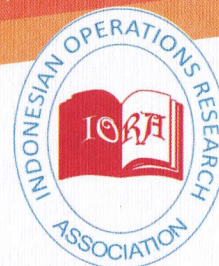




Certificate



is awarded to
PARLUHUTAN SIAHAAN
as
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The 4th INTERNATIONAL CONFERENCE ON OPERATIONS RESEARCH 2019

Theme:

"Policies and Optimal Decisions on Energy and Environment"

Which was Held at Faculty of Mathematics and Natural Sciences, Sam Ratulangi University - Manado
19-20 September 2019



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FAKULTAS MIPA UNIVERSITAS SAM RATULANGI



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Manado, 16th September 2019

Dear **Parluhutan Siahaan**

Thank you for your interest in The 4th International Conference on Operations Research 2019 (ICOR 2019) and submitting your Extended Abstract entitled:

“Exploration of Beauveria Bassiana Abundance and its Host Insects on Rice Plants in Bolaang Mongondow Regency”

It is our pleasure to inform you that your paper based on your Extended Abstract **has been accepted** for presentation at ICOR 2019 on 19-20 September 2019 in Manado.

Please do not hesitate to contact us if you need further information.
Looking forward to your participation in ICOR 2019.

Warm Regards,
Chairman of ICOR2019



Dr. Nelson Nainggolan, M.Si



INTERNATIONAL CONFERENCE ON OPERATIONS RESEARCH (ICOR)

4th

Policies and Optimal Decisions on Energy and Environment

Sam Ratulangi University, Manado, Indonesia
19 - 20 September 2019

BOOK OF ABSTRACTS



The 4th ICOR 2019

Operations Research (OR) has become powerful decision making tools worldwide. In its use, Management Science (MS) is used as another term for OR. Concept of OR is borderless as it can be derived from various disciplines such as Mathematics, Statistics, Economics, Engineering, Social, etc. to make a new set of knowledge for decision making. Today, OR has become a professional discipline which deals with the application of scientific methods in decision making theory.

The scope of OR can be used to find best solution for both simple and complex problems. It is beneficial in every aspect of human life regarding resources optimization. OR is widely used in important and main fields such as national planning and budgeting, transportation, education, agriculture, environment, and many others. Therefore, research and study involving OR are inevitable.

Number of research and study about OR or using OR as tools is high these years. This is accommodated by Indonesian Operations Research Association (IORA) IORA as one of OR organisations in an annual international conference entitled International Conference on Operations Research (ICOR). ICOR 2019 is the fourth conference (iCOR 4.0). This initiates to bring together OR/MS researchers, academicians and practitioners, whose collective work has sustained continuing OR/MS contribution to decision-making in many fields of application. It can be considered as good platforms for the OR/MS community, particularly in Indonesia, to meet each other and to exchange ideas.

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WELCOMING SPEECH

The 4th International Conference on Operations Research 2019

Director General of Conservation of Natural Resources and Ecosystems,
Ministry of Environment and Forestry
Rector of Sam Ratulangi University Prof. Dr. Ir. Ellen Joan Kumaat,
MSc, DEA.
IORA President and Dean of FMIPA University of Padjadjaran Prof. Dr.
H. Sudradjat Supian, MSc.

Distinguished Guests, Ladies and Gentlemen.

On behalf of ICOR 2019 Organizing Committee, I would like to Welcome you all and thank you for being here. Especially to Rector of Universitas Sam Ratulangi for fulfilling our invitation and to give opening speech for this conference. Special thanks also for Keynote Speakers, Plenary Speakers, Contributed Speakers and All Participants of this conference.



This conference can be held in collaboration of Indonesian Operations Research Association (IORA) and Faculty of Science Universitas Sam Ratulangi.

The point of this conference is to provide a perfect event for researchers, academics, and practitioners of Operations Research, to share experience, build communication and network with experts from all over the world. Furthermore, this conference is aimed at promotion and spread of scientific operations research field in Indonesia through Indonesian Operations Research Association (IORA).

The same conference had previously been held three time, initially hosted by Universitas Pakuan Bogor, followed by Universitas Terbuka Tangerang as second host and the third hosted by Universitas Sam Ratulangi. This conference is now held at Universitas Sam Ratulangi Manado for the forth time, that is why it is known as the 4rd International Conference on Operations Research (ICOR) under a main theme entitled Policies and Optimal Decisions on Energy and Environment.

Number of participants of this conference are more than 300, from 15 countries. Selected Papers will be published on scopus indexed Journal and IOP Publications.

Lastly, we want to gratefully thank again rector for her help and support, all keynote speakers, plenary speakers, contributed speakers, all participants, and all organizing committee who have given contribution to make this conference happen.

Dr. Nelson Nainggolan, MSi
Conference Chair

FOREWORD

From the Dean
Faculty of Mathematics and Natural Sciences, Sam Ratulangi
University
Prof. Benny Pinontoan, M.Sc

It is a great honor for the Faculty of Mathematics and Natural Sciences (FMIPA), Sam Ratulangi University (UNSRAT), Manado, Indonesia, to organize again the International Conference on Operations Research (ICOR); this year the 4th ICOR (iCOR 4.0), after organized the 3rd ICOR also by FMIPA UNSRAT in 2018. We thank, therefore, the Indonesian Operations Research Association (IORA) for this opportunity. It is an opportunity to open collaborations with other institutions, it is an opportunity to know other researchers, it is an opportunity to look at the problems more intense and eventually suggest some solutions, optimal solutions, to the problems.



The theme of iCOR 4.0 is Policies and Optimal Decisions on Energy and Environment. The motivation to suggest this theme as that we are facing decreasing of fossil energy sources on one side, but on the other side finding new energies, e.g. renewable energies, seems to create other conflict problems either with the efficiency of costs or with the sustainability of the environment. To look at these problems from the point of view of Operations Research is, therefore, relevant and can give better and optimal solutions.

This year, there are more than 300 participants registered. In compare with the 3rd ICOR with the theme Optimal Decisions for Marine Tourism [1], this is an increasing of about 50% more participants. The number of countries participated this year is 15 which is also increased. This shows increasing interests to both the ICOR and the theme of the conference. We also hope that number the papers successfully published in IOP Proceeding indexed in Scopus this year will be much more than last year.

Welcome to iCOR 4.0, Welcome to UNSRAT, Welcome to Manado. Enjoy your stay, enjoy the nature, the food, the hospitality and experience wonderful moments in Manado and surrounding areas.

Pakatuan wo Pakalawiden. God bless you.

Reference

[1] Pinontoan B 2019 From the Dean Faculty of Mathematics and Natural Sciences, Sam Ratulangi University IOP Conf. Series: Material Science and Engineering 567 pp. 6.

CONGRATULATORY SPEECH BY THE PRESIDENT OF THE INDONESIAN OPERATIONS RESEARCH ASSOCIATION (IORA)

Distinguished Guest, All invited Speakers, Participant, Ladies and Gentlemen,
It is a great pleasure for me on behalf of the Association of the Indonesian Operations Research Association, I would like to welcome you all at this special event International Conference On Operations Research at the Universitas Sam Ratulangi. This event is the fourth event for IORA-ICOR and congratulations to the Universitas Sam Ratulangi be able to host.



The theme of the conference, Policies and Optimal Decisions on Energy and Environment, reflects our belief that many future challenges in our life need involvement of operations research and typical analytic operations research. Our future and our capacity to reach sustainable development goal such as ensure availability and sustainable management of water and sanitation for all; ensure access to affordable, reliable, sustainable and modern energy for all; take urgent action to combat climate change and its impacts; end poverty in all its forms everywhere; conserve and sustainably use the oceans, seas and marine resources for sustainable development; end hunger, achieve food security and improved nutrition and promote sustainable agriculture, ensure healthy lives and promote well-being for all at all ages, and other challenges require the advances the roles of operations research in collaboration with other disciplines. Operations Research is the application of scientific & mathematical methods to the study & analysis of problems involving complex systems. Analytics is defined as the scientific process of transforming data into insights for making better decisions. Operations Research is multi-disciplinary therefore interaction with other fields of science is indispensable and proven to have given rise to new areas that improve the ability in decision making and techniques used are modeling.

Typically, applications of Operations Research in these and other areas deal with decisions involved in planning the efficient allocation of scarce resources - such as material, skilled workers, machines, money and time - to achieve stated goals and objectives under conditions of uncertainty and over a span of time. Efficient allocation of resources may entail establishing policies, designing processes, or relocating assets. OR analysts solve such management decision problems with an array of mathematical methodologies. Completely of the operations research field can be seen in AMS 2000 or MCS 2010.

And now, I need to clarify that IORA is new association in Indonesia he is beginning piloted in workshops in Operations Research and Optimization modelling on June 4, 2011 in the Department of Mathematics Faculty of Mathematics and Natural Science, Universitas Padjadjaran, then be disseminated to several universities, government and industry.

IORA is a container that provides a forum for scientists Operational Research and to expand our horizons through the exchange of knowledge and application technology, IORA established on August 25, 2014 by deed of Notary Number 42 and the Minister of Justice and Human Rights Number. AHU-00439.60.10.2014.

IORA members came from a variety of fields, education, researcher, government, industry, practitioners etc, in 2017 members numbered 130 members and until now IORA members numbered 240 members, and we wait for those who have become members through www.iora.or.id.

Ladies and gentlemen,

We need to inform that at the current conference will also be held meeting IORA board. Finally, Have a nice International Conference on Operations Research. I hope there are plenty of benefits we can share and empower through this and hopefully your participations and contributions will make this conference a productive and successful one.

President, The Indonesia Operations research Association

Prof. H. Sudradjat Supian, M.Sc., Ph.D

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Host Diversity of *Beauveria Bassiana* (Balsamo) Vuillemin in Rice Plantations in Bolaang Mongondow Regency

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Abstract

Beauveria bassiana can attack a variety of hosts and their virulence can vary at each host and location. Exploration of the diversity of hosts *B. bassiana* from local isolates needs to be done as initial information that can explain the ability of *B. bassiana* in infecting insects. This study aims to analyze the diversity, abundance, and density of host insects infected by *B. bassiana* local isolate. Sampling locations were selected in three district, each district selected three stations and each station consisted of 10 plots. The location of sampling is determined by the purposive random sampling method. Each station was made a plot measuring 1x 1 m and distributed randomly. Every insect infected with *B. bassiana* was taken to a laboratory for identification. The results showed that there were five insects that hosted *B. bassiana*, namely *Nilaparvata lugens*, *Scotinophara coarctata*, *Leptocorisa oratorius*, *Nezara Viridula* and *Paraeucosmetus pallicornis*. The highest host diversity index was found in North Dumoga with a value of 1.47. The highest abundance was found in *N. lugens* host in East Dumoga with a value of 43%. The highest density was found in the host *N. lugens* in Dumoga Tengah with a value of 1.93 ind / m². There were indications of differences in virulence of the *B. bassiana* local isolates that were influenced by the species of host and location

Keywords : Abundance, *Beauveria bassiana*, Bolaang Mogondow Regency, density, diversity,

Introduction

Rice ecosystems can be an ideal source of entomopathogenic fungi. As reported by Rosmini and Lasmini (2010) there were five entomopathogenic fungi that attacked the green leafhopper (*Nephotettix viresens*) in rice plantations in Donggala Regency, one of which found was *Beauveria* sp. Exploration of entomopathogenic fungi in rice cultivation needs to be done to provide biological agents that can replace the role of synthetic pesticides (Rizal *et al.*, 2017). Bolaang Mongondow Regency, North Sulawesi Province is a center of rice production that had experienced various pest attacks (Mandei *et al.*, 2011; Kila *et al.*, 2016; Kanakan *et al.*, 2017). Naturally, planting sites in this region must contain entomopathogenic fungi that are usually associated with rice pest insects. Exploration of local entomopathogenic fungi can be an environmentally friendly pest control alternative. One of the entomopathogenic fungi that promises to be utilized is *B. bassiana*.

Fungi *B. bassiana* is one of the entomopathogenic fungi that has been known its effectiveness as a plant pest control (Anggarawati *et al.*, 2017). This fungus colonies on in vitro media will be white flour. The colonis will turn yellowish or reddish color after aging (Effendy *et al.*, 2010). *B. bassiana* has been known to attack several species of

insects, both pest insects, disease vector insects, and other insects. Based on research from Priyatno *et al.* (2016) that *B. bassiana* can attack stinky bugs (*Leptocoris oratorius*), black ladybugs, and brown stem plant hopper (*Nilaparvata lugens*). According to Valero-Jiménez *et al.* (2014) this entomopathogen can also be used in controlling *Anopheles coluzzii* mosquitoes which become vectors of malaria. Mwamburi *et al.* (2015) reported *B. bassiana* could be used to control house flies (*Musca domestica*). *B. bassiana* was also reported to attack crickets (*Gryllus* sp.) (Ardiyati *et al.*, 2015).

The virulence of *B. bassiana* is known to vary depending on the origin, genetic diversity, the stage of the insect and the host. Valero-Jiménez *et al.* (2016) reported that there were several genes and molecular processes that could influence the virulence of *B. bassiana* against mosquitoes. Huang *et al.* (2019) reported that *B. bassiana* had different virulence qualities at each stage of *Haemaphysalis longicornis*. In India Bhadauria *et al.* (2013) reported no correlation between *B. bassiana* virulence and host insect origin. However, in China Li *et al.* (2014) reported that *B. bassiana* isolates had different virulence at each host and each location.

Based on this information it can be seen that *B. bassiana* can attack various hosts and their virulence can vary at each host and location. For this reason, a preliminary study on the diversity of *B. bassiana* hosts originating from local isolates, Bolaang Mongondow Regency needs to be done. This study aims to analyze the diversity, abundance, and density of host insects infected by *B. bassiana* local isolates.

MATERIALS AND METHOD

The study was conducted from April 2019 to February 2020 in Bolaang Mongondow Regency, North Sulawesi. Three sub-districts were taken as sample locations and three stations were made as replications in each sub-district. Station selection was carried out using a purposive random sampling method based on rice age. Each station was made with a plot size of 1x1 m, 10 plots were distributed randomly. All fungal-infected insects were collected and then were identified and selected at the Laboratory of Biological Agents, Center for Plant Protection and Horticulture, North Sulawesi Agriculture and Animal Husbandry Office.

Host diversity indexes were calculated using the Shannon-Wiener Diversity Index (Stilling, 2012).

$$H' = - \sum_{n=1}^s p_i \ln p_i$$

H' = Diversity Index

Pi = Comparison of the number of i-th individuals (ni) with the total number of whole individuals (N)

S = The number of species in the sample

The Host Abundance were calculated using the Abundance formula according to Fachrul (2007).

$$A = \frac{\text{Number of individual spesies } i\text{-th}}{\text{Number of individual of all spesies}} \times 100 \%$$

Host Density were calculated using the Density formula according to Stilling (2012).

$$DI = \frac{\sum xi}{L}$$

Xi = Number of i-individuals

L = area of sample (m²)

The identification of entomopathogenic fungi using the method in accordance with Nuraida and Hasyim (2009), Herdatiarni *et al.* (2014), Kulu *et al.* (2015) Trizelia *et al.* (2015), and Priyatno *et al.* (2016).

RESULTS AND DISCUSSION

1. Exploration of the host *B. bassiana*

Exploration results showed that insects infected with *B. bassiana* were found in each district. Five species of host insects infected with *B. bassiana* were found in all district. The host insects were *Nilaparvata lugens*, *Scotinophara coarctata*, *Leptocorisa oratorius*, *Nezara viridula*, and *Paraecusmetus pallicornis*. Data from Central Dumoga, North Dumoga, and East Dumoga show that the highest infected *B. bassiana* insect is *N. lugens* with successive values of 1.93, 1.40, 1.07 and the lowest is *N. viridula* with successive values ie. 0.20, 0.17, and 0.07 (Table 1).

Insects found to be infected with *B. bassiana* were common insect pests found in the rice ecosystem. *N. lugens* is one of the main pests of rice that is plastic which is easy to adapt to the environment and attacked the plant by sucking the liquid stem to dry (Nurbaeti *et al.*, 2010). *S. coarctata* is a pest that causes huge losses in rice plantations because it attacks almost all stages of rice growth (Sepe and Demayo, 2017). *L. oratorius* is an important pest of rice because its presence can cause yield losses. Generally these pests attack at the stage of generative growth in rice (Kartohardjono *et al.*, 2009). *N. viridula* is a pest that is commonly found in Legumes (CABI, 2016). This pest is an important pest in rice plants which causes considerable damage and is detrimental to the economy (Jones, 1988). *P. pallicornis* is a new pest since the 1980s that caused damage to rice plants in Bolaang Mongondow which must be watched out (Sembel, 2014).

Tabel 1. Successive values and host of *B. bassiana* in three district of Bolaang Monondow Regency .

Location (District)	Host Spesies (Infected Insects)	Means
Central Dumoga	<i>Nilaparvata lugens</i>	1.93
	<i>Scotinophara coarctata</i>	1.47
	<i>Leptocorisa oratorius</i>	0.93
	<i>Nezara viridula</i>	0.20
	<i>Paraeucosmetus pallicornis</i>	1.17
Total		5.70
North Dumoga	<i>Nilaparvata lugens</i>	1.40
	<i>Scotinophara coarctata</i>	0.80
	<i>Leptocorisa oratorius</i>	1.10
	<i>Nezara viridula</i>	0.17
	<i>Paraeucosmetus pallicornis</i>	0.87
Total		4.33
East Dumoga	<i>Nilaparvata lugens</i>	1.07
	<i>Scotinophara coarctata</i>	0.53
	<i>Leptocorisa oratorius</i>	0.40
	<i>Nezara viridula</i>	0.07
	<i>Paraeucosmetus pallicornis</i>	0.40
Total		2.47

2. Diversity Index of *B. bassiana* Host (H')

Diversity index of *B. bassiana* host varied among district. The highest value was in North Dumoga District ($H'=1.47$), followed by Central Dumoga District ($H'=1.45$) and the lowest was in East Dumoga District ($H'=1.38$). Host diversity index values can be seen in Figure 1.

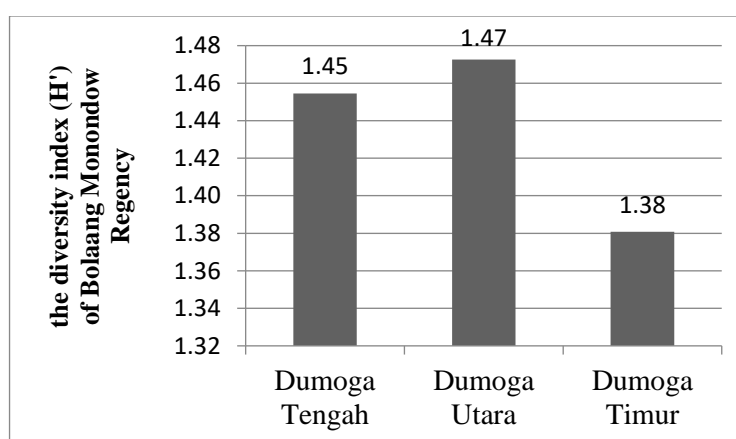


Figure 1. Diversity index (H') of *B. bassiana* host per district

The H' value obtained indicates that the diversity of host *B. bassiana* in all district was considered to be in the medium category (Alikodra, 2002). This showed that *B. bassiana* had moderate or quite diverse hosts. Ecosystem conditions were quite balanced

to sustain the survival of *B. bassiana*. Among the sample districts, East Dumoga district was in supporting the life of *B. bassiana* while North Dumoga was an in supporting the life of this fungus.

The diversity index highly dependent on the evenness of the number of individuals between species rather than on richness per species. So the high or low value of the diversity index depends on the evenness between species (Solle, *et al.*, 2017). Evenness can be seen from the differences between species obtained. This indicates that the difference in the number of fungal infections between hosts in the District of North Dumoga is not large because it has the highest diversity index, this is inversely proportional to the District of East Dumoga. The low diversity index value indicates the difference in the number of infections between hosts was very large when compared the other two distric.

3. Abundance of Host *B. bassiana*

The results showed that *B. bassiana* was abundant in *N. lugens* host in all district with the following values; Central Dumoga District 34%, North Dumoga District 32%, and East Dumoga 43% (Table 2)

Table 2. *B. bassiana* abundance for each host in three district of Bolaang Mongondow Regency

Location (District)	Abundance (%)				
	<i>N. lugens</i>	<i>S. coarctata</i>	<i>L. oratorius</i>	<i>N. viridula</i>	<i>P. pallicornis</i>
Central Dumoga	34	26	16	4	20
North Dumoga	32	18	25	4	20
East Dumoga	43	22	16	3	16

The high abundance of *B. bassiana* in *N. lugens* that these host were most often attacked by *B. bassiana*. This could possibly be caused by the population size of the pest (*N. lugens*) being quite high. According to Mardiana (2018) and Chandra (2019) population size can influence the spread of pathogens. In this case the greater the size of the *N. lugens* population, the more individuals in this population were infected by *B. bassiana*. The same thing happens with *N. viridula*, the abundance of *B. bassiana* in these insects were very low, ranging from 3 - 4%. This showed that the population *N. viridula* were very low in rice plants in three district.

The Abundance obtained can explain the high and low values of the diversity index. As mentioned earlier that the difference in the number of individuals between species can affect the value of the diversity index obtained. The difference in the number of species between infected species in North Dumoga was low. The difference in the value of the abundance between *N. lugens* (32%) and *L. oratorius* (25%) was 7%. The difference in value of abundance between *N. lugens* (32%) and *S. coarctata* (18%)

was 14% and the difference in value of abundance *N. lugens* (32%) with *N. viridula* (4%) was 28%, these were what causing the high value of diversity in the North Dumoga District. The opposite happened in East Dumoga District where the difference in the abundance values of *N. lugens* (43%) and *S. coarctata* (22%) was 21%. The difference in the value of abundance of *N. lugens* (43%) with *L. oratorius* and *P. pallicornis* (16%) was 27%, while the difference in the value of abundance of *N. lugens* (43%) with *N. viridula* (3%) was 40%. The difference in the abundance between different species of hosts was very large in East Dumoga, this caused the value of the diversity index in this area to be the lowest compared to the other two district.

4. Density of *B. bassiana* Based on Its Host

Density in all district showed that *N. lugens* insects had the highest density per m². Successively from the District of Central Dumoga, North Dumoga, and East Dumoga, the values were as follows; 1.93 ind / m², 1.40 ind / m², 1.07 ind / m² (Table 3).

Table 3. *Beauveria bassiana* Density for each host in three district of Bolaang Mongondow Regency .

Location (District)	Host Spesies	Number of individuals/m ²
Central Dumoga	<i>Nilaparvata lugens</i>	1.93
	<i>Scotinophara coarctata</i>	1.47
	<i>Leptocorisa oratorius</i>	0.93
	<i>Nezara viridula</i>	0.20
	<i>Paraeucosmetus pallicornis</i>	1.17
Total		5.70
North Dumoga	<i>Nilaparvata lugens</i>	1.40
	<i>Scotinophara coarctata</i>	0.80
	<i>Leptocorisa oratorius</i>	1.10
	<i>Nezara viridula</i>	0.17
	<i>Paraeucosmetus pallicornis</i>	0.87
Total		4.33
East Dumoga	<i>Nilaparvata lugens</i>	1.07
	<i>Scotinophara coarctata</i>	0.53
	<i>Leptocorisa oratorius</i>	0.40
	<i>Nezara viridula</i>	0.07
	<i>Paraeucosmetus pallicornis</i>	0.40
Total		2.47

The Density describes the population size in an area that is affected by the habitat area and the number of similar individuals found in the area (Suin, 2003). Based on the data obtained showed that the largest population size was in Central Dumoga where the largest population was found in the population of *N. lugens* followed by *S. coarctata*, *P. pallicornis*, *L. oratorius* and *N. viridula*. In North Dumoga the largest population was found in *N. lugens* followed by *L. oratorius*, *P. pallicornis*, *S. coarctata*, and *N. viridula*.

In East Dumoga the largest population was *N. lugens* followed by *S. coarctata*, *L. oratorius* and the smallest were *P. pallicornis* and *N. viridula* which had the same population size. The intended population size refers to the size of the population affected by *B. bassiana* attacks. Therefore, the population of *N. lugens* was the population of pests that experienced the greatest impact of attacks by *B. bassiana* so that *B. bassiana* isolates from Bolang Mongondow Regency had good effectiveness in controlling the population of *N. lugens*.

The *N. lugens* density was always the highest and the *N. viridula* was always the lowest in the three district while the other three hosts (*S. coarctata*, *L. oratorius* and *P. pallicornis*) had density that always varies in each district. This was an indication that there was a difference in virulence at each host and at each location against *S. coarctata*, *L. oratorius* and *P. pallicornis*. So that further research on the differences in virulence between hosts and locations for these three insect species needs to be done.

CONCLUSION

There were five species of insects found as the hosts of *B. bassiana* with varied Diversity Index values in each district, namely Central Dumoga 1.45, North Dumoga 1.47, and East Dumoga 1.38. The highest Abundance was found in *N. lugens* host in all district with the value of Central Dumoga 34%, North Dumoga 32%, and East Dumoga 43%. The highest Density is found in *N. lugens* hosts in all district with a value of 1.93 individuals / m² in Central Dumoga, 1.40 individuals / m² in North Dumoga, and 1.07 individuals / m² in East Dumoga. There were indications of differences in *B. bassiana* virulence by host species and locations that attack *S. coarctata*, *L. oratorius* and *P. pallicornis* insects.

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