

**ODONATA DIVERSITY AROUND THE ARFAK MOUNTAINS,  
WEST PAPUA****KEANEKARAGAMAN ODONATA DI SEKITAR PEGUNUNGAN ARFAK,  
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DOI: [10.47039/ish.2.2020.103-113](https://doi.org/10.47039/ish.2.2020.103-113)**Abstract**

West Papua is known to harbor high biodiversity and endemism. Odonata is one taxon that has a high diversity and endemism and plays an important role as an environmental bioindicator. As with many other taxa, field research on the diversity, distribution, and habitat of dragonflies is still very limited in West Papua. Yet, its habitats are under threat due to forest and land conversion for infrastructure developments. This study was designed to document the diversity of Odonata around the Arfak Mountains; especially in Uyehegrik Village (Prafi District), Hijou Village (Neney District) and Anggra Village (Minyambou District). Data was collected using the purposive sampling technique. The Shannon Diversity Index and t-test were used to calculate and compare species diversity at each research location; and Sorensen Index was used to analyze the similarity of species in each location. About 21 species from 7 families were recorded during this study, 10 of which species are likely new. Our main conclusions include: the Shannon Weaner Index ( $H'$ ) at the study sites 1.43-1.89 indicates moderate diversity; standing water is the main habitat of dragonflies; the temperature has positive, but weak correlation with species diversity and species abundance. Discovery of new species indicates that this area remains understudied.

**Keywords:** Arfak Mountains, neney, minyambouw, odonata diversity, prafi**Inti Sari**

Provinsi Papua Barat diketahui memiliki keanekaragaman hayati dan tingkat endemik yang tinggi. Odonata adalah salah satu taksa dengan keragaman jenis dan tingkat endemik yang tinggi dan berperan penting sebagai indikator keadaan lingkungan. Seperti kebanyakan taksa lainnya, penelitian lapangan mengenai keragaman jenis, penyebaran dan habitat Odonata (capung) masih terbatas di Papua Barat. Namun habitat Odonota terus terancam akibat konversi hutan dan lahan untuk pembangunan infrastruktur. Penelitian ini dirancang untuk mendokumentasi keragaman Odonata di sekitar Pegunungan Arfak, terutama di Kampung Uyehegrik (Distrik Prafi), Kampung Hijou (Distrik Neney) dan Kampung Anggra (Distrik Minyambou). Data lapangan dikoleksi secara purposif. Indeks Keragaman Shannon ( $H'$ ) dan uji t digunakan untuk menghitung dan membandingkan keragaman jenis antara lokasi penelitian, dan Indeks Sorensen untuk membandingkan kesamaan spesies antara lokasi penelitian. Ada 21 spesies dari 7 family yang berhasil dicatat dalam penelitian ini. Hasil penelitian menunjukkan Indeks Keragaman Shannon ( $H'$ ) berkisar antara 1,43 – 1,89 menunjukkan keragaman moderat, kolam merupakan habitat utama. Ada korelasi positif antara suhu dan kelimpahan spesies (individu). Penemuan beberapa spesies yang mungkin baru menunjukkan bahwa masih banyak belum diketahui.

**Kata Kunci:** Pegunungan Arfak, neney, minyambow, keanekaragaman odonata, prafi

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## I. INTRODUCTION

Papua and West Papua Provinces are known to harbor high species diversity and endemism (Marshall & Beehler, 2009). The Arfak Mountains, an isolated range located on the 'Bird's Head' of West Papua Province are considered an important area for biodiversity conservation in Indonesia (CI, 1997), and in 1982 the mountains were declared by the national Government as a Cagar Alam Pegunungan Arfak or Arfak Mountains Strict Nature Reserve (Craven & De Fretes, 1987) due to the high concentration of biodiversity and endemism there.

Unfortunately, since this declaration, only limited actions have been taken to effectively manage the area for conservation and infrastructure development continues to threaten the park and its resident species. If the trend of infrastructure development continues or accelerates without proper planning, and without significant improvement in the reserve management, we may lose many species before they are even documented.

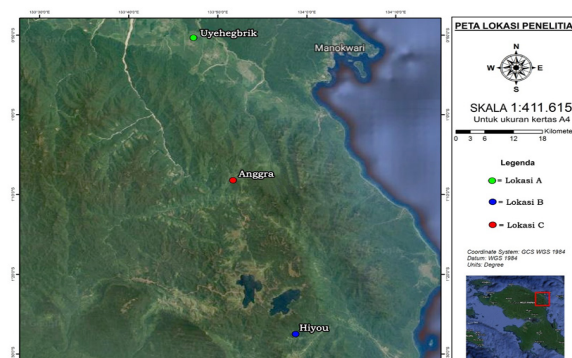
Habitat alteration is by far the main threat to many taxa with special habitat requirements or limited geographic distributions. One such taxon is Odonata (dragonflies and damselflies). This group remains poorly known in West Papua, but it is an excellent bioindicator and many species in New Guinea are restricted to good quality forests and streams (Kalkman & Orr, 2013; Orr & Kalkman, 2015). Furthermore, a high proportion of New Guinea's odonates are endemic to the region and many have small known distributions (Michalski, 2012).

A spectacular example of a locally endemic odonate species in the Arfak Mountains is the red and black damselfly *Palaiargia ernstmayeri*, a poorly known species known only from two localities (Orr et al., 2013). Given the potential usefulness of odonates as indicators of environmental change, and the poor state of knowledge about the odonate fauna of the Arfak Mountains, this study was designed to document odonate diversity in different habitats at several sites in the Arfak Mountains

## II. METHODS

Field data were collected from June - August 2019 in three villages: Uyehegbrik in Prafi District (S 00° 55' 27,2" E 133° 48' 25,7", "about 178 m above sea level-a.s.l)

representing lowland habitat; Hijou in District Nenei (S 01° 26' 49,3" E 134° 00' 28,00", about 932 m a.s.l) representing mid-mountain habitat; and Anggra in District Minyambouw (S 01° 08' 09,4" E 133° 53' 01,00", about 1570 m a.s.l) representing high mountain habitat (Fig 1).



**Figure 1.** Study Location: Uyehegbrik (District Prafi), Hijou (District Nenei) and Anggra (District Minyambouw), Manokwari Papua Barat

Sampling was conducted in the morning 09:00 - 11:00 and in the afternoon 14:00 - 16:00 with two insect nets, 30 cm in diameter. All species captured and coordinates, temperature and moisture as well as major habitat types were recorded. Species were identified using the field guides *Panduan Lapangan Capung Jarum di New Guinea* (Kalkman & Orr, 2013) and *Panduan Lapangan Capung Biasa di New Guinea* (A. Orr & Kalkman, 2015), and later with the assistance of Stephen Richards from the South Australian Museum.

### 1) Species Diversity and Diversity between the Sites

The Shannon-Weiner Diversity Index ( $H'$ ) and student t-test were used to calculate species diversity in each site and to compare species diversity between sites. The Shannon Diversity t-test Calculator (Gardener, 2017) was used to calculate Shannon Index Diversity for each site and to compare diversity between sites.

$$H' = - \sum p_i \ln p_i; p_i = n_i/N \quad (1)$$

where:

$H'$  = Shannon-Weiner Diversity Index

$p_i$  = the proportion of individual found in the  $i$ th species

$n_i$  = the total number of individuals in the  $i$ th species

ln = the logarithm natural  
 N = the total individual of individuals

2) *Relative Abundance and Evenness*

Relative abundance was calculated with

$$RA = \frac{n_i}{N} \times 100\% \quad (2)$$

where,  
 RA= relative abundance,  
 n<sup>i</sup> = the number of individuals of i<sub>th</sub> species,  
 N = the total individuals of all species observed.

Species evenness was calculated using (Magurran, 2013).

$$E = \frac{H'}{\ln(S)} \quad (3)$$

where:  
 E = species evenness,  
 H' = Shannon Weiner Diversity Index,

S = total number of species, and  
 ln = logarithm normal.

3) *Species Similarity between the Sites*

Sorensen Coefficient of Similarity was used to compare species similarity between sites (Krebs, 1999)

$$S_s = 2a/2a+b+c \quad (4)$$

where:  
 S<sub>s</sub> = Sorensen Coefficient of Similarity;  
 a = the total number of species found on both sites (site 1 and site 2)  
 b = the total number of species found only on site 1 and  
 c = the total number of species found only on site 2.

4) *Correlation between Numbers Individual with Temperature*

Corel at Excel Software was used to examine the correlation between the number of individuals observed and temperature.

**Table 1.**  
 Number of Species Recorded at Uyehegabrik (U), Hijou (H) and Anggra (A)

No.	Family	Species	U	H	A
	Aeshnidae	<i>Ictinogomphus lieftincki</i>	√	-	-
		<i>Oreaeschna dictatrix</i>	-	-	√
	Argiolestidae	<i>Argiolestes</i> sp.	-	√	-
	Calopterigidae	<i>Neurobasis</i> sp.	-	√	-
	Chlorocyphidae	<i>Rhinocypha tincta</i>	-	√	-
	Coenagrionidae	<i>Agriocnemis femina</i>	√	-	-
		<i>Coenagrionidae</i> sp.	-	√	-
		<i>Papuagrion</i> sp.	-	√	-
		<i>Pseudagrion silaceum</i>	√	-	-
		<i>Teinobasis</i> sp.	-	√	-
	Libellulidae	<i>Diplacina</i> sp.	-	-	√
		<i>Huonia</i> sp.	-	√	-
		<i>Lanthanusa</i> sp.	-	-	√
		<i>Nannophya pygmaea</i>	√	√	-
		<i>Neurothemis stigmatizans</i>	√	√	-
		<i>Orthetrum glaucum</i>	√	√	√
		<i>Orthetrum</i> sp.	√	-	-
		<i>Orthetrum villosovittatum</i>	√	√	√
	<i>Pantala flavescens</i>	√	-	-	
		<i>Rhyotemis resplendens</i>	-	√	-
	Synthemistidae	<i>Palaeosynthemis</i> sp.	-	-	√
Total	7	21	9	12	6

### III. RESULTS AND DISCUSSIONS

#### A. Number of Species (S)

Twenty-one species from seven families were observed across all three sites (Table 1). About 10 species recorded from Libellulidae, five species from Coenagrionidae, while the remaining families were represented by less than five species. About 12 species were recorded from Hijou village followed by nine species at Uyehegbrik, and six species at Anggra.

Table 1 reveals that four of the seven families recorded during this study were represented by a single species: Aeshnidae by two species and Coenagrionidae by five species. The most species-rich family was Libellulidae with 10 species represented, two of which (*Orthetrum glaucum* and *Orthetrum vilosovitattum*) were recorded at all three study sites: that this from the lowland up to the Arfak Mountain (ca. 1700 m asl). However, most species (80%) were observed only at a single study site. More systematic studies over a longer time are required to satisfactorily

document the species diversity and their distribution patterns.

Figure 2 shows the 21 species were recorded from 7 families, only one family (Libellulidae) contains all species, while other families only have one species. Similar results were documented from previous studies in Wondiwoi Mountains, Papua Barat, in which 9 of 14 species belongs to Libellulidae (Simanjuntak, 2009), and in Misool Islands, where 12 of 17 species recorded in Misool Island came from the same family (Rambu, 2015).

#### B. Habitat Preference

Figure 3 was constructed from the record of 123 individuals from 21 species. Habitat types were assigned to the most dominant habitat where individuals were observed. At least four major habitat types were recognized across all study sites. Figure 3 shows that standing water (56% observed individuals) and open forest (16%) are the most preferred habitats. *Orthetrum galucum*, *Orthetrum villosovitattum*, *Neurothemis*

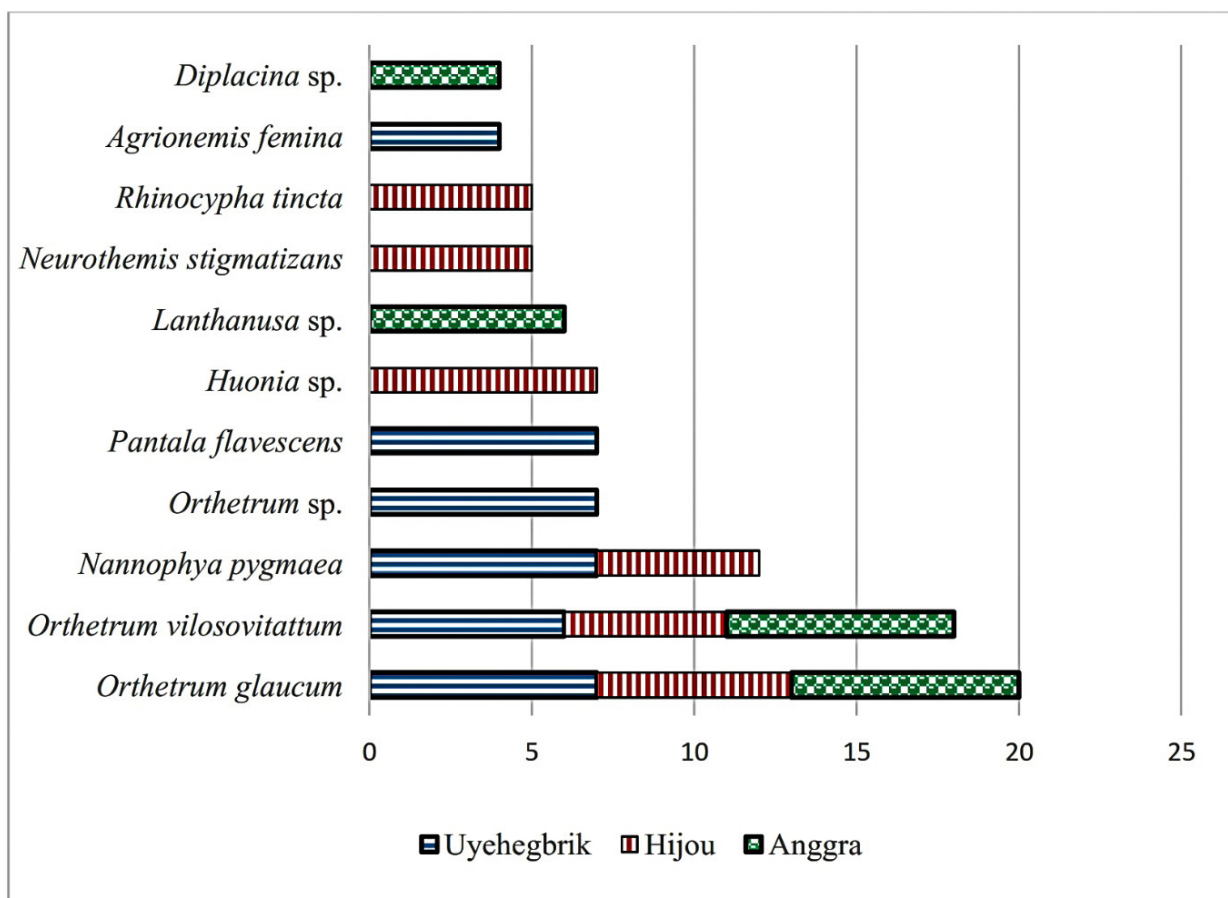
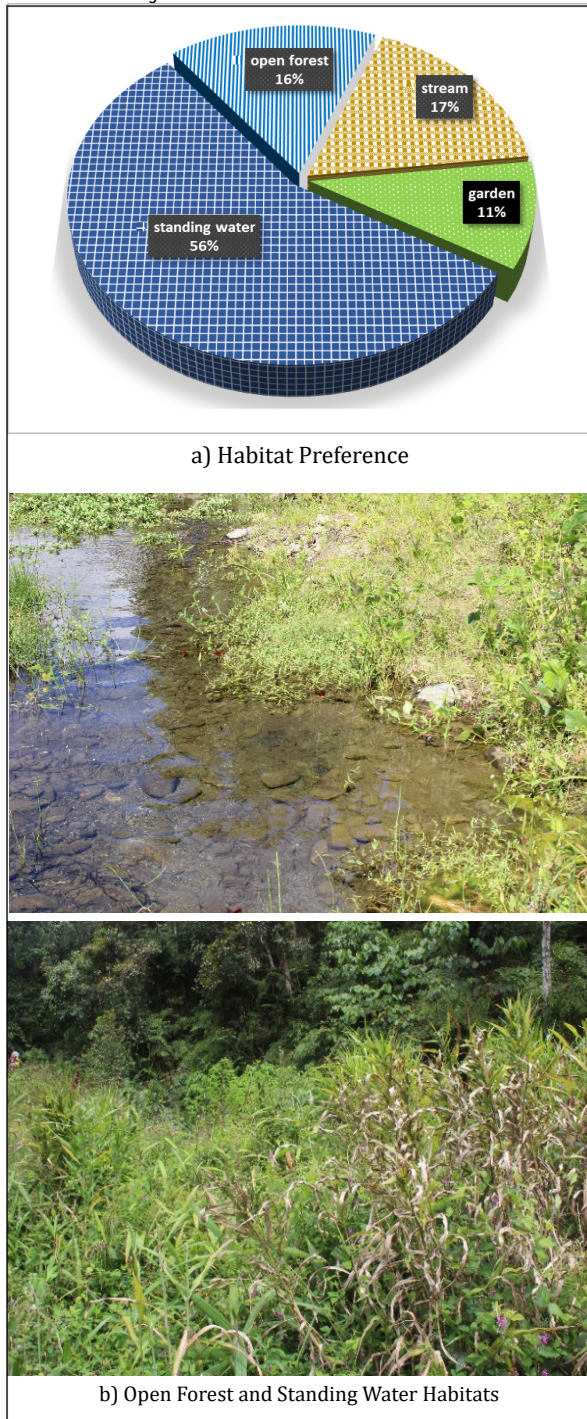


Figure 2. The 10 Most Abundant Species from 3 Study Sites. All the Species are Belonging to Libellulidae

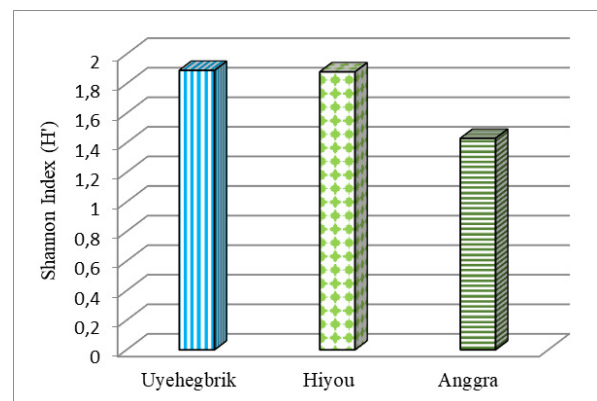
*stigmatizans*, *Nannophya pygmaea*, *Rhyothemis resplendens*, *Diplacina* sp., *Lanthanusa* sp., *Agrioncnemis femina* and *Pseudagrion silaceum*, all the most common species at the open water. *Orthetrum villosovittatum* was observed in all habitat types. Prior studies (Rambu, 2015; Simanjuntak, 2009) suggested that this species has the ability to fly over long distances, and therefore can be seen in almost all habitats within study sites.



**Figure 3:** Habitat Preference (constructed from 123 individuals) and Two Main Habitats (standing water and open forest)

### C. Species Diversity Index

Figure 5 shows the Shannon-Wiener Diversity Index ( $H'$ ); Uyehegbrik, 1.89; Hijou 1.88; and Anggra 1.4. Figure 4 revealed that Hijou and Uyehegbrik have similar species diversity, despite the fact that Hijou has more species than Uyehegbrik (Table 1). The number of individuals sampled in Uyehegbrik may contribute to more diverse species compared to Anggra. Figure 5 shows the t-test of Shannon Wiener Diversity Index between the sites. These results indicate that Odonata diversity in highly disturbed habitats is low to moderate in the study area (Krebs, 1999).



**Figure 4.** Shannon Wiener Diversity Index ( $H'$ ). It shows that Uyehegbrik and Hijou Contain Higher Species Diversity Kompare to Diversity in Anggra

Figure 6 shows there is no significant difference between species diversity at Uyehegbrik and Hijou but there are significant differences in diversity between Uyehegbrik and Anggra and between Anggra and Hijou (Table 2).

### D. Relative Abundance

Figure 7 shows the relative species abundance between the study sites. At Uyehegbrik, *Pantala flavescens* most abundance 35% of the total, and the lowest was *Ictinogomphus lieftinck* (4%). At Hijou, the most abundant species was *Orthetrum villosovittatum* (23%), and the lowest were *Rhynotemis resplendens*, *Papuaagrion* sp., *Teinobasis* sp., *Coenagrionidae* sp., and *Argiolestes* sp. (only 1% of the total). In Anggra, the most abundant species was *Orthetrum glaucum* (31%) and the least was *Oreaeschna dictatrix* and *Palaeosynthemis* sp. (1%).

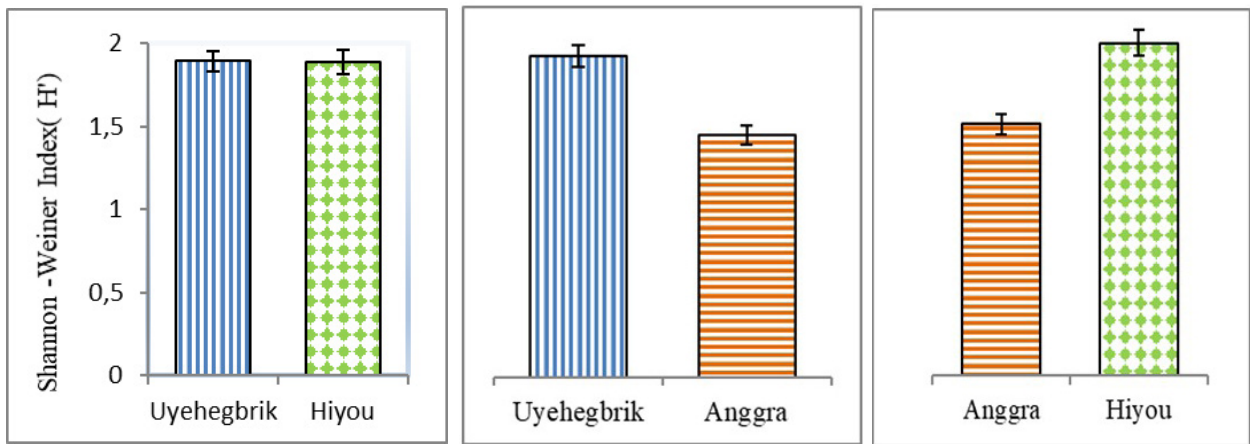


Figure 5. Comparison of Shannon-Weiner Diversity Index Between the Study Sites

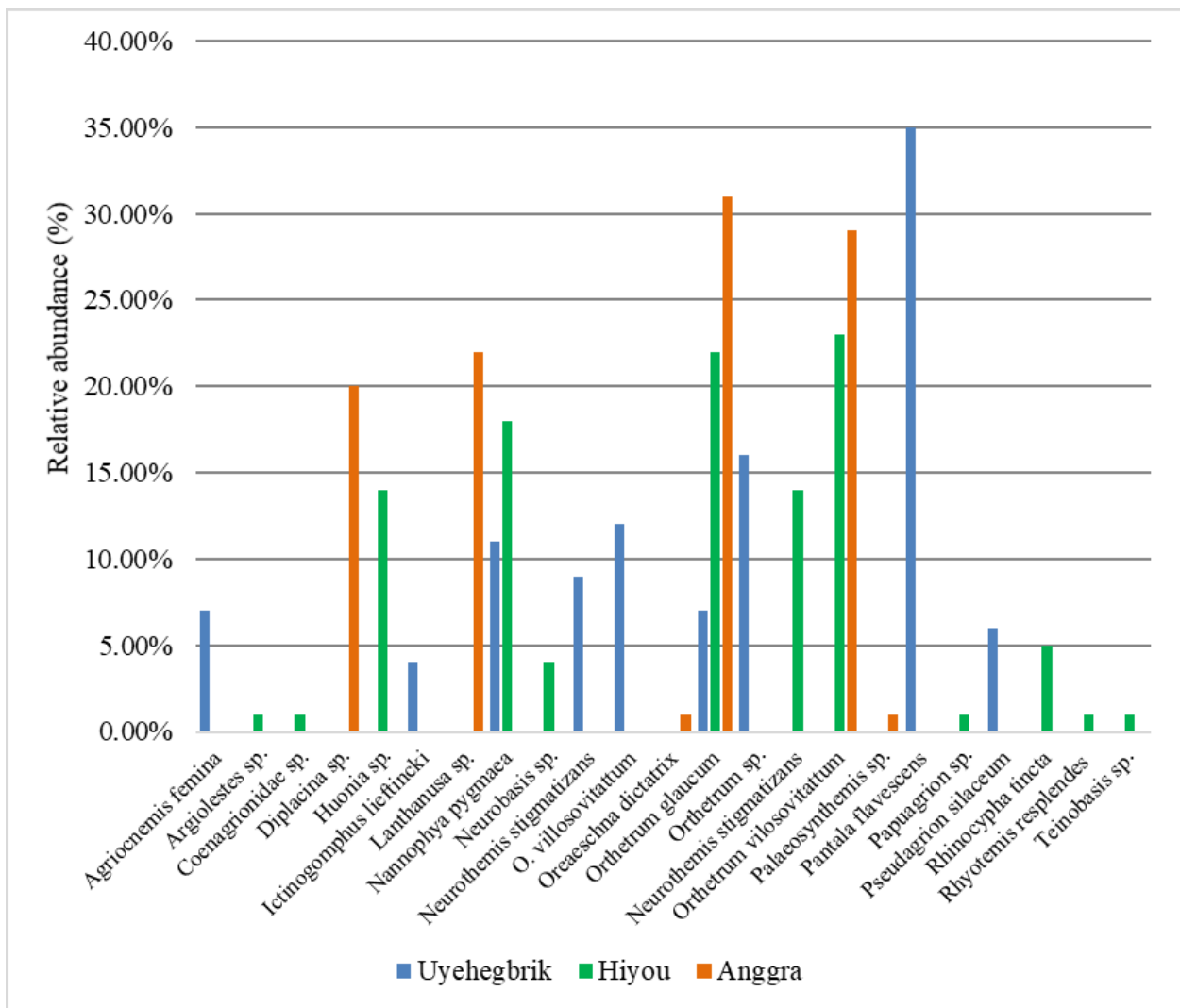


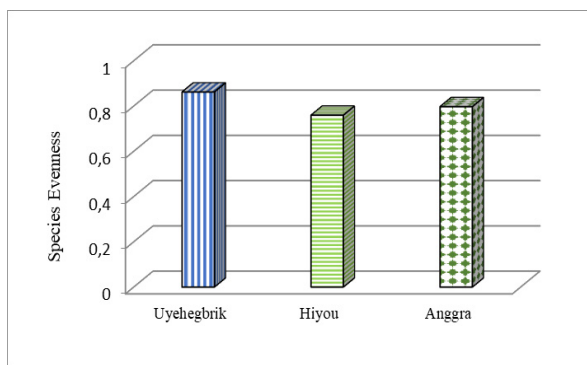
Figure 6. Relative Abundance at the Study Sites

**Table 2.**  
T-test Results Shannon Index Diversity Between the Sites.

No	Comparing Between Sites	t-value	t-critical	p-values	Remarks
1	Uyehegbrik vs Hijou	0.146	1.963	0.08	no significant
2	Uyehegbrik vs Anggra	10.987	1.964	0.05	significant
3	Hijou vs Anggra	10.091	1.964	0.01	significant

### E. Evenness

Figure 8 shows that Uyehegbrik has the most evenness (0.86), Hijou (0.76) and Anggra (0.79). Therefore, it can be concluded that species are evenly distributed between the sites.



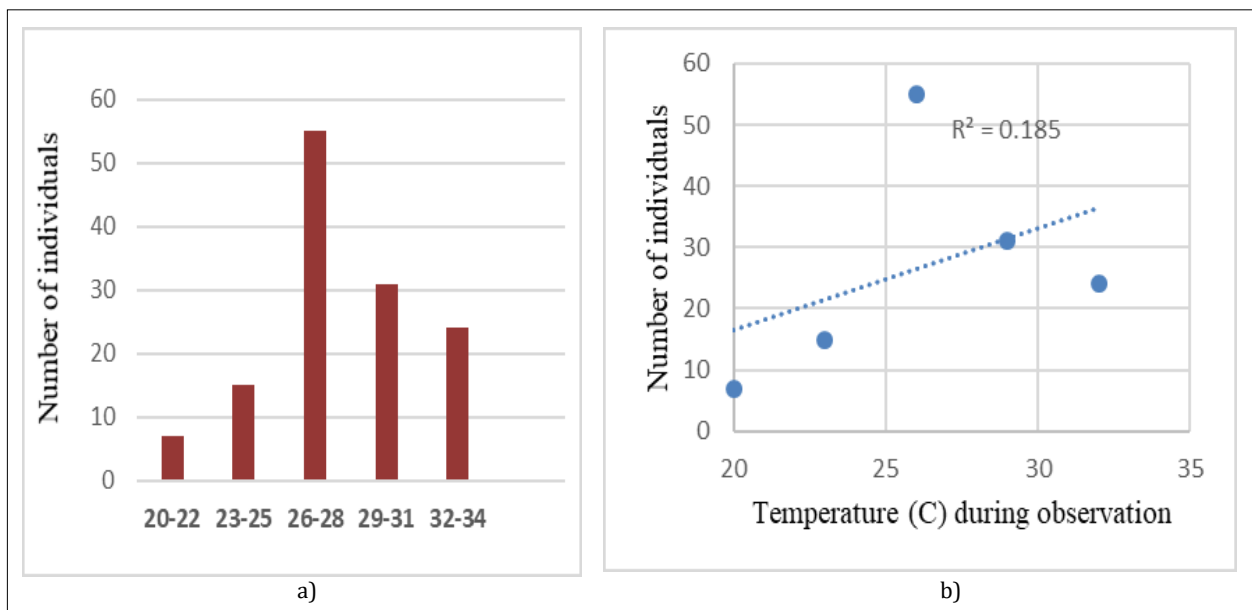
**Figure 7.** Species Evenness between Sites

### F. Species Similarity Between the Sites

Table 2 shows there is high species similarity between Uyehegbrik and Hijou (0.739), but low similarity with Anggra. This is remarkable as Anggra and Hijou are geographically close to each other, situated at the mid to high mountain habitat, whereas Uyehegbrik is located at the lowland. Further research is needed to examine this result.

**Table 3.**  
Species Similarity Index between the Sites

	Uyehegbrik	Hijou	Anggra
Uyehegbrik	1	0.739	0.266
Hijou		1	0.222
Anggra			1



**Figure 8.** a) Temperature and Number of Observed Individuals and b) Correlation between Temperature and Number of Observed Individuals

## G. Temperature and Abundance

Habitats, including temperature plays important roles in the presence or absence of species and number of individuals. Figure 9a. shows that many individuals were observed

at temperatures between 26-34<sup>o</sup> Celsius, while Fig 8b shows that there is a positive correlation between the number of observed individuals and temperature. The number of observed individuals increases as temperature



**Figure 9.** Some of the species observed in this study



**Table 4.**  
Species from Field Study Sites Around Arfak Mountains, Wondiwoi Mountains (Simanjuntak, 2009) and Misol Island (Rambu, 2015), Bird Head Region, Papua Barat.

Species	Study Areas				
	Uyehegbrik	Hijou	Anggra	Wondiwoi	Misol
<i>Agriocnemis femina</i>	√	-	-	√	√
<i>Agrioptera longitudinalis</i>	-	-	-	√	√
<i>Anax</i> sp.	-	-	-	√	√
<i>Argiolestes</i> sp.	-	√	-	-	
<i>Camacinia gigantea</i>	-	-	-	√	
<i>Coenagrionidae</i> sp.	-	√	-	-	
<i>Diplacina</i> sp.	-	-	√	-	
<i>Diplacodes triavilis</i>	-	-	-	√	√
<i>Gynacantha</i> sp.					√
<i>Huonia</i> sp.	-	√	-	-	
<i>Ictinogomphus lieftincki</i>	√	-	-	-	
<i>Lanthanusa</i> sp.	-	-	√	-	
<i>Lestes praemorsus</i>	-	-	-	√	
<i>Lyriothemis hirundo</i>	-	-	-	√	
<i>Nannophya pygmaea</i>	√	√	-	-	√
<i>Nesoxenia mysis</i>					√
<i>Neurobasis</i> sp.	-	√	-	-	
<i>Neurothemis stigmatizans</i>	√	√	-	√	
<i>Nosoticta plagiata</i>	-	-	-		√
<i>Oreaeschna dictatrix</i>	-	-	√	-	
<i>Orthetrum glaucum</i>	√	√	√	-	
<i>Orthetrum sabina</i>	-	-	-	√	
<i>Orthetrum serapia</i>					√
<i>Orthetrum</i> sp.	√	-	-	-	
<i>Orthetrum villosovittatum</i>	√	√	√	√	
<i>Palaeosynthemis</i> sp.	-	-	√	-	
<i>Pantala flavescens</i>	√	-	-	-	√
<i>Papuagrion</i> sp.	-	√	-	-	
<i>Protothemis coronate</i>	-	-	-		√
<i>Pseudagrion silaceum</i>	√	-	-	-	
<i>Rhinocypha tinctoria</i>	-	√	-	√	
<i>Rhyotemis resplendens</i>	-	√	-	-	
<i>Rhyothemis phyllis</i>	-	-	-	√	√
<i>Teinobasis rufithorax</i>					√
<i>Teinobasis</i> sp.	-	√	-		√
<i>Tholymis tillarga</i>	-	-	-	√	
<i>Tramea</i> sp.					√
<i>Xiphiagrion</i> sp.	-	-	-	√	
<i>Zyxomma multinervorum</i>					√

**Odonata Diversity Around the Arfak Mountains, West Papua**

Keliopas Krey, Ade Rahayu Pattiran, Agustinus Kilmaskossu, Yance de Fretes

increased, but this is not a linear relationship as at a certain temperature (ca. 34<sup>o</sup> Celsius), number of individuals decreased.

Table 3 show result from prior field studies on Odonata diversity around the Bird Head Region (Wondiwoi Mountains and Misool Islands) by students from Papua University. Although, these studies show similar number of species recorded, but very different in the species compositions. For instance, only one species (*Agriocnemis femina*) was observed in the Arfak Mountain Area (Uyehegabrik), Wondiwoi and Misool Islands. About 5 species were shared between Wondiwoi and Misool Islands (*Agriocnemis femina*, *Agrionoptera longitudinalis*, *Anax* sp., *Diplacodes triavilis* and *Rhyothemis phylis*), but only 3 species (*Neurothemis stigmatizans*, *Orthetrum villosovitatum*, and *Rhinocypha tincta*) were shared with Wondiwoi and Arfak Mountains. Only 3 species (*Nannophya pygmaea*, *Pantala flavescens*, and *Teinobasis* sp.) were shared between Arfak Mountains and Misol Island. This pattern shows all of the sampling seems to have been done in highly disturbed habitats and the faunas are dominated by common, widespread species.

#### IV. CONCLUSION

Although, the Shannon Weaner Index of Diversity revealed Odonata diversity in all study sites are low-medium diversity, many species recorded are the widespread species. This may due to the sampling that disturbed habitat. Although it would be essay, but, in order to capture a better representation of species, sampling must be done in forested area or more pristine areas. Due to proper species identification in the field, some specimens remain unknown, but the rest species may be new to science, indicates the richness of this mountain range remain unknown and more studies are needed.

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