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Ecological Studies of Odonata Population in Northern Sumatra, Indonesia

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Abstract

Odonata is important insect groups in the world. Ten ha rice field plot in three sites in Manik Rambung Rice Field (MRRF), Simalungun District, North of Sumatera (latitude: 2°53' 52.8"N and longitude: 99° 00'24.4"E, about 90 km from Medan City at 594 - 602 masl) were recorded of Odonata population. The farmers have rice culture practices, combine with fish farming during season paddy planting. The comparison was conducted which nine stations of green Campus areas with purposive randomness in a month (November, 1. 2011 until November, 28. 2011) using sweep net (400 µm mesh, 60cm x 90cm) which six swings started from 0900 to 1200 for collection of Odonata. The results were collected 445 individuals from sub-order Zygopteran and 892 individuals from sub order Anisoperan, 3 families, and 19 species of adults Odonata were identified IN MRRF. Family Coenagrionidae (Zygoptera) were dominant by *Agriocnemis femina*, *A. pygmaea*, and *Ischnura senegalensis*. Only *Ictinogomphus decoratus* recorded from Gomphidae and 11 species from Libellulidae. While two sub order, 4 families, 26 genera, 31 species and 436 individuals of Odonata identified in green campus, USU, Sumatera Utara, Indonesia. In MRRF, the ecological indices were calculated with score H' (0.88 - 2.50), Index Simpson (1-D) recorded were 0.49 until 0.99, while index Jaccard with 0.60-1.00. While Diversities indices Shannon and Evenness Pilou of Odonata in Campus USU was lower recorded in Station 7 and Station 1, while the highest were collected in Station 3 and Station 6. The diversities and evenness Odonata species were varied ($H'=2.20-3.42$ and $E=0.55-0.78$). Comparison to the evenness and richness of Odonata species in each stations were differences, which effected by natural habitat, heterogenous vegetations of plants, time and weather while taken sampling, biotic, physics, and chemicals factors in environmental system are varied.

Keywords: Ecological studies; Odonata; MRRF; Campus USU; Northern Sumatra

1. Introduction

Rice is primary food for half the people in the world, grown predominantly in the tropics and subtropics. De Datta (1981) describes the increase has been achieved largely by greater mechanization of farming, higher yielding varieties of rice, high levels of fertilizer use, and widespread use of pesticides and herbicides. Tropical rice field usually have a particular diverse insect fauna which serve as an important food source for fishes [20]. Based on the latest finding by Orr [41], the Indonesian Odonata comprises about 750 species, include zygopterans and anisopterans. Gunnathilagaraj [29] recorded 16 species of Odonata in rice fields of Tamil Nadu, India. There were at least 14 species of rice field Libellulidae (Odonata) in Northern Peninsular Malaysia [12], and 19 species of dragonflies (Odonata) in Thailand [3], one of important group of freshwater invertebrates in the rice fields. The

objectives of study to investigate the abundance and diversity of Odonata in upland rice field at Manik Rambung considered efficient predators in the rice fields.

Apart from taxonomic studies and unannotated species lists for particular areas a significant number of ecological studies have been made on odonate diversities in Peninsular Malaysia and North Borneo. Studies such as Furtado [25], Thompson and van Tol (1993) and Orr [39][40] in particular attempt to relate community structure to particular habitat types and environmental factors [46][47][48], knowledge which will certainly provide a better understanding of what habitat management protocols are needed to maximise odonate conservation. Studies of general biology and behaviour, mainly sexual behaviour [26][27][28][35][36][37][38][50] are generally of less direct benefit in conservation planning but undoubtedly enhance perceived conservation values of the group.

Based on the latest finding by Orr [41], the Indonesian Odonata comprises about 750 species, include zygopterans and anisopterans. Gunnathilagaraj [29] recorded 16 species of Odonata in rice fields of Tamil Nadu, India. There were at least 14 species of rice field Libellulidae (Odonata) in Northern Peninsular Malaysia [12], and 19 species of dragonflies (Odonata) in Thailand [3], one of important group of freshwater invertebrates in the rice fields. The objectives of study to investigate the abundance and diversity of Odonata in the green Campus USU and upland MRRF considered efficient predators in the rice fields and coservation in ecosystem.

2. Materials and Methods

2.1. Sampling Odonata in the green Campus USU Areas

Dragonfly sampling carried out since 1 November 2011 to 28 November 2011. Determined randomly ninth point of observation stations at random around the USU environment, consisting of station 1 (Sports Building = GOR area), station 2 (forest of FMIPA campus area), the station 3 (fields experiment in the Faculty of Agriculture area), the station 4 (around in the Library area), station 5 (around in the Faculty of Engineering area), station 6 (about Auditorium area), Station 7 (around in the Faculty of Nursing area), station 8 (around in the Faculty of Art and Culture area) and station 9 (around in the Faculty of Law area).

Dragonfly adults captured using a sweep net (400 µm mesh, 60cm x 90cm) (Kharif, 2000; [30] Sharma and Joshi, 2007; Benazzouz et al., 2009) with six swing to collect species/individual dragonfly between 0900 hours to 1200. Specimens were collected included insect box, then in collected into the insect collection of paper, then taken to the laboratory. Furthermore dragonfly insect on a pin on the box, put in the oven and heated for 72 hours at a temperature of 60°C, and then inserted into the prepared dragonfly insect collection box as dry preservation preparations.

Identification of adult dragonfly done visually see dragonflies in the field, photographed with a digital camera, or from specimens preserved dried using Olympus CX41 microscope (Olympus Tokyo, Japan). Book identification used is [22][23][24] Kumar (1973a, 1973b) [5][6][16][34][43]. Specimen data dragonfly acquired is recorded, made a brief description by taking into account the morphological features of the field and of preserved dried using book Orr (2003, 2005), then calculate the index of diversity Shannon [33] and diversity indices Pilou [33].

2.2. Sampling Odonata in MRRF

Odonata were sampled commenced into 4 seasons rice planting, since 2008-2010 from a ten ha rice field plot in Manik Rambung village, Simalungun district, North of Sumatera. The area is located at 2°53' 52.8"N and 99° 00'24.4"E, about 90 km from Medan City at 594 - 602 m asl. Thetemperature in this place ranged between 23° and 37°C. This area is loated in a dry zone with a rainfall of 10.7 to 16. 4 mm in a year. Usually two rice crops were grown in a year. The farmers have rice culture practices, combine with fish farming during season paddy planting. Rice cultivation in this field was partly mechanized and pesticides were minimally used. The six phases was defined according to shaded water areas and physical conditions of the field adopted from Mogi & Miyagi (1990). The areas

Total (N)	35	49	64	52	47	56	37	50	46
H' (Shannon)	2.36	2.65	3.42	2.89	2.97	3.29	2.20	2.78	2.84
Evenness (Pilou)	0.56	0.65	0.78	0.70	0.65	0.74	0.53	0.58	0.68

Noted: S1 = station 1 (Sports Building = GOR area), station 2 (forest FMIPA campus area), the station 3 (fields experiment in Faculty of Agriculture area), the station 4 (around in the Library area), station 5 (around in the Faculty of Engineering area), station 6 (about Auditorium area), Station 7 (around in the Faculty of Nursing area), station 8 (arround in the Faculty of Art and Culture area) and station 9 (around in the Faculty of Law area). - = Nol, + = 1-4, ++ = 5-19, +++ = 20-99, adopted by Oliveira and Vasconcelos (2010). Source: Primer data (2011).

Acquisition dragonfly around in the green campus USU different when compared with the ecosystem in other areas. It is based on a comparison with the findings of Benazzouz [10], Sharma *et al.* (2007) and, Tribuna *et al.* (2007) the number of dragonfly recorded a smaller collection, but resembles a dragonfly the data collected by Sharma and Joshi [44] and Ghahari *et al.* (2009), but the composition is lower than the Tiple *et al.* (2012) as many as 48 species in Madhya Pradesh, Central India. Such differences may be caused by the suitability of habitat, vegetation heterogeneous, current weather situation sampling and factors biotic, physical and chemical [15][47][48], which affect the amount and type of dragonfly caught.

The abundance of individuals and species richness of dragonflies obtained at each different station. Suspected factor natural habitat (pools, calm waters, fields with lots of herbs) and plant vegetation heterogeneous (water plants like *Juncus* sp, *Sagitaria* sp, *Manihot utilisima*, *Shorea leprosula*, *Myrtaca fragmantica*, etc.) that are often found in station 3 (field trial Fak. of Agriculture); 6 station (about Auditorium) and station 4 (pool Library) is very appropriate and supportive dragonfly life, so it affects the differences in diversity and diversity of dragonfly on the green campus of USU.

Dragonflies are identified in green campus of USU shows that there are diversity of dragonfly species are high and varied (H' = 2:20 to 3:42 and E = 0.55-0.78). When the index value keanekargaman Shannon and spread dragonfly lows recorded at Station 7 (about in the Faculty of Nursing, H = 2.36 and E = 0.56) and Station 1 (GOR, H = 2.36 and E = 0.56), allegedly factor incompatibility habitat and land for life dragonfly who likes close to water and plenty of plants to place dependent and copulate, but in both these stations are rare conditions. Walaubagaimanapun, green campus environment of USU indicated still awake habitat and vegetation, where dragonflies are many identified the number and kind, a dragonfly function as bio-indicators of our environment in an ecosystem.

3.2. Odonata in MRRF

Odonata in MRRF were quite diverse, consist of 3 families, 14 genera, and 19 species showed in table 2. Ghahari *et al.* (2009) recorded 30 species from 19 genera and 8 families of Odonata were collected and evaluated in Iran. Meanwhile Kandibane [30] revealed the inventory of 12 Odonata (9 species dragonflies and 3 species damselflies). Similar number of taxa were collected in the Phillipines (Mogi and Miyagi, 1990). Then Ansori [1] recorded 4 species (*Orthetrum sabina*, *Crocothemis servilea*, *Neurothemis terminata*, and *Anaciaeshna jaspidea*) in some fields in Bandung, Indonesia, supported by Salmah (1998) listed Libellulidae were dominant family found in Malaysia and Indonesia (Siregar *et al.*, 1999; 2004). Barrion and Litsinger [8] listed 14 species of Odonata in rice fields of Asia and Africa. However, the densities of family Gomphidae *Ichinogomphus acutus* was much lower which recorded in this study. Minimum pesticide application as used in this rice field plots had proven no harmful effect on the Odonata diversities.

Table. 2. Abundance of Odonata in Manik Rambung ricefield, North of Sumatera.

Sub-order/Family	Species	Number of species	Total individuals (%)
Zygoptera/Coenagrionidae	<i>Argiocnemis rubescens</i>	10	
	<i>Argiocnemis femina</i>	251	
	<i>A. pygmaea</i>	95	
	<i>Ischnura senegalensis</i>	78	
	<i>Pseudagrion microcephalum</i>	5	
	<i>P. pruniosum</i>	3	
	<i>P. rubriceps</i>	3	445 (33.2)
Anisoptera/Gomphidae	<i>Ictinogomphus decorates</i>	3	
Anisoptera/Libellulidae	<i>Acisoma panarpoides</i>	2	
	<i>Crocothemis servilia</i>	40	
	<i>Diplacodes trivialis</i>	7	
	<i>Neurothemis fluctuans</i>	23	
	<i>N. ramburii</i>	17	
	<i>Orthetrum sabina</i>	506	
	<i>O. testaceum</i>	12	
	<i>Pantala flavescens</i>	270	
	<i>Potomarcha congener</i>	2	
	<i>Tholymis tillarga</i>	9	
	<i>Trithemis aurora</i>	1	892 (66.72)

Table 3 showed ecological indices diversities of Odonata in MRRE, North of Sumatra were quite diverse. The existence of Odonata in the rice field was totally dependent on the availability of water. Temporary drying especially in rain fed rice fields was a major factor that reduced the abundance of most insect communities (Mogi, 1993). However, Odonata is the largest insect order, which is entirely predaceous in rice ecosystem. Both naiads and adults are the voracious predators on other insect [31].

Table.3. Ecological indices of Odonata in Manik Rambung ricefield, North of Sumatera.

Indices	Seasons 1 (2009)			Seasons 2 (2009)		
	A	B	C	A	B	C
Shannon-Wiener (H)	2.30	2.25	2.20	0.88	1.62	1.45
Simpson (1-D)	0.99	0.79	0.84	0.75	0.62	0.60
Jaccard (Jc)	0.70	0.74	1.00	0.60	0.72	0.75

3.3. Dragonflies Role in Ecosystems

Dragonfly serve as bio-indicators of a polluted environment, where dragonflies really liked the environment, clean water and categories of insects anti pollutant [14][15][46]; Tribuana, 2007), supported by the diversity of the number and type dragonfly were identified around the campus green ecological USU shows the area is still maintained

environment. In addition, often identified dragonfly nymphs eat mosquito larvae, eggs, frogs, insects, other small fish, even sebahagian our society consume some additional dragonfly as a protein source [7].

Dragonfly categorized role as natural enemies (*predators*) against the predominant pests of agricultural crops, particularly rice, horticulture and crops. Damselfly *Ischnura senegalensis*, *Agriocnemis pygmaea*, *Ischnura delicata*, and *Ceriatagrion coromandelianum* which can suppress the population of weevils leaves and rice stem borer (Krishnasamay *et al.* 1984). Dragonfly of *Orthetrum sabina types*, *Crocothemis servilea*, *Pantala flavescens*, and *Diplocoides nubilosa* very effectively used as a predator on lepidopteran pests in rice crops [30]; Krishnasamay *et al.*, 1984). This causes many types of dragonflies found in Station 3 suspected because dragonfly execute its strategic role as predators of rice plants, cassava, corn, or horticultural crops are planted in the field. Comparison to the evenness and richness of Odonata species in each stations were differences, which effected by natural habitat, heterogenous vegetations of plants, time and weather while taken sampling, biotic, physics, and chemicals factors in environmental system.

4. Conclusions

As many as two sub-orders, 4 families, 25 genera, 31 species and 436 individual dragonflies (Odonata) are identified in the green campus of USU. Diversity of dragonfly species are high and varied ($H' = 2:20$ to $3:42$ and $E = 0.55-0.78$). When the value of the Shannon diversity index and dissemination lowest dragonflies recorded at Station 7 and Station 1, while the highest recorded from at Station 3 and Station 6. While in MRRF, a total of 1337 individuals (two sub-orders: Zygopteran and Anisoperan), 3 families, and 19 species of Odonata adults were identified. ecological indices were calculated with the score H' (0.88 - 2.50), Simpson Index (1-D) were recorded 0:49 - 0.99, while the index Jaccard Showed with 0.60-1.00 were recorded in MRRF, Simalungun, Indonesia. The abundance of individuals and species richness of dragonflies obtained at each different station. Allegedly natural habitat factors, variations in plant vegetation, time and weather while sampling, biotic factors, will determine the physical and chemical dragonfly growth that affect the amount and types were identified. Diversity number and type of dragonfly identified ecological around in the green campus of USU shows the area is still maintained environment.

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