

Species diversity of adult Odonata in selected areas from Misamis Occidental Province, Philippines

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Abstract. Odonata is considered an environmental indicator group of freshwater habitats. Thus there is a need to have a good baseline data to use it for monitoring fluvial habitats. However, species composition of Odonata in Misamis Occidental is poorly known. This study was conducted to determine the species diversity of Odonata in the municipality of Sinacaban and in the cities of Oroquieta and Ozamiz, Misamis Occidental, Philippines. Opportunistic sampling method using sweep nets was employed. There were 266 Odonata individuals collected comprising 22 species. Seven species (31.82%) are Philippine endemic. Low species diversity was recorded in all the sampling sites with more or less even distribution of species. Results indicate that the sampled areas are already disturbed.

Key Words: damselflies, dragonflies, endemic, freshwater, indicators.

Introduction. The Order Odonata is among the most vibrant and energetic of all insects. There are over 5,800 species of Odonata that have been described, with the greatest number in forested tropical regions (Nelson et al 2011). Odonata is divided into two suborders: Zygoptera or damselflies and Anisoptera or true dragonflies (Kalkman et al 2008).

Odonata can be found in all the continents with the exception of Antarctica. The range of habitat it utilizes is very wide from the largest lakes and rivers to tiny wetlands, such as mossy pools on the surface of the peat bogs and seepages at the highest point of river system (Nelson et al 2011). It plays an important role in the ecosystem, often being utilized as indicator species. Its life depends upon the water for food and reproduction. Any shift in water quality can greatly disturb its population. Its sensitivity to environmental change makes some species of Odonata the most visible indicators of wetland health and diversity (Klym & Quinn 2003).

Biologically, the Odonata fauna in the Philippine archipelago is characterized by high percentage of endemic species (Hämäläinen 2004). Mindanao, the second largest island on the archipelago has extensive list of flora and fauna, some of which are endemic to the island or in a particular region of the island and has over a hundred species of Odonata (Villanueva & Mohagan 2009). New species are still regularly found particularly from poorly explored regions in Mindanao (Jumawan et al 2012). Most recently, Quisil et al (2013) surveyed Surigao del Sur in Mindanao, Philippines and found 49 species where two species are new records for Mindanao. Cayasan et al (2013) documented 36 species in Zamboanga del Sur. Odonatological record, however, is poor in Misamis Occidental.

This study was conducted to determine the species diversity of Odonata in the selected freshwater areas of Sinacaban, Oroquieta City and Ozamiz City, Misamis Occidental.

Materials and Methods. Sampling was conducted on October 16-29 and December 23-24, 2012 in selected freshwater areas of Sinacaban, Oroquieta City and Ozamiz City, Misamis Occidental (Figure 1). Eight sampling sites were established.

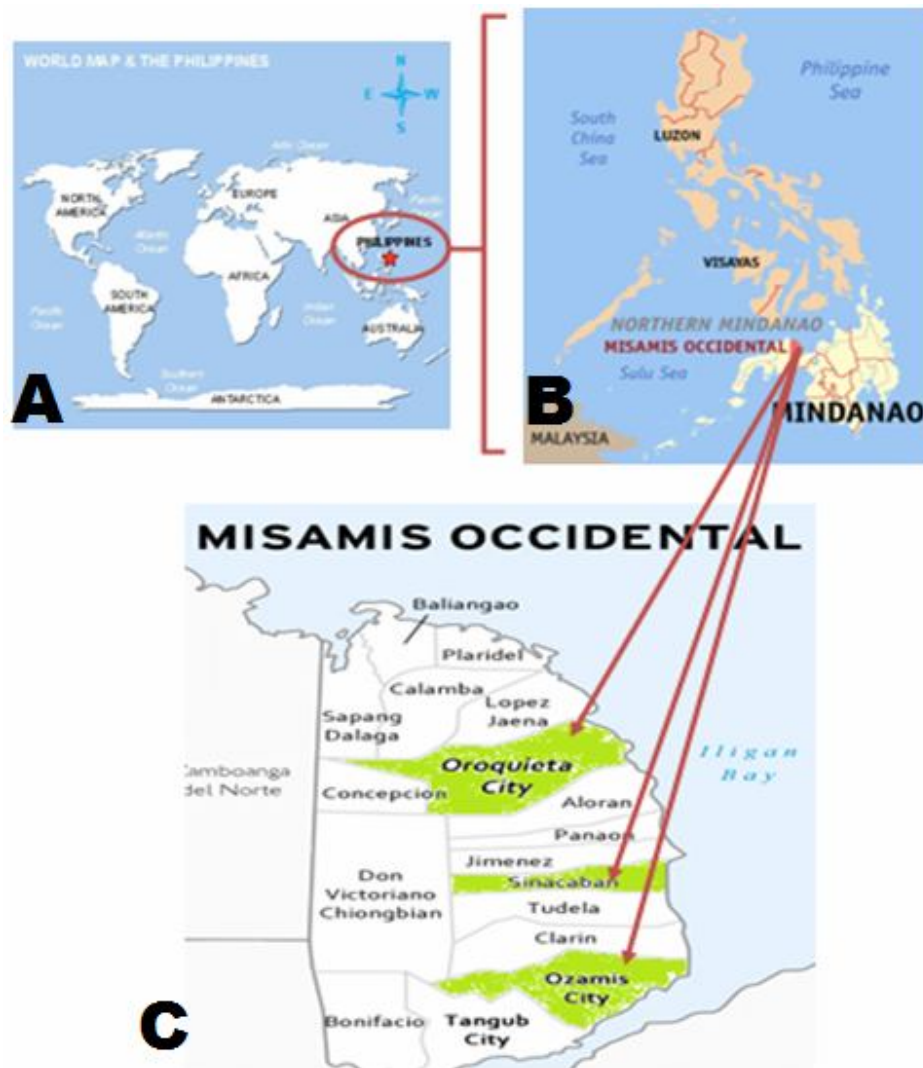


Figure 1. Map of the world showing the relative location of the Philippines (A) (tothephilippines.com), map of the Philippines showing the relative location of Misamis Occidental in Mindanao (B) (zamboanga.com), and the study areas, Sinacaban, Oroquieta City and Ozamiz City (C) (pinoyindexph.wordpress.com)

Sampling site 1. Colupan River located in Brgy Colupan, Sinacaban, Misamis Occidental. The site is located 114.91 meters above sea level (masl) and has coordinates of 8°18'02.27" N 123°49'03.54" E. The river is the source of water for laundry and for bathing. The area is surrounded by bamboos and shrubs. Agricultural ecosystem and fish pond are present near the area. Beside the river is a banana farm.

Sampling site 2. Sinonoc River located in Brgy. San Vicente, Sinacaban, Misamis Occidental. It has coordinates of 8°18'18.25" N 123°49'24.54" E and 69.19 masl. The river is also the source of water of the local community. Coconuts and bamboos are very abundant along the side of the river. A corn field can be seen in the area.

Sampling site 3. Camanse Stream located in Brgy. Camanse, Sinacaban, Misamis Occidental. It has coordinates of 8°18'03.66 N 123°49' 17.12" E and 107.9 masl. The area is disturbed since it is near a residential area. A flowering plant, *Lantana camara*, is very abundant in the area near the water system.

Sampling site 4. Bahay Stream located in Brgy. Bahay, Sinacaban, Misamis Occidental. It has coordinates of 8°18'14.23" N 123°49'25. 22" E and 92.4 masl. The area is the source of drinking water. The area is near a banana (*Musa sp.*) farm and surrounded by bamboos and shrubs.

Sampling site 5. Pines River located in Brgy. Pines, Oroquieta City, Misamis Occidental. It has coordinates of 08°26'51.7' N 123°48'13.4" E. The area is disturbed because it is near a human settlement. The river is the source of water for bathing and laundry. Coconut (*Cocos nucifera*) and "talisyay" (*Terminalia catappa*) were present in the area. Carabao grass (*Paspalum conjugatum*), "gabi-gabi" (*Colocasia esculenta*) and bamboo (*Bambusa spinosa*) were the ground cover plants identified. Fruit bearing plants such as Papaya (*Carica papaya*) and banana (*Musa sp.*) were present. Branches, twigs and aquatic vegetation were seen hanging over the river.

Sampling site 6. Dagatan Stream located in Brgy. Dagatan Alto, Oroquieta City, Misamis Occidental. It has coordinates of 08°27'445.9" N 123° 47' 46.2" E. The site is relatively flat to undulating and moderately disturbed. Carabao grass (*Paspalum conjugatum*), "makahiya" (*Mimosa pudica*), "gabi-gabi" (*Colocasia esculenta*) and bamboo were the ground plants observed. Banana (*Musa sp.*) was present and coconut (*Cocos nucifera*) was found to be abundant along the side of the river. Branches, twigs and aquatic vegetation were seen hanging over the river.

Sampling site 7. Talic River located in Brgy. Talic, Oroquieta City, Misamis Occidental. It has coordinates of 08° 28'02.8" N 123°47'15.9" E. It is an open and disturbed area near a rice field. The area which is near a human settlement is the source of water for bathing and laundry. Coconut (*Cocos nucifera*) and "langka" tree (*Artocarpus heterophylla*) were identified. Ground cover plants such as carabao grass (*Paspalum conjugatum*) and "gabi-gabi" (*Colocasia esculenta*) were present in the site.

Sampling site 8. Montol River located in Brgy. Stimson Abordo, Ozamiz City, Misamis Occidental. The site is mountainous with a lesser degree of disturbance. Carabao grass (*Paspalum conjugatum*), "gabi-gabi" (*Colocasia esculenta*) and bamboo (*Bambusa spinosa*) were the ground cover plants identified. Coconut (*Cocos nucifera*), "mahogany" (*Swietenia mahogany*), "lauan" (*Shorea spp.*) and "Gmelina" (*Gmelina arborea*) were observed in the site. Branches, twigs and aquatic vegetation were seen hanging over the river.

Opportunistic sampling method was employed using sweep nets for the collection of Odonata. Sampling was conducted for two days per site from 0900 hours-1300 hours. Each captured specimen was placed in an empty white triangular envelope with its wings folded and labeled according to the time, place and day it was collected. Photographs of the sites and representative species were taken during the sampling.

After labeling, all the specimens collected in each site were separately placed in a plastic container and small amount of acetyl acetate was used to kill the samples. Acetone was poured into the container wetting and soaking the specimens. The samples were preserved by soaking the dragonflies in acetone for about 24 hours and 12 hours for

damselflies. The specimens were air dried, placing them on tissue paper. The dried specimens were placed again in a white triangular envelope and kept in a plastic container separating the specimens collected according to the site of collection. The plastic containers containing the specimens were placed in a cool and dry place.

Identification of the collected samples was done by the fourth author. Shannon Diversity index and Cluster Analysis of Odonata species were determined using BioDiversity PRO software version 2.0.

Results and Discussion. Twenty-two Odonata species of which seven are Philippine endemic were identified in the eight sampling sites of Misamis Occidental. Twelve Anisoptera (Dragonfly) species and 10 Zygoptera (Damselfly) species were categorized into seven families: Corduliidae, Libellulidae, Calopterygidae, Chlorocyphidae, Coenagrionidae, Euphaeidae and Protoneuridae. Table 1 shows the species composition, distribution and endemism of Odonata.

The Family Libellulidae comprised the majority (11) of the collected species. This is one of the two largest families worldwide and dominates the dragonfly fauna of standing water in every continent. A high percentage of the species under this family has large distributional range (Kaize & Kalkman 2009). Presently, this family ranks among the most diverse and widespread subgroups of dragonflies (Bechly & Sach 2002).

Libellulidae breeds principally in still-water or lentic habitats, although larvae of some species are stream dwellers (Kiany & Minaei 2009). *Neurothemis r. ramburii* (Brauer, 1866) was present in all sampling sites. Dow (2009) stated that this species is widespread and locally common over much of its range. Larvae of most species are secretive, hiding among rotten vegetation at the bottom of the pond or lake; a few others have become secondarily adapted for a more active existence among growing vegetation (Gillott 2005). Siregar et al (2006) stated that the richness of the community is limited to those groups of species due to suitability and adaptability of the species to their habitats. Among the eight sampling sites, Colupan River had the most species of Libellulidae, because it is near an agro-ecosystem and a fishpond. Heckman (1979) stated that Libellulidae are very common in lowland areas such as freshwater swamp and rice fields. In the Philippines, Cayasan et al (2013) during their recent survey on the Odonata of Zamboanga del Sur reported 16 species of dragonflies under Family Libellulidae which comprised the majority of the species they collected.

Sinonoc River (site 2) had the most abundant Odonata species (13) comprising oriental and Philippine endemic species. The area is already disturbed since the river is a source of water for the local community. Presence of vegetation like coconut, bamboo and corn was seen in the area while Bahay Stream (site 4) had the least Odonata species. These results can be due to habitat conversion such as forest conversion to give way to coconut and banana farms. Subramanian (2002) reported that Odonata species are usually highly specific to a habitat. Some have adapted to urbanization and use man-made water bodies. Dolny et al (2011) observed in the Bornean rainforest that anthropogenic disturbance in a locality resulted in widespread species colonization or persistence.

The species composition of Odonata in Sinacaban, Oroquieta City, and Ozamiz City, Misamis Occidental was low compared to the 51 species recorded by Villanueva (2011) in Siargao and Bucas Grande Islands. Endemicity of Odonata in the area (31.82%) was also low compared to the 94% endemism for damselflies and 33.3% for dragonflies recorded by Villanueva & Mohagan (2009) in Mt. Hamiguitan Wildlife Sanctuary, Davao Oriental. Quisil et al (2013) who surveyed Surigao del Sur recorded a higher number of species. Cayasan et al (2013) also documented a higher number of species (36) in Zamboanga del Sur. Figure 2 shows an endemic species of dragonfly while figures 3-7 are some endemic species of damselflies.

Table 1

Species composition, distribution and endemism of Odonata in Sinacaban, Oroquieta City, and Ozamis City, Misamis Occidental

Sampling Sites										
Species	Distribution Status	Sinacaban			Oroquieta City				Ozamiz City	Total
		Colupan River	Sinonoc River	Camanse Stream	Bahay Stream	Pines River	Dagatan Stream	Talic River	Montol River	
ANISOPTERA										
Family Corduliidae										
<i>Heteronaias heterodoxa</i>	Philippine Endemic								1	1
Family Libellulidae										
<i>Acisoma panorpoides panorpoides</i>	Oriental Species		1							1
<i>Diplacina bolivari</i>	Philippine Endemic	1	2						6	9
<i>Diplacodes trivialis</i>	Oriental Species		2		1	6	1	14		24
<i>Neurothemis r. ramburii</i>	Oriental Species	14	10	1	2	3	1	1	2	34
<i>Neurothemis t. terminata</i>	Oriental Species		1							1
<i>Orthetrum pruinosum cleila</i>	Oriental Species	2	3		2				1	8
<i>Orthetrum sabina sabina</i>	Oriental Species	2	1	3		7	1	4		18
<i>Orthetrum testaceum testaceum</i>	Oriental Species	3								3
<i>Pantala flavescens</i>	Circumtropical	1		1			4	2		8
<i>Trithemis aurora</i>	Oriental Species	6		7	1				4	18
<i>Trithemis festiva</i>	Oriental Species	1	1	1					2	5
ZYGOPTERA										
Family Calopterygidae										
<i>Vestalis melania</i>	Philippine Endemic	1								1
Family Chlorocyphidae										
<i>Rhinocypha colorata</i>	Philippine Endemic	27	8	10	3	2	2			52
<i>Rhinocypha turconii</i>	Philippine Endemic								2	2
Family Coenagrionidae										
<i>Agriocnemis femina femina</i>	Oriental Species		1			1	1	3		6
<i>Agriocnemis pymaea</i>	Oriental Species					5	5	3		13
<i>Agriocnemis rubescens</i>	Oriental Species						2			2
<i>Ischnura senegalensis</i>	Oriental Species		1			7	1	3		12
<i>Pseudagrion pilidorsum pilidorsum</i>	Oriental Species	2	6	1	2	3	5	6		25
Family Euphaeidae										
<i>Euphaea amphicyana</i>	Philippine Endemic								1	1
Family Protoneuridae										
<i>Prodasineura integra</i>	Philippine Endemic	10	3	2	2	3	2			22
Total Number of Species	22	12	13	8	7	9	11	8	8	
Total Number of Individuals	266	70	40	26	13	40	25	36	19	
Total Number of Endemics	7	4	3	2	2	2	2	0	4	

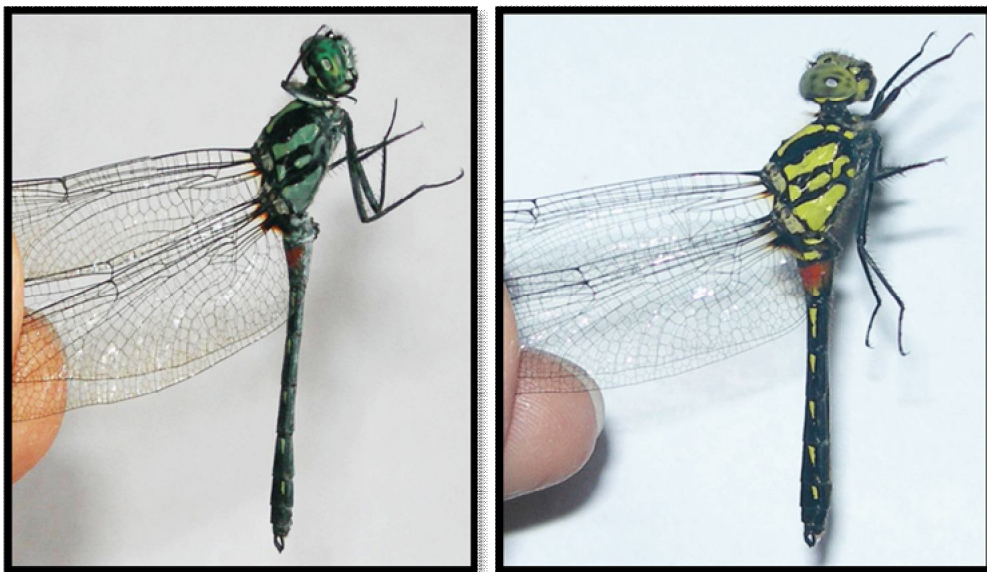


Figure 2. *Diplacina bolivari* (Selys, 1882) under Family Libellulidae, Suborder Anisoptera.

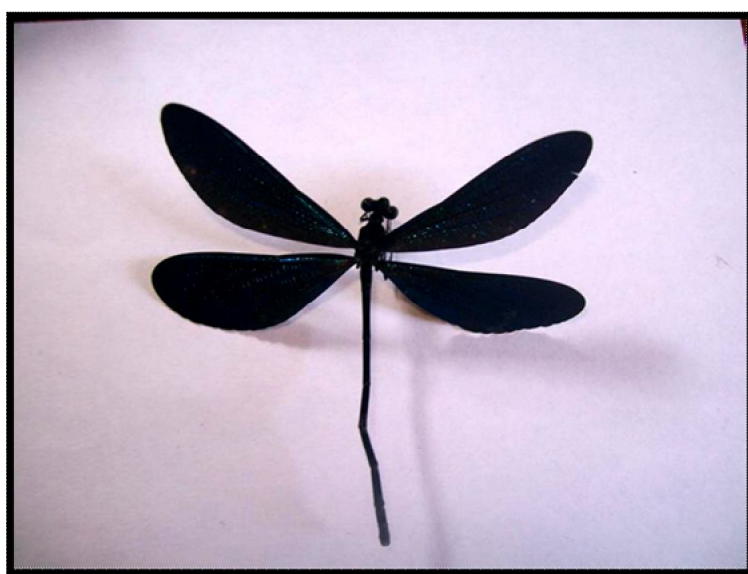


Figure 3. *Vestalis melania* Selys, 1873 under Family Calopterygidae, Suborder Zygoptera.



Figure 4. *Rhinocypha colorata* (Hagen in Selys, 1869); male (left), female (right) under Family Chlorocyphidae, Suborder Zygoptera



Figure 5. *Rhinocypha turconii* Selys, 1891 under Family Chlorocyphidae, Suborder Zygoptera

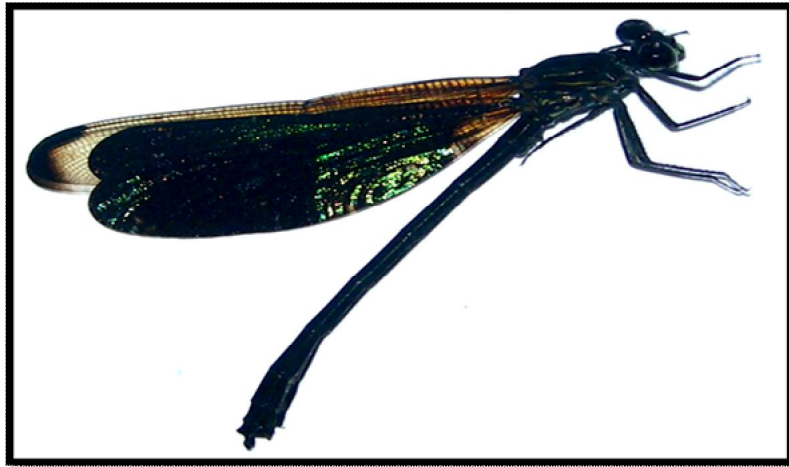


Figure 6. *Euphaea amphicyana* (Ris, 1930) under Family Euphaeidae, Suborder Zygoptera.



Figure 7. *Prodasineura integra* (Selys, 1882) in tandem; Family Protoneuridae, Suborder Zygoptera.

The most abundant damselfly species was *Rhinocypha colorata* (Figure 8), a Philippine endemic that can adapt and tolerate disturbed habitats. Villanueva (2012) observed that this species can be found even in areas with significant human activity and it can tolerate streams that have agricultural and domestic runoffs. Three Philippine endemic *species*: *Heteronaias heterodoxa*, *Euphaea amphicyana*, and *Vestalis melania* and two Oriental species, *Neurothemis t. terminata* and *Acisoma panorpoides panorpoides* were very few in numbers.

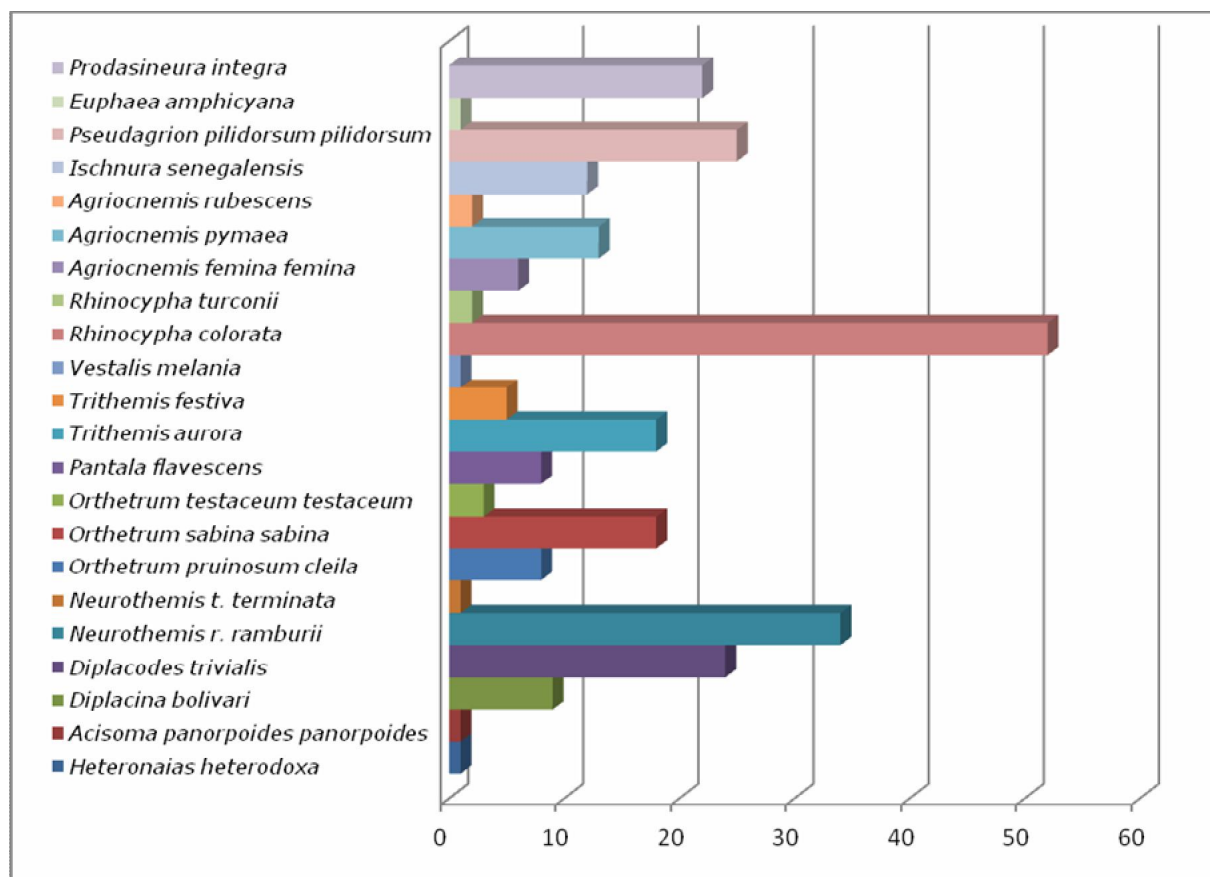


Figure 8. Abundance of Odonata in the eight sampling sites.

Shannon-Wiener diversity index was low in all sampling sites (Table 2). This indicates that the sampling sites are relatively disturbed. Another possible explanation for the low diversity is the limited sampling time which decreases the chance of finding isolated and secretive species. A more or less even distribution was recorded in all sampling sites except in Colupan River, which had a relatively low evenness probably due to the abundance of *R. colorata* which dominates the site. Dijkstra (2007) reported that Odonata is strongly dependent on structural characteristics, especially related to vegetation (Balzan 2012) that plays an important role throughout the lifecycle of Odonata. The lifecycle depends on the suitability of both aquatic and terrestrial habitats and on abundant and diversified preys. The adults too have specific preferences regarding favorite hunting or resting spots, as reeds beds, riparian scrubs or willows, ash trees etc (Maiolini & Carolli 2009).

Table 2
Biodiversity Indices of Odonata in the eight sampling sites of Misamis Occidental

Indices	Colupan River	Sinonoc River	Camanse Stream	Bahay Stream	Pines River	Dagatan Stream	Talic River	Montol River
Species Richness	12	13	8	7	9	11	8	8
Individuals	70	40	26	13	40	25	36	19
Shannon	0.808	0.953	0.725	0.819	0.895	0.95	0.778	0.811
Dominance	0.2216	0.145	0.2456	0.1598	0.125	0.1328	0.216	0.1856
Evenness	0.5355	0.6904	0.663	0.9408	0.879	0.8090	0.7497	0.8093

Figure 9 shows that Pines River and Talic River have the most similarities (57.5342%) which means that there is a high number of species common or similar in the two areas. Disturbed vegetation and exposed rocks are common in the two sites. The least similar habitats are Montol River and Talic River (3.6364%) which means that they share very few species. These sites have less similarity of species due to the fact that Montol River is a forested area with a lesser degree of disturbance consisting mostly of Philippine endemic species while Talic River is already a disturbed area consisting of oriental and common species.

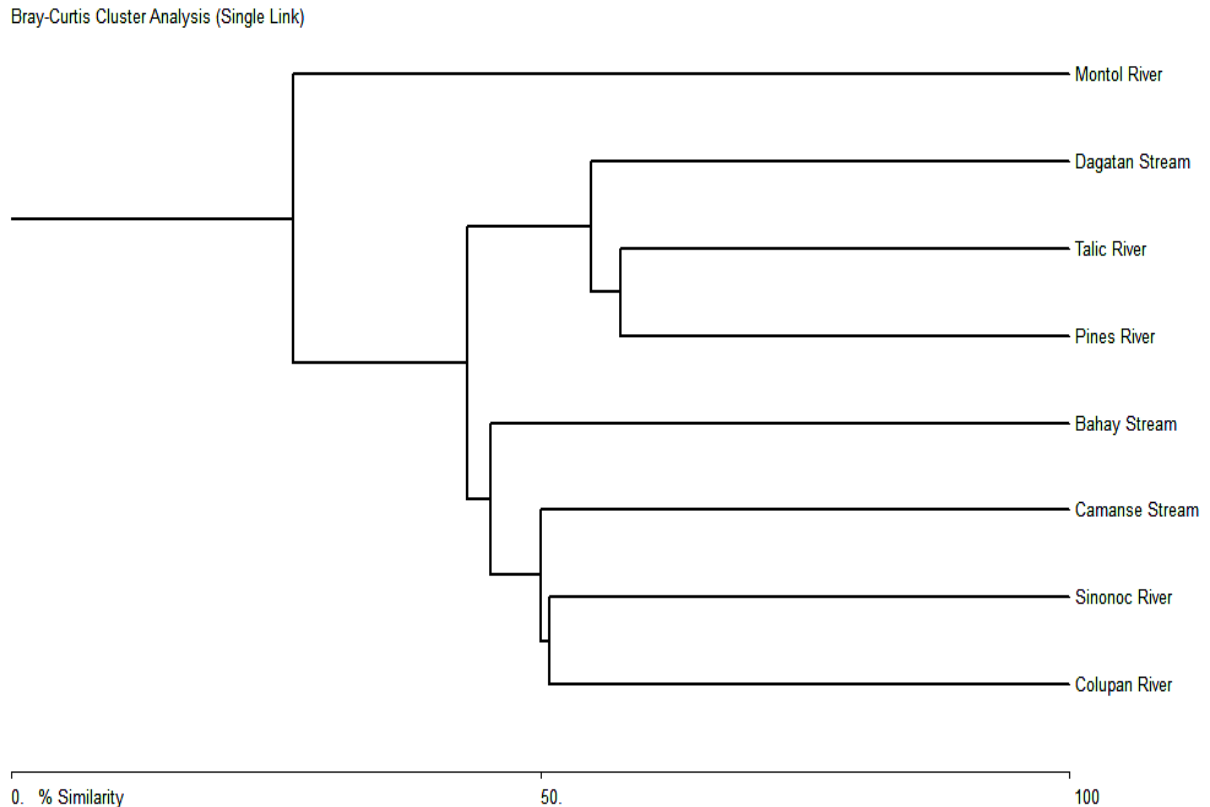


Figure 9. Dendrogram on the species composition of Odonata in the eight sampling sites.

Conclusion and Recommendation. Misamis Occidental has low species diversity and low endemism of Odonata. The sampling sites are already disturbed as gauged from the high number of Oriental species and the presence of on-site disturbances. It is recommended that sampling be done in other forested and undisturbed areas in Misamis Occidental to have a complete database of the Odonata species in the province.

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