

Odonata Recorded in the Buffer Zone of Mt. Hamiguitan Range Wildlife Sanctuary with Remarks on the Distribution of Endangered *Risicnemis antoniae* in Davao Oriental Philippines

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Abstract

Mt. Hamiguitan Range Wildlife Sanctuary is both a UNESCO and ASEAN recognised heritage site. There is a current move to expand the site by expanding the buffer zone. This area unfortunately is poorly studied in terms of its biodiversity. This paper explores the odonata species found in the proposed buffer zone. Transect line along fluvial ecosystem was established in the two bordering municipalities. A total of 32 species from 22 genera and nine families were recorded in which eighteen species (18) belong to the suborder Zygoptera while 14 species are Anisoptera. High level of endemism was recorded for Zygoptera (94.44%) endemism while low endemism for Anisoptera (21.43%). Distribution of *Risicnemis antoniae* (Gassmann and Hämäläinen, 2002), an IUCN endangered damselfly was recorded in the creeks of Barangay Tandang Sora, Governor Generoso at relatively lower elevation between 100-300 meters above sea level. Due to its habitat's close proximity to human habitation and the encroaching anthropogenic disturbances, it should be declared as Local Conservation Area.

Keywords: Buffer Zone; Davao Oriental; Odonata; Philippines; survey

Abbreviations: MHRWS: Mt. Hamiguitan Range Wildlife Sanctuary; EMBC: Eastern Mindanao Biodiversity Corridor

Introduction

Odonata is one of the most primitive insect groups in the world that dominates aquatic ecosystems (Grimaldi and Engel, 2005). They play pivotal role in the ecosystem as pest control, water quality and habitat bio-indicator and can be used in monitoring anthropogenic disturbances (Samway *et al.*, 2010; Medina *et al.*, 2016). They are found in both standing and running water with few species being able to withstand brackish water (Kalkman, 2008). Although they are found in almost all types of aquatic habitats there are several habitat specific species (Silva *et al.*, 2010). Majority of the rare and endemic species are associated with undisturbed and intact forests with good water quality (Gapud, 2005). Globally, there are 5,680 extant species with the tropics having the greatest diversity and numbers of species approximately about 1,500 (Kalkman, 2008).

The Philippines is a tropical country that belongs to one of the mega-diverse countries in the world contributing a significant number of flora and fauna to world's total

biodiversity (Convention on Biological Diversity, 2009). However due to the unprecedented habitat loss, it is also considered as one of the hottest of hotspots and is considered as a top priority for conservation (Myers *et al.*, 2000). The Philippine Odonata has about 300 recorded species which is characterized by a very high level of endemism- 90% for the Zygopterans and 40% for the Anisopterans (Hamalainen, 2004; Gapud, 2005). Despite the high level of endemism and the threats to the endemic species, very few species have been assessed by the IUCN thus only few species were considered as threatened. Among the threatened Odonata is the critically endangered *Risicnemis antoniae* which is exclusively found in Eastern Mindanao (Gassman and Hamalainen, 2002; Hamalainen, 2004).

Mindanao, the second largest island in the country, with a total of 97,530 km² is a home to more than 130 species of Odonata (Hamalainen, 2004). Mindanao's rugged topography of volcanic mountains also prides in the presence of Mt. Hamiguitan Range Wildlife Sanctuary (MHRWS) which is both an ASEAN and UNESCO biodiversity heritage park (UNESCO, 2014). It forms part

of the mountain range along Pujada Peninsula in the Southeastern part of the Eastern Mindanao Biodiversity Corridor (EMBC). EMBC is considered as one of the remaining intact forests in the country (Conservation International, 2016) and remains to be underexplored in terms of its odonata fauna. The only Odonata study conducted in Mt. Hamiguitan was made by Villanueva and Mohagan (2010) across the different vegetation types in the mountain of which a total of 31 species was recorded. No survey was done after that especially on the adjacent rivers in the buffer zone. This study aims to provide the list of Odonata found in the fluvial systems in the buffer zones of MHRWS as well as to document the distribution of the IUCN endangered *Risiocnemis antoniae* in Davao Oriental using GIS mapping. Since no Odonata study was conducted in the buffer zone, this study is crucial in supporting the move to expand the range of Mt. Hamiguitan. Mapping out the IUCN endangered *Risiocnemis antoniae* (Gassman and Hamalainen, 2002) will also provide critical data to the local government unit of Governor Generoso to consider its current distribution range as Local Conservation Area (LCA) through a municipal ordinance.

Materials and Methods

Place and duration

The study was conducted in the buffer zone of Mt. Hamiguitan Range Wildlife Sanctuary which comprises both agro-ecosystem and secondary forest. A 7 km transect walk was conducted in the fluvial systems of Brgy. TandangSora, Governor Generoso while a 2 km transect walk was conducted in Barangays La Union and Maputi, San Isidro, Barangay TandangSora, Governor Generoso, and Barangay Catmonan, Mati City between the months of September 2015 and January 2018.

Collection and species mapping

Collection of specimens was done by hand picking for low flying Zygopteran species and netting for the Anisopterans. To document the distribution of *R. antoniae*, a Global Positioning System (GPS) data of each site where the species were located was obtained using a handheld Garmin GPS Map 64S and GIS was created using Manifold System 8.0. Photo-documentation and visual encounter were also conducted to aid in data gathering.

Identification and deposition

Identification was done by examining the morphology of the Odonata species under stereomicroscope with the aid of published papers and Mindanao Odonata photo guide (Villanueva, 2011; Medina et al., 2016). Vouchered specimens are individually placed in paper triangle and properly labelled. Individual voucher collection is killed by immersing in the acetone for a few seconds and then properly positioned prior to soak for 24 hours in acetone. Materials were then air dried and placed again in individual paper triangle with collection label and placed in a sealed container for longer storage. Species richness was obtained using frequency count per barangay while endemism and geographic distribution of species were noted using IUCN Red List of Threatened Species (IUCN Red List, ver. 2017-3).

Results and Discussion

A total of 32 species from 22 genera and 9 families were recorded in which eighteen species (18) belong to the suborder Zygoptera while 14 species are Anisoptera. The 18 species of Zygoptera (Table 1) recorded belong to 12 genera and 7 families while 14 species of Anisoptera belonged to 10 genera and 2 families. A high level of endemism was recorded for Zygoptera with 94.44% endemism while low endemism was recorded for Anisoptera with 21.43%. Seven (38.88%) of the endemic Zygoptera are Philippine endemic, 8 (44.44%) are Mindanao endemic while 2 (11.11%) are Greater Mindanao endemic.

Zygoptera or commonly known as damselflies are low fliers with high habitat specificity as well as narrow geographic range. Endemic Zygoptera prefers pristine fluvial systems with good vegetation cover and they are sensitive to anthropogenic disturbances. They are often found in still waters and perch in twigs along the creeks and rivers. The high level of endemism of damselflies in the buffer zone of Mt. Hamiguitan suggests that the remaining fluvial systems areas sampled have pristine waters and good vegetation cover.

Among the 7 families documented, Platycnemididae is the most speciose with 7 species recorded (38.88%) followed by Coenagrionidae with 4 species (22.22%). Chlorocyphidae and Platystictidae were represented by 2 species (11.11%) while only one species (5.55%) represents the families Calopterygidae, Euphaeidae, Megapodagrionidae.

One of the most notable species recorded in the buffer zone of Mt. Hamiguitan is the Mindanao endemic and threatened *Risiocnemis antoniae* belonging to the family Platycnemididae. This species was described from Aliwagwag Falls, Davao Oriental in 2002 and its distribution is restricted in Eastern Mindanao from Davao Oriental to Surigao. According to IUCN, 2017 this species is among the few assessed species of Philippine Odonata and is considered as critically endangered due to “the very narrow area of occupancy is aggravated by rapid increase of settlement of upland areas and conversion of forest habitat to farming land” (Villanueva, 2009). A project supported by Mohammed bin Zayed made the assessment of the population and distribution of *Risiocnemis antoniae* possible in Davao Oriental. This is deemed necessary to further protect this critically endangered damselfly that is at great risk of extinction due to habitat loss. This damselfly was recorded in TandangSora, Governor Generoso and Tumulite, San Isidro.

Among the three sites surveyed, fluvial system in Barangay Maputi has the highest species richness with 16 species (88.88%) of Zygopteran followed by Brgy. TandangSora with 14 species (77.77%) while Brgy. Tumulite has only 9 (50%) species. The high species richness of Barangay Maputi is attributed to its semi-pristine and well vegetated fluvial system which catered to a high number of endemic and rare species viz *Rhinagrion reinhardi* (Kalkman and Villanueva, 2011), *Euphaea amphicyana* (Ris, 1930), *Vestalis melania*, *Coellicia dinocerus* (Laidlaw, 1925) among others. For Brgy. Tumulite, the presence of *Risiocnemis antoniae* and *Pandanobasis cantuga*

(Fig. 1) (Needham and Gyger, 1939; Villanueva, 2002) are notable records. *P. cantuga* used to belong to the genus *Amphicnemis* but has been revised and named after the plant it inhabits - *Pandanus* sp. Members of this genus are phytothelmites which inhabits the waters found in pandan. Unlike most damselflies which are found near creek, *Pandanobasis* are found in forests with abundance of *Pandanus* spp.

Despite the unique Zygopteran composition in the 3 fluvial systems surveyed which can be attributed to the difference in vegetation cover and level of anthropogenic disturbances, some species are shared by the 3 areas which

include *Vestalis melania*, *Rhinocypha colorata*, *Rhinocypha turconii*, *Pseudagrion pilidorsum pilidorsum*, *Euphaea amphicyana*, *Prodasineura integra*, and *Risiocnemis appendiculata*. One of the interesting species shared by Brgy. Maputi and Brgy. Tandang Sora belongs to the genus *Drepanosticta*, *D. lestoides* and *D. flavomaculata* they were both documented in the fluvial systems of the two barangays. *Drepanosticta* are forest dwelling damselflies and sensitive to anthropogenic disturbances. Furthermore this taxon indicates relatively pristine fluvial systems in both barangays. Its taxonomy remains unresolved and needs further study.

Table 1. Zygopterans recorded in MHRWS, Davao Oriental Philippines

Family	Scientific name	Sampling sites and habitat				GD	CS
		A	B	C	D		
Calopterygidae	<i>Vestalis melania</i> Selys, 1873	✓	✓	✓	✓	PE	DD
Chlorocyphidae	<i>Rhinocypha colorata</i> Hagen <i>in</i> Selys, 1869	✓	✓	✓	✓	PE	DD
	<i>Rhinocypha turconii</i> Selys, 1891	✓	✓	✓	✓	PE	DD
	<i>Coeragrion lieftincki</i> Asahina, 1967	✓		✓		PE	DD
Coenagrionidae	<i>Pandanobasis cantuga</i> (Needham and Gyger, 1939; Villanueva, 2002)		✓	✓		PE	DD
	<i>Pseudagrion pilidorsum pilidorsum</i> Brauer, 1868	✓	✓	✓	✓	O	DD
	<i>Teinobasis annamaijei</i> Hamalainen & Muller, 1989		✓	✓		PE	DD
Euphaeidae	<i>Euphaea amphicyana</i> Ris, 1930	✓	✓	✓	✓	GME	DD
Megapodagrionidae	<i>Rhinagrion reihnhardi</i> Kalkman & Villanueva, 2011			✓		ME	DD
	<i>Coellicia dinocerus</i> Laidlaw, 1925	✓		✓	✓	GME	DD
	<i>Prodasineura integra</i> Selys, 1882	✓	✓	✓	✓	PE	DD
Platycnemididae	<i>Risiocnemis appendiculata</i> (Brauer, 1868)	✓	✓	✓	✓	ME	DD
	<i>Risiocnemis atripes</i> Needham and Gyger, 1941	✓		✓	✓	ME	DD
	<i>Risiocnemis antoniae</i> (Gassman and Hamalainen, 2002)	✓	✓			ME	E
	<i>Risiocnemis erythrura</i> Brauer, 1868	✓		✓	✓	ME	DD
	<i>Risiocnemis tendipes</i> Needham and Gyger 1941	✓		✓	✓	ME	DD
Platystictidae	<i>Drepanosticta lestoides</i> (Brauer, 1868)			✓		ME	DD
	<i>Drepanosticta cf. flavomaculata</i>	✓			✓	ME	DD
	Total	14	10	16	12		

GD – Geographic Distribution; CS – Conservation Status; DD – Data Deficient; O – Oriental; A - Brgy. TandangSora, Governor Generoso; B - La Union, San Isidro; C - Brgy. Maputi, San Isidro; D - Catmonan, Mati City.



Fig. 1. A) *Coellicia dinocerus* (Laidlaw, 1925). B) *Pandanobasis cantuga* (Needham and Gyger, 1939; Villanueva, 2002). C) *Teinobasis annamaijei* (Hamalainen and Muller, 1989). D) *Rhinagrion reihnhardi* (Kalkman and Villanueva, 2011)

A total of 14 Anisopterans (Table 2) were recorded in the buffer zone of Mt. Hamiguitan belonging to 10 genera and 2 families. A low level of endemism was recorded for Anisopterans with only three out of 14 (21.43%) endemism. The three species recorded *viz* *Idionyx philippa* (Ris, 1912), *Heteronias heterodoxa* (Needham and Gyger, 1937), *Diplacinabolivari* (Selys, 1882) are all Philippine endemic while the rest are Oriental species. The fluvial systems surveyed were dominated by the family Libellulidae with 12 species (85.71%) while Corduliidae was only represented by 2 species (14.29%). The family Libellulidae were surveyed in fluvial systems which are open with mild anthropogenic disturbances while the members of the family Corduliidae were documented in areas with pristine waters and heavy vegetation. Libellulidae species favors open

standing waters and can highly tolerate moderate to severe anthropogenic disturbances (Kalkman *et al.*, 2008). In the three surveyed sites, they were often spotted near agro-ecosystems. One particular species - *Pantala flavescens* from the family Libellulidae is considered invasive species.

Among the sites surveyed, Brgy. Maputi is still the most speciose with 13 (92.86%) species followed by TandangSora with 12 species (85.71%), Brgy. Catmonan with 11 (73.33%) and Brgy. Tumlite with only 7 species (50%). Tandang Sora, Maputi and Catmonan shared Philippine endemic species includes *H. heterodoxa* (Needham and Gyger, 1937) and *D. bolivari* (Selys, 1882). Moreover, *I. philippa*, another Philippine endemic species, was recorded only in Brgy. Maputi while *L. cleis* was recorded only in Brgy. Tumlite (Fig. 2).

Table 2. Anisopterans recorded in MHRWS, Davao Oriental Philippines

Family	Scientific name	Sampling sites				GD	CS
		A	B	C	D		
Corduliidae	<i>Idionyx philippa</i> Ris, 1912			✓	✓	PE	DD
	<i>Heteronias heterodoxa</i> Needham and Gyger, 1937	✓		✓	✓	PE	DD
	<i>Agrionoptera insignis</i> Rambur 1842	✓		✓	✓	O	DD
	<i>Diplacina bolivari</i> Selys, 1882	✓		✓	✓	PE	DD
	<i>Diplacodes trivialis</i> Rambur 1842	✓	✓	✓		O	DD
	<i>Lyriothemis cleis</i> (Brauer 1868)	✓	✓			O	DD
	<i>Neurothemis ramburii</i> Brauer, 1866	✓		✓	✓	O	DD
Libellulidae	<i>Neurothemis terminata</i> Ris, 1911	✓	✓	✓	✓	O	DD
	<i>Orthetrum pruinatum clelia</i> Selys, 1878	✓	✓	✓	✓	O	DD
	<i>Orthetrum testaceum</i> (Burmeister, 1839)	✓		✓	✓	O	DD
	<i>Orthetrum sabina sabina</i> (Drury 1770)	✓	✓	✓		O	DD
	<i>Pantala flavescens</i> Fabricius 1798	✓	✓		✓	CT	DD
	<i>Trithemis aurora</i> (Burmeister 1839)	✓	✓	✓	✓	O	DD
	<i>Trithemis festiva</i> (Rambur 1842)	✓		✓	✓	O	DD
TOTAL		13	7	12	11		

GD – Geographic Distribution; CS – Conservation Status; DD – Data Deficient; O – Oriental; A - Brgy. TandangSora, Governor Generoso; B - La Union, San Isidro; C - Brgy. Maputi, San Isidro; D - Catmonan, Mati City.



Fig. 2. A) *Idionyx philippa* (Ris, 1912). B) *Heteronias heterodoxa* (Needham and Gyger, 1937). C) *Diplacina bolivari* (Selys, 1882). D) *Trithemis aurora* (Burmeister 1839)

L. cleis is a phytothelmate species together with the damselfly *P. cantuga* recorded from Mt. Hamiguitan. This species breeds in water filled tree holes, depressions in fallen tree trunks and small pools on the forest floor and has been observed to be capable of withstanding mild forest disturbance (R. Dow, pers. comm., 2010). All Anisopteran species are data deficient based on IUCN Red List of Threatened species (IUCN, 2017-3).

Distribution of R. antoniae

The recent distribution of *R. antoniae* in TandangSora is found nearby local communities. As shown in Fig. 3, majority of the population is found along the river bank of Barangay Tandang Sora, Governor Generoso at relatively lower elevation between 100-300 meters above sea level, hence making the location very accessible to local villagers.

At present, there is no conservation effort exerted to conserve *R. antoniae*. Considering the vulnerability of the species to human anthropogenic activities since it is very close to settlements, there is a greater tendency for its population to decline in the next years.

Some of the population is located outside the boundary of the Protected Area thereby calling for immediate conservation efforts. For two years of documentation within the area, a total of 114 individuals consisting of 112 males and only 2 females were recorded. In 2017, one male was sighted near the interpretation site of MHRWS. With

this, we are proposing to raise the protection status of *R. antoniae* (Fig. 4) to critically endangered species in the IUCN.

The urgent concern for this species is the very rare occurrence of females. For approximately 2 years of monitoring in the area, only 2 females are found. This poses greater threat to their extinction. Hence urgent conservation efforts are greatly needed to conserve *R. antoniae*.

Conclusions

The fluvial systems of the buffer zone of MHRWS host high species richness and endemism especially for Zygopterans. Odonates highest diversity is in forests edges due to the habitats suited for both endemic and highly sensitive forest dwelling species to the highly tolerant and widely distributed Oriental species which inhabits disturbed and agro-ecosystems. The high level of endemism indicates that its fluvial systems are still pristine and have good vegetation that suits the habitat requirements of the endemic species. The presence of the rare, endemic and critically endangered *R. antoniae* requires an immediate conservation action on the habitats where they were found. Monitoring and population assessment of the other lesser known endemic species should be conducted to strengthen conservation actions.

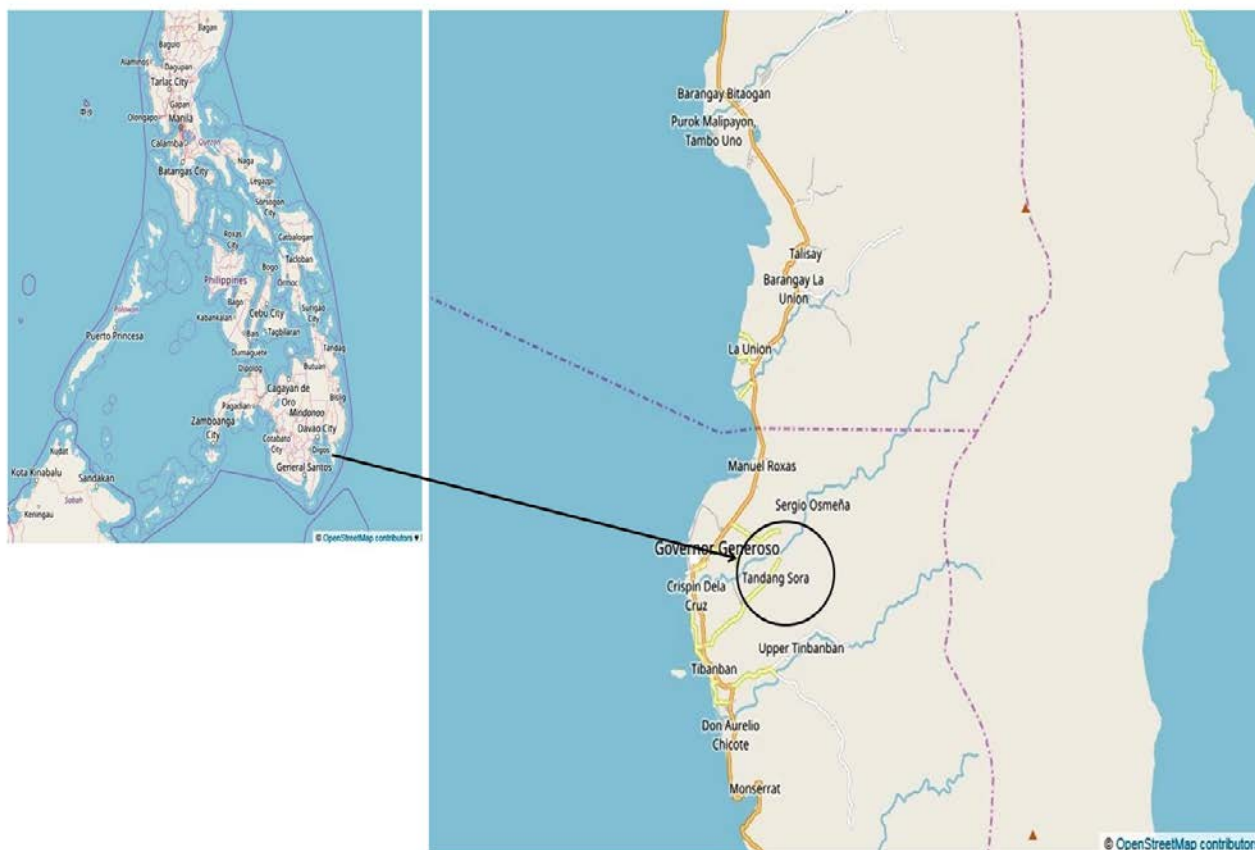


Fig. 3 A. Map of the Philippines; B. Map of Mt. Hamiguitan Range Wildlife Sanctuary showing the location of *R. antoniae* [Map copyright by © OpenStreetMap contributor]



Fig. 4. A. *Risiocnemis antoniae* - male (Gassman and Hamalainen, 2002); B. *Risiocnemis antoniae* - female (Gassman and Hamalainen, 2002)

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