



INVENTORY OF DRAGONFLIES AND DAMSELFLIES (ODONATA) IN ANDALAS UNIVERSITY'S LIMAU MANIS CAMPUS COMPLEX, PADANG: USING PHOTOGRAPHICAL APPROACH

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Abstract. Odonata, which consists of true dragonflies and damselflies, is considerably understudied in Sumatra, especially in West Sumatra region. While the campus area of Andalas University in Limau Manis provides many suitable habitats for dragonflies and damselflies, the least has been done in learning these organisms. In this paper, we intend to conduct the inventory of Odonata in Limau Manis area by using photography approach (by taking decent pictures only, without sampling the animal). After spending 14 days of data collection which spanned from October 2017 until February 2018), we listed 27 Odonata species. Of which, 11 species belong to four families under suborder Zygoptera and 16 species grouped into four families under suborder Anisoptera. Libellulidae is a family under Anisoptera that was found with most species members. Photography approach promises an immense help in doing species inventory for this animal group for its reliability in determining species identification without harming species' population.

Keywords: damselflies, dragonflies, Libellulidae, Limau Manis area, photography approach

I INTRODUCTION

It is estimated that there are around 6,000 species of Odonata globally, usually grouped into three main suborders; Zygoptera (damselflies, 18 families), Anisozygoptera (intermediate dragonflies, with one family) and Anisoptera (true dragonflies, consists of ten families) (1). Tropical region retains the highest diversity of dragonflies in the world, on account that this region possesses various types of aquatic habitat which typically available all year-round (2). Dragonflies and damselflies are ones among those of environmental biotic components, functioning as the balancers for the composition of other insects as they play roles as predators, either in their adult or larval stage (3). The larvae share similar predatorial habit by preying upon other aquatic insects and animals, including fishes and tadpoles (1). The larvae of dragonflies and damselflies heavily depend on clean aquatic habitat, which make them as an excellent indicator of the good quality of water body (1, 4). On the other hand, anthropogenic activities not only influence soil, yet also degrade the aquatic environment and significantly affect the existence of dragonfly

species and community within that area (5). It is stated that regular monitoring on the abundance of local dragonflies can reveal the degradation of environmental quality (6), while the well-organized monitoring on rare dragonflies and damselflies can provide a reliable indicator on the habitat sustainability as well as become the significant factor in assessing the importance of that habitat (7). Andalas University (hereinafter Unand) is the oldest state university outside Java, officially established on 23 December 1955 and possessed, eventually, its own campus complex in Limau Manis area in Pauh Subdistrict, 15 km from downtown of Padang city, on the late 1990s. The complex unified almost all previous separated faculties which scatteredly established since the university is borne. A 500- hectare of land is secured for this unification purpose, located on the hilly terrain of 300 meters above sea level, shares the same border with the mountainous chains of Bukit Barisan (8). Unand's Limau Manis campus complex, in general, can be divided into lecturing halls, laboratories, workshops, administration buildings and other supporting facilities; it consumed around 135 hectares of the complex area (8). In addition, there is a

proportion of forested area in the eastern side of campus, allocated purposively for field practicing for students from the Faculty of Sciences, Pharmacy, Agriculture and Veterinary (9). Around 160 hectares of this forested area allotted as part of Kebun Raya Universitas Andalas (Andalas University's Grand Park), includes; 1) Hutan Pendidikan dan Penelitian Biologi (Forest for Biology Education and Research - HPPB) of 150 hectares, 2) Arboretum of 3 hectare, and 3) Kebun Tanaman Obat (Medicinal Plant Garden - KTO) of 7 hectares (10). Being an important water catchment area for Padang City, Unand's Limau Manis campus complex also provides various habitat types that support the existence of dragonflies and damselflies. Until now, there is only one published research on dragonflies and damselflies from this area. The only study about Odonata in 2008 listed 23 species of Odonata from HPPB site, which consisted of four families of Zygoptera and two families of Anisoptera (11). The lack of research on Odonata in Sumatra has created some difficulties in species identification, as this process should be ideally assisted by the guidebooks made specifically for this island, instead of by ones purposed for other localities. On the other hand, this situation signals the urgency to conduct researches, especially on Sumatra dragonflies, recall the massive of deforestation and habitat destruction in this island. This study aimed to inventory the species of dragonfly and damselfly in Unand's Limau Manis campus complex by using photographic approach. This approach is intended to avoid specimen collection on any dragonfly or damselfly as the local population status is currently unknown. Thus, it will evade potential risk toward the population which resides in Limau Manis campus complex, as well provide baseline data for further study in the future.

II METHODOLOGY

This study used survey method, by following some available tracks along the aquatic and non aquatic habitats in Limau Manis campus complex, Padang. The survey procedure involved spotting and taking a photograph of any individual in its natural habitat, without collecting any specimens (12). The survey was adapted to the active time of most dragonflies or damselflies, between 08.00 am to 03.00 pm, with occasional observation extended until sundown. Nikon Coolpix P900 was used as the main equipment, set at macro mode (Normal Close-up Single Shot) to snap object in between 0.5-10 meters with picture resolution

kept at Fine mode (pixellation rate 4608x3456). The object, either dragonfly or damselfly, was portrayed on its natural position, preferably on its lateral and dorsal aspects, so most of its bodily characters recorded properly. Since there is no current data on Odonata population in Unand's Limau Manis campus complex, specimen collection was not encouraged in this study. Hence, precision and details of photographed objects, mainly focused on body characters (shape, color, size), are the keys to identify species. Additional information regarding habitats, behavior, and others, were also recorded to help describing the species. The survey was conducted in two major habitat types in Limau Manis campus complex; aquatic and non aquatic. The first included ditches, ponds, and rivers, while the later included forest edge, agricultural area, and anthropogenic area. Total of 14 days of survey, with average 2 hours per day spent for observation, had been spread between October 2017 and February 2018 (excluding November 2017). The details of observation days were as follow; one day each in October and December 2017, seven days in January 2018 and five days in February 2018. Photographs produced from the survey were then visually identified using guidebooks (4, 13, 14), by comparing the observed characters of photograph specimens (color, shape specifically on eyes, wings and other body parts) to the pictorial guides. This process was complemented with distributional information from the references, including from online sources, such as allodonata.com, odonata-of-malaysia.blogspot.my, singaporeodonata.wordpress.com and thaiodonata.blogspot.com. Identified species was then classified and grouped according to its taxa sequence (suborder, family, genus) and its habitat then descriptively outlined.

III RESULT AND DISCUSSION

Species, habitat and status of Odonata in Unand's Limau Manis campus complex

There were 916 photos taken during the survey, which later identified into 11 species that belong to suborder Zygoptera and 15 species that are Anisoptera (Table 1). One species, *Macromia cincta*, was identified through direct observation in the field using obvious features that indicated this species such as stout body, brilliant bluish-green eye, pale white line across the dorsum of thorax and body side, as well as clear wings. It was a very active diurnal species and very difficult to take its picture.

Table 1 Species of Odonata in Unand's Limau Manis campus complex

No	Suborder/Family	Species	Habitat
A	ZYGOPTERA		
1	Chlorocyphidae	<i>Heliochypa fenestrata</i> (Burmeister, 1839)	River
2		<i>Libellago lineata</i> (Burmeister, 1839)	River
3	Euphaidae	<i>Euphaea variegata</i> Rambur, 1842	River
4	Platycnemididae	<i>Coelliccia membranipes</i> (Rambur, 1842)	Forest edge, garden
5		<i>Prodasineura collaris</i> (Selys, 1860)	Forest edge, garden
6		<i>Prodasineura verticalis</i> (Selys, 1860)	Ditch, river
7		<i>Copera marginipes</i> (Rambur, 1842)	Garden
8		<i>Copera ciliata</i> (Selys, 1863)	Garden
9	Coenagrionidae	<i>Ishnura senegalensis</i> (Rambur, 1842)	Pond
10		<i>Agriocnemis femina</i> (Brauer, 1868)	Pond
11		<i>Archibasis viola</i> Lieftinck, 1948	Pond
B	ANISOPTERA		
12	Aeshnidae	<i>Gynacantha dohrni</i> Kruger, 1899	Garden
13	Gomphidae	<i>Ictinogomphus decoratus</i> (Selys, 1854)	Pond
14	Macromiidae	<i>Macromia cincta</i> Rambur, 1842	Pond
15	Libellulidae	<i>Agrionoptera insignis</i> (Rambur, 1842)	Garden
16		<i>Camacinia gigantea</i> (Brauer, 1867)	Pond
17		<i>Diplacodes trivialis</i> (Rambur, 1842)	Forest edge, garden
18		<i>Neurothemis ramburii</i> (Kaup in Brauer, 1866)	Forest edge, garden, anthropogenic area
19		<i>Neurothemis terminata</i> Ris, 1911	Forest edge, garden
20		<i>Orthetrum pruinatum</i> (Burmeister, 1839)	Forest edge, garden, anthropogenic area
21		<i>Orthetrum sabina</i> (Drury, 1770)	Forest edge, garden, anthropogenic area
22		<i>Orthetrum testaceum</i> (Burmeister, 1839)	Forest edge, garden, anthropogenic area
23		<i>Pantala flavescens</i> (Fabricius, 1798)	Forest edge, garden, anthropogenic area
24		<i>Tholymis tillarga</i> (Fabricius, 1798)	Forest edge, garden
25		<i>Tramea transmarina</i> Selys, 1878	Pond
26		<i>Trithemis festiva</i> (Rambur, 1842)	River
27		<i>Zyxomma obtusum</i> (Albarda, 1881)	Garden

Moreover, there were other four unidentified species, albeit they were represented by clear pictures. We restrained ourself from naming the species based on unclear characters, as there are frequent cases of polymorphism, species complex or sexual dimorphism in Odonata. These unidentified individuals were not listed within Table 1. All of the identified species were categorized as Least Concern based on IUCN Red List (see www.iucnredlist.org). We observed the increment of recorded species within the observation period, as in October and December 2017 the observation booked a total

12 species, while in January 2018 another 12 species added and three more new species recorded in February 2018 (Figure 1). This trend is possibly continuous, given more time paid for the survey as well as more observation conducted on the unvisited area. Platycnemididae is a family with the most members found under suborder Zygoptera (with five species), while Libellulidae becomes the Anisopteran family with the most member recorded (13 species) (Figure 2). Euphaidae (suborder Zygoptera), Aeshnidae, Gomphidae, and Macromiidae (suborder Anisoptera) were each represented by one

species. Libellulidae is indeed renown as Odonata taxon with the most members and dominantly found in various types of habitat (1, 15).

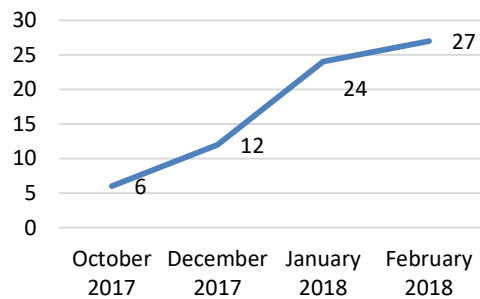


Figure 1 Odonata species increment curve from October 2017 – February 2018 in Unand's Limau Manis campus complex

By linking the sighting of dragonfly or damselfly and the habitat where it was found (see Table 1 and Figure 3), revealed that garden habitat (parts of campus complex intentionally cultivated with agricultural plants) as the place where most species observed (11 species), followed by forest edge (8 species) and anthropogenic area (5 species). The more an area affected by human activity, the fewer species of dragonfly can be observed in this area (15), where Zygoptera is considered to be more vulnerable than Anisoptera. Suborder Zygoptera attaches more to aquatic habitat than the suborder Anisoptera, which seems to determine the width of their distribution range.

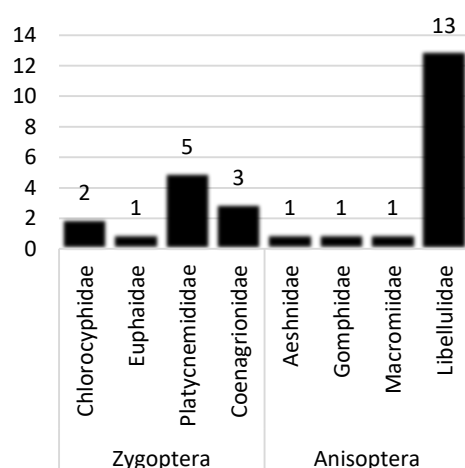


Figure 2 Number of Odonata species per family in Unand's Limau Manis campus complex. Platynemididae and Libellulidae were the families with most species from respectively Zygoptera and Anisoptera suborders

Within modified habitat, suborder Anisoptera is more dominant than suborder Zygoptera (13). Body size, endurance, and competitiveness become the determinant factors to survive in this modified environment. All identified dragonflies and damselflies from Unand's Limau Manis campus complex possess Least Concern (LC) status according to International Union for Conservation of Nature Red List (IUCN Red List). This status indicates that the global population of the species are still in abundant (16). Careful consideration should be paid whenever the study, involves sampling and specimen collection, conducted on this insect group, despite their less worrisome status. In addition to their unknown population status, current development of campus complex may have impacted them to some extent. Hence, the inventory survey using photographic approach without specimen collection seems plausible as it poses no threat to local population of Odonata (13).

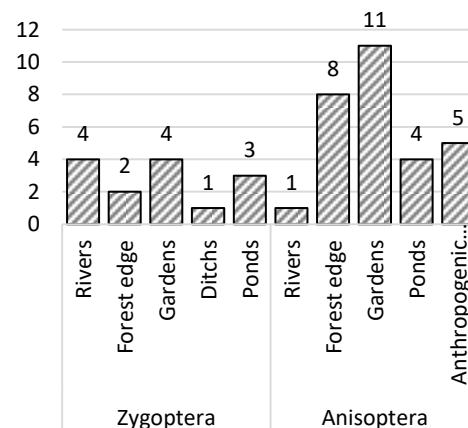


Figure 3 Composition of Odonata species in Unand's Limau Manis campus complex per habitat surveyed

During observation, some dragonflies and damselflies were qualitatively assessed for its abundance by qualitatively estimating the encounter rate with each species. Species such as *Prodasineura collaris*, *Ishnura senegalensis*, *Agriocnemis femina* of the Zygoptera were easily found in suitable habitats; *Ictinogomphus decoratus* and *Macromia cincta* of the Anisoptera, while not really abundant, were always encountered between 2-3 individuals in any pond within the campus complex. *Pantala flavescens*, *Tholymis tillarga* and *Zyxomma obtusum* of the Anisoptera were frequently observed within the garden habitat, yet they seem segregated in term of their active time; the first two species were more active during midday to

noon, while the later one got active during the afternoon. On the other hand, all species from genera *Neurothemis* and *Orthetrum* were observed existing in association with anthropogenic area and human settlement.

The implication of photographic approach for Odonata research

Benefits

There are several benefits from using photographic approach in studying Odonata, which prospect needs to be more elaborated for future use. Rough estimation of the population on certain species, habitat preference and occurrence were quantitatively estimated from the innate metadata of the photos taken for each species. Combined with detail record from field note, we can describe some biological aspects of a species, as well as lay the baseline knowledge for more future studies in various aspects on Odonata. The damselflies from Chlorocyphidae and Euphaidae of Zygoptera, along with dragonfly *Trithemis festiva* (Libellulidae: Anisoptera), were only found in the clean, nonpolluted and rocky stream. Two damselflies *Copera marginata* and *C. ciliata* were observed once, similar to two species of Libellulidae *Camacinia gigantea* and *Tramea transmarina*; it may signify the rarity of these species in Unand's Limau Manis campus complex and signals the needs for further study on them. *Agrionoptera insignis* (Libellulidae) was spotted only from one garden on campus, thus it is interesting to learn habitat conditions that this species requires. What learned from the existence of dragonflies and damselflies in Unand's Limau Manis campus complex should be able to contribute to the future development of the campus. In addition, species photographs produced from this study are excellent media for community awareness program to improve the communal knowledge on the diversity and importance of dragonflies and their habitats.

Limitation

Despite the prospect of using photographic approach for surveying dragonflies, there are few shortcomings that need careful consideration. The lack of research on Sumatran dragonflies and therefore the publication resulted from it, has created a gap of knowledge on biological aspects of local species. This situation also implies to the inadequate reference resource which can be used to identify Sumatran dragonflies. As the identification using sources used for other regions, we definitely exclude local variation and other typicality which may exist within the

local population. Species polymorphism, sexual dimorphism and other morphological variation which frequently happened in insects (1), unless corroborated by well-studied references, cannot be determined from photo specimens only. This situation can be resolved mainly by using molecular study, where the specimens should be collected from regarded taxa. Another shortage of this approach is the unattainable price of photographic equipment which may not affordable for some people, the delicateness of photographic apparatus under field condition, as well as the sophisticated photography techniques, which may not be manageable by any people and resulting in poor quality of and unidentifiable pictures.

CONCLUSION

This study has identified 27 species of dragonflies and damselflies from four families of Zygoptera (Chlorocyphidae, Euphaidae, Platycnemididae, and Coenagrionidae) and four families of Anisoptera (Aeshnidae, Gomphidae, Micromiidae, and Libellulidae). Libellulidae was family with most members observed in this research. Information pertained in this study has proven, to some extent, the reliability of photographic approach for inventory of the dragonfly diversity. The photographs resulted also serve as flexible media for species identification and clarification, without having any specimen collected.

ACKNOWLEDGEMENT

Gratitude is given to Rory Dow and Ahmad Zulfikar for their assistance in identifying species; the author thanks Aadrean for his great input and suggestion during manuscript revision; the author acknowledges the members of KCA-LH Rafflesia FMIPA Unand for their help during surveys in KTO and HPPB sites; as well as to Program Bantuan Seminar Nasional, Unand for financial assistance in attending SEMIRATA BKS-PTN Wilayah Barat Bidang MIPA 2018, where the material from this paper presented.

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Appendix 1. Representatives of Zygoptera



Heliochypa fenestrata ♂ (Chlorochypidae)



Libellago lineata ♀ (Chlorochypidae)



Euphaea variegata ♂ (Euphaidae)



Prodasineura collaris ♂ (Platynemididae)



Coperra marginipes ♂ (Platynemididae)



Agriocnemis femina ♂ (Platynemididae)

Appendix 2. Representatives of Anisoptera



Gynacantha dohrni ♀ (Aeshnidae)



Ictinogomphus decorates ♂ (Gomphidae)



Diplacodes trivialis ♀ (Libellulidae)



Agrionoptera insignis ♂ (Libellulidae)



Neurothemis terminata ♂ (Libellulidae)



Zyxomma obtusum ♀ (Libellulidae)