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Artículo científico
(Original paper)**VARIATION OF THE RAINFALL REGIME IN THE NORTHERN REGION AND ITS EFFECT ON THE ODONATA (INSECTA) IN BEEN RIVER, AMAZONAS, BRAZIL****VARIACIÓN DEL RÉGIMEN DE PRECIPITACIONES EN LA REGIÓN NORTE Y SU EFECTO SOBRE ODONATOS (INSECTA) EN EL RÍO BEEN, AMAZONAS, BRASIL****JOAO ANDERSON FULAN^{1*}, MARCELO RODRIGUES DOS ANJOS²**¹Universidade Federal do Amazonas, Instituto de Ciências Biológicas, Departamento de Biologia, Instituto de Ciências Biológicas. Av. General Rodrigo Octavio, 6200 - Coroado I - CEP: 69080-900 - Manaus, Amazonas, Brazil.
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Fulan, J. A., Anjos, M. R. (2019) Variation of the rainfall regime in the Northern region and its effect on the Odonata (Insecta) in Been river, Amazonas, Brazil. *Acta Zoológica Mexicana (nueva serie)*, 35, 1–6. <https://doi.org/10.21829/azm.2019.3502219>

ABSTRACT. The goal of this work was to know the effect of precipitation in four periods (Rising, Flood, Lowing and Dry) on Odonata larvae living near to the macrophyte *Salvinia auriculata* Aubl., in Been River, Amazonas, Brazil. The biological material was collected in the Been river in the section near the river Madeira, state of Amazonas, Brazil. Sampling was conducted in stands of three macrophytes *S. auriculata* in four periods: rising (November 2012), flood (February 2013), lowing (May 2013), and dry (August 2013). A total of 286 Odonata larvae were identified in the river studied. Six families and 14 genera were identified. The flood period showed the highest abundance in the studied period. *Acanthagrion* presented a positive correlation with flood period in axis 1 and *Telebasis* also positive, but in the dry period. In conclusion, although there are few studies on Odonata larvae associated with floating macrophytes in the Amazon, the results of this work showed the importance of knowing the distribution of larval abundance throughout the year. Flood and dry period showed to be the period with the highest abundance of Odonata genera. In addition, the principal component analysis showed that some species are more sensitive to the periods of the year, *Telebasis* in the dry period and *Acanthagrion* in the flood period.

Key words: Damselflies; macrophyte; Zygoptera; Coenagrionidae

Fulan, J. A., Anjos, M. R. (2019) Variación del régimen de precipitaciones en la región norte y su efecto sobre Odonatos (Insecta) en el río Been, Amazonas, Brasil. *Acta Zoológica Mexicana (nueva serie)*, 35, 1–6. <https://doi.org/10.21829/azm.2019.3502219>

RESUMEN. El objetivo de este trabajo fue conocer el efecto de la precipitación en cuatro períodos (aumento, inundación, baja y sequía) en las larvas de Odonata que viven cerca del macrófito *Salvinia*



auriculata Aubl., en el río Been, Amazonas, Brasil. El material biológico se recolectó en el río Been en la sección cerca del río Madeira, estado de Amazonas, Brasil. El muestreo se realizó en rodales de tres macrófitos en cuatro períodos: en aumento (noviembre de 2012), inundación (febrero de 2013), baja (mayo de 2013) y Seca (agosto de 2013). Se identificaron un total de 286 larvas de Odonata en el río estudiado. Se identificaron seis familias y 14 géneros. El período de inundación mostró la mayor densidad en el período estudiado. *Acanthagrion* presentó una correlación positiva con el período de inundación en el eje 1 y *Telebasis* también positivo, pero en el período seco. En conclusión, aunque hay pocos estudios sobre larvas de Odonata asociadas con macrófitos flotantes en la Amazonia, los resultados de este trabajo mostraron la importancia de conocer la distribución de la densidad larvaria a lo largo del año. El período de inundación y seco mostró ser el período con la mayor densidad de los géneros Odonata. Además, el análisis de componentes principales mostró que algunas especies son más sensibles a los períodos del año, *Telebasis* en el período seco y *Acanthagrion* en el período de inundación.

Palabras clave: Damselflies; macrófito; Zygoptera; Coenagrionidae

INTRODUCTION

Floods result from rainfall events and shows effects on the biotic component rivers as macrophytes and invertebrates (Robinson & Uehlinger, 2003; Downes & Street, 2005). Abundance of invertebrates can be reduced by 70–95% (Brooks & Boulton, 1991; Giller *et al.*, 1991). Invertebrates as Odonata actively move river margins during floods (Scrimgeour *et al.*, 1988; Rempel *et al.*, 1999).

Macrophytes are negatively impacted by precipitation (Westwood *et al.*, 2006). Presence of macrophytes is generally related to the characteristics of the resistance and resilience of aquatic plants to hydrologic disturbances of flood and drought (Pedro *et al.*, 2006). Consequently, macroinvertebrates living near macrophytes as Odonata larvae are directly affected by hydrologic regimes (Corbet, 1999; Hofmann & Mason, 2005).

Odonate larvae occupy a high variety of freshwater environments such as rivers and lakes (Merritt & Cummings, 1996; Pires *et al.*, 2013). Littoral zone is the site where Odonate larvae are registered more frequently, mainly close to macrophytes such as *Salvinia auriculata* Aubl. Odonata larvae use macrophytes as shelter against their main amphibian and fish predators. In addition, aquatic plants offer a high abundance of food resources to Odonate larvae such as oligochaetes, chironomid, mayflies, tadpoles and other preys.

It is evident that precipitation negatively affects macrophytes such as *S. auriculata* decreasing their abundance. This macrophyte in turn provides shelter for Odonata which can also be affected by precipitation. The goal of this work was to know the effect of precipitation in four periods (Rising, Flood, Lowing and Dry) on Odonata larvae living near to the macrophyte *S. ariculata* in Been River, Amazonas, Brazil. The Been river was chosen due to the presence of the macrophyte studied throughout the year allowing the study.

MATERIAL AND METHODS

The biological material was collected in the Been river in the section near the river Madeira, state of Amazonas, Brazil (Fig. 1). Sampling was conducted in stands of three macrophytes *S. auriculata* in four periods: rising (November 2012), flood (February 2013), lowing (May 2013), and dry (August 2013) in the site (7° 32' 39" S; 63° 01' 09" W). All samples were taken with hand sieves (mesh = 0.5 mm) carefully placed below the macrophytes. The specimens collected were fixed and preserved in 70% ethyl alcohol.



Odonata larvae were identified to genus level, using specialized keys (Carvalho & Calil, 2000; Costa *et al.*, 2004; Neiss, 2012).

Canonical Correspondence Analysis CCA was performed in the PAST 3.25 (free software). Canonical Correspondence Analysis was used to analyze the relationship between species abundance and periods: rising (November 2012), flood (February 2013), lowing (May 2013), and dry (August 2013). The level of significance (5%) was established.

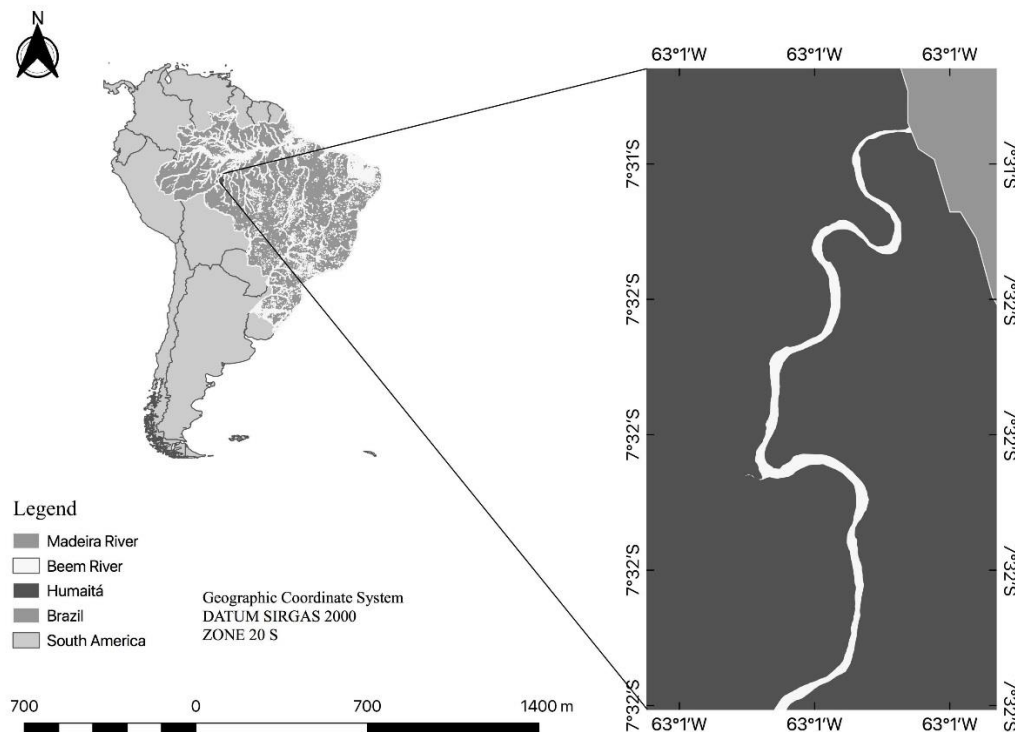


Figure 1. Rio Been near the river Madeira, state of Amazonas, Brazil.

RESULTS

A total of 286 Odonata larvae were identified in the river studied. Six families and 14 Odonata genera were identified (Table 1). The flood period showed the highest abundance in the studied period (336 ind.m⁻²). The lowing period presented the lowest abundance (171 ind.m⁻²).

The first two axes of the CCA explained 87.8% of the total variation (axis 1= 51.9%; axis 2= 35.9%). The CCA showed that *Acanthagrion* and *Telebasis*. *Acanthagrion* presented a positive correlation with flood period and *Telebasis* also positive however dry period.

DISCUSSION

In this study, only two genera of Odonata, *Acanthagrion* and *Telebasis* showed a significant difference between their densities and the studied periods: rising, flood, lowing, and dry. *Acanthagrion* and *Telebasis* are suborder Coenagrionidae (Zygoptera). Coenagrionidae is characterized by small animals of 20 to 45 mm

and short body and abdomen. Generally, the males show more intense colors than the females and they are distinguished of the other families for presenting a pigmented spot near the end of the wings (Lencioni, 2006). Coenagrionidae is the family with the greatest number of genera and species in the Neotropical region (Kalkman *et al.*, 2008). In the Been river Coenagrionidae was the family that presented the greater number of genera (six).

Table 1. Mean abundance (ind.m⁻²) of the Odonata genera identified in the Been River in the four periods studied.

Taxa	Rising	Flood	Lowng	Dry
ZYGOPTERA				
Calopterygidae				
<i>Hetaerina</i> Hagen in Selys, 1853	7	0	7	11
Lestidae				
<i>Lestes</i> Leach in Brewster, 1815	4	25	11	11
Coenagrionidae				
<i>Acanthagrion</i> Selys, 1876	21	89	25	32
<i>Argia</i> Rambur, 1842	14	18	21	18
<i>Enallagma</i> Calvert, 1902	50	14	4	14
<i>Homeura</i> Selys, 1876	7	14	11	11
<i>Ischnura</i> Charpentier, 1840	4	0	4	29
<i>Telebasis</i> Selys, 1865	32	7	29	82
ANISOPTERA				
Aeshnidae				
<i>Coryphaeschna</i> Williamson, 1903	11	11	7	25
Gomphidae				
<i>Aphylla</i> Selys, 1854	7	7	11	18
<i>Cacoides</i> Cowley, 1934	4	18	7	11
<i>Phyllocycla</i> Calvert, 1948	4	32	7	11
Libellulidae				
<i>Erythrodiplex</i> Brauer, 1868	14	61	14	11
<i>Orthemis</i> Hagen, 1861	4	39	14	11
TOTAL	182	336	171	293

The principal component analysis showed that *Telebasis* was positively correlated with dry period. A higher abundance of *Telebasis* in the dry period was previously recorded in the southeastern region of Brazil in floating macrophytes (Fulan & Henry, 2007). Unfortunately, studies on fauna associated with macrophytes are not very frequent in Brazil. However, it is possible that there is some correlation between *Telebasis* and the dry period, because in two different studies and in different regions of Brazil (North and Southeast) the result was similar. Robinson & Frye (1986) observed in a *Telebasis* species a behavior of females to lay their eggs inside the stem of floating macrophytes. It is possible that a similar survival strategy could favor the increase of the *Telebasis* abundance in the months of lower precipitation, i.e., the dry period. Unlike *Telebasis*, *Acanthagrion* was positively correlated with flood period. *Acanthagrion* currently has 39 species distributed in the southern United States to central Argentina (Garrison *et al.*, 2010). Species are small to medium size and are characterized by wings generally hyaline (Lozano & Anjos-Santos, 2012). Corbet (1999) pointed out that few species have the ability to fly during the rainy season. However, according to author, some species of *Acanthagrion* showed high capacity to fly even during the rain. In Suriname these species are known locally as "rain dragonfly". In Brazil, *Oxystigma petiolatum* also have the ability to fly during the rain. It is possible that behavioral characteristics such as flying ability in the rainy season may have resulted in a higher abundance of *Acanthagrion* larvae mainly in the flood period.



CONCLUSION

In conclusion, although there are few studies on Odonata larvae associated with floating macrophytes in the Amazon, the results of this work showed the importance of knowing the distribution of larval abundance throughout the year. Flood and dry period showed to be the period with the highest abundance of Odonata genera. In addition, the CCA showed that some species are more sensitive to the periods of the year, *Telebasis* in the dry period and *Acanthagrion* in the flood period. The results of this work are only preliminary and non-conclusive, additional and more detailed studies are necessary mainly identifying the species that are associated with the macrophytes and not only the genus. However, this work may encourage new researchers in the search for knowledge of the Amazonian Odonata species.

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