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First record of *Lopescladius* Oliveira, 1967 (Chironomidae: Orthocladiinae) in the Piranhas-Açu River basin, Brazil, with ecological notes on its habitat use

Rafaela Lima de Farias[1,2], **Thuanny Fernanda Braga Alencar**[1] and **Elvio S.F. Medeiros**[1*]

1 Grupo Ecologia de Rios do Semiárido, Centro de Ciências Biológicas e Sociais Aplicadas, Universidade Estadual da Paraíba – UEPB, Rua Horácio Trajano, s/n, CEP 58070-450, João Pessoa, PB, Brazil
2 Programa de Pós-Graduação em Ciências Biológicas, Universidade Federal da Paraíba – UFPB, Centro de Ciências Exatas e da Natureza, Jardim Cidade Universitária, CEP 58059-900, João Pessoa, PB, Brazil
* Corresponding author. E-mail: elviomedeiros@uepb.edu.br

Abstract: The present study describes a new site of occurrence for the genus *Lopescladius* in Brazil and reports the first record for the Piranhas-Açu River basin, in the state of Rio Grande do Norte, northeastern Brazil. This new occurrence expands the distribution of the genus and adds to the knowledge of the chironomid fauna. The presence of this genus in an intermittent stream highlights the importance of future research on this type of aquatic system as well as ecological aspects related to *Lopescladius*.

Key words: new occurrence, Chironomidae, habitat preference, intermittent stream

The family Chironomidae (Diptera) is a widely distributed taxon, occurring on all zoogeographical regions of the world (Ashe *et al.* 1987). Amongst the eleven subfamilies of Chironomidae, five have been recorded in Brazil: Chironominae, Orthocladiinae, Podonominae, Tanypodinae and Telmatogetoninae (Trivinho-Strixino and Strixino 2011); they are represented by 392 species and 136 genera (Mendes and Pinho 2014). In intermittent streams of semi-arid Brazil, three subfamilies (Chironominae, Tanypodinae, Orthocladiinae) with approximately 26 genera have been recorded. The subfamily Orthocladiinae is poorly represented with only three genera (Farias *et al.* 2012; Rocha *et al.* 2012; Soares *et al.* 2013).

Orthocladiinae larvae are ordinarily small to medium-sized organisms, between 10 and 12 mm long. The genus *Lopescladius* Oliveira, 1967 (Orthocladiinae) (Figure 1) is characterized by the presence of long antennae, with elongated and whip-like fourth segments. The mentum has nine scarcely pronounced teeth. The terminal portion of the body is characterized by short procerci located at the tip of a projection of the abdominal segment and long posterior pseudopods (Trivinho-Strixino and Strixino 2011). The feeding habit of *Lopescladius* is diverse, being classified as scraper, shredder, gatherer, predator or miner (Trivinho-Strixino and Strixino 2011). The genus is composed of species inhabiting lotic and lentic freshwaters in mostly sandy substrate (Higuti and Taketa 2002; Silva *et al.* 2008; Lisboa *et al.* 2011; Trivinho-Strixino and Strixino 2011).

Lopescladius was first described by Oliveira (1967) based on *Lopescladius minutissimus* Oliveira, 1967 originally found in the Amazon region of Brazil. With the review of the genus by Sæther (2004), three other species were described based on the pupae. In Brazil, the species *Lopescladius fittkaui* (Sæther, 1983), *L. minutissimus* (Oliveira, 1967), *L. morosus*, *L. uncatus* and *L. vibrissatus* (Hagenlund *et al.* 2010) have been recorded (Mendes and Pinho 2014). *Lopescladius* is widely distributed in several regions of Brazil, including most of the country's southern and southeastern states (Minas Gerais, Rio de

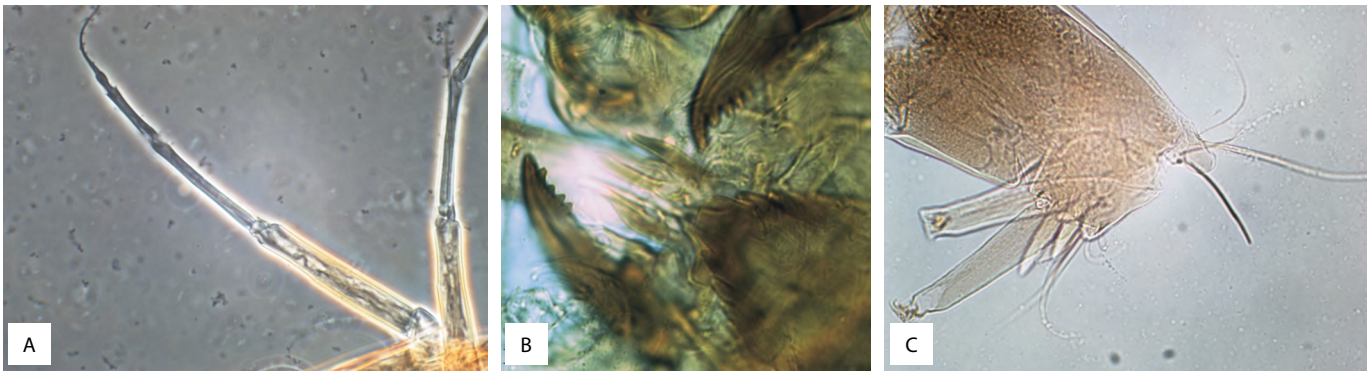

Figure 1. Morphological features that characterize the genus *Lopescladius*: Antennae (**A**), mentum and mandible (**B**) and posterior pseudopods (**C**).

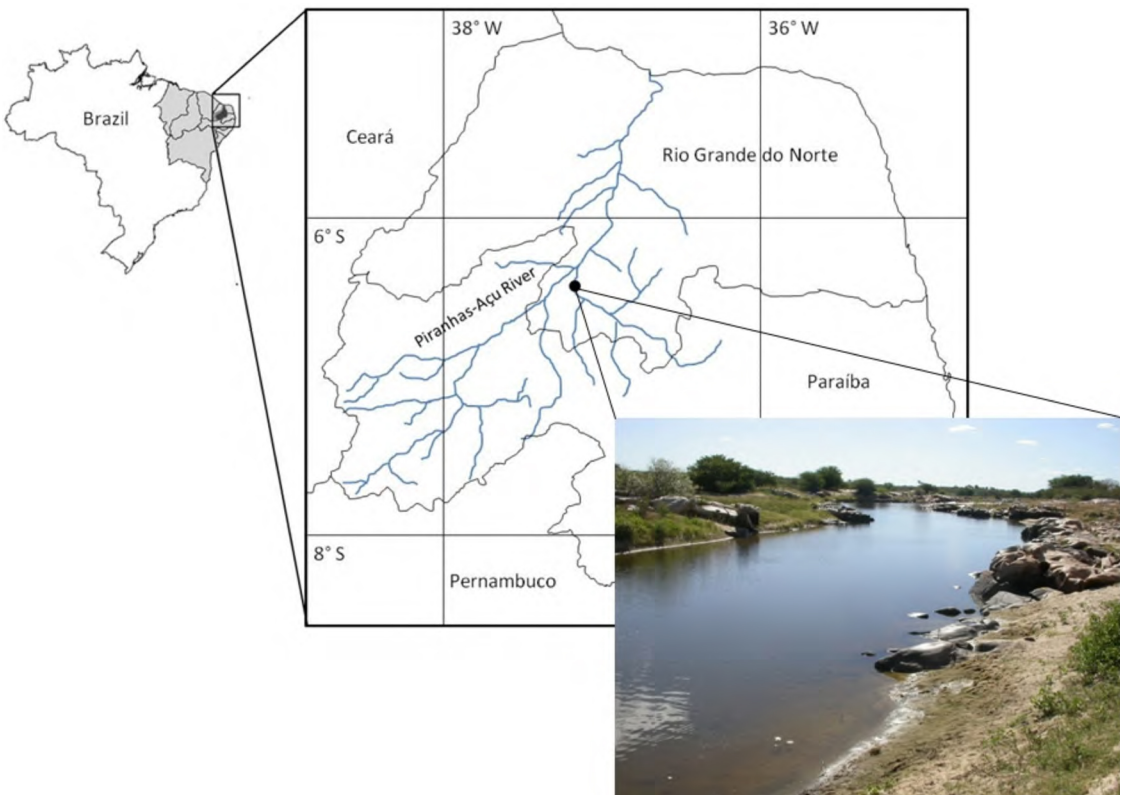

Figure 2. Site of occurrence of *Lopescladius* in the Piranhas-Açu river basin and in the state of Rio Grande do Norte.

Janeiro, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul) (Sanseverino *et al.* 1998; Henriques-Oliveira *et al.* 2003; Roque 2005; Anselmini 2007; Resende and Taketa 2007; Corbi and Trivinho-Strixino 2008; Sanseverino and Nessimian 2008; Lara 2011; Lisboa *et al.* 2011; Rosa *et al.* 2011; Sensolo *et al.* 2012; Rosa *et al.* 2013; Salvarrey *et al.* 2014; Saulino *et al.* 2014) and a few of the central and northern states (such as Mato Grosso do Sul, Amazonas and Pará) (Hagenlund *et al.* 2010; Rosin *et al.* 2010; Mendes and Pinho 2014). In the northeastern Brazil, this genus has been reported in the states of Alagoas and Piaui (Freitas 2004; Soares *et al.* 2013).

The present study reports a new site of occurrence for *Lopescladius* in Brazil, the first for the Piranhas-Açu River basin (with the new reference site for the genus in state of Rio Grande do Norte), which extends its geographic distribution and expands the knowledge of the habitat use for the genus.

This work expands the distribution of *Lopescladius* for the state of Rio Grande do Norte, in the Northeast region of the country (Figure 2). The site is located in the Seridó River (06°18′21.9″ S, 037°10′43.8″ W), an intermittent river in southern Rio Grande do Norte, a tributary within the Piranhas-Açu River system. In the study area, the mean annual air temperature is 30.7°C, with the maximum average in October (31.0°C) and minimum in February (29.3°C) (Melo 2008). Average annual precipitation is 600 mm, and is concentrated between January and April. Altitude ranges between 100 and 800 m above sea level (Medeiros *et al.* 2008).

Sampling of Chironomidae larvae was performed using a D-shaped net (40 cm wide and 250 µm mesh) during the wet season (July) of the 2007 hydrological cycle. Individuals were fixed in 10% formalin and preserved in 70% ethanol. Identification was based on individuals mounted into semi-permanent slides using Hoyer´s medium (Trivinho-Strixino and Strixino 2011). Identified specimens are deposited in the reference collection of the Laboratório de Ecologia, Universidade Estadual da Paraíba. Environmental variables measured at the study site consisted of river morphometry, water quality data, and the habitat structure (underwater structures and substrate composition). Physical and chemical variables were measured using portable equipment for pH (TECNOPON MPA-210), conductivity (µS/cm) (TECNOPON MCS-150), dissolved oxygen (mg/L), and temperature (°C) (Lutron DO-5510). Water transparency was measured using a secchi disk and velocity using the float method (Maitland 1990). Habitat structure was quantified as the proportional (%) cover on the margins according to Medeiros *et al.* (2008).

In the present study, five specimens of *Lopescladius* were collected (among a subsample of 371 individuals) and identified to the level of genus. Even though identification to the level of species is desirable in taxonomic studies, we highlight that many orders of insects will occur in aquatic systems only during their larval, pupae or nymph stages and it is not possible to have the information of first occurrences in advance to allow the capture of live individuals for posterior identification of the adult stages. Studies for intermittent streams of Brazil, often report large numbers of Chironomidae (Farias *et al.* 2012; Rocha *et al.* 2012; Carvalho *et al.* 2013), with average densities reaching thousands of individuals per square meter (refer to the studies cited above for information on sampling effort and design). This makes *Lopescladius* an inconspicuous taxon in intermittent streams of Brazil, occurring in low densities, which is corroborated by the few studies that cite this genera to northeastern Brazil (Freitas 2004; Soares *et al.* 2013). This is aggravated by the fact that aquatic larvae of this taxon are small and can be overlooked during sorting or not collected by standard methods (Farias *et al. in press*). Therefore, the presence of this genus in highly variable

systems like the one studied represents an opportunity to infer about its habitat use and distribution in intermittent streams. Additionally, the fact that the site where the specimens were found is a natural temporary pool has important implications on the conservation for the genus and other inconspicuous taxa of Chironomidae, because patterns of dispersion of the adults will be affected by the duration of pools and connectivity with neighboring pools. These patterns of distribution will be associated to the fact that these temporary pools dry out and do not necessarily return to their previous state (regarding to morphology and environmental variables), being therefore frequently altered by flooding of varying magnitudes, intensities and frequencies. This makes our new information on *Lopescladius* unique in the sense that it captures the presence of the genus and its surrounding habitat conditions in a changing environment.

Furthermore, the distribution of Chironomidae and other benthic invertebrates is influenced by environmental variables such as substrate composition, water flow, dissolved oxygen and depth (Townsend *et al.* 1997; Olsen *et al.* 2001; Soares *et al.* 2013). Also important are the water temperature and presence of aquatic macrophytes (Nessimian and Sanseverino 1998). Environmental information (Table 1) shows that the larvae of *Lopescladius* were present in slowly flowing and slightly alkaline waters, and at relatively slant river banks with sandy substrate. Taxa of the *Harnischia* complex and *Lopescladius* are known for inhabiting sandy lotic environments (Sanseverino and Nessimian 2001), such as in the present study. However, the presence of rocks, gravel, and cobbles and deeper areas must be noted and is likely to enhance the spatial segregation of the genus to sandy patches, contributing to the overall spatial segregation in Chironomidae reported for Brazilian intermittent streams (Farias *et al.* 2012; Carvalho *et al.* 2013). Overall, underwater structures usually abundant in Brazilian semi-arid intermittent streams, such as littoral grass, woody debris, and macrophytes (Medeiros *et al.* 2008; Carvalho *et al.* 2013), were either not present or present in low proportions during the sampling for the present study. Furthermore, dissolved oxygen concentration and conductivity were low, compared to other sites in intermittent streams, whereas transparency was high (*e.g.,* Farias *et al.* 2012; Carvalho *et al.* 2013). Temperatures typically do not fluctuate greatly in Brazilian semi-arid streams (Farias *et al.* 2012).

Table 1. Environmental variables and habitat structure data measured in July (wet season) at the site of occurrence of the *Lopescladius* larvae.

Morphometry	
Bank slope	30–60°
Altitude (m)	116.0
Width (m)	18.6
Average depth (cm, ± SD)	113.0 (31.9)
Maximum Depth (cm)	142
Average Marginal Depth (cm, ± SD)	56.4 (23.5)
Maximum Marginal Depth (cm)	94
Physical and chemical variables	
Water velocity (m/s)	0.13
Temperature (°C)	26.8
Conductivity (µS/cm)	370.0
Dissolved Oxygen (mg/L)	3.7
Transparency (cm)	139.5
pH	8.0
Substrate composition (%)	
Mud	0.25
Sand	73.50
Gravel	6.25
Cobbles	5.00
Rocks	15.00
Habitat structure (%)	
Macrophyte	0.25
Leaf litter	0.25
Algae	2.50
Woody debris	0.42

Macrophytes were present in low proportion in the present study. This is unexpected, since the presence of submerged vegetation, has previously been generally associated with the presence of *Lopescladius* (Sensolo *et al.* 2012). The vegetation provides substrate and is an important factor for the colonization of some taxa (Sponseller *et al.* 2001; Benstead *et al.* 2003). This enables a more structured fauna, with the presence of less pollution-tolerant groups, such as *Lopescladius* (Henriques-Oliveira *et al.* 1999).

Lopescladius characteristically inhabits sandy sediments deposited in areas of low flow (Henriques-Oliveira *et al.* 1999). Thus, we believe that the sandy substrate associated with the low flow were the main factors leading to the presence of *Lopescladius* in the study site. It is important to note that the environmental characteristics reported represent the hydrological cycle studied, and even though variables such as temperature and dissolved oxygen tend to fluctuate within some limits (Medeiros *et al.* 2008), the presence of underwater structures, pool morphology and, to some degree, substrate composition tend to vary greatly according to the intensity of water flow in a given hydrological cycle. Such variability is very likely to be affecting the distribution of *Lopescladius* and contributing to the low abundance of the genus recorded in the present study.

Despite that, few studies were performed on the habitat preferences of *Lopescladius* on freshwaters of Brazil (Lisboa *et al.* 2011). Given that fact, and taking into consideration the catchment area of the Piranhas-Açu River basin, the overall environmental conditions of this system and where the individuals were recorded, it is likely that this genus also occurs in other tributaries of the Piranhas-Açu and Seridó rivers, that flow through the state of Paraíba. Overall, the occurrence of an inconspicuous Chironomidae taxon in a temporary pool in a highly variable dry land river system raises important ecological questions on the structure and functioning of such biological communities. Given the context of high hydrological uncertainties and stress, the evaluation of less abundant and widespread taxa becomes of chief concern for the understanding of these systems as a whole and the knowledge on Chironomidae in intermittent streams.

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