ECOLOGY, BEHAVIOR AND BIONOMICS

Sponge-Dwelling Chironomids in the Upper Paraná River (Brazil): Little Known but Potentially Threatened Species

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Chironomidae Habitantes de Esponjas de Água Doce no Alto Rio Paraná (Brasil): Espécies pouco Conhecidas, mas Potencialmente Ameaçadas

RESUMO - Neste estudo é apresentada uma lista de espécies de Chironomidae habitantes de esponjas de água doce coletados no Alto Rio Paraná e é chamada a atenção para o problema de substituição de grandes áreas cobertas por esponjas de água doce por bancos da espécie invasora *Limnoperma fortunei* (mexilhão dourado). Também é descrita uma nova espécie de *Oukuriella* com base em adulto macho e feita uma descrição informal de uma larva de Chironomidae que provavelmente pertence ao complexo *Stenochironomus*.

PALAVRAS-CHAVE: *Oukuriella,* complexo *Stenochironomus*, *Limnoperna fortunei,* Região Neotropical

ABSTRACT - In this paper, we provide a checklist of chironomids living in freshwater sponges in the upper Paraná River (Brazil) and we call attention to the problem of complete substitution of extensive areas covered by freshwater sponges by banks of the invasive alien species *Limnoperna fortunei* (golden mussel). We describe a new species of *Oukuriella* based on male adults and also describe an unusual larva of Chironomidae that probably belongs to the *Stenochironomus* complex.

KEY WORDS: *Oukuriella, Stenochironomus* complex, *Limnoperna fortunei,* Neotropical region

Threats to insect diversity are often synergistic and have severe repercussions. Threats include habitat loss, fragmentation, invasive alien organisms, environmental contamination, biological control and global climate change (Samways 2007).

Loss of aquatic insect biodiversity has been expected to occur, but cases have been documented quantitatively only recently. Among the aquatic insects expected to be lost as a result of anthropogenic impacts are those groups that tend to have complex life cycles, low dispersal capability, specific environmental requirements, restricted areas of occurrence, and specific hosts (Samways 2005). One of these groups of insects is the chironomids that live in freshwater sponges in the Neotropical region (Roque 2006).

Freshwater sponges have been included among red-listed animals in Brazil (e.g. MMA, Instrução Normativa nº 5, 21 May 2004). According to Volkmer-Ribeiro (1981), some sponge habitats in Brazilian aquatic ecosystems are subject to strong anthropogenic impacts (e.g. by sedimentation), which gives urgency to carrying out further studies. Information on the sponges and their associated fauna should be included in a broad strategy for conservation.

In early 2000 we started a study with the purpose of reporting chironomid freshwater sponge relationships in Brazilian aquatic ecosystems. The study has resulted in the description of new species and ecological relationships (Roque & Trivinho-Strixino 2005; Roque *et al*. 2004, 2007). Prior to this study, in 1999, we collected three undescribed species of chironomids in the upper Paraná River: one *Xenochironomus,* two *Oukuriella* and one Chironomini sp. At that time, we observed that some areas on the bottom of Paraná River (Jupiá, SP/MS) and Tietê River (Itapura, SP) were covered by complex communities of freshwater sponges identified as *Oncosclera navicela* Carter; *Corvospongilla seckti* Bonetto and Ezcurra de Drago; *Drulia uruguayensis* Bonetto and Ezcurra de Drago; *Trochospongilla repens* Hinde and *Uruguaya corallioides* Bowerbank. Since then we have described *Xenochironomus ceciliae* Roque & Trivinho-Strixino, 2005 and have looked for additional material in an effort to obtain associations of all stages of the remaining chironomid taxa (samplings in 2002, 2005). However, in fieldwork carried out in August 2007 we were surprised by the complete substitution of extensive areas covered by freshwater sponges by banks of the invasive alien species of golden mussel - *Limnoperna fortunei* Dunker. Concerning the possibility of chironomid diversity loss we consider that this material needs to be described, even in the absence of all stages. Here, a new species of *Oukuriella* is described, an informal description is provided for a new species of Chironomini, and some guidelines for developing a conservation strategy are discussed.

Materials and Methods

We looked for freshwater sponges in the Paraná River by scuba-diving at depths ranging from 0.5 m to 35 m. We searched for sponges in several potential substrates, such as decaying wood, rocks, and macrophytes. In all expeditions two professional scuba-divers explored the rivers for at least 1h. When found, the sponges were taken to the laboratory and, when possible, they were kept in an oxygenated aquarium in order to rear the chironomid larvae to obtain adults. The larvae were sorted using a stereomicroscope, mounted on slides and identified to the lowest taxonomic level possible given the limited knowledge of the Neotropical fauna in this group. Four criteria were used to analyze the ecological relation between the chironomids and the freshwater sponges: 1) gut content, 2) morphology of the larvae, 3) the occurrence of the larvae inside the sponges, and 4) the restricted occurrence of larvae in sponges. In this paper we report and describe only those chironomids that fit all these criteria.

Slides were mounted using Euparal. Terminology and abbreviations used in the descriptions follow Sæther (1980). Larval head capsule size is given as the "ventral head length" from the tip of the mentum to the postoccipital margin. This measure is less susceptible to deformation during slide mounting than is any 'total' length. All measurements are given as ranges, the smallest measurement followed by the largest. Color is described based on uncleared mounted material. The material used in the description is deposited in the Museu de Zoologia of the Universidade de São Paulo (MZUSP).

Results

Based on the above criteria, four chironomid taxa showed characteristics that allow us to identify them as insects that are obligate dwellers in freshwater sponges:

Xenochironomus ceciliae Roque & Trivinho-Strixino, 2005

X. ceciliae larvae are the most frequent chironomid in sponges in the Upper Paraná River. Analyses of larval morphology and gut contents show that their larvae are probable collector-filterers and they can be favored by the aquifer system of the sponges. More information about the species can be found in Roque & Trivinho-Strixino (2005).

Oukuriella antonioi sp. n. (Figs. 1-12)

Type material. Holotype: ♂ imago: BRAZIL, Paraná River (20°48'S, 51°40'W), border between São Paulo and Mato Grosso do Sul states, 09.vii.2002, leg. F. O. Roque. Paratypes: one ♂ imago, same data as holotype.

Etymology. Named in honor of Antonio Melhado, an enthusiastic scuba-diver, who has contributed much to the studies on freshwater sponges of the upper Paraná River.

Diagnosis. Males of *Oukuriella antonioi* sp. n. are similar to those of *Oukuriella epleri,* but can be distinguished by the presence of only one setal tuft on the anterior portion of T II-VII, superior volsella broad with digitus longer than upper arm and absence of a setal tuft on the anterior part of scutum.

Male (n = 2, except when otherwise stated).
Total length about 3.98-5.14 mm. Wing 2.6 mm long and 0.62-0.72 mm wide. Color: Head yellowish-brown, and antennae brownish. Abdomen yellowish-brown with dark brown marks. Legs with brownish rings on basal 3/5 and apex of femur, base and apex of tibia.
Head. AR 1.54. Apical flagellomere 880 µm long. Temporals 6. Clypeus with 32 setae. Length of palp segments 1-5 (in µm): 63; 100; 155; 193; 240.
Thorax. Antepronotal lobes reduced, separated medially, each lobe with five lateral setae. Setal tuft on scutum absent.
Wing. (Fig. 1) VR 1.26-1.27. Brachiolum without setae. R with 8-15; R_1 with 13; R_{4+5} with 6-9, remaining veins bare. Squama bare. With markings in cells r_{4+5}, m_{1+2}, m_{3+4}, and cu.
Legs. (Figs. 10-12) Lengths (in µm) and proportions of legs as in Table 1. Tibial spur lengths (in µm) (Figs. 7-9): front 50; middle 70, hind 70-88.
Abdomen. T I without setal tufts (Fig. 6). One setal tuft on anterior portion of T II-VII (Fig. 5). S VIII with a proximal circular mound bearing a cluster of 38 setae. Paratergites I-VIII each with seven pairs of setae.
Hypopygium (Figs. 2-3). Posterior margin of TIX with seven setae and well developed median notch. Gonostylus slender. Superior volsella 75-85 µm long with 16 sensilla chaetica near bend of upper arm (Fig. 4). Inferior volsella 125-138 µm long with 10 dorsal sensilla chaetica, and two ventral sensila chaetica. Phallapodeme 88-93, transverse sternapodeme 53-83 µm long. HR 1.03-1.06.

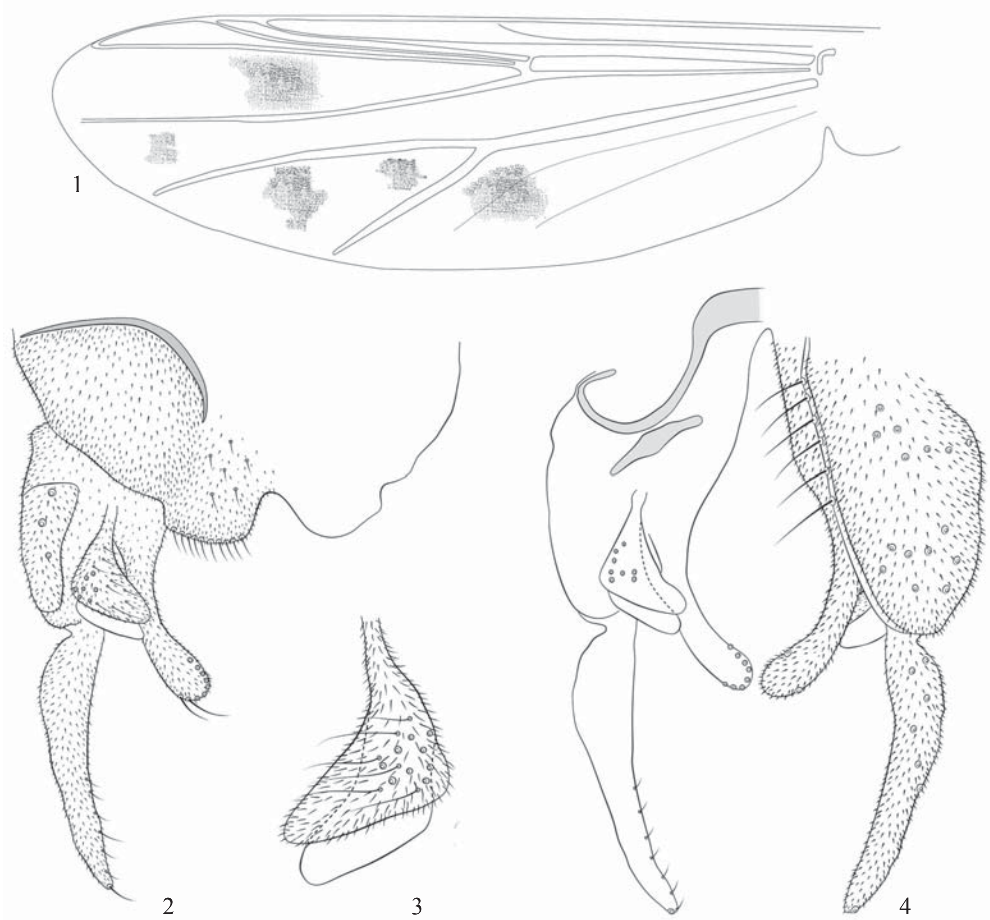
Oukuriella sp. 1 (Messias, 1998, informal description)

Table 1. Lengths (in µm) and proportions of legs of *Oukuriella antonioi* sp. n., males (n = 2).

	fe	ti	ta_1	ta_2	LR
P1	1400	640	-	-	-
P2	1380	980	-	-	-
P3	1620-1420	840-980	620	420	0.44

Material analyzed. One imago: BRAZIL, Paraná River (20°48'S, 51°40'W), border between São Paulo and Mato Grosso do Sul states, 09.vii.2002, leg. F. O. Roque.

In a recent study Roque *et al*. (2004) described the occurrence of *Oukuriella* larvae living in freshwater sponges,



Figs. 1-4. *Oukuriella antonioi* sp. n. male: 1, wing; 2, hypopygium dorsal aspects; 3, detail of superior volsella, dorsal view; 4, hypopygium with tergite IX removed, left ventral aspect, right dorsal aspect.

showing that at least three species are involved, two in sponges from the Paraná River and one (*Oukuriella epleri* Messias and Fittkau, 1997) in sponges from the Amazon River Basin. Up to the present date, all *Oukuriella* species found in freshwater sponges are members of the third group, according to the classification of Messias *et al*. 2000, which have wings with markings and setal tufts on the abdominal segments. When dissecting the intestines of *Oukuriella* larvae, we always find them filled with soft tissues and hard needles of sponges, indicating that these larvae may eat sponge tissue.

Oukuriella sp. 1 corresponds to the species informally described by Messias (1998) in her Ph.D thesis. According to Messias (1998) the new species will be described in a future paper. *Oukuriella* sp. 1 can be distinguished from all described *Oukuriella* species by the posterior margin of IX with concave shape and a setal patch on each side, presence of one setal tuft on abdominal segments and wings without markings.

Chironomini sp. 1 – *Stenochironomus* complex (Figs. 13-17)

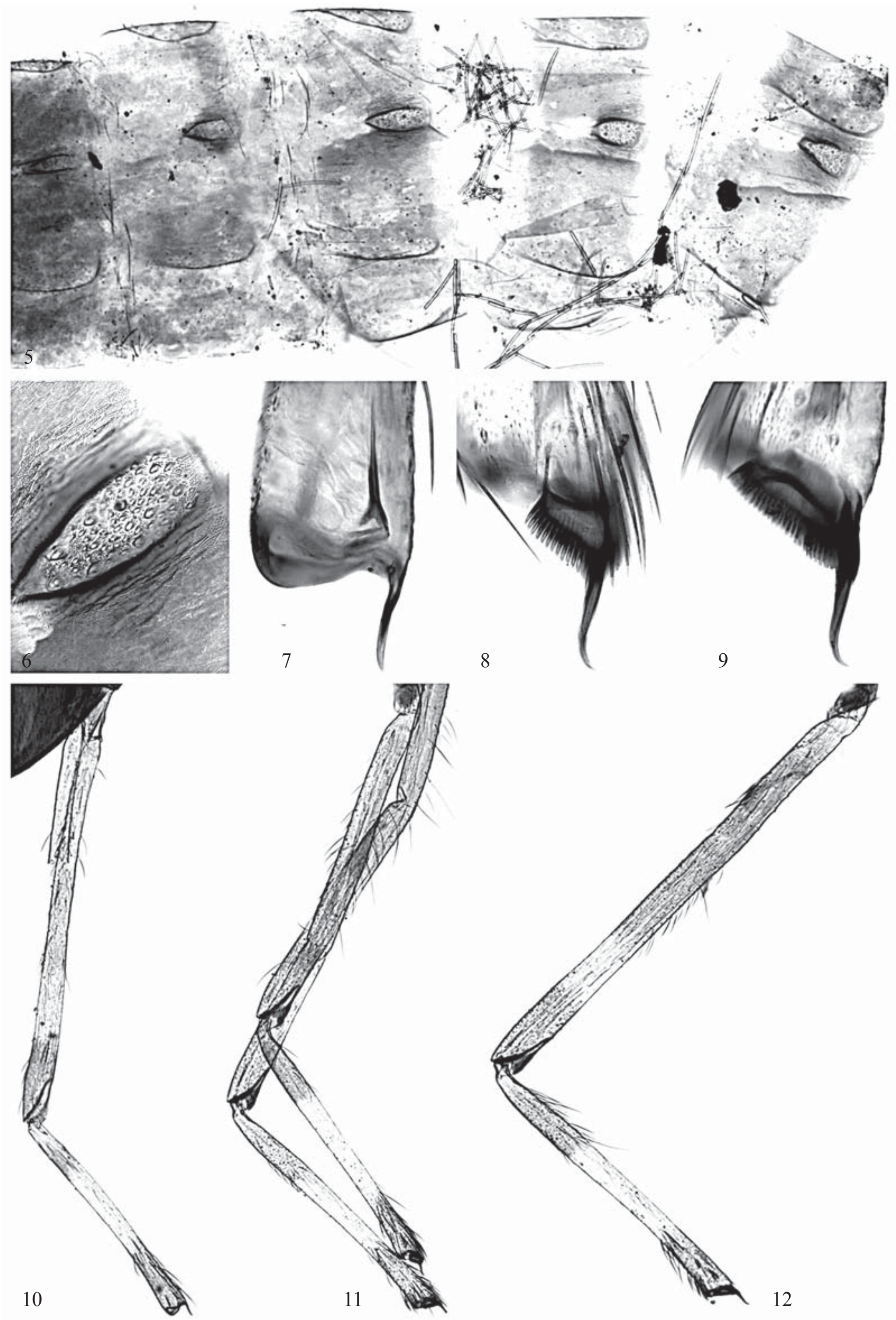
Material analyzed. Three larvae: BRAZIL, Paraná River (20°48'S, 51°40'W), border between São Paulo and Mato Grosso do Sul states, 09.vii.2002, leg. F. O. Roque and T. Siqueira

Larva (n = 3, except when otherwise stated).

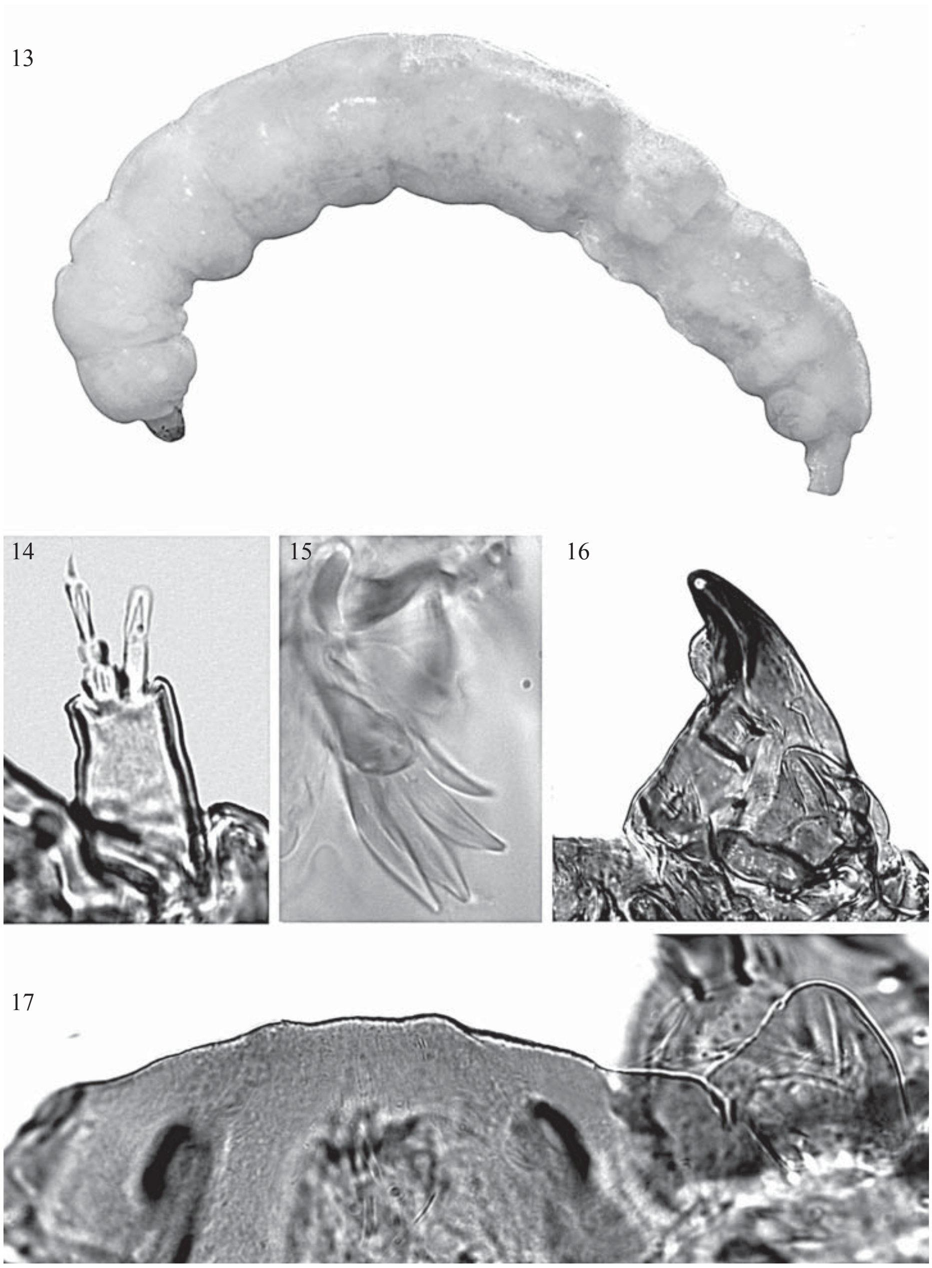
Total length 3.60-5.04 mm (Fig. 13). Head capsule 0.34-0.41 (2) mm long.

Head. Antenna as in Fig. 14; lengths of antennal segments (in µm): 27.5-35; 7,5; 2.5-4; 10; 2.5. Blade 15-20 µm long. Premandible 32.5-35 (2) µm long (Fig. 15). Mandible 97.5-105 µm long, with one large inner tooth (Fig. 16). Mentum 42.5-55 µm wide. Ventromental plates without striation (Fig.17).

Abdomen. Procercus with about 2-4 filaments. Anal tubule 124.8-670.8 (3) µm long with one setae on the middle portion.



Figs. 5-12. *Oukuriella antonioi* sp. n. male: 5, setal tufts on abdominal tergites II-VII; 6, setal tuft; 7-9, spurs of fore, middle and hind legs; 10, femur and tibia of fore leg; 11, femur and tibia of middle leg; 12, femur and tibia of hind leg.



Figs. 13-17. Chironomini sp. 1 larva: 13, body; 14, antenna; 15, premandible; 16, mandible; 17, mentum.

The larvae cannot readily be placed in any described genus. However, the ventromental plates are lacking striation, suggesting that they may belong to the *Stenochironomus* complex (see Borkent 1984). The larvae can be easily distinguished from all other chironomid larvae by the shape of mentum, the few small hooks on anterior parapods and a unique anal tubule that seems to be an apomorphy related to a sponge mining habit. The larvae are very fat and resemble the larvae of some Lepidoptera.

They mine sponge tissues. The larvae remain alive for only a few minutes after being taken out of a sponge. Attempts to rear larvae in the sponge were not successful.

Comments on Conservation of Chironomid-Sponge Associations in the upper Paraná River

The golden mussel (*L. fortunei*) has undergone a remarkable geographical expansion and has attained extremely high population densities of in some areas of Paraná River since this invasive species was first reported in early 2000 (Boltovskoy *et al*. 2006). The negative effects on industrial and power plants have been widely documented due to its economic impacts (Boltovskoy *et al*. 2006).

Although we have no quantitative data on the direct effects of *Limnoperna* or its synergetic effects with water pollution on freshwater sponge communities and their associated fauna, we believe that our narrative, based on our field experience, photographs and interviews with five local scuba divers, provide an important source of information. In contrast to the evidences presented by Darrigran *et al*. (1998) indicating positive impacts of *Limnoperna* on the diversity and abundance of most other benthic organisms in the Paraguay River, our observation suggests that, at least for highly specialized chironomids that depend on the conservation of their hosts, the effects appear to be negative.

According to Samways (2007), there are six basic principles that are interrelated and together provide guidelines for synthetic conservation management of insects at the landscape level. The principles are to maintain reserves, maintain as much quality landscape heterogeneity as possible, reduce contrast between remnant patches and neighboring disturbed patches, outside reserves, introduce land sparing, simulate natural conditions and disturbance, and connect similar patches of quality habitat. In the case of chironomids sponge associations all principles should be applied. In addition, we should immediately focus our attention on mechanisms to avoid new human-mediated dispersion.

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