Zootaxa 3911 (3): 381–395
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3911.3.5
http://zoobank.org/urn:lsid:zoobank.org:pub:4E11C1AB-2614-4C4A-809D-EF7C5BE959D9

New species of Limnephilidae (Insecta: Trichoptera) from Europe: Alps and Pyrenees as harbours of unknown biodiversity

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Abstract

New species are described from the genera *Consorophylax* and *Anisogamus* (Trichoptera, Limnephilidae, Limnephilinae, Stenophylacini). Additionally the larva of the genus *Anisogamus*, and the larval stages of *Anisogamus waringeri* **sp. nov.** and *A. difformis* (McLachlan 1867) are described. The new species *Consorophylax vinconi* **sp. nov.** is a microendemic from the Southern Alps and differs from its congeners in the shape of the parameres, which are distinctly straitened in the distal quarter in the new species. The new species *Anisogamus waringeri* **sp. nov.** represents the second species in the hitherto monospecific genus *Anisogamus*. Compared to *Anisogamus difformis*, the male of *A. waringeri* **sp. nov.** has more-slender superior appendages; a more-rounded basal plate of the intermediate appendages, lacking pointed protuberances; and parameres shorter than the aedaegus, proximally with one dorsal and several ventral tines. Further, the two species are disjunctly distributed in the European mountain ranges (*A. difformis*: Alps, *A. waringeri* **sp. nov.**: Pyrenees). Larvae of species in the genus *Anisogamus* are characterized by the lack of a dorsal protuberance on abdominal segment I, a unique feature among Eurasian Limnephilidae. *Anisogamus difformis* and *A. waringeri* **sp. nov.** larvae differ in pronotum shape. The discovery of two new species demonstrates the significance of taxonomic studies in Europe, and the importance of adequate training for young scientists in order to assess an incompletely described biodiversity under threat of extinction.

Key words: endemism, species description, *Consorophylax*, *Anisogamus*, caddisflies

Introduction

Both the Alps and the Pyrenees are centres of biodiversity in Europe. Particularly patterns of plant, vertebrate and terrestrial invertebrate diversity in European alpine ecosystems have been extensively studied (e.g., Wohlgemuth 2002; Nagy *et al.* 2003; Iserbyt *et al.* 2008; Huemer 2011). Increasingly, aquatic invertebrates (and EPT-taxa in particular) have become the focus of attention in both the Alps and the Pyrenees (e.g., Sipahiler 1999, 2000; Graf 2005; Graf *et al.* 2008a; Malicky 2004, 2008; Brown *et al.* 2009). The genus *Consorophylax* Schmid 1955 currently comprises seven cold-stenotherm species (Malicky 2004, 2008). Larvae of the genus prefer crenal to epirhithral segments of alpine to montane springs and brooks, and mainly behave as shredders (Graf *et al.* 2008b). *Consorophylax* species show a complex distribution pattern, with several microendemics and two widespread species inhabiting the majority of the Alpine arc. In particular, the southern slopes of the Alps can be identified as centres of species richness in the genus, as microendemics have been found exclusively on the southern slopes of both the Western and Eastern Alps (Kimmins & Botosaneanu 1967; Graf *et al.* 2008b).

The genus *Anisogamus* McLachlan 1874 is currently represented by a single species, *A. difformis* (McLachlan 1867). The species is known predominantly from the Alps, but has also been recorded in the Pyrenees. As the larva was hitherto not described, ecological parameters of adult collection points indicated a cold-stenotherm species

Accepted by J. Morse: 11 Dec. 2014; published: 20 Jan. 2015

TABLE 1. Inter- and intraspecific genetic distances of two mitochondrial cytochrome oxidase I (mtCOI) gene fragments recorded for *Anisogamus* species. Values below diagonal in second and third columns indicate number of nucleotide differences and above diagonal uncorrected pairwise distances (*p*) (shown as percents), respectively. Abbreviations are used to denote life stages; IM/M = adult male, L = larva.

Species	Stage	Specimen codes	mtCOI "barcode"		
			Andiff01	Ansp01	fAns0101L
Anisogamus difformis	IM/M	Andiff01		8.2	8.2
Anisogamus waringeri	IM/M	Ansp01	54		0.2
Anisogamus waringeri	L	fAns0101L	54	1	

TABLE 1. (Continued)

Species	mtCOI "S20-Jerry"			GenBank Access. No.	
	Andiff01	Ansp01	fAns0101L	"barcode"	"S20-Jerry"
Anisogamus difformis		9.6	9.6	KP174661	KP174658
Anisogamus waringeri	52		0	KP174662	KP174659
Anisogamus waringeri	52	0		KP174663	KP174660

Distribution & biogeography of *Anisogamus* species. The genus *Anisogamus* was established by McLachlan in 1874 based on the species *A. difformis*, and its type locality is situated in the Eastern Alps (Austria, Carinthia, Saualpe, Stelzing (Kimmins 1949)). Collated distribution data for *A. difformis* suggest a panalpine presence of the species (Fig. 3D).

Specimens of *A. waringeri* were collected at the Col de Jou, Mont Canigou, Pyrenées-Orientales, France. At a location close by, Décamps (1967) found putative *A. difformis* to be present (but very rare) in the valley of the Neste d'Aure at 1600 m a.s.l. and in the tributaries of the Têt river at 1100 m a.s.l. Specimens of *A. waringeri* **sp. nov.** were collected in the watershed of the Têt river, whereas the Neste d'Aure is some 125 km west of the recent collection points. Menéndez & González (2009) recorded *A. difformis* from the eastern Prepyrenees (Girona, Setcades), some 20 km south of the type locality of *A. waringeri* **sp. nov.**, and were re-identified by M. A. González as *A. waringeri* **sp. nov.** (pers. comm. M. A. González). From the same area, *Stenophylax nurianus* was described by Navás (1917), illustrating a specimen similar to the genus *Anisogamus*, but the type specimen is lost (pers. comm. M. A. González), and the description and the figure itself do not allow certain identification. Further, this species was proposed by Schmid (1949) to be a synonym of *A. difformis*, based on his own collection and identification of 2 putative *A. difformis* specimens. Thus, we consider *Stenophylax nurianus* a *nomen dubium* in concordance with Malicky (2005), justifying the description of *A. waringeri* **sp. nov.** We further conclude that *A. waringeri* **sp. nov.** is the single representative of the genus *Anisogamus* in the Pyrenees.

Acknowledgements

The authors are most grateful to Gilles Vinçon for his valuable material. Wolfgang Lechthaler, Vienna, provided outstanding photographs of larval characters. Füsün Sipahiler, Ankara, is thanked for valuable comments on the manuscript. WG acknowledges support of the BioFresh EU project-Biodiversity of Freshwater Ecosystems: Status, Trends, Pressures and Conservation Priorities (contract No. 226874); WG and SV acknowledge support of the Austrian Science Fund (FWF) (project number P23687-B17); AP acknowledges support of the University of Zagreb (PI: I. Ternjej, project number 202310). The authors thank Carmen Zamora-Muñoz, Marcos A. González, and John C. Morse for their vigilant reviews that significantly improved the quality of the manuscript.

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