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Rediscovery of *Stactobia eatoniella* McLachlan, 1880 (Trichoptera, Hydroptilidae) in Switzerland after more than seventy years

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Abstract

A specimen of *Stactobia eatoniella*, a hygropetric species of micro-caddisfly considered extinct in Switzerland, was discovered in the Morge in Valais in March 2020 during routine monitoring. This last instar larva in perfect condition is the first to be observed in Switzerland since 1944. Further research in the study area is needed to confirm the presence of a possible well-established population. This encouraging discovery should not hide the fact that two thirds of the micro-caddisfly species are on the Red List of threatened species of Switzerland, and that hygropetric habitats are both under-studied and highly endangered in Switzerland and worldwide.

Key Words

caddisfly, benthic macroinvertebrates, crenic habitats, petrimadicolous, stream, survey

Introduction

The Swiss fauna includes 302 species of caddisflies (Lubini et al. 2012), 33 of which belong to the family Hydroptilidae (info fauna 2021). This family, whose members are commonly known as micro-caddisflies, is the most diverse in the world with more than 2000 valid species (Morse 2011) and is widely distributed globally (Waringer and Graf 2011), although diversity is highest in warm tropical regions (de Moor and Ivanov 2008). At the Swiss level, too, it accounts for a significant part of the diversity of caddisflies, being the second richest family in genera and species after Limnephilidae (Lubini-Ferlin and Vicentini 2005). Hydroptilidae are very small (1.5 to 6 mm; Marshall 1978), with a unique larval development in caddisflies, called "hypermetamorphosis": the first four stages, tiny and without case, are very different morphologically from the last (fifth) instar, characterized by an enlarged abdomen and the presence of a silken case (Tachet et al. 2006; Waringer and Graf 2011). It is during this last stage that the larvae accumulate in their abdomen most of the food reserves necessary for the future adult stage (Marshall 1978).

The genus *Stactobia* McLachlan, 1880 currently consists of 168 species, 41 of which are in the Western Palearctic (Morse 2020). Three are reported from Switzerland: *Stactobia eatoniella* McLachlan, 1880, *Stactobia furcata* Moselyi, 1930 and *Stactobia moselyi* Kimmins, 1949. *Stactobia* larvae live exclusively in hygropetric (petrimadicolous) environments (Graf et al. 2004; Graf 2014), i.e. in rocky areas with a constant and uninterrupted flow of a thin film of water, such as margins of stream courses, spring seepage areas or spray zones around waterfalls or rapids (Coineau and Jacquemart 1961; Malicky 2014). In hygropetric habitats of Europe, they are among the most common and abundant caddisflies (Vaillant 1951, 1984). As grazers, they feed on the film of algae and lichens that covers the substrate (Coineau and Jacquemart 1961). Their case does not have marked lateral flattening like most other genera of Hydroptilidae (Tachet et al. 2006). Adults remain in the immediate vicinity of hygropetric habitats, directly on the water film or on the surrounding

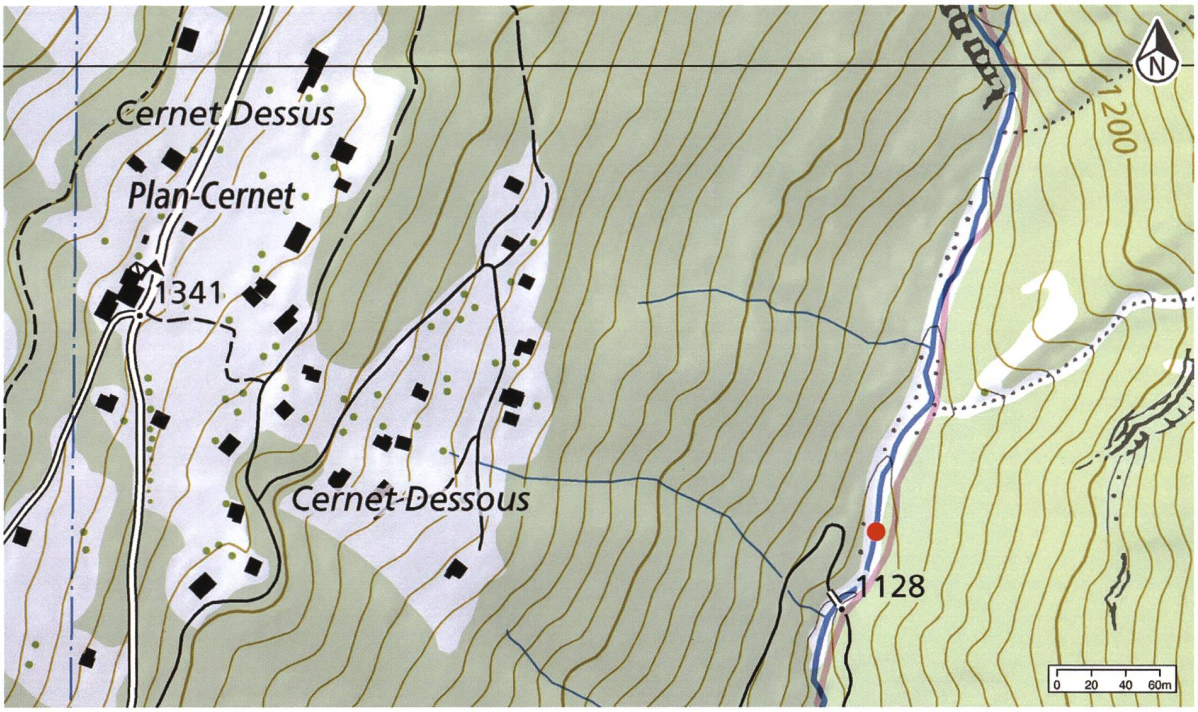

Figure 1. Location of the sampling site MOR 10.2 in the Morge (red symbol). Map generated in map.geo.admin.ch, scale 1: 2'500 (swisstopo, public.geo.admin.ch) and adapted in Photoshop CS5 (Adobe Systems, San Jose, CA).

dry areas (Coineau and Jacquemart 1961), no more than a meter away (Malicky 2014). Flying very little, they run quickly (Schmid 1959), hop (Waringer and Graf 2011) or make short circular flights over the substrate during the hottest hours of the day (Lodovici and Valle 2013).

Before the rediscovery of *S. eatoniella* reported here, eight observations between 1888 and 1944 were officially recorded in Switzerland (info fauna 2021): one in Zürich, one in gorges de l'Orbe, and six in Canton du Valais (in Val d'Illiez, Val d'Hérens, Crans and Binntal). The last official observation dates back to 27.07.1944 around Les Haudères in Val d'Hérens. The species was considered as extinct in Switzerland (category RE; Lubini et al. 2012) and is included in the Swiss List of National Priority Species and Habitats (high degree of priority; OFEV 2019a). Besides Switzerland, the species is recorded in France (Coppa and Tachet 2020), Italy (Lodovici and Valle 2013), Spain (González and Menendez 2011), Austria (Graf et al. 2017), Germany (Robert 2004) and Slovenia (Urbanič 2004). The species is also reported from Slovakia (Stloukal 2001) and Hungary (Vadadi-Fulop et al. 2007), but these observations are not mentioned in recent synthesis works (see Neu et al. 2018). The development cycle of *S. eatoniella* is univoltine (one generation per year; Waringer and Graf 2011). Adults are black with white markings (Schmid 1959) and are observed from June to August. About seventy red-orange eggs are deposited in empty pupal cases. The first larval instars appear in mid-June, and the last instar larvae can be found in August. Pupation takes place from May to June of the following year (Danecker 1961). Observations of the other two *Stactobia* species reported from Switzerland are as rare as for *S. eatoniella*: *S. furcata*, reported only from Canton Ticino, was not assessed in the Red List due to lack of sufficient data (category data deficient); *S. moselyi* is considered endangered (category EN), with a medium degree of priority (Lubini et al. 2012; OFEV 2019a).

Materials and methods

As part of the surface water quality monitoring of the Canton du Valais, the "Service de l'environnement" (SEN) commissioned the consultancy office "biol conseils" to conduct samplings of benthic macroinvertebrates in the Morge catchment using the Swiss biotic index (IBCH method; Stucki 2010; OFEV 2019b). These samplings were coupled with other analyses (physico-chemistry, flow measurement, diatom studies). Five sites were sampled in spring 2020 at altitudes between 480 (at the mouth of the Morge in the Rhone River) and 1480 masl. For each site, eight samples were taken from eight different substrates. These samples, consisting of benthic macroinvertebrates and various mineral and organic debris (composite samples), were combined into one sample per site and fixed with 100% ethanol. In the laboratory, the samples were sieved and benthic macrofauna was sorted out and identified to family level under a stereo microscope following the IBCH method.

Results

One last instar larva of *S. eatoniella* was found at the site located below the place called Cernet Dessous (Morge, site code MOR 10.2, Cernet, site coordinates 46°17'30.924"N, 7°19'46.046"E, 1125 masl, 18.03.2020; Figs 1, 2 and 4). The data was transmitted to info fauna,

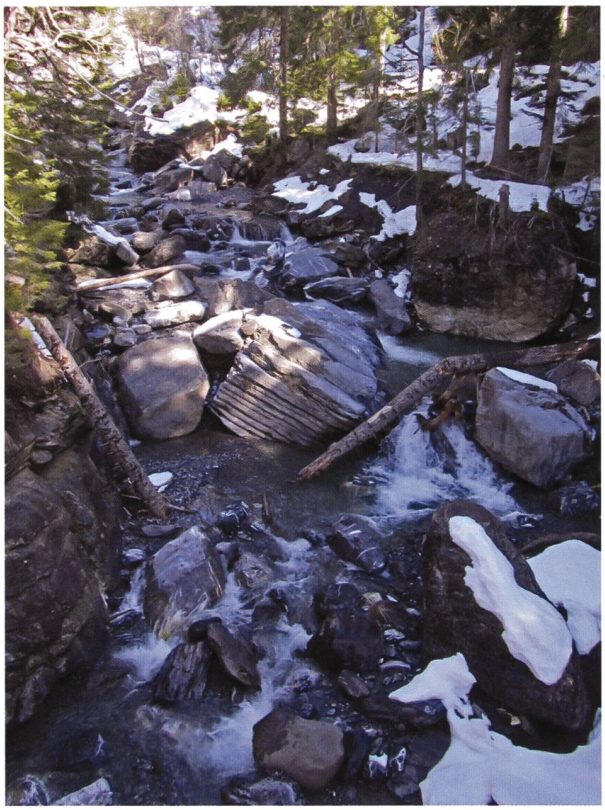

Figure 2. View (downstream) of the sampling site on 18.03.2020.

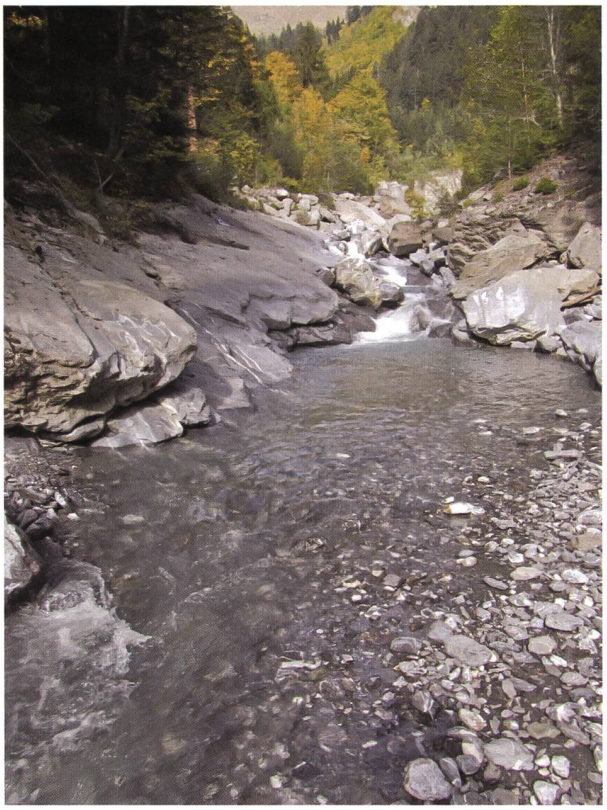

Figure 3. View (upstream) of the sampling site on 13.10.2020.

and the specimen was deposited at the Museum of Zoology in Lausanne (GBIFCH0082987) according to the official archiving procedure (available at www.cscf.ch/cscf/home/projekte/makrozoobenthos/sammlung-und-archivierung.html).

Discussion

The sampling site is situated in a deeply incised section of the Morge, accessible by a logging road. It is regularly subject to active water erosion which destabilizes the stream banks. The stream bed is made up of very large boulders, or even locally stone slabs, as well as sand and gravel on the stream banks (Figs 2 and 3). The bed incision forms steep banks, into which water seeps. The slope of the bed is around 12% on this section. All samples were taken from the wetted bottom (water depth between 15 and 25 cm), with flow velocities ranging from 75 cm/s to less than 5 cm/s (almost stagnant environment). Two mobile blocks, two organic litters, pebbles, gravel, sand and silt, and the top of one block were sampled. These environments do not correspond to the description of the microhabitat in which *S. eatoniella* usually lives. Moreover, all other investigations at the Cernet site of which we are aware, including a second survey on 13.10.2020 (Fig. 3), did not reveal any additional specimen. These observations suggest that the discovered specimen might have been dislocated from its original habitat (e.g. lateral seeps, films of water on the slabs or boulders wetted by spray from small waterfalls), and drifted to the river bed. It would be necessary to investigate more specifically the lateral wetlands and seepages to more precisely locate a possible well-established population. However, caution should be exercised in this type of research, to ensure that the investigations do not harm a population that would undoubtedly be fragile if it consists of a very small number of individuals.

More than half (51%) of the 302 assessed species of caddisflies are on the Red List of threatened species of Switzerland (Lubini et al. 2012), of which 21% have a high or very high national priority status (OFEV 2017). Within the family Hydroptilidae, this percentage is even higher (67% of the species on the Red List; 36% with high or very high national priority status). The main explanation for this alarming finding is an incomplete knowledge of the distribution of Hydroptilidae species, which contributes to a bias in the evaluation criteria. In fact, knowledge of their ecology is often lacking (Komzák and Kroča 2018), and the small size of these species and the difficulty in identifying larvae to species level results in neglecting them in general, as no adults are collected during monitoring projects or other routine studies (Urbanič 2004; Komzák and Kroča 2018). This is particularly true for *Stactobia* species, whose tiny size (ca. 2 mm for larvae) leaves them unnoticed by non-specialists (Coineau and Jacquemart 1961; Graf 2014). Moreover, the nature of hygropetric environments, which generally escape standardized sampling within the framework of routine monitoring, implies a distribution of species into small,

Figure 4. Discovered specimen (last instar larva) of *Stactobia eatoniella*. The larva and its case are shown in lateral (top), dorsal (bottom left), and ventral (bottom right) view. Figure adapted in Photoshop CS5 from photographs taken with a Canon 65 mm MP-E lens mounted on a Canon EOS 6D camera integrated in an LK lab imaging system (Dun, Inc., Virginia).

isolated populations (Schmid 1959). A second explanation invokes the extreme threats on freshwater ecosystems, both globally (e.g. Abell 2002; Dudgeon 2006; Reid et al. 2019) and in Switzerland (e.g. Kunz et al. 2016; Doppler et al. 2017). Crenic (spring-fed) ecosystems are emblematic examples of this reality. These habitats, which are in sharp decline in Switzerland (Zollhöfer 1997) mainly due to massive spring capture and drainage

(Küry 2009), are rich in specialized species and are home to numerous species of caddisflies (22% of European species; Hering et al. 2009). More than 30% of the red-listed Hydroptilidae species in Switzerland are closely linked to springs, including *S. eatoniella*, which colonizes spring brooks in particular (Lubini et al. 2012; Malicky 2014). These two considerations clearly illustrate, on the one hand, the lack of attention paid to Hydroptilidae in general, and to hygropetric habitats in particular, and, on the other hand, the importance of protecting our freshwater aquatic environments. At the Swiss level, the inventory of the ecological value of springs, which has been carried out or is in progress in several cantons (Küry et al. 2019), is an important step in this direction. Eventually, this inventory should make it possible to fill some of the gaps in our faunistic knowledge, while highlighting the crenic habitats to be protected as a priority, including the many hygropetric environments that depend on them.

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