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# First record of *Stenopelmus rufinasus* GYLLENHAL, 1835 (Coleoptera: Curculionidae) from Poland

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**ABSTRACT**. *Stenopelmus rufinasus*, a North American weevil introduced to Europe along with the invasive aquatic fern *Azolla filiculoides*, has been recorded from Poland for the first time. Its locality is a natural oxbow lake of the River Odra in Wrocław, the only city in Poland where *A. filiculoides* has been repeatedly recorded over the last dozen years. The diagnostic characters of this weevil species, its biology, current distribution in Europe and its prospects in Poland are discussed.

**KEY WORDS**: Weevils, Erirhininae, Tanysphyrini, adventive species, *Azolla filiculoides*, new record.

## INTRODUCTION

The monotypic genus *Stenopelmus* SCHOENHERR, 1835 is the type genus of a group of tribal rank, including mainly American and Australo-Pacific genera of weevils predominantly associated with aquatic habitats (ALONSO-ZARAZAGA & LYAL 1999), finally synonymized with the tribe Tanysphyrini GISTEL, 1848 (OBERPRIELER 2014). It belongs to the curculionid subfamily Erirhininae SCHOENHERR, 1825, sometimes regarded as a distinct family (e.g. THOMPSON 1992, CALDARA 2011) or a subgroup of another weevil subfamily Brachycerinae BILLBERG, 1820 (e.g. OBERPRIELER et al. 2007, BOUCHARD et al. 2011, OBERPRIELER 2014) in the still largely unstable phylogenetic systematics of true weevils (Curculionidae s. lato).

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*Stenopelmus rufinasus* GYLLENHAL, 1835 is indigenous to the southern and western USA (O'BRIEN & WIBMER 1982, O'BRIEN & ANDERSON 1996), but it was recorded in Europe as early as the late 19th century, first of all in France, and erroneously described under a different name *Degorsia champenoisi* by BEDEL (1902). Since then the weevil has been recorded in other European countries, e.g. the United Kingdom (JANSON 1921), Germany (MANZEK 1927), Hungary (PODLUSSÁNY 2001), Spain (FERNÁNDEZ CARILLO et al. 2005), Slovakia (STEJSKAL 2012) and Serbia (PEŠIĆ 2014). The current European distribution of *S. rufinasus* was summarized in the Cooperative Catalogue of Palaearctic Coleoptera Curculionoidea (ALONSO-ZARAZAGA et al. 2017), but to this should be added the most recent new record from Israel (FRIEDMAN 2017).

This weevil is biologically associated with aquatic ferns of the genus *Azolla* LAM., primarily with *Azolla filiculoides* LAM., which has become a cosmopolitan and invasive weed all over the world in the 20th and 21st centuries as a result of human activity (RICHERSON & GRIGARICK 1967, HILL 1998, WEBER 2005): this has been decisive for the subsequent expansion of *S. rufinasus* outside North America. While its presence in Europe is the result of unintentional introduction together with the fern over a century ago, the weevil was imported to South Africa, where it was released in 1997 with the intention of controlling the invasive *Azolla filiculoides* (MCCONNACHIE et al. 2003, 2004, HILL et al. 2008, HILL & MCCONNACHIE 2009).

Because of the long-documented occurrence of *S. rufinasus* in Germany (MANZEK 1927), its recent discovery in Slovakia (STEJSKAL 2012), and finally, the well-documented presence of its host plant in Poland (SZCZĘŚNIAK et al. 2009), the weevil has been anticipated in this country. Ultimately, it was discovered in the only area in Poland where *Azolla filiculoides* has been regularly observed in the last ten years.

## RESULTS

### Record

*Stenopelmus rufinasus* was found on a small, natural oxbow lake of the River Odra in the Pilczyce Forest, near the Kozanów housing estate (51.154537N/16.972923E, UTM 10×10 km grid cell XS36). The author sifted a total of 17 overwintering specimens from detritus on the oxbow lake shore on 27th February 2017. The elongated oxbow lake is bordered by a forested floodbank to the south and is currently separated into two parts by a low dike. The shores of both these parts were sampled separately: *S. rufinasus* was present only in the sample taken from the south-eastern corner of the eastern pond (about five metres of the shoreline were sampled).

All the voucher specimens are in the author's collection, which is deposited at the Museum of Natural History, University of Wrocław.

**Morphology**

As *Stenopelmus rufinasus* is not mentioned in the keys for identifying Polish weevils published in the 20th century by SMRECZYŃSKI (1972, 1976), brief diagnostic morphological characteristics of this species are provided below. At first glance, the weevil resembles the ceutorhynchine Phytobiini because of the relatively compact elytra and short, thick rostrum (Fig. 1), possibly also small species of Bagoini, but it is readily distinguishable from both these weevil groups by the following set of external characters.

Body length (rostrum excluded) 1.8-2.3 mm. Integument black except for testaceous distal half of rostrum, antennae and tibiae; tarsi and femora dark brown. Body densely covered with roundish ochraceous and white scales mixed in various proportions, forming a marbled pattern on elytra. Underside of entire body densely and uniformly covered with white to cream scales. Rostrum thick, not more than 1.5× as long as wide and distinctly shorter than pronotum, in dorsal outline slightly narrowed at mid-length, in lateral view narrowed apicad from antennal insertion; apex, besides a pair of dorsal epistomal setae, with a long, protruding seta on each side (Fig. 2). Antennae short, inserted dorsally to rostrum. Scrobes straight, ending below ventral margin of eye, well visible in dorsal view (Fig. 3). Eyes nearly flat. Frons at narrowest point between eyes 0.7 as wide as rostrum base. Pronotum tapering from base to apical margin, with obsolescent subapical constriction, densely punctured, without prescutellar fovea, instead with a short and fine median carina. Mesepimera concealed in dorsal view. Scutellum covered with white scales. Elytra ca. 1.3 times longer than wide, much wider than pronotum, sub-parallelsided on basal two-thirds of length, then broadly rounded, with prominent humeri each associated with a spot of white scales. Legs slender, fairly long; femora unarmed; all tibiae with a thin uncus (Fig. 4); tarsi slender, the 2nd segment distinctly shorter than 1st and 3rd ones, the 3rd segment only slightly wider than the two preceding ones; onychium with long simple claws and a minute median process (empodium?) between them, bearing two long hair-like setae (Fig. 5).

The peculiar structure of the tarsi in *Stenopelmus* beetles seems to be an adaptation to water surface walking, not to swimming. RICHERSON & GRIGARICK (1969) first confirmed the ability of *Stenopelmus* weevils to walk across the water surface film, but they never observed the beetles swimming or crawling beneath the water surface.


**Fig. 1-5.** *Stenopelmus rufinasus*: **1.** habitus (length of beetle 1.9 mm without rostrum). **2.** head, dorsal view; **3.** head, lateral view. **4.** protibia and protarsus; **5.** mesotarsus.

## DISCUSSION

The life history of *Stenopelmus rufinasus* was studied in the laboratory by RICHERSON & GRIGARICK (1967) and HILL (1998). Noteworthy is the very fast larval development, lasting about 7 days at room temperature. Its life cycle, including the time of hatching and the pupal period, takes no longer than about 20 days to complete, which yields 4-6 generations a year under Californian climatic conditions (RICHERSON & GRIGARICK 1967). This is probably the main reason for the spectacular efficiency of *S. rufinasus* in controlling the invasive red water fern, and even completely eradicating its host plant (HILL et al. 2008).

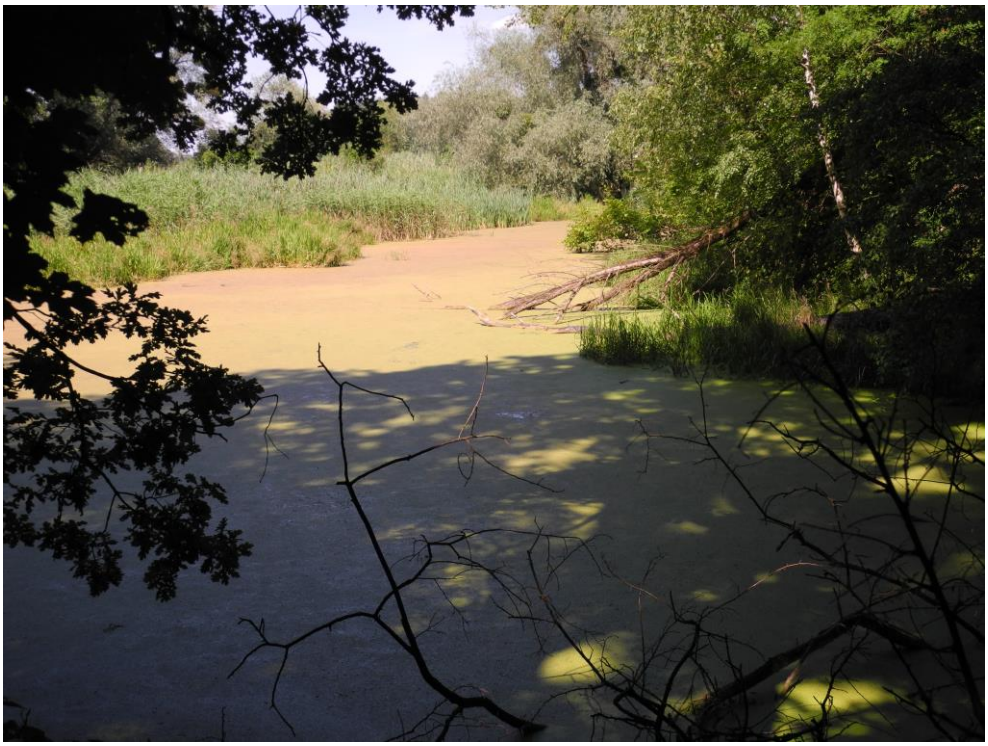

**Fig. 6.** The site of *Stenopelmus rufinasus* in the Pilczyce Forest, Wrocław (photo taken on 18 July 2017).

No *Azolla* was recorded before from the site where *Stenopelmus* was discovered, but as the sifted sample was taken before the growing season, there was no opportunity then to see live ferns. However, the number of beetles collected clearly indicates that this finding was not accidental and the weevil must almost certainly have developed *in situ*. The presence of *Azolla* in this and neighbouring oxbow lakes was finally confirmed in July 2017 (Fig. 6). The occurrence of this fern on another oxbow lake in the Kozanów housing estate, approximately 1.5 km distant from the *Stenopelmus* locality in the Pilczyce Forest, has been documented since 2007, and temporarily in the nearby small pond even as early as 1996 (SZCZĘŚNIAK et al. 2009). As often happens to *Azolla* stands in Wroclaw, the fern has apparently become extinct there in recent years (E. SZCZĘŚNIAK pers. comm.). According to SZCZĘŚNIAK et al. (2009), it was then one of the three localities of the red water fern in Lower Silesia, and also in Poland as a whole. Although its presence in this region was first noticed well before World War II (SCHUBE 1928), and outside Silesia, once in Bielsk Podlaski in north-east Poland (WOŁKOWYCKI 1999), both these records were confined to artificial ponds and were thus ephemeral, like one of the two localities in Wrocław discovered in the 21st century (the fire protection pond in Wilkszyn).

The time and nature of the migration of *Stenopelmus* migration to Wrocław remain unclear. In the countries bordering south-west Poland, *Azolla filiculoides* is a common invasive plant in Germany, but is as yet unknown in Czechia (HUSSNER 2010); in Slovakia it was first found in the western part of the country in 2011 (STEJSKAL 2012). There is a European record of *S. rufinasus* feeding on *Salvinia natans* (L.) ALL. (RHEINHEIMER & HASSLER 2010), an aquatic fern long known and widely distributed in Poland in the basins of the Rivers Vistula and Odra (ZAJĄC & ZAJĄC 2001). The feeding of this weevil on another species of *Salvinia*, *S. minima* BAKER, was confirmed in the USA by PARYS & TEWARI (2015), and its development on another *Azolla* species – *A. pinnata* R. BR. – in Florida was documented by PEMBERTON & BODLE (2009). STEJSKAL (2012) reported large numbers of *S. rufinasus* which had been sifted on the Île d'Oléron (south-west France) by R. SUIKAT, even though *Azolla* does not grow on this island. There are also regular records of single specimens of *S. rufinasus* sifted on the coast of Schleswig-Holstein or at an altitude of 1600 m in France (STEJSKAL 2012). Hence, it is not at all clear that this adventive weevil is a strict monophage of *Azolla filiculoides* in Europe.

The closest recently confirmed sites of *Stenopelmus* are in western and northern Germany (DIECKMANN 1983, ZIEGLER 2017) and western Slovakia (STEJSKAL 2012), all of which are some considerable distance from Wrocław (330-540 km). The first German record by MANZEK (1927) was from the vicinity of Magdeburg, not very far from the western border of Poland (200 km), but some 400 km from Wrocław. According to German botanists, *Azolla filiculoides* had become extinct there before 1960 and the occurrence of *S. rufinasus* in that locality was not confirmed during a search in the 1970s (DIECKMANN

1983). The *Azolla* fern may be passively transported to new localities, primarily by aquatic birds or humans (MOORE 1969). Hence, the associated accidental transportation of *Stenopelmus* larvae or pupal cocoons to new sites cannot be ruled out. However, I consider another possible explanation of the successful long distance dispersal of *Stenopelmus* beetles much more likely, following the opinion of P. SPRICK in STEJSKAL (2012) and resulting from their biology. *Stenopelmus* itself has a strong migration potential, as it is capable of locally producing several generations a season, thus achieving a very large number of individuals (according to HILL et al. (2008) >30 000 adult weevils were reared from 2 $m^2$ of rotting red water fern mat in South Africa), which are forced to seek new *Azolla* stands after the eradication or at least a very significant reduction in the host plant at the end of the season. Field studies in South Africa showed *S. rufinasus* to be capable of very effective short-distance dispersal, enabling it to find most *Azolla* mats within a distance of up to 20 km, but also of long-distance dispersal up to 350 km (MCCONNACHIE et al. 2004, HILL et al. 2008). This is a distance approximating that between Wrocław and the nearest published localities of *S. rufinasus* in Germany and Slovakia; hence, the weevil might well have found the sites of *A. filiculoides* in Wrocław by itself. This is especially likely given the probably very incomplete knowledge of the real distribution of *S. rufinasus* in Germany, where its host plant is common (HUSSLER 2010), and in Poland, where *A. filiculoides* was found in 2007, besides Wrocław, by the River Nysa Łużycka near Koźlice, on the border between Germany and Poland (SZCZĘŚNIAK et al. 2009).

The strong potential of *S. rufinasus* for migration is indirectly confirmed by its frequent and abundant flights to light traps installed many kilometres from any water bodies, which I observed in KwaZulu-Natal province (north RSA) in 2012. It is still not known whether *Stenopelmus* beetles have any sensory adaptations facilitating the active search for water bodies or whether they are just passively carried by winds, successful migration depending simply on the long-distance dispersal of large numbers of these insects. The records from the coasts of the Île d'Oléron and Schleswig-Holstein mentioned by STEJSKAL (2012) favour neither of these two hypotheses.

As regards the European range of *S. rufinasus*, the newly discovered locality in Wrocław appears to be the most northerly one in central Europe (excepting western Germany). Further east it is known only from Slovakia, Hungary, Serbia and Ukraine (CALDARA 2011, ALONSO-ZARAZAGA et al. 2016, 2017). The weevil inhabits more northerly areas of western Europe, including Belgium, Great Britain and Ireland (ALONSO-ZARAZAGA et al. 2017), which have a typically Atlantic climate with mild winters. It thus follows the biological limitations of its host plant, which cannot withstand long, freezing winters (JANES 1998), and is therefore unable to form stable, long-lasting populations in central and eastern Europe; these are either non-existent or at best ephemeral. In Poland the red water fern has the status of a non-established species (HUSSNER 2010) and propagates

only vegetatively (SZCZĘŚNIAK et al. 2009). Its stands in Wrocław are ephemeral, often lasting just one or two seasons regardless of whether the water body is natural or artificial (E. SZCZĘŚNIAK pers. comm.). Severe frosts persisting for several days at least are a regular occurrence here almost every year; *Azolla* can survive such cold spells only if it produced a thick mat during the previous growing season (JANES 1998); but such mats are often removed, either when artificial ponds are cleaned or natural oxbow lakes are flooded (E. SZCZĘŚNIAK pers. comm.). Given this rather precarious position of its host plant in Wrocław, the occurrence of *S. rufinasus* there may well turn out to be ephemeral as well. On the other hand, the activity of *Stenopelmus* may to some extent itself contribute to the instability of the red water fern stands in Wrocław, but this problem requires further study, and above all, a better knowledge of the distribution of *S. rufinasus* and *A. filiculoides* in this city.

## CONCLUSIONS

A weevil species new to the Polish fauna, *Stenopelmus rufinasus*, was found on a natural oxbow lake of the River Odra in Wrocław. It is associated with the red water fern *Azolla filiculoides*. With the exception of two incidental historical records from ephemeral sites, this invasive fern has recently been recorded from Poland only in Lower Silesia, at less than 10 localities during the last 20 years, the great majority from Wrocław (SZCZĘŚNIAK et al. 2009, SZCZĘŚNIAK pers. comm.). Although the localities of this plant are highly ephemeral, persisting for just a few years, new ones are regularly being discovered in Wrocław (SZCZĘŚNIAK pers. comm.). In view of the status of *A. filiculoides* in Wroclaw, the migration of *Stenopelmus* to Poland must have been relatively recent and may well turn out to have been ephemeral. This weevil appears to have the potential to migrate, extending its range at least within south-western Poland, but it is a specialized herbivore, strictly dependent on the migration success of its main host plant.

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