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Hypera temperei Hoffmann, 1958 – first discovery of the western alpine element in the Swiss Alps with biological details, and new morphological insights (Coleoptera, Curculionidae)

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Abstract

Since its description based on a single female from the Maritime Alps in France, no other localities of this enigmatic alpine species have become public. In a scree slope in the Valais at high montane altitude *Hypera temperei* Hoffmann, 1958 was discovered for the first time elsewhere, in Switzerland. The species' biology is unravelled, its habitat is described, and photographs of the male, larvae and pupa are presented. The re-investigation of the species morphology revealed that *Hypera temperei* is closest to *H. postica* (Gyllenhal, 1813), and not to *H. viciae* (Gyllenhal, 1813) as previously supposed. A revision of specimens in collections revealed that *H. temperei* is distributed even more eastern in the alpine Arc in Grisons at high montane to high alpine altitudes. Hence the species shows a considerably wider distribution in the Alps than supposed before.

Key Words

Hyperinae, alpine species, new record, host plant, biology

Introduction

The Swiss weevil fauna (Curculionoidea) comprising 1083 taxa is well explored, with a regularly updated checklist (Germann 2010a, 2011a, 2013a, 2017, 2019). But especially regarding alpine species with restricted distributions, some unexpected and thus surprising discoveries have been made in the past. In the Entiminae, *Otiorhynchus grischunensis* Germann, 2010 was such an unexpected discovery (Germann 2010b, 2012), still only known from four localities in the canton of Grisons. In Cyclominae, *Dichotrachelus sondereggeri* Germann, 2011 from Val Poschiavo is another example, where an investigation of the whole species-complex of *D. augusti* F. Solari, 1946 is likely to result in further discoveries of isolated populations at high alpine altitudes (Germann 2011b; Germann et al. 2017). Or the records of the apionid *Loborhynchapion amethystinum* (Miller, 1857) in the Binntal in Valais by Giusto and Germann (2015), a remarkable species with a distribution from Central Asia

to the Alps, with solely small and isolated populations towards the West.

In the present contribution, the subfamily Hyperinae bears such an unexpected discovery, on which I report in the following. Hyperinae are represented in Switzerland with 31 species out of the genera *Brachypera* Capiomont, 1868, *Coniatus* Germar, 1817, *Donus* Jekel, 1865, *Limobius* Schoenherr, 1843 and *Hypera* Germar, 1817, where the latter genus includes eleven species, the presently recorded *H. temperei* included. All Hyperinae show an ectophagous life-style, which is rather exceptional in Curculionidae. At first sight, the larvae of Hyperinae are morphologically more similar to caterpillars of Lycaenidae than to typical larvae of other Coleoptera, and can be determined to species level using chaetotaxy (Skuhrovec 2004, 2006, 2007; Skuhrovec and Bogusch 2016), but in several cases also based on their colouration and characteristics of their cuticula (Dieckmann 1989). Often these larvae are more easy to find and breed than searching for adult beetles. This was the case in the present discovery, where details are given in the following.

Material and methods

The live photos were taken with an Olympus T4 tough camera partly in the field and partly in the lab. The mounted specimens and their genitalia were photographed with a Keyence 6000 photosystem at the NMB. All given coordinates in decimal degrees within square brackets should be understood as approximates of the localities written on the labels. The collected specimens of *Hypera temperei* from Valais, Zinal are conserved in the collections of the author, at the Naturhistorisches Museum Basel (NMB), and The Natural History Museum London (NHML). For subsequent DNA extraction two specimens are conserved in alcohol. Additional specimens were found and/or examined in the following collections: cCG – collection Christoph Germann, Rubigen. NMBE – Naturhistorisches Museum Bern. NMSO – Naturmuseum Solothurn.

Results

Excursions and breeding of larvae

During a first excursion to Zinal [46.13365°N, 7.62454°E], canton of Valais on the 2nd of July 2020, six larvae of at least two different larval stages (based on different sizes) of an unknown species of Hyperini were collected from *Astragalus leontinus* Wulfen growing along a path (Figs 1–3). The locality is situated at the bottom of an alpine scree slope facing towards east at 1650 m a.s.l. Three of those larvae (Figs 4–6) reached the stage of the last larval instar and built a net cocoon, whose colour reached from transparent-whitish (Figs 8–10) to slightly brownish (Fig. 11), where they pupated in the following 5 days. After 16–18 days the three adults, one female and two males, hatched. After 1 or 2 additional days, they showed a characteristic dark colouration (Figs 12–14).

On the 22nd and the 23rd of July 2020 a second excursion to the same place was taken in order to estimate the size of the whole habitat, the abundance of the host plant *Astragalus leontinus* (Figs 1–3) and to test for suitable surrounding habitats. The scree slope is surrounded by a *Larix-Picea* forest. The host plants are restricted to an artificial path which was broken through the scree slope in north-south direction. The host plants grew on both sides of the path in finer crushed rocks, likely an ideal substrate for the plant (Fig. 1). Along the scree the habitat consists the path (along 60 m), where more than 120 individual plants were counted. In the surroundings of the scree, in the forest and in the scree itself (on or between the rocks) no further plants could be detected. Hence, it can be supposed that at least in closer vicinity to the detected habitat no other suitable habitats are present. Under the host plant, also two adults could be found from the old (hibernated) generation (see sternite IX Fig. 20, in specimens which hatched in the same year, the sternite remains thin and feebly sclerotized for a longer time). In the leaves of an *Astragalus leontinus*, a cocoon with a

not yet pupated larva was found. Another 12 larvae (from totally 21 counted larvae) were taken home for breeding. Moreover, a search more southern in a flood plain (Les Plats de la Lé) along the rivulet La Navisence revealed three additional larvae – also from *H. temperei* which could be confirmed after successful breeding – collected from *Astragalus penduliflorus* Lam. Despite of the tested 30 specimens of the plant not more larvae were found.

Morphology

The subsequent morphological comparison of the adults from Zinal with the description of *Hypera temperei* by Hoffmann (1958), the addition by Tempère and Péricart (1989) and a critical check (see comments below) of the identification key including a photo of the female holotype (Skuhrovec 2009) allowed its determination. Hence, the *Hypera* found in Zinal was definitely conspecific with *H. temperei*. Hoffmann (1958) described *Hypera temperei* in a short note of a first supplement of the Faune de France volume on page 1747 based on a single female collected by Gaston Tempère on the 24th July of 1956 at the Col de la Cayolle (2300 m a.s.l.) [44.2591°N, 6.7439°E] in the southwestern Alps. *Hypera temperei* was compared with its supposed sister species *H. viciae* (Gyllenhal, 1813) (Figs 29, 34, 35), from which *H. temperei* differed in the following characters: i) darker brownish colour, ii) rostrum bigger, iii) antennae and legs (mainly tibiae and tarsi) reddish, iv) bifid scales on elytra finer, v) those in middle of pronotum simple, vi) white bristles on elytra longer and somewhat elevated, vii) striae well visible. The addition on the species variation by Tempère (1961) can be confirmed. The integument of the elytra is more maculate, which concerns the odd intervals including sutural interval (Figs 12–14, 15) than in the type specimen. The white bristles in the punctures of the striae, and those longer ones on the intervals are well visible. The penis (Figs 30, 31) is similar to the hand drawing provided by Tempère (1961) and reprinted in Tempère and Péricart (1989), where the mentioned (lateral) constriction in the apical part is well visible (Fig. 30, arrow).

However, a thorough comparison with the common and widespread *Hypera postica* (Gyllenhal, 1813) (Figs 17, 19, 24, 26, 28, 32, 33), which also reaches altitudes up to 1800 m a.s.l. (e.g. Hoffmann 1954, and own unpublished data), was a first decisive result. Based on its morphology, *H. temperei* indeed looks much more similar to *H. postica* than to *H. viciae*, and can easily be confused with it, especially when the coloration patterns are more contrasting, as expressed in the Swiss specimens shown here. Even the larva looks much more like the ones of *Hypera postica* (Fig. 7), although all larvae of *H. temperei* had a dull surface (Figs 4–6), whereas those of *H. postica* are shining (Fig. 7). Dieckmann (1989: 101) characterised the larva of *H. viciae* as follows: “Larve durch zahlreiche schwarze Körnchen in der gelb-weißen



Figures 1–3. Habitat in a scree slope near Zinal. **1.** The arrows point at the microhabitats of *Hypera temperei* where *Astragalus leontinus* grows. **2, 3.** Host plant *Astragalus leontinus* where larvae, a cocoon and adults of *H. temperei* were found (Photos: C. Germann).

Haut grau bis grauschwarz aussehend...” which is clearly not the case in *H. temperei*. Concerning the adult weevil, the character of the rostral length used by Skuhrovec (2009) in the key to separate the “group *postica*” from the others is difficult or – in the case of *H. temperei* – not really possible to use. On the one side the rostrum is “short and robust” which leads to the *postica* group, on the other side the rostrum is “long and slender”,

which leads to *H. temperei* among others. It is even more difficult, if one of the typical traits of *H. temperei* is the longer rostrum, as mentioned above. Hence I here provide additional traits compared to the key by Skuhrovec (2009) that help separating *H. temperei* from *H. postica*, namely by: i) Its slightly more slender habitus, where the humeral calli are weakly pronounced (more pronounced in *H. postica*); ii) Colouration much



Figures 4–14. Different life stages of *Hypera temperei*. **4.** Young larva shortly after first moulting. **5, 6.** Older larva on leaves and flowers of *Astragalus leontinus*. **7.** Larva of *Hypera postica* for comparison. **8.** Larva spinning a net cocoon. **9.** Larva lying in the finished net cocoon. **10.** Ventral view on pupa in an opened cocoon. **11.** Freshly hatched adult. **12, 13.** Freshly emerged adult males with contrasting colouration, the white bristles are well visible. **14.** Ditto darker coloured male (Photos: C. Germann).

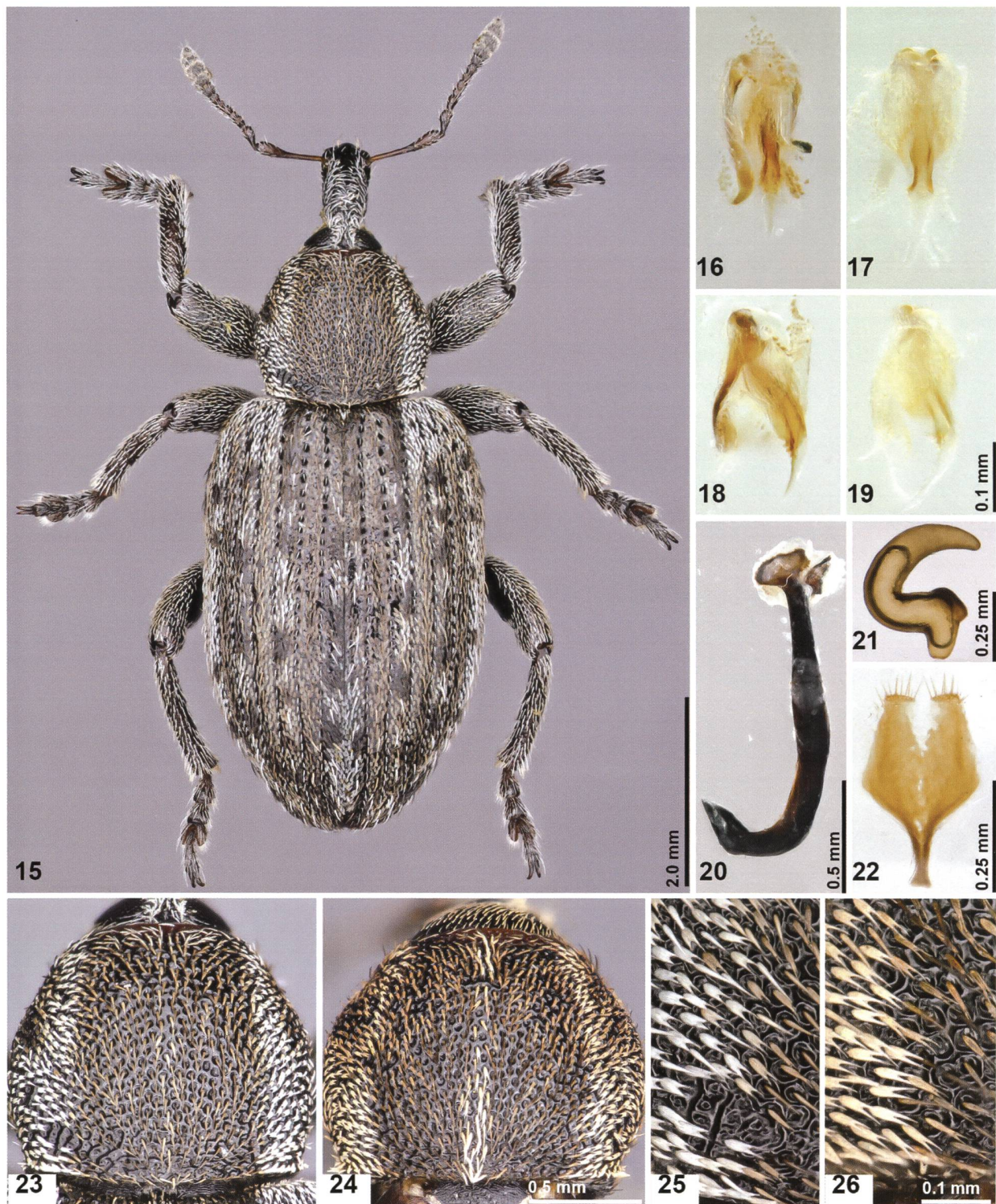
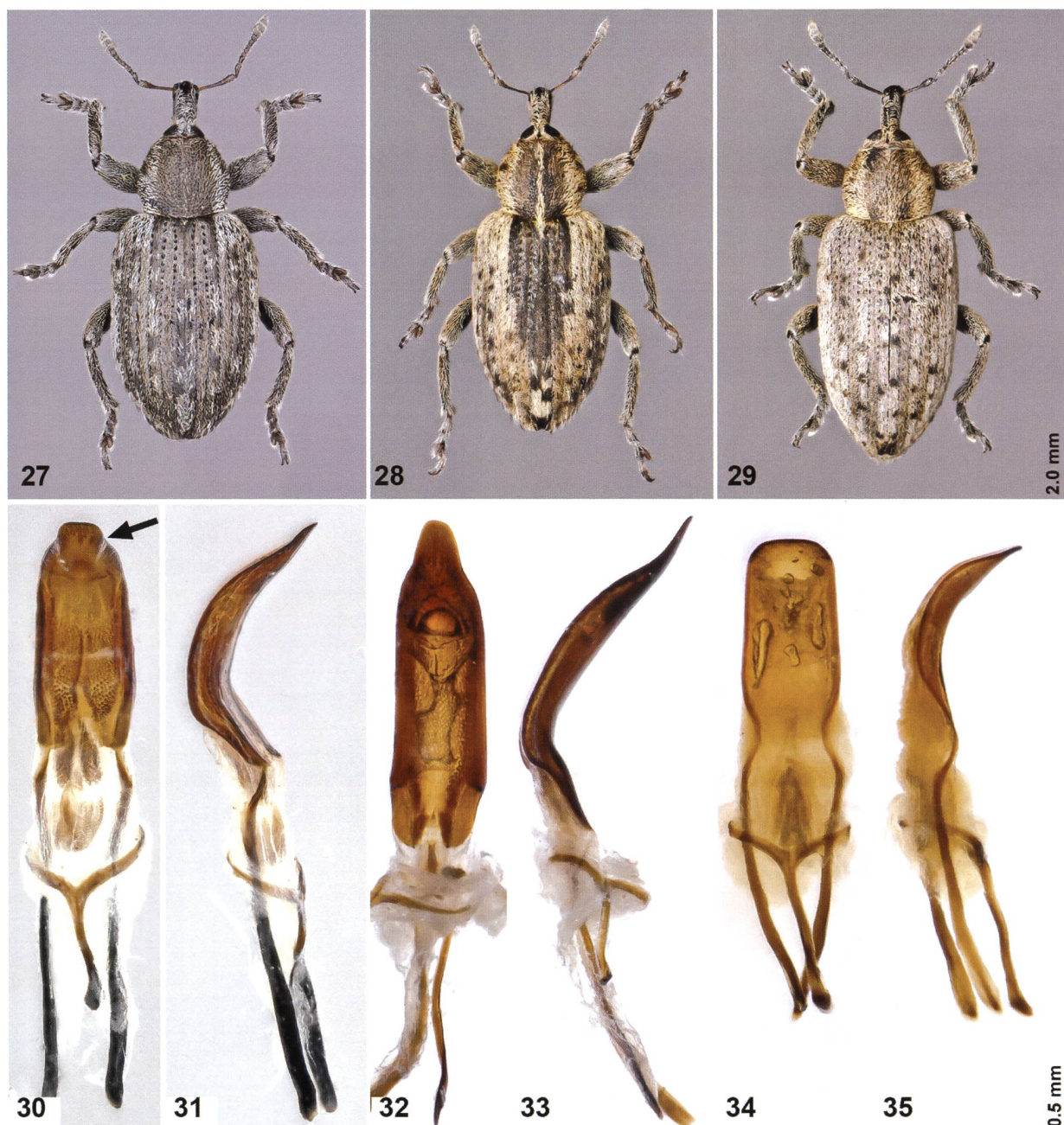


Figure 15–26. 15. Habitus of *H. temperei*, dorsal view. 16, 18. Internal sclerites of penis of *H. temperei* in dorso-ventral, and lateral views. 17, 19. Ditto of *H. postica*. 20. Male sternite IX; rather thick of a hibernated specimens from the last year generation. 21. Spermatheca. 22. Female sternite VIII. 23, 25. Scales on pronotum of *H. temperei*. 24, 26. Ditto of *H. postica* (Photos: C. Germann).

darker (beige to light brown or yellowish in *H. postica*); iii) Pronotum and elytra with whitish scales of the lateral bandings less deep cut, about to one third of a scale (Figs 23, 25) – this shape of the scales is most similar to those of *H. viciae* – in *H. postica* the yellowish to beige coloured scales are deeper cut, to one half of a

scale (Figs 24, 26); iv) Scales of the dark middle band on pronotum in general simple in *H. temperei*, almost all bifid ones (deeply cut) in *H. postica*; v) Shape of the penis (Figs 30, 31) with a short and basally constricted tip (Fig. 30, arrow), in lateral view more rounded in *H. temperei*, where the penis is more elongated, with apex longer and



Figures 27–35. 27–29. Habitus dorsal of males of 27. *Hypera temperei*. 28. *H. postica*. 29. *H. viciae*. 30–35. Penis ventral and lateral views of 30, 31. *H. temperei* (arrow indicates typically constricted tip). 32, 33. *H. postica* (Baden-Württemberg). 34, 35. *H. viciae* (Baden-Württemberg). Photos: C. Germann.

flattened in *H. postica* (Figs 32, 33); vi) Internal sclerites (= internal sac) of the penis are rather similar in both species, the paired sclerite is more strongly sclerotized in *H. temperei*, and the single sclerite in the middle is narrower and more sword-like (Figs 16, 18) compared with the broader and tube like one of *H. postica* (Figs 17, 19). As the habitus of *H. temperei* is more gracile, the hind wings were examined in all of the collected adults with the result that in all specimens the hind wings were rudimental. This last character is very likely not unique in the case of *H. temperei*, and was therefore checked on specimens of *H. postica* collected at higher

altitudes: 1720 m a.s.l. at Tschier, Chasuras in Grisons (cCG), from Tschlin [46.87657°N, 10.42957°E], lower Engadine at 1500 m a.s.l. in Grisons (NMSO), and from Griesalp [46.54745°N, 7.76217°E], Kiental at 1400 m a. s. l. (NMB) where again in all specimens only short rudiments were perceptible. However, such differences in hind wing length in *H. postica* (where flight capability is widespread and thus long and functional hind wings are developed in certain populations) had already been documented (e.g. Hsiao and Hsiao 1985), and can vary between geographically close populations, even at low altitudes in the Netherlands.

Data from collections

The search for more specimens of *H. temperei* from Switzerland, but also elsewhere in the Alps, hidden under the common *H. postica*, resulted in the following specimens and localities (in chronological order): 1 male: “Suisse GR Samedan [46.53982°N, 9.86773°E] 15.7.1975 [above 1700 m a.s.l.], [leg.] P. Scherler” (NMBE). – 2 males: «SCHWEIZ, GR, Ftan, Umgb., N813.000 /E186.000 [46.79127°N, 10.22890°E], 1700 m, 19.6.2006, leg. Germann, *Hypera postica* det. C. Germann 2007» (cCG). – 2 males: «SCHWEIZ, GR, Ftan, Piz Clünas [46.81956°N, 10.24457°E], S-exp. Hang, 2500–2700 m, GS Pflanzenstreue Felsbänder, 10.8.2011, e.l. an Fabaceae (undetermined), leg. C. Germann, *Hypera postica* det. C. Germann 2012” (cCG, NMB).

Additionally, one single female from the following locality was examined, and could be only assigned with doubts to *H. temperei*: “Suisse BE Rothorn [46.78701°N, 8.04596°E] Brienz 11.8.2000 [assumed altitude 2300 m a.s.l.], Mousses sol [sifted from], [leg.] P. Scherler” (NMBE). Male specimens are needed to definitely confirm that record.

Host plants

All present records of larvae, and two adults from two excursions were collected from *Astragalus leontinus*. Only three additional larvae were collected from *A. penduliflorus*. The breeding of the larvae was mostly successful. The larvae were held in small plastic boxes (for details see Germann 2021). The larvae fed on leaves but also on the flowers of the plant. The hatched adults fed on their cocoons, but did not feed on the plant leaves during the first days. Then small roundish holes were fed into the host plant's leaves. When Tempère (1961) rediscovered *Hypera temperei* at the type locality on 21 July 1958, he added a potential host plant (*Oxytropis montana* L., now *Oxytropis jacquinii* Bunge), however without any proof of a development: “L'insecte vit, très probablement, sur *Oxytropis montana* D. C., Papilionacée montagnarde, sous les touffes serrées de laquelle j'ai trouvé une bonne partie des individus. » (Tempère 1961: 94).

Discussion

Focarile (1988) once mentioned *Hypera temperei* in an article on the Coleoptera collected in Val Piora, canton of Ticino in the south of Switzerland. As this record was quite a surprise then, since the French locality was still the only known one for this enigmatic species, I personally asked him in 2012 whether a revision of the determination of the specimen would be possible, and he agreed. Rather disappointingly, the specimen was of a misidentified *Hypera plantaginis* (De Geer, 1775), a widely distributed, often misinterpreted species (Germann 2013a, 2013b). However, a possibility of occurrence of *H. tem-*

perei in the Swiss Alps remains, now corroborated with discoveries of this western alpine element in southern Valais and in Grisons.

The herein presented morphological re-investigation may help substantially to recognise *Hypera temperei* in the field and in collections, if male specimens are present; the female genitalia did not provide relevant differences when compared (Figs 21, 22). The possibility exists that *H. temperei* is more often present in collections, but hidden among misidentified *Hypera postica* from sub-alpine or alpine localities. However, in most collections visited, only *Hypera postica* was found. The records from Piz Clünas above 2500 m a.s.l. show that the species can also be expected at high alpine altitudes in Switzerland. The hereby presented characteristics, clearly show that *H. temperei* is morphologically most similar to *H. postica*, and not to *H. viciae* as originally proposed by Hoffmann (1958), followed by Tempère (1961), Tempère and Péricart (1989), and Skuhrovec (2009). The only remaining similarity shared with *H. viciae* is the shape of the scales on elytra and pronotum, reported and shown above (Figs 23, 25). Despite the hereby facilitated morphological recognition of the species, at least when male specimens are available, a subsequent molecular investigation should be made, to test the sister group relationships of *Hypera temperei*, and to evaluate if a certain genetic isolation is visible regarding its low mobility and rather big distance from the type locality in the Maritime Alps, in the hope that fresh samples from the type locality in France are still available 62 years after the last specimens were collected. However, a thorough investigation of the whole *Hypera postica*-species complex seems necessary and even a precondition before focusing on *H. temperei*, which is obviously part of this complex. This because of other taxa as e.g. *H. transsilvanica* (Petri, 1901), or *H. ornata* (Capiomont, 1868) which show close affinities to *H. postica*. The morphological background, which proofs the existence of such a species complex around *Hypera postica*, was already set by Petri (1901), and then re-mentioned by Dieckmann (1989). Based on experiences with the barcode sequence COI used for possible species discrimination in the *H. nigrirostris*-species group, including the species *H. nigrirostris* (Fabricius, 1775), *H. ononidis* (Chevrolat, 1863) and *H. melarynychus* (Olivier, 1807) – where no separate clades resulted likely due to recent speciation and incomplete lineage sorting (Germann et al. 2017), it might be wise to use a broader set of molecular markers.

The plant on which Tempère (1961) found specimens of *H. temperei* (*Oxytropis jacquinii*) may i) either have been confused with the somewhat similar looking *Astragalus leontinus* (which is recorded from around the Col de la Cayolle (<https://www.tela-botanica.org/bdtfx-nn-8107-repartition>), or ii) the *Oxytropis* only served as hiding plant for *H. temperei*, or iii) the species develops on several species around the genera *Astragalus* and *Oxytropis*. The latter hypothesis is based on knowledge of host plants of other *Hypera*-species, which are mostly

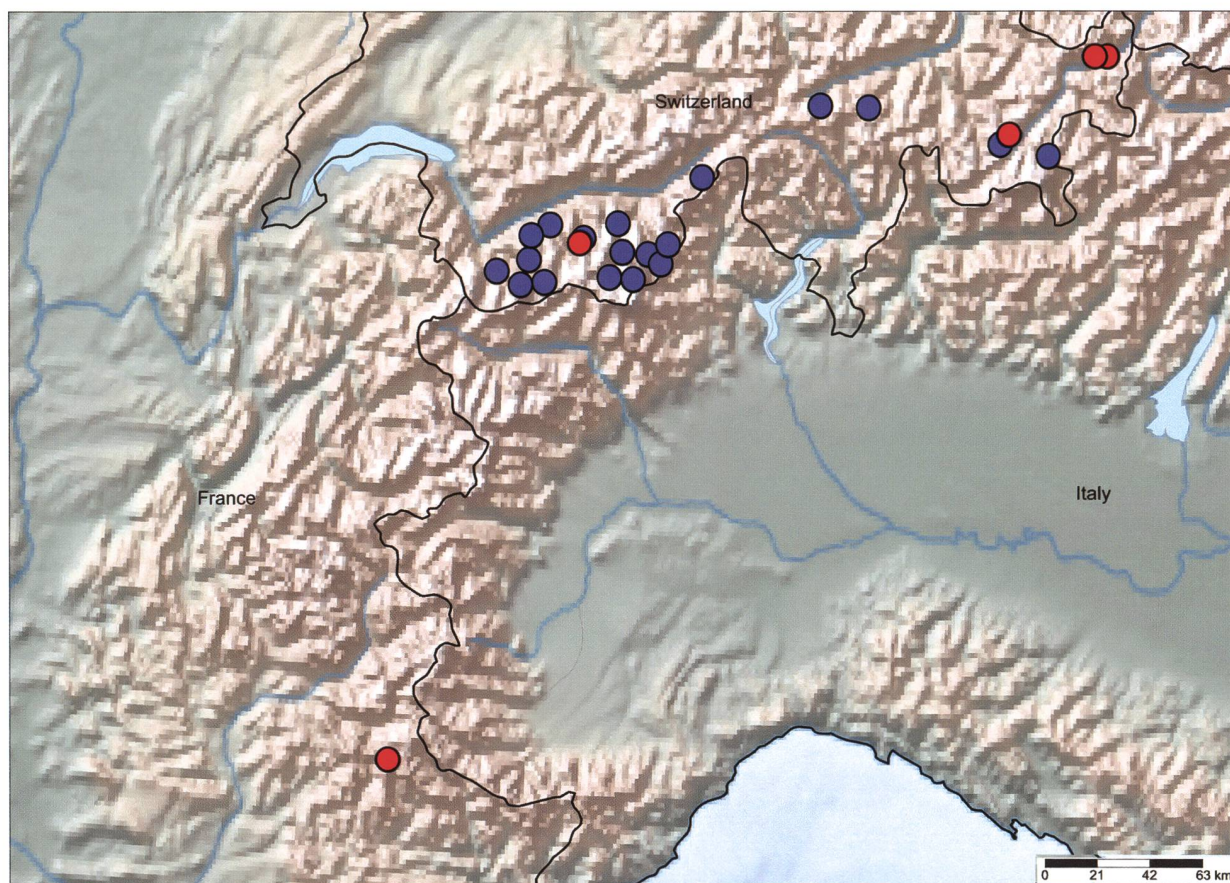


Figure 36. Map with records of *Hypera temperei* (red dots) and potential localities (blue dots) where the host plant *Astragalus leontinus* grows (only validated records from the southern side of the central Alps were included, taken from Info Flora; <https://www.infoflora.ch/de/flora/astragalus-leontinus.html>). Map background by www.simplemappr.net.

oligophagous (Skuhrovec 2005), and only in three species a monophagy may occur, as far as they were yet subject of any feeding tests. This should be considered in further searches for other populations, hence different plant species of the genera mentioned should be tested for occurrences of *H. temperei*. The hereby reported and validated host-plant *Astragalus leontinus* and its records might serve as first search-aid (Fig. 36) to locate more populations of this exceptionally rarely collected alpine weevil. Although the finds of additional larvae on *Astragalus penduliflorus* already show that more species are accepted by *H. temperei*, and from the additionally listed specimens from collections no specific host plant, but at least an undetermined species of the genus *Astragalus* was listed from the locality Piz Clünas in the lower Engadine (Germann 2012: 52). However, it was surprising that not more larvae could be found on the large plants of *A. penduliflorus* nearby Zinal despite of the effort of 30 plants tested. This may indicate that *H. temperei* shows certain preferences (thus prefers *A. leontinus* over *A. penduliflorus*), and/or that the microclimatic conditions were more favourable in the habitat of the scree slope presented. What contributes further to certain preferences regarding its microhabitat is also the observation that despite of numerous occurrences of *Astragalus leontinus* in the area

of Chalbermatten close to Zermatt (1800–2000 m a.s.l.) a thorough search for *Hypera temperei* in September 2020 remained unsuccessful. The place's ground substrate beneath the plants consists of dense stone split, which may be hardly accessible for the adults to hide themselves.

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