Coleophora paeltsaella Palmqvist & Hellberg, 1999 a junior synonym of *Coleophora derasofasciella* Klimesch, 1952

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Coleophora paeltsaella was described in 1999 with the type locality Pältsa, the northernmost mountain in Sweden. However, it soon became obvious that the species showed similarities with *Coleophora derasofasciella* Klimesch, 1952, distributed in the Alps. They also share the same host plant. Additional examination of the genitalia morphology of the two species complemented with bionomic and DNA studies stronly suggest that they belong to the same species, and that *Coleophora derasofasciella* Klimesch, 1952 is the valid name.

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The family Coleophoridae consists of at least 1386 species distributed worldwide (Nieukerken et al 2011). Many of the species are extremely difficult to separate from each other, even if their genitalia usually constitute an important determination tool, and several species occur with considerable gaps. In certain cases it is troublesome to decide if specimens from two widely separated populations belong to one or two species.

The species *Coleophora paeltsaella* Palmqvist & Hellberg, 1999, was recently described based on specimens collected in an alpine habitat in northernmost Sweden (Pältsa) (Elmquist et al. 1994). However, soon it was suggested that the species might be synonymous with *Coleophora derasofasciella* Klimesch, 1952, a species occurring in the European Alps and also living on the same foodplant, *Dryas octopetala* (Jukka Tabell in Baldizzone & van der Wolf 2000). In order to find out if these two taxa are separated and belong to two valid species, we have compared morphology, DNA data and biological data. We conclude that they undoubtedly belong to the same species.

Material and methods

The comparative study of the two taxa *C. paeltsaella* and *C. derasofasciella* started in 2002 when five specimens from Zoologische Staatssammlung (ZSMC) in München were borrowed for the diagnosis. The specimens originated from the Alps and had been collected by J. K. Klimesch and K. Burman and included one male paratype. The Swedish material consisted of four specimens with the male holotype and paratypes of one male and two females. The morphological studies showed similarities but also some smaller differences and the validity of *C. paeltsaella* remained uncertain. The late Ingvar Svensson, as always interested and supportive of the work, suggested a DNA analysis and made that possible with further loans of *C. derasofasciella*

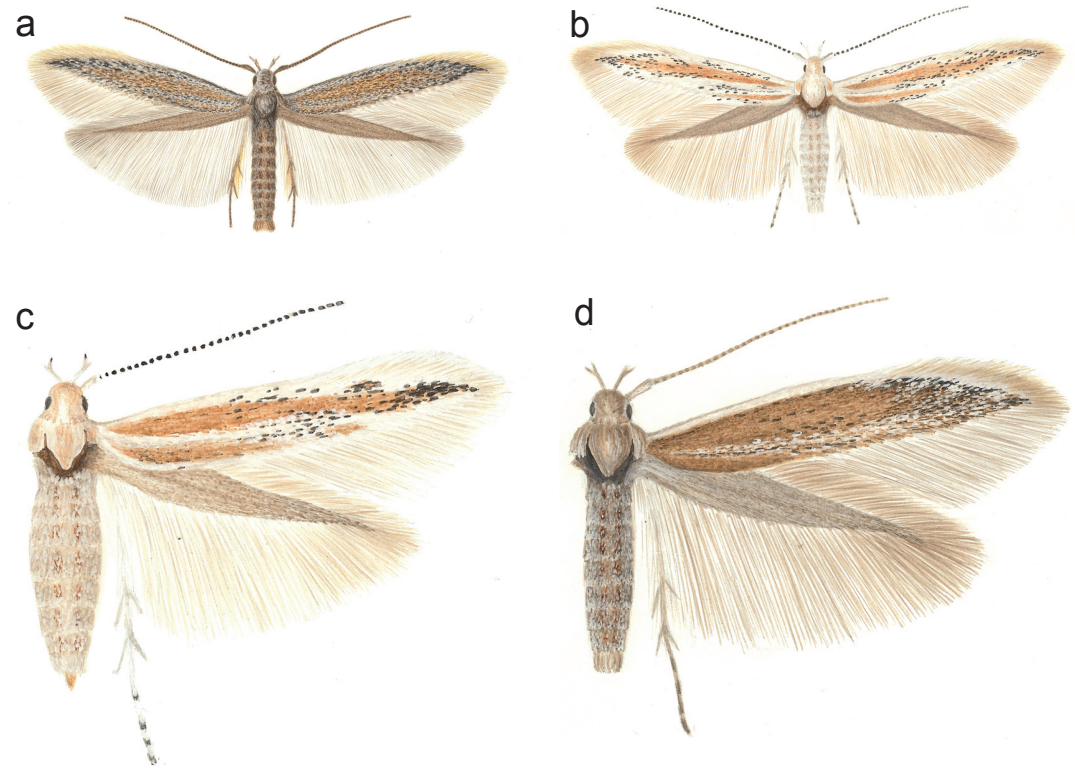

Figure 1. – a) ***Coleophora paeltsaella*** *Palmqvist & Hellberg, 1999. Holotypus male. SUECIA To, 30.VI.1998 Pältsan, SV-slope 800–1100 m. Leg. G. Palmqvist. Coll. Riksmuseum, Stockholm, – b)* ***C. derasofasciella*** *Klimesch, 1952. Male. Carinthia, Ferlach, Singerberg, ex l.* ***Dryas octopetala*** *june 1949. Leg. J. Klimesch, – c)* ***C. derasofasciella*** *Klimesch, 1952. Female. Teriol.sept. Halltal 1400 m, ex. l May on* ***Dryas octopetala****, imago 1.VII.1958. leg. K. Burman. Coll. ZSM, – d)* ***C. derasofasciella*** *Klimesch, 1952. Paratypus, male. Ter. Or. Lienzer Dol. Kerschb.Alm 2000m, ex l.24.VI.1948 on* ***Dryas octopetala****, imago 20.VII.1948. J. Klimesch. Coll. ZSM. Illustrations made by Roland Johansson.*

Individer av de två olika ***Coleophora*** *taxa illustrerade av Roland Johansson.*

from München, which were sent to J.-F. Landry in Ottawa, Canada, together with one specimen of *C. paeltsaella*.

DNA was subsequently extracted from five specimens: four of *C. derasofasciella* including one paratype, and one paratype of *paeltsaella* (Appendix). DNA sequencing was performed at the Canadian Centre for DNA barcoding at the Biodiversity Institute of Ontario, University of Guelph. Barcoded specimens were labelled with individual voucher codes (Sample IDs), databased, and photographed. DNA was extracted from 1-2 legs removed from adult moths. Primers LepF1 and LepR1 were used to sequence 658bp from the 5' end of mitochondrial cytochrome c oxidase I – or the COI gene (Hebert et al. 2003, Floyd et al. 2009) following standard protocols (www.dnabarcoding.ca). All collecting data, images, sequences, and trace files were deposited in the Barcode of Life Database (BOLD) (www.barcodinglife.org) (Ratnasingham & Hebert 2007). Sequences were also deposited in GenBank. Sample IDs, Barcode IDs, and GenBank Accession numbers are listed in Appendix. A neighbour-joining (NJ) similarity tree was drawn and genetic distances were esti-

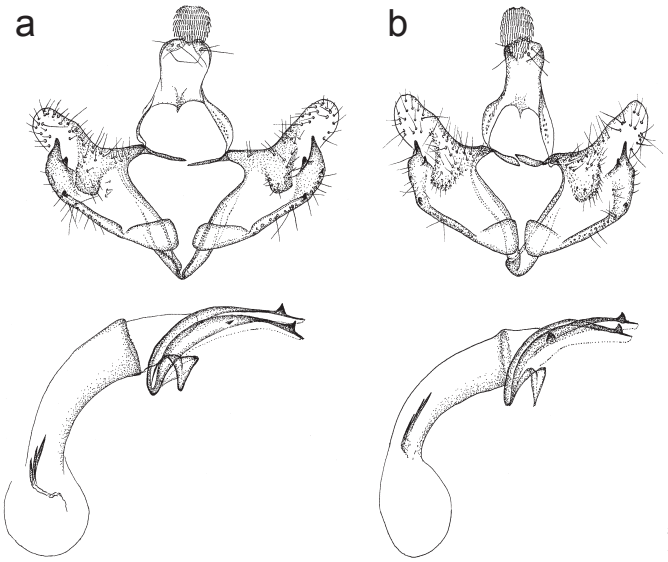

Figure 2. Male genitalia of – a) ***Coleophora paeltsaella****. Holotype, – b)* ***C. derasofasciella****.*

Hanliga genitalier av – a) ***Coleophora paeltsaella****. Holotype, – b)* ***C. derasofasciella****.*

mated with MEGA 5.05 (http://www.megasoftware.net accessed 20 Sep 2011, Tamura et al. 2011) using the Kimura 2-parameter model of base substitution.

Results

Morphology

Specimens from Sweden (*C. paeltsaella*) have a wingspan of 12–14 mm. The forewing is covered with greyish white and brownish scales and towards the apex scattered blackish scales are present; the longitudinal costal and discal streaks are diffuse and the costal fringes are light greyish, but dorsal fringes more greyish proximally. The underside of the wing is dark grey. The hindwing is grey with grey fringes. The head is more greyish brown and the thorax more brownish grey (Fig. 1a).

There are some differences compared with *C. derasofasciella* found at lower altitudes in the Alps, about 1400 m. These specimens have a wingspan of 13-14 mm. The wings are more yellowish brown, and the whitish costal streak is wider as is also the discal streak. The head and thorax are whitish grey and the antennae are more sharply ringed white and greyish black. The abdomen is also more greyish compared with *C. paeltsaella* (Fig. 1b, c). Interestingly,

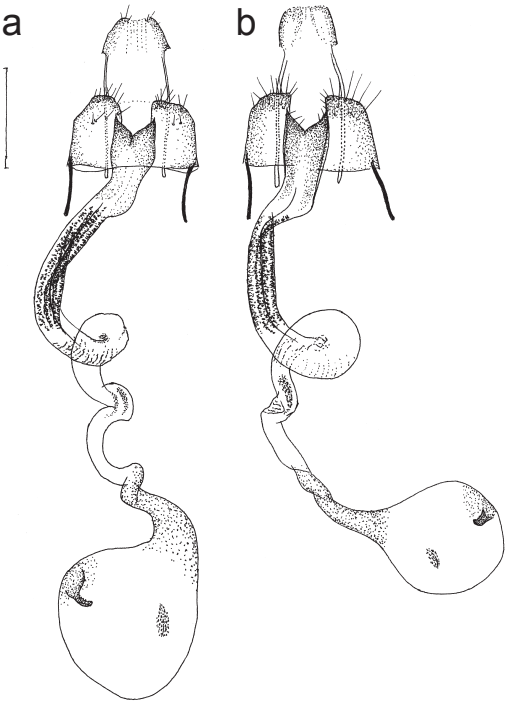

Figure 3. Female genitalia of – a) ***Coleophora paeltsaella****. Paratype, – b)* ***C. derasofasciella****.*

Hongenitalier av – a) ***Coleophora paeltsaella****. Paratype, – b)* ***C. derasofasciella****.*

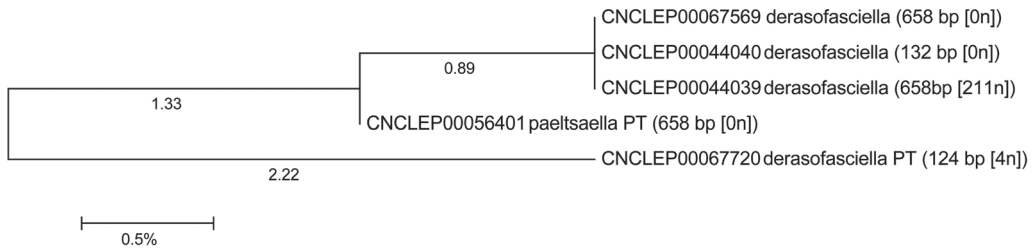

*Figure 4. Neighbour-joining tree of genetic distances in **Coleophora derasofasciella** (4 specimens) and **C. paeltsella** (1 specimen). Numbers beside names are specimen SampleIDs (see Appendix). Numbers below branches indicate % of sequence divergence. Numbers in parentheses after species names indicate sequence lengths with the number of ambiguous positions in square brackets. PT = paratype; bp = base pairs.*

*Likhetsträd som visar likheten i en DNA sekvens för fyra individer av **Coleophora derasofasciella** och en individ av **C. paeltsella**. Bara en individ av varje taxa gav en fullständig sekvens, men deras likhet (0.89 %) indikerar att de är samma art.*

those specimens of *C. derasofasciella* from altitudes of 2000-2500 m above sea level resemble specimens from Sweden but have more pronounced costal and discal streaks. However, the head and thorax are greyish brown and the antennae are ringed fuscous and grey like specimens of *C. paeltsaella* (Fig. 1d). The specimens of *C. derasofasciella* from lower altitudes have the head and thorax more whitish grey and the antennae more distinctly ringed. The genitalia seem to be almost identical in specimens from Sweden and the Alps (Fig. 2, 3).

DNA-data

Overall, only two specimens yielded full barcodes without ambiguity, one *derasofasciella* and the *paeltsaella* paratype. One *derasofasciella* yielded a full-length barcode with a high number of ambiguous sites. The two remaining specimens gave only an abbreviated barcode. Age may have been a factor affecting sequencing success as the *derasofasciella* specimens were collected in 1948 and 1971.

Despite modest sequencing success, the *paeltsaella* barcode showed only 0.89% divergence from *derasofasciella* (Fig. 4), supporting the morphological evidence that the two taxa are not specifically distinct. The high distance (%) between the *derasofasciella* paratype and the rest of the cluster is likely an effect of short sequence length.

Biology

The larva of *Coleophora derasofasciella* makes a tubular case of whitish silk threads ornamented with blackish lines of excrement (Fig. 5a). The larval case of the fully-grown larva is about 6-7 mm on Pältsa in Sweden and in the Alps above 2000 m it is 6.5-8 mm while at lower altitude it is 9-12 mm. This difference in size is probably due to the difference in climate, as individuals in colder climate are often smaller. The larva of both taxa makes a patchmine on *Dryas octopetala* and the larval case is attached to the underside of the leaf (Fig. 5b, 6). On Pältsa the larval cases were found at 900-1100 m above sea level often in small niches on the S-SW slopes with the food plant sheltered by a mound of stones or boulders. In the Alps Klimesch (1952) also noticed that the species occurs at sites which are sheltered from the wind. The imagines have been found in late June and in the beginning of July on the mountain Pältsa, and in the Alps and Russia in July, but due to the weather situation the timing can vary much. In 2002 nearly full-grown larvae were found at the end of July on Pältsa, which indicates that they may have a two-year life cycle. However, many of the arctic species are opportunistic and can be flying early in the summer if the weather is warm and perhaps sometimes manage to develop in one year (Mikkola 1992).

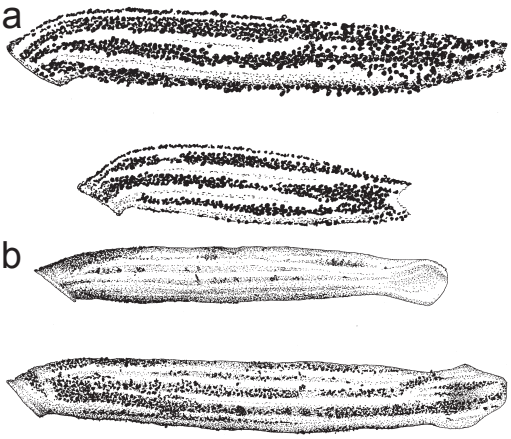

Figure 5. The larval case of – a) ***Coleophora paeltsaella****, – b)* ***C. derasofasciella****.*

Larvsäckar av de två jämförda taxa.

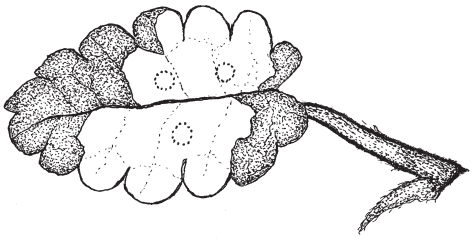

Figure 6. The patchmine made by the ***Coleophora paeltsaella*** *larva on* ***Dryas octopetala****.*

Bladmina gjord av ***Coleophora paeltsaella*** *larv på fjällsippa.*

Discussion

The conclusion of this study is that *Coleophora paeltsaella* has to be considered a junior synonym of *C. derasofasciella*. The distribution of *Coleophora derasofasciella* is disjunct. It is known from the east parts of the Alps both in Austria and Germany (Klimesch 1952, Baldizzone 1996), in Russia, on the Chuckhi Peninsula nearby the Bering Strait (Falkovitsh et al. 1997), and on the mountain Pältsa in Sweden (Palmqvist & Hellberg 1999). It is also recorded from Italy (Baldizzone et al. 2006) and Slovenia (Fauna Europaea 23 October 2011: http://www.faunaeur.org/distribution_table.php). Falkovitsch et al. (1997) stated that *C. derasofasciella* as a species distributed in the alps and the alpine regions of north Russia.

Acknowledgements

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Sammanfattning

Pältsasäckmalen *Coleophora paeltsaella* beskrevs på grundval av material från Sveriges nordligaste fjäll Pältsa (Palmqvist & Hellberg 1999). Trots avvikande yttre utseende misstänktes senare *C. paeltsaella* vara en yngre synonym till den alpina arten *C. derasofasciella* Klimesch, 1952. För att få visshet om statusen hos dessa båda taxa har vi gjort jämförelser av dem. DNA analyser vid Guelph-universitet i Ontario, Canada visade på små skillnader och ger slutsatsen att de båda med största sannolikhet är en enda art. Detta stöds också av genitalmorfologin hos både hane och hona samt biologin, inklusive utseendet hos säckarna. *C. derasofasciella* är funnen i Sverige, Österrike, Italien, Slovenien, Tyskland och Chuckhi-halvön i den östligaste delen av Ryssland (vid Berings Sund). Larven lever på fjällsippa *Dryas octopetala*.

Appendix. Sample information for the ***Coleophora*** *specimens included in the DNA barcode analysis. Sample IDs are specimen identifiers; Barcode IDs (or Process IDs in BOLD) are sequence identifiers. Details of collecting data, specimen deposition, images, sequences, and trace files are available in the Barcode of Life Database (BOLD) (www.barcodinglife.org) under project code COLDE. PT = paratype.*

Data för de individer som användes i DNA-sekvenseringen.

Identification	Locality	Sample ID	Barcode ID	Gen bank accession	Sequence length	Collecting date
C. derasofasciella	Austria: Tyrol: Teriol Sept.	CNCLEP00067569	MPEA882-09	GU694131	658[0n]	15-Jul-1971
C. derasofasciella	Austria: Tyrol: Teriol Sept.	CNCLEP00044040	MPEA724-08	n/a	132[0n]	01-Jul-1971
C. derasofasciella	Austria: Tyrol: Teriol Sept.	CNCLEP00044039	MPEA723-08	n/a	658[211n]	15-Jul-1971
C. derasofascie. PT	Austria: Lienzer Dolomiten: Kerschb Alm	CNCLEP00067720	MNAJ658-09	n/a	124[4n]	20-Jul-1948
C. paeltsaella PT	Sweden: Torne lappmark: Paltsa	CNCLEP00056401	MPEA871-09	GU694122	658[0n]	30-Jun-1998