Baranowskiella ehnstromi Sörensson, 1997 (Coleoptera: Ptilidae) in Luxembourg and adjacent parts of Germany, Belgium and France – first record of a member of the tribe Nanosellini in western Europe

Ben Schultheis, Raoul Gerend, Sylvie Hermant & Guy Colling

Musée national d'histoire naturelle, 25 rue Munster, L-2160 Luxembourg (raoul.gerend@pt.lu, corresponding author; benschul@pt.lu; sylvie.hermant@mnhn.lu; guy.colling@mnhn.lu)

Schultheis, B., R. Gerend, S. Hermant & G. Colling, 2014. *Baranowskiella ehnstromi* Sörensson, 1997 (Coleoptera: Ptilidae) in Luxembourg and adjacent parts of Germany, Belgium and France – first record of a member of the tribe Nanosellini in western Europe. *Bulletin de la Société des naturalistes luxembourgeois* 115 : 203-209.

Abstract. *Baranowskiella ehnstromi*, one of the world's smallest known beetles has been recorded at 31 different locations in Luxembourg (27), Germany (1), Belgium (1) and France (2). These are the first published records of a nanoselline featherwing beetle (Ptilidae) from this part of Europe. The species was solely found on sporocarps of the polypore fungus *Phellinus conchatus*, growing on goat willow *Salix caprea* and crack willow *Salix fragilis* despite attempts to obtain it from the closely related *Phellinus punctatus*. Sequence analysis of the mitochondrial CO1-5P region showed that this species is closely related to the eastern Palaearctic *Primorskiella anodonta* Prilov.

1. Introduction

In 1997 the Swedish coleopterist Mikael Sörensson published the description of a tiny beetle found for the first time nine years before by the entomologist Bengt Ehnström in Sweden. *Baranowskiella ehnstromi* Sörensson is the first species of the featherwing beetle tribe Nanosellini (Ptilidae) found in Europe, most of the extant species being known from the Americas, New Zealand and Papua New Guinea, though other taxa discovered in Africa and India are still awaiting their description (Sörensen, 1997). The species differs from other European Ptilidae by its very small size, its elongated, slender shape and its ten-segmented antennae, along with the yellow colour of elytra and pronotum and a darker head. (Fig. 1)



Fig. 1. *Baranowskiella ehnstromi* sitting on a basidiocarp of *Phellinus conchatus*. The elongated body, fulvous colour and hairy pronotum and elytra readily distinguish this species from other European Ptilidae. Scale bar 200 µm. Photo: G. Marson.

Like other Nanosellinae *B. ehnstromi* seems to be closely associated with fruiting bodies of bracket fungi growing on trees. The beetles live inside the spore tubes of the fungus, where both adults and larvae were observed, and up to now have never been found away from their host (Sörensson, 1997, Anders et al., 2003). Their elongated body can be seen as an adaptation to the fact that the species spends its whole life cycle in the narrow spore tubes.

B. ehnstromi has so far been exclusively found on two species of the family Hymenochaetaceae (Basidiomycetes), i.e. *Phellinus conchatus* (Pers.) Quél. 1886, a parasite infesting trees of the willow family (Fig. 2) and *Phellinus punctatus* (P. Karst) Pilat, 1941, (Fig. 3) growing on decaying deciduous trees and shrubs (Andersen et al., 2003).

As this fungus is well known from quite a few sites in the Grand Duchy and as the prospect of discovering one of the world's tiniest beetles was a strong incentive by itself, the first author went looking for both organisms. Luckily enough the beetle was discovered straightaway at the first location. Roused by this success, further attempts to find the beetle in different parts of the country were undertaken, while more enthusiasts joined the quest, resulting so far in a surprising 31 locations for a species up to recently hardly known outside of Scandinavia.

As the host fungus *P. conchatus* is relatively wide-spread in Luxembourg, the aim of the present paper was to confirm the occurrence of *B. ehnstromi* in Luxembourg and to report the geographic locations were the beetle was found thus far.

2. Methods

Sporocarps of *Phellinus conchatus* were sampled in the field and brought back to the laboratory where they were investigated under a strong light source. After being exposed to the light, beetles, when present, soon started to back out of their spore tube and move around on the surface of the fruital body. They were then swept from the fungus with a soft wetted brush and transferred to vials with a conservation agent. A few were deep-frozen. Some specimens were later dry mounted and their genitalia dissected.

A few specimens were preserved in absolute ethanol and transferred to the population biology laboratory of the MNHNL where the mitochondrial CO1-5P region of the *Baranowskiella ehnstromi* specimen MNHNL17636 was sequenced. The Phire Animal Tissue Direct PCR kit (Finnzymes, Finland) was used and PCR fragments were amplified according to the protocol recommended by the kit provider in a iCycler Thermal Cycler (Bio-Rad). Annealing temperature was 62°C. The universals primers LCO1490 (GGTCAACAAATCATAAAGATATTGG) and HCO2198 (TAAACTTCAGGGTGACCAAAAAATCA) were used to amplify the COI. PCR products were purified prior to sequencing with the Agencourt AMPure XP system (Beckman Coulter). DNA sequencing was performed with the ABI Big Dye Terminator v3.1 Cycle sequencing Kit (Applied Biosystems), using the thermal cycle parameters : 30x (95°C, 20 s; 50°C, 15 s; 60°C, 1 min). The products were sequenced on an ABI 3730XL automated sequencer. A neighbour joining tree (results not shown) with a Kimura 2 distance model using the full BOLD (Barcode of Life Data Systems) database including records without species designation was then assembled

3. Results

So far *B. ehnstromi* has been found at the following 31 locations in Belgium, France, Germany and Luxembourg:

Belgium: prov. Luxembourg, Guelff, 49°36'09.04"N, 5°46'11.98"E, 358 m a.s.l., 09.03.2014, on lying trunk and branches of *S. caprea* in patch of scrub, leg. et det. B. Schultheis.

France: Moselle, Evrange, „le Haeselter", 49°29'44.31"N, 6°11'06.18"E, 251 m a.s.l., 01.03.2014, on trunk and branches of *S. caprea* in secondary succession woodland, leg. et det. B. Schultheis. – Moselle, Métrich, (Koenigsmacher), 49°24'39.07"N, 6°17'39.64"E, 152 m a.s.l., 02.03.2014, on trunk and branches of *S. caprea* in scrub, leg. et det. B. Schultheis.

Germany: Perl, opposite „Schengenerwiss", 49°28'51.87" N, 6°22'09.18" E, 147 m a.s.l., 07.01.2014, on upright bole of *S. caprea* in secondary succession woodland close to River Moselle, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL.

Luxembourg: Bonneweg, "Izigerstee", 49°35'41.04" N – 6°09'39.98" E, 284 m a.s.l., 27.12.2013, on lying and standing boles of *Salix caprea* in the floodplain of River Alzette, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Kayl, "Holleschbierg", 49°28'39.28" N, 6°01'22.21" E, 366 m a.s.l., 28. 12.2013, on lying and standing trunks of *S. caprea* in secondary succession woodland in a former open-cast iron ore mining area, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Steinfort, "Schwaarzenhaff", 49°40'03.55" N, 5°54'34.02" E, 325 m a.s.l., 03.01.2014, on lying and standing trunks and boughs of *S. caprea* in secondary succession woodland, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Garnich, "Schilzenheck", 49°38'02.26" N, 5°57'44.16" E, 318 m a.s.l., 03.01.2014, on dead upright bole of *S. caprea* in deciduous woodland, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Oberkerschen, "Huppegriecht", 49°35'20.16" N, 5°55'16.83" E, 354 m a.s.l., 03.01.2014, on dead upright trunk of *S. caprea* in deciduous woodland, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Bettemburg, "Mosselter", 49°30'35.16" N, 6°07'36.44" E, 305 m a.s.l., 04.01.2014, on lying and upright trunks of *S. caprea* growing on the embankments of a former landfill zone, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Mersch, „Rouscht", 49°46'10.81" N, 6°05'01.36" E, 268 m a.s.l., 05.01.2014, on upright trunk and fallen branches of *S. caprea* growing on the edge of a mixed deciduous and coniferous stand, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Bissen, „Leinebierg", 49°46'57.57" N, 6°02'57.43" E, 250 m a.s.l., 05.01.2014, on fallen trunk of *S. caprea* in oak-hornbeam woodland, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Remerschen, „Haff Réimech, Greissen", 49°29'50.68" N, 6°21'53.94" E, 145 m a.s.l., 07.01.2014, on fallen branches of *S. caprea* in secondary succession woodland, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL17636. – Schengen, „Schleed", 49°28'52.27" N, 6°20'47.47" E, 250 m a.s.l., 07.01.2014, on fallen branches of *S. caprea* in a flood-prone area by a stream, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Kalborn, „Kaalbermillen", 50°06'19.13" N, 6°07'58.91" E, 326 m a.s.l., 10.01.2014, on lying trunk of *S. caprea* in secondary succession woodland by the river Our leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Diekirch, „Fridhaff", 49°53'45.67" N, 6°07'55.17" E, 376 m a.s.l., 10.01.2014, on trunk of *S. caprea* amidst scrub by a road, vid. B. Schultheis, observed in small number. – Dudelange, „Haard" (nature reserve), 49°29'07"N, 6°03'51"E, 392 m a.s.l., 11.01.2014, on dead upright bole of *S.* cf. *caprea* in secondary succession woodland in former open-cast iron ore mining zone, leg. et det. R. Gerend (only 2 specimens), in coll. R. Gerend. – Tetingen, „Langertergrond", 49°28'21.70" N, 6°03'12.50" E, 353 m a.s.l., 12.01.2014, on lying trunk of *S. caprea* in secondary growth woodland, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Oberkorn, „Kallék", 49°30'15"N, 5°53'30.6"E, 375 m a.s.l., 12.01.2014, on trunks and branches of *S. caprea*, leg. et det. G. Marson, in coll. R. Gerend et MNHNL. – Kockelscheuer, „Kräizhaff", 49°33'51.16" N, 6°06'28.61" E, 305 m a.s.l., 13.01.2014, on upright and lying trunks of *S. caprea* in secondary growth woodland, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Lieler, „Fréin", 50°07'18.18"N, 6°07'46.82"E, 337 m a.s.l., 17.02.2014, on lying trunk of *S. caprea* in secondary succession woodland by the river Our, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Wolper, 49°45'53.32"N, 6°20'37.31"E, 379 m a.s.l., 18.01.2014, on dead branch of an upright bole of *S. caprea* in scrub by the roadside, observed in small numbers, B. Schultheis vid. – Koedange, „Pönn", 49°43'54.17"N, 6°12'34.14"E, 297 m a.s.l., 21.01.2014, on a dead branch of *S. caprea* lying on the ground amidst scrub, observed in small numbers, B. Schultheis vid. – Kehlen, „Aeschebéichel", 49°40'00.11"N, 6°02'41.56"E, 338 m a.s.l., 22.01.2014, on a dead branch of *S. caprea* in an abandoned quarry, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Simmerschmelz, „Breibierg", 49°41'23.08"N, 5°59'11.19"E, 322 m a.s.l., 22.01.2014, on a dead branch of a lying *S. caprea* trunk amidst roadside scrub, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Blumenthal, 49°44'36.35"N, 6°15'56.70"E, 293 m a.s.l., 24.01.2014, on dead bole of *S. caprea* by a stream, observed in small numbers, B. Schultheis vid. – Fentange, 49°33'47.8"N, 6°08'51.5"E, 278 m a.s.l., 24.01.2014, on fallen branches and trunk of *S. caprea*, ca. 20 beetles vid., leg. et det. G. Marson, in coll. MNHNL. – Leudelingen, „Kueleschweier", 49°33'21.03"N, 6°04'32.12"E, 293 m a.s.l., 25.01.2014, on a dead branch of a fallen *S. caprea* by a small stream, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Dudelange, „Haard" nature reserve, 49°28'23.37"N, 6°03'47.26"E, 360 m a.s.l., 26.01.2014, on a partly dead bole of *S. caprea* in a ravine amidst abandoned open-cast iron ore mining area, at least 6 beetles, leg. et det. R. Gerend, in coll. R. Gerend (Fig. 4). – Wilwerwiltz, 49°59'23.86"N, 6°00'01.53"E, 309 m a.s.l., 28.01.2014, on trunk of *S. caprea* growing on roadside, leg. et det. B. Schultheis, in coll. R. Gerend et MNHNL. – Aspelt, „Gëll", 49°31'04.54"N, 6°14'12.27"E, 243 m a.s.l., 01.03.2014, on trunk and branches of *S. fragilis* by a stream, B. Schultheis vid.



Fig. 2. Basidiocarp of *Phellinus conchatus* growing on dead bole of *Salix caprea* in a humid environment. Dudelange "Haard" nature reserve. Photo: R. Gerend.



Fig. 3. Resupinate fruital body of *Phellinus punctatus* growing on dead hazel stem. Dudelange "Haard" nature reserve. Photo: R. Gerend.



Fig. 4. Habitat of *Baranowskiella ehnstromi*: decaying goat willow infested by *Phellinus conchatus* growing in secondary succession woodland. Dudelange "Haard" nature reserve. Photo: R. Gerend.

While examining sporocarps, the beetles were always found with their rear parts protruding from the spore tube in which they were lodged (Fig. 5). Under the influence of light or warmth they soon started to stir and then backed out of the tube to move about on the surface. They moved rather sluggishly and did not attempt to take to the air (although in one instance one might actually have done so but the sheer tininess of the insect thwarted any attempts to retrieve it, G. Marson rep.).

Beetles didn't seem to be randomly distributed but, rather, were found several at a time in neighbouring tubes, often in small depressions (Fig. 6), where the growth of the tubes seemed to be hampered. Whether this is due to the beetles' activity, we cannot say for sure at the moment.

When breaking up the sporocarp we found what seemed to be small plugs of hyphae at the base of the tubes separating the most recent layer of tubes from older ones. We believe these plugs to be linked to the pres-

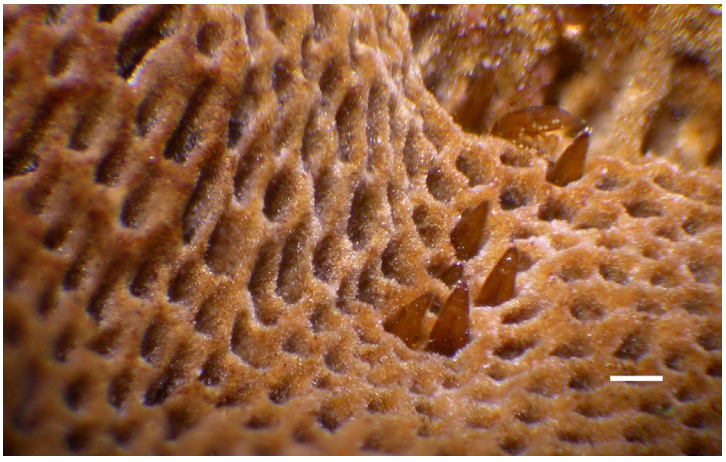


Fig. 5. Adults of *Baranowskiella ehnstromi* with their apices characteristically protruding from the spore tubes of *Phellinus conchatus*. Scale bar 200 µm. Photo: G. Marson.

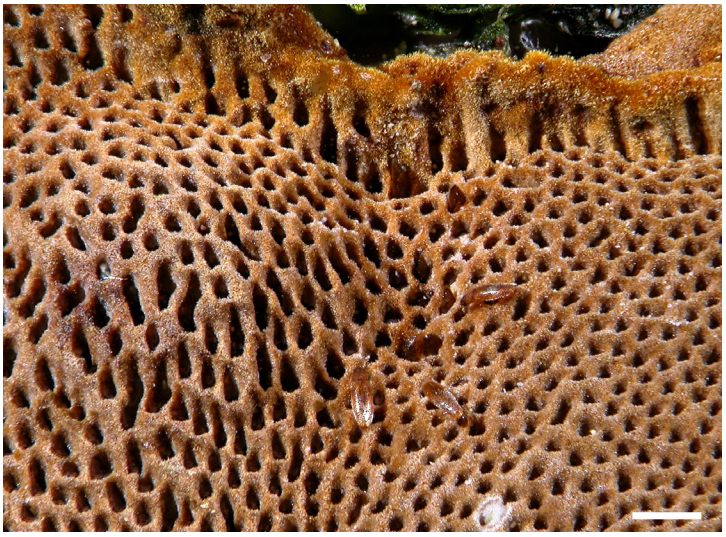


Fig. 6. Adults of *Baranowskiella ehnstromi* typically clustering in a small depression of a *Phellinus conchatus* basidiocarp. Scale bar 200 µm. Photo: G. Marson.

ence of the insect but this observation certainly needs further investigation. The large number of plugged spore tubes found in some basidiocarps might be seen as an indication that at a given time in the past the beetles were far more numerous as was the case during our investigation carried out in the midst of winter.

As goat willow is an early colonizer of open ground in previously disturbed areas, most of the records of both host fungus and beetle are from either groves of the secondary succession type or woodland edges. They are hence not restricted to alluvial or riparian situations where *Salix caprea* is usually supplanted by other species of the willow family.

Despite efforts to find the beetle on a different willow species, only a single record from *Phellinus conchatus* infesting crack willow *Salix fragilis* could be obtained.

A query of the full BOLD (Barcode of Life Data Systems) database including records without species designation showed that the *Baranowskiella ehnstromi* sequence (GenBank accession number KJ168043) is closely related to *Primorskiella anodonta* Polilov, which is indeed the second nanoselline species known from the Palaearctic region. The description is based on specimens taken in Primorye, the southernmost of the Russian Far Eastern territories (Polilov, 2008).

4. Discussion

Baranowskiella ehnstromi has been recently found in several locations outside of Fennoscandia where it is currently known from Sweden, Finland and Norway (Sörensson, 1997, Anders et al., 2003). These latest Central-European records have as yet not been formally published (Coray & Siede, in press).

Together with our data they allow to considerably extend the known range of the species towards the south and west and it can be reasonably assumed that it will be discovered in most parts of central-western Europe, a fact already hinted at by Anders et al. (2003) who pointed out that a species linked to the presence of trees and woodland habitats could hardly be a Fennoscandian endemic.

The species has been recorded from a total of 27 locations in Luxembourg, most of them in the southern two thirds of the country. Despite repeated efforts to discover it in the North (Oesling) of the country, only three sites could be added to the list.

Goat willows, in Luxembourg the preferred host of *Phellinus conchatus*, actually favour richer soils in limestone areas. While it is therefore easy enough to find the tree and its associated fungus in the "Gutland", they are relatively rare in the upland "Ösling", where the soils tend to be poorer in minerals and slightly more acidic.

It might be interesting to point out that basidiocarps infested with beetles were usually found on goat willows growing in rather humid environments as could sometimes be gauged from the exuberantly growing bryophytes and ferns around them (Fig. 4)

In the nature reserve "Haard" near Dudelange for instance, it was impossible to find basidiocarps of the host fungus on goat willows growing on level areas of waste rock resulting from the iron ore exploitation, as these places tend to be very hot and parched in summer. Willows growing in ravines on the other hand often presented numerous fruital bodies of varying shapes and were covered in moss. It was here that the beetles could be found.

For the time being *B. ehnstromi* has almost exclusively been found on *Phellinus conchatus* growing on goat willow in Luxembourg. Anders et al. (op.cit.) mention its presence on *Phellinus punctatus* growing on a dead stem of hazel *Corylus avellana*. Though we did not find any beetles on basidiocarps of this species, hyphae plugs did actually occur in the spore tubes of some of them (see below).

We would like to attract attention to the fact that with species like *P. punctatus* and *P. pomaceus* (the latter generally associated with trees and shrubs of the genus *Prunus*) unlike *P. conchatus*, the spore tubes tend to be overgrown and thus effectively closed. How then should these same tubes be used by the beetle? Resupinate sporocarps of both *P. conchatus* and *P. punctatus* have been found growing together on the same stem of *Salix* in Luxembourg, in which case it might be difficult, even for a seasoned mycologist, to tell them apart in the field. So, while not ruling out the possibility that *Baranowskiella* may still be found on other *Phellinus* species after all, we are inclined to believe that *P. conchatus* is the main host species, while occasional breeding or attempts to do so on *P. punctatus* can't be ruled out. As a matter of fact, host specifity has already been stated for other nanoselline ptilids in North America (Dybas, 1990, cited in Sörensson, 1997).

In an attempt to explain its late discovery, Sörensson (op. cit.) commented on the presumed flight avoidance of this diminutive beetle, pointing out that unlike other small, yellowish ptilid species, it had never been caught in a flight trap in Sweden. This observation is seen in accordance with a general lack of evidence for recorded flight activity in nanoselline beetles, which would also explain their tendency to be associated with old, rather stable habitats away from human activities (Sörensson, 1997).

The locations where the species has been found in Luxembourg do not support this hypothesis. Most places are in fact woodlands or groves of the secondary succession type and, although not exactly situated in highly disturbed areas, can hardly be claimed to be "far from human activities"(Sörensson, 1997). The mere presence of the goat willow is generally an

indicator for some sort of past disruption as it tends to establish itself in rather open conditions. The former open-cast iron ore mining areas straddling the border with France are a good example of a landscape that has been utterly modified in the past and where, since the early seventies of the last century, a re-colonization by spontaneous secondary woodlands of birch, aspen and goat willow can be observed. So, a certain degree of flight activity is a prerequisite for the beetle's ability to find and colonize its host fungus which itself tends to be patchily distributed.

Baranowskiella ehnstromi turned out to be a species widely distributed in Luxembourg and one bound to be found in most places where its host fungus occurs. As all the records published herein are from the winter months, it remains to be seen whether adults of the species are present all year round and whether they are even more numerous during the warmer season. In fact the unseasonably warm weather persisting from December 2013 to January 2014 probably allowed adult beetles to prolong their activity and hence made this recording campaign a success.

Acknowledgements

The authors would like to thank Dieter Siede and Heinz Ebert (both Germany) for drawing attention to the fact that the well-known *Phellinus conchatus* harbours a specialized ptilid beetle hardly known thus far outside Scandinavia. Guy Marson (MNHNL) produced the pictures of this tiniest of beetles. We would like to express our gratitude to him for his dedication and the permission to use these pictures and his own data in our paper. Last not least we are indebted to Mikael Sörensson (Sweden) for sending us a PDF of his original description of *Baranowskiella ehnstromi*.

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