

Where do endemics reside? Endemic beetles in the Gesäuse National Park (Austria) and their relevance for nature conservation

Sandra Aurenhammer, Christian Komposch, Daniel Kreiner

Abstract

The Gesäuse National Park is one of the most important hot spots for endemics throughout the Eastern Alps. The aim of the current study is to present the first species inventory of the endemic beetle fauna of this alpine area. Results from fieldwork as well as historical sources provide the database for this survey. The latest fieldwork investigations were carried out during 25 days in the vegetation period of 2015 and 2016 using 370 pitfall traps at 74 sample sites, hand collecting, beating of vegetation, sweep netting and sieving.

In total 2,827 individuals and 478 beetle species were documented. Among these 5 endemics and 19 subendemics of Austria were recorded within the range of the Gesäuse National Park. Due to their distribution pattern we expect another 15 (sub)endemic species to occur in the study area. Most of the (sub)endemics are stenotopic and stenocious, being bound to Alpine meadows or screes. The records concentrate on the subalpine and alpine zone. The occurrence at locations with special microclimatic conditions indicates a preference for cold-stenothermic biotopes.

Grazing in Alpine meadows as well as climate warming are considered the main threats for most endemic beetle species. The long term protection of habitats throughout the Gesäuse National Park and the continuation of research will be the main requirement for the protection of its endemic beetle fauna.

Keywords

endemics, insects, Arthropoda, Coleoptera, *Oreina elongata styriaca*, climate change, protected area, FFH-directive, Gesäuse National Park, Ennstal Alps, Austria, Eastern Alps

Introduction

Located on the fringe of the last glacial maximum during the Würm ice age, the North-eastern Calcareous Alps are known for their richness in endemic species. The Gesäuse National Park is part of the 'Ennstaler Alpen' and counts as one of the most important hot spots for endemics throughout the Eastern Alps.

Scientific documentation reaches back to the end of the 19th century, where the first zoological specimens were collected in the abbey of Admont. Of major importance for scientific research on the national park's beetle fauna was the comprehensive work of Herbert FRANZ (1974). Over the years, numerous coleopterologists dedicated their private research activities to this region and studies were commissioned by the Gesäuse National Park since its foundation in 2002 (e.g. NEUHÄUSER-HAPPE 1993, ADLBAUER 2010, PAILL 2012, WAGNER et al. 2016, AURENHAMMER et al. 2017). In 2009, PAILL & KAHLLEN gave the first profound coleopterological overview over Austria's endemic beetle fauna within the nationwide endemics catalogue (RABITSCH & ESSL 2009). In the following study, surveys of the national park's endemic invertebrate fauna were carried out by the ÖKOTEAM – Institute for Animal Ecology and Landscape Planning (ÖKOTEAM 2009, KOMPOSCH & PAILL 2012).

Today for many beetle families the available data is, however, still limited to historical sources. The present study is part of a comprehensive survey about the invertebrate endemic fauna of the Gesäuse National Park. This project aims to present an endemic species inventory, reveal new insights in the distribution of beetle endemics within the national park and seeks to produce results for use in the practice of nature conservation.

Study area, Material and Methods

The project area comprises the Gesäuse National Park (Ennstaler Alpen, Northern Calcareous Alps, Styria) with its nearest surroundings and reaches from the colline zone (480 m a.s.l.) up to the alpine zone (2369 m a.s.l.). Due to preceding projects, two altitudinal belts were predominantly investigated: forests between 600 and 700 m and alpine meadows between 2000 and 2200 m. Furthermore, historical records of endemic beetles were extracted from FRANZ (1974). Concerning historical data, records from adjacent localities were also included (e.g. Admont, Kaiserau, Haller Mauern, Hieflau). The majority of records are, however, located within the recent borders of the national park.

The collected material of the current zoological investigation originates from recent field studies as well as from preceding surveys by the ÖKOTEAM. The latest fieldwork was carried out within 25 days in the vegetation period of 2015 and 2016 and included the following methods: pitfall traps (370 traps at 74 sites, mainly in cold-stenothermic habitats), hand collecting (during daytime and at night, mainly in the subalpine zone under stones),

beating of vegetation and sweep netting (mainly shrubs and hydrophilous tall herb communities) and sieving (leaf litter in beech and ravine forests and dwarf shrub heaths). Beetles were collected and transferred into ethyl acetate. Records from carabids, staphylinids and scydmaenids were treated separately and appear in separate papers.

Concerning the range-status of endemic species we use the following terminology and definitions: a = endemic of Austria, b = subendemic of Austria sensu stricto (75 % of the distribution area lies within the borders of Austria), c = subendemic of Austria sensu lato (25–75 % of the distribution area lies in Austria), d = endemic of the Eastern Alps, e = endemic of the Alps, f = arcto alpine species.

Species inventory

Overall a total of 478 beetle species were documented from the investigation area; this comprises 2875 individuals, 1579 datasets and 260 sample sites. The full list of species will be published on another occasion. We recorded a total of 24 (sub)endemic beetle species that occur within the range of the Gesäuse National Park. The percentage of endemics amounts to 5.3 % of the species inventory.

family	species	cur.	end.	habitat	EU code
Aphodiidae	<i>Neagolius montivagus</i> (Erichson, 1848)	x	b	Calcareous (sub)alpine meadows (calcareous grasslands)	6170
Byrrhidae	<i>Byrrhus picipes</i> Duftschmid, 1825		e	Alpine meadows and dolines	6170
	<i>Simplocaria acuminata</i> Erichson, 1847 (Fig. 1)	x	f	Beech forests, shrubs and dwarf shrubs	4070*
Cantharidae	<i>Malthodes subductus</i> Kiesenwetter, 1863	x	d	Shrubs (<i>Pinus mugo</i>) and calcareous screes	4070*
Chrysomelidae	<i>Cryptocephalus albolineatus</i> Suffrian, 1847		e	(Sub)alpine dwarf shrub heaths	4060
	<i>Chrysolina lichenis ahena</i> (Germar, 1824)		a	(Sub)alpine meadows and rocky heaths	6170
	<i>Oreina elongata styriaca</i> (Franz, 1949) (Fig. 1)	x	a	(Sub)alpine tall herb communities (with shrubs of <i>Alnus viridis</i>)	6430
	<i>Oreina frigida</i> (Weise, 1883)		e	Alpine dwarf shrub heaths	4060
Curculionidae	<i>Psylliodes subaenea styriaca</i> Heikertinger, 1921	x	b	Calcareous screes	8120
	<i>Brachiodontus alpinus</i> (Hampe, 1867) (Fig. 1)	x	b	(Sub)alpine screes and snow pockets	8120
	<i>Dichotrachelus vulpinus</i> Gredler, 1857 (Fig. 1)	x	e	Calcareous alpine screes, dolines and snow pockets	8120
	<i>Leiosoma cyanoptera</i> Redtenbacher, 1849		d	Beech forests	6430
	<i>Oreorrhynchaeus alpicola</i> Otto, 1894		a	Calcareous (sub)alpine screes	8120
	<i>Otiorhynchus auricomus</i> Germar, 1824	x	e	Dwarf shrub heaths	4060
	<i>Otiorhynchus chalconus</i> Stierlin, 1861		d	Calcareous alpine screes and erosion gullies	8120
	<i>Otiorhynchus costipennis</i> Rosenhauer, 1856	x	d	(Sub)alpine meadows, snow pockets and rocky heaths	6170
	<i>Otiorhynchus globulus</i> Gredler, 1866		d	Alpine dwarf shrubs and shrubs	4060
	<i>Otiorhynchus nocturnus</i> Reitter, 1913		b	Calcareous rocky heaths and screes	6170
	<i>Otiorhynchus picitarsis</i> Rosenhauer, 1856		a	Rocky heaths and rock faces	6170
	<i>Otiorhynchus pigrans</i> Stierlin, 1861 (Fig. 1)	x	b	Rocky heaths and screes, alluvions	6170
	<i>Rhinomias austriacus</i> (Reitter, 1894)	x	b	Beech and mixed beech forests	9130
<i>Thamiocolus paravilis</i> Dieckmann, 1973		d	Calcareous (sub)alpine meadows (calcareous grasslands)	6170	
<i>Tropiphorus styriacus</i> Bedel, 1883	x	a	Tall herb communities and (sub)alpine meadows	6170	
<i>Tylotus chrysops</i> (Herbst, 1797) (Fig. 1)	x	d	(Sub)alpine tall herb communities	6430	

Table 1: List of (sub)endemic beetle species in the Gesäuse National Park stating the currency of records (cur.): x = recent record; endemism status (end.): a = endemic of Austria, b = subendemic of Austria s. str. (75 % of the areal in Austria), d = endemic of the Eastern Alps, e = endemic of the Alps, f = arcto alpine species; habitat association and attribution to one main appropriate FFH habitat type (EU code): 4060 - Alpine and Boreal heaths, 4070* - * Bushes with *Pinus mugo* and *Rhododendron hirsutum* (Mugo-Rhododendretum hirsutum), 6170 - Alpine and subalpine calcareous grasslands, 6430 - Hydrophilic tall herb fringe communities of plains and of the montane to alpine levels, 8120 - Calcareous and calcichist screes of the montane to alpine levels (*Thlaspietea rotundifolii*).

Currently 5 endemic and 19 subendemic beetle species are known to occur in the Gesäuse National Park (Table 1). In total 451 individuals were registered, whereby 36 % of the records stem from historical sources (FRANZ 1974). During the recent field studies 13 (sub)endemic species could be detected. Regarding their distribution patterns, another 15 (sub)endemic beetle species are likely to occur in the Gesäuse National Park. Weevils and leaf beetles dominate the endemic species inventory.

Respecting their range, 5 species are considered as endemics and 6 species as subendemics of Austria. The other species are endemic to the Eastern Alps or show a broader distribution (Fig. 1).



Figure 1: (Sub)endemics of Austria occurring in the Gesäuse National Park: *Tylotus chrysops* (top left), *Otiorynchus pigrans* (centre left), *Brachiodontus alpinus* (bottom left), *Oreina elongata styriaca* (top right), *Dichotrachelus vulpinus* (centre right), *Simplocaria acuminata* (bottom right) | Photos: S. Aurenhammer/ÖKOTEAM.

Distribution and ecology of endemics

Endemic and subendemic species are found in all altitudinal zones of the Gesäuse National Park. The records of species and datasets concentrate, however, in the subalpine and alpine zone. Endemics of Austria (category a) were only recorded at an altitude above 1000 m (Fig. 2). From a nature conservation perspective high level habitats are therefore of great value.

Subalpine and alpine meadows, dwarf shrub heaths and shrubs (*Alnus viridis*, *Rhododendron hirsutum*, *Pinus mugo*), screes and snow pockets as well as hydrophilic tall herb communities are numbered among the main habitats of endemic beetles in the national park (Fig. 3). Their occurrence at locations with special microclimatic conditions indicates a preference for cold-stenothermic biotopes.

The majority of the (sub)endemic species are considered stenotopic and stenoecious, being bound to specific habitats, structures and environmental conditions. This is the case for many terricolous species as well as for species living in the low herb layer that hide underneath stones during the day time and become active at night. These include the strict Austria-endemics *Chrysolina lichenis ahena* (Chrysomelidae) and *Tropiphorus styriacus* (Curculionidae). Species living in (dwarf) shrubs are often bound to its leaf litter.

The endemic species inventory includes phytophagous specialists, there mainly under weevils and leaf beetles like *Brachiodontus alpinus* or *Oreina elongata styriaca*.

Endemics as character species of FFH habitat types

According to current definitions, the protection and conservation status of FFH habitat types is also related to their fauna (e.g. LANDESAMT FÜR UMWELTSCHUTZ SACHSEN-ANHALT 2002). Stenotopic beetle species are valuable character species for FFH habitat types. A good state must therefore be related to the presence of endemic beetle species as well as the completeness of its community of beetle species. The major habitats where endemics occur in the national park can be assigned to 6 FFH habitat types (Table 1).

Alpine and subalpine calcareous grasslands are the most significant habitats for endemic beetles in the national park. Second, are calcareous and calchist screes of the montane to alpine levels (*Thlaspietea rotundifolii*). Apart from their structural preference for alpine rocky grassland and scree, several species are highly calciphilic and occur only on limy soils. This applies to the weevils *Otiorynchus chalceus*, *O. nocturnus* and *Dichotrachelus vulpinus*.

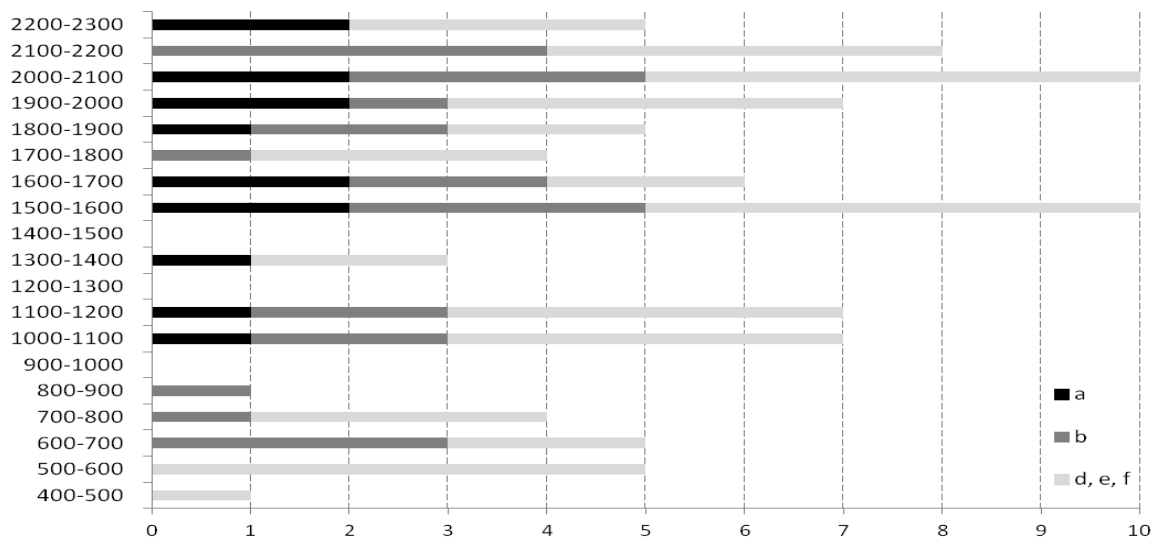


Figure 1: Number of (sub)endemic beetle species (abszissa: categories of endemism-status) recorded along the altitudinal gradient (ordinate: metres a.s.l.): a = endemic of Austria, b = subendemic of Austria s. str. (75 % of the areal in Austria), c = subendemic of Austria s. l. (25-75 % of the areal in Austria), d = endemic of the Eastern Alps, e = endemic of the Alps, f = arcto alpine species. Gaps of records at single altitudinal belts result from a varying sampling intensity.



Figure 3: Endemics habitats in the Gesäuse National Park: Snow pockets in the Tellersack (top left); hydrophilous tall herb communities at the Untere Koderalm (bottom left); rocky alpine meadows at the Unterlugauer (top right); various FFH-habitat types in the high altitudes, viewing the Sulzkarhund with Rotofen from the Hochtorn/Tellersack (bottom right). | Photos: Ch. Komposch & S. Aurenhammer/ÖKOTEAM.

The ‘flagship-endemic’ *Oreina elongata styriaca*

The alpine leaf beetle *Oreina elongata* occurs in isolated populations across the Alps and Apennines. So far 7 allopatric subspecies have been described. Recent genetic analyses on its phylogeography suggest *Oreina elongata* however to be a species complex with 5 species showing a strong genetic differentiation long before the last glacial maximum (BORER et al. 2010).

The Styrian alpine leaf beetle (*Oreina elongata styriaca*) (Fig. 1) is endemic to Austria. It was so far only found in some places in the Northern and Central Alps of eastern Carinthia and Styria (PAILL & KAHLEN 2009). The Gesäuse National Park comprises one-eighth of its worldwide distribution. Like its sister species, *O. elongata styriaca* is adapted to high altitudes (1500-2000 m).

Interestingly, both historical and recent records only stem from three adjacent localities in the national park: Stadlalm, Koderalm and Sulzkaralm. These alpine pastures feature hydrophilic tall herb communities with *Adenostyles* spp., which is known to be the species host. The distribution of *O. elongata styriaca* apparently not only depends on the occurrence of its host plants, as the beetle is capable of flight and both *Adenostyles* species are widely distributed throughout the national park. It might rather be microclimatic conditions that help to explain the species' disjointed distribution pattern. We assume a habitat preference for cold stenothermic and hydrophilic tall herb communities with shrubs of *Alnus viridis*, which are only found at few sites in the national park (Fig. 3).

Nature conservation aspects

The need for action is great, as is the time pressure due to habitat destruction, climate warming and the loss of experts (KOMPOSCH 2010).

Threats

As many endemic beetle species inhabit alpine meadows, grazing is considered one of the main threats in the subalpine and alpine zone. Climate warming also has negative effects on endemics habitats, as it promotes the shrinking and, in the long run, even the loss of the alpine zone.

The situation appears dramatic in the Northern Calcareous Alps with their comparably lower peaks: scientific modelling predicts a loss of the alpine zone up to 80–90 % (DIRNBÖCK et al. 2011). A raised temperature will result in a structural change of open grassland into heath land and forest which makes these habitats unsuitable for particular species. Forestry is considered the main threat for endemics of the deciduous forest in the Gesäuse. The past large-scale conversion of primary beech and ravine forests in spruce forest had a major effect on today's forest habitats and is still being practised in the woodlands outside the borders of the national park.

Management measures

As management measures we propose to exclude habitats with endemic beetle species and coenoses from grazing. We further suggest the specific preservation of hydrophilic tall herb communities that grow on alpine pastures and the reconversion of spruce forests into natural forest communities. The expansion of the road network is considered as counterproductive, as it promotes the negative impact of forestry and dispersal of alien species and synanthropic species. A proper Red List of endangered (endemic) species in the Gesäuse National Park according to the IUCN categories as well as the inclusion of endemics in the federal conservation law ('Artenschutzverordnung des Landes Steiermark') would be of paramount importance for the handling of conservation issues. The long term protection of habitats through the Gesäuse National Park and the continuation of research (Fig. 4) will, however, be the main requirement for the protection of its endemic fauna.



Figure 4: Further research is urgently needed! | Photo: Ch. Komposch/ÖKOTEAM, 2.8.2016

Acknowledgements

We would like to express our thanks to our colleagues and friends, Erwin Holzer, Manfred Schneider, Rudolf Schuh, Roman Borovsky, Heri Wagner and many other experts who supported our work by active assistance in the field or with identification-checks and providing data. The Gesäuse National Park supported the project financially. Jason Dunlop kindly corrected our English – big thanks to Berlin! Kristina Bauch invited and encouraged us to present these results, organized this unique Symposium and did everything possible making this event familiar and successful!

References

- ADLBAUER, K. 2010. Die Bockkäfer des Nationalparks Gesäuse (Coleoptera, Cerambycidae). *Joanna Zoologie*, 11: 51-95.
- AURENHAMMER, S., SCHNEIDER, M., HOLZER, E. & R. SCHUH 2017. Käferfauna im Hartelsgraben. In: Maringer, A. & D. Kreiner (red.): NATURA 2000 – Europaschutzgebiete. *Schriften des Nationalparks Gesäuse*, 13: 175-182.
- BORER, M., ALVAREZ, N., BUERKI, S., MARGRAF, N., RAHIER, M. & R. E. NAISBIT 2010. The phylogeography of an alpine leaf beetle: Divergence within *Oreina elongata* spans several ice ages. *Molecular Phylogenetics and Evolution*, 57: 703-709.
- DIRNBÖCK, T., ESSL, F. & W. RABITSCH 2011. Disproportional risk for habitat loss of high-altitude endemic species under climate change. – *Global Change Biology*, 17: 990-996.
- FRANZ, H. 1974. Die Nordost-Alpen im Spiegel ihrer Landtierwelt IV. Universitätsverlag Wagner, Innsbruck-München, 707 pp.
- KOMPOSCH, Ch. 2010. Alpine treasures – Austrian endemic arachnids in Gesäuse National Park. – *eco.mont*, 2: 21-28.
- KOMPOSCH, Ch. & W. PAILL 2012. Endemiten im Nationalpark Gesäuse – alpine Schätze der Tierwelt Österreichs. In: Kreiner, D. & A. Maringer (red.): Erste Dekade – *Schriften des Nationalparks Gesäuse*, 9: 62-69.
- LANDESAMT FÜR UMWELTSCHUTZ SACHSEN-ANHALT 2002. Die Lebensraumtypen nach Anhang I der Fauna-Flora-Habitatrichtlinie im Land Sachsen-Anhalt. – *Naturschutz im Land Sachsen-Anhalt*, 39 (Sonderheft), 368 pp.
- NEUHÄUSER, L. 1993. Die Palpenkäfer der Steiermark aus landesfaunistischer und ökologischer Sicht. – Diplomarbeit an der Naturwissenschaftlichen Fakultät der Karl-Franzens-Universität Graz, 345 pp.
- ÖKOTEAM – KOMPOSCH, Ch., FRIESS, T., HOLZINGER, W. & W. PAILL 2009. Tierische Endemiten im Nationalpark Gesäuse. Auftreten ausgewählter endemischer und subendemischer Spinnentiere und Insekten. Unpublished project report on behalf of the Gesäuse National Park GmbH, 140 pp.
- PAILL, W. & M. KAHLEN 2009. Coleoptera (Käfer). – In: RABITSCH, W. & F. ESSL (eds.): Endemiten – Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. Naturwissenschaftlicher Verein für Kärnten und Umweltbundesamt GmbH, Klagenfurt und Wien, pp. 627-783.
- RABITSCH, W. & F. ESSL (eds.) 2009. Endemiten – Kostbarkeiten in Österreichs Pflanzen- und Tierwelt. – Naturwissenschaftlicher Verein für Kärnten und Umweltbundesamt GmbH, Klagenfurt und Wien, 924 pp.
- WAGNER, H. C.; KOMPOSCH, C., AURENHAMMER, S., DEGASPERI, G., KORN, R., FREI, B., VOLKMER, J., HEIMBURG, H., IVENZ, D., RIEF, A., WIESMAIR, B., ZECHMEISTER, T., SCHNEIDER, M., DEJACO, T., NETZBERGER, R., KIRCHMAIR, G., GUNCZY, L.W., ZWEIDICK, O., PAILL, W., SCHWARZ, M., PFEIFER, J., ARTHOFER, P., HOLZER, E., BOROVSKY, R., HUBER, E., PLATZ, A., PAPPENBERG, E., SCHIED, J., RAUSCH, H.R., GRAF, W., MUSTER, C., GUNCZY, J., FUCHS, P., PICHLER, G.A., ALLSPACH, A., PASS, T., TEISCHINGER, G., WIESINGER, G. & D. KREINER 2016. Bericht über das zweite ÖEG-Insektencamp: 1019 Wirbellose Tierarten aus dem Nationalpark Gesäuse (Obersteiermark). – *Entomologica Austriaca*, 23: 207–260.

Contact

Sandra Aurenhammer, Christian Komposch
aurenhammer@oekoteam.at; c.komposch@oekoteam.at
ÖKOTEAM – Institute for Animal Ecology and Landscape Planning
Bergmannsgasse 22
8010 Graz
Austria
<http://www.oekoteam.at>

Daniel Kreiner
daniel.kreiner@nationalpark.co.at
Nationalpark Gesäuse GmbH
Naturschutz & Naturraum
Weng 2, 8913 Admont
Austria
www.nationalpark.co.at

MIT UNTERSTÜTZUNG DES LANDES STEIERMARK UND DER EUROPÄISCHEN UNION



Europäischer
Landwirtschaftsfonds für
die Entwicklung des
ländlichen Raums:
Hier investiert Europa in
die ländlichen Gebiete

