

# **The beetles of the county of Salzburg - a contribution to the survey of European invertebrates (Coleoptera)**

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## **Abstract**

Recently the author has published the book ‘Die Käfer des Landes Salzburg – Faunistische Bestandserfassung und tiergeographische Interpretation’ (‘The beetles of the county of Salzburg – faunistic survey and zoogeographical interpretation’). It contains more than 30 000 records, covering a period of more than 100 years. This large amount of information, combined with the co-operation with ZOBODAT (Linz, Austria), made it possible to conduct some statistical and biogeographical analyses. The county of Salzburg covers 7153 km<sup>2</sup>, less than 1% of the area of central Europe. It was almost completely covered with ice during the last ice age period until 18 000 years ago. Despite this, 3750 beetle species have been found in the area. The main cause for this relatively high number of species is the high degree of heterogeneity of the landscape in the county of Salzburg. Besides, the analysis of the distributional ranges of the beetles of Salzburg reveals that most of them occupy a very large range, which indicates a high dispersal capacity.

This faunistic study of beetles was published in the German language, because it will predominantly be used by colleagues from German speaking countries. Nevertheless, the book can also be used by entomologists without or with very little knowledge of the German language. The general chapters are richly illustrated and the distribution in Salzburg of 154 beetle-species is figured in grid maps. The recording sites are registered in an index, containing precise data on the locality including the coordinates according to a small scale grid. This comprehensive work of more than 700 pages can be considered as a contribution to the survey of the European invertebrate fauna.

Key words: Coleoptera, faunistics, biodiversity, Austria, Salzburg, Alps, biogeography.

## **Introduction**

Faunistic research on Coleoptera has a long tradition in Central Europe. For most of the counties comprehensive studies exist, most of them written decades ago. These were updated from time to time by articles in local journals. Such intentions have also existed for the county of Salzburg, but a comprehensive study on the Coleoptera fauna was never published until 2001. Because of the accumulation of the information, this study grew to a book with more than 700 pages, which also contains some results of a zoogeographical analysis on the beetles of this small part of central Europe (Geiser 2001).

The county of Salzburg covers an area of 7153 km<sup>2</sup>. It is part of the Federal Republic of Austria (fig. 1). From the view of a biogeographer it has the disadvantage that both the capital and the county are named Salzburg. In this article ‘Salzburg’ always means ‘county of Salzburg’.

## **Data sources and methods**

For this first comprehensive study on the Coleoptera of Salzburg it was necessary to collect all faunistic data from a period of more than 100 years. An important data source are insect collections. There are three important Coleoptera collections with a large amount of specimens from Salzburg, but more than 60 other collections were screened.

A lot of additional faunal information is scattered in papers and books. More than 200 publications could be found with more or less important faunal data from Salzburg.

The third important data source is the unpublished information from coleopterologists, which was gathered for their own research and for studies on behalf of nature conservation authorities. To obtain these records, it is necessary to know these coleopterologists, and they have to know the author. Otherwise you would not get the informa-

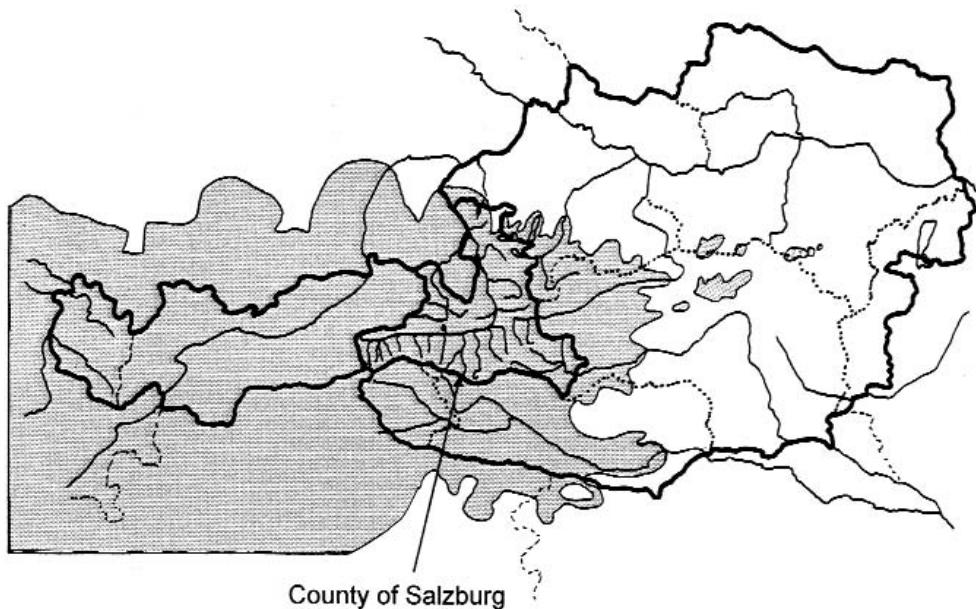


Figure 1  
The eastern Alps during the Würm-glacial period, 20 000 years b.p.

tion and the permission to publish it. The author also has to decide whether this information is reliable.

The major part of the data collected from these sources was also sent to ZOBODAT (former: ZOODAT) in Linz.

Of course it is impossible to check every specimen in the screened collections. Besides, even if you are careful, you would not know whether the published or the unpublished records have all been identified correctly. If you collect data from

a period of more than 100 years, even well identified specimens may belong to other species now, because of taxonomic revisions. Therefore, before the manuscript was finished, more than 50 renowned coleopterologists of central Europe were asked to have a look at that part of the manuscript which deals with their own taxonomic group. The coleopterologists quickly found the main mistakes, so these could be removed before the statistical analysis was started.

Table 1

Percentage of area and number of Coleoptera species of the county of Salzburg in comparison with Austria and some other countries and areas of Central Europe.

	number of Coleoptera species	Salzburg: percentage of of the area	Salzburg: percentage of the number of species
Central Europe	~9000	< 1%	40%
Germany	6479	2%	55%
Bavaria	5456	10%	65%
Austria	7379	8.5%	48.2%
South Tyrol	4475	96%	80%
Slovenia	6000	35%	60%

### Numbers of records, species and records per species

For the county of Salzburg 3750 Coleoptera species have been recorded. This is the result of the collection of more than 30 000 records, most of which are published for the first time. These records are very heterogeneously distributed over the area of Salzburg (fig. 3).

The number of records per species is also very varied (fig. 2). For 624 species only one record is known, while 453 are represented by only two records. For 17 species more than 90 records could be found.

### Statistical analysis

There are several definitions of Central Europe, but the area of the county of Salzburg is always

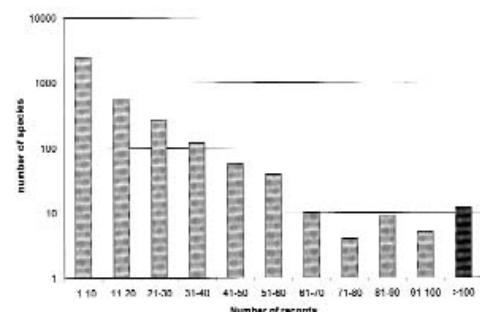


Figure 2  
Frequency of records of the Coleoptera species from the county of Salzburg on a logarithmic scale.

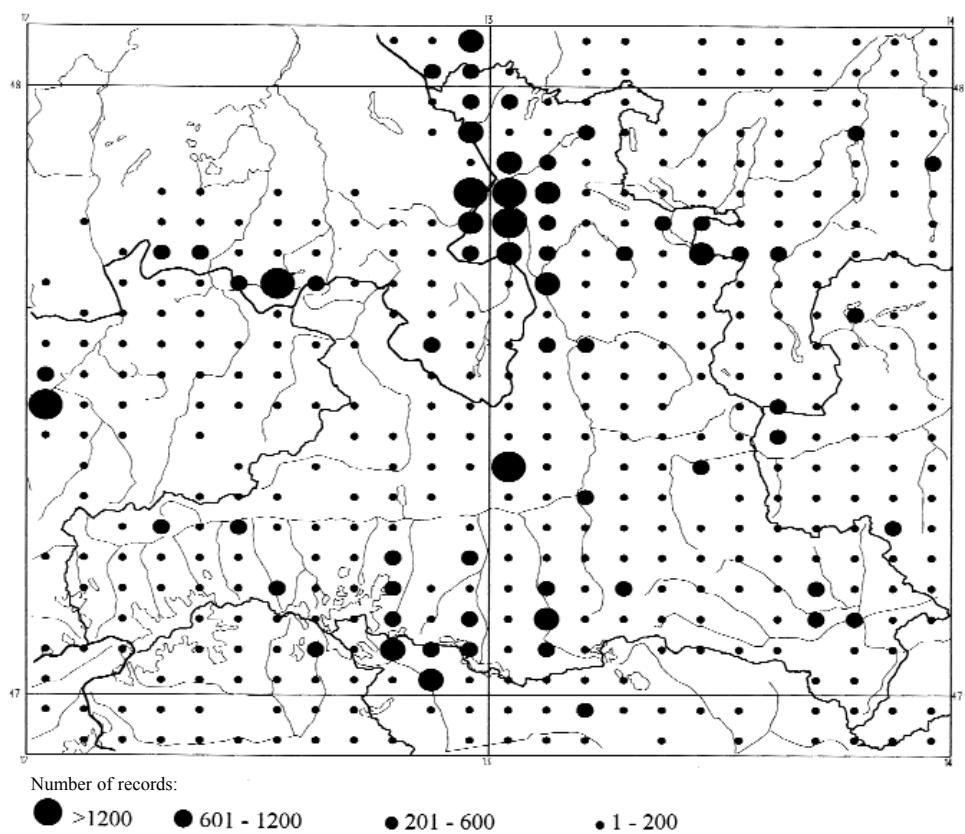


Figure 3  
Frequency of records of the Coleoptera fauna from the county of Salzburg in square grids of 3 x 5 arc minutes (about 6 x 5.5 km). Map produced by ZOBODAT (Linz, Austria), 26.i.2001.

smaller than 1% of the area of Central Europe. In comparison with other European areas at nearly the same degree of latitude, 3750 beetle species is a relatively high number for such a small county (table 1).

### Zoogeographical analysis

There are always several factors which have an influence on the recent distribution of species. In Central Europe, especially in the Alps and their surroundings, the most important factor was the ice age, especially the Würm period, when the glaciers covered large parts of central Europe until 18 000 years ago (fig. 1). The area of

Salzburg was almost completely covered with thick glaciers, except for a few species that survived on mountain tops (nunatakr species). It seems paradoxical that this recently devastated area is inhabited by a relatively high number of species, in comparison with counties of the same degree of latitude without such glacial devastation. What is the reason for such a high number of Coleoptera species in Salzburg?

#### 1. High diversity in orography and geology and climate

Salzburg is an orographically very heterogeneous area of central Europe (fig. 4). There are low-

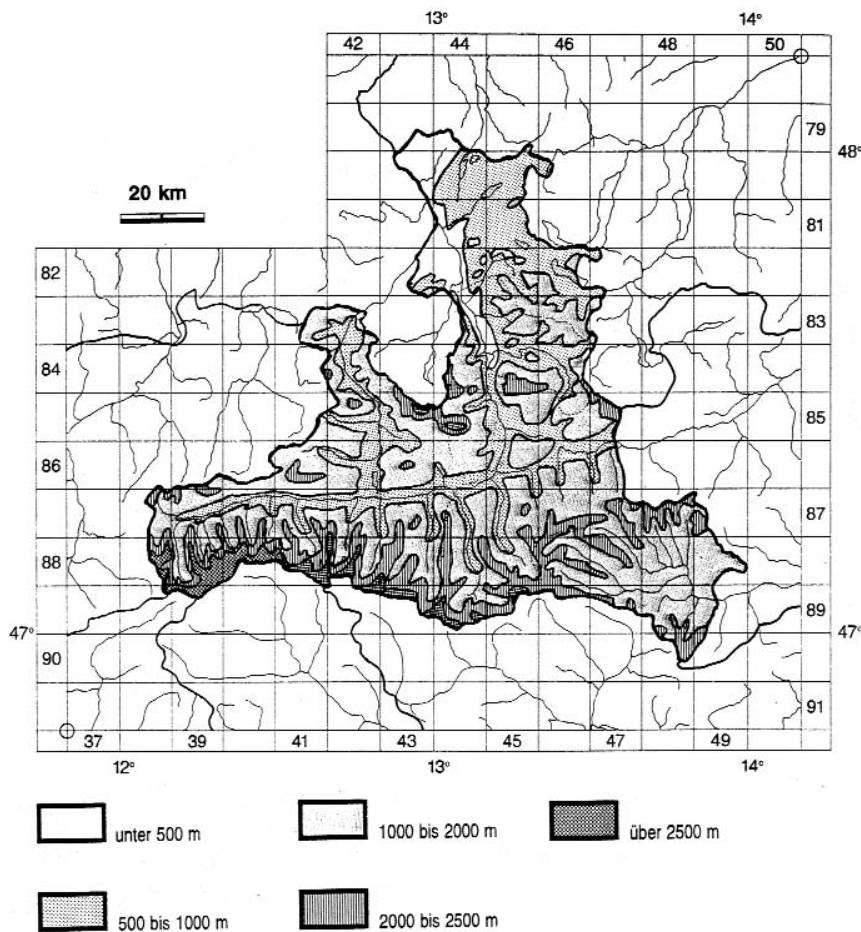


Figure 4  
Orographic diversity of the county of Salzburg.

lands (only 400 m altitude) with alluvial forest regions and also some high mountain massifs with very diverse geology: the northern calcareous Alps with special soil conditions and vegetation, which differ in many features from the central Alps with silicate minerals and special landscape types. There are several mountain areas of more than 3000 m altitude, the habitat of a very specialized fauna.

These mountain massifs cause a sharp gradient in the climate. The city of Salzburg is well known for its frequent rain (about 1300 mm a year), but in the northern calcareous Alps the precipitation is even more (2400 mm a year). On the contrary, in some parts of the central Alps the annual precipitation is less than 1000 mm. The driest region of Salzburg is the 'Lungau', which is situated south of the main ridge of the Alps. Some species which have their range in southern central Europe and even in southern Europe have been recorded there. As this dry region with a relatively high insolation is situated above 1000 m altitude, the typical xerothermic fauna, which occurs in the lowland of other counties of Austria, is absent.

## **2. Partition of the distribution types of the beetles of Salzburg**

The major part of the Coleoptera species of Salzburg have a very large range (87% have a range which covers more than Central Europe), 33% of the species are recorded from several parts of the Palearctic region (fig. 5). For these species we can assume a high dispersal capacity, so they resettled their habitats in Salzburg presumably within a few hundred years during the postglacial period. But the species with less dispersal capacity were also successful in the resettlement of their alpine habitats within a few thousand years (see also Geiser 1998).

Some remarkable species with a small range in central Europe have been recorded from Salzburg: 81 species endemics of the Eastern Alps and 37 arctoalpine species. Their contribution to the number of species in Salzburg is very small, but these Coleoptera species are of interest for biogeography, systematics and nature conservation.

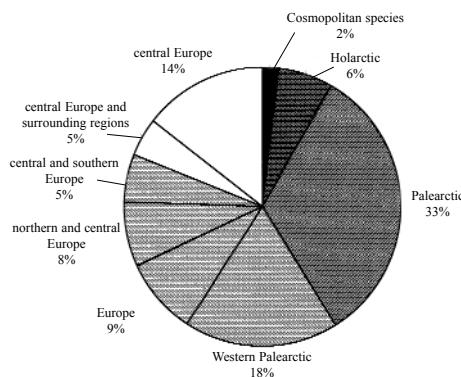


Figure 5  
Partition of the distribution types of the beetles of Salzburg.

## **Further information about the comprehensive faunistic study on the Coleoptera of the county of Salzburg**

Here it is only possible to give some hints of the results of this study of the Coleoptera of Salzburg. This book is a detailed survey of every record of beetles from Salzburg and also from sites in the immediate surrounding parts, which the author got to know until December 2000. In almost 500 pages you will find for more than 3750 species the exact site and the exact data source of the records, as well as the date, the collector and the identifier, as far as this information was available. One chapter deals with records which were published erroneously on the Coleoptera fauna of Salzburg. All mentioned geographical sites are listed alphabetically in the geographical index with further information on the exact site, the geographic grid and, if necessary, with further remarks on geographic homonyms.

This book is published in German, because most of the coleopterologists who will be interested in this information are German speaking persons. But this book is also useful for entomologists without or with only little knowledge of the German language. You will find the beetle species by their scientific names. The taxonomy is used consequently according to the well known series by Freude-Harde-Lohse 'Die Käfer Mitteleuropas', volume 1 to 11 and the supplementary volumes 12 to 15. The sites of the records can be found

easily on a map of Salzburg by the detailed geographic index. The chapters describing the orographical, geological and climatic conditions of the county are illustrated with many thematical maps. The other chapters contain a large variety of diagrams, maps and tables. For 154 frequently recorded species you will find grid maps of their distribution.

The European Invertebrate Survey has the ambitious goal to make European distribution maps for all invertebrates and the approach is only possible step by step. This Coleoptera fauna of Salzburg is such a step, for a very small part of

Europe, but for a large and important group of invertebrates.

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