

Springs in Gesäuse National Park - Hotspots of biodiversity

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Abstract

Over ten years research on springs and headwaters in Gesäuse National Park (Styria, Austria) produced an overview on biodiversity in the area. Many species found represent first records for Austria or new species. This knowledge will guide to understand distribution of species and their demands on habitats as a base for future conservation. In the course of these investigations, a case study focussing on water mites, black flies, and caddis flies, allowed to get insight into the process of first colonization of a newly originated spring. This habitat is now going to be covered with gravel again. The results can give an insight of how spring fauna react to changes.

Keywords

Biodiversity, spring habitats, newly originated habitat, succession

Introduction

Over ten years of research on spring habitats and headwaters in the Gesäuse National Park helped to fill a huge gap in our knowledge of the water fauna of the Austrian Alps: A large-scale approach allowed the documentation of more than 100 springs and headwaters, in addition about 70 stream sectors and 32 standing water bodies were also studied. In spring habitats, a total number of eight species new to science, and much more than 100 previously unknown for the Austrian fauna were detected. The still ongoing inventory helps to understand altitudinal zonation, zoogeography and ecology. Furthermore, it provides a thorough base for future monitoring of potential environmental change under the stable conditions of a protected area. This paper gives a survey of the composition of the spring fauna in the area, and provides a case study of first colonization of a newly originated spring habitat. This part of the study concentrates to three groups of invertebrates strongly differing in biology and relationship to spring habitat:

1. Water mites (Hydrachnidia and Halacaridae) are insect parasites at the larval stage and predators as nymphs and adults. Many species have a particular relationship to spring habitats as crenobionts or crenophiles.
2. the filter feeding larvae of black flies (Diptera Simuliidae: adults are blood sucking parasites) are generally considered as untypical for spring habitats. Due to their nutrition style, many species are crenoxenes and their presence in springs may indicate particular water quality condition. However, several very interesting species have specifically adapted to this type of habitat.
3. An insect order including a wide variety of taxa with diverging habitat preferences are the caddis flies (Trichoptera). A considerable number of species has a particular preference for headwaters and springs. Here, due to their wide range of adaptations Trichoptera communities are extremely suitable as ecological indicators.

Methods

Springs in the Gesäuse National Park are small biotopes covering in average seven sqm, the half of them less than two sqm. As, due to mosaic-like microhabitat structures Surber sampling would produce little representative results and lead to long lasting damage (GERECKE et. al. 2012), hand net sampling was applied, spot checking submerged benthos from representative small sectors differing in microhabitat quality. In order to complete biodiversity documentation, emerging and flying insects were hand-netted in the surrounding of springs (GERECKE et. al. 2012).

At selected sites, emergence traps were placed for a one-year-period and emptied twice the month. They are equipped with data loggers for temperature of water and surrounding air.

Results

Over 100 of the more than 600 registered springs were investigated by changing groups of specialists during yearly organized research meetings. In parallel, 70 stream sectors and 32 standing water bodies were also studied. Until now much more than 100 species new for the fauna for Austria could be detected including eight species new to science.

About 300 species of Diptera were found, with some described at first time worldwide (See Fig. 1). 110 species of chironomids are registered with more than 25 new for Austria (Reiff, pers. comm. Feb. 2016). More than 60 stone flies (Plecoptera) were detected with one new species. Caddis flies (Trichoptera) are wide spread with about 80 and mayflies (Ephemeroptera) with 13 species. From more than 10.000 studied specimens of mites 110 species could be determinate including one halacarid new to science

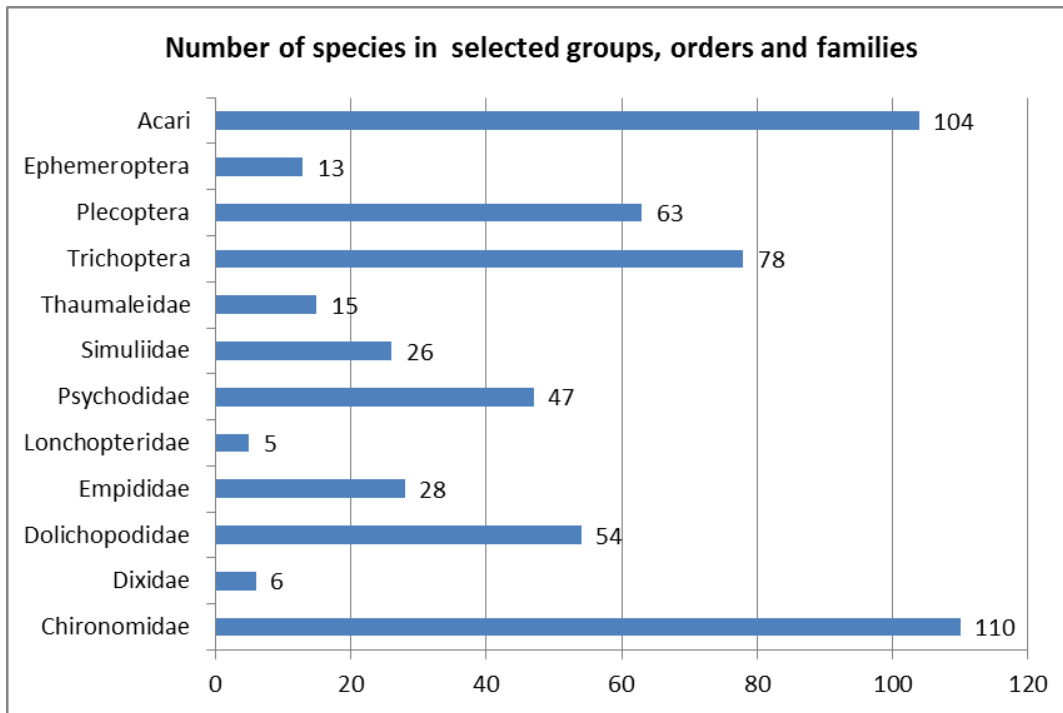


Fig 1: Species numbers in selected taxonomic groups in springs of the Gesäuse National Park.

Special case: GSENG spring - primary colonization of a newly developed spring habitat

The spring in GSENG is situated in an abandoned gravel-pit and existed in 2008 as pure groundwater outflow. The location had been stable, but composition and position of substrata continuously shifted due to excavation works. Monitoring started in 2009 with seasonal insect net collection. Since 2012 annual benthos samplings were made and an emergence trap equipped with data logger for temperature of air and water was installed (See Fig. 2). During that time vegetation grew up with mosses, willows and higher plants. In May 2014 substrata in the surrounding area began to get instable and covered a part of the spring and in consequence the emergence trap too (See Fig. 3). This process of continuously shifting is still going on. In August 2017 the trap was totally covered by gravel and had to be removed.



Figure 2: Primary colonization of GSENG Spring - only some mosses and algae are growing. Picture: H. Haseke, 2012



Figure 3: Situation in 2017 - mosses, willows and higher plants form a rich spring habitat - which is covered by gravel from both sides. Picture: C. Remschak, 2016

Results

Regarding the number of individuals chironomids dominate in all years (see Fig. 4). The numbers of stone and caddis flies (Plecoptera, Trichoptera) rised first but are reduced since 2014, when spring and emergence trap began to be covered by gravel.

1. Only one water mite species (*Sperchon thienemanni*) is dominant, while six other species were found in single individuals.
2. Totally seven species of black flies (Simuliidae) were detected. Their appearance showed an sucession (see Fig.5).
3. In total five species of caddis flies (Trichoptera) were found. In 2013 four species emerged, 2016 only two.

Discussion

With regard to its number of endemic taxa (70, among them 46 endemic animal species), the Gesäuse National Park has a leading position in Austria (RABITSCH & ESSL 2009). High diversity and density of endemites are best explained by the situation of the area during and after the last ice age, when it was situated at the east edge of the gigantic alpine glacier (GERECKE 2012).

Springs are attractive for species with particular ecological needs. They are:

1. refuges for species with a specific habitat preference (stable flow and temperature conditions, particular electrolyte composition).
2. island habitats for terrestrial species bound to a particular degree of humidity (wood- and grassland insects e.g. of the families Mycetophilidae, Sciaridae, Syrphidae). Many semiterrestrial representatives of several dipteran groups prefer the surrounding of springs or wet wood submerged in spring waters (Dolichopodidae, Chironomidae, Psychodidae, Stratiomyidae).

In GSENG spring pioneer colonization takes place since 2008. Initially water appeared at the spring mouth without any vegetation, gradually a spring habitat established. Recently a process of natural covering by gravel began. The colonization process is documented in three examples:

1. Water mites: Quick appearance and mass development of *Sperchon thienemanni* which is parasitic on chironomid diptera. The species build up a stable population since the first investigation, other species were found as casual single individuals only (Gerecke, pers. comm. 2017).
2. All species of black flies (Simuliidae) are typical for hypocrenal or epirhithral streamsectors (Seitz 2017, pers. comm.). They showed a strong succession from year to year. After a first, quick colonization by different species, *Simulium cryophilum* and *S. beltukovae* became eudominant. Two species which are rare in the area appeared later: *S. aureum*-group and *S. petricolum*, a species only known from one other spring in the National Park. In 2014 species number and population size of black flies were found reduced, maybe due to covering of gravel over the spring.
3. The caddis fly (Trichoptera) fauna was counted four species in 2013, with *Wormaldia copiosa* dominating. *Drusus monticola*, *Wormaldia copiosa* and *Micropterna sequax* disappeared in 2014 and *Plectrocnemia geniculata* dominated. In 2016 *Allogamus uncatatus* appeared for the first time. This data suggest a succession process: After a first quick colonisation by different species, diversity is reduced to a few species after covering the emergence trap by gravel.

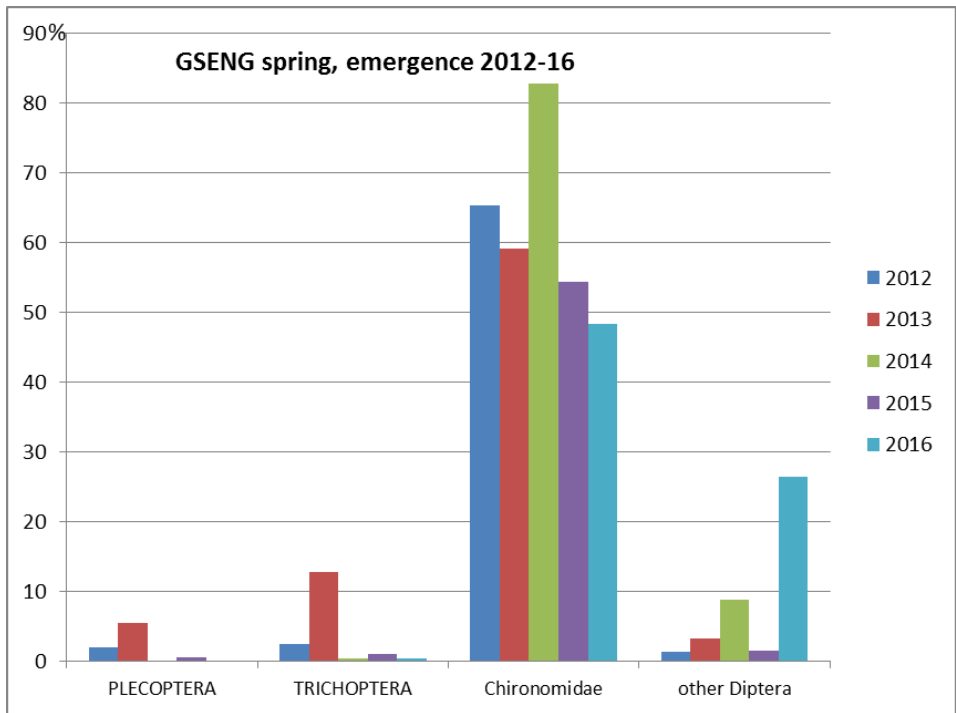


Figure 4: Composition of the emerging insect fauna (Plecoptera, Trichoptera, Chironomidae, other Diptera) in GSENG spring 2012-16 based on number of individuals in percent.

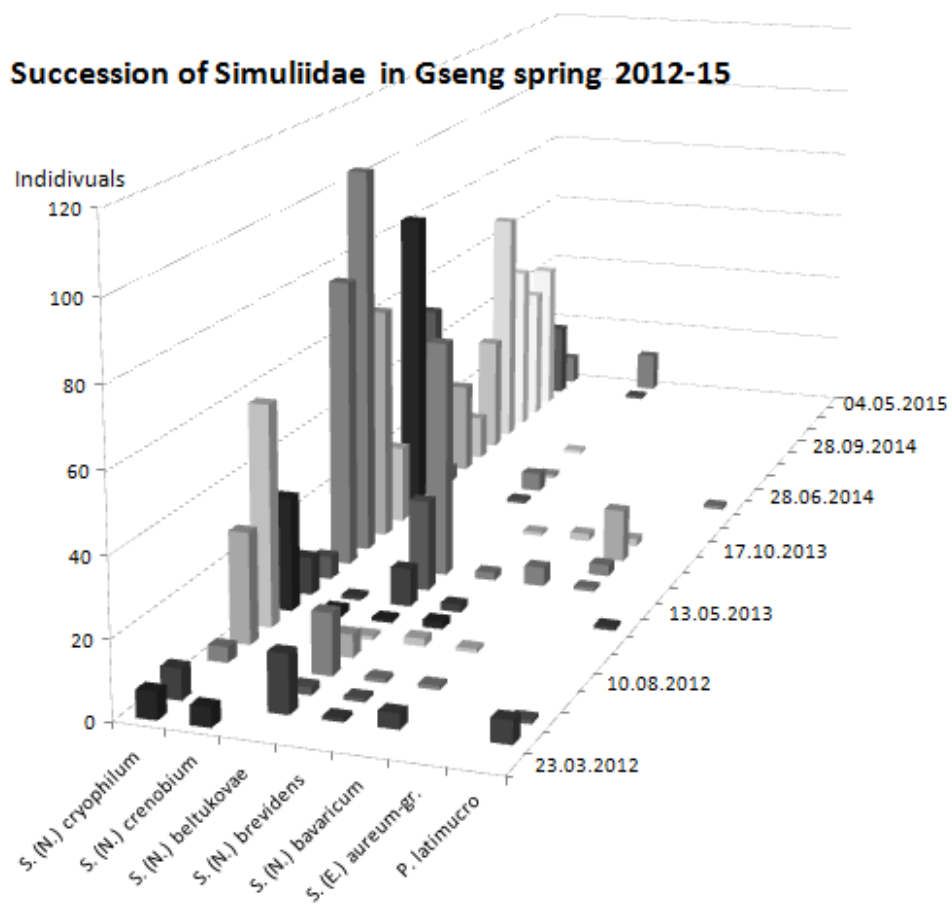


Figure 5: Succession of black flies species (Simuliidae) in GSENG spring from 2012-15. Data: G. Seitz, Grafik: C. Renschak, 2017.

Conclusion

The main topics of spring research in Gesäuse National Park are:

1. A zoogeographical interpretation at minor and larger scales.
2. An ecological analysis of species distribution patterns along transects from springs to streams may lead to better understanding of habitat preference (crenobiont, crenophile, crenoxene species).
3. Providing ecological data from case studies
4. Providing faunistic data for future monitoring (changes in species composition, longitudinal and altitudinal zonation)

In order to gain more data from a wide geographic range a spring monitoring should be installed inside the network of Alpine National and Natural Parks. Documentation with standard methods should become established also in protected areas of other European mountain ranges and on other continents. Due to lack of documentation, our knowledge on potential faunal exchange between, and recolonization of springs is extremely scanty. The special case of GSENG spring may give answer to how springs react on (natural) changes.

References

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