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Ecology of springs in the Swiss National Park: first results and future plans

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Abstract

In protected areas springs are usually still pristine. They are important refuges for species which elsewhere are endangered. Protected areas can be seen as flagship areas within a widely managed, anthropogenically altered landscape. For venturing future predictions and proposing possible counteractions two prerequisites are needed: We need to know the status quo in springs and we need to conduct long-term monitoring projects in order to understand future developments. I will present first results and future plans from springs and their inhabitants in the Swiss National Park.

Keywords

Macroinvertebrates, spring ecology, long-term monitoring, Swiss National Park

Introduction

Springs are ecotones between the groundwater and the surface water and provide a habitat for specialised species due to constant environmental conditions (GERECKE & FRANZ 2006). Owing to environmental changes and anthropogenic impacts springs are highly endangered. Alpine springs are especially sensitive habitats as they often exhibit a high degree of individuality (BONETTINI & CANTONATI 1996) and usually have a small spatial extent (CANTONATI et al. 2006).

The Swiss National Park (SNP) was founded in 1914 and has been subject to total nature protection since then. As research is one of the main aims of the Park, the fauna and flora is well investigated. Scientific research on springs in the SNP mostly focused on chemical and physical parameters in the past decades (e.g. NOLD & SCHMASSMANN 1955). Only NADIG (1942) intensively investigated the fauna of five springs around Il Fuorn.

Fifty-seven springs have been monitored faunistically in the SNP during the past five years. From all springs the fauna was sampled quantitatively and physico-chemical as well as structural parameters were measured. An explicit aim was to assess the function of the SNP as a refuge for endangered species and to provide a data basis for a long-term monitoring of undisturbed springs at high altitude.

Methods

The park area measures 172 m². The geology mainly consists of limestone (TRÜMPY et al. 1997), the isolated Macun plateau is of granite origin. The altitudinal range of the investigated springs varies from 1600 m to 2600 m a.s.l..

Of each spring at least four quantitative samples were taken with a surber-sampler (10 x 10 cm; 500 µm mesh). Additionally a qualitative sample was taken. Water temperature, pH, oxygen and electrical conductivity were measured using portable meters. The springs were mapped using the evaluation sheet of LUBINI et al. (2014).

For a long-term monitoring continuous analysis of physical and chemical parameters is inevitable. Data loggers are useful tools, which have proven to provide reliable data (e.g. KÜRY et al. 2017; VON FUMETTI et al. 2017a). Additionally ions such as K^+, Ca^{2+}, Mg^{2+}, SO_4^{2-}, F^-, HCO_3^- will be measured annually. The faunistic monitoring includes all taxa, also meiofaunal elements such as copepods and water mites. For an accurate determination the knowledge of experts and the application of genetic analyses are needed. Certain taxa such as caddisflies or water mites may be in focus of specific research questions.

Results

Substrate composition varies considerably and is mostly influenced by altitude (VON FUMETTI et al. 2017b). Water temperature in the springs varies from <4 °C to >15 °C in some springs at Macun. The pH is around 7 and the electrical conductivity is mostly between 200 and 450 µS/cm. Owing to the geology the springs at Macun have a much lower electrical conductivity (<50 µS/cm).

Over 120 species and higher taxa were identified, of which 72 taxa were determined to species level. The most diverse order were Trichoptera (33 taxa), Plecoptera (20 taxa), and Acari (20 taxa). Among the Ephemeroptera, Plecoptera and Trichoptera 21 of 48 species are listed on the Swiss Red List (LUBINI et al 2012). This is mostly due to their strong restriction to springs. *Apatania helvetica* was detected in the SNP for the first time in the springs at Punt Periv and the Clemgia valley.

Especially high diversity was found among the Drusinae: 8 different species were identified. For implementing a long-term monitoring the development of a data base is very helpful. Just recently such a data base for springs in the SNP has been developed (RUGGLI 2017). Over 700 springs were recorded in the past 100 years. From those, only about 10% were monitored faunistically. Moreover, only six springs were monitored several times and only hydrological data were measured.

Discussion

Electrical conductivity was determined as an important environmental factor differentiating springs at the Macun plateau from springs in the main part of the SNP. Owing to the harsh conditions at high altitude Macun springs are sparsely populated. Therefore Macun springs will not be selected for a long-term monitoring. The only limnocrene in the SNP has already been described by NADIG (1942). It is characterised by an extremely high electrical conductivity, mostly resulting from high sulfate concentrations, which makes it hostile for invertebrates.

Overall, eight different *Drusus* species were found. As they are often restricted to small distribution areas and are typical cold-stenothermic species, they are valuable bioindicators (WARINGER & GRAF 2011). An emphasis should be therefore placed on their monitoring in the upcoming long-term monitoring. Water mites are the most intensively investigated taxon in the SNP. The Wegerhaus spring was investigated several times by Carl Bader in the past decades. Recent results show that a species shift happened and the number of species decreased considerably (STEINER 2017).

Long-term monitoring projects of streams are scarce. The Breitenbach, a brook in the low mountain ranges of Germany, was investigated intensively over several decades (WAGNER & SCHMIDT 2004). In the Alps, over 300 springs in the Berchtesgaden National Park were monitored (GERECKE & FRANZ, 2006). In Berchtesgaden the aim was to attain a general overview of all springs in the park. In the SNP we want to identify springs which represent perennial, undisturbed springs at high altitude. We will monitor selected springs over several decades to be able to predict long-term developments of their hydrological conditions and their fauna. The selection of representative and well investigated springs – faunistically as well as hydrochemically – is a crucial aspect for obtaining reliable long-term data.

Conclusion

Compared to other alpine regions, the springs in the SNP are totally protected and suffer only minor anthropogenic impact. Considering Global Change and anthropogenic impacts the SNP provides a refuge for crenobiontic and cold-stenothermal freshwater species. This is an important prerequisite for the implementation of a long-term monitoring as it is planned in the SNP.

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