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Alpine Ökosysteme im Schweizerischen Nationalpark: Die Seenplatte Macun [Alpine Ecosystems in the Swiss National Park: The Macun Glacial Cirque and Lake Area]. Edited by Stefanie Gubler and Christopher T. Robinson

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This book offers a detailed insight into the habitats, ecosystems, and species of a high alpine landscape characterized by block glaciers and mountain lakes, which was incorporated into the Swiss National Park at the beginning of this century. The Swiss National Park, founded 111 years ago, pioneered the idea of protected areas in the form of national parks in Europe and was the first one in the Alps (Swiss National Park n.d.). From its outset, the park combined an extended concept of nature conservation, involving the protection of biotic resources, including the natural processes of the geo-ecosystem, with interdisciplinary research. This included setting up permanent observation plots at medium to high elevations within and adjacent to the park as early as the 1910s and 1920s.

While the mountains within the boundaries of this strictly protected area consisted almost exclusively of carbonatic bedrock, mainly dolomite, the park was expanded to include an alpine area of crystalline bedrock approximately 25 years ago. This territorial expansion, known as "Macun Kar," encompasses a scenic high alpine catchment located above the village of Zernez, to the northeast, draining northward to the Inn River. The high-elevation cirque, which is rich in lakes, is located between 2600 and 2700 masl and surrounded by a mountain ridge ranging from 2800 to more than 3000 masl. Although comprising little more than 2% of the park's area, it is representative of a glacier-formed high-mountain cirque in the siliceous Eastern Alps.

The richly illustrated book vividly describes the landscape, its geology, geomorphology, climate, and different terrestrial and aquatic habitats, as well as their organism groups, based on interdisciplinary monitoring and research work conducted in Macun during the past 25 years. The 52 contributing authors are from various academic disciplines and institutions, thereby reflecting the interdisciplinary nature of the work presented.

The introductory section contains a detailed account of the use of the area prior to its incorporation into the national park. Because of Macun's high elevation, it was used only to a limited extent and exclusively during the short midsummer season for grazing cattle. People visited the lakes for recreation, including fishing for various introduced species. Most critical was the decision of the Engadiner Kraftwerke AG, the regional electricity provider, to build a hydropower plant in the lake area. This construction project, however, was abandoned after the affected municipalities of Zernez and Lavin voted against it in the 1970s. Fortunately, the municipality vote was held after the introduction of women's voting rights in 1971, since women's participation was decisive in the result. One objection to the hydropower plant was that the area was home to the country's largest population of the tiny buttercup, *Ranunculus pygmaeus*, an arctic-alpine plant species that is particularly rare in Switzerland.

Climatically, the Swiss National Park is exposed to a significantly drier inner-Alpine climate, compared to conditions in the outer Alps. Temperature time series from the park's meteorological station, dating back to 1917, show that mean temperatures have increased by 2.1°C, well above the global average, and precipitation has declined since 2010. Measurements of snow depth reported from Macun, however, show that it remains stable on average, but that snowmelt occurs 15 days earlier. The geology of the area, with siliceous bedrock, such as gneiss and amphibolite, is described along with the geomorphology, which was shaped by glaciers; active rock glaciers are still a main feature in the landscape.

The soils and vegetation composition described differ greatly from those of the dolomite part of the national park. Typical siliceous soil types and plant communities are shown along with their patterns in relation to the geomorphology and the seasonal duration of snow cover. The most common plant communities belong to one of the following 3 alliances: *Salicion herbaceae*, snowbed communities with a late snowmelt; *Caricion curvulae*, siliceous alpine grassland communities in habitats of early to medium snowmelt and often stable conditions; and *Androsacion alpinae*, siliceous scree communities on less stable to mobile scree substrates that extend to the ridges surrounding the Macun cirque. All 95 locations of phytsociological surveys and 19 soil sample locations of the Macun area have been georeferenced and are thus suitable for future resampling. This complements the park's historical observation sites, established in the early 20th century, that partly overlap with summit sites of the international Global Observation Research Initiative in Alpine Environments (GLORIA) monitoring network, which studies the effects of climate change on alpine plant communities (GLORIA Coordination n.d.). Particularly noteworthy are the book's contributions on the rare arctic-alpine *Ranunculus pygmaeus*, lichen taxa, and

vertebrates, and especially the reports on various arthropod groups, including those living in soils, which have not often been sampled in the Alps to date, even though some are good indicators of climate change impacts on soil ecosystems.

Given the area's numerous alpine lakes, tarns, and small creeks, the book contains detailed chapters on the hydrology of surface waters and their aquatic life. Long-term measurements of freshwater habitats include physical and chemical compositions, as well as thermal conditions, showing lower temperatures in the surface waters of the southern part of the area, due to inflows from block glaciers, compared to those of the northern part that is not directly connected to glacial inflow. A separate chapter deals with alpine spring habitats, their water temperature, and invertebrate fauna, which does not strongly differ from those of the surrounding aquatic habitats. Studies of the aquatic plants and fauna of Macun include diatoms, zooplankton, and a range of different macroinvertebrates. Among them, 3 new species of *Orthocladiinae*, a subfamily of the nonbiting midges (*Chironomidae*), were described for Macun between the years 2018 and 2023. This points to the relevance of isolated glacial cold-water habitats in the Alps as hotspots of endemism, which have so far been understudied.

I can particularly recommend this book to readers interested in alpine ecosystems. It will make an important contribution to the continuation and advancement of ecological research in this high mountain region.

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