Limnological Research in the Swiss National Park

Research has been conducted in the Swiss National Park for over 80 years. Botanists and zoologists have been particularly interested in this area because of minimal human impact. It was not until the construction of hydroelectric power plants on the Spöl, creating the Lago di Livigno, that limnologists appeared on the scene. The current project is a "first" worldwide, where artificial flood events are being used in an attempt to revitalize the Spöl. The goal is to optimize the rest water regime and to restore the Spöl to its original condition as closely as possible.

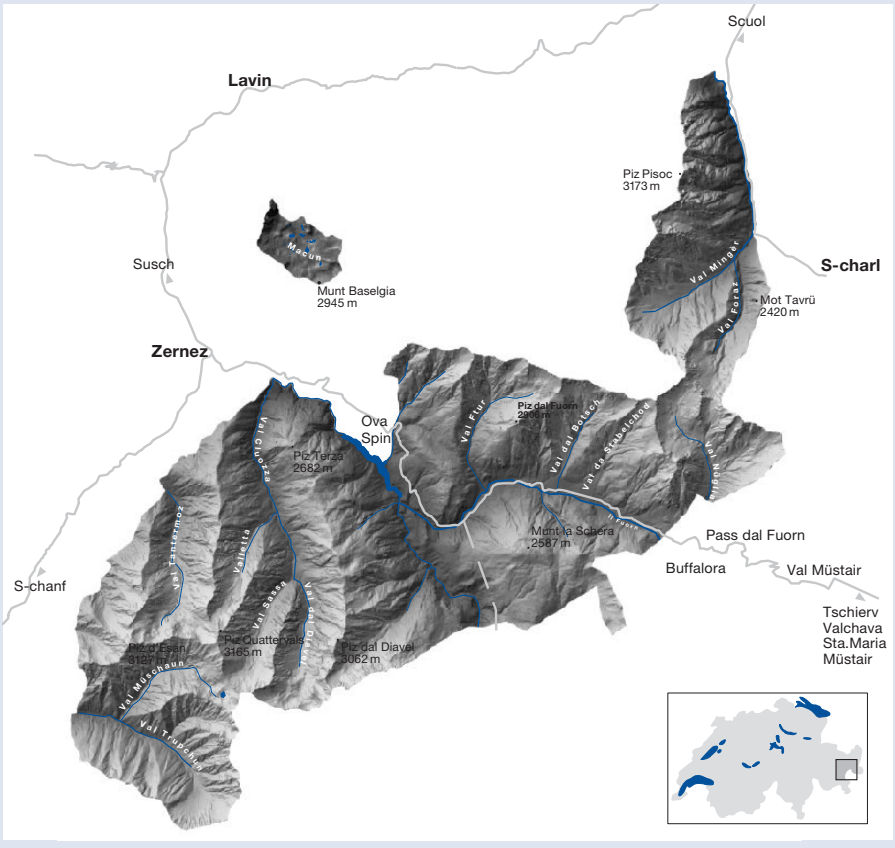
Streams and lakes in Switzerland are highly used and their natural flow regimes are altered to a large degree. Nature reserves are, therefore, especially important, both for studying natural processes and for assessing background impacts of regional and global environmental change (see box). The Swiss National Park, established in 1914, has only gradually assumed the role of a reference area.

Limnological Research Gained in Intensity after 1950

During the first few decades following establishment of the Park, limnological research was mostly limited to hydrobiologists who investigated the algal communities of springs and streams [1]. Limnological research within the National Park increased around 1950 with the onset of the planning process for hyrdroelectric power plants on the Spöl – water protection paradoxically being the trigger for more intensive limnological research even within the National Park. In 1952, a hydrobiological subcommission was formed within the Science Commission of the National Park. After this point in time, extensive chemical/physical investigations were conducted, resulting in the compilation of an inventory of approximately 100 springs in the Fuorn area and the determination of the water quality of these springs [2]. Three hydrological gauging stations were established within the Park in connection with the planning process for the hydroelectric power plants. These gauging stations are still in operation today and provide runoff data for the regulated Spöl and for the two natural tributaries, Ova Fuorn and Ova Cluozza.

Severe Impact: Construction and Operation of the Spöl Hydroelectic Power Plants

Despite strong opposition from environmental organizations and the National Park, the construction of the hydroelectric power plants on the Spöl could not be prevented. It would have been up to the scientific community to investigate the ecology of the Spöl before construction of the power plants and to establish a long-term monitoring program; unfortunately, this was not realized. Research at the time was limited



Map of the Swiss National Park.

P. Rey, HYDRA

The heavily impacted Spöl under resiual flow conditions.

to a few sporadic measurements before construction and only a few checks during the construction phase between 1960 and 1970. However, scientists did succeed in gaining a relatively generous rest water regime for the Spöl, providing 35 Million m^3 water per year. Even after the power plants started operations in 1970, research was limited to occasional studies (for example, a limnological study at the Livigno reservoir) and to checks on the biological condition of fisheries.

Dynamic Flow Regime for the Spöl

In 1990, the Engadin Power Plants released deep water from the Livigno reservoir, which provided an opportunity for scientific studies covering a wide range of disciplines. These studies revealed that the section of the Spöl within the National Park below the dam had gradually turned into a series of pools with fairly stagnant water. This development did not appear to be prevented even by occasional flushing events and draining of the reservoir. In addition, it was discovered that the smaller retaining reservoirs within the National Park functionally turned into additional wastewater treatment basins for the Upper Engadin since they received water from the Inn. After extensive discussions, the Science Commission for the National Park decided to revert this stream system, which is significantly impacted by sediment transport and deposition, back to its original condition as far as this is possible under the current conditions. The primary tool available for achieving this are artificial flood events. Due to good relationships between the board of directors for the EKW and the administration of the Canton Grisons, the first flooding experiments were conducted in 2000. Until 2002, three annual high water events are planned for the period between June and August. These experimental floods are accompanied by interdisciplinary research, with intensive collaboration by the Limnology Department of EAWAG (see also article p. 27). The purpose of these preliminary experiments is to optimize the environmental benefit, i.e., to achieve the highest ecological gain with the least amount of water [3].

The flooding experiments primarily use the monitoring system which was installed in 1996 and provide data for the heavily impacted Spöl and the relatively pristine Ova

Why and What Kind of Research in the National Park?

Research gave the impetus for creating the National Park: a piece of pristine nature was to be protected from human activity to serve as a study object for natural processes. The National Park has, therefore, a research mandate in addition to the environmental preservation mandate, a charge that was passed to the Research Council of the National Park (currently called FoK-SNP) by the Swiss Academy of Sciences (SAS).

Important research goals were and still are:
- **Comprehensive inventory of "nature" within the Park**
- **Observation of natural evolution or regeneration in the Park (long-term research, monitoring)**
- **Comparison with utilized areas outside the Park (reference area)**
- **Recognition of interdependencies between ecosystems (ecosystem research)**

Within this general framework, there are currently several interdisciplinary research foci:
- **The future of the National Park in times of global climate change**
- **The importance of disturbances in ecosystem development**
- **Hooved animals (Ungulates) in alpine habitats**
- **Interactions between society and the National Park**

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Fuorn. The monitoring efforts since 1996 provide the baseline information against which the effects of the artificial flood events will be evaluated. To our knowledge, this is the first time such an experiment has ever been conducted. The National Park provides an ideal setting for such an experiment, since hydroelectric power generation and environmental protection are the only two interests that have to be considered. Initial results indicate that one or two smaller flooding events per year, lasting one day and providing flows of 10–30 m^3/s, yield significant environmental improvements. We can only hope that artificial flooding events will soon be an integral part of rest water management in all of Switzerland.

Impulses from Acid Rain and Global Climate Change

Apart from hydroelectric power plant operations, an additional impetus for limnological research was provided after approximately 1970 by indications that atmospheric conditions are changing. Emerging evidence of acid rain led to chemical measurements and studies of algal vegetation in the Macun lakes in the late 1970s [4]. After the incorporation of these lakes into the National Park in 2000, we now have the opportunity to continuously monitor the condition and dynamics within the plateau containing these lakes, which is situated at an elevation of 2500 m. The Limnology Department of EAWAG will also participate in the development of this monitoring program.

In addition, preparations have been started for a systematic repetition of the measurements conducted in the 1950s, where the water quality of springs was investigated. This is a first step in assessing to what degree atmospheric changes, e.g., increased nitrogen emissions, have an effect on water below the ground. Another question will be, whether and how global warming affects the overall moisture content of mountain ranges.

Opportunity National Park: Reveal Long-term Processes

As the example of the National Park demonstrates, conflicts over water use and atmospheric impacts do not stop at the boundary of nature reserves. Limnological research is a crucial part of research in protected areas in at least two ways: first, long-term environmental changes impact aquatic ecosystems, and we need to know what effect these changes have on the condition of the streams and lakes; second, basic, well-founded information about aquatic ecology – for example that of the regulated Spöl or of the retaining basins – is an prerequisite for effective park management and preventative environmental and water protection. For the most part, we are dealing with questions that can only be answered by long-term investigations or monitoring programs. With respect to the research in the National Park, we hope that EAWAG will continue the current engagement in limnological research in the Park and will contribute to understanding long-term processes.

Thomas Scheurer is executive director of the Research Council of the Swiss National Park (a council of the Swiss Academy of Sciences SAS).

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