

The importance of long term monitoring in protected areas: The case of butterflies in the Swiss National Park

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Lepidoptera order, who counts more than 165'000 species in the world and about 3'660 in Switzerland (LSPN 1987; SAUTER & WHITEBREAD 2005), is classically divided into Macrolepidoptera and Microlepidoptera. The Macrolepidoptera are themselves separated in two groups: the Rhopalocera (Butterflies) and the Heterocera (Moths). In Switzerland, 196 species of Rhopalocera are considered as resident (GONSETH 1994).

Butterflies have long captivated amateur and professional scientists and more is known about them than is known about almost any other group of insects. They depend on resources and habitats that we can easily characterize. They have important links with vegetation (caterpillar's development and pollination by imagoes). They are relatively easy to census. But more important, they show variations in diversity and abundance from place to place, which may suggest the geography of their evolution. Moreover, changes in their number over time are powerful indicators of changes in their environment.

Between 1920 and 1941, Arnold Pictet conducted an elaborate study, in which he recorded the occurrence of Macrolepidoptera encountered across the Swiss National Park (SNP) and its surroundings (PICTET 1942). The Swiss National Park (SNP) was created in 1914 and a scientific research program in the SNP was first established in 1916 to allow scientists to increase our knowledge on this specific area. The SNP is situated in the eastern part of Switzerland (Canton of Grisons). Its surface of 172.4 km² is composed of 28% of forest, 21% of alpine lawns and meadows and 51% of bare rocks (<http://www.nationalpark.ch/>). Nature is therefore evolving more or less sheltered from human disturbances since about 100 years.

During 21 consecutive years, Pictet observed 102 species of Rhopalocera. More recently, new monitoring (in 1998, 2001 and 2004) updated Pictet's records and allowed tracing population dynamics since 1942 (PASCHE et al. 2007). The sampling method is an easy-to-use one, and well adapted to protected areas (GONSETH et al. 2007). It is based on 1 ha (specific diversity) and 0.25 ha (relative specific abundance) plots. Such plots are also well adapted for monitoring other taxonomic groups as for example Orthoptera, Spiders, Coleoptera or for botanical statements. In recent inventories, 89 species of Rhopalocera were recorded, representing 87% of the Rhopalocera diversity observed by Pictet and almost half of the Swiss Rhopalocera species. Butterfly diversity of the SNP remained almost unchanged for over 80 years. The SNP plays well its role of protection. Most of the species that were not re-sampled occur in habitats that were not involved in recent studies (e.g. forest or habitats under 1600 m). However, the monitoring revealed a decrease in the abundance of some species, in particular alpine species *Pontia callidice* (Hübner, 1800), *Euphydryas aurinia debilis* (Oberthür, 1909), *Euphydryas cynthia* (Denis & Schiffermüller, 1775) and *Melitaea asteria* (Freyer, 1828). For these four species, the contrast between 1920-1942 and nowadays is really impressive. According to Pictet, these species were common and well distributed in the whole park. Nowadays, only some specimens were observed. In addition, the distribution range of some species apparently shifted towards higher altitudes between 1942 and today (e.g. *Spialia sertorius* (Hoffmannsegg, 1804) observed 500 m higher in 1998 than in 1942). These results indicate that climate changes, such as global warming, may have a strong influence on the diversity, the abundance and the distribution range of SNP Rhopalocera species. That's the reason why in 2009, a detailed survey of *Spialia sertorius* (Hoffmannsegg, 1804) has been initiated in the SNP. The presence and reproduction of this species has to be confirmed and verified in particular in one valley (Val Trupchun) where it has shifted towards higher altitude. In parallel to that study, a new sampling area has been selected (6 plots) in high altitude grazed area (Val Mora). This future biosphere reserve adjacent to the SNP will bring more data for comparisons.

But these recent surveys have another objective. We dispose today of a network of reference plots for long-term monitoring of Rhopalocera. In 2006, some plots studied in 1998 or 2001 were re-sampled for the first time, providing the opportunity to monitor how the diversity and distribution of Rhopalocera species evolved during recent years. It appears that the populations of Rhopalocera are almost stable in SNP during this time interval. There are only small differences between comparisons (species not seem or new species encountered). We discovered three new species in 2006.

Long term monitoring of butterflies in the SNP and adjacent areas will become a very useful tool to the Park Direction towards management decisions.

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