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Larval monitoring of fire salamanders within a Sparkling Science Project

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Abstract

The mixed forest of the locally protected Aigner Park in the city of Salzburg, Austria, is a good example of a perfect fire salamander habitat. It provides ideal habitat conditions for the aquatic and terrestrial life of this threatened amphibian species. It was therefore chosen as the study site for long-term larval monitoring and for defining the best conditions for larval detectability. Monitoring started in 2010 in the Schwarzenbach first-order stream and is still in progress. In 2012, it was possible to show for the first time the dependence of larval detection rates on the time of day and on weather conditions. Hence, nightly counts in the main larval season (April–May), in combination with dry weather conditions, can be recommended for future larval monitoring studies. Involving local school children in the field work raised and increased their awareness of this amphibian species and nature protection in general. Once more it was shown that successful conservation is only possible by involving the public, starting with the children, who are responsible for future protection. Altogether, the Sparkling Science Project turned out to be a perfect way to attain this goal.

Profile

Protected area

Aigner Park

Mountain range

Alps

Country

Austria

Introduction

Amphibian populations are declining worldwide. The fire salamander *Salamandra salamandra* (Figure 1) is cited on the IUCN Red List and is considered a near threatened species in Austria and a vulnerable species in Salzburg (Kyek & Maletzky 2006). The first step to achieve effective protection is to analyse the exact distribution of the fire salamander. The Alpine Salamander Project was founded in 2009 with the main aim of collecting distribution data on fire and Alpine salamanders in Austria with the help of the public and of schools (Meikl & Reinthaler-Lottermoser et al. 2010). In the context of a Sparkling Science Project, 30 schools from all over Salzburg province were involved in field work as well as in research and the design of protection measures for salamanders. By now the database on www.alpensalamander.eu is the most comprehensive collection of fire salamander observations and has registered more than 4000 entries all over Austria since 2009. Based on the datasets, the locally protected Aigner Park in the south of the city of Salzburg was defined as the site with the highest density of fire salamander observations in the whole province of Salzburg. As this area provides perfect habitat structures for the aquatic and terrestrial life of fire salamanders, it was chosen as the site of regular larval monitoring. Moreover, the optimum conditions for registering larval fire salamanders were investigated to improve the method for future monitoring studies.

Figure 1 – Adult fire salamander (bottom) and fire salamander larva (top). © Julia Schauer

Study area

The Schwarzenbach, where regular larval monitoring was carried out, is about 1 265 m long and situated on the western slope of the Gaisberg, in the district of Aigen, in the south-eastern part of the city of Salzburg. It runs through a mixed forest with beech as the dominant tree species, at an altitude of 400–560 m. The stream is characterized by alternating pools, rapids and waterfalls, surrounded by a rich herbal layer and several small brooks (<50 cm wide). Big rocks (up to 3 m high) can be found throughout the entire wooded area or in the streams and can be considered as potential hiding or hibernating places for salamanders. Human influence at the monitoring site is moderate, also due to the fact that the Schwarzenbach forms the eastern border of the Aigner Park, a locally protected area (22.2 ha). As an old English-style country

Figure 3 – Salamander field excursions with primary schools. © Julia Schauer & Magdalena Meikl

park, it is protected mainly due to its cultural-historical significance and the richness of its natural landscape elements. Forestry activities are confined to thinning without clear cutting in the mixed deciduous forest. In 1971, it was declared the first Nature Park in Salzburg and has been a locally protected area *(Geschützter Landschaftsteil)* since 1980. The area is frequently used for all sorts of recreational activities. Even so, it presents high salamander density (Schauer 2011; Leitich & Müller 1997; Land Salzburg, Naturschutzbuch 2011).

Material and methods

The Sparkling Science School Project

Sparkling Science is a research programme of the Austrian Federal Ministry of Science and Research to support projects in which schools collaborate with scientists. The project involves 30 schools throughout Salzburg province (Figure 2). It intends to survey the current Alpine and fire salamander populations and to design and implement protection measures for salamanders and amphibians. Since 2010, 2500 children have been sensitized to salamanders by means of workshops, lab and field excursions. Aigen primary school (7–8 year olds, 18 children, plus teacher Alexandra Eibner) (Figure 3) helped with regular excursions to gain exact distribution data for adult and larval fire salamanders in Aigner Park. One pupil of secondary school BRG Salzburg participated in the scientific field work by monitoring the Schwarzenbach and in several rescue measures for desiccating larvae. A detailed overview of all partnerschools can be found under the following link: http://alpensalamander.eu/blog/?page_id=840&lang=de.

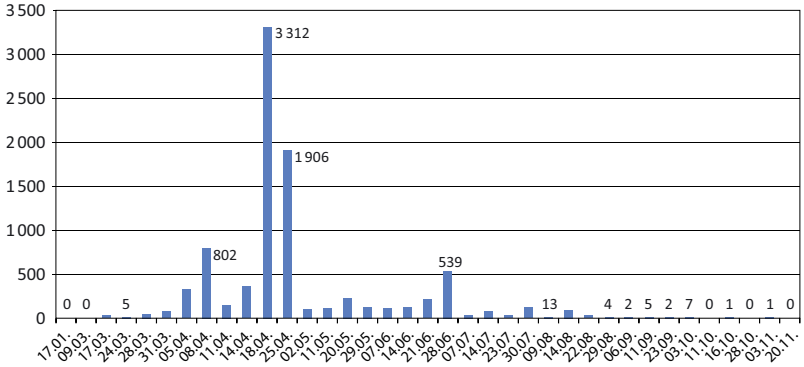

Figure 4 – Larval monitoring 2011. Night-time counts on 18.04., 25.04., 29.05., 28.06., 30.07., 14.08., 22.08., 29.08., 11.09., 23.09., 03.10., 16.10.; the rest was conducted at daylight.

Larval Monitoring

Regular monitoring of larval abundance was initiated in 2010, intensified in 2011 and continued in 2012 in the Schwarzenbach stream on Gaisberg. The monitoring site was defined as a 300 m long stretch of the stream, interrupted by 5 small natural waterfalls (each max. 3 m high). Larvae counting was always started downstream at 430 m (13° 05'34.1" and 47° 46'56.2") and ended at an altitude of 520 m (13° 05'44.4" and 47° 46'59.7").

In 2010, larval abundance was checked a total of 9 times between April and September at irregular intervals. Generally, the survey was always conducted at daylight. In the next year, monitoring started in January, ended in November and included both day and night surveys. During the period of the most rapid increase of larvae numbers (March–May 2011), the specimens were counted twice a week. Later, monitoring was conducted at weekly intervals until 20 November 2011. To determine the factors influencing detectability, different times of the day (morning, afternoon, evening) and variable weather conditions (sunny, rainy) were chosen for monitoring in the Schwarzenbach. In 2012, monitoring started in March when the first larvae were found and is still in progress.

Results

Larval Monitoring 2011 and 2012

In 2011, monitoring started with the first specimens found on 17 March. Then, larval amount increased until 18 April when the highest number was counted (3312 larvae). After that day, numbers fluctuated, de-

pending on weather conditions and time of day when monitoring took place. Fewer or no larvae were found on rainy days with high water levels and increased water turbidity. Moreover, both day and night counts showed that larval detectability increased significantly at dark conditions after sunset. After 30 July, larval density declined gradually until 20 November, when no more larvae were found (for details see Figure 4). Monitoring in 2012 started on 5 March, when the first larva was found and is still in progress.

Larval detectability: dependence on the time of day

To show the dependence of larval detectability on the time of day, larvae were counted on 28 May 2012 in an interval of two hours (starting at 8:00 and ending at 22:00). The weather on this day was a mix of sunny and cloudy conditions with a short rainfall at 14:00. Counting was repeated on sunny 18 June 2012. On both occasions, the weather had been dry and sunny for at least three days before the survey took place. For detailed results see Figure 5 and Tables 1.

Discussion

Larval phenology

In Europe, at altitudes below 500 m, larval density usually peaks at the end of April / beginning of May, followed by a continuous decline (Cabela et al. 2001). The monitoring section of the Schwarzenbach is situated at an altitude of 430–520 m and the results of 2011 are in accordance with the general phenology of these altitudes (refer to Figure 4 and Cabela et al. 2001, p. 183).

Factors influencing larval detectability

Several factors, including reproductive cycle, animal activity patterns, air and water temperature, rainfall, unpredictable seasonal events such as drought or floods, moon phase, as well as prey and predator activity can influence the detectability of amphibians in water (Jung et al. 2004). Therefore the count data in the Schwarzenbach do not reflect the exact number of larvae in this stream, but give an idea of the approximate larval abundance. Moreover, it was possible to show for the first time the dependence of larval detectability on the time of the day as well as on weather conditions. To sum up the results of three years of monitoring, the highest larval abundance was detected in April and May in the evening after dusk, following a dry period. The counting of larvae in an interval of two hours on two days in May and June 2012 also confirmed this observation. While the percentage of larval visibility varied between these two days, larval detectability increased about 50% at darkness on both days. The differences of larval visibility (see Results) can be explained by distinct water levels on these two days (low water level in May, high water level in June), which may have an effect on the hiding behaviour of the larvae. Generally, refuge use was increased on days after heavy rainfall in the Schwarzenbach. Additionally, the unclear water conditions, stronger currents, higher water level and increased turbidity reduced the larval detectability in the stream. After several days without rainfall, the water level was generally low and larval detectability increased.

Table 1 – Time-dependent percentage of larval visibility on 28 May and 18 June 2012, for five times of day (morning, noon, afternoon, dusk, night). As the maximum amount of larvae was always found at 22:00, this time was used as reference point for calculating the percentage of visible larvae at each time, i.e. the percentage of visible larvae at 22:00 was set as 100%. For example, at 20:00 on 28 May, 33% of larvae were visible compared to the maximum amount found at 22:00 on that day.

Time	Percentage of visibility (mean values in %)	
	28.05.2012	18.06.2012
Morning (8:00–10:00)	6,5	22
Noon (12:00)	7,5	33
Afternoon (14:00–18:00)	15	54
Dusk (20:00)	33	53
Night (22:00)	100	100

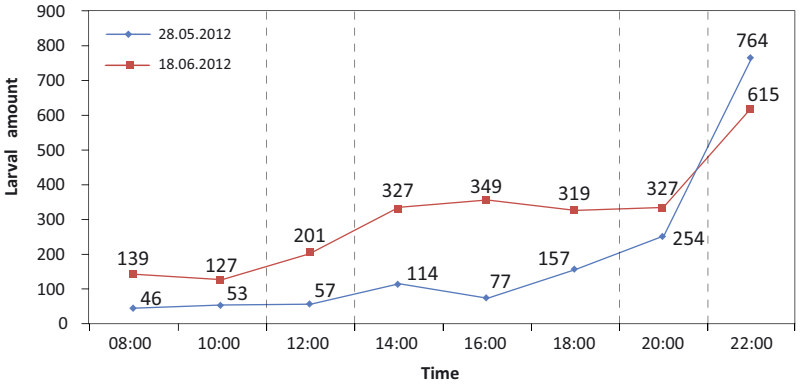

Figure 5 – Comparison of larval detectability on 28 May and 18 June 2012. The gray dotted lines indicate the time-dependenency of larval visiblility.

Regarding the time of day, larvae in the Schwarzenbach were mainly active and therefore detectible after sunset. This behaviour can be explained by the negative effect of UVB radiance on larval growth rate. According to Scheessele (2007), salamander larvae demonstrate an UVB avoidance behaviour by preferring shady microhabitats and seeking deeper water regions during day. At night, their activity rate increases (Scheessele 2007).

Conclusion

The distribution of the fire salamander is strongly linked to environmental features, including both the aquatic breeding site and the surrounding upland habitat (Manenti et al. 2009). Consequently, preservation of headwaters, in combination with nature-oriented management of the surrounding forests, is the most important protective measure for the fire salamander. The mixed woodland of the locally protected Aigner Park is a good example for a perfect salamander habitat. It provides ideal habitat structures for this threatened amphibian species. Regarding the larval monitor-

ing conducted in this area, nightly counts during the main larval season (April–May) were shown to provide the best estimates of the amount of larvae present in a stream. For future larval monitoring studies, we recommend this time of day as well as dry weather conditions on the day of monitoring and 1–2 days beforehand. Generally, the involvement of children and schools in the work of this study has been shown to be the most promising way for enduring conservation. Children are the future for successful conservation and only by raising their awareness of nature will we be able to preserve the beautiful moment of watching a salamander in the wild for future generations!

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