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Preliminary report on the occurrence of *Batrachochytrium salamandrivorans* in the Steigerwald, Bavaria, Germany

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The invasive chytrid fungus *Batrachochytrium salamandrivorans* (*Bsal*) is one of the most devastating amphibian pathogens that was introduced to Europe, where it is threatening the entire Western Palearctic urodelean diversity, especially the European fire salamander *Salamandra salamandra* (MARTEL et al. 2013, 2014, 2020, SPITZEN-VAN DER SLUIJS et al. 2016, STEGEN et al. 2017). So far, Germany represents the most affected country with almost 50 *Bsal*-positive sites, mainly concentrated to two regions, Eifel Mountains (Northrhine-Westfalia and Rhineland-Palatine) and Ruhr District (Northrhine-Westfalia) (DALBECK et al. 2018, SCHULZ et al. 2018, WAGNER et al. 2019a, LÖTTERS et al. 2020 in this issue, SCHULZ et al. 2020 in this issue).

Here we provide the first evidence for the occurrence of *Bsal* in southern Germany. The pathogen was detected in the nature park Steigerwald, located in the north of the state Bavaria constituting the first record of the pathogen within this state, at a distance of more than 250 km distance from other previously known records (Fig. 1). A dead European fire salamander (*S. salamandra*) was found on 8 May 2020 in the Ebracher Forst, lying in a small stream, a tributary to the Mittelebrach, next to a forest street (coordinates in decimal degrees: 49.864623 N, 10.488179 E). The specimen had characteristic *Bsal* lesions all over the body. It was collected and tested *Bsal*-positive by qPCR analysis

(Technische Universität Braunschweig; see SCHULZ et al. 2020 in this issue for laboratory methods). An independent qPCR analysis carried out by Trier University (S. LÖTTERS pers. comm. June 2020) revealed the same positive result. In addition, a histological examination at Ghent University (see MARTEL et al. 2013 for methods) confirmed the presence of *Bsal*-induced skin lesions associated with chytrid organisms.

A recent monitoring of the affected fire salamander population in June/July 2020, commissioned by Bayerisches Landesamt für Umwelt, revealed further eight positive animals out of 21 tested. The first analyses (A-samples) identified seven *Bsal*-infected fire salamanders including two dead individuals as well as two individuals with suspicious looking skin aberration. Besides, one Alpine newt *Ichthyosaura alpestris* was also tested *Bsal*-positive. All specimens were found in close proximity of the first case.

The Steigerwald is a low mountain range in Bavaria. The northern part is characterized by a large connected area of deciduous forest, mostly state owned. This area is mainly classified as FFH-Area as well as Special Protection Areas (SPA) of the European Natura 2000 network, which is a popular excursion destination. The Steigerwald represents a hybrid zone where both fire salamander subspecies, *S. salamandra terrestris* and *S. salamandra salamandra*, occur together.

Since 2015, the fire salamander population in the Steigerwald is monitored in the frame of a citizen science project conducted by C. DITTRICH (Museum of Natural History Berlin) in cooperation with the Bavarian State Forestry Commission (buergerschaffenwissen.de/projekt/amphibien-taskforce). Although the number of observations fluctuated, there have never been any signs indicating the presence of *Bsal* within that area until the recent detection (DITTRICH 2019). Additionally, two studies examined the distribution of *S. salamandra* in the Steigerwald in 2014 and 2017 (URBANIEC 2014, BANDORF 2017), under the direction of M.-O. RÖDEL, Museum für Naturkunde Berlin. Both studies found the fire salamander distributed across the entire area, larvae being present in almost all of the examined rivers. There was no indication of *Bsal* or any other disease in the seemingly very healthy populations.

The fact that many fire salamander larvae were observed in the stream next to the infected specimen implies that the pathogen was recently introduced to the Steigerwald. The passive transmission and further distribution of spores can occur via contaminated soil, which could stick to hiking shoes, forest machinery, animal paws, or wheels of bikes

and cars. Therefore, a profound cleaning and disinfection of shoes, machinery and equipment is necessary, when a contaminated area was visited (VAN ROOIJ et al. 2017), in order to minimize further dispersal.

However, the disease dynamic of this pathogen is not well understood, and seems to be even more ambiguous within a huge forest as observed in the Eifel Mountains where the populations are connected and individuals free to migrate giving the possibility that *Bsal* has already been present for a long time (LÖTTTERS et al. 2020 in this issue). A further intensive monitoring and screening of the fire salamander population is already planned to gain more information about the current infection status of the population. A larval monitoring will be implemented, not only in the Steigerwald but also as an early warning system in fire salamander habitats all over Bavaria where *Bsal* is still absent.

The apparent spread of *Bsal* towards southern Germany is extremely worrying when taking into account that the new locality narrows the gap towards the Alps, where the alpine salamander, *Salamandra atra*, as well as the even more threatened Lanza's alpine salamander, *Salamandra*

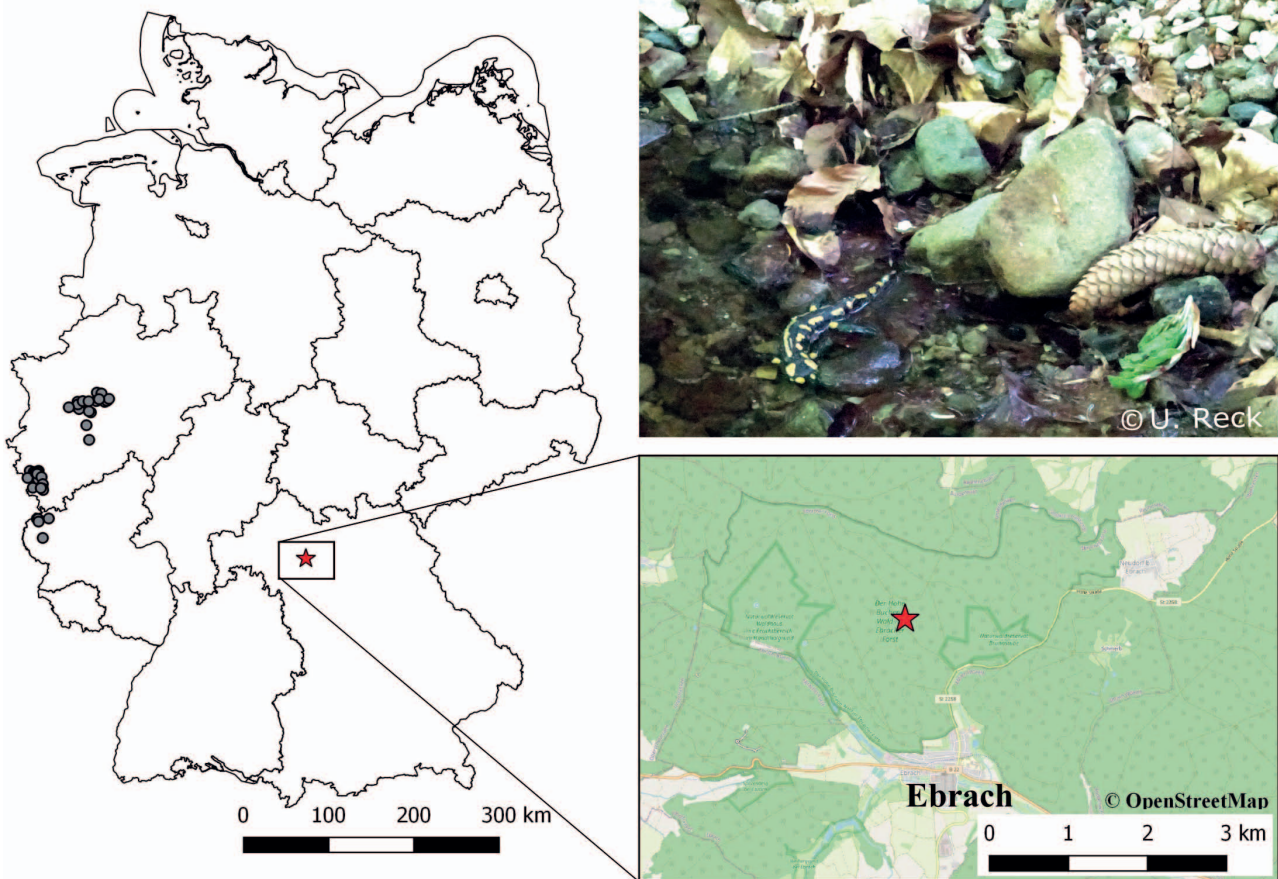


Figure 1. (left) Grey dots indicate *Bsal*-positive sites in Germany (LÖTTTERS et al. 2020a in this issue, SCHULZ et al. 2020 in this issue) (top right) Picture of the dead, *Bsal*-positive tested European fire salamander found in the Steigerwald (Ebracher Forst) taken by U. RECK. Small inset map shows the locality where the dead specimen was found on 8 May 2020. The shape file is based on Bundesamt für Kartographie und Geodäsie, Frankfurt am Main, 2011.

lanzai, occur. These species are likely to be as susceptible to *Bsal* as the European fire salamander. This alarming development supports the need of an urgent German *Bsal* Action Plan mentioned in detail in LÖTTERS et al. (2020 in this issue).

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