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RISING SUMMER TEMPERATURES FAVOUR SPREAD OF HOUSE CENTIPEDE, *SCUTIGERA COLEOPTRATA* (CHILOPODA), IN CENTRAL EUROPE

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Abstract The house centipede (*Scutigera coleoptrata*) is a thermophilic species mainly distributed in the Mediterranean region. This nocturnal predator kills its pray with toxic bites. As early as shortly after the last Ice Age it has settled in the "Kaiserstuhl", one of the warmest regions in Germany. Proceeding from these first settlements it has established autochthonous populations in the entire region along the Upper and Middle Rhine. In the past 20 years, an increasing spread has been detected in the north-eastern parts of Switzerland and around Lake Constance. Actual climate data suggest that this spread is favoured by rising summer temperatures. Due to its hidden way of life and its low population densities, it is nearly impossible to get scientific data about *S. coleoptrata*. Alternative methods of cartography had to be applied. Citizen Science Appeals were published; articles from yellow press, postings from social media as well as pictures from photo-platforms were analyzed to get the demanded information.

Key words Neozoa, climate change, thermophilic species, citizen science

INTRODUCTION

Scutigera coleoptrata (L.) is a Chilopoda species with 15 pairs of long legs, each one with a unique set of 34 muscles or more, that allow the centipede to reach a velocity of 1.5 km/h. It has strong forcipules, pincer-like forelegs capable of injecting its effective venom. They enable the nocturnal predator to kill even big insects like cockroaches or butterflies. Defense bites cause severe pain but are not dangerous for humans.

The house centipede prefers xerothermic sites near rivers and lakes, as well as rocks and caves. However, it is also adjusted to many synanthropic sites like vineyards, (wine-) cellars, bridges, all kinds of buildings and building sites. It spends the day in damp hides; therefore, it normally cannot be detected during daytime.

S. coleoptrata is indigenous to Southern Europe and Northern Africa, and it has been introduced to other parts of Europe, to America and Asia by human transports. In regions with average summer temperatures higher than 16 °C, it can establish populations on its own (Schlotmann and Simon, 2005). In cooler, northern regions, it can exclusively be observed indoors or near buildings.

The first distribution map of *S. coleoptrata* in Europe (Christian, 1983) shows a western population along the Upper and Middle Rhine supplied by a western trail from the Mediterranean region along the east side of the Jura mountain chain. This population is totally separated from stocks in Eastern Austria and neighbouring countries. Those are supplied by an eastern trail originating from the south-eastern parts or Europe. The western population along the Upper and Middle Rhine had already been established a long time ago. According to Christian (1983) these populations date back to the warm interglacial period after the last Ice Age. Although they could not have been supplied permanently along the western trail during colder periods, they were capable to survive in the areas along the river Rhine favoured by a warm climate. Since 1980, these autochthonous stocks have shown intense spreading tendencies to Northern Germany favoured by rising summer temperatures (Schlotmann and Simon, 2005).

Beginning approximately in the year 2000 another range extension of these autochthonous stocks of *S. coleoptrata* in eastern direction has been observed. The species nowadays settles along the High Rhine and Lake Constance-region. It covers main parts of north-eastern Switzerland, south-western Germany and Vorarlberg, the

westernmost federal state of Austria. In 2013, the first specimen of *S. coleoptrata* in Vorarlberg was detected in Gaissau (A). There are no earlier proofs of the house centipede in Vorarlberg (Janetschek, 1961). In 2016, it appeared in Bregenz (A). During the last 15 years, the Urban Pest Advisory Service in Zurich (CH) also has noted a rising number of inquiries dealing with this species.

MATERIALS AND METHODS

It is nearly impossible to study the spread of *S. coleoptrata* with classical scientific methods. In general, its stocks show only low densities. With strictly nocturnal activity, its way of life is extremely hidden (Schlotmann and Simon, 2005). Creative forms of cartography had to be applied, and alternative data sources had to be analysed.

The basic information of this study is a result of pest advisory in Zurich (Urban Pest Advisory Service) and Dornbirn (inatura – Biological Advisory Service). Additional scientific data were available from Christian (1983), Schlotmann (2010), from the Bündner Naturmuseum (2019), from databases (Edaphobase 2018), and from Citizen Science Projects (Schlotmann, 2005; BUND Bretten, 2015; inaturalist.org, 2018). These proofs have been combined with chance finds in yellow press articles, social media postings, blogs and photographic web-platforms and through personal communication with pest management professionals.

Furthermore, the summer temperatures of the study area have been analysed. For Bregenz (A) the average summer temperatures (mean air temperatures in May, June, July) between 1961 and 1990 were calculated and compared with actual data (1991-2018) (ZAMG, 2019). In a similar way, maps of historic summer isotherms in south-western Germany (Deutscher Wetterdienst, 2018) and north-eastern Switzerland (MeteoSchweiz, 2018) were compared with actual mean temperatures.

RESULTS AND DISCUSSION

Historic proofs of *S. coleoptrata* from western Central Europe were only available from the autochthonous populations along the Upper and Middle Rhine and a few more from south-western Switzerland (Christian, 1983; Schlotmann, 2010). Beginning with the new millennium a rising number of specimens has been observed in the study area (Figure 1). A total of 102 proofs of *S. coleoptrata* was documented for the period between 1997 and 2019. 11 of these records originate from areas in Southern Switzerland (5 from Canton Ticino, 4 from Canton Valais and 2 from Canton Vaud). 91 records came from the study area – Northern Switzerland (60), Liechtenstein (1), Western Austria (Vorarlberg, 9), Southern Germany (Baden-Württemberg and Western Bavaria, 21).

Almost half of the data were from pest advisory (30 records from Urban Pest Advisory Service (Zurich) and 15 from inatura - Biological Advisory Service (Dornbirn)). 13 records from scientific collections (Bündner Naturmuseum, 2019), 15 were results of Citizen Science Projects (2 from Schlotmann (2010), 13 from Bund Bretten (2015)). Entomologist and photographer André Mégroz acquired 13 records from photographers´ platforms; 16 records were from yellow press and blogs. Many of these data contain only the location name and year. They are not sufficient for special scientific analyses, but they can be a valuable source to describe the spreading tendencies. *S. coleoptrata* can easily be identified, and there are no mistakable species in Central Europe (Schlotmann, 2010).

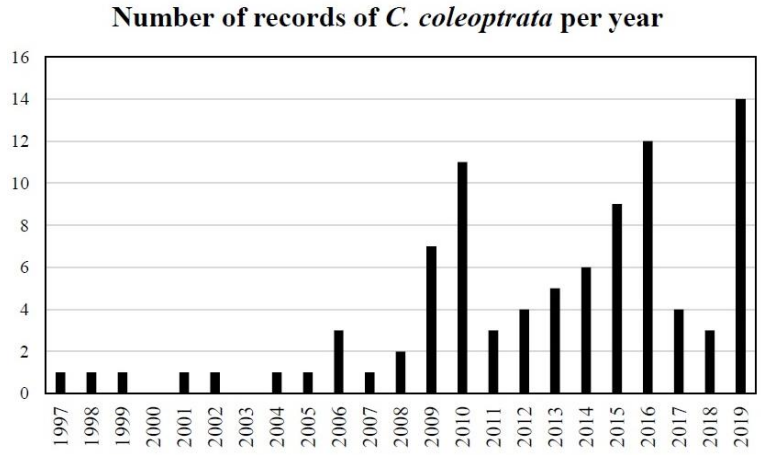

Figure 1. *S. coleoptrata* per year in the study area

The distribution map (Figure 2) shows a progressive spreading of *S. coleoptrata* from the regions around Basel (CH) and Zurich (CH) in eastern direction and from Chur (CH) to the North. During the past few years, it has conquered Vorarlberg (A) along Lake Constance in the North and via the Alpine Rhine Valley from the South. As *S. coleoptrata* frequently spreads along highways and railway lines, it is often classified as an adventive species being distributed by human transports. However, to establish a population in a newly settled area, it needs warm summer

temperatures. Therefore, the actual spreading in Central Europe is a consequence of the rising temperatures, and it happens for natural reasons. Records of multiple occurrences over several years and of juvenile specimen in the area of interest prove this fact.

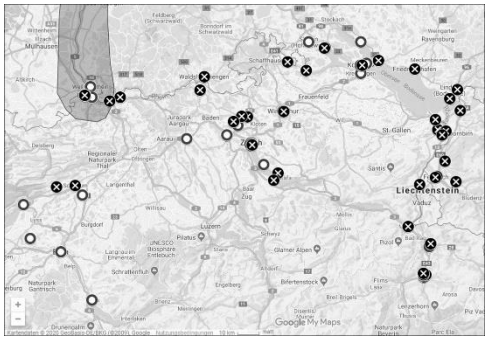

Figure 2. Distribution of *S. coleoptrata* in Northern Switzerland, Southern Germany and Western Austria. Grey polygon: area with autochthonous stocks (schematically). Black rings: records from 1997 to 2010, white crosses: records from 2011 to 2019.

The mean summer temperatures in Bregenz (A) already reached the 16-degree-level between 1990 and 2000 (Figure 3). The long-time average of the summer temperatures between 1961 and 1990 had been 15.9°C, between 2000 and 2018 it was 17.7°C, and it still shows rising tendencies. The comparison with actual temperature maps from Switzerland and Germany reveals that big areas along the High Rhine, the shores of Lake Constance, in the Alpine Rhine Valley and in many more regions in Northern Switzerland, Liechtenstein, Vorarlberg (A) and Southern Germany show similar summer temperatures like Bregenz. This means that the potential habitats for *S. coleoptrata* are still growing. It is not useful analyze the summer temperatures along the 16-degree-isotherme more detailed, they will always remain approximate values. It is more important to mention, that today the temperature values are already more than 1.5 degrees higher, and therefore the conditions for a persistent spreading of *S. coleoptrata* nowadays are optimal.

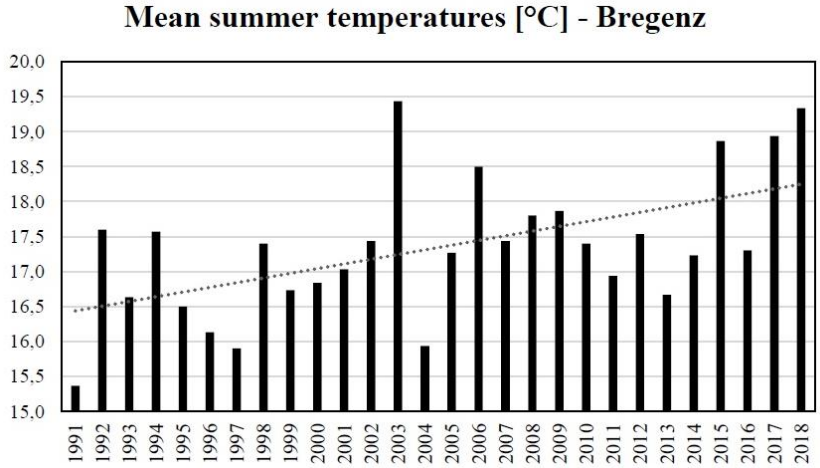

Figure 3. Mean summer temperatures [°C] in Bregenz (A).

CONCLUSIONS

The results indicate that since about 2000 the climatic conditions have been ideal for the settlement of *S. coleoptrata* in wide areas of Central Europe. The rising summer temperatures still favour this spreading. Current distribution data mark the main immigration trails of the house centipede to Vorarlberg (A): there is the western trail along the High Rhine Valley and Lake Constance a distance of more than 150 km. Another western trail leads from the region around Zürich (CH) along the Walensee and the Alpine Rhine Valley to Liechtenstein and Feldkirch (A). Upcoming populations in this region are also supported by a southern trail along the traffic routes crossing the Alps. The population in Chur (CH) is a remarkable hotspot on this trail to the North.

These routes are important for the Austrian State of Vorarlberg, as they can be the immigration path for several other thermophilic species. All other regions of Austria are colonized by Mediterranean species along south-eastern routes exclusively. Knowledge of the local immigration trails is important for monitoring or controlling of critical invasive species.

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