

Rapid Communication

The first established population of the invasive silverfish *Ctenolepisma longicaudata* (Escherich) in the Czech Republic

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Abstract

The silverfish *Ctenolepisma longicaudata* (Escherich) (Zygentoma, Lepismatidae) is an invasive, synanthropic, warehouse, and economic pest, probably of Central American origin. During recent decades, its occasional occurrence has been recorded from some European countries. Here, we report the first established population of *C. longicaudata* within the territory of the Czech Republic. In the autumn 2017, the population was discovered in a warehouse and surrounding office buildings in Prague. Since this species causes damage to starch components and fabrics as well as food contamination, we strongly recommend further monitoring and possibly eradication.

Key words: Lepismatidae, insect, invasive species, biological invasion, Prague

Introduction

Ctenolepisma longicaudata (Escherich), also known under the common names giant silverfish, long-tailed silverfish, and paperfish, is strictly synanthropic and a successful invasive insect species belonging to the order Zygentoma, family Lepismatidae. Since *C. longicaudata* is of no serious medical importance apart from the potential for food contamination, it is considered to be an economic pest (Smith 2017), especially due to its ability to feed on cellulose and starchy materials (Van der Weijden et al. 2007), including wallpapers, books, photo albums, and archives. Moreover, they can also cause damage to cotton or silk (Mallis et al. 1958).

Although first described in South Africa (Escherich 1905), its native range and origin is unclear. This species may originate from central parts of America (Zettel 2010) while Wygodzinsky (1972) marked it as non-native in this region. From there it has been introduced indirectly by human activities, especially as a contaminant of transported commodities, to all

continents excluding Antarctica. In Europe, the first individual was captured in France in 1914 (Paclt 1967). However, the nocturnal and hidden way of life probably caused *C. longicaudata* to remain under-recorded and the establishment of this silverfish in several European countries was only confirmed in recent decades. For instance, in the Netherlands, where *C. longicaudata* is currently the dominant species in the modern household environment (Schoelitz and Brooks 2014), this invasive species was first identified in 1989 (Nierop and Hakbijl 2002). Subsequently, it was reported in Austria (Zimmermann 2016), Belgium (Lock 2007), Germany (Meineke and Menge 2014), Italy (Molero-Baltanás et al. 2000), Sweden (Pape and Wahlstedt 2002), and the United Kingdom (Goddard et al. 2016). Considering relatively intensive trade among the aforementioned countries and the Czech Republic, the introduction of these cardboard package inhabitants was rather a question of time. In the summer 2017, several local Czech online mass media (idnes.cz or euro.cz) even informed about potential risks associated with an invasion of this species.

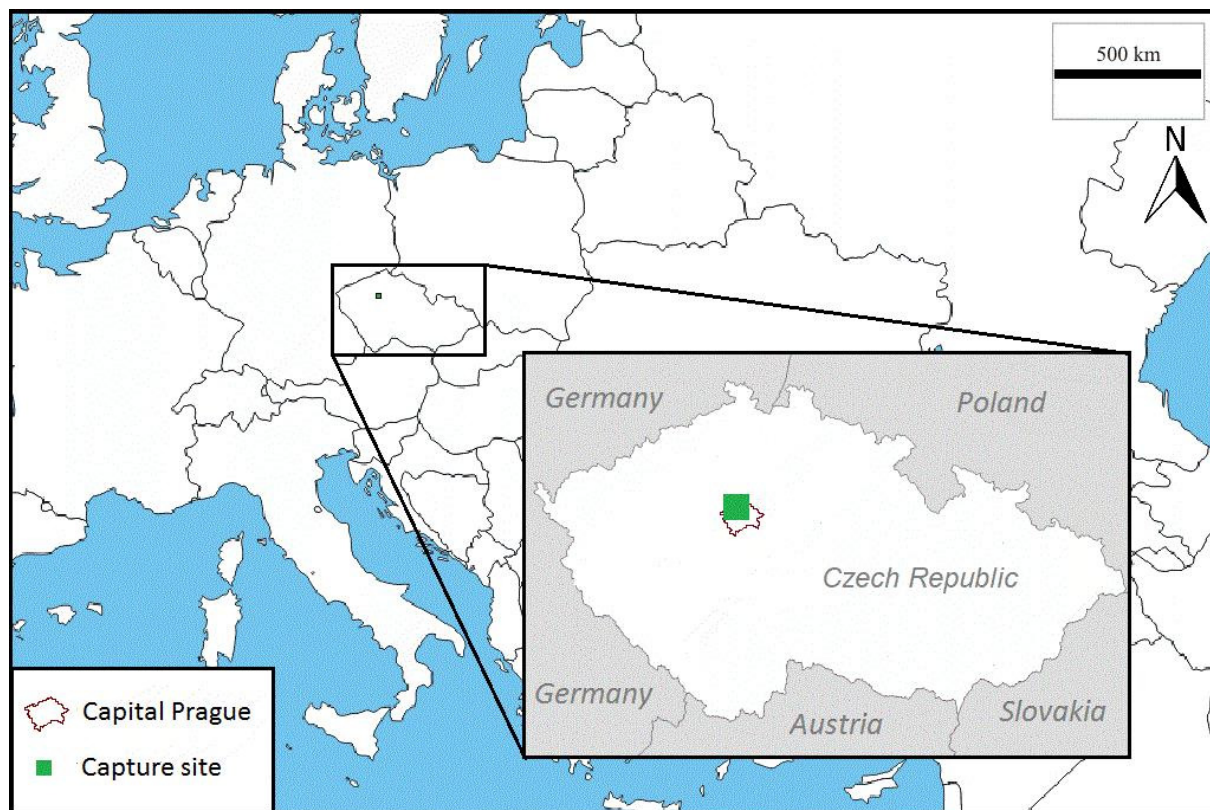


Figure 1. Location of the established population of invasive *Ctenolepisma longicaudata* in Prague, Czech Republic.

Methods

Site

On 18 October 2017, a private company contacted the Department for Vector Control of the National Institute of Public Health (Czech Republic) to report the occurrence of an unusual silverfish species in their offices, archive, and the adjacent warehouse located in the suburb of Prague (Staré Bohnice district, GPS: 50.1346N, 14.4154E, Figures 1 and 2A), where it was causing damage by feeding on documents. Afterwards, the area was visited by the authors, who detected dozens of silverfish, collected some individuals using an aspirator, and preserved them in plastic vials with 70% ethanol for further identification.

Species identification

The collected individuals were examined with an Olympus SZ61 stereomicroscope, and measurements were taken with an ocular grid. Photos were taken using Canon MP-E 65mm/2.8 1–5x macrolens on bellows attached to a Canon EOS 550D camera. Partially focused images of each specimen were

stacked using Helicon Focus 3.20.2 Pro software. All individuals were morphologically identified using recent keys (Theron 1963; Wygodzinsky 1972). The species identification was then confirmed by Patrizia Visentin (Entostudio s.r.l., Italy) and Fabrizio Montarsi (Istituto Zooprofilattico Sperimentale delle Venezie, Italy). The voucher specimens are deposited at the National Institute of Public Health in Prague, Czech Republic and in the collection of the Czech University of Life Sciences, Prague, Czech Republic.

Results

During the onsite inspection in the warehouse, we captured 14 individuals (six adults and eight juveniles). Based on the morphological features, all captured silverfish were identified with certainty as *Ctenolepisma longicaudata*. The highest density of *C. longicaudata* was found in the warehouse, on shelves with empty paper boxes (Figure 2A). Additionally, species-specific damage (Figure 2B, C) was observed throughout the entire area of the company, including administrative offices. During the collection of the samples, the humidity in the warehouse was 35%

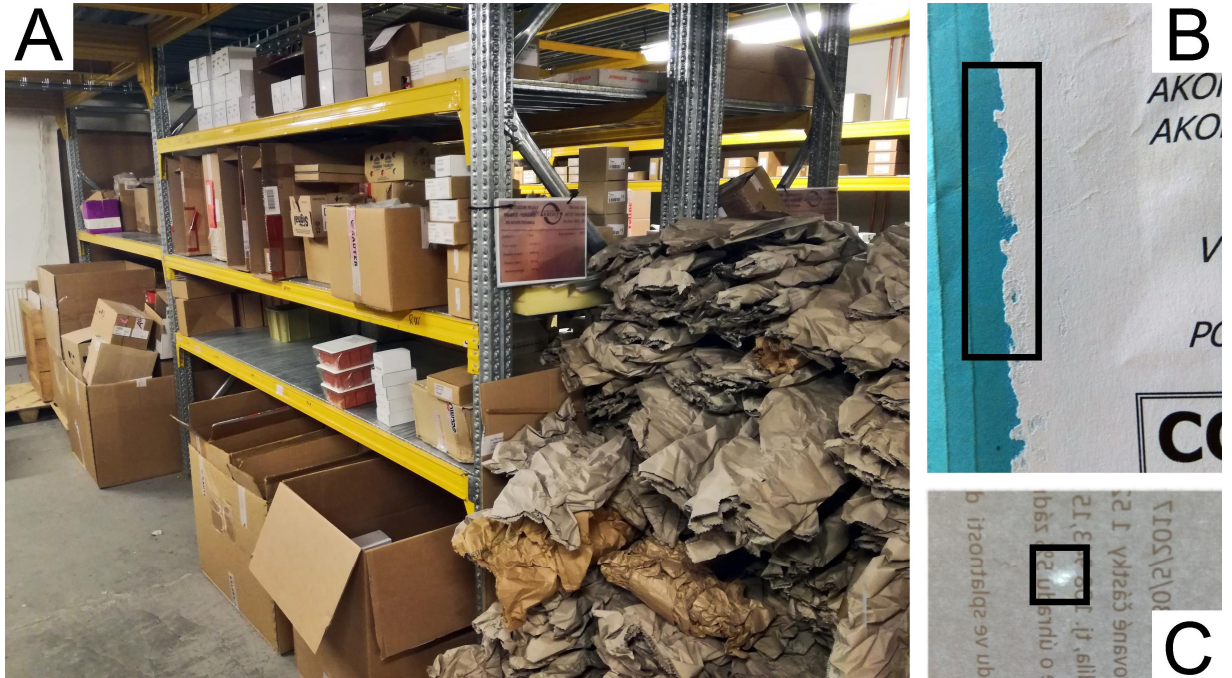


Figure 2. (A) A warehouse as the habitat of *Ctenolepisma longicaudata*; (B, C), damage caused by silverfish feeding in a neighbouring office building. Photo: J. Patoka (A), J. Dvořáková (B, C).

and air temperature was 23 °C. The captured adult individuals had a body length of more than 12 mm (Figure 3A), with a dark grey dorsal abdomen, uniform in color, antennae, and tails (cerci) longer than the body. The head bore numerous setae on the front margin (Figure 3B), and the last abdominal segment was truncate with slightly emarginate posterior margin. Unlike the other local silverfish species, every collected individual had 3+3 bristle combs of macrosetae on the II–VI urotergites. Finally, nine sensory papillae on the terminal segment of the labial palpus (Figure 3C) supported the identification as *C. longicaudata*.

Discussion

In the Czech Republic, four silverfish species have been reported to date: *Atelura formicaria* Heyden, *Ctenolepisma lineata* Fabricius, *Lepisma saccharina* L., and *Thermobia domestica* Packard (Rusek 1977). While *L. saccharina* is very common in households throughout the country, the other species mentioned above are quite rare. *Thermobia domestica* Packard occurs only in warmer artificial habitats, such as bakeries, boiler rooms, hot-water heaters, or heating plants, and is also commercially reared for use as live prey for small insectivorous pets. *Ctenolepisma*

lineata, which was confirmed in the South Moravian Region (Štys and Rozkošný 1996; Král and Davidová-Vilímová 2001), is very rare and is listed as a critically endangered species (Rusek 2005). The last silverfish species, *A. formicaria* (family Nicoletiidae), lives in ant colonies, especially of the genus *Lasius* (Parmentier et al. 2013). Here, we record for the first time the occurrence of *C. longicaudata* in the Czech Republic. Given the observed abundance and presence of all developmental stages of *C. longicaudata* including small nymphs, the species is considered established.

In the past, households, libraries, and museums used to be the main habitats for *C. longicaudata*. Unlike other European anthropophilic Zygentoma species, *C. longicaudata* does not necessarily need high air humidity and temperature for its development. The temperature optimum lies at around 24 °C; however, *Ctenolepisma longicaudata* might also survive in temperatures as low as 1 °C for several months (Lock 2007). This species feeds mainly on cellulose (paper) or starch including glue (Van der Weijden et al. 2007) and has also been reported to be attracted by food residues (Goddard et al. 2016). Additionally, it can survive long periods of starvation (Lindsay 1940). Therefore, it is able to spread easily with the aid of parcel and post services and, consequently, readily colonizes new areas. Its introduction

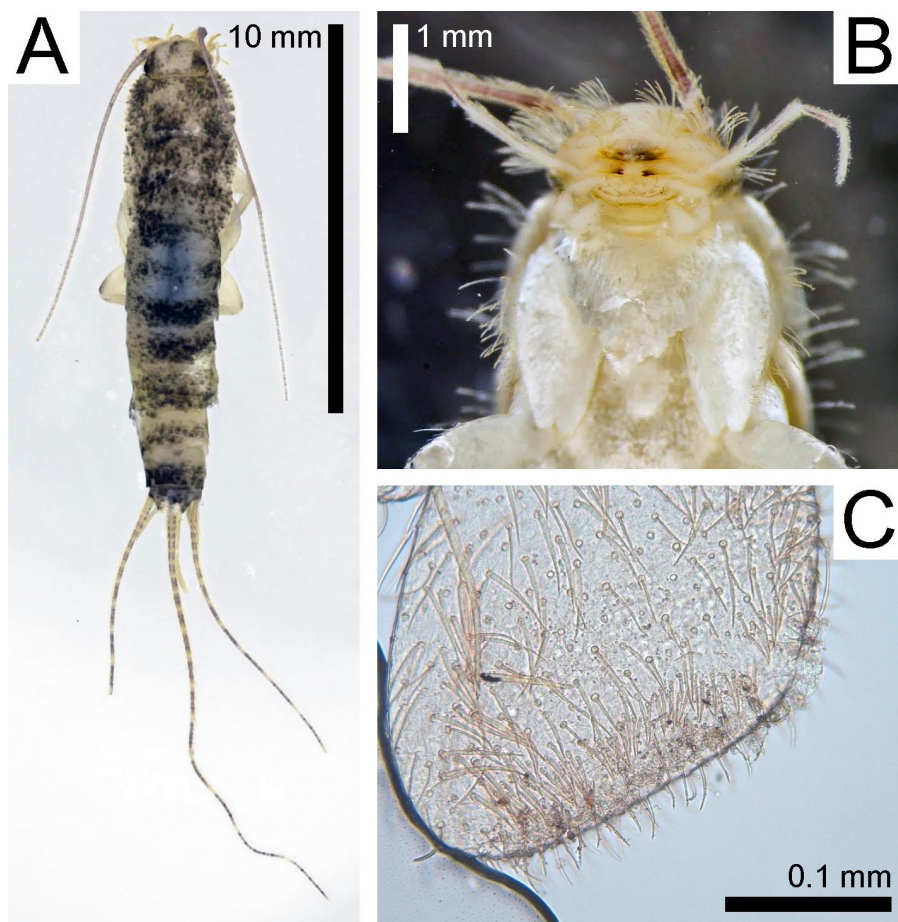


Figure 3. A captured specimen of *Ctenolepisma longicaudata*: (A) dorsal view; (B) head, ventral view; (C) terminal segment of the labial palpus. Photo: R. Sehnal (A), M. Petrtýl (B), P. Visentin (C).

into the rest of Europe, where offices and warehouses may become its primary habitat, is thus expected in the years to come. Now, the risk is re-emerging for archives, museum collections, and libraries, naturally involved in exchanges, in the remaining European countries as well as in the Czech Republic. We strongly recommend that further monitoring and possibly eradication should be conducted and the awareness of conservationists, wild life managers, and other stakeholders should be raised about these risks.

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