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Non-native terrestrial planarian species in Germany and Austria, with first locality records of *Caenoplana variegata* for both countries

(Platyhelminthes, Geoplanidae)

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At least 25 introduced and partly invasive species of land flatworms have been recorded from Europe in recent years. In this study we give an overview of the non-native land flatworm species recorded in Germany and Austria and provide the first locality records of *Caenoplana variegata* for both countries. The outdoor population in a garden in North Rhine-Westphalia has survived the winter 2023/2024, whereas the record from Austria is from a zoological indoor facility in Vienna.

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Introduction

Terrestrial planarians or land flatworms are mainly distributed in tropical and subtropical regions, but some are also native to Europe (Arndt 1934, Thunnissen et al. 2022). At least 25 non-native and partly invasive species have been recorded in Europe over the last decades (Soors et al. 2022). In Central Europe most of these alien species have been recorded from indoor facilities (mostly greenhouses and garden centers), and only few species, including *Caenoplana variegata*, *Diversipalium multilineatum*, *Marionfyfea adventor*, *Parakontikia ventrolineata*, and *Obama nungara* have established outdoor populations (Jones & Sluys 2016, Justine et al. 2018, Justine et al. 2020, Thunnissen et al. 2022, Langner 2023). Some of the invasive flatworms are believed to have almost no natural predators and are considered as potential threats of soil ecosystems in Europe (Justine et al. 2020, Thunnissen et al. 2022).

In contrast to several neighbouring countries, very little is known on non-native land flatworms in Germany and Austria. In their recent literature review of alien terrestrial planarians in The Netherlands and surrounding countries, Thunnissen et al. (2022: Table 1) listed 15 species for the United Kingdom, nine species for The Netherlands, nine species for France, and six species for Belgium, but only three species for Germany, namely *Bipalium kewense* (native to Southeast Asia), *Dolichoplana striata* (native to the Philippines), and *Marionfyfea adventor* (native to New Zealand) and only one species for Austria (*Bipalium kewense*).

Since this publication several additional species, including *Obama nungara* (native in Argentina and Brazil), *Caenoplana coerulea* (native in Australia), and *Anisorhynchodemus* sp. (native range apparently uncertain) have been recorded for Germany and Austria and several older species records from the literature not listed in Thunnissen et al. (2022) have

been found (see Table 1 for details and references).

Caenoplana variegata, native to Australia, but known from England since 2008 and from The Netherlands since 2014 has apparently not yet been

recorded for Germany or Austria (Thunnissen et al. 2022). In addition, as of 1 August 2024, no records of this species from Germany or Austria have been available on iNaturalist or Observation.org. How-

Table 1. Introduced terrestrial planarian species (identified to genus or species level) hitherto recorded from Germany and Austria. * identification in need of confirmation. ** originally published as *Geoplana multicolor*. *** originally published as *Rhynchodemus bilineatus*, which is currently considered a synonym of *R. sylvaticus* and possibly native to Europe. **** validity uncertain, probably a synonym of *Dolichoplana striata*. Additional records from iNaturalist without meaningful photographs were not included. *Rhynchodemus sylvaticus* and *Microplana terrestris* are considered as native in Germany and records of these species are not listed here.

Species	Location, Federal State	Date of record	Habitat
Austria			
<i>Bipalium kewense</i>	Austria	before 1899	unknown
<i>Caenoplana coerulea</i>	near Graz, Steiermark	2 Jun. 2024	outdoor
<i>Caenoplana variegata</i>	Vienna, Wien	20–29 Feb. 2024	indoor
<i>Obama nungara</i>	Ludesch, Vorarlberg	19 May 2024	outdoor?
<i>Rhynchodemus sylvaticus</i> ***	Vienna, Wien	May 1953	outdoor
Germany			
<i>Anisorrhynchodemus</i> sp.	Potsdam, Brandenburg	17 Jan. 2024	indoor
<i>Bipalium kewense</i>	Botanical Garden Berlin	1886	orchid house
<i>Bipalium kewense</i>	Schloss Bellevue, Berlin	1912	orchid house
<i>Bipalium kewense</i>	Botanical Garden Dahlem, Berlin	1923–1933	palm house
<i>Bipalium kewense</i>	Botanical and Zoological Garden Hamburg	since 1901	indoor?
<i>Bipalium kewense</i>	Botanical Garden Göttingen, Lower Saxony	before 1934	indoor?
<i>Bipalium kewense</i>	Dresden, Saxony	before 1891	unknown
<i>Bipalium kewense</i>	Leipzig, Saxony	before 1891	unknown
<i>Bipalium kewense</i>	Frankfurt am Main, Hesse	before 1887	unknown
<i>Bipalium kewense</i>	Botanical Garden Bonn, North Rhine-Westphalia	1933	greenhouse
<i>Bipalium kewense</i>	Heidelberg, Baden-Wuerttemberg	before 1896	
<i>Bipalium kewense</i>	Plant nursery, Berlin-Zehlendorf	Nov. 1955–Feb. 1957	greenhouse
<i>Caenoplana coerulea</i>	Hannover-Herrenhausen, Lower Saxony	16 Oct. 2022	indoor
<i>Caenoplana coerulea</i>	Oberreute, Bavaria	31 Jul. 2023	indoor
<i>Caenoplana coerulea</i>	Sulzburg-Laufen, Baden-Wuerttemberg	26 April 2024	unknown
<i>Caenoplana variegata</i>	Kleinenbroich, North Rhine-Westphalia	16 Sep. 2023–3 Aug. 2024	outdoor
<i>Dolichoplana feildeni</i> ****	Botanical Garden Leipzig, Saxony	Dec. 1954	greenhouses
<i>Dolichoplana feildeni</i> ****	Plant nursery, Berlin-Weißensee	May 1955–Dec. 1956	greenhouse
<i>Dolichoplana striata</i>	Germany	unknown	unknown
<i>Marionfyfea adventor</i>	Billerbeck, North Rhine-Westphalia	Oct. 2014–2016	outdoor
<i>Obama nungara</i>	Botanical Garden München, Bavaria	2019	indoor
<i>Obama nungara</i>	Regensburg, Bavaria	Apr. 2021	outdoor?
<i>Obama nungara</i>	Kernen im Remstal, Baden-Wuerttemberg	14 Aug. 2020–26 Mar. 2021	outdoor
<i>Obama nungara</i> *	Sulzburg-Laufen, Baden-Wuerttemberg	4–29 Apr. 2024	
<i>Obama nungara</i>	Grunbach, Baden-Wuerttemberg	1 May 2024	outdoor?
<i>Obama nungara</i>	Jülich, North Rhine-Westphalia	6 June 2024	outdoor?
<i>Paraba multicolor</i> **	Hamburg	1901?	unknown
<i>Rhynchodemus sylvaticus</i> ***	Berlin and many additional cities	1933	terraria
<i>Rhynchodemus sylvaticus</i> ***	Plant nurseries in Berlin	Nov. 1955–Aug. 1956	indoor

ever, online articles in several German newspapers from April 2023 (e. g., Kölner Stadtanzeiger, <https://www.ksta.de/panorama/giftige-plattwuermer-breiten-sich-in-deutschen-gaerten-aus-3-553960>) have claimed that three invasive flatworm species are spreading in Germany (*Obama nungara*, *Caenoplana variegata* and *Diversipalium multilineatum*). *Obama nungara* has been recorded repeatedly from Germany in recent years (e. g., Kutschera & Ehnes 2021, Rabitsch & Nehring 2022), but we were unable to

find any concrete locality records for the latter two species. However, their spreading in Germany is plausible and expected given their occurrence in The Netherlands (Thunnissen et al. 2022) as well as in France and Switzerland (Justine et al. 2018).

In this paper we summarize the published records of introduced land flatworms in Germany and Austria and provide the first locality records of *Caenoplana variegata* for both countries.

Materials and methods

The collected specimens were photographed, and three of them were preserved in 70 % ethanol and deposited in the Zoologische Staatssammlung München. A small piece of the body was removed as a tissue sample and preserved in 96 % ethanol. Individuals were identified as *Caenoplana variegata* based on their characteristic colouration by using the comparative photographs and information in Jones et al. (2020) and Thunnissen et al. (2022). The overview of locality records provided in Table 1 is based on a review of scientific literature and on informative (usually labeled as “research quality”) records from iNaturalist, which provide photographs and data of sufficient quality for a reasonable species identification.

Results

First locality record of *Caenoplana variegata* in Germany

On 16 September 2023, Robert Mass discovered a terrestrial flatworm in his garden in Korschenbroich-Kleinenbroich (51°11'33.25"N, 6°33'9.08"E, 44 m a. s. l.), North Rhine-Westphalia, which he had never noticed before. This specimen had a maximum length of 9 cm, a reddish-brown narrow head region without tentacles, blackish flanks and a golden band dorsally with two parallel brown lines inside. Its slender body, which moved in a manner similar to that of a slug, left a trace of slime behind. This and a few additional individuals captured in the following weeks were transferred in a terrarium, but probably died and could not be re-discovered again on 29 January 2024. A targeted search in this garden on 1 and 3 March 2024 revealed two additional individuals (Fig. 1) under wooden boards covering a water-filter of a garden pond with ornamental fishes, on moist earth together with few slugs, few woodlice and numerous small earthworms with an orange clitellum. All individuals were found at least 10 m away from the next house, confirming that this species is able to survive the winter in Germany under outdoor conditions. Between March and August 2024 approximately 12 further specimens of different

Source

Arndt (1934), Thunnissen et al. (2022)
<https://www.inaturalist.org/observations/220003684>
 this paper
<https://observation.org/observation/310468582>
 Schremmer (1954)

<https://www.inaturalist.org/observations/196922395>
<https://www.inaturalist.org/observations/196908183>
 Arndt (1934)
 Arndt (1934)
 Arndt (1934)
 Arndt (1934)
 Arndt (1934)
 Arndt (1934)
 Arndt (1934)
 Arndt (1934)
 Arndt (1934)
 Arndt (1934)
 Pfitzner (1958)
<https://www.inaturalist.org/observations/138990516>
<https://www.inaturalist.org/observations/175916716>
<https://www.inaturalist.org/observations/209674040>
 this paper
 Pfitzner (1956)
 Pfitzner (1956, 1958)
 Winsor et al. (2004), Thunnissen et al. (2022)
<https://www.inaturalist.org/observations/203702505>
 Langner (2023)
 Rabitsch & Nehring (2022)
 Kutschera & Ehnes (2021)
<https://www.inaturalist.org/observations/72291784>
<https://www.inaturalist.org/observations/72165396>
<https://www.inaturalist.org/observations/211458935>
<https://www.inaturalist.org/observations/206617865>
<https://www.inaturalist.org/observations/205356683>
<https://observation.org/observation/307190809>
<https://observation.org/observation/313294442>
 Kraepelin (1901), Arndt (1934)
 Arndt (1934)
 Pfitzner (1958)



Fig. 1. *Caenoplana variegata* from a garden in Korschenbroich-Kleinenbroich, Germany, collected in March 2024. Photo: Kathrin Glaw.

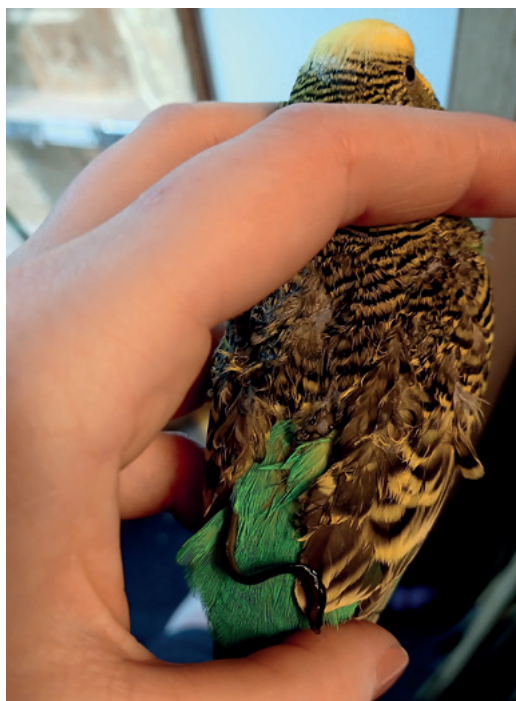


Fig. 2. *Caenoplana variegata* sticking to the back of an adult budgerigar (*Melopsittacus undulatus*) in the Australia enclosure at Haus des Meeres Aqua Terra Zoo, Vienna, Austria, in February 2024. Photo: Nadine Strasser.

sizes have been observed, especially after heavy rain, demonstrating that this species has established an outdoor population in this garden.

First record of *Caenoplana variegata* for Austria

On 20 February 2024, a living flatworm was discovered in the Australia enclosure at Haus des Meeres Aqua Terra Zoo, Vienna, Austria, while sticking to the back of an adult budgerigar (*Melopsittacus undulatus*) (Fig. 2). Within the few weeks before, several pieces of dead specimens had been found in this enclosure. On 29 February 2024, the zookeepers discovered another flatworm on a rock in the same enclosure and kept it alive (Fig. 3). The indoor facility has tropical temperatures during day and night throughout the year. The last plant imports took place on 5 April, 11 September, and 1 November in 2023, delivered by a wholesale supplier of plants and planters from The Netherlands. The plants placed in this enclosure were mainly of the genera *Schefflera*, *Ficus* and *Cordyline*. The second individual was kept alive until 25 July 2024 and finally preserved in 96 % ethanol for future genetic analysis. In order to prevent the spreading of this potentially invasive species an extensive search was conducted in the Australia enclosure on 3 August 2024 by digging through the soil wherever possible, turning stones and trunks and checking the areas around water sources. This search did not reveal any additional specimens.



Fig. 3. *Caenoplana variegata* on a rock in the Australia enclosure at Haus des Meeres Aqua Terra Zoo, Vienna, Austria, in February 2024. Photo left: Miriam Jandrisics, photo right: Frank Glaw.

Discussion

Many records of alien planarians in Europe were from greenhouses and garden centers, and the transport and trade of potted plants and soil is obviously a crucial factor for the spreading of introduced flatworms in Europe (Arndt 1934, Thunnissen et al. 2022, Rabitsch & Nehring 2022, Saladin 2022). Arndt (1934) and Pfitzner (1958) recorded *Rhynchodemus bilineatus* (currently a synonym of *R. sylvaticus*) from terraria and plant nurseries in Germany and also recent sources on the internet report on unidentified terrestrial planarians in terraria for tropical frogs (e.g., <https://www.kaktusfisch.de/landplanarie.html>). Another website suggests that geoplanid flatworms are often unintentionally imported and dispersed together with ornamental waterplants, which are bred above the water-surface (<https://www.garmelenhaus.de/wiki/landplanarien>).

The German outdoor population of *Caenoplana variegata* was found at the edge of a garden pond with ornamental fish. The distance to the nearest garden center is 150 m only, suggesting that the origin of this population was either the garden center or water plants introduced in the garden pond. The indoor record from the Haus des Meeres Aqua Terra Zoo in Austria was most likely introduced with plants from a wholesale in The Netherlands, although the introduction of flatworms through the soil in the

enclosure, predominantly sourced from Austria, cannot be excluded. Our observation of a living flatworm sticking on the plumage of a bird is probably accidental, but we also cannot entirely exclude that birds or mammals can be used in rare cases by land flatworms as carriers for their dispersal, facilitated by their sticky slime on the body surface.

The recent overview of Thunnissen et al. (2022) recorded only three species of alien terrestrial planarians from Germany and one species from Austria. Our findings of *C. variegata* together with additional records from the literature and new records from iNaturalist and observation.org (Table 1) demonstrate a substantial increase to nine identified species recorded for Germany and at least four for Austria, most of them found only in greenhouses and other indoor facilities. These species (e.g., *Bipalium kewense*) are unlikely to become invasive under the climatic conditions in Central Europe. The few species from outdoor localities were mostly found in gardens or urban areas and rarely in nature, and their invasive potential remains unknown. The still very low number of recorded alien planarian species and localities in Germany and Austria compared to neighbouring countries, as well as the drastic increase of new records in recent time (Table 1), suggests that additional species might have been overlooked in both countries and that the actual distribution of non-native flatworms is still very poorly known.

Future research on these organisms should therefore be intensified to get a better understanding on their distribution, the dynamic of their range extension, and their impact on the soil ecosystems in Europe. In order to obtain large datasets and to increase the public awareness on alien flatworms we recommend the usage of citizen science, which has been successfully applied for France by Justine et al. (2018, 2020). In any case we support the application of phytosanitary measures as discussed in Thunnissen et al. (2022) in order to limit the rapid dispersal and the unintentional import of additional alien planarian species.

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