

First records of two alien land flatworms (Tricladida, Geoplanidae) from Northeastern Italy

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During a period of intense rainfall (May 2019), several specimens of land flatworms were collected from a private garden in Palazzolo dello Stella (Friuli Venezia Giulia, Udine, Italy: 45°47'40.5"N, 13°05'17.2"E). Planarians were found both in a cultivated part of the garden and in a part covered with gravel and with trees and shrubs (*Pyracantha* sp., *Olea europaea*, *Pyrus communis*). The animals were observed under branches, stones, tufa blocks, and pots close to a small artificial pond, but also in other parts of the garden, as well as inside buildings.

These flatworms concern the species *Caenoplana bicolor* (Fig. 1) and *Diversibipalium multilineatum* (Fig. 2). The determination was kindly confirmed by J-L. Justine, also by using genetic analysis.

The owners of the garden observed *D. multilineatum* already in 2017 (first photo: 04 November 2017), while they noticed the presence of *C. bicolor* only since May 2019. We observed the two species to be present in the same microhabitats, which are very close together (only a few centimeters). In order to study the population density of the two species, we used 37x20 cm tufa blocks as surrogate plots. During four nights (9, 12, 15, and 26 July 2019) we checked for the presence of the two species under the blocks in three different environments: in an open space near a garden faucet, around an artificial pond (about 150 x 80 cm), and under *Pyracantha* shrubs.

Our more standardized investigation of the population density of the two species yielded the following results: on average, in four evenings 53,75 specimens of land planarians were observed per night; among those were on average 47,75 specimens of *C. bicolor* and 6 worms concerned *D. multilineatum*. However, *C. bicolor* was always much more abundant than *D. multilineatum*, with densities at least 5 times higher.

Furthermore, our searches outside of the garden, in the surrounding ditches, revealed the presence of specimens of *C. bicolor* at a few meters from the garden. Some natural areas in the vicinity of the garden (woods on the Stella river banks, woods of Muzzana) were investigated also, but to date have not resulted in findings of terrestrial flatworms.

In Italy, there are only a few records of alien land planarians, viz., *Diversibipalium multilineatum* (Mazza *et al.* 2016), and *Bipalium kewense* (Gremigni 2003); inclusion of Italy in the records for *Caenoplana bicolor* by Sluys (2016) rests on a *lapsus calami*, as does the exclusion of France from this list. The native distribution of *D. multilineatum* is Japan, while *Caenoplana bicolor* is native to Australia (Sluys 2016). As is the case with many other invasive land flatworm species, the current distribution outside of their native ranges is presumably the result of transportation of potted plants by the horticultural trade. As successful invasion of allochthonous flatworms seems to be strongly influenced by soil moisture (Fraser and Boag 1998), they mostly occur in private gardens, or in human-modified habitats, where they continue to be associated with ornamental plants (Boag *et al.* 1994; Alford *et al.* 1996; Moore *et al.* 1998) and are always found in particular microhabitats with moist conditions. Since many of these alien planarians are recent colonizers (Justine *et al.* 2014), it is not possible to predict what their status will be in the future, in view of the fact that alien species often exhibit their invasiveness only after an initial period of adaptation, which may be rather long (Crooks 2005), as acclimatization to new environmental conditions plays an important role during establishment (Hänfling *et al.* 2011).

We believe that it is likely that the two alien species *C. bicolor* and *D. multilineatum* have invaded also other gardens in its vicinity. It is noteworthy that this locality is in the proximity of two protected areas (two Special Areas of Conservation, according to 43/92CEE Directive: codes IT3320034 and IT3320036) being 1.6 km and 3,4 km from the private garden, respectively. The fact that we found specimens of *C. bicolor* at a locality a few metres from the garden, suggests that it is possible for these animals to spread into neighboring territories. Therefore, it is important to monitor the distribution and spread of the land planarian populations over time, particularly in natural habitats.



FIGURE 1. *Caenoplana bicolor* from Palazzolo dello Stella



FIGURE 2. *Diversibipalium multilineatum* from Palazzolo dello Stella, while feeding on an earthworm

Summary

In this paper we report new findings for Northeastern Italy of the allochthonous species *Diversibipalium multilineatum* (Makino and Shirasawa 1983) and *Caenoplana bicolor* (Graff 1899), both found in a private garden in Friuli Venezia Giulia. The two species occur in the same microhabitats at very close distance. Although their spread is linked to the horticultural trade, some specimens occur in natural ditches, and therefore there is some concern that the worms may invade also nearby protected areas.

Conflict of Interest

The authors declare that they have no conflict of interest.

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