



Short Communication

High abundance of an exotic amphipod indicates disturbance in tropical rainforests



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ABSTRACT

Previous studies have proposed terrestrial amphipods as potential bioindicators of forest condition. In order to investigate the response of the exotic terrestrial amphipod *Talitroides topitotum* (Crustacea: Amphipoda: Talitridae) to anthropogenic disturbances and its potential as a bioindicator, we compared its abundance among three forest reserves in southeastern Brazil, under different types and intensities of disturbance. We observed significantly higher abundances in disturbed sites compared to undisturbed sites in two of the reserves sampled, corroborating previous studies. In the third reserve, in which both forest disturbance and the abundance of amphipods were much lower than in the other two reserves, there was no significant difference between the sampling sites. We also speculate about the potential use of terrestrial amphipods as global indicators of forest disturbance.

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1. Introduction

Epigeic invertebrates are considered good indicator taxa of forest disturbance due to their life history and because they can be directly affected by changes in soil properties (Lavelle et al., 2006); among these invertebrates are the amphipods. Previous studies have shown that beach amphipods are key species in biomonitoring, acting as good indicators of environmental changes caused by human intervention in complex ecosystems (Bessa et al., 2013; Gonçalves et al., 2013). Studies in Afrotropical forests in South Africa have also identified a native terrestrial amphipod as a potential bioindicator of forest condition, relating “a consistent trend of high abundance with increasing forest disturbance” (Kotze and Lawes, 2008). The authors concluded that amphipod abundance might be used as indicators of forest conditions at a local scale, as disturbance effects vary mainly in intensity rather than type.

In Brazil, where native terrestrial amphipods are unknown (Friend and Richardson, 1986), the presence of *Talitroides topitotum* (Crustacea: Amphipoda: Talitridae) has been reported since 1972, when this terrestrial amphipod species was introduced by the importation of plants from the United States (Lemos de Castro,

1972), especially *Eucalyptus* species. Currently, *T. topitotum* occurs in different regions of the Atlantic Forest, along southeastern and southern Brazil (Lopes and Masunari, 2004; Matavelli et al., 2009b).

Here we studied the response of the exotic terrestrial amphipod *T. topitotum* to different kinds of anthropogenic disturbances and its bioindicator value in the Atlantic Forest. Based on previous studies on terrestrial amphipods, we hypothesize that disturbed forests will host a higher abundance of amphipods than less disturbed forests. We also speculate on the potential of using terrestrial amphipods as global indicators of forest disturbance.

2. Methods

The study was conducted in three Atlantic Rain Forest reserves along the Serra do Mar biogeographical sub-region: Santa Virgínia Nucleus at Serra do Mar State Park (SVN), Boracéia Biological Station (BBS), and Parque das Neblinas Private Reserve (PNR) (Fig. 1), located in a well-preserved Atlantic Rain Forest area of more than one million hectares (Ribeiro et al., 2009).

Sites with both high and low degrees of disturbance were sampled within each reserve (hereafter referred as “disturbed” and “undisturbed”) (Table 1). Despite variation in disturbance intensity and age, all sampling sites were similar in vegetation structure. In order to avoid variation in *T. topitotum* abundance due to site idiosyncrasies, samplings were performed in sites with similar features, such as litter depth, canopy closure and slope angle.

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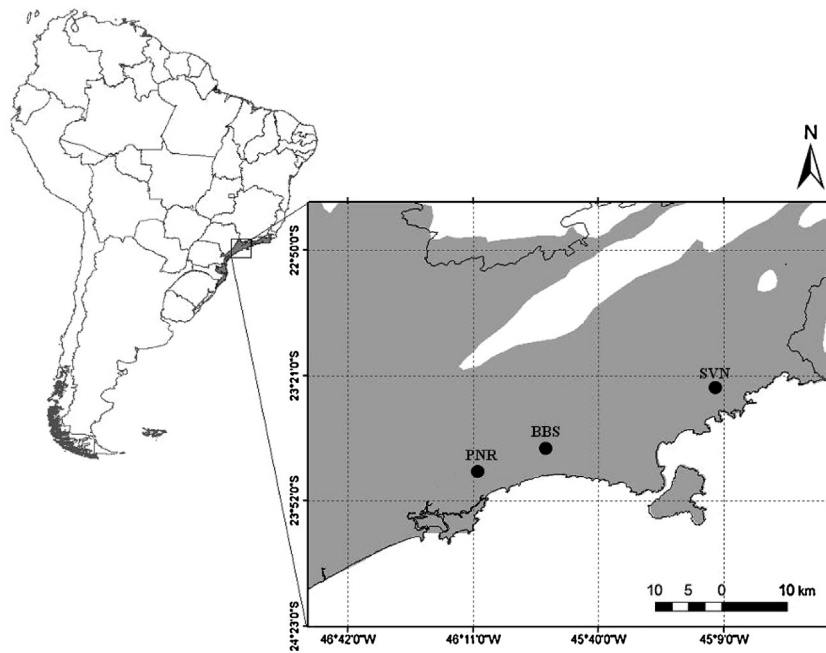


Fig. 1. Locations of the reserves in the Atlantic Forest biome, Brazil. PNR = Parque das Neblinas Particular Reserve; BBS = Boracéia Biological Station; SVN = Santa Virgínia Nucleus.

Table 1
Main characteristics of the reserves sampled in this study.

Reserve	Code	Legal area (ha) ^a	Vegetation condition		Anthropogenic activity	
			Disturbed sites	Undisturbed sites	Disturbed sites	Undisturbed sites
Santa Virgínia Nucleus	SVN	9000	Secondary forest	Mature forest	History of slash and burn (1960) ^b	History of selective logging (1970) ^b
Boracéia Biological Station	BBS	100	Mature forest	Mature forest	Intensive trail management (currently) ^b	Extensive trail management (abandoned in 1970) ^b
Parque das Neblinas Reserve	PNR	2788	<i>Eucalyptus</i> plantation	Secondary forest	<i>Eucalyptus saligna</i> plantation (since 1939) ^b	Native forest

^a The three reserves are located in an Atlantic Forest continuum.

^b See Magrini et al. (2011).

Amphipods were collected using pitfall traps, which can be reliably used for monitoring population size (Mantzouki et al., 2012). Pitfall traps consisted of 500 ml plastic containers with an 8.5 cm opening, leveled with the soil surface and containing 30% propylene glycol, 0.1% formaldehyde, and a few drops of detergent to break the surface tension. Traps were protected from direct rainfall and falling leaves by a circular styrofoam cover placed above each trap. Each sampling unit consisted of a transect with five pitfall traps placed 2 m apart. Traps were kept open for six days per month from November to May, which is the high activity period of *T. topitotum* (Lopes and Masunari, 2004). Sampling was conducted during 2004/2005 at SVN, and during 2005/2006 at BBS and PNR. In each reserve, 12 sites were selected, with six replicates in disturbed and six in undisturbed conditions, placed at least 120 m apart (median 150 m, max 450 m). Collected amphipods were preserved in 70% alcohol and deposited at the Museu de Zoologia da Universidade Estadual de Campinas (Unicamp) collection.

Differences in abundance between disturbed and undisturbed sites per reserve were tested using Mann–Whitney test.

3. Results

A total number of 208 amphipod individuals were collected at BBS, 771 at PNR and 3593 at SVN. The minimum number of *T. topitotum* collected per sampling unit was zero at all three

reserves, while the maximum was 78 at BBS, 187 at PNR, and 1602 at SVN.

Ninety-nine percent of all *T. topitotum* individuals occurred in the disturbed sites at PNR ($U=0.0$, $P=0.004$). At SVN, 97.7% of all individuals occurred in the disturbed sites ($U=1.0$, $P=0.007$). No difference in abundance was observed between disturbed and undisturbed sites at BBS ($U=11.5$, $P=0.298$) (Fig. 2).

4. Discussion

We confirmed the indicator potential of terrestrial amphipods in our study, where amphipod abundance was significantly higher in more disturbed sites compared to less disturbed sites. Furthermore, the least disturbed reserve (BBS) showed the lowest abundance of *T. topitotum*.

The invasive success of *T. topitotum* in Brazil can be explained by Darwin' naturalization hypothesis, which states that a species may have higher invasive success in areas where phylogenetically related species are absent (see Ricciardi and Mottiar, 2006). A species inventory made in Austria demonstrated that Crustacea had the highest proportion of naturalization among all taxa, and this success is likely due to life history traits (e.g. high mobility, high fertility and fecundity, and high tolerance to adverse conditions) (Rabitsch and Essl, 2006). Accordingly, life history traits of *T. topitotum* allow new areas to be colonized. For example,

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