

Oligochaetes (Clitellata) of the Mata Atlântica (Parana, Brazil): first results of the SOLOBIOMA project

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Abstract. In the framework of the German–Brazilian SOLOBIOMA project, oligochaete worms (mainly Glossoscolecidae and Enchytraeidae) are being sampled in early, medium, and advanced secondary forests and pastures under different soil conditions in the Brazilian Mata Atlântica (in total 27 sites). One objective of this work is to identify the factors that determine the presence or absence of species. Preliminary results indicate that the species diversity of earthworms is low and does not differ between the various forest and soil types, whereas their abundance and biomass are highly variable. The enchytraeid communities show a different picture with high taxonomic diversity, but low abundance and biomass at nearly all sites.

Key words: Enchytraeidae, Glossoscolecidae, biological soil classification, diversity.

INTRODUCTION

This contribution presents preliminary results of the project SOLOBIOMA. In this project, the diversity of two families of oligochaete worms (Glossoscolecidae and Enchytraeidae) is determined in young, medium-aged, and advanced secondary forests and pastures under different soil conditions in the Brazilian Mata Atlântica (in total 27 sites). These data will be compared with the site properties (age, geology, soil conditions, and vegetation type). The aim of this work is to identify the factors that determine the presence or absence of species, and also the factors

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that may be relevant for species richness and community structure. In a second, so-called functional approach, not further discussed here, the role of microflora and soil fauna in organic matter breakdown and nutrient cycling is identified in the same area. The overall project is performed by a group consisting of German and Brazilian partners (e.g., universities, museums, and local stakeholders such as NGOs interested in the management of the area) (Höfer 2004).

MATERIAL AND METHODS

The study area is situated in the coastal plain of the Serra do Mar near the town of Antonina (25°25' S, 48°40' W) in the Área de Proteção Ambiental Guaraqueçaba (Reserva Natural do Rio Cachoeira), where Cambisols and Gleysols are widely distributed. The natural vegetation is denominated “Floresta Ombrófila Densa Submontana”. In total, four to five different age stages can be identified (Table 1).

The sampling methods for oligochaetes have already been successfully used in central Amazonia (Höfer et al. 2001). In the case of earthworms, hand-sorting (good efficiency) and formalin extraction (poor efficiency) were used (ISO 2004a). Enchytraeids were sampled using a soil corer, followed by wet extraction in the laboratory (ISO 2004b).

Five earthworm samples were taken per site, using a combination of hand-sorting and formalin extraction. A site comprises a rectangular field (20 m × 50 m); the samples were arranged in the form of a pentagram at the four corners and the centre of the site, respectively. Ten enchytraeid samples (each subdivided into two layers of 0–4 cm and 4–8 cm) were taken per site. The samples were arranged in two parallel, partly staggered, rows across the whole site. At present, 18 out of the 27 sites have been sampled in three campaigns in May 2003, November 2003, and March 2004. In the following account, quantitative data refer only to the first two campaigns (11 sites).

Table 1. Overview of the sampling design with numbers of sites per combination of successional stage and soil type. Pasto – pasture; Início – pasture abandoned for 3–5 years, beginning of succession from pasture to secondary forest; Arboreo – 10–20 years old secondary forest; Medio – more than 30 years old secondary forest; Floresta – presumed to be primary rain forest, no Floresta sites were found on Gleysol

Soil type	Vegetation types → increasing age and decreasing human impact →				
	Pasto (P)	Início (H) 3–5 y	Arboreo (A) 10–20 y	Medio (M) >30 y	Floresta (F) “primary”
Cambisol (CA)	3	3	3	3	3
Gleysol (GL)	3	3	3	3	–

RESULTS

Earthworms

Only peregrine species have been found so far. Highly dominant is *Pontoscolex corethrurus* (Müller, 1857) (Glossoscolecidae), which always reaches over 90% in numbers and biomass. Other species such as *Amyntas* sp. (Megascolecidae) and *Dichogaster* sp. (Octochaetidae) rarely occur. Species numbers per site and date are very low (<4) and show no differences between sites.

The mean abundance of earthworms on both dates and at all sites varied between 30 and 250 ind/m², while the biomass was from 2 to 43 g fresh weight (FW)/m² (in general trends there is no difference between abundance and biomass). At all sites, both values are in the same order of magnitude (Table 2). No clear trend in relation to soil type or vegetation type is identifiable, but there is a tendency that sites with an “initial” vegetation type (H) have on average a higher abundance and biomass in both soil types than most of the higher sites (high densities and biomasses were also found at A sites (Cambisol) and M sites (Gleysol)).

Table 2. Average abundance (ind/m²) and biomass (g FW/m², mean of two dates, of earthworms at the different sites

Vegetation type	Abundance, ind/m ²		Biomass, g FW/m ²	
	Cambisol	Gleysol	Cambisol	Gleysol
Pasto (P)	80.0	62.4	19.0	13.2
Inicio (H)	191.2	106.7	39.3	27.1
Arboreo (A)	142.8	31.2	29.7	7.6
Medio (M)	53.6	106.1	9.2	27.6
Floresta (F)	52.8	No data	8.8	No data

Enchytraeids and other microdrile oligochaetes

Any statement concerning the microdrile species composition is preliminary due to the fact that most are new to science. Furthermore, the process of sorting and characterizing taxa implies a large amount of basic taxonomic and revisionary work on the genus and species levels. New standards for the interpretation of character variations (intra- or inter-specific) must be developed, especially in the apparently species-rich genus *Guaranidrilus*. At least one new genus has been found. It was not possible to assign one species to any known family. Table 3 gives an overview of the taxonomic diversity found.

The number of species found per site is 6–26. At most sites *Guaranidrilus* and *Hemienchytraeus* dominated the community. In Figure 1, the species number is given from 9 sites sampled in May 2003. Although the taxonomic work is still in

Table 3. Number of distinguishable enchytraeid and other annelid taxa at 18 sites sampled until November 2003

Taxon	Number of species
<i>Achaeta</i> (Enchytraeidae)	5
<i>Enchytraeus</i> (Enchytraeidae)	1–3 (fragmenting and non-fragmenting, character variation inconclusive)
<i>Fridericia</i> (Enchytraeidae)	2 or 3
<i>Guaranidrilus</i> (Enchytraeidae)	20 forms distinguishable. Not all of them may deserve species rank
<i>Hemienchytraeus</i> (Enchytraeidae)	ca. 6, probably more
<i>Tupidrilus</i> (Enchytraeidae)	1
Enchytraeidae gen. sp.	ca. 6, belonging to at least 3 genera
<i>Pristina</i> (Naididae)	<i>P. jenkiniae</i> (dominant); 2 more species
<i>Bothrioneurum</i> sp. (Tubificidae)	2
Tubificidae/Naididae gen. sp.	1
Oligochaeta gen. sp.	1, family affiliation unknown
Aeolosomatidae (Polychaeta)	1

progress, formalized descriptions (including figures) are already available for all species and distinguishable forms. In addition, keys to genera as well as to species have been prepared. Besides Enchytraeidae, a diverse and abundant naidid and tubificid fauna was found at many sampling sites, belonging mostly to species of *Pristina* (Naididae) and *Bothrioneurum* (Tubificidae). Actually, similar observations concerning the microdrile community were also made in the Amazon (Collado & Schmelz 2000).

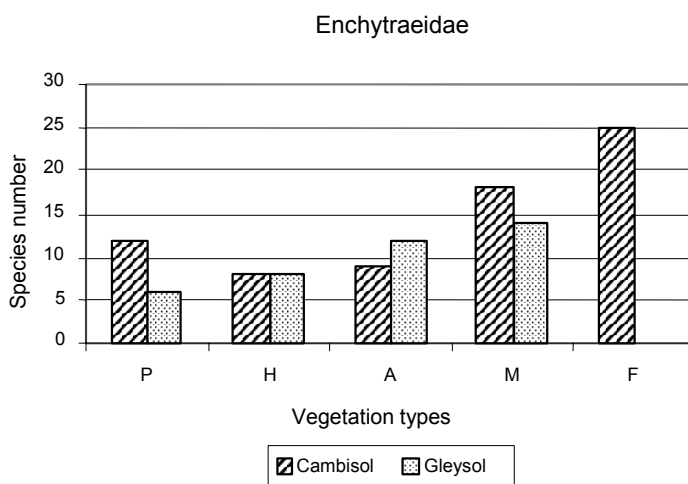


Fig. 1. Number of enchytraeid species at 9 sites and two soil types in May 2003.

Abundance (ind/m²) at each of the 9 sites sampled in May 2003 and at the nine sampled in November 2003 is given in Figs 2 and 3. Clear differences between the sites were found but no consistent trend related to the type of site was obvious for either of the sampling dates. While in May between 2000 and 6000 ind/m² were sampled, this number decreased at some sites to less than 1000 ind/m² in November.

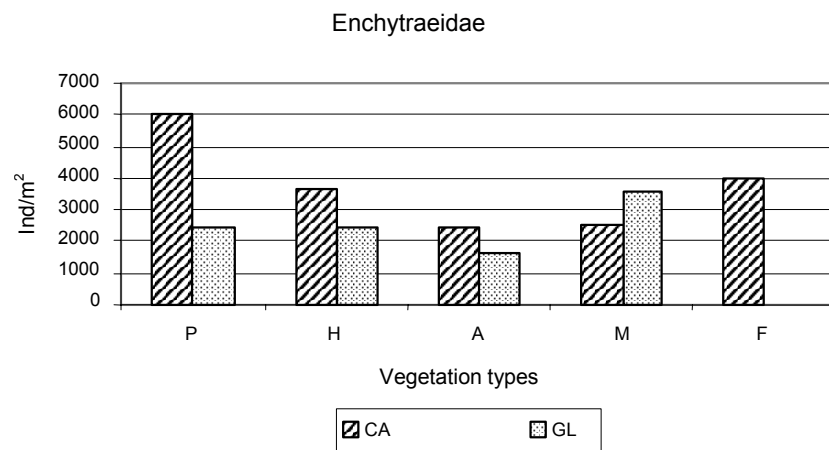


Fig. 2. Abundance of enchytraeids at 9 sites and two soil types in May 2003.

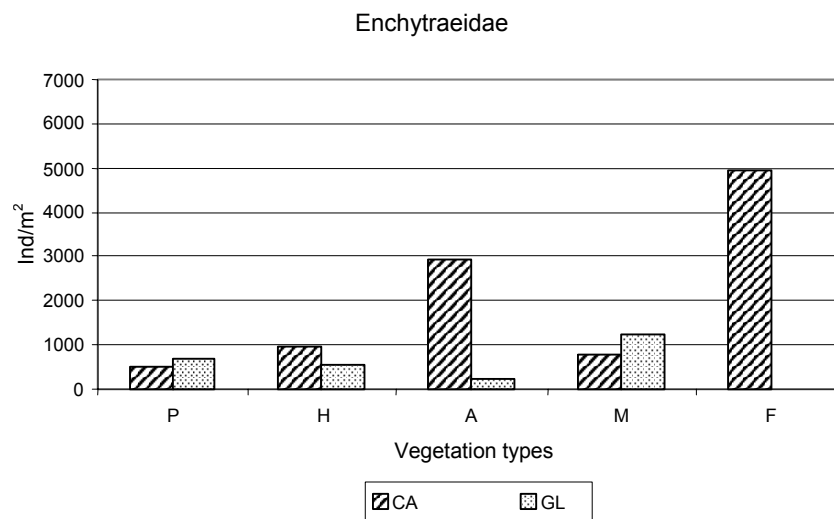


Fig. 3. Abundance of enchytraeids at 9 sites and two soil types in November 2003.

Table 4. Mean enchytraeid abundance (ind/m²) at 5 sites, each sampled in two different seasons

Site	November 2003	March 2004
Cambisol – Pasture (P)	500	2600
Cambisol – Início (H)	1000	3600
Gleysol – Pasture (P)	700	4300
Gleysol – Início (H)	600	1900
Gleysol – Medio (M)	1200	900

Table 5. Mean enchytraeid abundance by vegetation types (ind/m²)

Vegetation type	March 2003	November 2003
Pasture (P)	4200	700
Início (H)	3100	800
Arboreo (A)	2000	1600
Medio (M)	3100	1000

In order to check variability in time, five sites were sampled twice (Table 4). According to these numbers, the abundance was about three times higher in March than in November. Further sampling is needed to show whether this result is an artefact (of small sample size) or a general, seasonal trend. In addition, the numbers of individuals found in the different vegetation types (independent of the individual site) were compared (Table 5). Independent of the soil type, there was no clear influence of the vegetation type on abundance (ind/m²). On average for the two sampling dates, the enchytraeid abundance at the Cambisol sites was twice as high as the abundance at the Gleysol sites (3400 : 1700 ind/m²).

DISCUSSION AND OUTLOOK

Our results show that earthworms are ecologically highly relevant in the Mata Atlântica region due to their high biomass; the species composition (low species numbers, the fact that all species are peregrine, with one species dominating (>90%)), however, makes them unsuitable for biodiversity assessments. The dominance of peregrine species in the earthworm fauna of Parana confirms previous unpublished observations (G. G. Brown, pers. comm.). The enchytraeids, on the other hand, appear to be not very relevant in ecological terms due to their very low abundance (average numbers in temperate forest soils range usually between 10 000 and 140 000 ind/m² (Didden 1993)) and thus biomass (in relation to other soil invertebrates, in particular earthworms); their taxonomic richness, however, makes them good diversity indicators in the Mata Atlântica.

Although most of the species found are new to science, it is impossible to say whether they are endemic or not because almost no thoroughgoing taxonomic

studies on enchytraeids in Latin American forests have been carried out. Practically nothing is known about the enchytraeids of this region (Römbke 2003). Two of the new species of *Hemienchytraeus* were also found in Amazonia in different studies (Römbke & Meller 1999, Schmelz & Römbke 2005). Currently, it is impossible to estimate the total diversity of microdrile worms in the Mata Atlântica region. The data presented here will be used as a baseline for the application of a “regionally differentiated BBSK” approach (Soil Biological Site Classification) (Ruf et al. 2004) with the long-term objective of assessing the biological quality of the soil (i.e. its habitat function). However, the following work has still to be completed:

- Oligochaete sampling of the last nine sites in autumn 2004;
- Basic taxonomic and revisionary work to clearly describe and delineate the enchytraeid species;
- Assessment of the results in 2005: in particular, multivariate analysis of the relationship between soil and site properties and oligochaete communities;
- Further literature research for data from comparable sites;
- Integration of oligochaete, arthropod, and microflora data determined at the same sites.

Hopefully, the project will run again from 2006 to 2008, allowing further work with enchytraeids and other oligochaetes in the Mata Atlântica region.

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Mata Atlântica (Parana, Brasiilia) väheharjasussid: “Solobioma” projekti esimesi tulemusi

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Saksamaa-Brasiilia ühisprojekti “Solobioma” raames on kogutud väheharjasusse, peamiselt sugukondadest Glossoscolecidae ja Enchytraeidae, 27 punktist Brasiilia rannikumadalikul Antonina linna ümbruses: erinevas arengujärgus sekundaarsetest metsadest ning karjamaadelt ja mitmesugustest muldadest. Esialgsed tulemused näitavad, et elupaiga tüübist olenemata on vihmausside (Glossoscolecidae) liigiline mitmekesisus seal madal, kuigi arvukus ja biomass võivad kõvasti varieeruda. Valgeliimuklastel (Enchytraeidae) seevastu on taksonoomiline mitmekesisus kõrge, kuid arvukus ja biomass peaaegu kõikjal madalad.