Mapping spatial distribution of preferential flow using earthworm distribution models in combination with tracer infiltration patterns

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Measurements
At 16 locations in the Weiherbach Catchment (see Fig. 3) a set of measurements were performed in March 2010:
- dye tracer rainfall experiments with approx. 43 mm/h on 1 m²
- earthworm extraction using a mustard solution on 0.25 m²
- profile excavation: three vertical and three horizontal profiles;
- macropore counting and labelling in size groups (<2 mm, 2-6 mm, >6 mm) and stained or non-stained;
- additional descriptive data: local slope, topographical position, crop, soil texture, soil moisture), and topography (slope, elevation).

Results and Discussion

Relationships earthworm types and different macropore classes (Table 1)
As can be expected of the different ecological earthworm types the correlation coefficients show that the endogeic worms are mainly correlated with the small sized macropores in 10 cm soil depth, while the Lumbricus terrestris is mainly correlated with the larger sized macropores (>6 mm) in all soil layers.

Macropore effecitvity (Fig. 5)
The relationship between total number of macropores and active macropores is linear for the different pore sizes and also for the different soil depths. The strength of this relationship does decrease with depth (R² = 0.9 for the first two soil layers and R² between 0.5 and 0.7 for 50 cm depth). Generally the relative amount of macropores which are stained decreases with depth.

Conclusions and Outlook
- The abundance and biomass of different earthworm types are correlated to different sizes of macropores in different soil depths.
- The amount of flow effective macropores is linearly related to the total number of macropores.
- The distribution of water to the macropores or matrix shape strongly depends on the matrix characteristics.

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References

For further information please keep an eye on the Biopore project website: http://brandenburg.geologie.uni-potsdam.de/users/schroeder/biopore/home.html

Fig. 1: Dye-tracer infiltration pattern, with macropores stained decreases with depth.

Results and Discussion

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Table 1. Correlation coefficients for different earthworm types and macropore classes in various soil depths. Blue marked correlations are significant at p < .05 (Biomass = BM, number of worms = N, Endogeic = ENDO, Epigeic = EPI and Lumbricus terrestris = LT).

<table>
<thead>
<tr>
<th>Macropore Diameter</th>
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<td>&gt;6 mm</td>
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Fig. 2. Lumbricus terrestris-earthworm in stained macropore at 90 cm soil depth

Fig. 3. Weiherbach Catchment with 16 measurement locations (•).

Fig. 4. a) Tracer irrigated plot, b) Lumbricus terrestris coming out of the soil, c) position of vertical and horizontal soil profiles, d) examples of horizontal profiles (with matches to indicate the macropores).

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<tr>
<th>Macropore Diameter</th>
<th>BM_ENDO</th>
<th>BM_EPI</th>
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<td>&gt;6 mm</td>
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Fig. 5. Numbers of active macropores related to the total number of macropores, for different size classes and profile depth.

Fig. 6 Infiltration profiles showing a large variability in infiltration front at soil surface and infiltration from macropores to the matrix.