



DEPARTMENT OF BIOSCIENCE
AARHUS UNIVERSITY, FACULTY OF SCIENCE AND TECHNOLOGY

Ecological properties of earthworm burrows in an organically managed grass-clover system

Paul Henning Krogh¹, Mathieu Lamandé², Jørgen Eriksen², Martin Holmstrup¹

phk@dmu.dk

¹DEPARTMENT OF BIOSCIENCE

²DEPARTMENT OF AGROECOLOGY





Digging a whole

Vacuum cleaning the surface





Delineating burrows





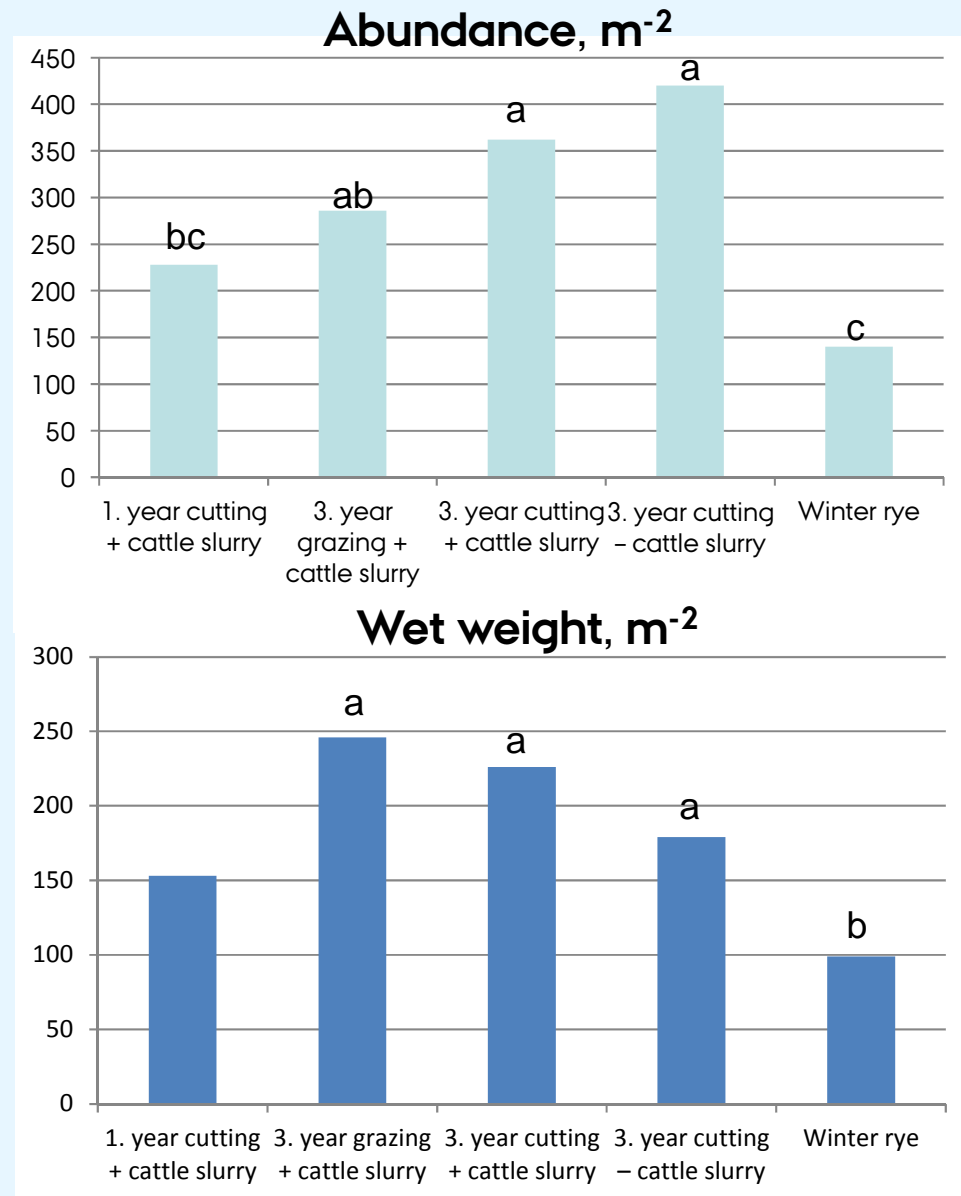
Burrow distribution ready for image analysis





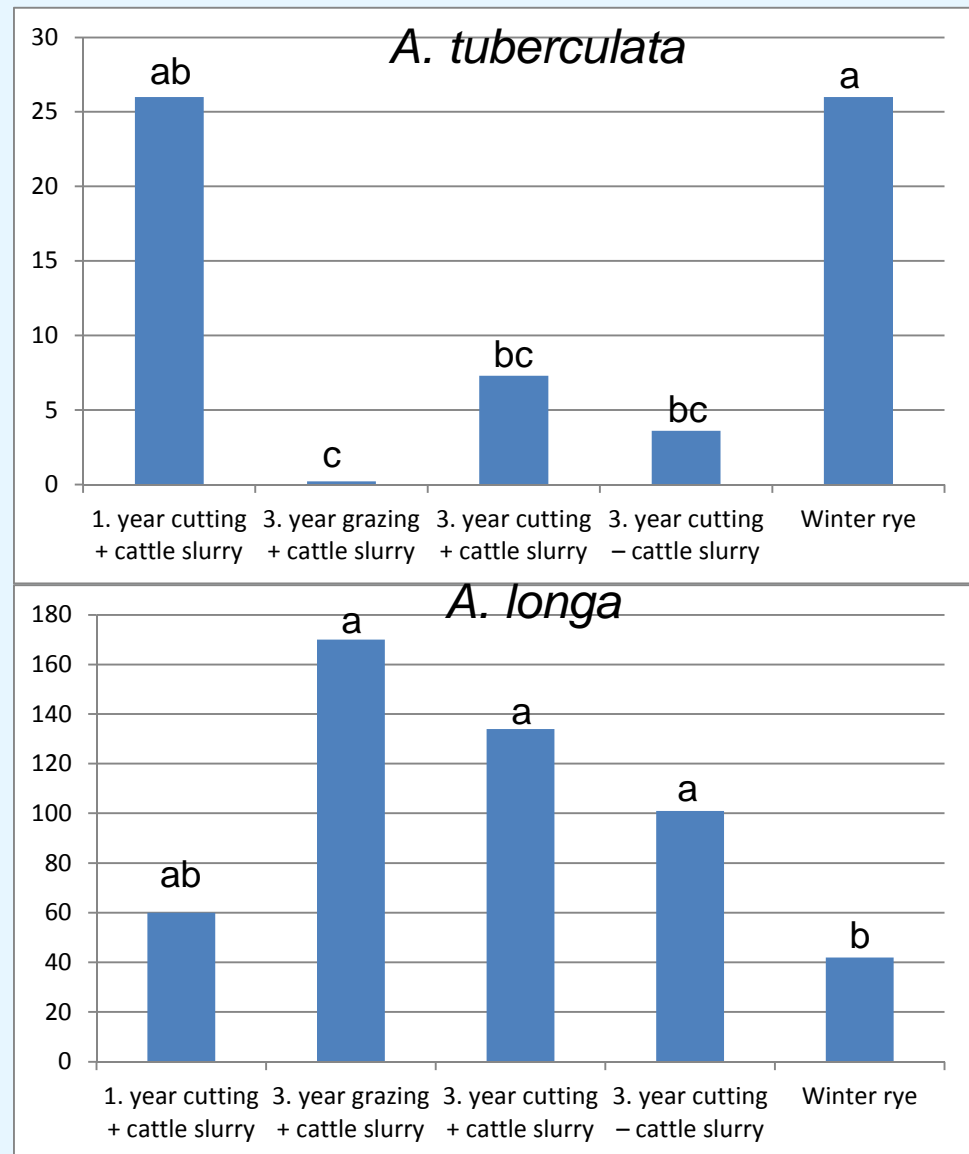
Total earthworm abundance and biomass

250 g earthworm biomass m^{-2}
= 2500 kg ha^{-1}





Biomass of two life-forms





Influence of agronomic elements of clover-grass cropping

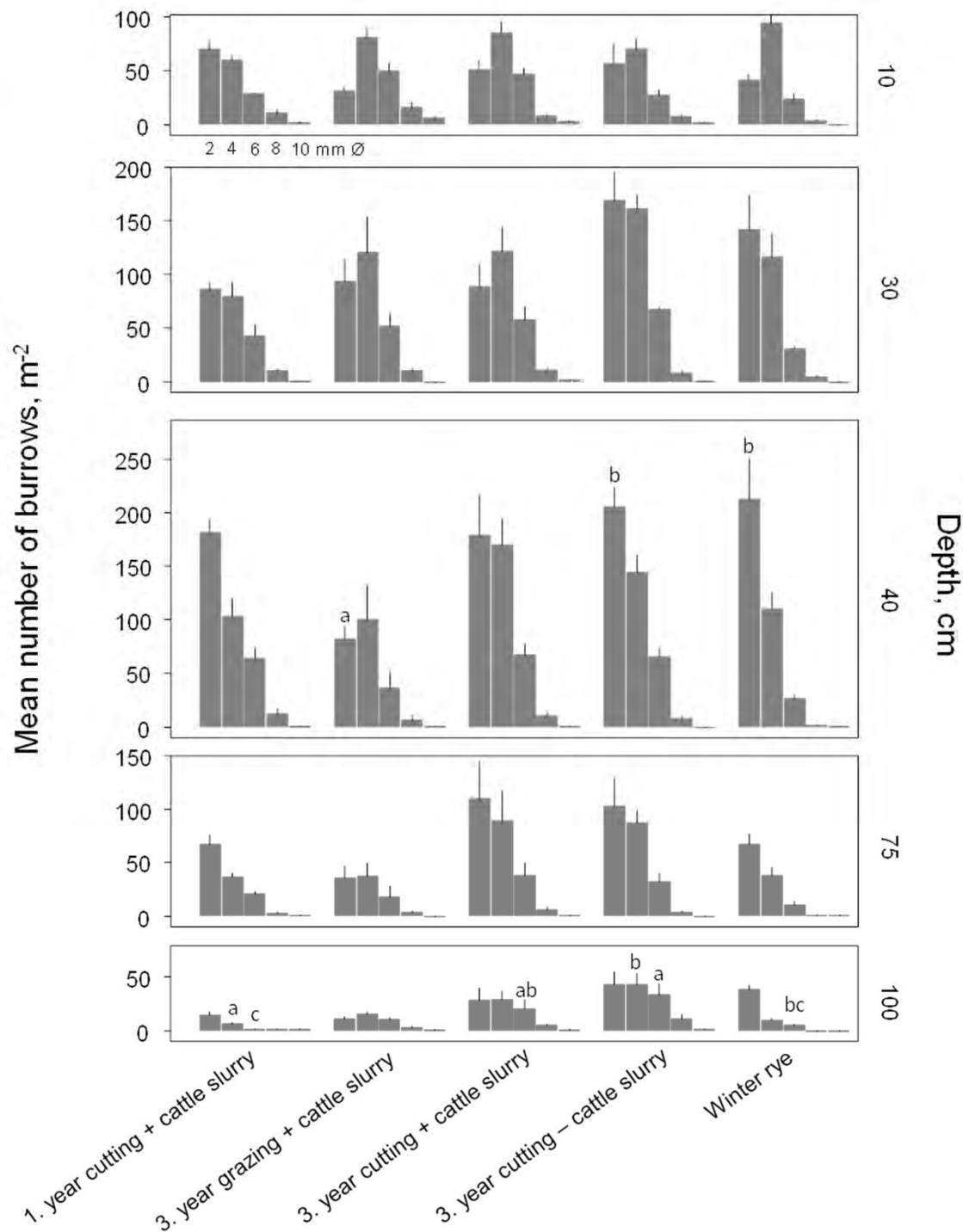
	Species	Slurry	Clover-grass age	Grazing	Annuals
Endogeic	<i>A. tuberculata</i>	0	÷	÷	+
	<i>A. rosea</i>	0	+	÷	÷
Anecic	<i>L. terrestris</i>	0	0	0	÷
	<i>A. longa</i>	+	+	0	÷



Burrow diameter size distribution

- > **Grazing reduces macropore density at 40 cm**
- > **Few large (<<10) macropores at 1 m in annual crops**

But even few could provide high water-flow





Correlations between burrows and earthworm species - summary

- > **Anecic species and *A. rosea* are significantly positively correlated with burrows**
- > **The endogeic *A. tuberculata* was consequently negatively correlated to macropores**
- > **No correlation between small macropores, 1 mm Ø, and earthworms**



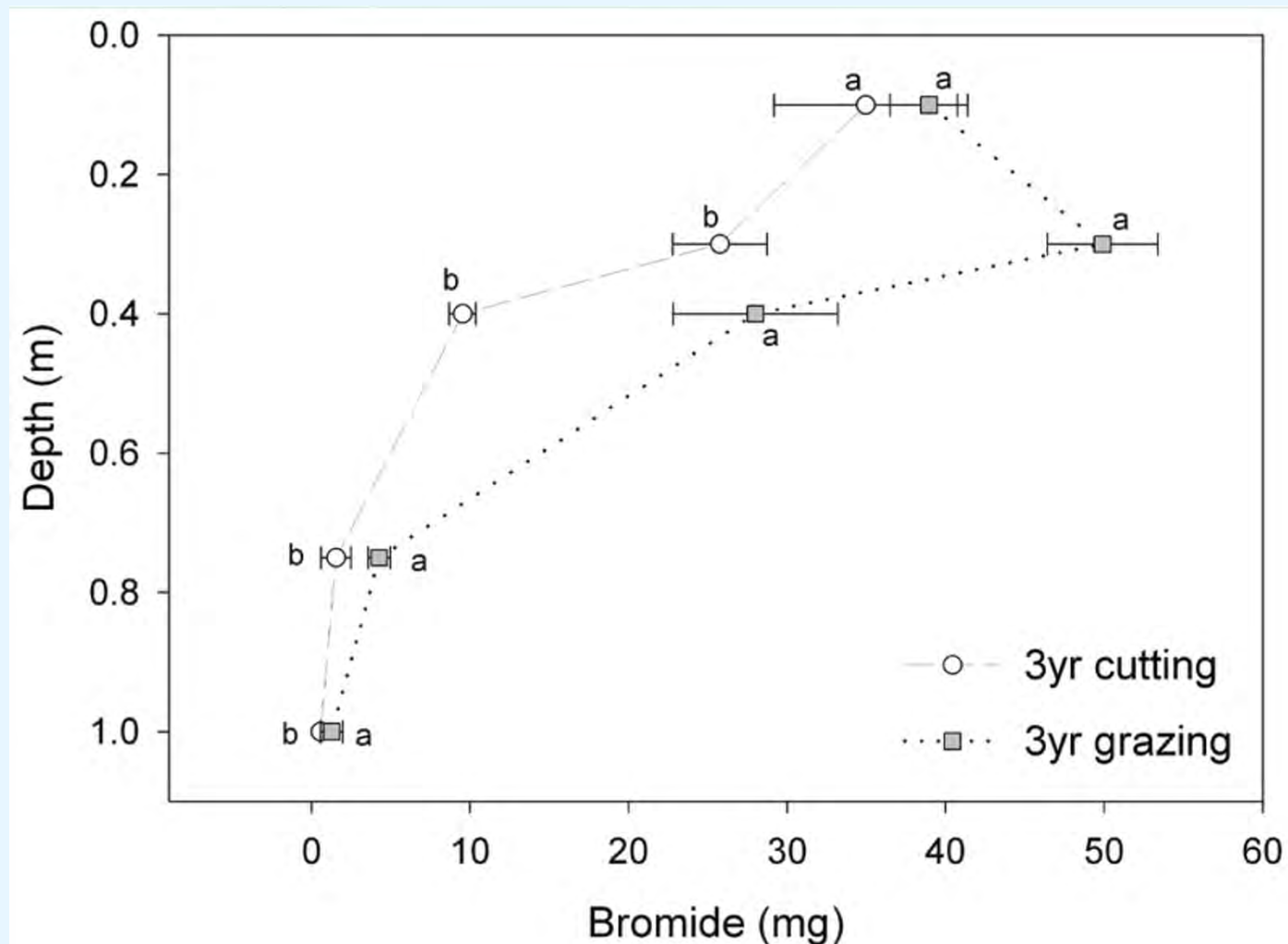
Addition of bromide to the soil – simulation of heavy rainfall

- > **Irrigation for one hour of 18.5 mm bromide solution (moderate-heavy rainfall)**
- > **Bromide is analysed down the soil profile after 24 hours**



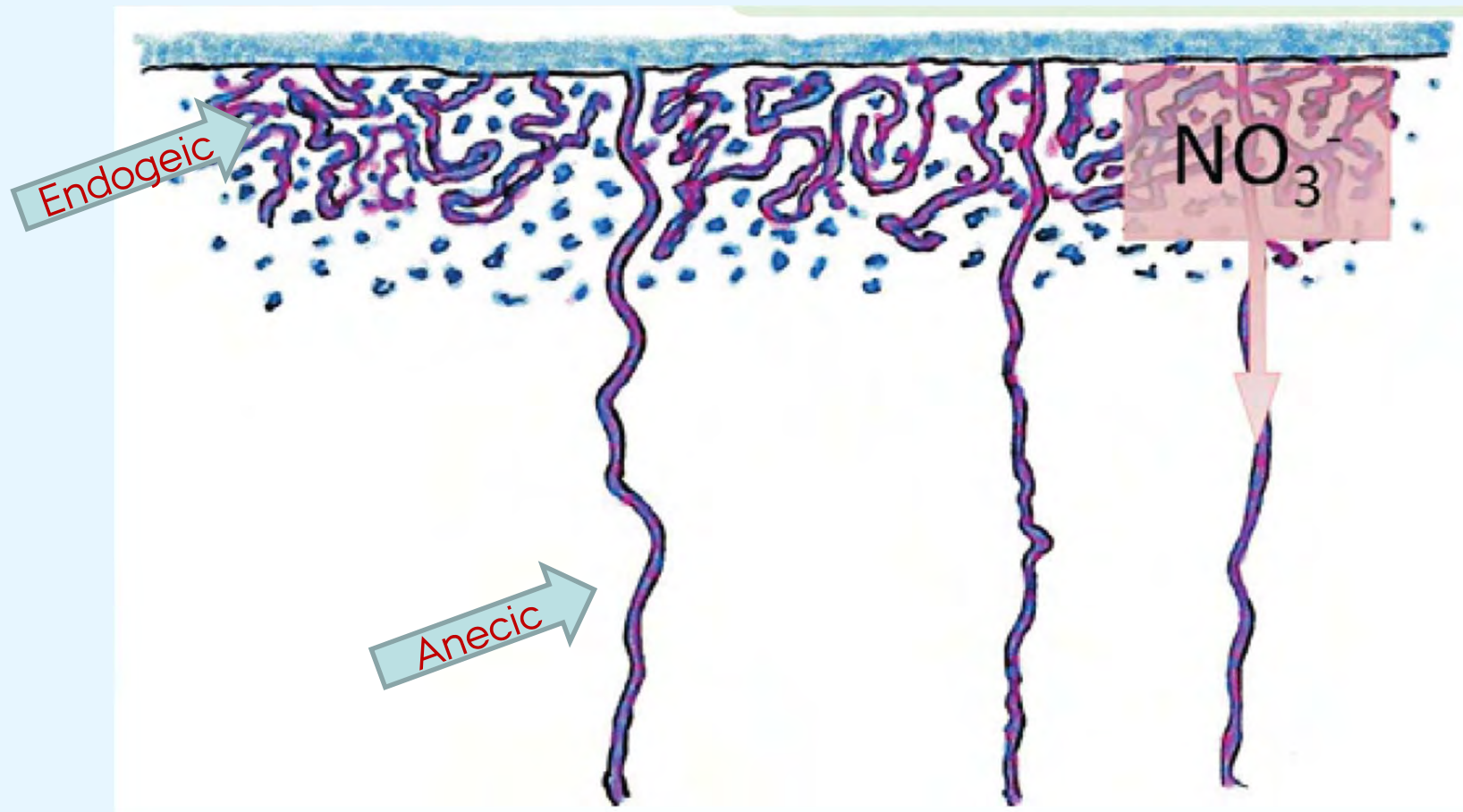
Lamandé *et al.* (2010). "Cattle trampling reduces the risk of nitrate leaching in organic dairy rotations." ICROFS news **2010(2)**: 5-7.

Water flow through the soil





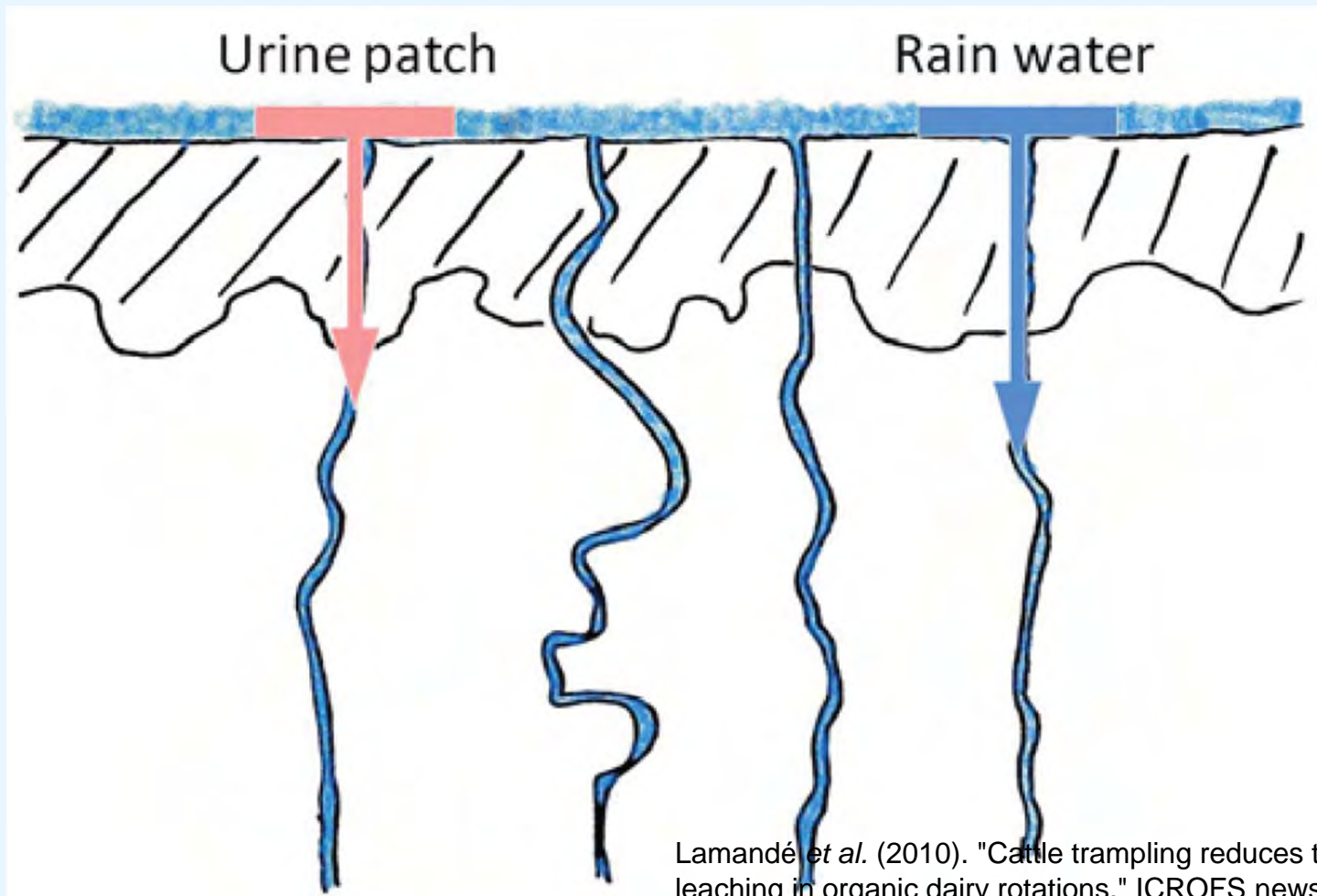
Burrow spatial distribution as made by endogeic and anecic earthworms



Lamandé *et al.* (2010). "Cattle trampling reduces the risk of nitrate leaching in organic dairy rotations." *ICROFS news* **2010(2): 5-7.**



Schematic presentation of water flow when cattle trampling has reduced top soil porosity



Lamandé *et al.* (2010). "Cattle trampling reduces the risk of nitrate leaching in organic dairy rotations." *ICROFS news* **2010(2): 5-7.**



Results of bromide application

- > **Water velocity was higher with grazing**
- > **Suggestion: due to less number of macropores water was flowing to the large macropores leading to higher velocity**



Conclusions

- › **All main element of clover-grass cropping affects earthworm communities as demonstrated just by our study:**
 - › **Fertilization**
 - › **Crop age**
 - › **Grazing**

Agroecological consequences of earthworm burrows:

- › **Leaching depends on the macropore density and size distribution**
- › **Water can by-pass the bulk soil through large macropores and avoid leaching of nitrate**



New research activities

> **EcoFINDERS - EU FP7**

- > Including earthworm ecology and burrow distributions in the JULES (Joint UK Land Environment Simulator) hydrological model including runoff and infiltration dynamics

> **PESTPORE - Danish EPA**

- > The occurrence and influence of deep biopores on pesticide leaching from land surface to chemically reduced ground water in glacial clayey till