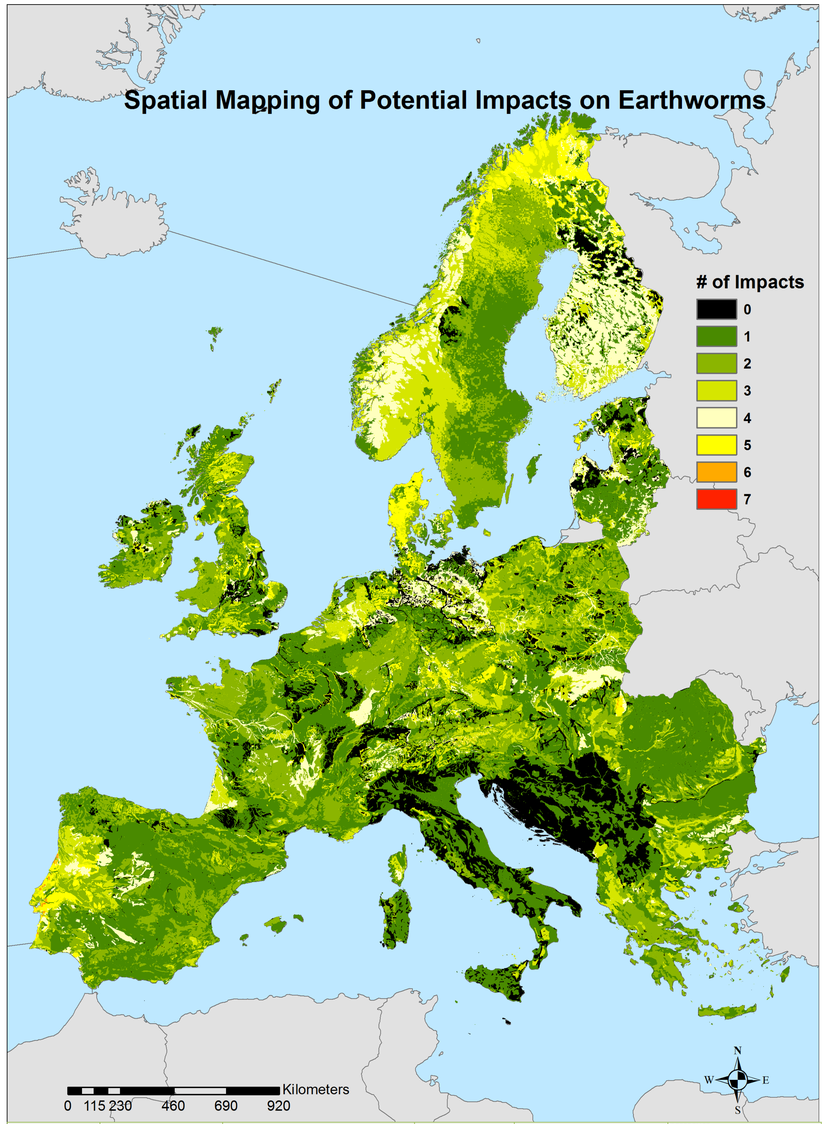
Impact assessment of major pressures on Earthworms in Europe

Aksoy, E. [1], Abdul Malak, D. [1], Gardi, C. [2] and Fons, J. [1]

[1] European Topic Centre- Spatial Information Analysis, University of Malaga, Spain. [2] University of Parma, Department of Biosciences, Italy



OUTLINE:

Earthworms dramatically alter soil structure, water movement, nutrient dynamics, and plant growth. They are not essential to all healthy soil systems, but their presence is usually an indicator of a healthy system. Earthworms perform several beneficial functions;

Stimulate microbial activity
- Mix and aggregate soil
- Increase infiltration
- Improve water-holding capacity
- Provide channels for root growth
- Bury and shred plant residue

MATERIAL:

The burrowing and feeding activity of earthworms, as well as their overall population, are affected by the soil environment in which they live. “Moisture, Temperature, pH, Soil texture, Food Supply, Management effects, Fertilizer and lime and Pesticides” are some of the properties which are important to earthworms.

Since, a single threshold value does not represent the boundary or cut-off between sustainable and unsustainable (high or low danger), due to the lack of information only limited number of indicators (and threshold values) were used in this study. Such as;

- Temperature
- Soil pH
- Soil texture (sub-soil and surface)
- Salinity
- Land use change (Land cover flows)
- Natural susceptibility to compaction
- Soil water regime classes
- Available water capacity (sub-soil and topsoil)

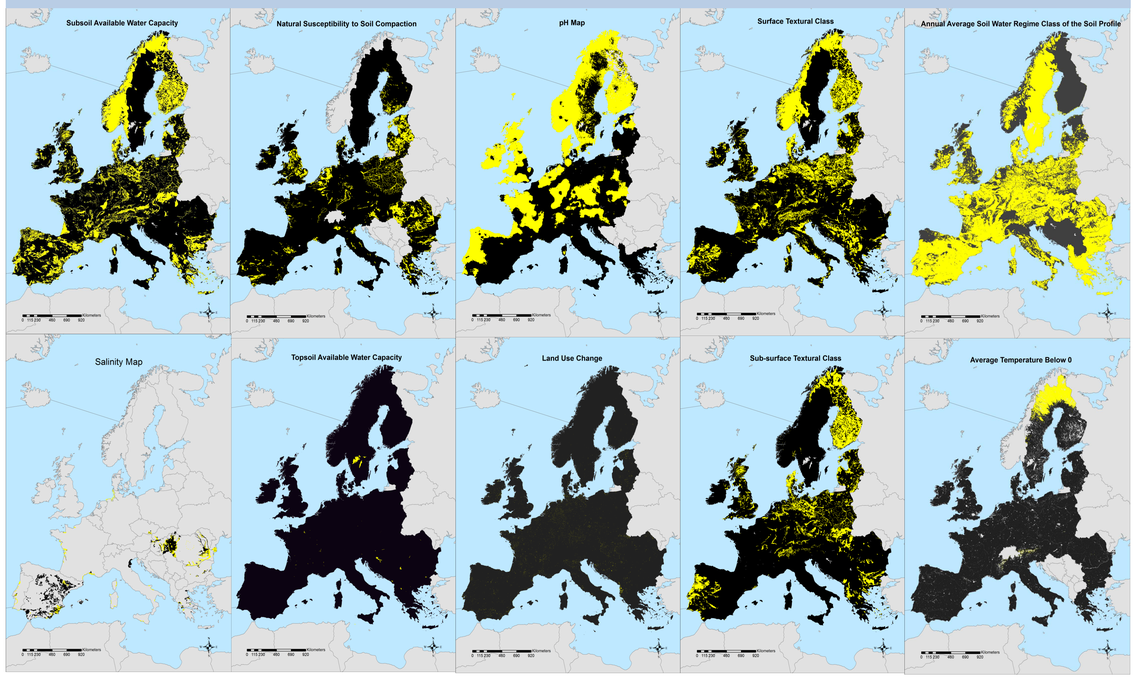
Number of Risks	Area(%)
0	10,050
1	39,832
2	25,467
3	11,861
4	9,212
5	3,516
6	0,062
7	0,001
Total	100

METHOD:

A spatial identification of the pressures was linked to the evidence on their impacts to develop spatial indicators. After literature survey and gathering some critical thresholds on the topic, the data layers were found and prepared. A spatial analysis of all developed layers derived from processed critical thresholds of the indicators (10 layers in total) were re-classified as binary layers (condition exist (yellow)or not (black) and then overlaid by equally weighted influence.

This study aims at putting together adequate knowledge and develops tools to spatially predict areas around Europe where natural habitats of earthworms could be impacted as a result of pressures’ effects on the functional traits of soil biodiversity using tracing evidence from literature. A meta-analysis highlighted critical thresholds of studied pressures, being the level of a specific indicator beyond which the particular system of soil biodiversity is no longer sustainable. This evidence will support the quantification of their impacts on natural habitats of earthworms.

Indicators



RESULTS:

- This method can be count as a first step of the observation of correspondences of the areas where have high risks and pressures on natural habitats of earthworms.
- Maximum 7 risks were found at the same location with very low percentage (0.001%), which highlights the most risky areas for earthworms in terms of current indicators.
- It’s not expected any negative impacts 10.1% of the study area (black colors), however, at least one of those risks exist in nearly 40% of the study area.

DRIVER	PRESSURE	IMPACT - Indication on exceedance	Units	CRITICAL THRESHOLD	REFERENCE
Climate change/ Soil temperature and moisture	Critical thresholds of temperature for some species	Lose weight, increase their burrowing activity, or enter into quiescence or diapause	°C Degree	Too dry soils	Booth, Heppelthwaite et al. 2000; Holmstrup 2001
Climate change/ Soil temperature and moisture	Critical thresholds of temperature and soil water potential for food consumption	In the case of Lumbricus terrestris, for example, the optimum temperature and soil water potential for food consumption are about 22 °C and 7 kPa, respectively. These results suggest limited burrowing and more intensive feeding in wetter soils, through a greater consumption of soil and organic substances, while slightly drier, non-compacted soils favour tunnelling and exploration in the soil profile	°C Degree and kPa	22 and 7	Bolton and Phillipson 1976; Scheu 1987; Daniel 1991
Climate change/ Soil temperature and moisture	Critical thresholds of temperature and soil water potential for food consumption	Most earthworms don’t tolerate temperatures below freezing, nor they tolerate high temperatures. Prolonged exposure to temperatures above 35 Kills them.	°C Degree	Below 0 and over 35	http://extension.psu.edu/plants/crops/soil-management/soil-quality/earthworms
Soil texture and structure		High population density and biomass of soil earthworms in loamy texture. Coarse sand is a negative factor either because the abrasive action of sand grains damages their skin, or because these soils dry out more easily.		Higher in medium textured (loamy) soils with high silt contents. Coarse sand risky.	Kainz (1991) http://extension.psu.edu/plants/crops/soil-management/soil-quality/earthworms
Salinity		Survival and reproduction of soil earthworms. After few days of exposure of below critical treshold, its already lethal for it.	Electrical conductivity (EC) dSm^{-1}	1,03	Owojori (2009)
pH		Higher biomasses and diversities at neutral pH in temperate soils.	pH	Outside the limits 5.0 to 8.0	Lavalle et al. (1995)
Land-use change		Decreasing the amount of anecic earthworms		Conversion of grassland into cropland	EU technical report on soil biodiversity (2010)
Land-use change		Decreasing the amount of earthworms		Conversion of cropland into urban land	EU technical report on soil biodiversity (2010)

Contact: Ece Aksoy, Senior Environmental Researcher.
Ece.aksoy@uma.es