Case study 26. The invasion and degradation of pastures due to biologically created soil compaction results in negative feedbacks to climate change

In the Brazilian Amazon, 95 percent of the deforested area is converted into pasture, 50 percent of which is considered degraded due to mismanagement, phytosanitary problems, poor soil fertility and soil structural modification (linked to soil macro-invertebrate activity). When the forest is converted to pasture, the use of heavy machinery and, later, cattle trampling lead to severe soil compaction, particularly in the 5–10 cm layer, impeding root development.

The native soil macro-invertebrate communities are radically and drastically depleted, i.e. most of the native taxa disappear (151 vs. 48 morphospecies). An opportunistic invading earthworm (*Pontoscolex corethrurus* (Müller); Glossoscolecidae) benefits from anthropic disturbances and occupies the empty niche left by native earthworms and soil macrofauna, increasing its biomass to more than 450 kg/ha, equivalent to nearly 90 percent of total soil macro-invertebrate biomass. When *P. corethrurus* is present in the forest there is no negative effect on the native species communities, which have similar or higher densities in the presence of *P. corethrus*. The evidence suggests that this invasive species, unlike native species, is able to feed and develop in environments where litter resources are decreased while soils have been enriched in carbon and nutrients by deforestation and burning. It produces more than 100 t/ha of castings, dramatically decreasing soil macroporosity down to a level equivalent to that produced by the action of heavy machinery on soil (2.7 cm3/100 g). During the rainy season these casts plug up the soil surface, saturating the soil and producing a thick muddy layer, where anaerobic conditions prevail (increasing methane emission and denitrification). In the dry season, desiccation cracks the surface and the inability of roots to extract water from the soil causes the plants to wilt and die, leaving bare patches in the field.

This case study shows how mismanagement linked to high impact of just one soil invertebrate species may bring catastrophic consequences to soil ecosystem functioning by increasing greenhouse gas emissions from soils.

Prepared by Juan J. Jiménez and Patrick M. Lavelle

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