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Ecological Restoration of Ultramafic Soils: organic amendments and plant functional traits

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Scientific issues

- Mining activities worsen extreme soil conditions in ultramafic areas.
- Ecological succession provides a low-cost nature-assisted tool for restoring postmining environments.
- Some critical factors (e.g. lack of initial nutrient stock in soils, soil toxicity, low immigration of seeds and soil biota) may impede the onset of ecological succession processes.
- Identification of soil amendments and well-performing plant species needed for successful ecological restoration.

State of the art

- Passive restoration (i.e. no planting) can be a effective way to recover a functioning ecosystem on disturbed areas.
- In some cases soil fertilisation is needed to provide a nutrient stock to start ecosystem recovery. Locally-produced oil-palm wastes can be a green low-cost soil amendment.
- Plant functional traits determine plant performance in response to different environmental factors.
- These traits can be used for the selection of interesting species for ecological restoration.



▲ Unvegetated serpentine accumulation at Garas site. Pioneer vegetation, plant functional traits and mesocosm. ▼



Results

Mesocosm experiment:

- Organic amendment had a slight acidifying effect on soil, although this effect has been lost after 3 months.
- Control and decompaction treatments had higher plant colonisation than organic amendments.

Vegetation on ultramafic disturbed areas:

- 50% of bare soil on ultramafic rocky tailings.
- Dominant vegetation grasses (Poaceae) and sedges (Cyperaceae). Shallow root systems (less than 30 cm depth).
- Plants/litter cover almost 100% of burnt areas.
- Ferns (mainly the bracken fern *Pteridium esculentum*) are the dominant species.
- High prevalence of vegetative spreading (mainly rhizomes).

Perspectives

- **Mesocosm experiment** to be finished on July 2017. Obtained data valuable for feeding into models of early evolution of technosols.
- Planned **soil aging experiment** (spring 2017) to assess soil evolution along longer periods.
- Physico-chemical and microbiological soil analyses of disturbed ultramafic plots (pending on samples importation).
- **List of 14 functional traits** to evaluate plant strategies on ultramafic disturbed habitats (pending on samples importation).
- A **third field mission** planned for summer 2017: analysis of nutrient flow and pedogenesis by pioneer tree species on serpentine quarry.

Methodological approach

Two field mission on Sabah ultramafic areas (Malaysian Borneo).

Amelioration of recolonization of ultramafic technosols → mesocosm experiment. Plant cover surveyed each two weeks, leached water sampled each month.

15 sampling plots on serpentine quarry tailings and rocky wastes and on serpentine burnt areas. Soil and plant samples collected. Soil cover described. Plant species identification not finished yet. Several **functional traits** have been registered from field observations, database will be completed upon samples arrival at France.

