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Recovery of mesofauna after volcanic disturbances on Reunion Island



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CONTEXT

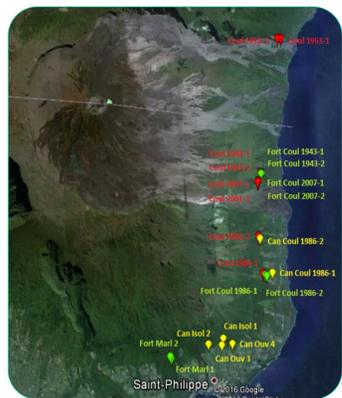
Natural recolonization by soil invertebrates of disturbed environments is a key issue for the maintenance of biodiversity, especially in a context of habitats threatened by exotic plant species. Studies related to the recolonization by soil invertebrates of habitats destroyed by lava flows are particularly scarce. Among soil fauna, Collembola (arthropods) contribute greatly to many functions in soil like litter decomposition and nutrient cycling.

OBJECTIVES

This study aimed at answering the following questions: Does distance to natural habitats (forests) affect Collembola recolonization? Do exotic plant species influence this recolonization? Which traits allow rapid recolonization? Our study was performed in the Reunion island, where several habitats have been destroyed by lava flows over several years (1943, 1953, 1986, 2007) and where 3500 introduced plant species threaten the functioning of ecosystems.

Exploratory sampling in 2014: 14 sampling points.

Sampling design in 2015: 11 sites (4 forests, 3 sugar cane crops and four lava flows) and 22 sampling points (2 /site) around the Piton de la Fournaise (volcano)



3 Habitats



MATERIAL AND METHODS

4 Microhabitats



Soil on trees samples (behind mosses or bark on trunks or suspended in the canopy below epiphytic plants (50.24 cm³, at 1m-2m height for 5min)



Litter samples (113 cm²)



Epigeic samples: Herbaceous and/or fern sample (0.25m²) + collembola from beaten bushes and sucked on trunks at 1m height.



Soil samples (19,6cm² x 10cm deep)

Extraction

Identification (species and morphospecies level)

Measurement of Collembola traits (Salmon et al 2014)

Trait categories	Trait
Body morphology	Body shape
	Body length
Locomotory organs	Furca length
	Leg length
Sensory organs	Ocelli number
	Antenna length
	Post-antennal organs lobes number
	Trichobothria presence
Protective features	Scales presence
	Pigmentation presence
Defensive features	Pseudocelli presence



Salina celebensis



Ptenothix sp1

Locomotion-Dispersal

Relation to environment

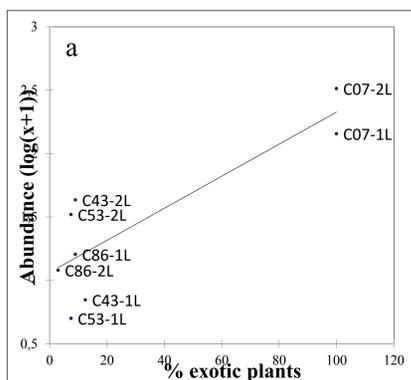


Figure 1a: Abundance in litter as a function of the percentage of exotic plants in Lava flow.

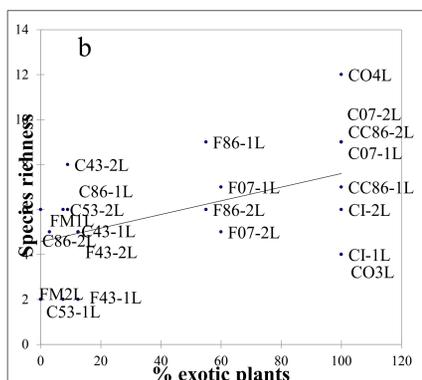


Figure 1b: Species richness in litter as a function of the percentage of exotic plants in the three habitats (Lava flow, forest culture).

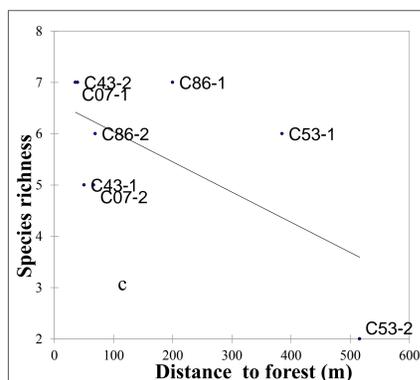


Figure 1c: Species richness in soil as a function of the distance to the closest forest in Lava flows.

RESULTS

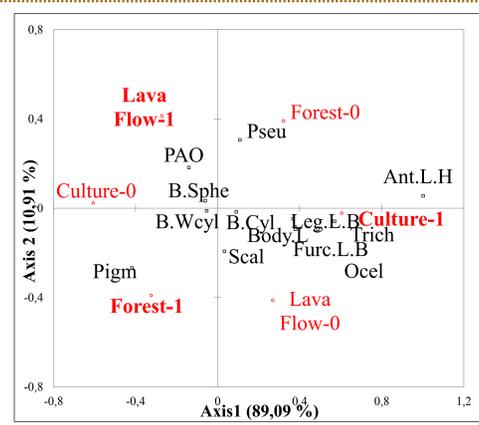


Figure 2: Redundancy analysis (RDA) of Collembola species traits in all microhabitats, constrained by habitats. Constrained inertia= 25,13%. PAO: post-antennal organ; Pseu: pseudocelli, B.Cyl, B.Wcyl and B.Sphe: cylindrical, wide cylindrical and spherical body; respectively; Leg.L.B: ratio leg length to body length; Furc.L.B: ratio furcula length to body length; Ant.L.H: ratio antenna length to head length; Scal: Scales; Ocel: Ocelli; Pigm: pigmentation; Trich: trichobothria

Furc.L.B: ratio furcula length to body length; Ant.L.H: ratio antenna length to head length; Scal: Scales; Ocel: Ocelli; Pigm: pigmentation; Trich: trichobothria

RDA of collembola traits constrained by habitats (Fig. 2) shows that dominant traits in lava flows (Pseudocelli, and Post-Antennal Organ) are traits characteristics of edaphic species (permutation test: PseudoF=2,013; p=0,01). Other RDA and partial RDA with percentage of exotic plant species and distance of sites to forest as constraining factors, indicate that % of exotic plant species significantly explained 9% of trait distribution (PseudoF=1,271;p=0,034).

Abundance of collembola in litter of lava flows (Fig.1a; F=22,98; p=0,003) and species richness in litter of the three habitats (Fig. 1b; F=6,99; p=0,016) increased with the percentage of exotic plants. Species richness in soil of lava flows decreased with the distance to the nearest forest (Fig. 1c; F=3,651; p=0,056). Result of type III analysis from linear regression on the variable previously selected by GLM with stepwise among, % exotic plants, Longitude, Latitude, Altitude, Distance to forest and Lava flow year (Fig.1a, 1c) or Habitat (Fig. 1b).

Footnotes: C-43, C-53C-86, C-07: lava flows of 1943, 1953, 1986 and 2007 respectively

DISCUSSION & CONCLUSIONS

- **Exotic plant species** influence the recolonization of lava flows by Collembola as they **increased the abundance of Collembola in the litter of lava flows**. This effect of exotic plants is supported by the increase in collembolan species richness with exotic plants in the litter of the three habitats. Exotic plant species may provide organic matter supply and nutrient availability (Ehrenfeld, 2003).
- The fact that **species richness in soil decreases with the distance to forest** suggests that forest would be a habitat source for the recolonization of lava flow soil. This does not support the observation of Fattorini and Borges (2012) in the Azores.
- The dominance of **edaphic trait species in lava flows** was unexpected as epigeic species with developed locomotory appendices and sense organs were supposed to colonize more rapidly. **We hypothesize a colonization through air from soil on trees in forests** (Dunger et al. 2002).

References

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