

Preliminary results on evaluating and modelling impacts of recreational trails in the Azorean native forests

Rui Miguel dos Santos Mendes Carvalho, cE3c – Azorean Biodiversity Group, Azores University, Portugal, rui.m.carvalho@gmail.com

Pedro Cardoso, Finnish Museum of Natural History, University of Helsinki, Helsinki, Finland

Artur Gil, cE3c – Azorean Biodiversity Group, Azores University, Portugal

Paulo AV Borges, cE3c – Azorean Biodiversity Group, Azores University, Portugal

Nature trails are currently the infrastructures that allow local populations and tourists to visit the most valuable and representative natural heritage in the Azores archipelago. In this archipelago, the trail network covers the endemic-rich mountain native forests, bogs and lava fields, all of which are not only rare (covering 2% of the original area) but extremely sensitive to physical and biotic disturbance. All these habitats and their species are currently under threat due to the impact of agriculture activities, invasive species and climatic changes, but the impact of recreational activities, given their recent importance, is still debatable.

Presently, Azorean park managers and other regional decision makers lack the necessary tools to understand and evaluate the impact of touristic recreational activities on current and long-term ecosystem integrity. Therefore, it is impossible to know how to obtain the optimum equilibrium between two potentially contrasting policies: i) safeguarding the Azorean native ecosystems and their species, and ii) maintaining trails open to the highest possible number of visitors in some cases inside pristine native areas. This is a wicked problem and a conservation management challenge that needs to be addressed urgently, given that the liberalization of the low-cost aerial transports to this archipelago has caused a steep increase in use of these infrastructures, with a trend to continue.

We present the first results of a project that aims to understand the main drivers of change on ecological processes putatively caused by trail disturbance. To reach this goal, we will: 1) test the efficiency of different methodologies to monitor changes in both trail infrastructures and biota. A study system will be implemented in 5 trails, A continuous infrastructure study will be carried out for each, and each trail will have 6 sampling areas to monitor arthropod and plant communities. We will use the COBRA protocol for assessing the spider community, since in the Azores this group is proven to serve as surrogate for a relevant part of the forest arthropod community. It will contribute then with knowledge about a crucial group for this ecosystem's integrity. Plant assessments will be done by using a T-shaped sampling area, providing a high precision monitoring about invasive species spread and trampling effects; 2) perform a manipulative experiment where two different trail building techniques will be tested for their resistance to wear and their efficiency in avoiding ecological impacts from trampling; 3) perform a manipulative trampling experiment where different intensities of trampling will be induced, observe the shifts in taxonomical and functional characteristics deriving from it; 4) model the *recreational use– ecological impact* relation using an Agent Based Modelling framework. This model be built based on the use-effect interactions obtained from the previous methodologies, together with spatial and environmental variables. It will allow us to variate parameters such as visitor number, building and maintenance investment, and simulate different management scenarios.

This research program aims to allow Protected Area managers to make knowledge-based decisions for recreational impacts, and provide them with specific tools for designing a sustainable policy for recreational activities in Azores.

References

- Pickering, C. M., Rossi, S., & Barros, A. (2011). Assessing the impacts of mountain biking and hiking on subalpine grassland in Australia using an experimental protocol. *Journal of Environmental Management*, 92(12), 3049–3057.
- Wimpey, J., Marion, J. (2011). Formal and informal trail monitoring protocols and baseline conditions: Great Falls Park and Potomac Gorge. Virginia Tech, College of Natural Resources Department of Forest Resources & Environmental Conservation.
- Cardoso P, Borges PAV, Gaspar, C. (2007) Biotic integrity of the arthropod communities in the natural forests of Azores. *Biodiversity and Conservation*, 16: 2883–2901
- Cardoso, P., Rigal, F., Carvalho, J.C., Fortelius, M., Borges, P.A.V., Podani, J. & Schmera, D. (2014). Partitioning taxon, phylogenetic and functional beta diversity into replacement and richness difference components. *Journal of Biogeography*, 41: 749–761.
- Cardoso, P., Rigal, F., Fattorini, S., Terzopoulou, S. & Borges, P.A.V. (2013) Integrating landscape disturbance and indicator species in conservation studies. *PLoS One*, 8: e63294.