**Musschia isambertoi** a Desertas Islands endemism on the edge of extinction

Menezes de Sequeira, M.1,2, Jardim, R.1, Gouveia, M.1,2, Góis-Marques, C.1,2 & Eddie, W.M.M.4

1 Madeira Botanic Group (GBM), Faculty of Life Sciences, University of Madeira, Funchal, Portugal
2iBios, Research Network in Biodiversity and Evolutionary Biology, GBIO-Azores, Portugal
3Departamento de Geografia, Faculdade de Ciências da Universidade de Lisboa and Instituto Dom Luis I (IGL), Laboratório Aparicio, Universidade de Lisboa, Lisboa, Portugal
420+25) Godal Place, Edinburgh EH4 6BF, Scotland, United Kingdom

**INTRODUCTION**

The Madeiran endemic genus Musschia Dum. includes three endemic species M. aurea (L.) Dum., M. wollastonii Lowe and M. isambertoi M. Seq., R. Jardim, M. Silva & L. Carvalho. This last taxon was described in 2007 from 2 locations in Deserta Grande. The largest known population corresponds to the holotype locality “Portugal, Madeira, Ilhas Desertas, Deserta Grande, perto da Fajã Pequena, Porto das Moças, 16-V-2006, M. Silva, L. Carvalho, C. Viveros & P. Gouveia B86 (MA 73:1034)” (Fig. 1). “Porto das Moças” population is known to be the largest by far (possibly less than 5 individuals were ever found outside the range of this location). Images taken in 2006 show age complex population with several fully flowering/fructifying plants and other mature but not flowering plants, along with many younger and seedlings (Fig. 3 and 4). Nevertheless the species was classified by Menezes de Sequeira and collaborators (2007) as Critically Endangered (CR, C2a (iii); D), mainly due to the scarce number of populations and the rapid decline in age complex and occurrence (...) and also due to the grazings effects through the introduction of goats”. Feral goats in Deserta Grande are a very well-known threat to local flora (Fig. 2). M. isambertoi is a monoporic plant with greenish flowers that are pollinated by endemic lizards (although other pollinators could probably occur) (Fig. 3).

**MATERIAL AND METHODS**

Field work (June 2018) took place in “Porto das Moças”, Deserta Grande, the locus typicus where in 2006 many plants were detected with a high variation of age/size between individuals, and with both fully flowering and non-flowering adult plants as well as seedlings, corresponding to a healthy population (Fig. 3 and 4). The present study included counting of individuals, age/size and (non-destructive) leaf sampling (for molecular studies), as well as a floristic inventory.

Total genomic DNA was extracted from silica gel dried leaves using the method of Pich & Shubert (1993) with minor modifications. DNA solutions were quantified by ImageJ program and diluted to 10 ng µL⁻¹. ISSR assays were performed as described before (Gouveia et al. 2014). Primers were from the University of British Columbia, UBC 856, UBC 869 and UBC 890. Amplification products were resolved by electrophoresis on 1.5% agarose gels, in 1x TAE buffer containing 0.5 µg ml⁻¹ ethidium bromide and photographed under ultraviolet light (Digilux, Syngene, UK).

**RESULTS AND DISCUSSION**

Ecological data and direct herbivory evidence suggest that perennial plants are subjected to elimination during the short summer season by the feral goat population. The non-chaemophyte habitats, i.e., mesic conditions of M. isambertoi habitat, observed in Porto das Moças, corresponds to approximately 1500 square meters. Floristic/cenological data suggest a shift to annual/biennial plant taxon domination, and direct evidence of herbivory was detected (Fig. 5 and 6). Table 1 resumes the floristic data, it is clear (1) the absence of chaemophytes, (2) almost absence of chaemophytes except chaemophytes, (3) the reduced number of hemichryprous, (4) the domination of therophytes. These results and the fact that the scarce chaemaphytes present are all represented by young plants support the view of a perrenial factor that prevents successional dynamics.

Only 10 M. isambertoi plants were detected, all corresponding to young plants no more than 15 cm high, all presenting the same size and number of leaves (4 to 8), no adult plants were seen and no remains of adult plants were also found (Fig. 7 and 8). The threat factor that can be observed is the presence of feral goats (Fig. 2 and 4) and evidence of herbivory was observed directly and by community shift to annual plant domination (Fig. 6). ISSR results clearly show that all plants sampled (all plants present) are absolutely genetically similar (Fig. 9 and 10). Therefore presumably being the offspring of one plant. Musschia isambertoi being monocarpic the parent plant is not expected to survive seed production, since no remains of any adult plants were found during field work. The presence of young plants (1 year?) is coherent with a pioneer plant community dominated by annuals where perennials (hemichryprous or chaemophytes) are grazed yearly during summer drought. Therefore, both age and lack of genetic diversity support a conclusions about a lack of recruitment on a limited seed bank of M. isambertoi originated from one single parental plant.

Results clearly suggest that Musschia isambertoi is on the edge of extinction. Urgent conservation measures should include fresh leaf material collection for tissue culture, moving some seedings into conservation gardens, an urgent fencing of the population and finally the elimination of feral goats from the Deserta Grande, a process long initiated (LFEIE NAT/P/000125, 383,467.00 €) but stopped due to wrong conservation policies of the former Services of the Natural Park of Madeira.

**REFERENCES**


**ACKNOWLEDGMENTS**

We are grateful to the Instituto das Florestas e Conservação da Natureza that gracefully supported our visit and also to the "Vigilantes da Natureza" that integrate the crew of the ship "Buteo" that took us to Deserta Grande, without their help this study could not have been developed.

This work was funded by: FEDER funds through the Operational Programme for Competitiveness Factors – COMPETE: National Funds through FCT – Foundation for Science and Technology under the Cooperation Programme INTERREG MAC 2014-2020; Figure 3 and 4 correspond to photos taken by Magda Silva and Lígia Carvalho.