

Assessing Human Impact on Southern Mediterranean Forests: Novel Anthropogenic Pollen Indicators from Rif Mountains

Aboubakr Boutahar * ^{1,2}, Paloma Cariñanos Gonzalez ³, Zouhaire Lamrani ², Abderrahmane Merzouki ¹

¹ Laboratory of Applied Botany, Department of Biology, Abdelmalek Essaâdi University,

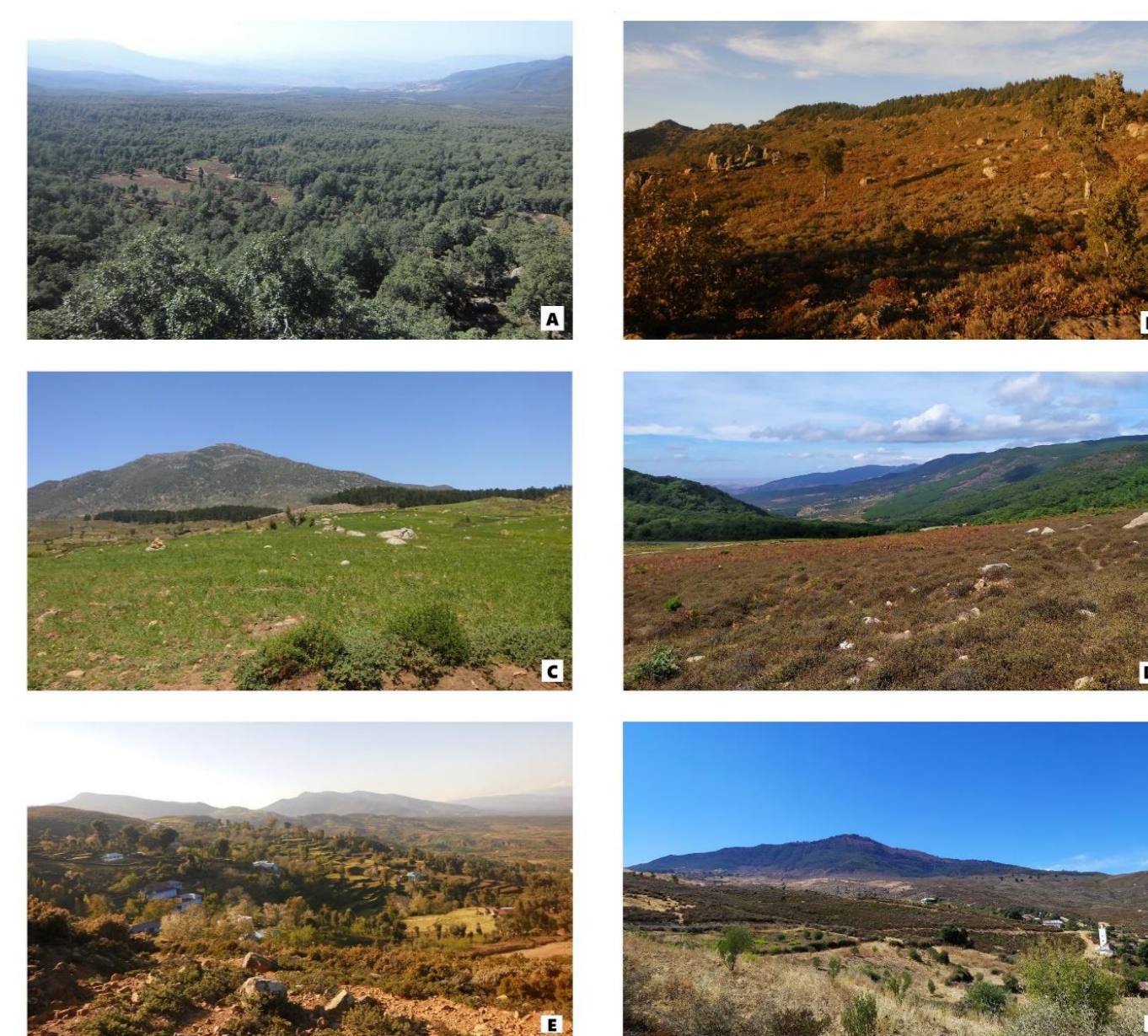
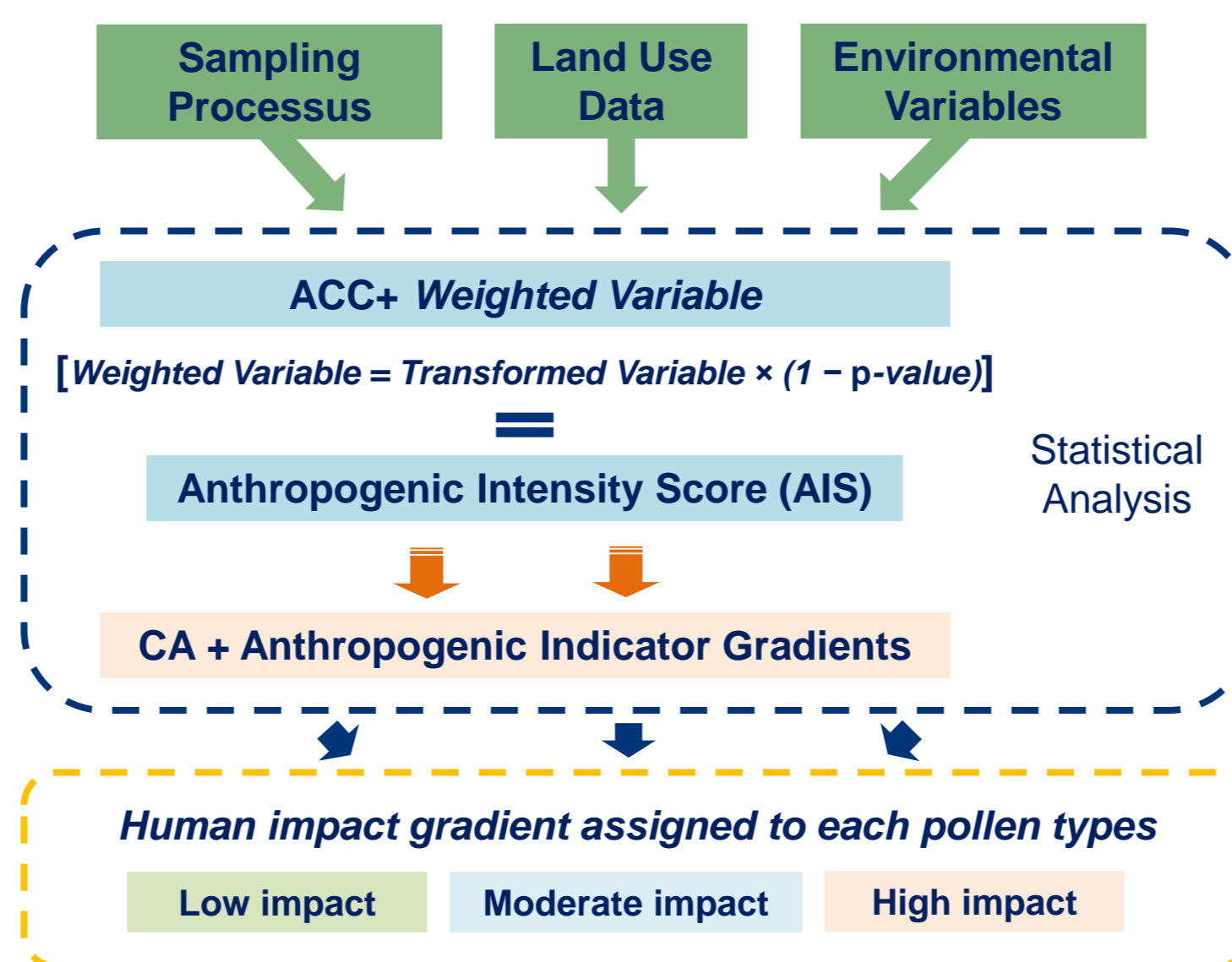
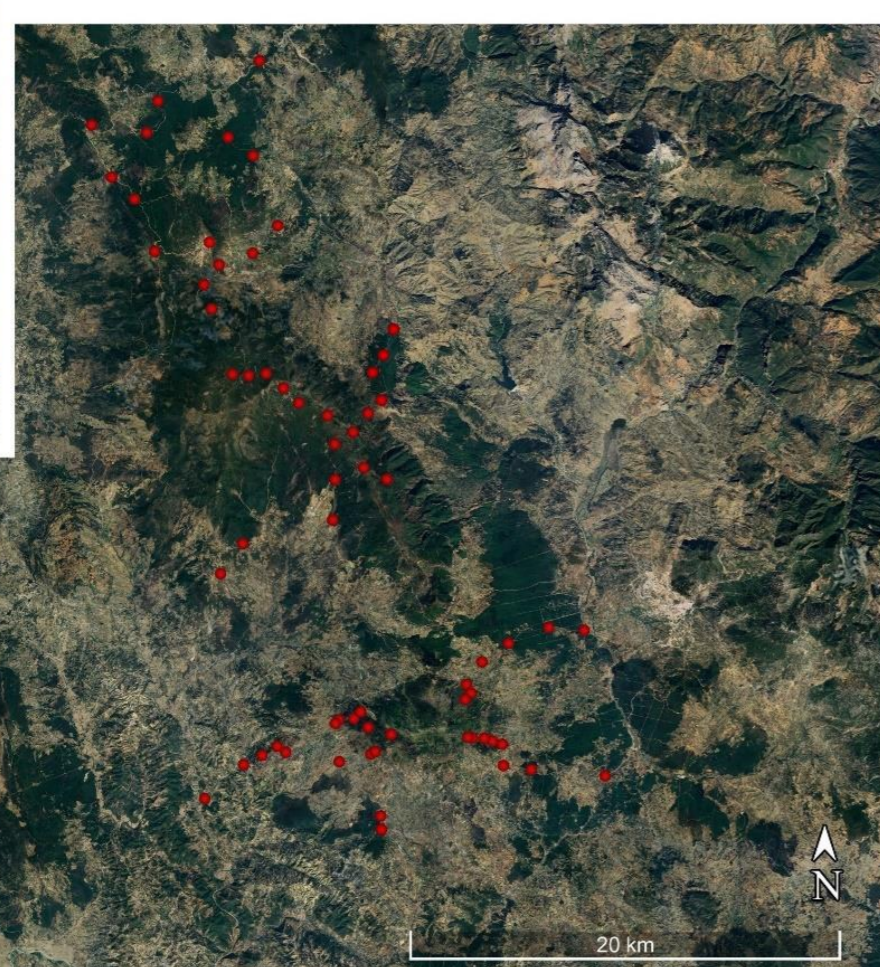
² Biology, Environment, and Sustainable Development Laboratory, ENS, Abdelmalek Essaadi University

³ Department of Botany, Faculty of Pharmacy, University of Granada

INTRODUCTION & AIM

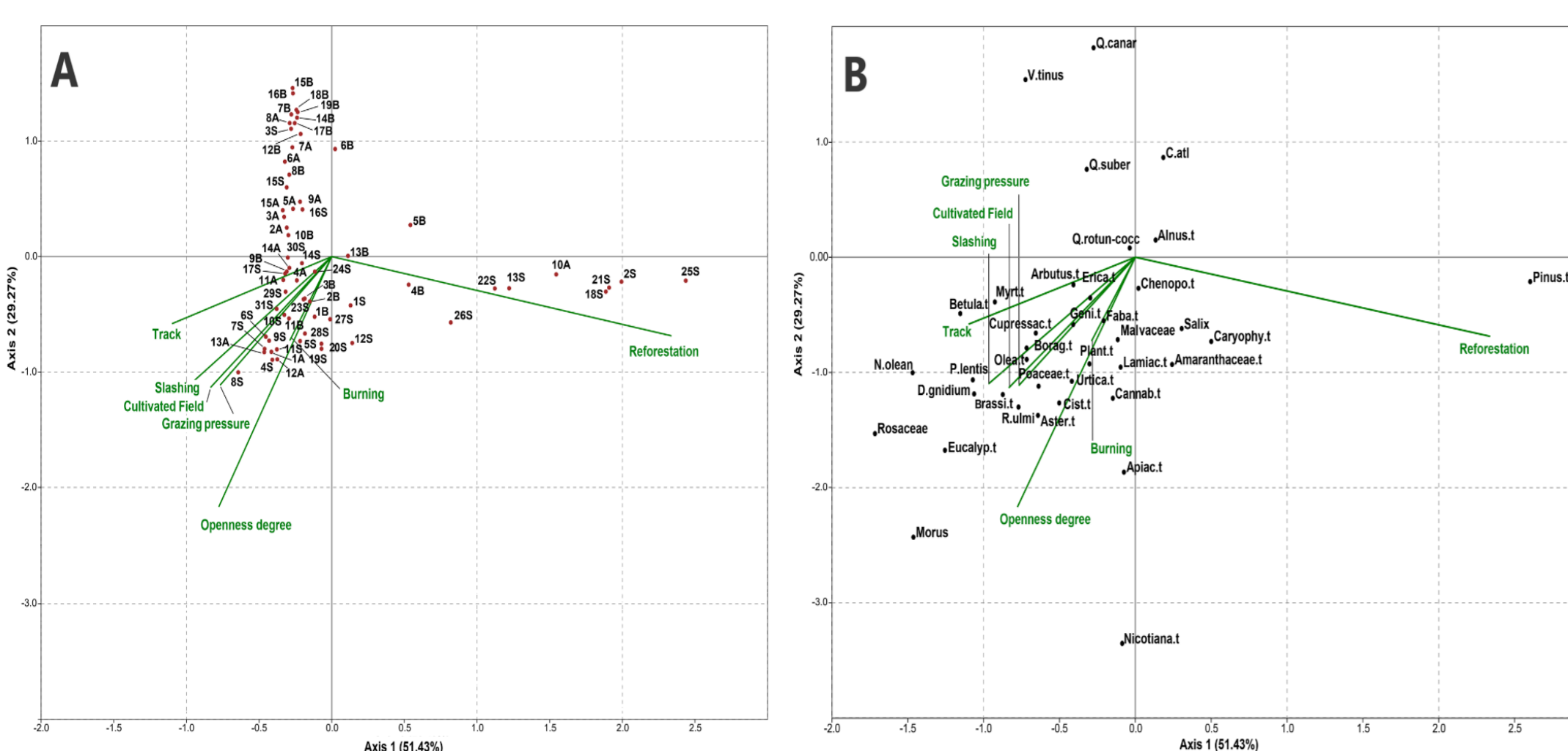
Studying modern pollen and vegetation relationships is vital for interpreting fossil pollen records and assessing human impacts on forests, both of which are essential for effective forest management strategies. Despite numerous studies on fossil pollen records in the Rif landscape, there is a notable lack of research specifically focusing on modern pollen and its implications for understanding human impacts on these forests. This paper introduces novel anthropogenic pollen indicators for the Rif Mountains and aims to evaluate the gradients of human impact on the forests of the southern Mediterranean. We employed a combination of modern pollen analysis, vegetation survey, and ordination techniques, incorporating various environmental and land-use variables.

METHOD



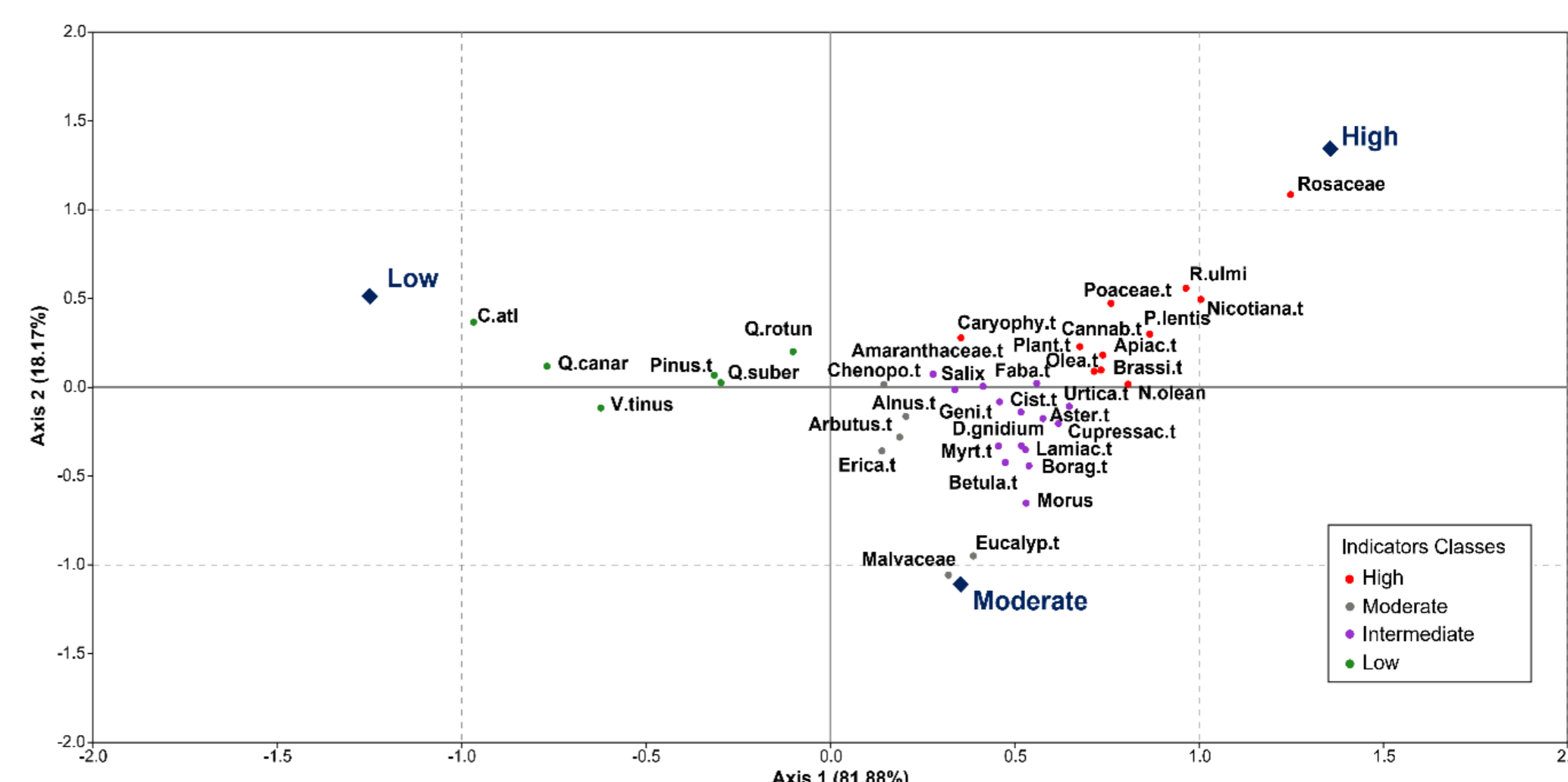
RESULTS & DISCUSSION

Canonical correspondence analysis (CCA)



CCA allowed us to evaluate the relationships between pollen types and environmental variables, helping us identify key anthropogenic pollen indicators associated with land use and human activities: Poaceae, Cannabis-t, Olea-t, and Asteraceae for cultivation; Brassicaceae, Genista-t, Poaceae, Asteraceae and Plantago-t, for grazing; Apiaceae, Urtica-t and Genista-t for slashing and burning.

Correspondence analysis (CA)



The anthropogenic index score (AIS) was calculated for each sampled location and used on the CA to correlate each specific pollen type with levels of human impact as follows (a) low (e.g., Cedrus atlantica-t, Quercus canariensis-t), (b) moderate (e.g., Erica-t, Arbutus unedo-t, Eucalyptus-t), and (c) high (e.g., Cannabis-t, Brassicaceae, Olea-t, Nicotiana-t).

CONCLUSION

As the modern pollen analogues studies offer new perspectives on the relationships between pollen and vegetation formations, this work extends this knowledge by using land use dynamics as a means of identifying the human impact degree, which is essential for evaluating the anthropisation dynamics in the Rif forests. The innovative methods developed in this study hold promise for future interdisciplinary research in environmental restoration and for palaeoecological and environmental fields.