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Application of Spectral Signature of selected Invasive Alien Plants (IAPs) of Malta for ecological monitoring

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Introduction

The introduction and spread of Invasive Alien Plant species (IAPs) disrupt the ecosystem processes and affect native communities. At the population level, the resource competition between introduced IAPs and native species may lead to geographical exclusion and/or local extirpation, with a low species richness observed at the community level.

As in many islands of the Mediterranean Basin, the protected habitats of the Sicilian and Maltese Archipelago are subject to biological invasions from Invasive Alien Plant species (IAPs). The detection and the monitoring of the spatial distribution are therefore required for appropriate management measures, and remote sensing based on aerial imagery offers an efficient and cost-effective alternative to ecological surveys. However, the geographical scale of invasion in both archipelagos considerably limits the use of most open-source aerial imagery due to the very low spatial resolution they offer (10-20m pixel size). Fortunately, the development of geospatial technology is no longer limited to satellite imagery. In fact, in the last decade, Consumer-grade Unmanned Aerial Vehicles (UAVs, or drones) have extended the accuracy of vegetation mapping and can directly be applied to IAPs' ecological monitoring.

The aim of this research is to develop a methodology based on commercial UAVs and open source software to facilitate the ecological monitoring and mapping of Non-indigenous vegetation in Natura 2000 sites.

Methodology & Ongoing Work

Target areas and target species

UAVs surveys are being carried out in different S.A.C of the Natura 2000 Network, including L-Inħawi tax-Xlendi u tal-Wied tal-Kantra (Gozo); l-Inħawi tal-Buskett u tal-Girgenti, Rdumijiet ta' Malta, (western coast of Malta) and Il-Magħluq tal-Baħar ta' Marsaskala (southern Malta, Figure 1). These aerials surveys aim to characterize the distribution of the most widespread IAPs of the Maltese Islands (including *Agave* spp., *Ailanthus altissima*, *Arundo donax*, *Cardiospermum* spp. and *Opuntia ficus-indica,* **Figure 2**).

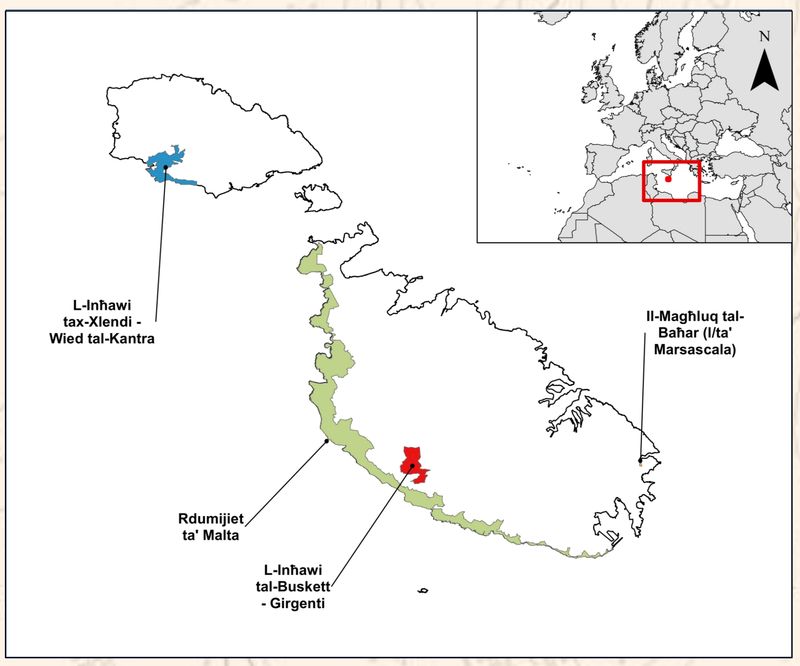

Figure 1: Target Protected Areas of the Maltese Islands

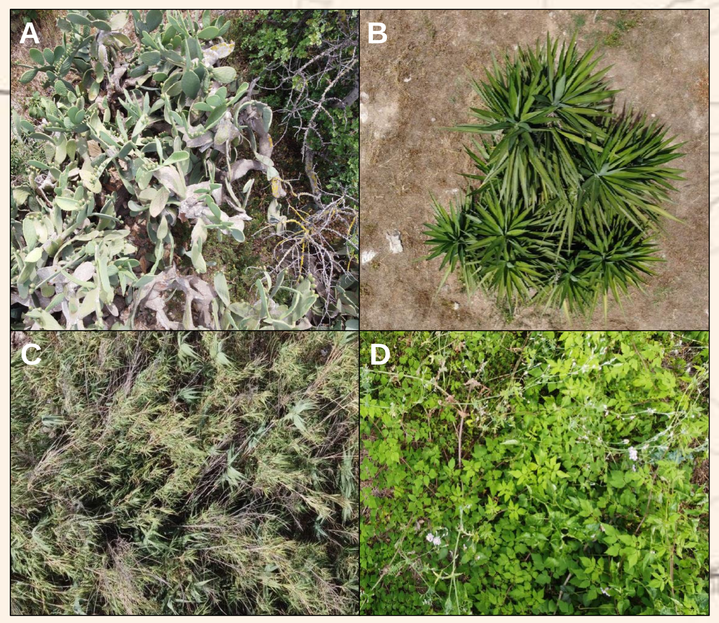

Figure 2: Aerial photography of the target species :
A: *Opuntia ficus-indica*, B: *Yucca* sp.,
C: *Arundo donax,* D: *Cardiospermum* sp.

Classification:

Training sites were identified in the Area of Interest, and are composed of a dense cluster of vegetation dominated by one of the target Non-Indigenous species.

Non-Indigenous Vegetation is being classified to species level using visual identification on the orthophotos and various classification algorithms are being tested. The classifications include different supervised and semi-supervised algorithms, such as Random Forest, a machine learning algorithm, implemented in Python. Results of the classification must then be validated by ground truthing.

Data collection:

These surveys were carried out using the fleet of drones of the FAST project, including a DJI Mavic Mini for preliminary surveys, a DJI Mavic 3 for high spatial resolution, and a DJI Phantom 4 for increased spectral resolution. Surveys were carried out between 10-40 m above ground level, using either manual flight or the Litchi software for Android.

The aerial imagery obtained from the UAVs surveys was curated and stored in the database of the Interreg FAST project, then orthophotos were processed using the WebODM software.

Spectral signatures of the target IAPs are being collected using the SCP (Semi-Automatic Classification Plugin) in QGIS 3.22.7, while the spectral indexes collected are computed in WebODM.

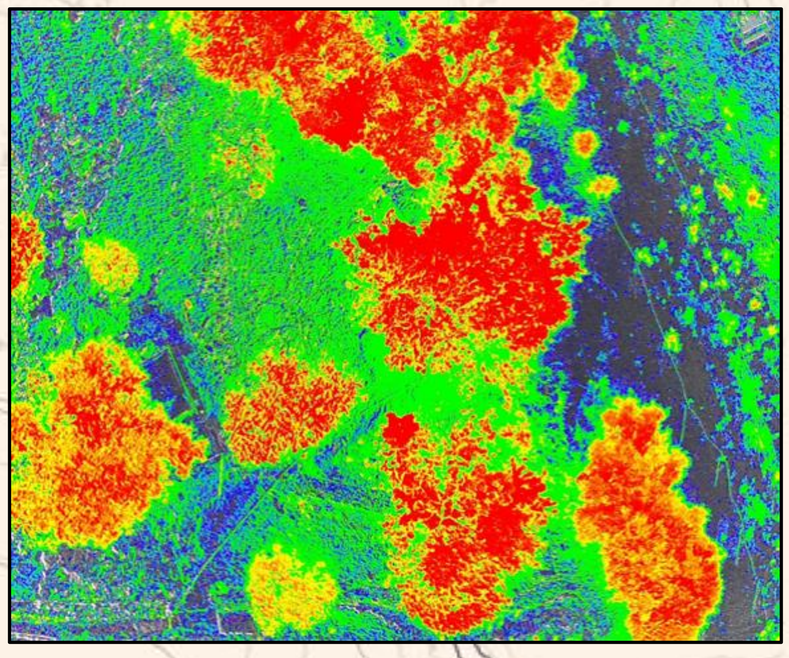

Figure 3: Pseudocolor orthophoto extract of Non Indigenous vegetation (*Eucalyptus* sp.)

Way forward:

Eventually, the output of the classification will be used to produce vegetation maps in Special Areas of Conservation (SACs) of the Maltese Islands. Although unfinished, this methodology represents an opportunity for the managers of Protected Areas as this ecological survey would be entirely carried out using open-source data and commercially available UAVs and therefore will provide a sustainable tool for ecological monitoring.

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