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GOVERNMENT OF MALTA
MINISTRY FOR AGRICULTURE, FISHERIES,
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Interreg Italia-Malta FAST



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Submitted by	Arthur Lamoliere, Sandro Lanfranco, Stefano Battaglia, Stephen Mifsud, Daniel Mangion, David Mifsud, Immanuel Joseph Grima, Immanuel Joseph Grima, Maria Di Maio, Gaetano Torrisi, Umberto Troja, Pietro Minissale, Gianmarco Tavilla, Matilde Tessitori, Vera D'Urso, Giorgio Sabella.

1. Introduction

The work carried out as part of WP2, WP3 and WP4 - Interventi transfrontalieri di contenimento delle specie aliene e ripristino della biodiversità, was disseminated through several Scientific and popular publications:

1. Cutajar S., Mangion D., Lamoliere A., Lisi O. P. V. & Mifsud D. (2022) Fighting Alien species Transborder. A Citizen Science perspective. *Biological Invasions in a changing World. Book of Abstracts*. Neobiota 2022. 12th International Conference on Biological Invasions, Tartu, Estonia. Estonian Naturalists' Society, P36: 108.
2. Lamoliere A., Tavilla G., Lanfranco S., Grima I. J. & Mifsud D. (2022) Application of Spectral Signature of selected Invasive Alien Plants (IAPs) of Malta for ecological monitoring. *Biological Invasions in a changing World. Book of Abstracts*. Neobiota 2022. 12th International Conference on Biological Invasions, Tartu, Estonia. Estonian Naturalists' Society, P32: 105.
3. Lamoliere A., Mifsud M., Abela J., Tavilla G., Roy R.G., Lanfranco S. & Mifsud D. (2023) Automated Detection and Classification of Invasive *Cardiospermum grandiflorum* in Wied Babu, Malta. 15th International Seminar Biodiversity Management and Conservation "Plant Ecology and Conservation in The Mediterranean Area" Linguaglossa (Sicily), Italy.
4. Lisi O.P.V., Le specie aliene e il progetto Italia-Malta FAST (Fight Alien Species Transborder). *Le Scienze Naturali nella scuola*, XXX, 66, I: 79-81.
5. Mifsud S. (2022) Management towards the eradication of *Pennisetum setaceum* from the island of Gozo. *Biological Invasions in a changing World. Book of Abstracts*. Neobiota 2022. 12th International Conference on Biological Invasions, Tartu, Estonia. Estonian Naturalists' Society, P86: 105.
6. Pieghevole FAST (2020). Evento apertura
7. Pieghevole FAST (2023). Evento chiusura italiano
8. Pieghevole FAST (2023). Evento chiusura inglese

Details of the presentations and books of abstract are attached to this deliverable. A full resolution, digital copy of posters and video recording are attached to this deliverable.

2. Presentation:

1. Fighting Alien Species Transborder – A Citizen Science Perspective: The First BioBlitz of the Maltese Islands – Poster

Citation: Cutajar S., Mangion D., Lamoliere A., Lisi O. P. V. & Mifsud D. (2022) Fighting Alien species Trans-border. A Citizen Science perspective. Biological Invasions in a changing World. Book of Abstracts. Neobiota 2022. 12th International Conference on Biological Invasions, Tartu, Estonia. Estonian Naturalists' Society, P36: 108.

Fighting Alien Species Trans-border: A Citizen Science Perspective

The First BioBlitz of the Maltese Islands

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Introduction

NEOBOTA 2022 – 12th International Conference on Biological Invasions
Tartu (Estonia) – September 12-16 2022

In late August 2022, the University of Malta, a principal partner within the Interreg Italia-Malta's FAST project (Fighting Alien Species Trans-border), organised the first national BioBlitz on the Maltese Islands. The focus of this three-day Citizen Science (CS) event was finding and identifying as many plant alien species as possible at *I-Inħawt tal-Busketta u tal-Girgenti*, a Special Area of Conservation within Malta's the Natura 2000 network. The data was collected using a structured survey methodology carried out by volunteers after receiving a short training session prior the fieldwork.

The aim of this BioBlitz was to investigate the spatial distribution of these species while engaging the general public and raising general awareness about ecological issues related to biological invasions. In addition to the long-term conservation and monitoring of the designated Natura 2000 site this BioBlitz was an important source of social and demographic data which is invaluable for understanding participants' motivation to continue participating in the CS initiative, as well as to encourage new participants to join other CS initiatives.

Keywords: BioBlitz, Citizen Science, alien species, IAPS, Natura 2000, data collection.

Methodology

Sampling effort
Initially, participants were trained on what species they would be looking out for, where they would be conducting the survey and how they would be collecting data.

Overall, 36 alien plant species were targeted across the 19 sectors comprising the study-area. Each sector was surveyed by at least one participant team for a maximum period of one hour.

Data collection
GPS points, photos and species ID were collected by participants on Epicollect 5 and subsequently reviewed by the authors through a two-stage verification process (species ID and GPS position).

Individual records were classified as either 'accurate', 'uncertain', or 'inaccurate' in terms of GPS and species identification.

	Species ID	GPS
Accurate	ID confirmed by matching picture and name	GPS accuracy < 20 meters
Unclear	ID does not match picture but ID possible from picture	GPS accuracy > 20 meters
Inaccurate/missing	ID inaccurate, no further ID possible	GPS data not collected

Data classified as accurate were plotted by species in ArcMap (Figure 1), showing spatial distribution by species, overlaying the BioBlitz sectors and the 2022 SinteGRAM basemap layer.

Social data was collected through a standardised survey developed by the European Citizen Science Association. This was completed by each citizen scientist following participation in the BioBlitz.

Results & Discussion

BioBlitz Participation
All participants were positive about their experience, with 65% rating it as excellent. The majority of volunteers indicated their main reason for joining the BioBlitz was because it 'sounded like fun'. This was followed by wanting to 'contribute to the understanding of biodiversity', to 'engage with/understand science' and because it was something they could do 'with family and friends'. The majority were willing to continue contributing to CS efforts (96%) and to explore nature and the outdoors on their own (80%).

Species ID & Distribution
The most accurately identified species were *Ailanthus altissima*, *Amaranthus retroflexus*, *Arundo donax* and *Agave* spp.. Whereas *Pistacia atlantica* and *Echinochloa crus-galli* were the most misidentified species.

Of all the records collected, 44% were found to be accurate, with no need for correction.

Overall, 15 different species were identified out of 97 records, as plotted on the Figure 1.

Figure 1. Mapping of the 15 spp. identified in 19 sectors.


Concluding remarks & acknowledgments
The FAST Team would like to thank all the Citizen Scientists who contributed to the success of this BioBlitz, as well as Ambjent and the Environment and Resource Authority for their support. Special thanks to Daniil Golomovzky for his help in data analysis.

This project is part-financed by the European Union European Regional Development Fund (ERDF), through the INTERREG V-A (Italy-Malta) Programme. Co-Financing rate 85% EU Funds, 15% National Funds

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

Citation: Lamoliere A., Tavilla G., Lanfranco S., Grima I. J. & Mifsud D. (2022) Application of Spectral Signature of selected Invasive Alien Plants (IAPs) of Malta for ecological monitoring. Biological Invasions in a changing World. Book of Abstracts. Neobiota 2022. 12th International Conference on Biological Invasions, Tartu, Estonia. Estonian Naturalists' Society, P32: 105.

NEOBIOTA 2022 – 12th International Conference on Biological Invasions
Tartu (Estonia) – September 12-16 2022



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

UAV's surveys are being carried out in different S.A.C of the Natura 2000 Network, including L-Infraħil tar-Xlendi u tar-Wied tar-Kantira (Gozo), Hifni tal-Buġied u tar-Girgent, Rabuniet tar-Malta (western coast of Malta) and I-Magħluq tar-Baħar tar-Marsakala (southern Malta, Figure 1). These aerial surveys aim to characterize the distribution of the most widespread IAPs of the Maltese Islands (including Agave spp., *Alternanthera versicolor*, *Arundo donax*, *Cardiocrinum* spp. and *Cynoda dactyloides*, Figure 2).




Figure 1: Target Protected Areas of the Maltese Islands

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 of the Litchi software for Android.

The aerial imagery obtained from the UAV's 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 GCP (Semi-Automatic Classification Plugin) in QGIS 3.22.7, while the spectral indexes collected are computed in WebODM.

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.

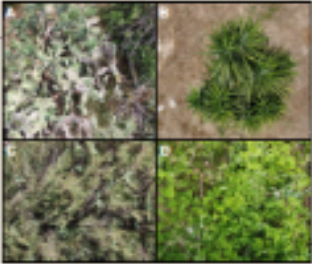


Figure 2: Aerial photography of the target species:
A. *Opuntia basilaris*, B. *Sida* sp.,
C. *Arundo donax*, D. *Cardiocrinum* sp.

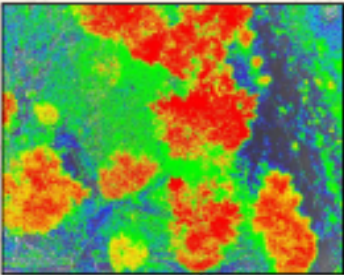



Figure 3: Pseudocolor orthophoto extract of Non-Indigenous vegetation (*Elymus* sp.)

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 UAV's and therefore will provide a sustainable tool for ecological monitoring.



FAST
Fourth Accession of the Region Programme
European Regional Development Fund

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3. Management towards the eradication of *Pennisetum setaceum* from the island of Gozo.

Mifsud S. (2022) Management towards the eradication of *Pennisetum setaceum* from the island of Gozo. Biological Invasions in a changing World. Book of Abstracts. Neobiota 2022. 12th International Conference on Biological Invasions, Tartu, Estonia. Estonian Naturalists' Society, P86: 105.

A screenshot of the oral presentation is provided below. Please enquire for a full record of the video due to copyright on the material.



4. Automated Detection and Classification of Invasive *Cardiospermum grandiflorum* using Multispectral Orthophotos and Deep Learning Models in Wied Babu, Malta.

Lamoliere A., Mifsud M., Abela J., Tavilla G., Roy R.G., Lanfranco S., Mifsud D. (2023) Automated Detection and Classification of Invasive *Cardiospermum grandiflorum* in Wied Babu, Malta. 15th International Seminar Biodiversity Management and Conservation “Plant Ecology and Conservation in The Mediterranean Area” Linguaglossa (Sicily), Italy.

(This presentation was not recorded, the full presentation is attached to the deliverable)

The slide features a topographic map background with green and white geometric shapes on the sides. The title is centered in green text. A circular portrait of Arthur Lamoliere is on the right. Logos for Interreg Italia-Malta FAST, the European Union, and L-Università ta' Malta are at the bottom left. The event details are at the bottom.

Automated detection and classification of invasive *Cardiospermum grandiflorum* using multispectral orthophotos and deep learning

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XV International Seminar "Biodiversity Management and Conservation" - Linguaglossa - Thursday, 8 June