Multiple Airdrones-based System for Data Gathering ingestion and modelling to protect biodiversity

Marco Ghio[1], Andrea Cuneo[1], Abramo Pischedda[1] *
[1] Inspire S.r.l., Genoa, Italy, info@be-inspire.com

Introduction

The **BIOUAV** project developed an integrated system for monitoring invasive alien plant species using autonomous drones and hyperspectral data analysis. The main goal was to support biodiversity conservation through efficient, large-scale, and cost-effective monitoring.

This is made possible by the **M.A.R.S. (Multiple Airdrones Response System)** platform, which enables fully servicing autonomous operations by automatically replacing drone batteries and payloads enabling continuous operation. The system was re-engineered and adapted to address biodiversity monitoring needs, extending its capabilities beyond the original application.

Figure 2. Invasive aquatic vegetation (*P. crassipes*) covering a river in Sardinia.

Material and Methods

The BIOUAV system represents the **integration** between a customization of the M.A.R.S. platform and a new software infrastructure designed for hyperspectral image processing and visualization.

The **M.A.R.S. platform** includes (Fig. 1):

- a Robotic Autonomous System mounted on a pickup vehicle;
- a custom air drone with integrated hyperspectral camera payload;
- a precision landing pad with RTK system;
- a robotic arm for autonomous battery and sensor replacement;

The acquired images were corrected (radiometric and geometric), converted to GeoTIFF, and analyzed using **spectral indices and band ratios** to detect *Pontederia crassipes* and *Hydrocotyle ranunculoides* in Sardinia (Fig. 2). This hardware and software integration extends the system's capabilities toward continuous, autonomous, and scalable biodiversity monitoring.

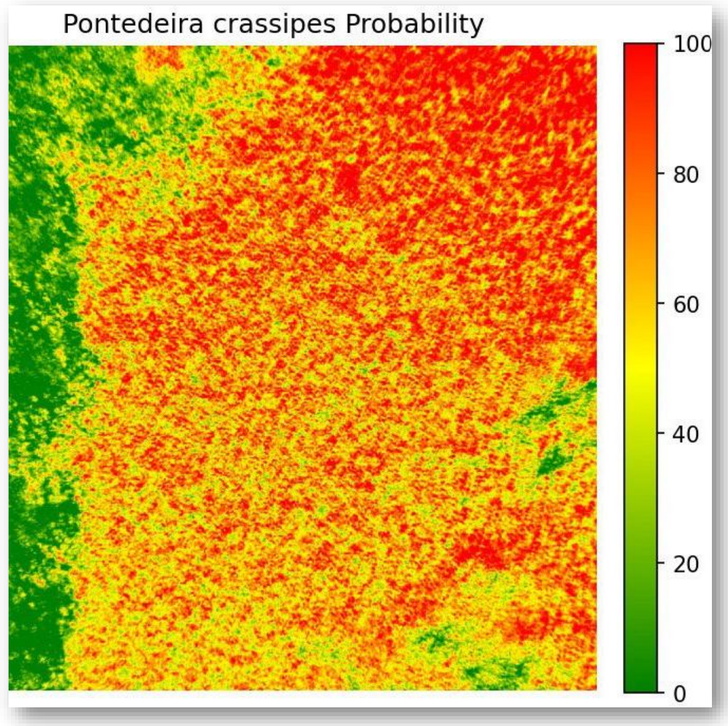
Results

Figure 1. BIOUAV system mounted on pickup vehicle.

Field campaigns in Riola Sardo, Budoni, and Oristano (Sardinia) confirmed the system's ability to detect and map invasive aquatic plants.

The analysis produced **species-presence probability maps**, accessible through an interactive **web interface** showing georeferenced spectral data.

Compared to traditional surveys, BIOUAV extends land monitoring **reducing time and costs** while improving spatial accuracy and efficiency.



Conclusion

The BIOUAV project demonstrated the feasibility of an autonomous drone-based continuous monitoring system for early detection of invasive alien plants. By combining robotics, hardware, and analytical software, the platform offers a scalable and sustainable tool for biodiversity monitoring and environmental management.

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