AERIAL MAPPING OF FLOWERING JERUSALEM ARTICHOKE: A COMPARISON OF TWO METHODS

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INTRODUCTION

Invasive alien plant species (IAPS) are a major threat to biodiversity, economy and human health. Monitoring play an essential role in managing invasive plants. A new approach to invasive species monitoring is by using drones. This kind of monitoring can be used for species with easily recognizable features and only in periods when these features are present on the plant. *Helianthus tuberosus,* also known as Jerusalem artichoke is a suitable species for aerial mapping because of its bright, yellow-coloured flowers during the flowering season.

The **aim** of the present study was to compare the economic and labour effort for mapping *H. tuberosus* by two methods (aerial mapping and traditional ground field mapping) and to develop the protocol for identification and monitoring IAPS by drone.

H. tuberosus

Fieldwork

MATERIALS AND METHODS

Mapping area: The Mirna river in Istria (west part of Croatia)

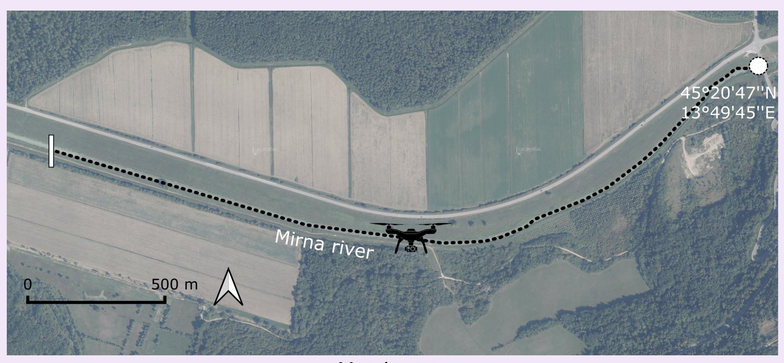
Georeferenced point: crossroad Livade-Motovun (45°20'47''N, 13°49'45''E)

Traditional ground based methodology:

- one georeferenced point determined by a device with an accuracy of +/- 50 m
- the presence of targeted invasive species was assessed visually

Aerial mapping by drone:

- 1. YEAR- October 2020, DJI Mavic 2 pro model of drone
- 2. YEAR - October 2021, Mavic 2 Enterprise Dual model of drone
  - ➢ three drone flight modes tested (Mapping, Linear Flight Mission and Manual flight) at different heights
  - ➢ manual video recording at three different heights and at different speed (6, 10, 15 m - 0.6, 0.6, 1.2 m/sec)



Mapping area

RESULTS

Traditional ground based methodology:

- spatial coverage of observations from a single point: 8000 m^2 (we didn't achieve 100% coverage)
- abundance of *H. tuberosus* according to Braun-Blanquet cover-abundance scale: 3/5

Aerial mapping by drone:

1. YEAR- PRELIMINARY FIELDWORK:

- different altitudes (3, 15, 30, 60, 120 m)
- *H. tuberosus* was recognizable at a maximum of 60 meters

H. tuberosus at 3 m height

H. tuberosus at 60m height

2. YEAR- 4 TECHNOLOGICAL POSSIBILITIES

- Mapping: not appropriate, too long flight time, too many unnecessarily taken photos, high battery consumption, photo stitching software required
- Linear flight mission at 50 m: suitable at shorter distances, suitable for mapping species that follow a straight line, photo stitching software required
- Manual flight at 20 m: suitable at shorter distances, photo stitching software required
- Manual video recording: **the most appropriate - 15 m height and 1.2 m/sec speed** (recognizable plant features, wide enough field of view, large area coverage in shorter time, no need for additional software)

H. tuberosus at 20 m height

H. tuberosus at 50 m height

Table 1. Comparison of two mapping methods in the case of *H. tuberosus* recording

CRITERIA	GROUND BASED MAPPING FROM ONE POINT	AERIAL MAPPING BY DRONE FROM ONE POINT
Mapping field time (min)	20	26.03
Data elaboration time (min)	15	Basic 120 min, detailed review endless
Total mapped area	8000 m^2	28 500 m^2
Coverage	Low-point limited	100%
Costs (transportation* +experts+equipment) (eur)	50 + 100 + 50 (paper and photo equipment) TOT 200	50 + 100 + 200** (drone), TOT 350
Possibility of data re-use	Limited (written records and photo material)	Very high
Species identification reliability	Highly reliable – possibility of taking samples	Mostly reliable
Interchangeability	Low	High

*costs are related to present study
**costs are related to drone rental

Table 2. Advantages and limitations of drone mapping

+	-
Practical to screen inaccessible terrain	Dependence on weather conditions
Non experts can collect data to be later use by experts	Poor visibility in strong sunlight due to reflection
Drone generated data can be used by other applications	Possible restriction of flights (military area, settlements…)
Minimal impact to habitats	Reading images requires a skilled eye
Large amounts of information	Power limitation
Large area coverage in shorter time	Expensive equipment
Easy generation of interactive maps	Flight planning and permissions

CONCLUSIONS

- **Drone proved to be perspective method for *H. tuberosus* mapping;**
- Compared to traditional visual ground based mapping, drone mapping proved to be more expensive when used only on one point but taking into account the larger coverage it would be more useful for mapping large areas;
- Drone mapping is faster and more useful in the long run since it is possible to collect a larger amount of data in a shorter time;
- Suggested best protocol for drone mapping of *H. tuberosus* is **video recording at height 15 m and speed 1.2 m/sec**. This protocol may be integrated into larger planning documents which are essential for a good long term management plan.

FUNDATION

The project is funded by Croatian Science Foundation – NATURALLY (IP-2020-02-6899)

ACKNOWLEDGEMENTS

We are grateful to the colleague Patrik Marcan for his valuable expertise and assistance during the first year fieldwork.