Testing RiVe: a citizen science methodology for monitoring riparian vegetation at the European scale

Authors:

Francesco Maria De Matteis

Bruna Gumiero

Cristian Di Stefano

Patricia María Rodríguez González

Simon Dufour

Marta González del Tánago

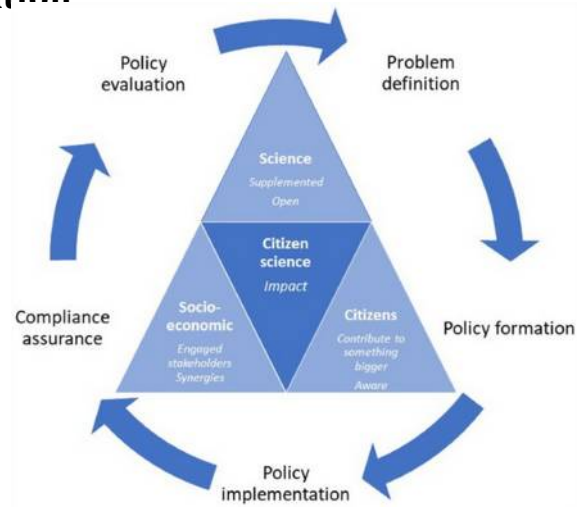
First of all… what is citizen science?

Involving non-experts in collecting data of scientific interest.

Collecting **a large amount of data** on a wide spatial and temporal scale.

Broadcasting of mobile technologies and Internet access → implications for **participation and data sharing.**

Promoting **environmental education** and fostering **community building.**



OBJECTIVES

I Using the demo version of the App and testing RiVe method to characterize the vegetation of a protected riparian area of the Idice River, in the municipality of Castenaso (North Italy).

II Involving different groups of volunteers in testing the method, examining reliability and feasibility of RiVe project.

III Proposing adequate modifications and designing an index of riparian naturalness to be integrated with the revised methodology.

The collaboration with the professors **González del Tánago** (University of Madrid), **Dufour** (University of Rennes) and **Rodríguez-González** (University of Portugal) was an essential element to pursue the objectives II and III.

RiVe methodology

Cristian Di Stefano (a computer expert of the ISPRA) → *design of the **App**, the website and the data **submission and validation system**.*

The monitoring scheme

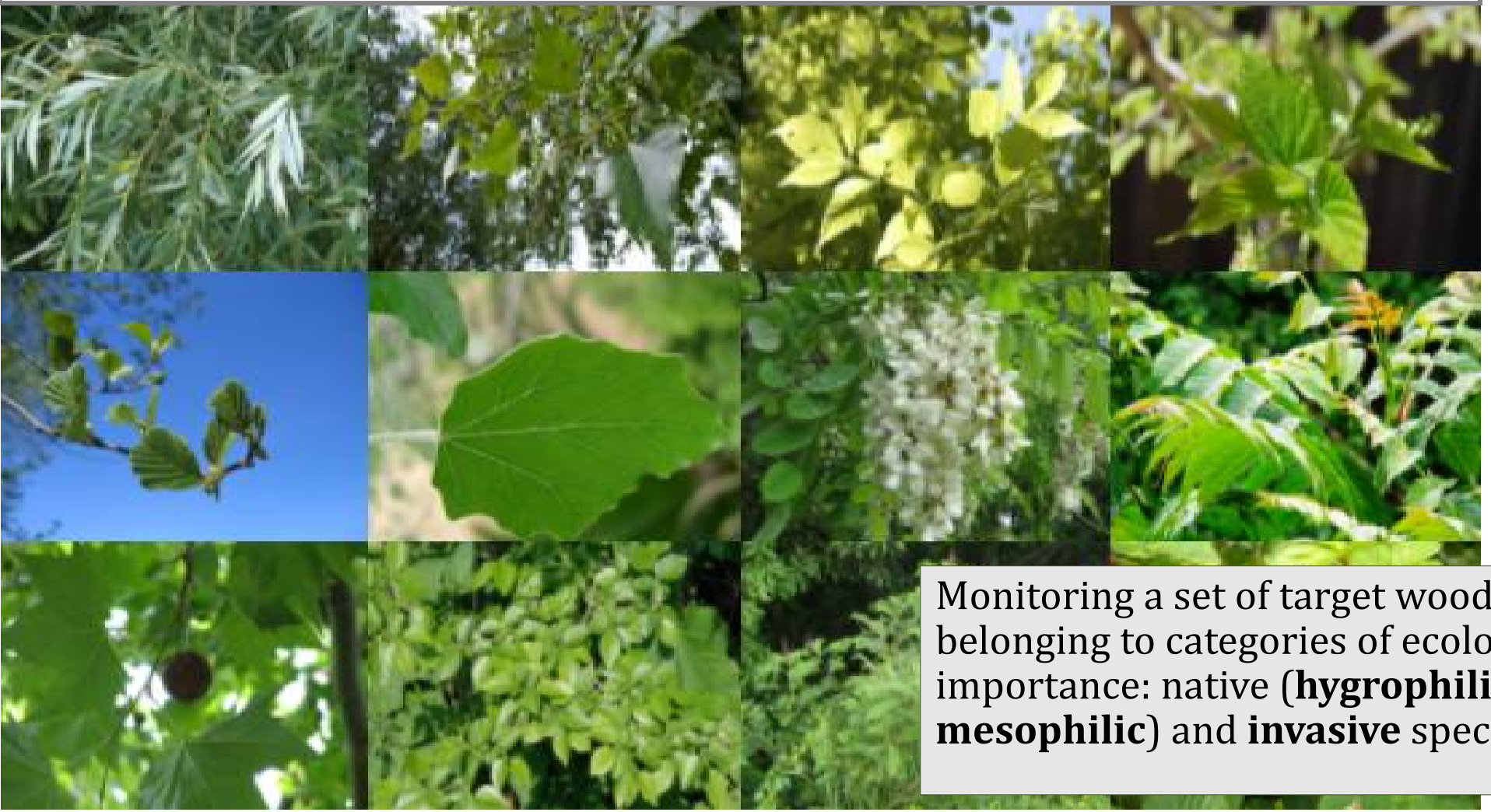
Defining a transect: identifying an area with a quite homogeneous vegetation cover (ex:10x15m)

1) General site characterization:

- Approximate vegetation height
- Bank erosion
- Bank modifications
- Dead and fallen trees
- Vegetation structure

Submit a representative photo of the site monitored!

The target species



Monitoring a set of target woody species, belonging to categories of ecological importance: native (**hygrophilic and mesophilic**) and **invasive** species.

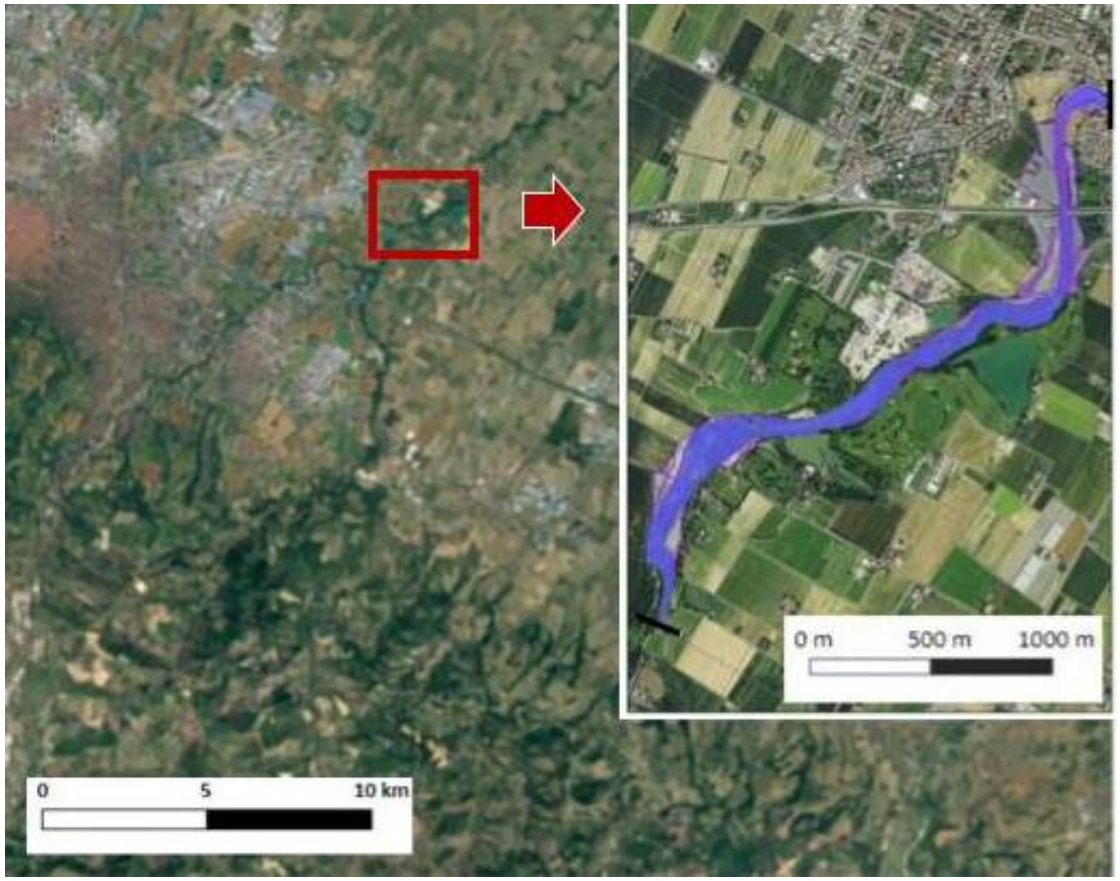
2) Monitoring the target species: the three layers system

- >3m → Current **forest composition**

- 1-3m
- <1m → Forest **regeneration** stages

Five abundance classes:
absent,
rare,
common,
abundant,
dominant.

The area monitored



In violet, the municipality-owned area where protection measures were undertaken.

A 4-km long stretch of the Idice River, in Castenaso (BO).

Providing a relevant **ecological connection between plain and hill ecosystems.**

The establishment of an "**Ecological Re-Equilibrium Area**", recognized at the regional level, was demanded by Castenaso municipality.

The monitoring process

152 samples realized through the App.

The abundance of **13 target species**, mainly arboreal, was assessed.

Native hygrophilic	*Native mesophilic*	*Invasive*
Populus alba	*Quercus robur*	*Robinia pseudoacacia*
Populus nigra	*Ulmus minor*	*Ailanthus altissima*
Salix spp.	*Acer campestre*	*Acer negundo*
Alnus glutinosa	*Rubus ulmifolius*	*Amorpha fruticosa*
	Morus nigra	

Per-segment analysis

The study area was divided into **7 reaches** of equal length (500m), the most downstream being longer (850m).

About **10 samples per bank** were realized on each reach.

Analysis at the reach scale was performed considering left and right bank separately.

The analysis of the study area in Castenaso

General site characterization

Evident geomorphological alterations were detected along the study area.

The low average value of bank condition mainly depends on the **incision of the Idice River.**

River incision is a widespread issue in the Padana Plain.

General site characterization

In most of the sites sampled, vegetation structure is **complex** and abundance of dead and fallen trees is **high**.

Simplified vegetation structure was observed in some localities (17%) mainly along the left bank, in proximities of **open areas**

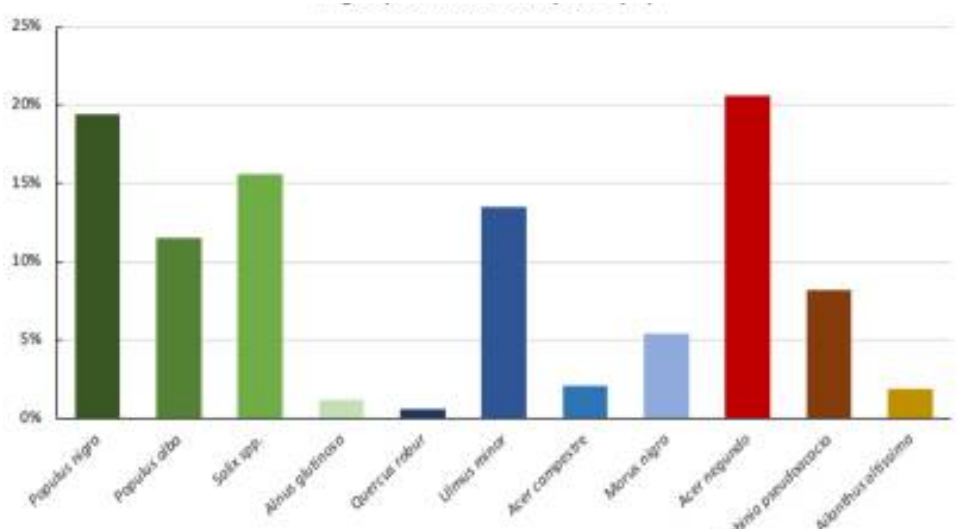
Vegetation composition in the three layers

Invasive species abundance, moderate in the >3m layer (31%), is significantly higher in the <1m (42%) and the 1-3m (51%) layers.

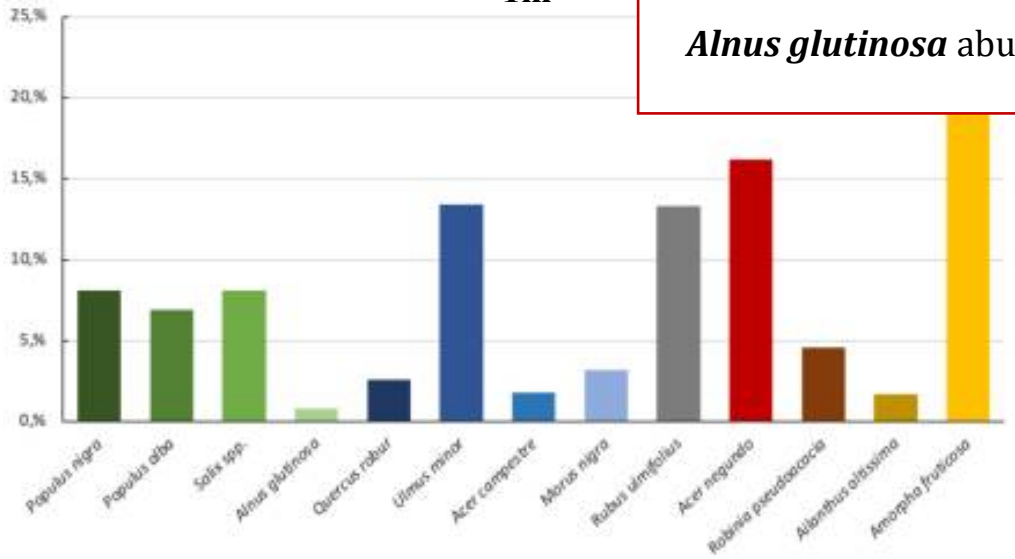
The abundance of **hygrophilic species** decreases significantly in the in the lower layers.

Among **mesophilic species**, *Ulmus minor* is significantly represented, though there is no significant difference between layers.

>3m

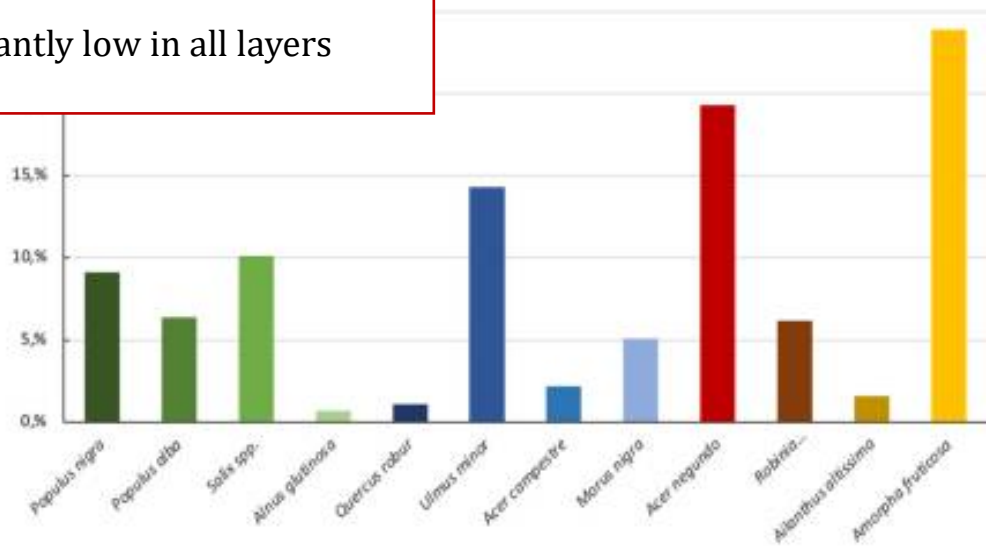


<1m

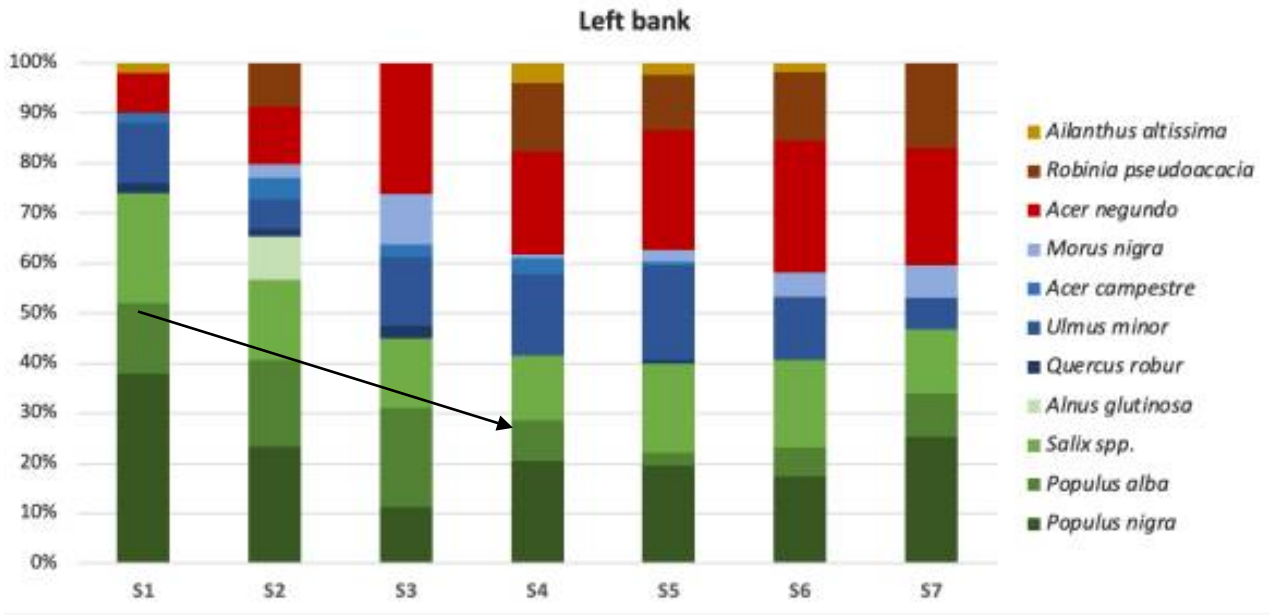


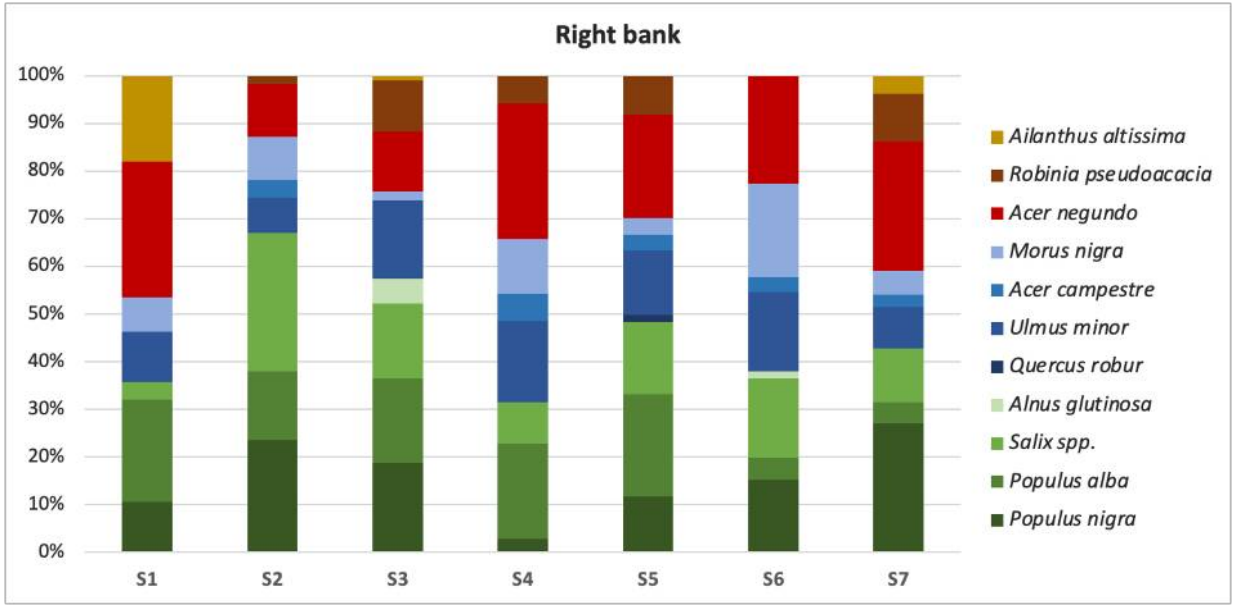
Alnus glutinosa abundance is significantly low in all layers

1-3m



Wood composition in the >3m layer





Along the left bank, the abundance of hygrophilic taxa in the >3m layer is significantly higher in the first reaches.

On the right bank the trend is more complex. However, higher abundance of hygrophilic species is observed in the upstream part of the study area.

Testing the App with Italian, Spanish and French volunteers

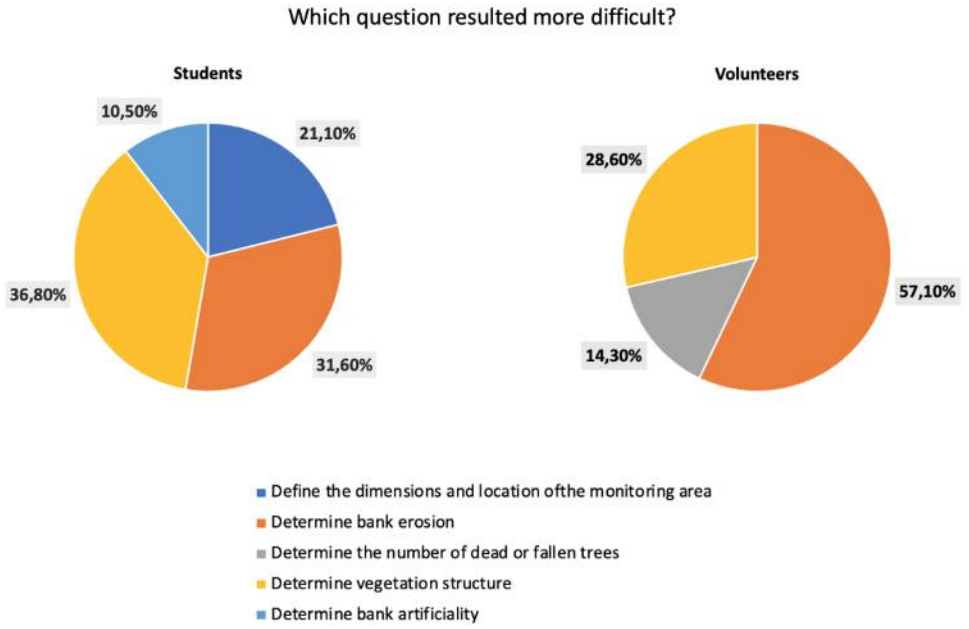
Image from the RiVe website

- **16** Italian volunteers tested the App in North-Italy.
- During curricular activities, **27** university students tested the app close to Madrid (Spain) and in Rennes (France).
- Specific **questionnaires** were delivered to all participants.
- The 111 **photos** of target species submitted in the project database **were revised.**

Questionnaires analysis

General site characterization

Major difficulties related to the determination of **bank erosion** and **vegetation structure**.



Vegetation analysis

Both the questionnaires and the on-field experience points out that **seedling recognition** is a **critical step** of the process.

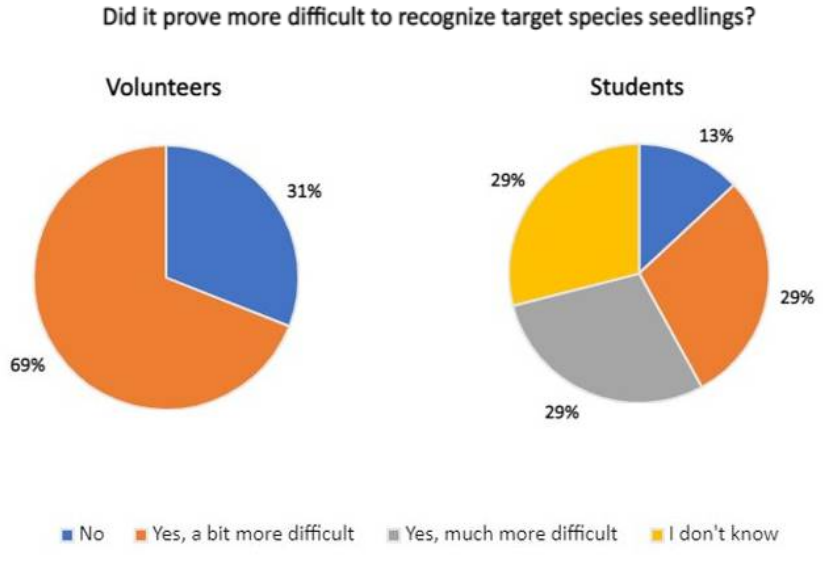
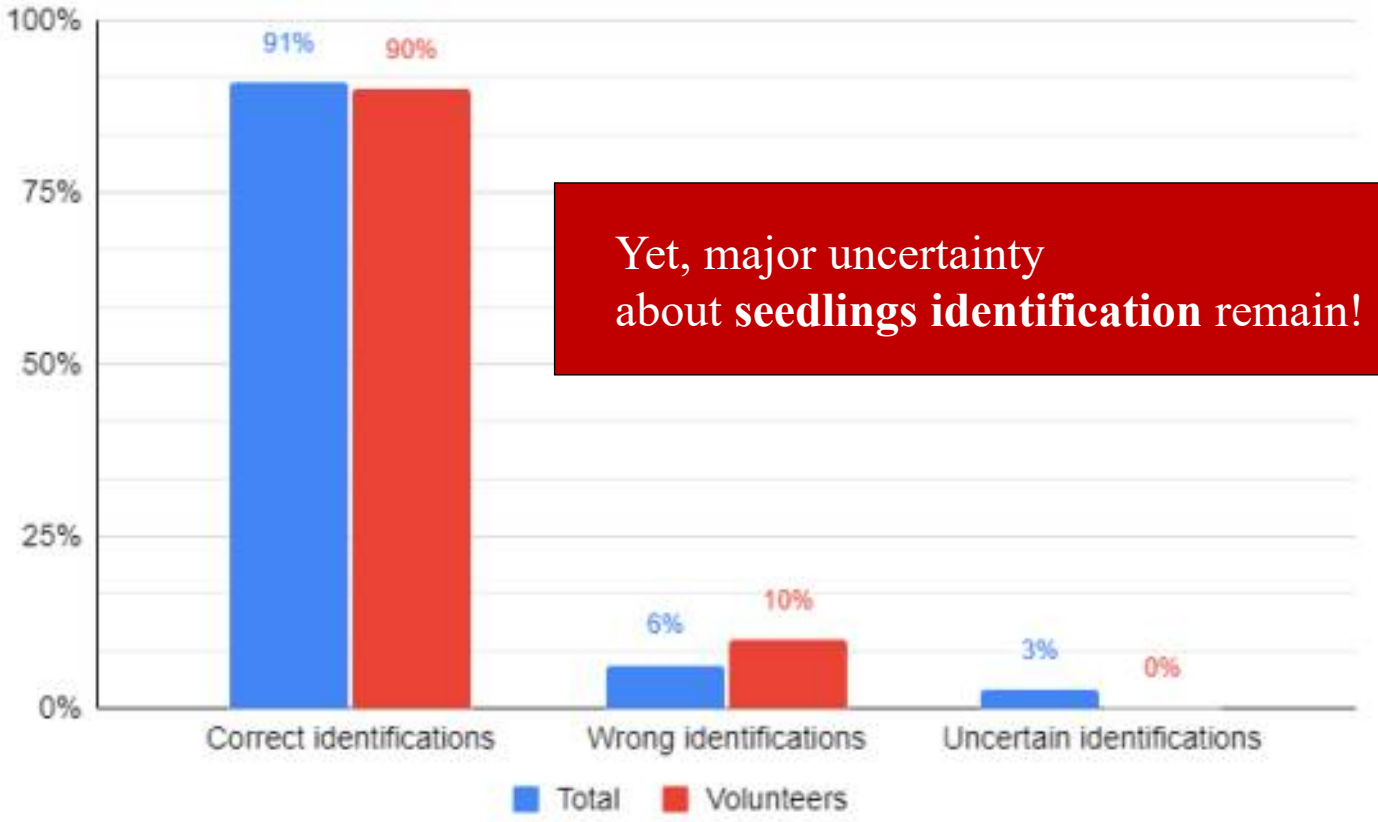


Photo revision: implications for data quality



Yet, major uncertainty about **seedlings identification** remain!

- More than **90% of correct identifications**
- **High revision potential** (**97%** of the photos submitted could be **revised efficiently**)

➢ Adding the possibility of submitting more photos in the survey can significantly **enhance the revision potential.**

The 1-3m layer, seeming to reflect the same dynamics observed in the <1m layer, should be **favored** with respect to the latter in characterizing **riparian forest regeneration**

The structure of the Index of Riparian Naturalness (IRN)

IRN

Six indicators.
Each score spaces from

20 points (highest naturalness)

to

0 points (highest artificiality)

Site characterization **(SUB-REACH SCALE)**

Four indicators assessed at the **reach scale (80 points max)**

- Cross-section artificiality
- Vegetation structure
- Forest maturity
- Vegetation management

Sub-index of invasion ***(TRANSECT SCALE)***

Two indicators assessed at the **transect scale** (40 points max)

- Invasive species abundance in the >3m layer
- Invasive species abundance in the 1-3m layer

Riparian vegetation naturalness in Castenaso

The IRN final score is calculated at the **reach scale (500 m)**

5 quality classes of riparian naturalness.

Very bad	Bad	Moderate	Good	Very good
0-24	25-49	50-74	75-99	100-120

In the study area, riparian vegetation naturalness varies from **moderate to good** in different reaches.

Most **impacted** indicators (lower values) are those referring to **cross-section artificiality** and **invasive species abundance.**

CONCLUSIONS

I To contain further spreading of **invasive** woody **species, containment measures** are needed in the protected riparian area of Castenaso. Revegetation of open areas can provide a substantial help to achieve this target.

II The testing phase of RiVe method highlighted some relevant criticalities. Introducing the modifications proposed can significantly improve **standardization and reliability** of the method**.**

III The index designed provides a synthetic overview on riparian naturalness and an insight into the alterations that affect single riparian components.

CONCLUSIONS

Recommendations and future perspectives

The integration of RiVe methodology with **secondary data sources** (e.g., remote sensing, GIS) could significantly enhance the depth and the scale of the analysis.

Projects in which main woody riparian species representative of **distinct regions** are presented must be created to make the app available in different geographic areas.

Thanks to...

... to the scientific group of the University of Madrid, to Castenaso municipality, to the many volunteers and the students of the Universidad Politécnica de Madrid, the Universidade de Lisboa and the Université de Rennes 2 who have contributed to this study.