



Analysis of the distribution and environmental impact of invasive alien plants in waterbodies of Latium (Central Italy)



Invasive alien species and biological invasions

- Alien species → species voluntarily or accidentally transported by humans outside their native range (IUCN, 2000)
- Characteristics of invasive alien species
 - Very competitive
 - Wide ecology
 - High reproductive potential
 - High ability to spread in environments
- Environmental and socio-economic problems
 - Alter the invaded ecosystem
 - Threaten native biodiversity
 - Have negative effects on human activities (navigability, fisheries, management costs, etc.)



Biological invasions → second most important factor in biodiversity loss, right after habitat fragmentation (Perzanowska et al., 2019)

The susceptibility of freshwater ecosystems to biological invasions

► Importance of freshwater environments

- High biodiversity and peculiarity of species
- Provide many ecosystem services

► Environmental characteristics

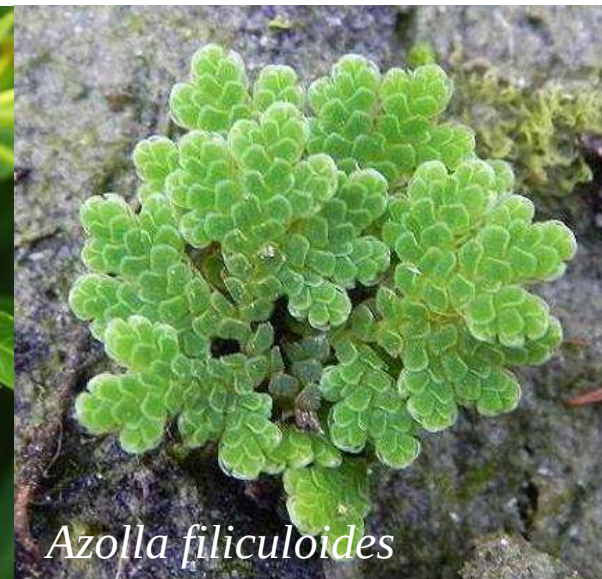
- Disturbed by humans
- Dynamic and unstable
- High amount of nutrients

} Susceptible to biological invasion
(Liccari et al., 2020)

- In fact, freshwater ecosystems are among the habitats most invaded by alien plants in Europe
(Lazzaro et al., 2020)



- The trade of aquatic plants for ornamental purposes
→ main reason of the spread of alien species in the world
(Brunel, 2009)
- In the last decade, alien vascular flora in Italy has increased by 56%
(Celesti-Grapow et al., 2009; Galasso et al., 2018)



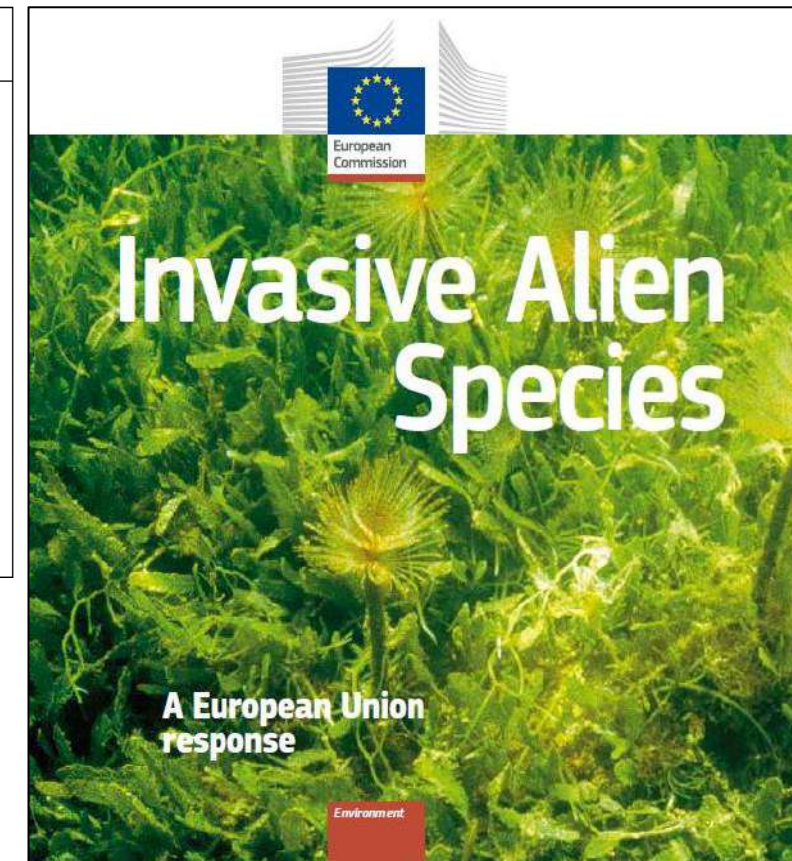
- Scientific literature on the ecosystem impacts of freshwater invasive alien plants (IAPs) in Europe
→ very scarce (Lazzaro et al., 2020)
- EU Regulation 1143/2014 → list of the most IAPs in Europe

LIST OF INVASIVE ALIEN PLANT SPECIES OF UNION CONCERN

<i>Baccharis halimifolia</i> L. <i>Cabomba caroliniana</i> Gray <i>Eichhornia crassipes</i> (Martius) Solms <i>Heracleum persicum</i> Fischer <i>Heracleum sosnowskyi</i> Mandenova <i>Hydrocotyle ranunculoides</i> L. f. <i>Lagarosiphon major</i> (Ridley) Moss <i>Ludwigia grandiflora</i> (Michx.) <i>Ludwigia peploides</i> (Kunth) P.H. Raven <i>Lysichiton americanus</i> Hultén e St. John <i>Myriophyllum aquaticum</i> (Vell.) Verdc. <i>Parthenium hysterophorus</i> L. <i>Persicaria perfoliata</i> (L.) H. Gross	<i>Pueraria montana</i> (Lour.) Merr. <i>Alternanthera philoxeroides</i> (Mart.) Griseb. <i>Asclepias syriaca</i> L. <i>Elodea nuttallii</i> (Planch.) St. John <i>Gunnera tinctoria</i> (Molina) Mirbel <i>Heracleum mantegazzianum</i> Sommier & Levier <i>Impatiens glandulifera</i> Royle <i>Microstegium vimineum</i> (Trin.) A. Camus <i>Myriophyllum heterophyllum</i> Michaux <i>Pennisetum setaceum</i> (Forssk.) Chiov. <i>Acacia saligna</i> (Labill.) H.L.Wendl. <i>Ailanthus altissima</i> (Mill.) Swingle <i>Andropogon virginicus</i> L. <i>Cardiospermum grandiflorum</i> Sw.	<i>Cortaderia jubata</i> (Lemoine ex Carrière) Stapf <i>Ehrharta calycina</i> Sm. <i>Gymnocoronis spilanthoides</i> (D.Don ex Hook. & Arn.) DC. <i>Humulus scandens</i> (Lour.) Merr. <i>Lespedeza cuneata</i> (Dum.Cours.) G.Don <i>Lygodium japonicum</i> (Thunb.) <i>Prosopis juliflora</i> (Sw.) DC. <i>Salvinia molesta</i> D.S. Mitch. (<i>Salvinia adnata</i> Desv.) <i>Triadica sebifera</i> (L.) Small (<i>Sapium sebiferum</i> (L.) Roxb.) <i>Hakea sericea</i> Schrad. & J. C. Wendl. <i>Koenigia polystachya</i> (Wall. Ex Meisn.) <i>Rugulopteryx okamurae</i> (E. Y. Dawson) <i>Pistia stratiotes</i> L. <i>Celastrus orbiculatus</i> Thunb.
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- 41 alien plant species, 15 of which are aquatic and bank plants

Many aquatic/bank alien plants considered most invasive in Italy
→ ARE NOT included on this black-list



Research Aims

1° phase

- Perform a spatio-temporal analysis of IAPs in volcanic lakes and rivers of Latium.
- Assess the role of rivers as biological corridors in the dispersal of IAPs.

2° phase

- Quantify and classify the impact of selected IAPs by applying the recent EICAT protocol based on bibliography.

3° phase

- Analyze the environmental impact of the most widespread IAPs in the investigated sites by field and laboratory studies.
- Identify new IAPs to be included in the black-list of Union concern.

Study area

- All freshwater volcanic lakes and the main rivers of the Tiber river basin in Latium.



Bolsena Lake



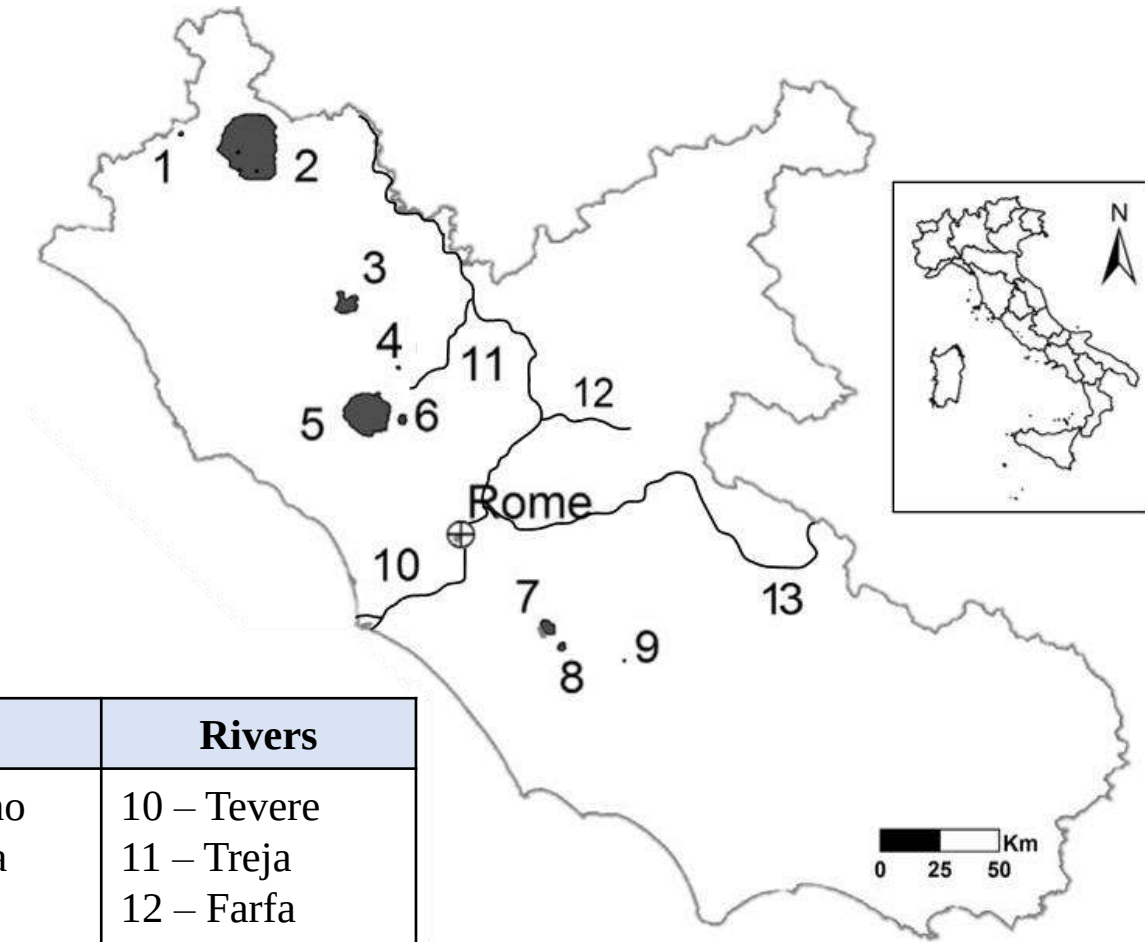
Tevere River



Vico Lake



Aniene River



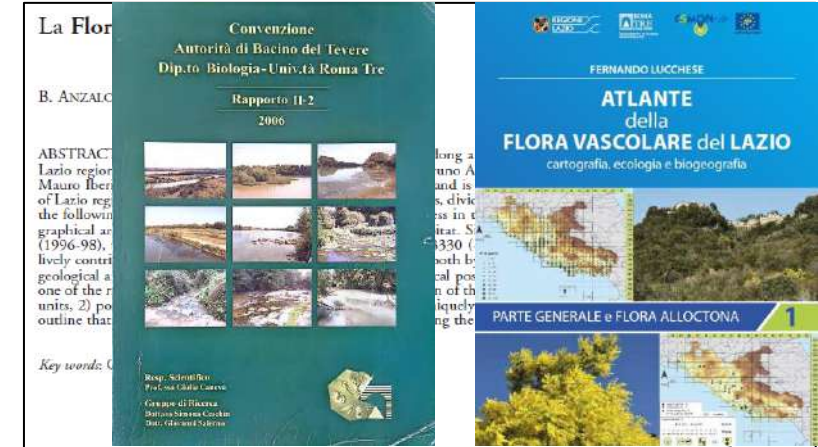
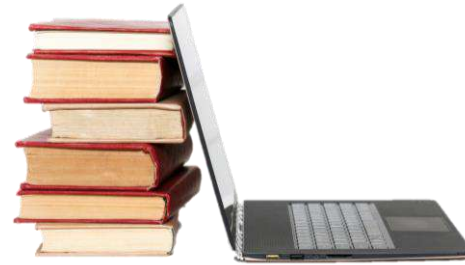
Lakes	Rivers
1 – Mezzano	10 – Tevere
2 – Bolsena	11 – Treja
3 – Vico	12 – Farfa
4 – Monterosi	13 – Aniene
5 – Bracciano	
6 – Martignano	
7 – Albano	
8 – Nemi	
9 – Giulianello	

Introduction	Aims	Materials and Methods			Expected results	Timeline
		1° phase (1-22 months)	2° phase	3° phase		

1 – Spatio-temporal analysis of IAPs in volcanic lakes and rivers of Latium

- Bibliographic research of previous spatial and temporal data on IAPs in the considered waterbodies

- Floristic sampling of the presence and abundance of IAPs



- Georeferencing of distributional floristic data for their spatio-temporal analysis using QGIS software
→ from which we will evaluate the role of biological corridors in the dispersal of IAPs

- Selection of target alien plants



Introduction	Aims	Materials and Methods			Expected results	Timeline
		1° phase	2° phase (10-16 months)	3° phase		

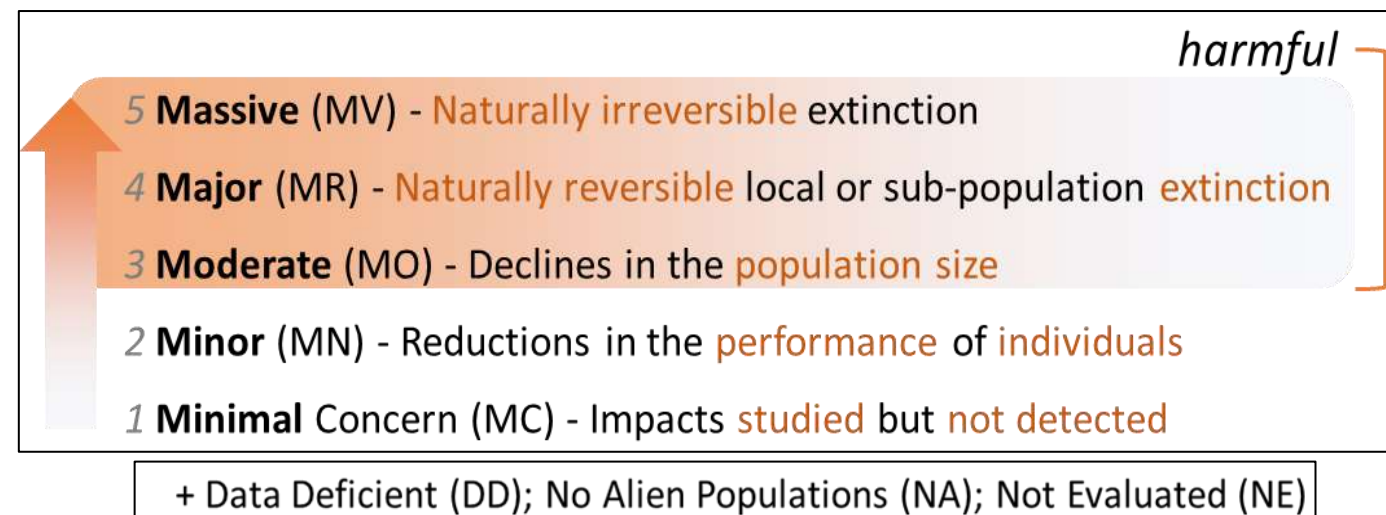
2 – Quantification and classification of the entity of the environmental impact of target alien plants applying the recent standard EICAT protocol

- EICAT - IUCN protocol → based on bibliographic data



- Applying the protocol will assess the type of impact, its severity, and the mechanisms by which IAPs exert this impact on native biocoenoses and the invaded ecosystem

- Classify the level of severity of impact



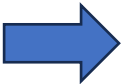
Introduction	Aims	Materials and Methods			Expected results	Timeline
		1° phase	2° phase	3° phase (17-32 months)		

3 – Analysis of the ecosystem impact of target alien plants

3.1 – Analysis of the impact of target alien plants on native plant biodiversity

- Floristic sampling will be carried out separately in aquatic and bank environment
- In sites with (invaded) and without target alien plants (control sites)
- Presence and percent cover (%) of alien and native species
- Diversity indexes (Shannon, Simpson)

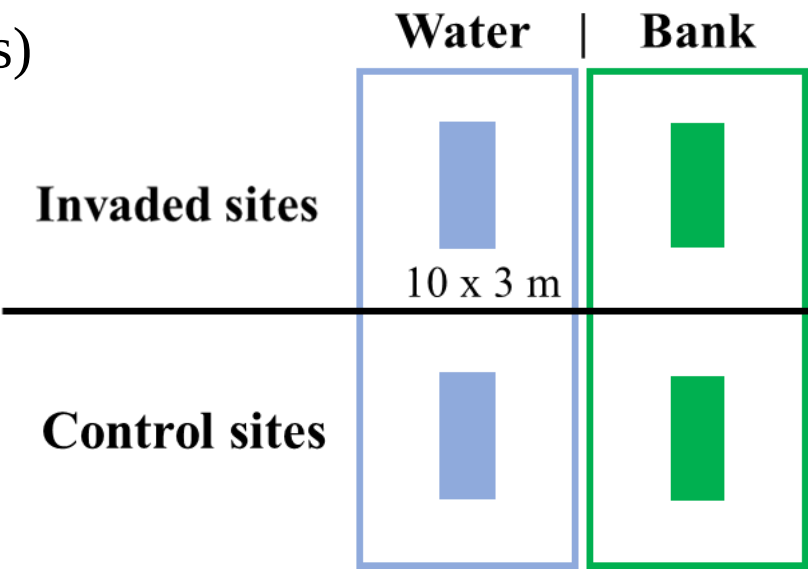
$$H = - \sum p(x) \log p(x) \quad D = - \log \frac{\sum_j N_j(N_j - 1)}{N(N - 1)}$$




Microsoft®

Excel

- Correlation between diversity index values and alien species cover (%)



Introduction	Aims	Materials and Methods			Expected results	Timeline
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3.2 – Analysis of the impact of target alien plants on environmental parameters

➤ Sampling of the main environmental parameters

➤ Highlight any chemical and physical alterations due to the presence of target alien plants

- Water and air temperature (°C)
- pH
- conductivity ($\mu\text{S}/\text{cm}$)
- salinity (‰)
- dissolved oxygen (mg/l)

multiparameter probe
(Hach-Lange HQ40d)



- Water and air light ($\mu\text{mol photon m}^2/\text{s}$)

luxometer

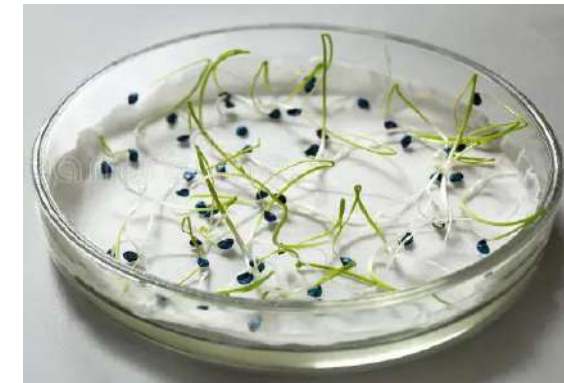
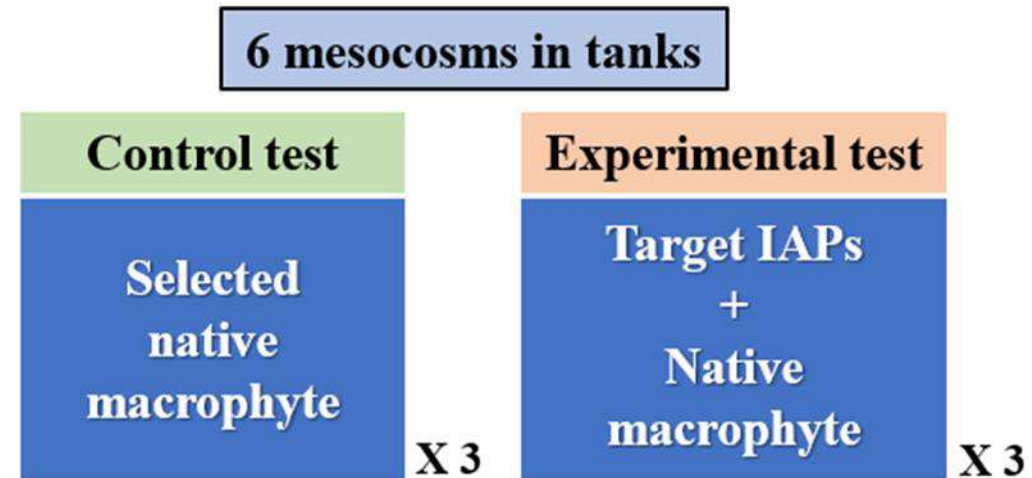
(LI-250A light meter and quantum sensor LI 193 SA;
LI-COR GmbH)



Introduction	Aims	Materials and Methods			Expected results	Timeline
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3.3 – *Indoor experimentation*

- Assessment of the impact of the target alien plants on native macrophytes of naturalistic importance in Italy
 - Every 10 days → Record of variation of percent cover (%) of each species
 - Changes of morphological traits of individuals of native species grown together with alien plants
 - Measurement of water chemical/physical parameters
 - Germination test of seeds of selected native plant species
 - To verify the inhibitory effect of any allelopathic substances produced by target alien plants
- Identify any new aquatic/bank alien plants to be included in the black-list of species of Union concern



Expected results

- Updated mapping of IAPs distribution and biological pollution status of investigated waterbodies
- Evaluation of the role of rivers as biological corridors in the dispersal of IAPs
- Analyze the impact of target IAPs on environmental parameters and native plant biodiversity, evaluating the most impactful in the investigated freshwater ecosystems (develop possible management protocols)
- Identification of possible new IAPs to be included in the black-list of species of Union concern
- Development and production of scientific articles related to individual project aims



Introduction	Aims	Materials and Methods	Expected results	Timeline
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Timeline of this research project

	1st year												2nd year												3rd year											
Project phase Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Bibliographic research																																				
Spatio-temporal analysis of the distribution of IAPs in the investigated waterbodies																																				
Quantification and classification of environmental impacts of selected IAPs (EICAT protocol)																																				
Characterization of the environmental impact of selected IAPs by field and laboratory data																																				
Writing and production of scientific papers																																				

Collaborations

- **Università degli Studi di Roma Tre:** Prof. Marta Carboni, Prof. Simona Ceschin, Dr. Silvia Del Vecchio and Dr. Silvia Giulio
- **Università degli Studi di Roma La Sapienza:** Prof. Laura Celesti-Grapow
- **Università degli Studi di Sassari:** Prof. Giuseppe Brundu
- **Università degli Studi Milano-Bicocca:** Prof. Sandra Citterio and Dr. Chiara Montagnani
- **IUCN-ISSG (Invasive Species Specialist Group):** Prof. Rodolfo Gentili
- **Parco Naturale Regionale di Bracciano-Martignano**
- **Riserva Naturale Regionale Nazzano Tevere Farfa:** Dott. Umberto Pessolano
- **Parco Naturale Regionale del Vulture**
- **Parco Regionale dei Castelli Romani**
- **Riserva Naturale Valle dell'Aniene**



RISERVA NATURALE REGIONALE NAZZANO
TEVERE FARFA



Riserva Naturale Valle dell'Aniene



Thank you for your attention



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