



Risk assessment for the alien species *Cacyreus marshalli* in a Italian Alpine valley



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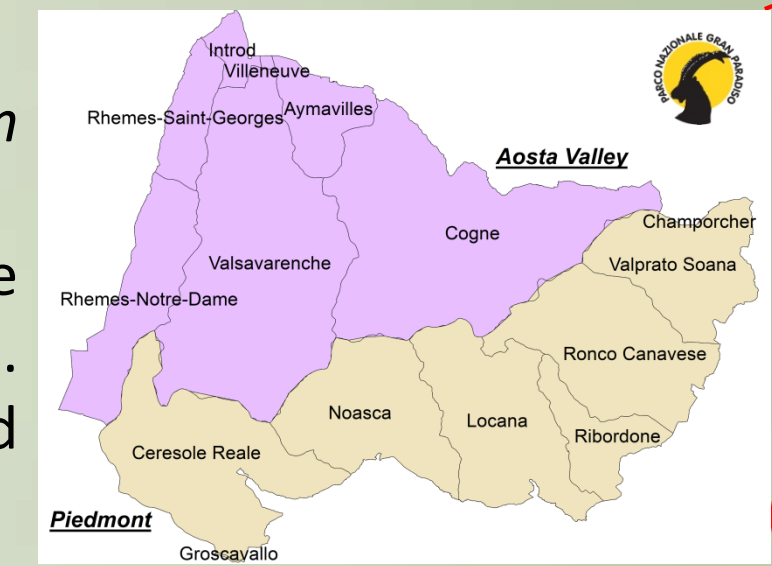
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GERANIUM BRONZE: the only alien butterfly in Italy (Bonelli et al., 2018)

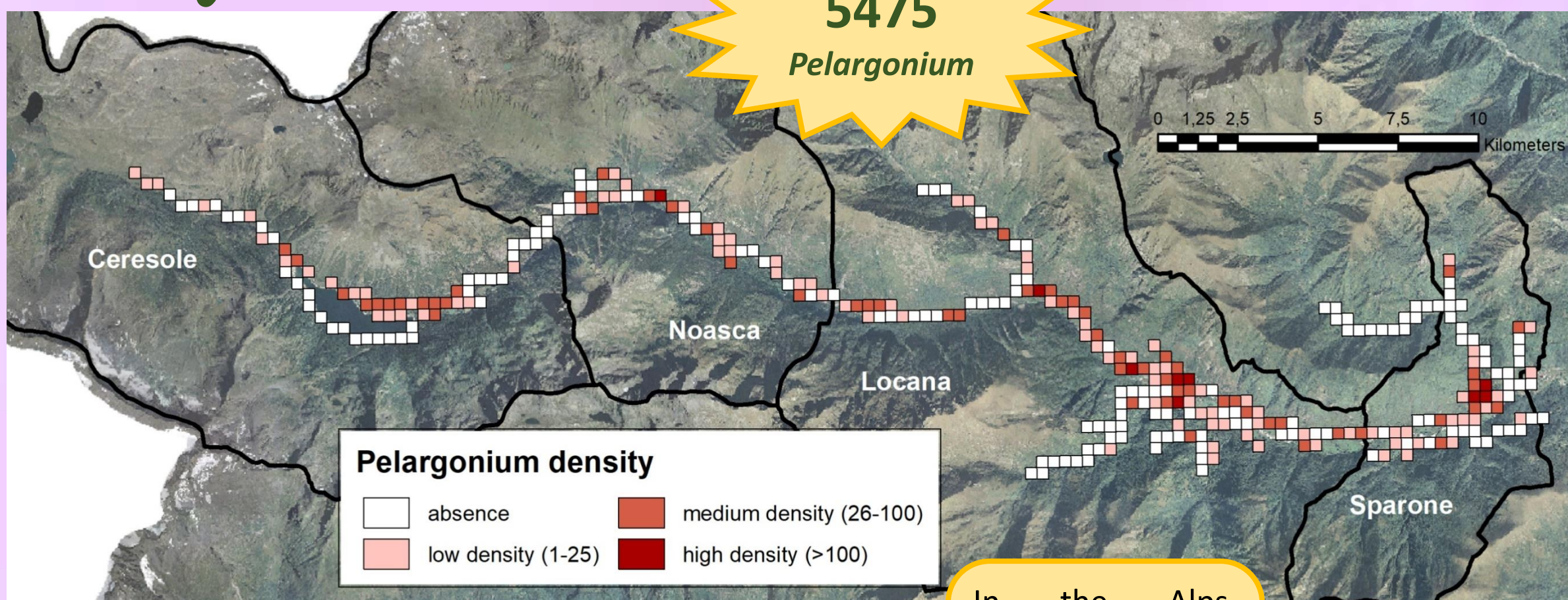
Originally from Southern Africa, *Cacyreus marshalli* (Geranium Bronze) was introduced in Europe through the trade of *Pelargonium* (Geraniaceae), genus not native to Europe but widely used for ornamental purposes.

1988: first found in Mallorca Island; **1996:** first sighting in Italy (Quacchia et al. 2008). After the first sightings in central Italy, the species has spread throughout the territory and in the last 10 years has also been reported in the Alps at medium-high altitudes. Recently, two alpine National Parks (Gran Paradiso and Val Grande) have reported sporadic adult individuals at altitudes comprised between 1200 and 2400 m asl, also far from villages.

Despite low impact on ornamental *Pelargonium*, *C. marshalli* is **A THREAT FOR BIODIVERSITY** → Gran Paradiso National Park (GNPN) promoted a project to **census** and **eradicate** the alien lycaenid in the protected area. *C. marshalli* hasn't natural enemies and the risk of naturalization would lead to the disappearance of Italian native lycaenids, such as *Aricia* spp. and *Eumedonia eumedon* feed on *Geranium* (native Geraniaceae). This was demonstrated in laboratory experiment by Quacchia and colleagues (2008).



Pelargonium census



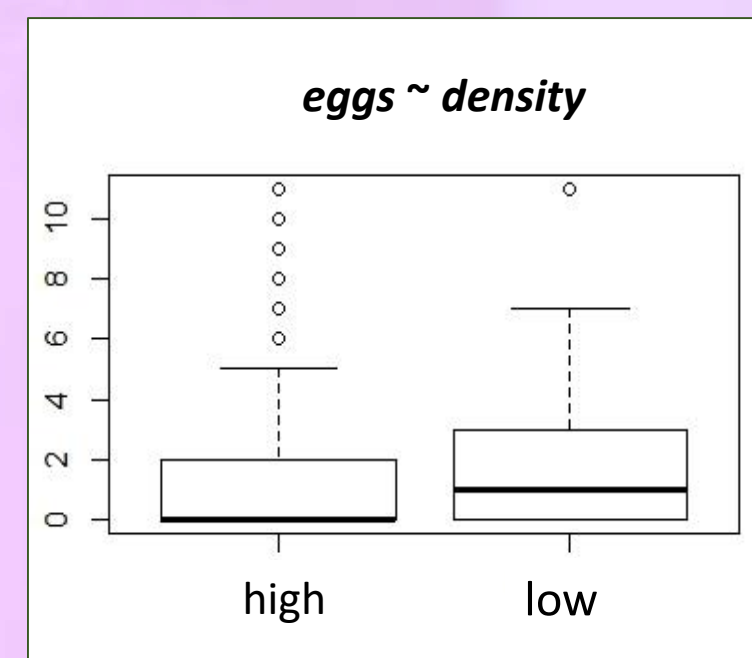
We evaluated the **risk of presence** of *C. marshalli* recording the **Pelargonium abundance**, exploring all the more or less populated municipalities, small villages and mountain huts of the Orco Valley (550-2200 m a.s.l.). We recorded all plant species, flower colour, habitat, GPS point and we realized a map with *Pelargonium* abundances in grids (250x250m).



In the Alps, *Pelargonium* is very popular as ornamental plant in urban areas.

C. marshalli census in the park

258 *Pelargonium* checked
53% colonised
• **518** *C. marshalli* eggs
• **50** *C. marshalli* caterpillars



We counted all eggs, caterpillars and pupae found on *Pelargonium* in 24 selected areas. For each Orco Valley's municipality (Sparone, Locana, Noasca and Ceresole) we chose six areas in three different contexts i) centre of the village, ii) border of the village and iii) isolated small village, each one split up in two areas with high and a low density of *Pelargonium*.

Number of *C. marshalli* eggs in relation to high and low *Pelargonium* density ($p < 0.001$). The highest number of eggs occurred with a lower density of plants. The differences between the average eggs number in low density (1.909 ± 0.203) and in high density (1.369 ± 0.159) are statistically significant, even if minimal.

Preimaginal stages census

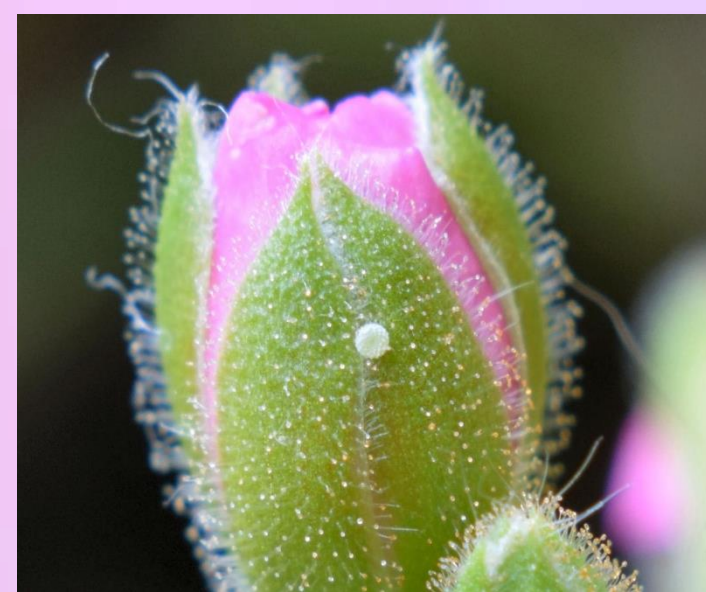
	presence/absence
Intercept	-1.1576 (± 0.4628) *
context ("isolated small village" as baseline)	
center	0.9907 (± 0.3167) **
border	0.4112 (± 0.3428)
density ("high" as baseline)	
low	1.4436 (± 0.3001) ***
Marginal r^2	0.1073994
Conditional r^2	0.2364758

Results of the **GLMM** analysis (logit link, binomial error distribution) of preimaginal stages and traces (presence/absence) on *Pelargonium* plants as a function of *context* and *density*. *Municipality* was considered as a random variable.

The life cycle of *C. marshalli* in non native countries

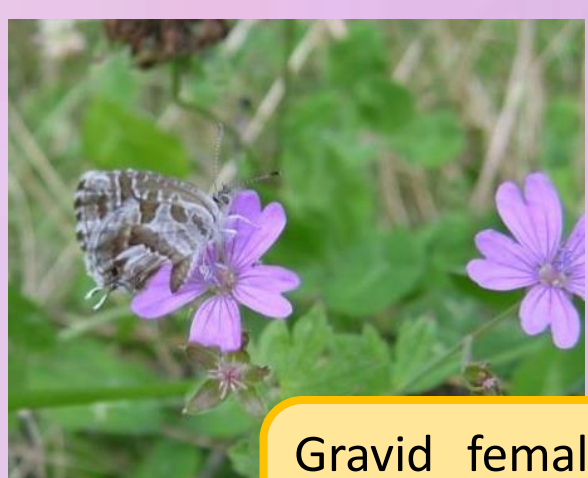
Polyvoltine species: more overlapping generation (4-6) from May to October. It overwinters as pupa or mature larva.

- **Eggs:** laid in the flower buds or in the leaves of the *Pelargonium*
- **Caterpillars:** tunnel inside the bud and then start to burrow a gallery in the stem, where remain until the last instar
- **Pupae:** remain adherent to the stem
- **Adults:** feeds on *Trifolium* spp., *Vicia sativa*, *Viola* spp., *Artemisia* spp and *Geranium* spp. (Favilli & Manganelli 2006)

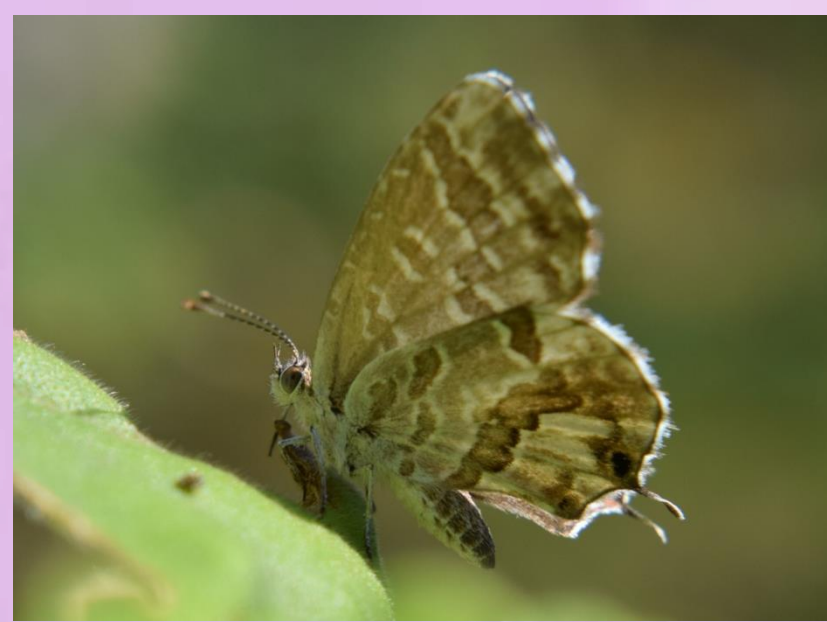


About 7 month

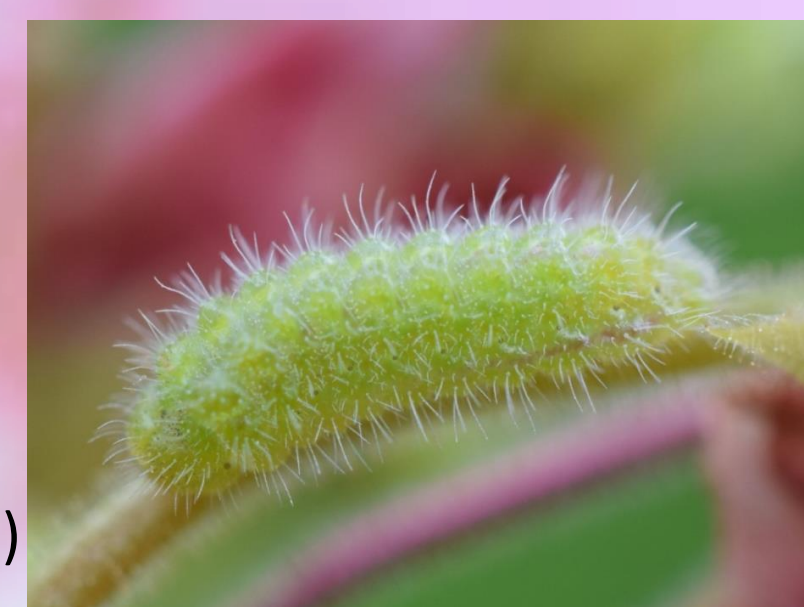
About 7 days



Gravid female feeding on *Geranium* can accidentally lays its eggs on it. Larval development is equally possible.



About 7 days



About 15 days

Feeding on flower and stem tissues, high densities of caterpillars cause serious **damages to plants** and lead soon to *Pelargonium* death.

Dispersal experiments

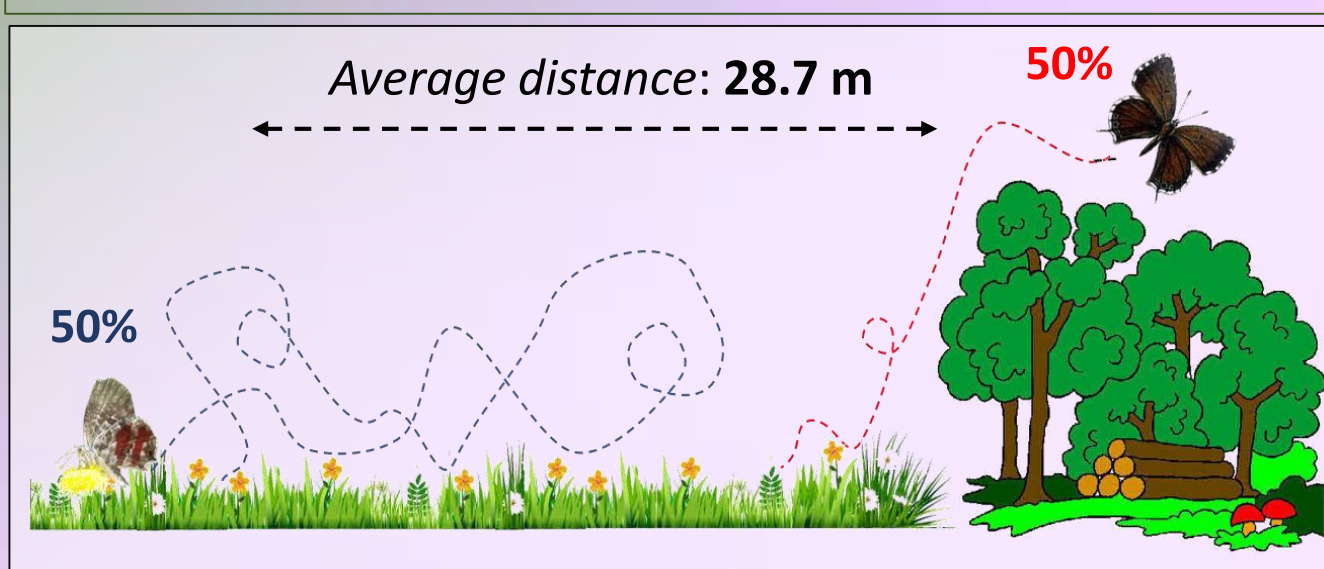
We investigated the **ability of the species to fly and overcome barriers**, represent by trees, to reach the larval host plants (*Pelargonium*). We released 20 gravid females in two areas and we recorded all their movements and activities.

We selected **two areas**, within different landscape matrices:

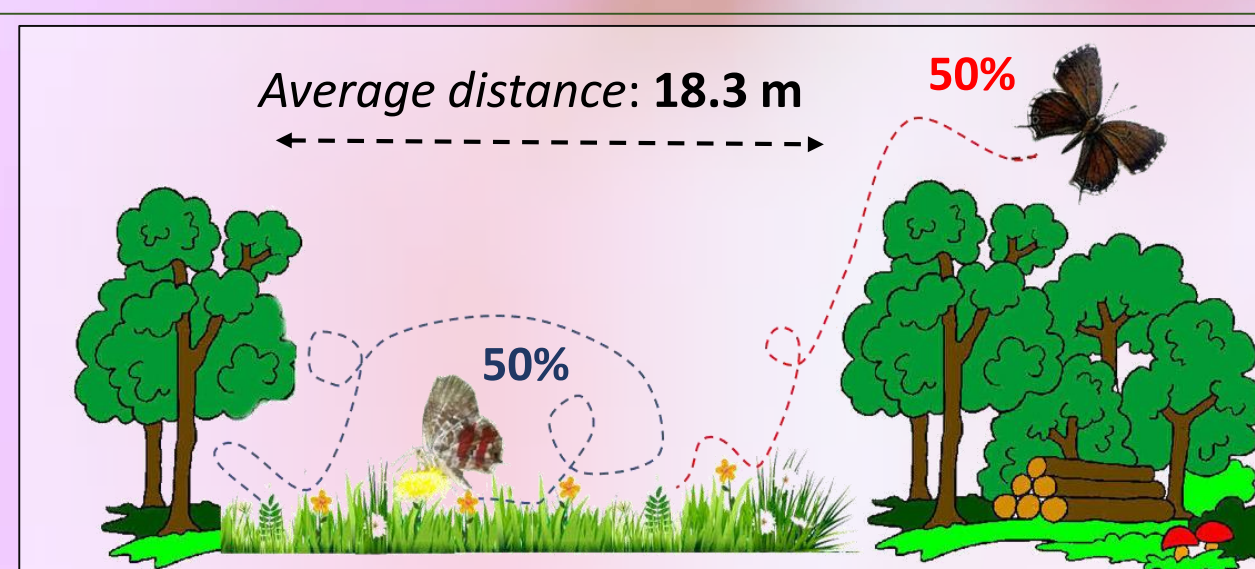
1. a **meadow** with an **ecological corridor** connecting to *Pelargonium*
2. an **isolated meadow**, entirely surrounded by woods.

The **results** of these experiments showed that:

- In both areas, the **50%** of females remained in the area.
- However, the **50%** of the females **overcame the wood**, so the species is able to overcome barriers.



Area 1



Area 2

Work in progress

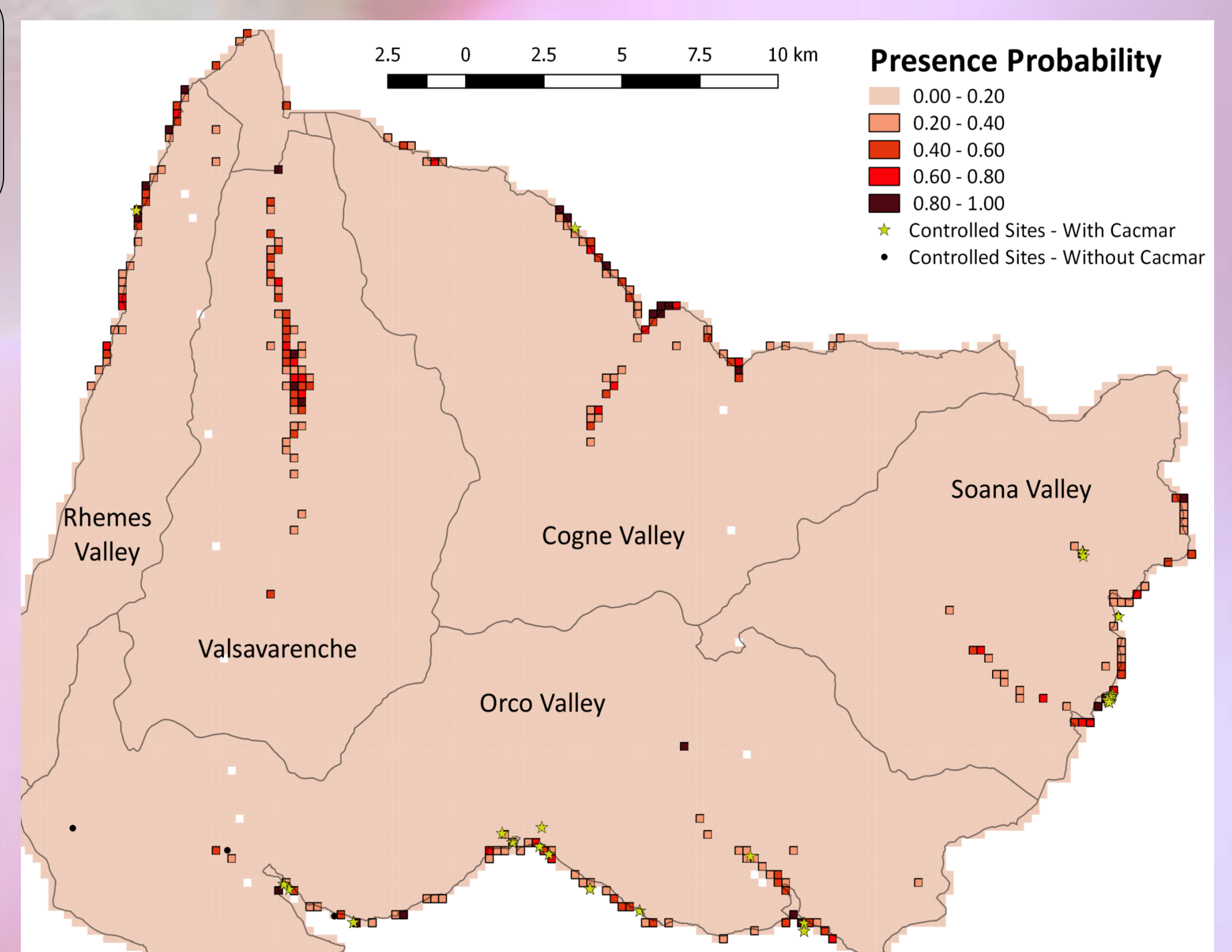
- ❖ Evaluation of the **naturalization risk** and the potential threats to biodiversity i) inside the park ii) at regional level and iii) at national level, realizing risk maps, also considering the distribution of the native potential larval host plant (*Geranium* spp.)
- ❖ More detailed species distribution models at GPNP level, with a deeper field evaluation of *C. marshalli* presence in less explored areas of the park and far from urbanized areas
- ❖ Involvement of local people in recognizing eggs and caterpillars
- ❖ Realisation of a brochure to increase local public awareness of this alien species and to promote the correct management of *Pelargonium*, as a tool to reduce the naturalization risk

References

Bonelli, S., Casacci, L. P., Barbero, F., Cerrato, C., Dapporto, L., Sbordoni, V., ... & Rondinini, C. (2018). The first red list of Italian butterflies. *Insect Conservation and Diversity* doi :10.1111/icad.12293
Favilli, L., & Manganelli, G. (2006). Life history of *Cacyreus marshalli*, a South African species recently introduced into Italy (Lepidoptera Lycaenidae). *Bollettino della Società entomologica italiana* 138(1): 51-61
Quacchia, A., Ferracini, C., Bonelli, S., Balletto, E. & Alma, A. (2008). Can the Geranium Bronze, *Cacyreus marshalli*, become a threat for European biodiversity? *Biodiversity and Conservation* 17: 1429-1437

Photographs by Francesca Martelli

Current Potential Distribution



We applied a **Species Distribution Model** (Maxent) at GPNP level, to identify current suitable areas and to show the *C. marshalli*'s current potential distribution. Influential explanatory variables were related to **temperature** (isothermality), **topography** (elevation) and **land cover** (artificial and woodland areas). It results that:
- about **1%** of the protected area has a **probability of presence** for the species **above 0.5**.
- the peak of presence probability is around **1000 m a.s.l.**, with a constant decrease at higher altitude.