Comparing insect herbivory between native and invasive *Senecio* species in NE Spain: a test for the *Native Enemy Host Switching Hypothesis*

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1. Introduction

The invasion of exotic species is an important factor affecting biodiversity at global scale. Success of plant invasions could be determined by changes in herbivore – plant interactions. When exotic plants colonize a new habitat they may be release from the associated phytophagous insects from its indigenous area (*Enemy Release hypothesis*) but at the same time colonized by native enemies from the invasive range (*Native Enemy Host Switching hypothesis,* Kean & Crawley 2002). Native enemy host switching, particularly for specialist insects, is expected to be more frequent when phylogenetically related plants are present in the invaded area. Also, longer introduction times should increase the probability of native hosts on using exotic plants as alternative hosts.

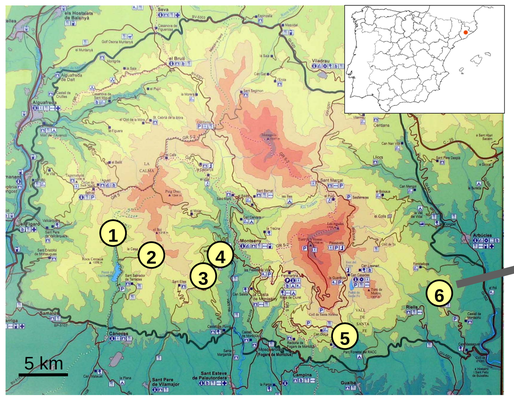
The potential new interactions between exotic plants and native insects could decrease the plant invasive capacity by depleting plant fitness. Here we have evaluated the *Native Enemy Host Switching* hypothesis using *Senecio pterophorus* D. C. (*Asteraceae*) as a model species, a South African plant that colonized NE Spain at least 30 years ago. We determined the presence of native enemies on *S. pterophorus* and compare it to two phylogenetically related native species from the invaded area (*S. vulgaris* and *S. lividus*) and one exotic species with longer introduction time (100 years) (*S. inaequidens*).

2. Objectives

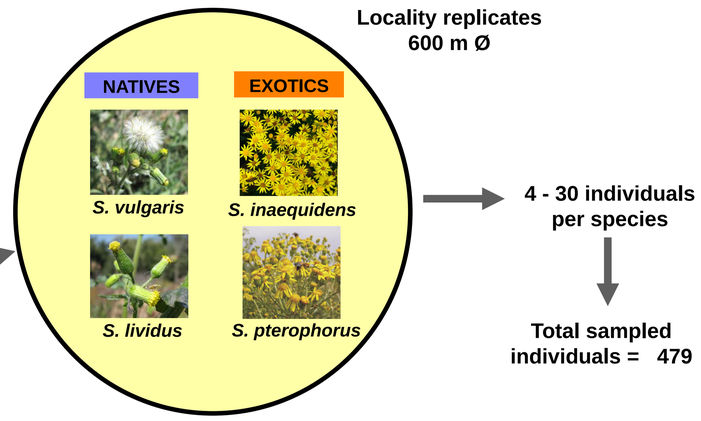
(1)To quantify the presence of herbivores on reproductive and vegetative plant parts on the native and exotic *Senecio* species
(2) To identify the insects associated to *Senecio* species and determine their host breadth
(3) To determine whether longer introduction times increases herbivore host switching
(4) To determine whether herbivore host switching significantly reduces the exotic plant reproductive capacity

3. Materials and Methods

Our study area was located at Montseny Natural Park (NE Spain) where the 4 *Senecio* species coexist. We located 6 sites with 600 m diameter distributed along the park that contained between more than 4 individuals of each species. Plants were surveyed every 7-10 days from May to November during the species blooming stage. Each sampling day all mature flower heads were counted and damage by phytophagous insects and other pathogens on vegetative plant parts was recorded. All the fructified flower heads were sampled and dissected in the laboratory to determine the presence of any herbivores growing therein. All insect immature stages were raised in the laboratory and emerged adults were kept for a posterior taxonomical identification.



Montseny Natural Park



4. Results and discussion

Quantification of herbivores on reproductive and vegetative plant parts

Despite of the higher flower head production of the exotic species (Fig.1A), *S. pterophrous* and *S. inaequidens* showed lower levels of herbivory compared to *S. lividus* (Fig.1C). The damage on flower heads was similar between *S. vulgaris* and the two exotics (Fig.1B,C). Aphids on vegetative plant parts affected more the exotic species compared to the natives (Fig.2A). Of the two fungal pathogens identified, *Uredinales* were present in *S. vulgaris* and *S.inaequidens*, and absent to *S. lividus* and *S. pterophorus,* while *Erysiphales* were only present in the native species.

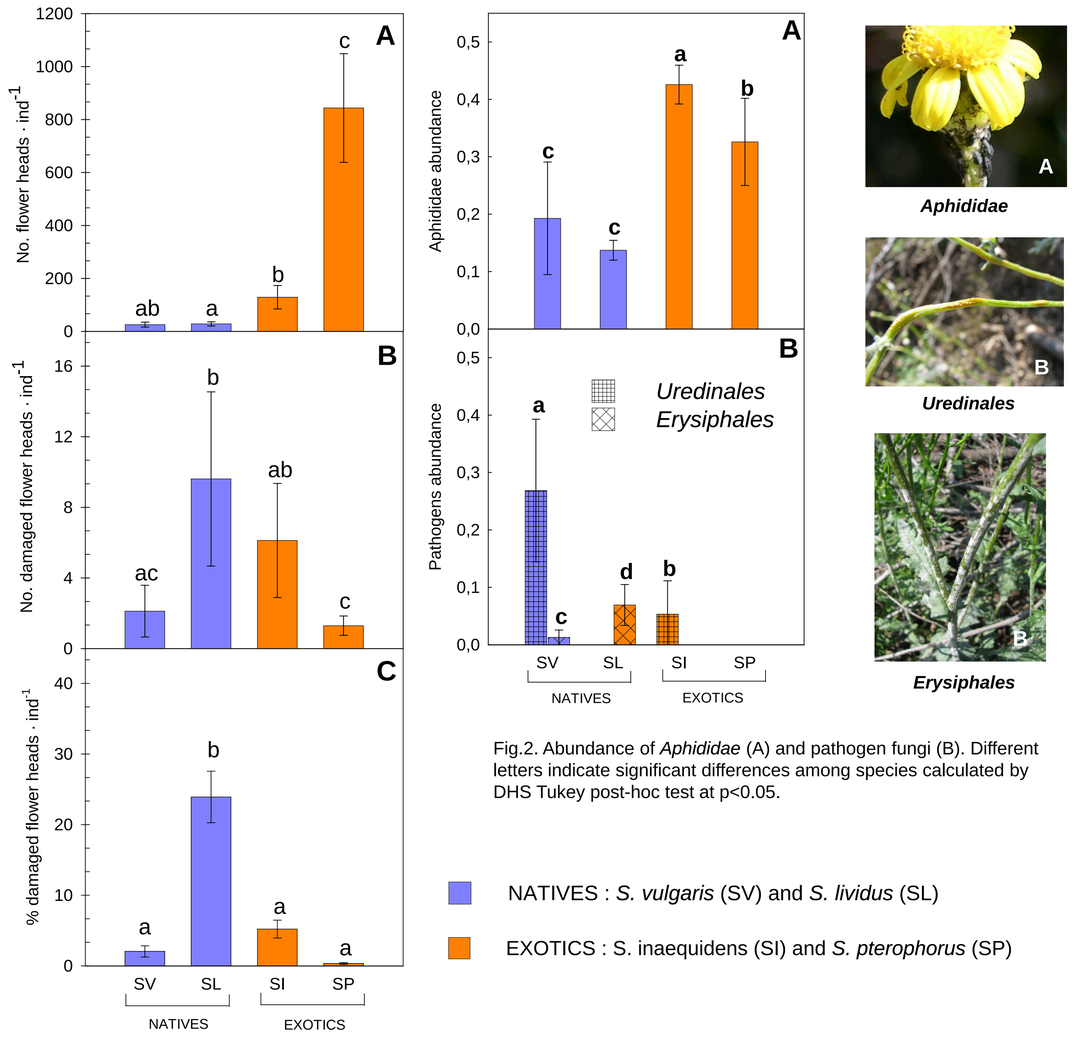


Fig.2. Abundance of *Aphididae* (A) and pathogen fungi (B). Different letters indicate significant differences among species calculated by DHS Tukey post-hoc test at p<0.05.

NATIVES : *S. vulgaris* (SV) and *S. lividus* (SL)

EXOTICS : S. inaequidens (SI) and *S. pterophorus* (SP)

Fig.1. Number of total flower heads (A), number of damaged flower heads (B), and percentage of damaged flower heads per species (C) Different letters indicate significant differences among species calculated by DHS Tukey post-hoc test at p<0.05.

Phytophagous insects on reproductive plant parts

We found three types of herbivory on *Senecio* flower heads:

A. *Sphenella marginata* (Diptera: *Tephritidae*)
This *Senecio* monophagus that grows and pupates inside the flower heads was present in all native *Senecio* causing a higher impact on the fitness of *S. lividus* (Fig.3A). *Sphenella marginata* was also found on *S. inaequidens,* the exotic species with longer invasion time, but not *S. pterophorus* even the plant was blooming at the time the insect was present.

B. *Phycitodes albatella* (Lepidoptera: *Pyralidae*)
Reported as an *Asteraceae* specialist, and thus considered an oligophagous, this microlepidoptera was only found on the two exotic *Senecio* species, *S. inaequidens* and *S. pterophorus,* but not on the natives (Fig.3B). The synchrony of the plant blooming period with the insect live cycle is probably critical on establishing this plant - herbivore interaction: the insect was only found from July to November, when the natives were not present. The damaged caused by *Phycitodes albatella* on plant fitness was low in *S. pterophorus* compared to *S. inaequidens* (Fig.3B).

C- Other type of damage
Damage flower heads with no insects therein were also found. This damage was caused by other Lepidoptera that may include, but are not restricted to: *Autographa gamma*, *Helicoverpa armigera*, *Heliothis peltigera*, and *Eupithecia sp*. All these Lepidoptera are polyphagous as they consume plants from several families. This type of damage was not found on *S. pterophorus*, while *S. lividus* and *S. inaequidens* showed similar values significantly different than the low levels showed by *S. vulgaris*.

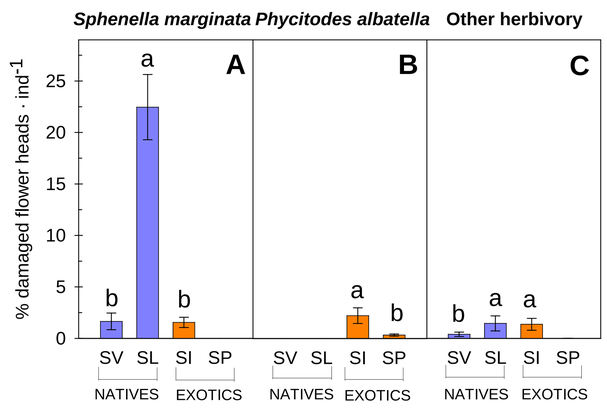


Fig.3. Percentage of damaged flower heads for each herbivory type. Different letters indicate significant differences among species calculated by DHS Tukey post-hoc test at p<0.05.

Fig. 4. Pupa and adult of *Sphenella marginata*

Fig.5. Larva and adult of *Phycitodes albatella*

5. Conclusions

•Both exotic species, *S. inaequidens* and *S. pterophorus*, were damaged by native insects. Level of herbivory on the exotics was significatly lower compared *S. lividus*. However, no differences between the exotics and *S. vulgaris* was found.

•The longer time since invasion of *S. inaquidens* may have contributed to establish more divers interactions with local insects, including a monophagous, an oliphagous and several polyphagous species. *S. pterophorus*, more recently introduced, was nearly free from herbivory on reproductive plant parts.

•Reproductive capacity of the exotic species was reduced by 6% and 1% for *S. inaequidens* and *S. pterophorus,* respectively. Newly established interactions between native herbivores and exotic plants may decrease plant invasive capacity in the long run.

Bibliography

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