Approach to the invasive potential of *Senecio pterophorus* using SDMs and niche comparison analyses

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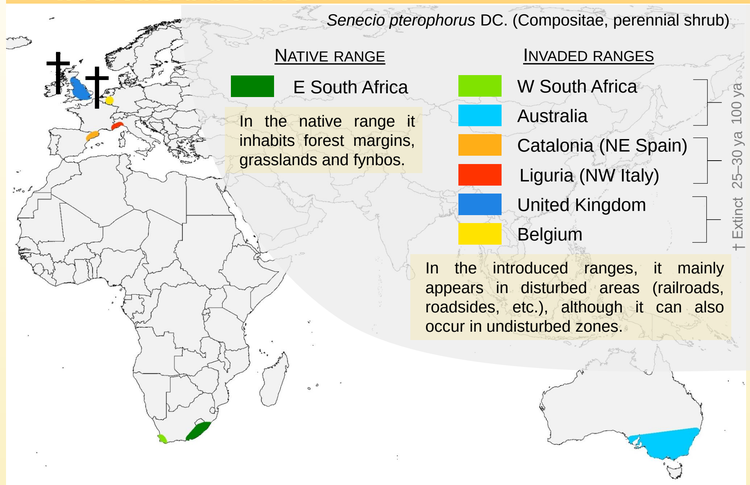
INTRODUCTION

Senecio pterophorus DC. (Compositae, perennial shrub)



NATIVE RANGE

E South Africa

In the native range it inhabits forest margins, grasslands and fynbos.

INVADED RANGES

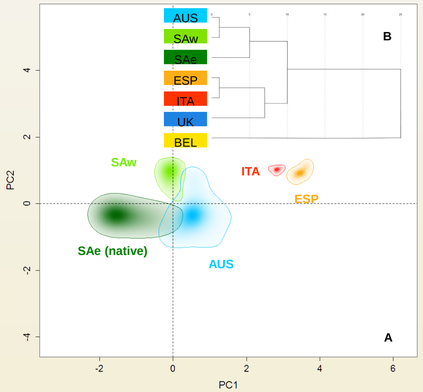
W South Africa
Australia
Catalonia (NE Spain)
Liguria (NW Italy)
United Kingdom
Belgium

† Extinct 25–30 ya, 100 ya

In the introduced ranges, it mainly appears in disturbed areas (railroads, roadsides, etc.), although it can also occur in undisturbed zones.

RESULTS

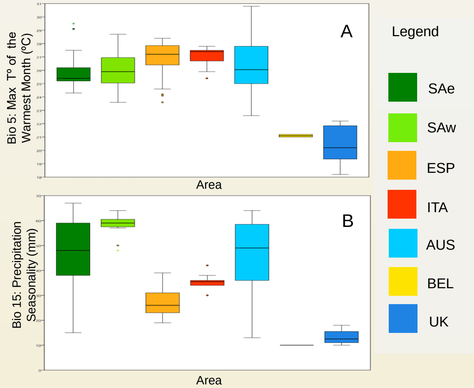
1 Determine if the species has changed its niche during the invasion process.



(A) Overlap of the realized climatic niches of *Senecio pterophorus* in all its considered (native and invaded) ranges. Belgium and United Kingdom are not shown because we had <10 occurrences, the minimum required to perform the method. The solid line represents 25% of the occurrence density. PCA-env obtained following the Broennimann *et al.* (2012) method.

(B) Dendrogram based on UPGMA cluster analysis using the average of PC1, PC2, and PC3 obtained from PC scores of the 10 variables. Ranges are coded as follows: E South Africa –*native*– (SAe), W South Africa (SAw), Australia (AUS), NE Spain (ESP), NW Italy (ITA), United Kingdom (UK), and Belgium (BEL).

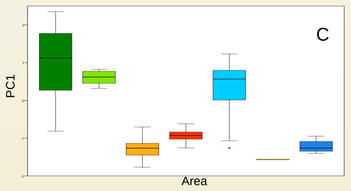
2 Ascertain why it has not succeeded neither in Belgium nor in the United Kingdom.



(A) Boxplot diagram showing values of the **maximum temperature of the warmest month** –*bio 5*– (°C) for each area.

(B) Boxplot diagram showing values of the **precipitation seasonality** –*bio 15*– (mm) for each area.

(C) Niche breadth boxplot for each area, obtained from the PC1 scores of the 10 variables.



MATERIALS, METHODS & AIMS

We used a total of **267 occurrence data records** from *S. pterophorus* (E South Africa –*native*– = 37; W South Africa = 15; Australia = 136; NE Spain = 51; NW Italy = 18; United Kingdom = 8; and Belgium = 2). After a variable selection process (Pearson correlation r < |0.5|), we ended up by using a total of **10 variables** to perform the analyses:

Altitude (m)	Bio 16: **Precipitation of the wettest quarter** (mm)
Aspect: downslope direction (degrees)	Bio 17: **Precipitation of the driest quarter** (mm)
Bio 3: **Isothermality**	**Distance to the coast** (km)
Bio 5: **Maximum temperature of the warmest month** (ºC)	**Distance to the closest river** (km)
Bio 15: **Precipitation seasonality** (mm)	**Human footprint** (%)

We employed species distribution models [geographic (G) space] and niche comparisons analyses [environmental (E) space] in order to:

1 Determine if the species **has changed its niche** during the invasion process.

- **UPGMA dendrogram** to examine clustering groups between all realized niches.
- **Broennimann *et al.* (2012) method** (Glob. Ecol. Biogeogr. 21: 481–497) to represent the niches currently occupied by the species.

2 Ascertain why it **has not succeeded** neither in Belgium nor in the UK.

- **Niche breadth boxplots:** to graphic niche differences between native and invaded ranges.
- **Variables boxplots:** to determine which variables may explain the unsuccessful establishment.

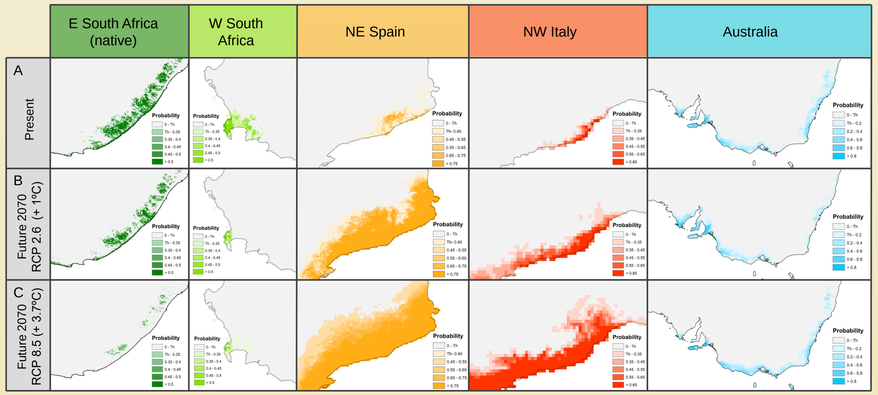
3 Assess **possible expansions and/or contractions** under different climate change scenarios.

- **Geographical projections of the present model to the future** (MaxEnt): to compare habitat suitability between present and future models (2070).

2 future scenarios: +1 ºC (GFDL RCP 2.6) and +3.7 ºC (GFDL RCP 8.5).

RESULTS

3 Assess possible expansions and/or contractions under different climate change scenarios.



Comparison of species distribution models under the present climate and two climatic scenarios in future (2070).

(A) Potential distribution under the present climate.

(B) Potential distribution under the climatic scenario 2070-GFDL RCP 2.6.

(C) Potential distribution under the climatic scenario 2070-GFDL RCP 8.5.

CONCLUSIONS

1 Realized niche of *S. pterophorus* seems to have changed during the invasion process. While older introduced areas showed similar niche to the native range, recent invaded areas showed a more divergent and non-stabilized niche.

2 Climate is an important factor to explain the successful establishment of *S. pterophorus* in new ranges. This species could be adapted to the Mediterranean climate, which does not fit with that of the unsuccessfully established areas (UK and BEL), where temperatures and precipitation seasonality are lower than successfully invaded areas (SAw, AUS, ESP, and ITA).

3 For the future climate change scenarios considered, we detected different variation patterns in habitat suitability depending on the geographic range: reduction for SAe (native) and SAw, expansion for ESP and ITA, and relatively stable for AUS.