

The invasion of Senecio kleinia, an endemic plant from Canary Islands, on the south-eastern Spanish coastline.

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ABSTRACT: *Senecio kleinia*, an endemic plant of the Canary islands that is commonly used as an ornament in private gardens of the south-eastern Spanish coast, has been discovered invading some native plant communities of the Alicante coastal region. We suggest that a favourable microclimate, and the ability to disperse by both seed and vegetative growth, have allowed the plant to establish stable and spreading populations. The presence of potential habitat along the south eastern Spanish coast increases the risk of expansion of *Senecio kleinia* to many other localities including protected areas.

Keywords: *Senecio kleinia*, Alicante, invasive plant, Canary Islands species.

RESUMEN: *Senecio kleinia*, una planta endémica de las Islas Canarias, comúnmente utilizada como ornamental en jardines del sureste español, ha sido encontrada en dos localidades costeras alicantinas formando parte de diferentes comunidades vegetales. Así mismo, la existencia de un microclima favorable y la capacidad de la planta de reproducirse con éxito tanto vegetativamente como por semillas, han permitido la consolidación de poblaciones estables. La presencia de hábitats potenciales a lo largo de la costa sureste de la Península Ibérica incrementa el riesgo de expansión de la planta hacia otras localidades, entre las que se incluyen espacios protegidos.

Palabras clave: *Senecio kleinia*, Alicante, plantas invasoras, Islas Canarias.

INTRODUCTION

The coastal area of Alicante province has experienced a very high construction pressure in the last 40 years, due to its international popularity as a tourist destination. Private gardens are often included in these constructions, and a large number of non-native species from the Cape, Macaronesian, and Irano-Turanian regions are commonly used because of their exotic appearance and easy adaptation to the semiarid climate of this region.

This report focuses on one of these species, *Senecio kleinia*, which is beginning to escape private gardens and invade some coastal locations. The presence of *S. kleinia* in wild habitats was detected for the first time in the spring of 2001 in 'Serra Grossa', a coastal mountain range close to Alicante city centre. In 2006, the plant was also found in the hills and cliffs that surround 'Cala Lanuza' beach, 20 Km. north from El Campello (figure 1).

S. kleinia is a succulent shrub, endemic to the Canary Islands, up to 2,5m. high, which is able to use both seed and vegetative reproduction strategies. It forms part of Taibaiba formations of infra-thermomediterranean thermotypes and arid-semiarid ombrotypes. This plant appears as characteristic of the vegetation class *Kleinio-Euphorbietea canariensis* (Rivas Goday & Esteve

1965, Santos 1975), which is also endemic to the Canary Islands (figure 2).

Stretching from "Santa Pola" cape to its northern limits, the coast of the Alicante region is quite rough, with hills, cliffs and coastal ranges providing a broad range of different microclimates. Amongst these microclimates, we shall focus upon those in which orientation and inclination generate arid inframediterranean conditions within the thermomediterranean semiarid macroclimate. This macroclimate is dominant in the southern Alicante province, itself part of the Murciano-Almeriense biogeographical province Rivas Martinez & al. (2001-2002). Therefore, we might expect to find the northern limit for those microclimatic conditions in the border between the Murciano-Almeriense and Catalano-Provençal-Balear biogeographical provinces.

The 'Serra Grossa' lies parallel to the coast (NE-SW), and thus the south-eastern side receives a high number of sunshine hours. This generates the microclimatic conditions in which *S. kleinia* can find a very similar habitat to its natural one in the Canary Islands. A second population encounters similar conditions in the southern hill of 'Cala Lanuza', as the orientation of the invaded site corresponds with that of 'Serra Grossa'.

The Alicante coast is no stranger to non-native species, and it is not difficult to find other

alien species at the same locations, for example *Cupressus sempervirens*, *Platycapnos orientalis*, *Lantana camara*, *Carpobrotus edulis*, *Aptenia cordifolia*, *Atriplex semibaccata*... and of the genera *Aeonium*, *Pelargonium*, *Ipomoea*.

However for this report we choose to focus on *Senecio kleinia*, due to its ability to adapt to: i) the nitrophilous communities of the *Pegano harmalae-Salsoletea vermiculatae* class; ii) shrub communities belonging to climax communities of *Chamaeropo humilis-Rhamneto lycioidis Sigmetum*; iii) coastal grasslands, "albardinares", of the *Salicornietea fruticosae* class.

MATERIALS AND METHODS

Surveys were conducted to search for and count individual *S. kleinia* plants. Young plants were distinguished from adults as those that had passed at least one flowering season.

In "Serra Grossa", sampling were undertaken during 2001, 2002, 2003 and 2007, while "Cala Lanuza" was surveyed only once in 2007, upon discovery of a new population in that location. These surveys were used to map the spread of the species.

Succulent trunk morphology provides *S. kleinia* with an easy method of vegetative reproduction. However in order to test the effectiveness of seed dispersal and germination, an experiment was conducted in which 35 seeds (from the "Serra Grossa" population) were placed in Petri dished containing an enriched medium. Climatic data from between 1998 to 2007 (three years before first observations, to present) was obtained from 'Labclima' (University of Alicante). This was compared with the values of three existing populations of *Senecio kleinia* on the Canary Islands, using the following parameters: T, m, and M (respectively, yearly average temperature, minimum average temperature of the coldest month, maximum average temperature of the coldest month).

The evolution of winter temperatures in Alicante was also analysed for the period since the plant was first observed in "Serra Grossa". Monthly minimum temperatures were also considered in order to compare it to the average temperature values.

RESULTS AND DISCUSSION

In "Serra Grossa", *S. kleinia* is colonising the south-eastern edges.

The first source of invasion is located in an abandoned garden in the north-eastern limit of the affected area. High xeric and thermic conditions have allowed the expansion of the invaded

area, which has not stopped spreading since the first countings were conducted (figure 3). The population was first detected in the spring of 2001, and counts uncovered 148 individuals, most of which were young. In 2002 the number of counted individuals increased to 210; and by May 2003 the population had grown further to 334 individuals. In the spring of 2007, the population number (not the area) had decreased to 200 individuals, including 70 adults.

In the "Serra Grossa" population, the oldest individuals and highest densities of *Senecio kleinia* occurred into the nitrophilous shrub communities, which are of the *Salsola oppositifoliae-Suedion verae* (Rigual 1972), alliance. These high density shrub communities are located in a zone of high human disturbance near the invasion focus. Elsewhere it occurs at much lower densities, however the area in which *Senecio kleinia* is distributed has been considerably increased along the range side, where the dominant vegetation belongs to the *Chamaeropo humilis-Rhamnetum lycioidis signetum* alliance camephytic grasslands, "espartales", and open brushwoods, "tomillares (figure 4). A phytosociological releve taken at a 100m² scale in the nitrophilous shrub communities showed the following results: *Salsola oppositifolia* 4, *Senecio kleinia* 2, *Osyris lanceolata* 1, *Carthamus arborescens* 1, *Fagonia cretica* + *Ballota hispanica* +, *Opuntia subulata* +, *Lavatera maritima* +, *Coronilla juncea* +, *Piptatherum coerulescens* +, *Asparagus horridus* +.

In the "Cala Lanuza" site, 6 individuals were observed in the spring of 2006 Vicedo (*pers. comm.*) on the southern hill of the beach (figure 5).

After two visits in May 2007, a detailed count revealed 79 individuals distributed throughout the higher isolation area, of which 19 were adult. The population has become established in nitrophilous shrub communities from the *Pegano-Salsoletea* Br.-Bl. & O. Bolòs 1958 class; and also in halophylous graminoid communities of the *Limonietalia* Br.-Bl. & O. Bolòs 1958 order, belonging to *Salicornietea fruticosae* Br.-Bl. & Tüxen ex A. & O. Bolòs 1950. An isolated adult individual was also found in the northern cliff of the beach, 300m away from the main population, near to a pile of plant cuttings from a nearby house (figure 6).

Seed viability is quite high. After 3 days in the germination camera 6 seeds had germinated, and after another 2 days a total of 16 germinated seeds were found, showing an overall seed viability result of 45.7%.

Field observations prove that the plant can disperse to a higher altitude than the invasion focus, thus further illustrating the efficiency of seed dispersal in the wild.

Climatic data analysis revealed some differences between the plants natural habitat in the Canary Islands and its new habitat on the coast of Alicante. January was the coldest month, and the winters of 2005 and 2006 were the coldest since the presence of *Senecio kleinia* was detected in "Serra Grossa". The minimum temperatures would have registered very close to 0°C (considering that temperatures will be lower at the inland weather station of Alicante University, 6 Km away from the "Serra Grossa"). The yearly average temperature is about 2°C higher on the Canary Islands, and this parameter was the most similar between the climatic stations compared. Maximum average temperature of the coldest month is nearly 5°C lower in Alicante than in the Canary locations. The minimum average temperature of the coldest month was between 5 and 7°C warmer in the Canary locations (figure 7).

Considering the ready dispersal of *S. kleinia*, its ability to naturalise in many different plant communities, and its adaptation to the slightly colder climate of Alicante, we could expect that the only barriers to further dispersal may be the availability of suitable microhabitat and increasing urban development.

In the case of "Serra Grossa", suitable microhabitat can be found all along the south-eastern range side, and therefore we may expect the population to continue its spread.

A slight decrease in density of the "Serra Grossa" population was observed between 2003 and 2007, and this may have been due to the cold Alicantine winters of 2005 and 2006, in which the minimum temperature was lower than that of its native habitat. The lower minimum average temperature of both the coldest month and winter in general, could be compensated by the high number of sunshine hours. However since minimum temperatures are registered at night, when the lack of sunshine does not allow compensation, we can assume that it could be the most critical factor for *S. kleinia* in its new habitat adaptation. Despite this fact, our results suggest that the low winter temperatures of the Alicantine coast seem unable to efficiently prevent the expansion of *S. kleinia* populations.

Good seed dispersal must be the key factor for such a rapid spread of the colonised area, and also for the establishment of new populations. Once an individual is established in a proper location, its capacity for vegetative reproduction may have an important role in the consolidation of populations, thereby generating an aggressive occupation which can out-compete the native flora.

Finally, suitable microhabitat for *S. kleinia* occurs all along the coastline of Alicante, and is not simply restricted to the two sites named in this study. Therefore a large proportion of the

Alicantine coast is at risk of invasion, including areas of high natural value such as "Serra Gelada" in Benidorm, recently designated a protected area. In conclusion, in order to proactively control this potential invasion, we feel that it is urgent to ensure the rapid identification of new invasion sites.

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REFERENCES

- GARCIA-GALLO, A., J.R. ACEBES, M.A. VERA, M.V. MARRERO, & P.L. PÉREZ DE PAZ (1993) Avance del Atlas Cartográfico de los Endemismos Canarios. *Itinera Geobotanica* 7:405-436.
- RIVAS-MARTÍNEZ, S., W. WILDPRET, M. DEL ARCO, O. RODRÍGUEZ, P.L. PÉREZ DE PAZ, A. GARCIA-GALLO, J.R. ACEBES, T.E. DIAZ, & F. FERNÁNDEZ-GONZÁLEZ. (1993) Las comunidades vegetales de la Isla de Tenerife (Islas Canarias). *Itinera Geobotanica* 7:169-374.
- SANTOS, A. (1975) *Estudio ecológico, filociológico y florístico de vegetación de la Isla de La Palma*. Tesis Doctoral inéd.
- SCHÖNFELDER, P., M.C. LEON ARENCIBIA & W. WILDPRET (1993) Catálogo de la flora vascular de la Isla de Tenerife (Islas Canarias). *Itinera Geobotanica* 7:375-404.

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Figure 1: Map showing the sites where *Senecio kleinia* was found in the wild.

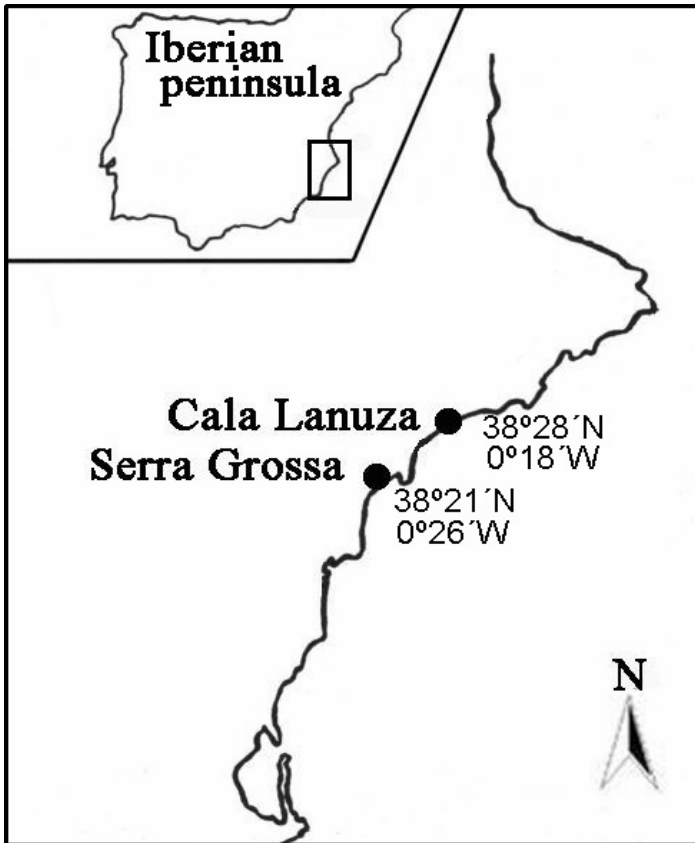


Figure 2: *Senecio kleinia*, an adult individual of the 'Serra Grossa' location.



Figure 3: Aerial photo of 'Serra Grossa', showing the distribution of *Senecio kleinia* in both 2003 (yellow colour / small perimeter) and 2007 (red colour / large perimeter).

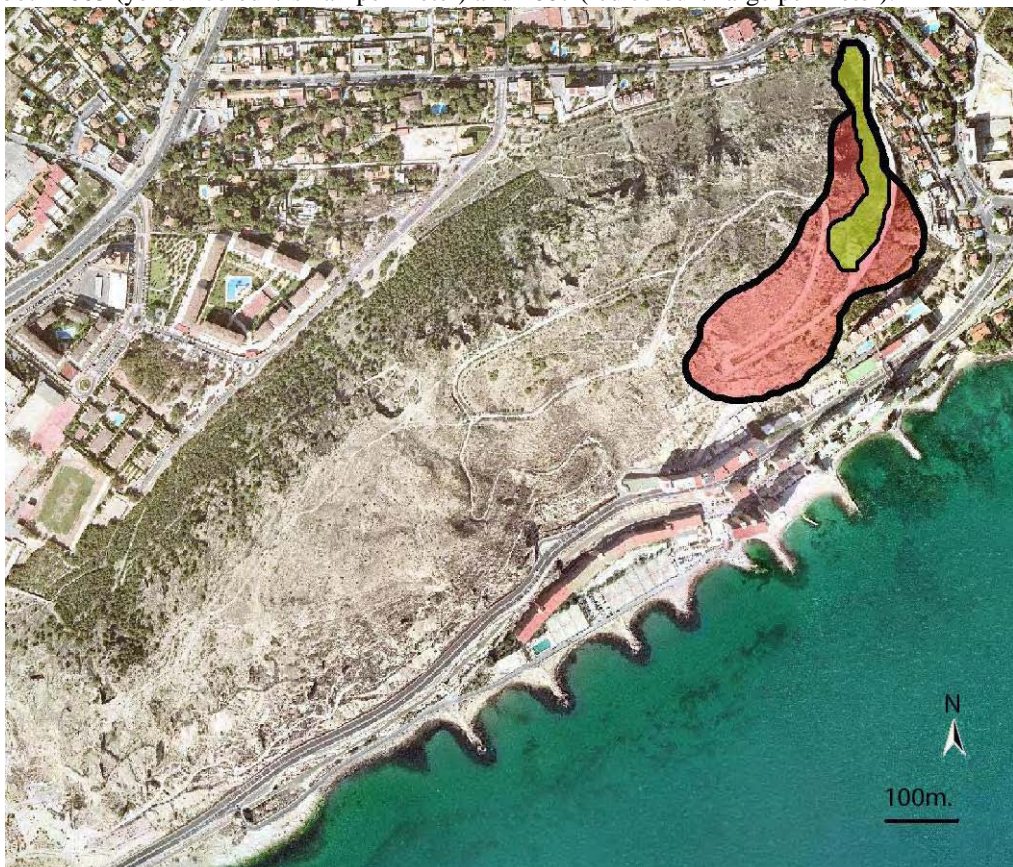


Figure 4: **a.** A large *Senecio kleinia* individual growing among nitrophilous shrub communities. **b.** A small *Senecio kleinia* individual (bottom-left of image) growing among the dominant vegetation of open brushwoods.



Figure 5: Aerial photo of 'Cala Lanuza', showing the distribution of *Senecio Kleinia* in 2007.



Figure 6: Population sizes recorded during the observation years in both locations.

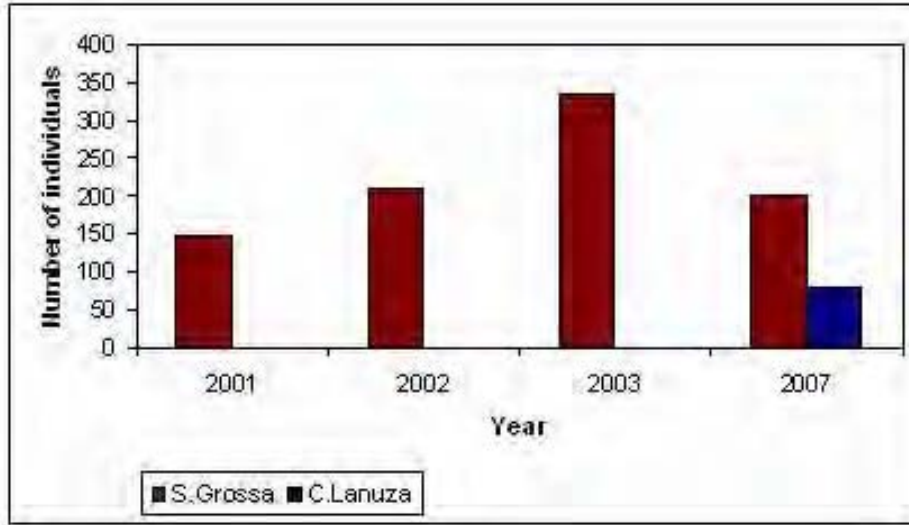
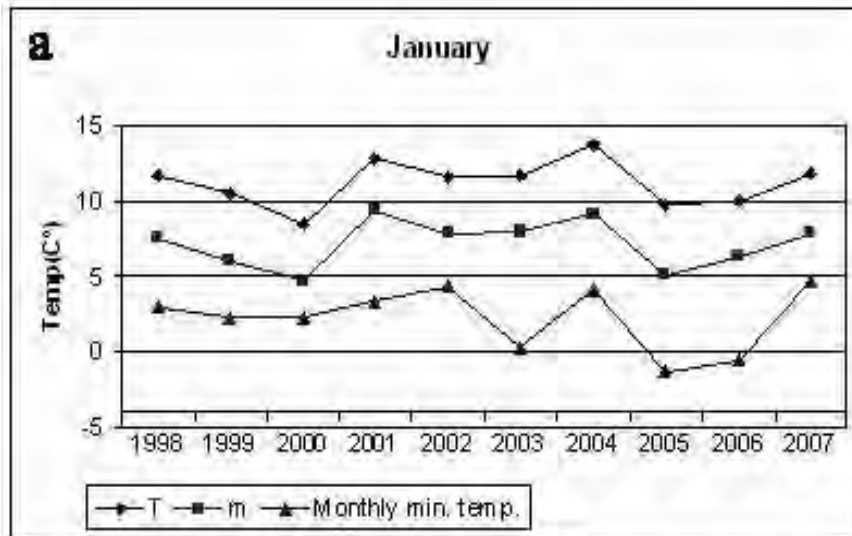


Figure 7: a. Some temperature data (in January, the coldest month) recorded in Alicante during the establishment of the *Senecio kleinia* population in 'Serra Grossa'.
b. Comparison of climatic parameters between locations in the Canary Islands (from which *Senecio kleinia* is native) and Alicante.



b	Alicante	Sta. Cruz de Tenerife	Puerto de la Cruz	Güímar-Planta
T	17.9	21.1	19	19.5
M	15.5	20.8	20.8	20.2
m	7.2	15.1	12.2	12.3

T: Yearly average temperature

M: Maximum average temperature of the coldest month

m: Minimum average temperature of the coldest month

Monthly min. temp. (monthly minimum temperature)