



**Pest Risk Analysis for
Senecio angulatus L.f.**



Senecio angulatus (SENAN) - <https://gd.eppo.int>

Senecio angulatus showing mat forming habit in France (EPPO Global Database, Courtesy: Guillaume Fried)

EPPO Technical Document No. DT1099
September 2026

EPPO
21 Boulevard Richard Lenoir,
75011 Paris
www.eppo.int
hq@eppo.int

The risk assessment follows EPPO standard PM 5/5(1) *Decision-Support Scheme for an Express Pest Risk Analysis* (available at <http://archives.eppo.int/EPPOStandards/prs.htm>), as recommended by the Panel on Phytosanitary Measures. The risk assessment uses the terminology defined in ISPM 5 *Glossary of Phytosanitary Terms* (available at <https://www.ippc.int/index.php>).

Cite this document as:

EPPO (2026) EPPO Technical Document No. DT1099. Pest risk analysis for *Senecio angulatus*. EPPO, Paris.

Available at <https://gd.eppo.int/taxon/SENAN/documents>

Based on this PRA, *Senecio angulatus* was added to the EPPO A2 List of pests recommended for regulation as quarantine pests in 2026. Measures for plants for planting are recommended.

Pest Risk Analysis for *Senecio angulatus*

PRA area: EPPO region

Prepared by: Expert Working Group (EWG) on *Senecio angulatus*

Further reviewed and amended by EPPO core members and Panel on Invasive Alien Plants (see below).

Composition of the Expert Working Group (EWG)

BRUNDU Giuseppe (Mr)	University of Sassari, Department of Agriculture, Italy
CHAPMAN Daniel (Mr)	University of Stirling, United Kingdom
FOLLAK Swen (Mr)	Austrian Agency for Health and Food Safety (AGES), Institute for Sustainable Plant Production, Austria
FRIED Guillaume (Mr)	ANSES - Laboratoire de la santé des végétaux, Unité Entomologie & Botanique, France
KHAMAR Hamid (Mr)	Institut Scientifique, Université Mohammed V de Rabat, Morocco
VAN VALKENBURG Johan (Mr)	Netherlands Food and Consumer Product Safety Authority, Netherlands
TANNER Rob (Mr)	EPPO Scientific Officer, EPPO hq@eppo.int

The first draft of the PRA was prepared by Mr Swen Follak (AT).

Ratings of likelihoods and levels of uncertainties were made during the meeting. These ratings are based on evidence provided in the PRA and on discussions in the group. Each EWG member provided a rating and a level of uncertainty anonymously and proposals were then discussed together in order to reach a final decision. Such a procedure is known as the Delphi technique (Schrader *et al.*, 2010).

Personal communications were obtained from Mr Paul Champion (NIWA New Zealand) on 2026-02-11 via an online meeting with the EWG.

Following the EWG, the PRA was further reviewed by the EPPO Core Members for PRA Claire Gent (UK) and Anastasia Korycinska (UK).

The PRA, in particular the section on risk management, was reviewed and amended by the EPPO Panel on Invasive Alien Plants on 2026-05-6. EPPO Working Party on Phytosanitary Regulation and Council agreed that *S. angulatus* is added to the A2 List of pests recommended for regulation as quarantine pests.

Contents	
Summary.....	4
Stage 1. Initiation.....	5
Stage 2. Pest risk assessment	6
1. Taxonomy.....	6
2. Pest overview	7
2.1 Introduction.....	7
2.2 Description.....	7
2.3. Life cycle	8
2.4. Environmental requirements.....	11
2.5 Habitats	11
2.6 Existing PRAs.....	11
3. Is the pest a vector?.....	11
5. Regulatory status of the pest.....	12
6. Distribution.....	12
8. Pathways for entry	20
8.1 Pathways studied	20
9. Likelihood of establishment outdoors in the PRA area	24
10. Likelihood of establishment in protected conditions in the PRA area	26
11. Spread in the PRA area.....	26
12. Impact in the current area of distribution (excluding the PRA area).....	27
12.1 Impacts on biodiversity.....	28
12.2 Impact on ecosystem services.....	28
12.3 Socio-economic impact	28
13. Potential impact in the PRA area.....	30
13.1 Current and potential impacts on biodiversity in the PRA area	30
13.2 Current and potential impact on ecosystem services in the PRA area	30
13.3 Current and potential socio-economic impact in the PRA area.....	31
14. Identification of the endangered area	31
15. Overall assessment of risk	31
Stage 3. Pest risk management.....	33
16. Phytosanitary measures	33
16.1 Measures on individual pathways to prevent entry	33
16.2 Eradication and containment	33
17. Uncertainty	34
18. Remarks	34
19. References.....	35
Appendix 1. Climatic suitability modelling for <i>Senecio angulatus</i> establishment in the EPPO region	41
Appendix 2. Images of <i>Senecio angulatus</i>	56

Summary of the Express Pest Risk Analysis for <i>Senecio angulatus</i>			
PRA area: EPPO region (Albania, Algeria, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Guernsey, Hungary, Ireland, Israel, Italy, Jersey, Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, The Republic of North Macedonia, Malta, Moldova, Montenegro, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tunisia, Türkiye, Ukraine, United Kingdom, Uzbekistan).			
Describe the endangered area: The EWG considered that the endangered area includes Atlantic coastal areas of southern Europe (especially northern Spain), Mediterranean, Black sea and Macaronesia biogeographic regions. The endangered area includes all Mediterranean islands. Habitats at risk in the coastal area are those listed in section 7.			
Main conclusions: <i>Senecio angulatus</i> has a high phytosanitary risk for the endangered area with a moderate uncertainty.			
Entry <i>Senecio angulatus</i> is already present and established in the EPPO region. The overall likelihood of further entry of <i>S. angulatus</i> into the EPPO region is moderate with a moderate uncertainty.			
Establishment The likelihood of establishment outdoors is very high with low uncertainty. Habitats are widespread within the EPPO region, and further establishment is likely in regions where habitats and climatic conditions are conducive for growth. The likelihood of establishment in protected conditions is very low with moderate uncertainty.			
Spread The potential for spread within the EPPO region is high, with a moderate uncertainty. <i>S. angulatus</i> spreads naturally via plant fragments and via human assisted spread (e.g., horticulture trade, dumping of garden waste and fragmentation due to management practices).			
Impact The magnitude of impact in the current area of distribution (excluding the EPPO region) is high with a moderate uncertainty where the rating reflects its impact on biodiversity. Persistent populations can modify habitats, displacing native plant species. The EWG considered that the potential impact in the EPPO region will be the same as the current area of distribution. Habitats affected in the current area of distribution are likewise present in the PRA area and of equal importance. Observations of the species' behaviour in the current area of distribution are similar to the observations in the EPPO region. Based on the high likelihood of spread (moderate uncertainty) from existing established populations in the EPPO region, and high impact (moderate uncertainty), the overall risk appears correct.			
Phytosanitary risk for the <u>endangered area</u> (Individual ratings for likelihood of entry and establishment, and for magnitude of spread and impact are provided in the document)	Low ☐	Moderate ☐	High X
Level of uncertainty of assessment	Low ☐	Moderate X	High ☐
Other recommendations: • Study the mechanism of clonal spread and seed viability (see section 2.3.1.2); • Monitor the rate of spread of <i>S. angulatus</i> from existing populations and check for the occurrence of seedlings in the EPPO region; • Carry out scientific studies on the impact of <i>S. angulatus</i> in the EPPO region; • Assess the toxicity and contamination of food and feed; • Be aware of the risk of <i>S. angulatus</i> alkaloids for animals; • Studying the autecology of <i>S. angulatus</i> in the non-native range; • Promote awareness raising of <i>S. angulatus</i> in the EPPO region.			

EPPO Pest Risk Analysis:
***Senecio angulatus* L.f.**

Prepared by: EPPO Expert Working Group

Date: 2026-02-09/11

Stage 1. Initiation

Reason for performing the PRA:

This PRA was conducted to determine the phytosanitary risk posed by *Senecio angulatus* to the EPPO region. *S. angulatus* is a climbing, perennial plant that has been introduced as an ornamental plant to the EPPO region. It is a fast-growing plant that can form dense thickets, covering and smothering other plant species. It produces large numbers of seeds, and stem fragments can easily form roots. It is widely recognised as a weed in both natural and human-disturbed ecosystems. *S. angulatus* alters community structure and species composition and reduces the regeneration of native species, threatening rare species. The species is increasingly being recorded as an escape from cultivation. The species spreads easily by runners from existing populations and over long distances by vegetative fragments by human means. Transient and established populations of the species are present in several EPPO countries. It is considered invasive, for example, in France, Portugal, Spain and Italy, where it infests open and disturbed areas, particularly in coastal habitats. *S. angulatus* was prioritised as part of a horizon scanning exercise conducted by the EPPO Panel on Invasive Alien Plants in 2024/25. The outcome of this process is that *S. angulatus* has been added to the EPPO List of invasive alien plants, and the species is a high priority for PRA.

PRA area:

EPPO region (Albania, Algeria, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Guernsey, Hungary, Ireland, Israel, Italy, Jersey, Jordan, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, The Republic of North Macedonia, Malta, Moldova, Montenegro, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tunisia, Türkiye, Ukraine, United Kingdom, Uzbekistan).

(see https://www.eppo.int/ABOUT_EPPO/eppo_members)

Stage 2. Pest risk assessment

1. Taxonomy

Kingdom: Plantae, Division: *Spermatophyta*, Sub-Division: *Angiospermae*, Class *Dicotyledonae*, Order: Asterales, Family: Asteraceae, Genus: *Senecio*, Species: *Senecio angulatus* L.f., first published in Suppl. Pl.: 369 (1782).

EPPO code: SENAN (EPPO, 2026)

Synonyms:

Cineraria laevis A.Spreng. in Tent. Suppl.: 23 (1828)

Senecio canalipes E.Mey. in J.F.Drège, Zwei Pflanzengeogr. Dokum.: 220 (1843)

Senecio macropodus DC. in Prodr. 6: 403 (1838)

Senecio tredecimsquamosus Sch.Bip. in Flora 27: 700 (1844)

This list of synonyms and accepted name is based on Plants of the World Online (<https://powo.science.kew.org/>).

Common names:

Croatian: staračac, English: Cape ivy, French: séneçon anguleux, Italian: senecione angoloso, Russian: крестовник угловатый, Arabic: الشیخة المضلعة (Sheikha modalla'a)

Plant type: Perennial, Phanerophyte, Woody liana

Related species in the EPPO region:

The genus *Senecio* L. (Asteraceae) is a large genus of over 1400 species of almost cosmopolitan terrestrial distribution (POWO, 2025). A considerable number of species within *Senecio* L. are considered agricultural or environmental weeds or are highly toxic to livestock, e.g. *Senecio inaequidens* DC. (EPPO List of Invasive Alien Plants), *Senecio brasiliensis* Spreng. ex Baker (EPPO Alert List, EPPO, 2023) and *Senecio pterophorus* DC. (Vilatersana et al., 2016; Dana et al., 2021; EPPO, 2025).

2. Pest overview

2.1 Introduction

Senecio angulatus is a climbing shrub that is native to the Cape Province of South Africa (Foden & Potter, 2005; POWO, 2025). It has been intentionally introduced to the EPPO region, Australia, New Zealand, and North and South America, where it is cultivated as an ornamental plant (Flora of New Zealand, 2004; Weeds of Australia, 2016; California Invasive Plant Council 2025, EPPO, 2026). It has demonstrated its ability to escape, naturalise and spread in areas outside cultivation (Iamónico, 2017). The species has several invasive functional traits, e.g., prolific fruit production (the fruit is called cypsela and contains a single seed) and hereafter called seed in this PRA document production (wind dispersed), growth from fragments and the ability to form massive thickets (Newton, 1996; Willams & Hayes, 2007). However, in the EPPO region, there is no evidence of seed germination in the wild. It is described as “spreading (“major invader”) in Mediterranean France” (Brunel & Tison, 2005). Likewise, Gómez-Bellver et al. (2025) described the species as “one of the most problematic plants in Mediterranean Spain, with rapid and aggressive spread”.

2.2 Description

The following description is taken from the “A Flora of the Eastern Cape Province” (Bredenkamp, 2019) and Calvo & Aedo (2019).

Stems up to 1.5(3) m long.

Leaves ovate to lanceolate, angle-lobed, lobes few, sinuate to dentate, base cuneate; petioles up to 35 mm long, slightly fleshy.

Inflorescence terminal, corymbose, much-branched, many-headed; pedicels ± nude.

Capitula numerous, radiate, disc and rays (4–6) yellow; involucre up to 7 mm long; bracts 10–12, narrowly campanulate; calyculus bracts few, short.

Cypselae cylindrical, 2.5 mm long, ± ribbed, ± hairy pappus.

$2n = \text{ca. } 182$ (Lawrence, 1980)

Images of *S. angulatus* can be found in Appendix 2 and can also be retrieved from the EPPO Global Database (EPPO, 2026).

Similarities to other Species

Delucchi et al. (2016) and Weeds of Australia (2016) indicate that *S. angulatus* is very similar to *Delairea odorata* Lem. (syn. *Senecio mikanioides* Otto ex Walp), *Senecio tamoides* DC. and *Senecio macroglossus* DC. In addition, *Senecio deltoideus* Les. is similar but easily distinguished with *S. angulatus* (Pers. Comm., G. Fried, 2026). All four species occur in the EPPO region (Iamónico, 2017; EPPO 2025). Likewise, *S. angulatus* is a climbing shrubs (POWO, 2025). *Senecio angulatus* is very similar in appearance, habit, and habitat to *D. odorata*. The most important distinguishing feature concerns the flower-heads (Table 1).

Table 1. Morphological differences between *Senecio angulatus*, *Delairea odorata*, *S. deltoideus*, *S. macroglossus*, and *S. tamoides* (adapted from Weeds of Australia, 2016).

Species	Key descriptive features
<i>Senecio angulatus</i>	moderately large bright yellow flower-heads (capitula) with several 'petals' (ray florets) 6-9 mm long
<i>Delairea odorata</i>	small bright yellow flower-heads (capitula) with no obvious 'petals' (ray florets)
<i>Senecio deltoideus</i>	leaves are deltoid to sagittate, bearing more than five pairs of teeth, with no petals, whereas in <i>S. angulatus</i> leaves are oval to rounded with fewer than five pairs of teeth
<i>Senecio macroglossus</i>	relatively large pale-yellow flower-heads (capitula) with several prominent 'petals' (ray florets) more than 2 cm long
<i>Senecio tamoides</i>	moderately large bright yellow flower-heads (capitula) with several 'petals' (ray florets) about 10 mm long

2.3. Life cycle

Note: Although there are many factsheets including observations of this species, there are almost no known detailed ecological studies conducted on *S. angulatus* (e.g. Scott 2001).

In its native range, South Africa, *S. angulatus* is an autumn-winter bloomer producing flowers “... mostly in May.” (Cron et al., 2019). In Australia, the species flowers from May to July (Thompson, 2006; Atlas of Living Australia, 2025). In New Zealand (Webb et al. 1988), flowering occurs from March to August. In California (USA), the species flowers from April to November (8 months).

EPPO region

Few reports are available on the flowering period of *S. angulatus* from different countries in the EPPO region. In Morocco, flowering occurs from early March to September and can extend into late autumn, with peak blooming in summer (Khamar and El Bakhouch, 2024). In Tunisia, the flowering period is from May to January (El Mokni & Iamónico, 2018). In Greece, Italy and France, flowering occurs from October/November to March (extending to June) (Tan et al. 2025, Fried, 2017). Observations from iNaturalist (2025) may be considered to reflect the general flowering phenology in the EPPO region, with a peak from November to January (Fig. 1).

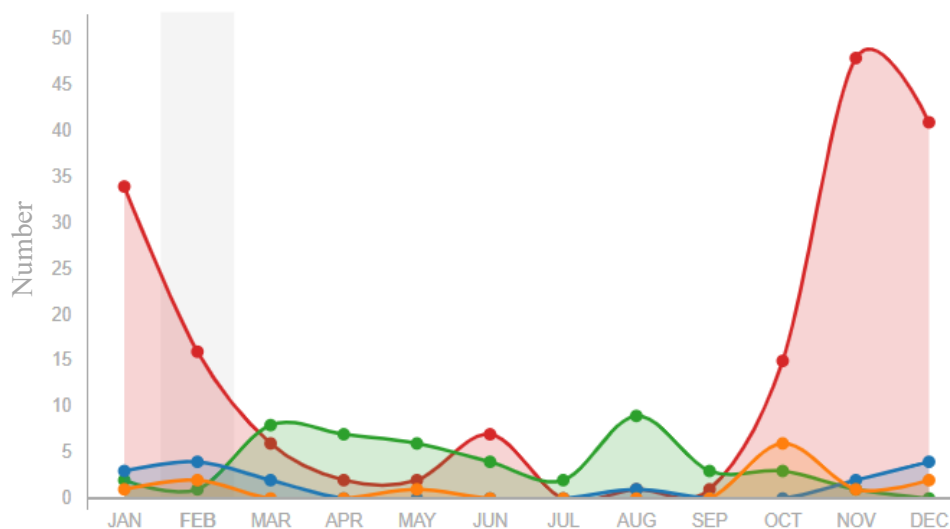


Figure 1. General flowering phenology of *Senecio angulatus* for the EPPO region from iNaturalist. (2025). Where the red line shows number of observations of flowering, orange line shows flower buds, green line shows flowers or buds and the blue line shows fruit or seed.

2.3.1 Reproduction

Senecio angulatus can reproduce both sexually by seed and asexually by vegetative regeneration (Williams and Hayes, 2007; Scott, 2001). Throughout the current area of distribution, seed production and viability varies.

2.3.1.1 Vegetative reproduction

Australia and New Zealand

Senecio angulatus reproduces vegetatively by stem fragments that can easily root (Williams and Hayes, 2007).

Scott (2001) showed that cuttings of various ages and lengths and treatments, including those grown horizontally and buried under sand and leaves, had the ability to establish. The author concluded that the predominant mode of dispersal of *S. angulatus* in New Zealand (Wellington region) is by vegetative reproduction.

Scott (2001) demonstrated in experiments under controlled conditions that cuttings of *S. angulatus* were effective in establishing. The author observed that *S. angulatus* cuttings are most likely to establish if they are 10 cm long, apical (soft shoot tips), have nodes, and are buried (in sand at a minimum depth of 1 cm) (Table 2).

A decrease in the length of a cutting corresponded with a decrease in the number that established. The 10 cm semi-hardwood cuttings were the most successful, with 36 establishing compared to 17 of the 5 cm cuttings and just one of the 2 cm cuttings. The authors remarked that, over a longer period, the number of successful 2 cm cuttings might have been greater, as several remained unchanged for the duration of the experiment (a minimum of 10 weeks) (Scott, 2001)

Table 2. *Senecio angulatus*: number of cuttings of different age, and of semi-hardwood cuttings of different length, orientation and burial that established under controlled conditions (Scott, 2001, modified).

Parameter	Total (n)	Number established
Hardness		
Apical (soft shoot tip)	50	49
Semi-hardwood	50	36
Hardwood	50	23
Length		
10 cm	50	36
5 cm	50	17
2 cm	50	1
Orientation		
Upright	50	46
Surface (horizontal)	50	15
Burial		
Surface	50	15
Leaf Litter burial	50	9
Sand burial	50	25

EPPO region

González Costales (2007) remarked that propagation occurs vegetatively through stem fragments, which, after separating from the mother plant, are capable of rooting. Online gardening forums corroborate this statement, with gardeners noting the predominant mode of reproduction is vegetative reproduction e.g., <https://fjpower.forumgratuit.org/t5517-senecio-angulatus>.

The EWG considers that vegetative reproduction is the predominate mode of reproduction of *S. angulatus* in the natural environment in the EPPO region.

2.3.1.2 Sexual reproduction

Seed production and viability varies in different regions of the world. There is conflicting information available from regions where the species occurs.

South Africa (native range)

No information has been found on sexual reproduction in the native range, however, the EWG considers the species will reproduce sexually.

United States (California)

Seed production has not been confirmed in California (California Invasive Plant Council, 2025).

Australia and New Zealand

Although this plant is described as producing copious quantities of seed, there is also evidence that the seed is either sterile or not viable. Williams and Hayes (2007) stated that *S. angulatus* sets seed within its first year and that “seeds [are] produced in abundance”. Likewise, Bergin (2006) mentioned “the small flowers [...] produce many, far-dispersing, long-lived seeds”, but both authors do not provide a count or any further details (New Zealand). In contrast, Scott (2001) found that “no seed was produced” by the studied *S. angulatus* populations in New Zealand (Wellington region). It was found that *S. angulatus* is self-incompatible.

EPPO region

In the EPPO region, *S. angulatus* does produce seed, however, there is limited evidence that seed is viable. In fact, in some areas of the region (Malta), *S. angulatus* is known to produce seed continuously throughout the season resulting in thousands to millions of seeds (Pers. Comm. Stephen Mifsud, Maltawildplants.com, 2026). González Costales (2007) stated that *S. angulatus* does not appear to produce viable seeds (Asturias/Spain). However, on the island of Fuerteventura (Canary Islands, Spain) Scholz et al. (2013) related the origin of the first detected population to seed produced by plants in gardens.

In an online gardening forum (<https://fjpower.forumgratuit.org/t5517-senecio-angulatus>), there is however reference to germination of *S. angulatus* seeds in moist soil (irrigated) in gardens in central-west (Limousin) and south France (La Ciotat).

The authors of this risk assessment have assumed that at the current time in the risk assessment area, *S. angulatus* does not:

- (1) produce seedlings in the natural environment, or does not
- (2) produce seedlings that persist to grow into mature plants.

The authors base these assumptions on no scientific evidence having been found to suggest one or more of the above occur in the risk assessment area.

Following the EWG, J Van Valkenburg planted seed of *S. angulatus* collected from Sardinia (Italy). Seeds were obtained from a freshly harvested infructescence, from a naturalized plant from Sardinia in mid-February 2026. The seeds were sown on top of four different media, pure sand, pure potting soil, a mixture of potting soil and sand, a mixture of potting soil and substrate for aquatic plants. These 11 x 11 cm pots were watered and placed in a growing container to retain moisture. In the greenhouse a temperature regime of 18 oC at night and 22 oC during daytime was maintained. Seeds germinated after 5 days irrespective of the media used and developed into viable plants.

Throughout the risk assessment, only vegetative reproduction (via a stem fragment containing a node) is considered when answering and scoring the questions (except for some questions on entry when potentially viable seed could be imported). However, when providing the overall score for the risk assessment and the associated confidence, the uncertainty of viable seeds has been taken into consideration.

If point 1 and 2 occur in the future this may increase the scores in the spread sections. This may require a revision of the spread scores. The authors do not consider that the lack of seed production in itself is a limitation to invasiveness.

2.4. Environmental requirements

Williams & Hayes (2007) stated that *S. angulatus* is “frost tender to a certain extent”. It grows in USDA hardiness zones 9a through to 11b, tolerating temperatures between 10°C (50°F) and 38°C (100°F) (USDA, APHIS, 2013).

Senecio angulatus requires full sun exposure; it can grow in semi-shade but will produce more leaves than flowers. It is quite resistant to heat and drought (Williams & Hayes, 2007; Consulta Plantas, 2025).

According to Williams & Hayes (2007) the species “tolerates a range of soil conditions”. The plant prefers soils of black calcareous and grey sand, sandy clay and limestone, where it will be found in coastal areas on cliff faces, mudflats, wet depressions in dunes, near swamps, in landfills, scrubland and near settlements, especially near the sea (Webb et. al., 1988). Thompson (2006) reported that *S. angulatus* “[g]rows in various soils in shrubland and woodland in disturbed environments” (Australia).

EPPO region

In Morocco, *S. angulatus* grows on sandy and clay-loam soil (Khamar & El Bakhouch, 2024). Miara et al. (2018) states that *S. angulatus* has no requirements in terms of substrate and can grow in any type of soil.

Senecio angulatus is resistant to cold temperatures down to -6°C. It freezes at lower temperatures, but its roots recover very quickly, while its resistance to high temperatures is excellent (Algeria) (Miara et al. 2018).

2.5 Habitats

In its native range, in South Africa, *S. angulatus* occurs along coastal regions. It regularly grows along forest margins of different types of vegetation. Cron et al. (2019) lists the following habitats Drakensberg grassland, Fynbos (natural shrubland or heathland), forests. It grows in an altitude from 50 to 700 m a.s.l. However, label information from 18 herbarium specimens from the Bolus Herbarium in South Africa (<https://bolus-herbarium.uct.ac.za/collections/list.php?usethes=1&taxa=55733>), detail the species can grow up to 850 to 1,200 m a.s.l. (South Africa, KwaZulu-Natal, Mount Currie - <https://bolus-herbarium.uct.ac.za/collections/individual/index.php?occid=148984&clid=0>). Weber (2017) mentioned grassland, heathland, woodland, saline wetlands, coastal dunes and disturbed sites as suitable habitats.

2.6 Existing PRAs

In the USA, USDA's Animal and Plant Health Inspection Service (APHIS) prepared a risk assessment (USDA, APHIS, 2013). The result of the weed risk assessment for *S. angulatus* is “High Risk”.

In California (USA), the California Invasive Plant Council prepared a risk assessment (California Invasive Plant Council, 2025). The PRE score was 21 (>15: “High Potential Risk”). This species scored highly and would appear to be a strong candidate for invasiveness in California.

In Victoria (Australia), *S. angulatus* is on the “Advisory list of environmental weeds in Victoria 2022” (<https://www.environment.vic.gov.au/invasive-plants-and-animals/weed-risk-ratings>). This list is intended to provide general advice to conservation managers on the relative risks posed by different environmental weeds and the relative urgency of managing them across Victoria’s natural ecosystems. Risk rating of *S. angulatus* was “Very High Risk”.

In the EPPO region, the species has been assessed in both France (EPPO Prioritization and a simplified version of Weber & Gut (2004)) and Italy (WRA). For France, *S. angulatus* was a priority for a PRA, and for the risk assessment, a score of 32 was given, indicating a high risk (Fried, 2010). For Italy (Tuscany Island), the species scored 10, indicating a high risk and rejection, which would equate to a ban on introduction (Lazzaro et al., 2016).

- | | | |
|---|------------------------------|--|
| 3. Is the pest a vector? | Yes ☐ | No ☒ |
| 4. Is a vector needed for pest entry or spread? | Yes ☐ | No ☒ |

5. Regulatory status of the pest

No information has been found on the regulatory status on EPPO Global Database (EPPO, 2025).

Note: *Senecio angulatus* is listed as an Alert List species in the Republic of Korea (Son et al., 2021). However, this listing may be a mistake, as Son et al. (2021) detail that *S. angulatus* is listed in Japan and New Zealand. No evidence can be found for this, and it is likely the species Son et al. (2021) are referring to is *Sicyos angulatus* (Cucurbitaceae).

6. Distribution

Senecio angulatus is native to the Cape Province in South Africa (Table 3; Foden & Potter, 2005). The species has been introduced for ornamental purposes to North and South America, Europe, Oceania and Northern Africa (POWO, 2025).

Native range

South Africa

The species regularly occurs in the Western and Eastern Cape Provinces (Fort Beaufort S to Baviaanskloof, Port Elizabeth, Grahamstown and Port Alfred and from Storms River Mouth to Humansdorp) as well as a few observations are available from the province KwaZulu-Natal (Manning & Goldblatt 2012; SANBI 2025).

Introduced range

North America

Senecio angulatus has been recorded in the United States in California (counties of Santa Barbara, Ventura, Los Angeles and San Diego) (Calflora, 2025; California Invasive Plant Council, 2024) in the natural environment. The database iNaturalist lists records in other federal states: Alabama, Florida, New Mexico, Wyoming, and Washington DC (iNaturalist, 2025). However, these records are not considered further in the PRA as they are not research-graded records. USDA-APHIS (2013) stated that the species was probably introduced to the United States after 1930. The USDA PLANTS Database and the Flora of North America do not list the species (USDA PLANTS Database, 2025; Flora of North America, 2025).

In Mexico, *S. angulatus* has been found in the federal state of Baja California according to iNaturalist observations (iNaturalist, 2025).

South America

Chile

Senecio angulatus was first recorded in 1919 (Ugarte et al., 2011). From iNaturalist, the records are from urban and coastal areas.

Argentina

Senecio angulatus has been found naturalized in modified environments in the province of Buenos Aires, in the district of La Plata (Gonnet, Los Hornos) and on the Atlantic coast of Buenos Aires, in the districts of Villa Gesell and Monte Hermoso (Delucchi et al., 2016).

Oceania

Australia

In Australia, *S. angulatus* is widely established, and it has been recorded as a weed of the natural environment (Randall, 2007). Observations are available from Western Australia, South Australia, Victoria, New South Wales, Queensland, and Tasmania (Thompson, 2006; Atlas of Living Australia, 2025; The Australasian Virtual Herbarium, 2025). The plant was first collected as a weed in the southern Melbourne suburb of Mornington in 1936.

New Zealand

The first published record of *S. angulatus* is in Allan's (1940) "A Handbook of the Naturalized Flora of New Zealand". The earliest dated herbarium specimen (WELT SP61014), collected in Wellington in 1935,

was initially identified as *Senecio macroglossus* DC. A further specimen (WELT SP61015) suggests that the species was introduced to New Zealand (specifically Paekakariki) by a soldier after returning from the South African War in 1901 (Scott, 2001; Bergin 2006). In New Zealand, *S. angulatus* was first recorded as an adventive weed in 1940 (Bergin, 2006). It is currently distributed in Northland (SC), Auckland (SC), Bay of Plenty (SC), Canterbury (OOI), West Coast (E), and Otago (PC) (Webb et. al., 1988; McAlpine and Howell, 2024; The Australasian Virtual Herbarium, 2025).

The Australasian Virtual Herbarium has published a map of the distribution of *S. angulatus* in Australia and New Zealand (Fig. 2).

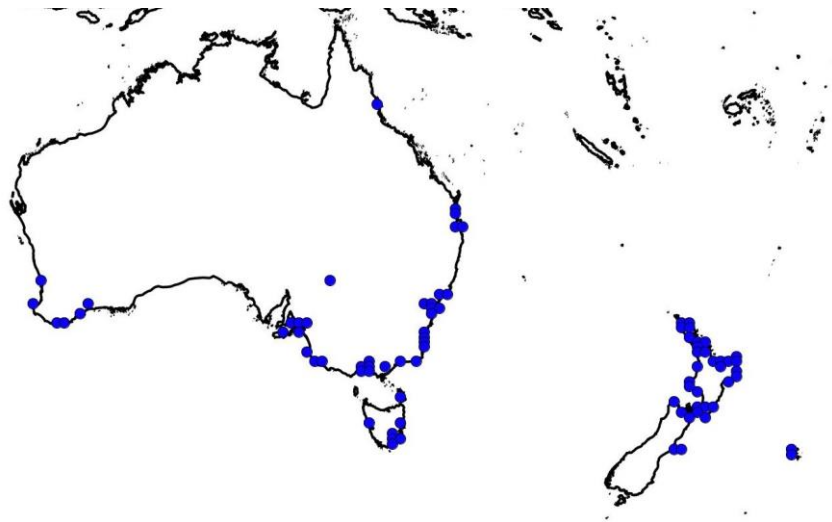


Figure 2. Distribution of *Senecio angulatus* in Australia and New Zealand (adapted from The Australasian Virtual Herbarium, 2025).

Asia

Senecio angulatus has been introduced to Iran as an ornamental plant during the current decade and is distributed in many parts, especially in the northern region of the country (Sohrabi et al., 2025).

There is one record from Saudi Arabia (Abha city) from GBIF (Herbarium sample from the University of Tokyo).

EPPO Region

Senecio angulatus was likely introduced as an ornamental plant in the 19th century (or even earlier). The first record of *S. angulatus* in the EPPO region cannot be determined with certainty. Early records are from the end of the 1970s and the beginning of the 1980s (e.g., Jeanmonod et al., 2011). Since then, more populations have been observed in different countries of the EPPO region. At present, established populations occur in a few EPPO countries (Croatia, France, Greece, Italy, Portugal and Spain). The distribution of *S. angulatus* is concentrated in the Mediterranean in the EPPO region (Fig. 3, Table 3).

Readers should refer to EPPO (2026) for more up-to-date information on the global distribution of *S. angulatus*.

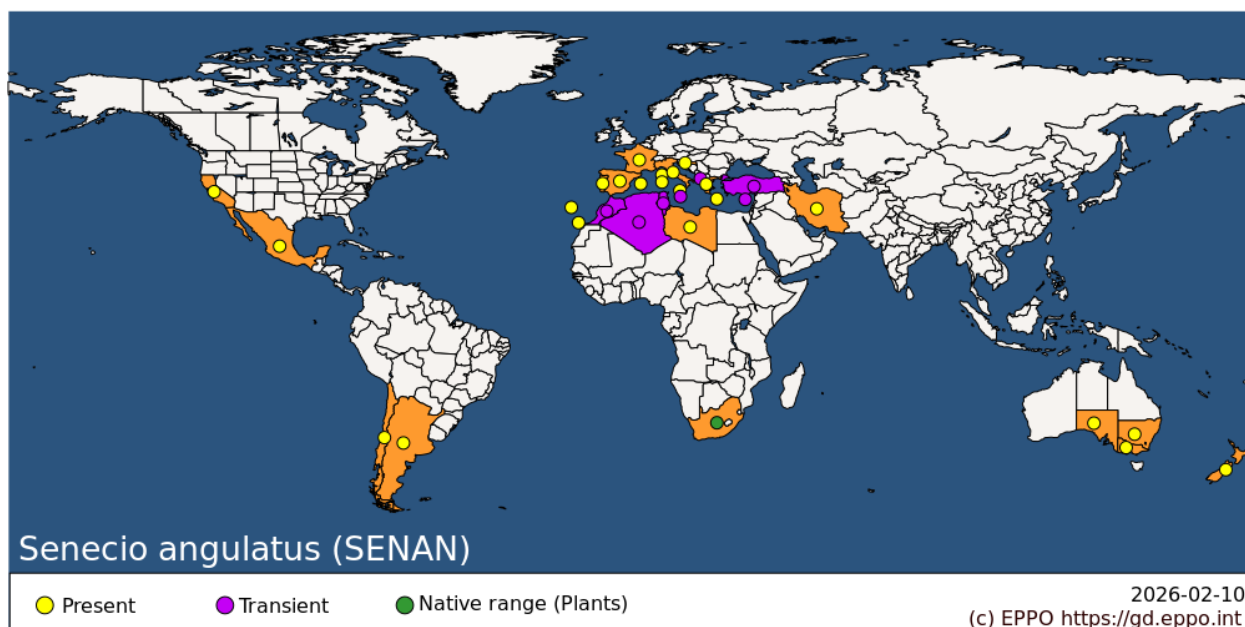


Figure 3. The global distribution of *Senecio angulatus* (EPPO, 2025).

Table 3. Global distribution and status of *Senecio angulatus*.

Region	Distribution	Status	References
Asia			
	Iran	Introduced (established)	Sohrabi et al. (2025)
North America			
	Mexico (Baja California)	Introduced (established)	California Invasive Plant Council (2024)
	United Sates (California)	Introduced (established)	Calflora (2025); California Invasive Plant Council (2024)
South America			
	Argentina	Introduced (established)	Delucchi et al. (2016)
	Chile	Introduced (established)	Ugarte et al. (2011)
EPPO region			
	Algeria	Introduced (transient)	Miara et al. (2018)
	Albania	Introduced (transient)	Barina et al. (2011)
	Croatia	Introduced (established)	Milović et al. (2010)
	Cyprus	Introduced (transient)	Hadjikyriakou et al. (2025)
	France	Introduced (Corsica) (established)	Jeanmonod & Gamisans (2013); Tison & de Foucalt (2014) ; Tison et al. (2014)
	Greece	Introduced (Including Crete, Rhodes) (established)	Tan et al. (2025); Verloove, 2024
	Italy	Introduced (including Sicily and Sardinia) (established)	Galasso et al. (2018); Portale della Flora d'Italia (2025)
	Israel	Introduced (transient)	BioGIS (2026)
	Malta	Introduced (transient)	Greuter (2006+); Mifsud (2007)
	Morocco	Introduced (transient)	Khamar & El Bakhouch (2024)
	Portugal	Introduced (Including Maderia) (established)	Marchante et al. (2014) ; Clamote et al. (2017)
	Spain	Introduced (Including Balearic and Canary Islands) (established)	Sánchez Gullón et al. (2017)

Region	Distribution	Status	References
	Tunisia	Introduced (transient)	El Mokni & Iamónico (2018)
	Türkiye	Introduced (transient)	Yıldız & Haşayacak (2025)
	United Kingdom	Introduced (transient)	BSBI (2026)
Oceania			
	Australia	Introduced (established)	Randall (2007)
	New Zealand	Introduced (established)	McAlpine & Howell (2024); Roy et al. (1998)
Africa			
	Libya	Introduced (established)	Alavi (1983)
	South Africa	Native	POWO (2025); SANBI (2025)

Note: The table does not include countries where *S. angulatus* is only recorded from GBIF or iNaturalist (e.g. Peru and Uruguay). Sicyos

Specific details about the distribution in selected EPPO countries

Albania

Senecio angulatus was found in 2010 in Sarandë (south Albania) as a remnant of cultivation in different parts of the town, especially on rock walls (Barina et al., 2011).

Algeria

Senecio angulatus has recently been documented in Algeria (Miara et al., 2018). The authors recorded *S. angulatus* in several regions in central and eastern northern Algeria.

Croatia

In Croatia, *S. angulatus* was found in Zadar in 2005. Several specimens have been growing in the courtyard of a house that has been abandoned for some time now. It has also been detected, in the settlement of Vela Rava on the island of Rava (Zadar archipelago) (Milović et al., 2010). Since then, new populations (e.g., in Northern Dalmatia, islands of Hvar, Lastovo, Lošinj, and Ilovik) have been found (Nikolić 2015+; Šegota et al., 2021).

Cyprus

Senecio angulatus is a relatively new addition to the flora of Cyprus, only mentioned in 2020 (Brandes, 2020a). It is recorded as transient in Paphos (Hadjikyriakou et al., 2025).

France

Senecio angulatus is mainly established in the most thermophilous parts of the French Mediterranean coast, including the Albères (near the Spain border) and Provence (from Marseille to the Italian border) (Tison & de Foucault, 2014; Conservatoire botanique national méditerranéen, 2025). The earliest record in the wild dates to 1970, on Mont Boron in Nice, Alpes-Maritimes (Lapraz, 1970). By the early 1980s, botanists of the French Riviera already considered it to be “highly invasive” (Alziar, 1984). It was then successively detected in the neighbouring department of Var in 1985 and further west in Bouches-du-Rhône in 1997 (Conservatoire botanique national méditerranéen, 2025). More recently, it was observed for the first time in the Albères in 2004 and in the Hérault department in 2015 (Conservatoire botanique national méditerranéen, 2025).

In Corsica, *S. angulatus* was first recorded in 1984 near Bastia (Jeanmonod and Burdet, 1996; Jeanmonod et al., 2011), and from 1995 onwards on the eastern coast at Coti-Chiavari, behind one of the Cupabia beaches. It is now scattered all over the coastal area of the island.

Greece

Senecio angulatus is considered established in Greece (Tan et al., 2025). It was first reported in Greece by Galanos (2015) in 2014. It is present on the Ionian Islands, Aegean Islands, Crete, the Peloponnese, and the Cyclades. A distribution map can be found in Tan et al. (2025).

Italy

The species was introduced as an ornamental in Italy in 1875 and was regularly cultivated, e.g., in Sicily (Rossini Oliva et al., 2003). The first records of *S. angulatus* cannot be determined with certainty. For example, in Campania, the species was first found spontaneously in 1991 (Del Guacchio and La Valva, 2017). *S. angulatus* is now widely distributed in Italy (Galasso et al., 2018; Portale della Flora d'Italia, 2025). The status of *S. angulatus* in different regions in Italy is as follows: Abruzzo: transient; Basilicata: established; Calabria: established; Campania: established; Lazio: transient; Liguria: invasive; Marche: established; Molise: established; Puglia: established; Sardinia: invasive; Sicily: established; Toscana: invasive.

Morocco

Senecio angulatus has been recorded for the first time in 2023 from two locations, namely Agdal (Rabat Province) and Bettana (Salé Province) (Khamar & El Bakhouch, 2024), and it has also recently been observed in Tangier and Mohammedia (Khamar, pers. obs., 2025).

Tunisia

In Tunisia, the species was found at three localities along the coast (2016, 2017 and 2018). *Senecio angulatus* is to be considered as casual in Tunisia (El Mokni & Iamónico, 2018).

Portugal

In Portugal, the species occurs in the provinces of Minho, Estremadura and Lisboa (Marchante et al., 2014; Silva et al., 2015). Marchante et al. (2014) also mention Madeira. Several records of *S. angulatus* for other coastal provinces (e.g., Algarve, Alentejo Litoral) are listed in Flora-On (Clamote et al., 2017). The first record of the species is from 1984 (Domingues de Almeida and Freitas, 2006).

Spain

In Spain, several occurrences are known. The first records of it becoming naturalized in Spain date back to 1991 (González Costales, 2007). *S. angulatus* has been mentioned in Punta Umbría, Cadiz, and Granada, in Levant in Murcia, Alicante, Valencia, Barcelona, and the Balearic Islands (Menorca); and in the northern part of the peninsula in the Basque Country (García de Lomas et al., 2011; Guillot Ortiz et al., 2013; Sánchez Gullón et al., 2017; Gonçalves et al., 2023). Recently, Gómez-Bellver et al. (2025) recorded the species in more than 40 localities along the Costa Brava (Catalonia). Likewise, the project LIFE medCLIFFS lists > 400 observations along the Costa Brava from Aiguafreda to Tordera (as of: October 9, 2025). These observations were made by the LIFE medCLIFFS Observers Network and by volunteers (<https://lifemedcliffs.org/en/context/invasive-flora/creeping-groundsels-senecio-angulatus/>). The species is also known from the Canary Islands (Otto & Verloove, 2016).

7. Habitats and where they occur in the PRA area

Habitat classification based on EUNIS habitat types, Version from 2021:

<https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification-1>)

Table 4. Habitats of *Senecio angulatus*.

Habitat (main)	Classification	Status of habitat	Is the pest present in the habitat in the PRA area	Comments (e.g., major/minor habitats in the PRA area)	Reference
N: Coastal habitats	N3 Rock cliffs, ledges and shores, including the supralittoral	Protected in part	Yes	Minor	Misuri et al. (2024), Tan et al. (2025)
Q: Wetlands	Q6 Periodically exposed shores	Protected in part	Yes	Minor	Misuri et al. (2024)
R : Grasslands and lands dominated by forbs, mosses or lichens	R1 : Dry grasslands	Protected in part	Yes	Major	Conservatoire botanique national méditerranéen (2026)
S : Heathland, scrub and tundra	S5 : Maquis, arborescent matorral and thermo-Mediterranean scrub S6 : Garrigue	Protected in part	Yes	Major	Conservatoire botanique national méditerranéen (2026)
T: Forest and other wooded land	T2 Broadleaved evergreen forest T212 : Quercus ilex and Q. rotundifolia forest T24 : Olea europaea-Ceratonia siliqua forest T3A : Mediterranean lowland to submontane <i>Pinus</i> forest	Protected in part	Yes	Major	Manning & Goldblatt (2012), Weeds of Australia, (2016), Gómez-Bellver et al. (2016), Miara et al. (2018), Conservatoire botanique national méditerranéen (2026)
V: Vegetated man-made habitats	V2 Cultivated areas of gardens and parks V23 Recently abandoned garden areas	Not protected	Yes	Major	Rossini Oliva et al. (2003) Milović et al., (2010), Barina et al. (2011)
Transportation networks, cargo handling areas	Roadsides [no EUNIS classification]	Not protected	Yes	Moderate	García de Lomas et al. (2011)

In Australia, *S. angulatus* occurs mostly in urban areas, growing in shrubland and woodland in disturbed environments (Southern Australia) (Thompson, 2006). It occurs on coastal banks, in rock gullies, and also in open woodlands, urban bushland, disturbed sites, waste areas, gardens, and roadsides (Thompson, 2006; Weeds of Australia, 2016).

In New Zealand, it grows in a range of habitats, such as sand dunes, riparian habitats, scrub and forest margins, cliffs, and banks (Williams & Hayes, 2007). It grows in drier, more open habitats mostly near the sea (New Zealand Plant Conservation Network, 2025).

Suitable habitats occur for *S. angulatus* in the PRA area. In the EPPO region, *S. angulatus* is found across six EUNIS habitats at Level 1 (Table 4). It occurs on maritime cliffs, rocky slopes, on abandoned sites, along fences and walls, on dry grasslands, next to streams, and along roadsides in ruderal, urban, and suburban areas (Croatia: Milović et al., 2010; Albania: Barina et al., 2011; Greece: Tan et al., 2025; Spain: García de Lomas et al., 2011; Italy: Iamónico, 2017; Motti et al., 2018; Del Guacchio & La Valva, 2017; Galasso et al., 2019). This species is cultivated as an ornamental in gardens (Rossini Oliva et al., 2003).

S. angulatus shows an ecological preference for low-altitude areas ranging from 9 to 320 m a.s.l. close to the coastline and areas characterized by high levels of human disturbance (Tan et al., 2025; Misuri et al., 2024).

Specific details

In Spain, *S. angulatus* occupies bands parallel to the road (thickets of *Rubus ulmifolius* and *Pistacia lentiscus* scrub) and coastal pine forest (dominated by *Pinus pinea*) in the Cádiz province (southern Spain), (García de Lomas et al., 2011). It was found on disturbed wasteland near Barcelona (Gómez-Bellver et al., 2016). It occurs in habitats, such as: “Matorral de zarzas (*Rubus ulmifolius*), a la sombra de *Populus alba*, *Populus nigra* y *Fraxinus angustifolia*.” *Senecio angulatus* was also observed in high presence in habitats of *Limonium* spp., and halophilous or halo-nitrophilous vegetation (near Malaga) (Goncalves et al., 2023).

In Italy, on the Capraia Island, *S. angulatus* was found in different Natura 2000 habitats (see <https://eunis.eea.europa.eu/>): it occurs regularly in the 1240 habitat (coastal vegetation); it occurs forming small patches in at the borders of the 3120 habitat “Oligotrophic waters containing very few minerals generally on sandy soils of the West Mediterranean, with *Isoëtes* spp.” and in the 3170 habitat “Mediterranean temporary ponds” (Misuri et al., 2024). The species was found growing on a brick retaining wall together with *Arundo plinii* Turra, *Ficus carica* L., and *Rubus ulmifolius* Schott (Galasso et al., 2019). In Apulia, as well as in the central and southern part of Italy including Sicily and Sardinia, *S. angulatus* easily grows in the Mediterranean maquis and is associated with *Phillyrea latifolia* L., *Juniperus macrocarpa* Sm. and *Smilax aspera* L., *Pistacia lentiscus* L., *Cistus* spp., and wild *Olea* plants (e.g., Iamónico and Maglio, 2008; Iamónico, 2017).

In Morocco, *S. angulatus* is found near dwellings, in wasteland, at the edge of gardens, scrubland, and along roadside cuttings and forest margins (Khamar & El Bakhouch, 2024). In Algeria, the plant is often found in relatively large populations along roadsides, private property boundaries or the edges of farms (Miara et al., 2018;).

In France, *S. angulatus* occurs on coastal cliffs, in shrublands, along forest edges, and near human settlements (Tison et al., 2014). For example, *S. angulatus* was detected within the *Oleo-Ceratonion siliquae* alliance, that is, in tree or shrub formations dominated by the wild olive (*Olea europaea* var. *sylvestris*) and the carob tree (*Ceratonia siliqua*) on dry soils and warm exposures near Nizza/Alpes-Maritimes department (Lapraz, 1970, 1974). In these early relevés, it was noted as “+”, corresponding to a very low cover (< 1%) (Mont Boron and du Mont Alban) (Lapraz, 1970). On Cap Ferrat, *S. angulatus* was recorded with low abundance (1: 1–5% cover) and a sociability level of 2 to 3 (from small loose groups to dense clumps or small stands) (Lapraz, 1974). It was also found in plant communities of sea rocks (Cap Ferrat) (Lapraz, 1979). Brandes (2020b) recorded *S. angulatus* on steep and woody slopes, and retaining walls, especially near gardens, and climbing in trees (e.g., *Olea europaea*, *Phillyrea latifolia* and *Pinus* spp.). Table 5 provides an overview of the species’ frequency of occurrence across the different habitats it occupies in Mediterranean France (Conservatoire botanique national méditerranéen, 2026).

In Corsica, *S. angulatus* was first found within a forest edge dominated by *Juniperus phoenicea* and *Quercus ilex* (Jeanmonod & Burdet, 1996). It occurs more generally in ruderal habitats and abandoned land, as well as at the margins of maquis shrubland (Jeanmonod & Gamisans, 2013)

Table 5 shows that in France *S. angulatus* mainly occurs in the two EUNIS habitats N32 (Mediterranean and Black Sea rocky sea cliff and shore) and S51 (Mediterranean maquis and arborescent matorral). The plant also occurs in habitats strongly influenced by human activity (V: Vegetated man-made habitats).

Table 5. Number of occurrences of *S. angulatus* in different habitats in Mediterranean France based on the Simethis database (Conservatoire botanique national méditerranéen, 2025).

EUNIS Habitats	Occurrences	Percentage
N1 : Coastal dunes and sandy shores	5	2.5
N32 : Mediterranean and Black Sea rocky sea cliff and shore	44	22.3
Q6 : Periodically exposed shores	4	2
R1 : Dry grasslands	3	1.5
S51 : Mediterranean maquis and arborescent matorral	36	18.3
S6 : Garrigue	8	4.1
T3A : Mediterranean lowland to submontane <i>Pinus</i> forest	9	4.6
T212 : <i>Quercus ilex</i> and <i>Q. rotundifolia</i> forest	3	1.5
T24 : <i>Olea europaea</i> - <i>Ceratonia siliqua</i> forest	6	3
V : Vegetated man-made habitats	76	38.6

8. Pathways for entry

The following pathways for entry of *S. angulatus* are discussed in this PRA. Pathways in bold are studied in section 8.1; other pathways were considered as having a very low likelihood of entry and are detailed in section 8.2.

- **Plants for planting**
- Soil and other growing media (on its own or associated with plants for planting)
- Conveyances, vehicles & equipment
- Natural spread.

8.1 Pathways studied

All the pathways are considered from areas where the pest has been reported to be present, into the EPPO region. Pathways are also relevant from areas where it occurs in the EPPO region into countries where it does not occur in the EPPO region.

Examples of prohibition or inspection are given only for some EPPO countries (in this express PRA, the regulations of all EPPO countries were not fully analysed). Similarly, the current phytosanitary requirements of EPPO countries in place on the different pathways are not detailed in this PRA (although some were considered when looking at management options). EPPO countries would have to check whether their current requirements are appropriate to prevent the introduction of the pest.

Table 6. Pathway: plants for planting

Pathway	Plants for planting
Coverage	This pathway covers the entry of <i>S. angulatus</i> into the EPPO region via plants for planting (seeds, cuttings, live plants). Ornamental use: <i>S. angulatus</i> is used as an ornamental in gardens and parks in the EPPO region (e.g., Rossini Oliva et al., 2003). It is cultivated for its satiny foliage and sweet-scented flowers. If plant material enters the EPPO region, it is likely that this material is used solely for the purpose of horticulture. The pathway also covers <i>S. angulatus</i> misidentified as other similar looking species. YouTube video: <i>Senecio angulatus</i> - grow & care (Creeping groundsel) - Senecio angulatus - grow & care (Creeping groundsel)
Pathway prohibited in the PRA area?	The import of <i>S. angulatus</i> plants for planting is not prohibited in the EPPO region.
Pathway subject to a plant health inspection at import?	Yes, partly in some EPPO countries. All consignments of plants for planting are subject to a phytosanitary certificate at import in the EU and consignments may be subjected to inspection.
Pest already intercepted?	<i>S. angulatus</i> is available from nurseries and online stores, e.g. Seeds: E-bay 50 x Climbing Groundsel (Senecio Angulatus) SEEDS eBay Australia (Australia), https://seedsandall.co.za/product/cape-ivy-senecio-angulatus-3-seed-pack/ (South Africa) Live plants: Senecio angulatus, Climbing Groundsel, Cape Ivy from Shrubland Nurseries in Suffolk (UK) Senecio angulatus - ivy leaf senecio (Square vase 7x7x8 cm) – Vivai Mola della Badia (Italy) Cuttings: E-bay Senecio angulatus Cuttings - Cape Ivy - Talee di Senecio angulatus Senza Radici eBay (Italy)
Most likely stages associated with the pathway	The plant itself is the pest. Seeds: seeds can be purchased from online suppliers and sent via mail order in packets. Live plants: live plants can be purchased from nurseries and online suppliers. Live plants will be most likely propagated and traded within the EPPO region, although live plants may be imported into the EPPO region. Cuttings: cuttings can be purchased from online suppliers and sent via mail order in packets. Cuttings will be most likely propagated and traded within the EPPO region, although cuttings may be imported into the EPPO region.

Pathway	Plants for planting
Important factors for association with the pathway	Plants for planting will be packaged and maintained to ensure their survival during transportation along the pathway. Plants will be planted outdoors following entry into an area.
Survival during transport and storage	It is likely that live plants and cuttings will survive transport and storage as the plant (or seed) is the commodity itself. Provided they are cared for, live plants and cuttings should be able to survive the period of transport and storage.
Trade	Trade of <i>S. angulatus</i> occurs within the EPPO region though there is no specific data on the amounts. An import of the plant from outside the EPPO region will also occur, but no data is available here either.
Will the volume of movement along the pathway support entry?	There is a low volume of movement along the pathway, in particular for entry into the EPPO region. There is little information on volumes of movement within the EPPO region. The species is not a very popular species in horticulture in the EPPO region. However, the volume of movement from one EPPO country to another can support entry into areas where the pest does not occur. Most of the live plants will be propagated and traded within the EPPO region.
Will the frequency of movement along the pathway support entry?	There is a low frequency of movement along the pathway, in particular for entry into the EPPO region. Most live plants will be propagated and traded within the EPPO region, though there is little information on frequency of movement within the EPPO region. The species is not a very popular species in horticulture in the EPPO region. However, the frequency of movement from one EPPO country to another can support entry into areas where the pest does not occur. <i>S. angulatus</i> can propagate vegetatively and even with a low volume of trade, one individual is enough to establish and spread.
Transfer to a suitable habitat	<i>S. angulatus</i> can transfer to a suitable habitat via the pathway plants for planting. Live plants, or viable plant parts and seed are likely to be grown outside in private gardens. If <i>S. angulatus</i> is planted and becomes ‘weedy’ in the garden, management practices may facilitate transfer from where it is planted to a habitat suitable for establishment. Improper disposal of garden waste can facilitate the transfer of the species to a suitable habitat, as has been seen in Morocco where <i>S. angulatus</i> has been dumped as garden waste near an oak forest (Pers. Comm. H. Khamar, 2026). Likewise, Tan et al. (2025) mentioned that discarded <i>S. angulatus</i> stems (as garden waste) root and establish easily in the areas where they are dumped (Greece).
Likelihood of entry and uncertainty	For plants for planting moderate rating with a moderate uncertainty. There is a trade of plants for planting though the volumes and frequency is likely to be low, the species is a relatively specialised plant in trade. Moderate uncertainty score is based on a lack of data of volume and frequency, geographical origin of traded plants for planting, seed viability.

8.2 Pathways with a very low likelihood of entry

- **Soil and other growing media (on its own or associated with plants for planting)**

Soil attached to plants is mostly prohibited from import into the EPPO region, and only certain types of growing media are allowed for import, and these must have been stored and/or treated to ensure freedom from pests (Regulation (EU) 2019/2072 (EU, 2019); see ISPM 40 (IPPC, 2021)).

It is very unlikely that *S. angulatus* is associated with this pathway as a contaminant because soil or other growing media is unlikely to be collected from areas where the pest occurs. Seed which may occur in the soil or growing media is unlikely to be viable or have conditions suitable for germination. Stem fragments are unlikely to be associated with the pathway.

Risk can be reduced by following the recommendations set out in the EPPO Standard PM 3/98 (1) Inspection of growing media associated with consignments of plants for planting (EPPO, 2024).

The EWG allocated a moderate uncertainty for this pathway. Lack of data on interceptions and seed ecology.

- **Conveyances, vehicles & equipment**

Small fragments of *S. angulatus* may be attached to e.g., landscaping equipment. There is no information or evidence on the movement of the species along this spread pathway. The EWG allocated a moderate uncertainty for this pathway. Lack of data on interceptions .

- **Natural spread**

Senecio angulatus is unlikely to enter the EPPO region through natural spread from areas outside of the EPPO region. Nevertheless, natural spread, from EPPO countries where *S. angulatus* occurs to EPPO countries where it does not occur is covered in section 11.

Overall rating of the likelihood of entry combining the assessments from the individual pathways considered:

The overall rating is based on the worst case scenario plants for planting.

Rating overall	Very low ☐	Low ☐	Moderate X	High ☐	Very high ☐
Rating of uncertainty			Low ☐	Moderate X	High ☐

9. Likelihood of establishment outdoors in the PRA area

Senecio angulatus is established in Croatia, Greece (including Crete and Rhodes), France (including Corsica), Italy (including Sicily and Sardinia), Portugal (including Maderia), and Spain (including the Balearic and Canary Islands).

In Italy, *S. angulatus* is considered established in several regions (e.g., Calabria, Campania, Lazio, Liguria, Marche, Molise, Puglia, Sardinia, Sicily, and Tuscany) (Galasso et al., 2018; Portale della Flora d'Italia, 2025). In Spain, multiple observations have been made along the Costa Brava (<https://lifemedcliffs.org/en/context/invasive-flora/creeping-groundsel-senecio-angulatus/>). In Portugal, the species has been known from the wild since 1984 and is now established in many areas (Smith et al., 2015), and Clamote et al. (2017) lists more than 70 observations. In France, the plant is established in the most thermophilous parts of the French Mediterranean coast including the Albères (near the Spain border) and the Provence (from Marseille to the Italian border) (Conservatoire Botanique National Méditerranéen, botanique national méditerranéen, 2025).

Habitats which are suitable for *S. angulatus* are detailed in section 7. In the EPPO region, *S. angulatus* is mainly established in coastal habitats. Further establishment is likely in regions where habitats, soils, and climatic conditions are conducive.

9.1 In the natural environment

Senecio angulatus can be found in the natural environment. For example, the species was found growing in the Mediterranean maquis (Iamonico & Maglio, 2008), in coastal vegetation (cliffs, rocky slopes) and in low scrub vegetation (with *Cistus* spp. and/or *Erica* spp.) (Misuri et al., 2024).

9.2 In the managed environment

It is likely that *S. angulatus* can establish in the managed environment. The species occurs predominately in habitats with high levels of anthropogenic disturbance, such as fences, stone walls, abandoned land, and ruderal, urban and suburban areas (Milović et al., 2010; Miara et al., 2018; Tan et al., 2025). These habitats are very common in EPPO countries (Mediterranean area) and are a factor that may strongly favour the establishment of *S. angulatus* once the habitat has become infested.

Senecio angulatus has also been found along roadsides in Spain and Morocco (e.g., García de Lomas et al., 2011; Khamar El Bakhouch, 2024).

The species is likely to be dumped (as garden waste) in ruderal habitats and potentially on waste ground where management practices may be minimal and the native vegetation sparse; this may make the establishment of the species in these areas likely. However, it is unlikely that the species will survive in the agricultural environment. It is possible that it could encroach into permanent crops i.e., of poorly managed fruit crops and olive groves (Pers. Comm., G. Brundu, 2026), or pastures due to its rapid growth rate.

9.3 Factors affecting establishment

Climate conditions

The species distribution model developed for this PRA (Appendix 1, Figure 5) estimated that *S. angulatus* prefers areas with mild winter temperatures (mean winter temperature bio11 > 6°C), consistent with reports that the species is somewhat frost sensitive (Williams & Hayes, 2007). In the model projections, low winter temperature was the main limiting factor for the species in central and northern Europe, partly restricting inland establishment.

Summer temperatures are likely sufficient to support growth of the species in most of the PRA area other than northern UK and Scandinavia, based on the low number of growing degree days it experiences in the areas of establishment such as Tasmania. However, the model suggested that low solar radiation may be a limiting factor in some northern areas (e.g., British Isles mainlands).

The model also suggested there may be inland areas with suitable climates in southwest Europe, but where a lack of suitable coastal habitats prevents widespread establishment. Mostly, the model predicts climate suitability along coastal areas in the Mediterranean region (Figure 4).

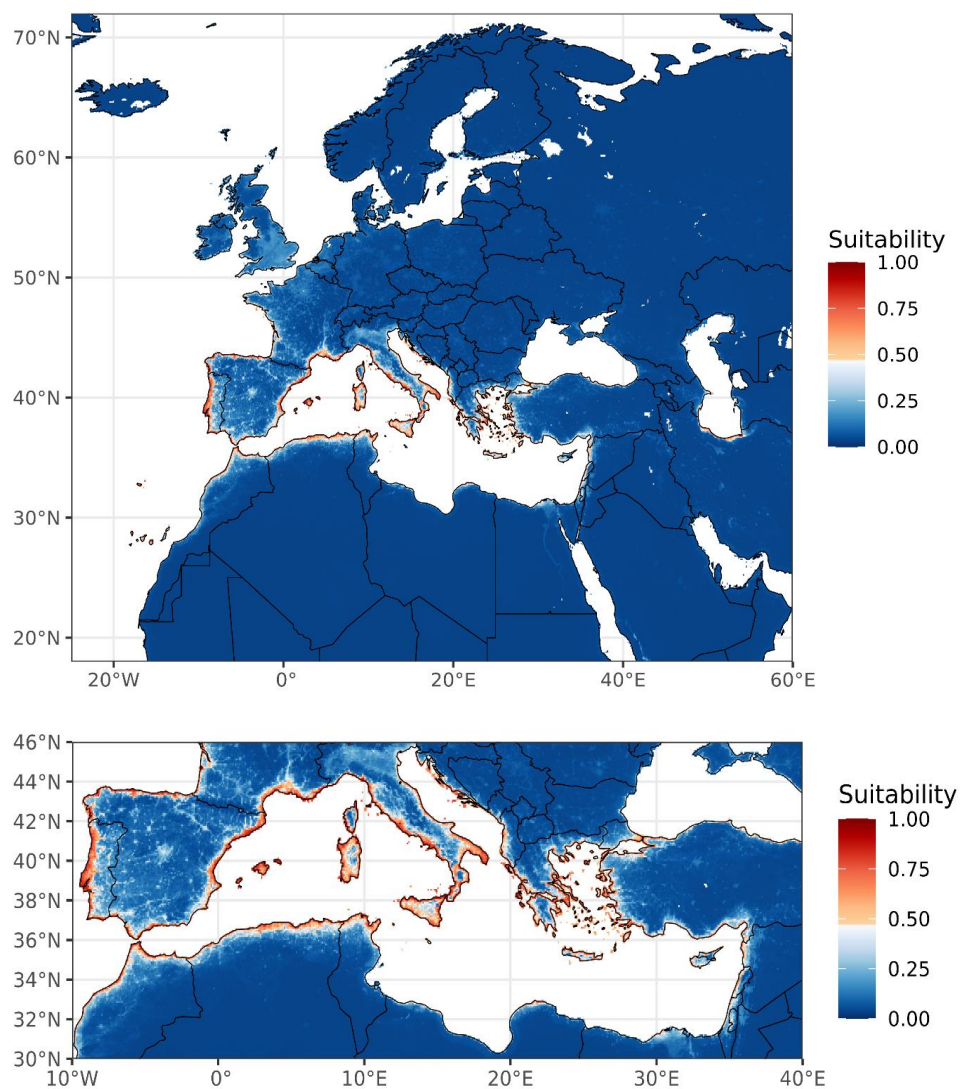


Figure 4. Projected current suitability for *Senecio angulatus* establishment in Europe and the Mediterranean region, with a zoomed in view of the Mediterranean coast (see interactive version at <https://rpubs.com/dc55/1389739>).

Predictions for 2041-2070, under both the moderate SSP1-2.6 and more extreme SSP3-7.0 climate change scenarios, suggest relatively little change in the suitability maps (Appendix 1: Figures 7 and 8). There are slight northward shifts in suitability around the coastline so that marginally suitable conditions appear further north in Great Britain and around the Black Sea. Conversely, there are reductions in suitability in North Africa and the southernmost parts of Mediterranean Europe.

These results are reflected in the suitability of different European Biogeographical Regions (Bundesamt für Naturschutz (BfN), 2003). Regions highly suitable for establishment in the current climate are Macaronesia, Mediterranean, the Black Sea and the Atlantic (Appendix 1: Figure 9). By 2041-2070, overall modelled suitability remains similar in all of these, but with a slight reduction in Macaronesia and slight increases in the Atlantic and Black Sea (Appendix 1: Figure 9).

Competition with other plant species

Competition with native vegetation is unlikely to limit the establishment of *S. angulatus*. The growth habit of *S. angulatus* can facilitate its establishment; the species climbs over most other vegetation, forming a solid cover that blocks light and smothers other vegetation. Some competition may occur with native (e.g.,

Smilax aspera) or introduced lianas in forests within the PRA area. A higher diversity of lianas is present in Mediterranean shrublands and forests.

Soil conditions

Soil conditions in the EPPO region are suitable for the species. *S. angulatus* tolerates a wide range of soil types (Webb et al., 1988; Williams and Hayes, 2007; Thompson, 2006).

Natural enemies

Specific natural enemies are not known to occur on *S. angulatus* within the EPPO region. There are only observations. For example, the larvae of the weevil *Orthochaetes insignis* Aubé (1863) were considered feeding on the leaves of *S. angulatus* (Kroatiens Fauna und Flora, 2024). Other generalist natural enemies (e.g., aphids) may potentially attack the plant, but these are unlikely to cause enough damage to influence establishment. It is very likely that the species will become established in the PRA area despite natural enemies.

The EWG rated the likelihood of establishment very high with a low uncertainty. Considering the number of countries where it is already established, and those where it is transient with the potential to become established in the future, a very high rating is given. There is the potential for further establishment in habitats with suitable climates. Low uncertainty is given, as there is detailed evidence in the scientific literature showing the establishment of the species.

Rating of the likelihood of establishment outdoors in the PRA area	Very low ☐	Low ☐	Moderate ☐	High ☐	Very high X
Rating of uncertainty			Low X	Moderate ☐	High ☐

10. Likelihood of establishment in protected conditions in the PRA area

No evidence was found of the presence of *S. angulatus* under protected conditions in areas where the species occurs. The management of temperatures under protected conditions (e.g., polytunnels, glasshouses) maintains average temperatures between 20 and 35°C which would be favorable for the development of the species.

It cannot be excluded that seeds or fragments of *S. angulatus* are introduced into facilities under protected conditions. However, these facilities produce crops in highly managed production systems (with possible rotation e.g., for polytunnels) that limit the likelihood of establishment due to short intervals between consecutive management practices. If the species occurs, it must be assumed that it will quickly be recognized as a weed and removed.

Rating of the likelihood of establishment in protected conditions	Very low X	Low ☐	Moderate ☐	High ☐	Very high ☐
Rating of uncertainty			Low X	Moderate ☐	High ☐

11. Spread in the PRA area

The general increase in the number of records in recent years/decades in some EPPO countries may indicate that the species is spreading (e.g., Spain: Gómez-Bellver et al., 2025; Greece: Tan et al., 2025; France: Conservatoire Botanique National Méditerranéen, 2025).

The species fits perfectly the definition of an invasive species according to the framework of Colautti & McIsaac (2004), which proposes that an invasive species is one that becomes both locally abundant and regionally widespread.

Increase in regional frequency. In Spain, Gómez-Bellver et al. (2025) claim that the species spreads rapidly and aggressively along the Costa Brava. The observations of *S. angulatus* along the Costa Brava from the LIFE medCLIFFS project show very dense occurrences, which indicates a high level of spread (<https://lifemedcliffs.org/en/context/invasive-flora/creeping-groundselsenecio-angulatus/>).

Increase in local abundance. In France, *S. angulatus* was recorded with low abundance (1: 1–5% cover) and a sociability level of 2 to 3 (from small loose groups to dense clumps or small stands) on Cap Ferrat (near Nizza/Alpes-Maritimes department) at the beginning of the 1970s (Lapraz, 1974). An assessment carried out on Cap Ferrat in 2021–2022 indicated that in the same area, *S. angulatus* is now among the three main invasive plant species of the area and forms cover exceeding 75% over large areas (Fried, 2022).

The spread of *S. angulatus* could be classified as (1) local spread through the vegetative spread from existing populations and (2) long distance dispersal through the movement of vegetative propagules by human assistance.

Natural spread

Vegetative spread

Senecio angulatus can spread vegetatively by runners for several meters (up to 5 m per yr). Branches touching the ground become rooted, and the plant produces numerous suckers from the base (Bergin, 2006; Weber, 2017). In this way, the species can form larger contiguous mats of several square meters up to 50 m² (e.g., García de Lomas et al., 2011; Tan et al., 2025). Stems can easily be broken and fragment – leading to new viable plants and new populations. The vegetative spread is shown by the fact that many of the new populations in the wild apparently originate from previously cultivated (and then abandoned) populations in gardens (e.g., Milović et al., 2010; Sánchez Gullón et al., 2017).

In the EPPO region, *S. angulatus* rarely grows along banks of streams; however, if it does, fragments may be dispersed by water. In New Zealand, it has been observed to spread in riparian areas (Pers. Comm., Paul Champion, 2026).

Human assisted spread

Stem fragments of *S. angulatus* are spread in dumped garden waste (Weeds of Australia, 2016; Williams & Hayes, 2007), which can be dispersed into the natural environment.

Many of the records of *S. angulatus* in the EPPO region are attributed to dumped garden waste (e.g., Khamar and El Bakhouch, 2024, Šegota et al., 2021), though the movement of plants for planting in horticulture can also contribute to long distance movement of the species.

Disturbance of existing populations, through direct management or habitat restoration, can act to spread stem fragments. Small stem fragments have the potential to be spread by contaminated soil and as contaminants of used machinery and equipment (Pers. Comm. Paul Champion, 2026). However, there is no information for this purpose in the literature.

Fragments of stems have the potential to be spread through human activities along cliffs and coastal paths. Human activities at recreational points such as car parks and picnic sites could act to spread the species.

The EWG rated the magnitude of spread as high, with a moderate uncertainty. The high rating is associated with human assistance through the movement of plants for planting coupled with the disposal of garden waste and regular maintenance work. Natural spread alone is likely to be low.

<i>Rating of the magnitude of spread</i>	Very low ☐	Low ☐	Moderate ☐	High X	Very high ☐
<i>Rating of uncertainty</i>				Low ☐	Moderate X
					High ☐

12. Impact in the current area of distribution (excluding the PRA area)

12.1 Impacts on biodiversity

The EWG has evaluated the literature and did not find any scientific evidence or detailed studies on *S. angulatus* negatively affecting biodiversity.

Several sources (other published literature), however, describe the growth habit of *S. angulatus* (i.e., dense vine tangles and mats) as rather clearly affecting biodiversity within the current area of distribution (Newton, 1996; Bergin, 2006; Williams and Hayes 2007; USDA, APHIS, 2013; Weber, 2017). They conclude that *S. angulatus* may change community structure, alter species composition, reduce regeneration of native species, and is likely to threaten rare species.

- Newton (1996): “*S. angulatus* poses a serious threat because of its prolific growth and ability to cover and smother native flora.” (Australia).
- Bergin (2006): “It spreads rapidly by runners, scrambling over shrubs and the ground, often forming dense tall thickets that prevent native species from establishing.” “The existence and continuing spread of cape ivy throughout these steep Pleistocene sand gullies is a major threat to existing native vegetation and will prevent regeneration of natives.” (New Zealand).
- Williams & Hayes (2007): “Potential to invade bush margins, regenerating scrub and native shrublands, banks, cliffs where it outcompetes early successional native species such as mahoe.” (New Zealand).
- In New Zealand *S. angulatus* can colonise sand dunes where it changes the habitat of back-dunes replacing low growing vegetation with 1 m or more thickness of dense mats (Pers. Comm., Paul Champion, 2026).
- In Australia, *S. angulatus* is considered to threaten the orchid *Corybass diemenicus* (Department of Sustainability and Environment, 2002).
- In a laboratory study, *S. angulatus* has been shown to have allelopathic effects on native plants from Iran (Sohrabi et al., 2025). This can support the establishment of the species, but at a cost to native plant species. Sohrabi et al. (2025) suggest that the allelopathic properties of *S. angulatus* can prevent the germination of native seed.

Its former congener *Delairea odorata* has caused considerable biodiversity and ecosystem impacts in its invasive range. In California (USA), Alvarez & Cushman (2002) compared the effect of *D. odorata* on invaded and not invaded coastal scrub, and willow and alder riparian communities. Their results showed that plots invaded by *D. odorata* had a 31, 88, and 92% decrease in species diversity, abundance of native seedlings, and non-native seedlings, respectively, compared to uninvaded sites of the same community types. Robison & DiTomaso (2010) observed that in California three sensitive animals and five sensitive plants were expected to have a reduction of 40% of their occurrences with a 500 m buffer to *D. odorata* infestations.

12.2 Impact on ecosystem services

No scientific information has been found regarding negative impacts on ecosystem services.

Senecio angulatus has a potential impact on ecosystem services within the current area of distribution. For provisioning ecosystem services, *S. angulatus* can be toxic to animals and humans when ingested (Porter & Geissman, 1962; EFSA, 2016). For cultural ecosystem services, the species can degrade areas of conservation value and restrict access to recreational sites due to the formation of mats and dense stands (Pers. Comm., Paul Champion, 2026).

No impacts have been reported on regulating and supporting ecosystem services.

12.3 Socio-economic impact

There is no evidence that *S. angulatus* is a weed in crops. However, it cannot be ruled out that the species will encroach from outside into pastures or permanent crops, such as citrus, olive groves, or vineyards, especially in traditionally managed plots under extensive practices. Individual plants within the plots may be smothered or *S. angulatus* may compete with the crop for resources.

Senecio species in general are known to be toxic to livestock and humans (Stegelmeier et al., 1999; Burrows and Tyril, 2013). *Senecio* species contain hepatotoxic pyrrolizidine alkaloids (PAs), a large group of toxins produced by different plant species that are plant secondary metabolites against herbivores. *Senecio angulatus* contains the PA angularine (Porter and Geissman, 1962).

The consumption of PAs results in acute and chronic hepatotoxic effects, but also cancerogenic potential in humans and livestock has been observed. They are therefore undesirable in food and feed. PAs can enter the food supply by co-harvesting PA-containing plant parts and seeds (weeds), e.g., in spices, teas, leafy vegetables, and lettuce (e.g., Code of practice for weed control to prevent and reduce pyrrolizidine alkaloid contamination in food and feed CAC/REP 74-2014 – Codex Alimentarius – International Food Standards – FAO-WHO). In fact, The European Food Safety Agency (EFSA) Panel on Contaminants in the Food Chain (CONTAM) adopted in 2011 a scientific opinion on pyrrolizidine alkaloids in food and feed (EFSA 2011). The report highlighted that, in general, grazing animals will avoid PA-bearing plants but may have little choice in conditions of drought or when searching for food on over-grazed or otherwise depleted pastures. If weedy crops are used for the production of hay or silage the animals can no longer exercise discrimination when feeding because the toxins survive storage processes and are completely intermixed with the fodder. Mortality is reported to be high. The CONTAM Panel concluded that there is a possible health concern for those toddlers and children who are high consumers of honey. There is generally a low risk of PA poisoning in livestock and companion animals in the EU as most PA poisonings reported recently are due to accidental exposure. In 2017, The Panel recommended continuing the efforts to monitor the presence of PAs in food and feed, including the development of more sensitive and specific analytical methods. A recommendation was also issued on the generation of data to identify the toxic and carcinogenic potency of the PAs commonly found in food (EFSA 2017).

As detailed above, in general, direct ingestion of the plant by livestock does not occur frequently, as due to the toxic compounds the plant is not considered widely palatable. However, it has been demonstrated that *Senecio* species had an impact on cattle production. For example, in Uruguay, Argentina and southern Brazil the consumption of *Senecio* species is the main cause of poisoning in cattle grazing, responsible for up to 50% of all deaths. Particularly in the eastern region of Uruguay, poisoning by *Senecio* species is one of the main pathologies observed in extensive breeding systems, only overcome by bovine piroplasmiasis (García et al., 2020).

Senecio angulatus can affect honey production. Bees can forage on flowers of *Senecio* species, which leads to contamination of honey with PAs. In some cases, a high concentration of the alkaloids has been detected, for example in Poland (Kowalczyk & Kwiatek 2018). In addition to honey, other beekeeping products, such as pollen, royal jelly, propolis, and beeswax, are also vulnerable to PA contamination (Brugnerotto et al., 2021). Negative effects on honeybees themselves and overall colony fitness have been documented as well. In the absence of alternative nectar and pollen sources, PA-containing plants such as *Senecio* spp. might exhibit a threat to vulnerable bee larvae, and this might affect the overall colony fitness. (Reinard et al., 2009).

The EWG rated the magnitude of impact in the current area of distribution as high, with a moderate uncertainty. Taking into consideration the mat-forming nature of the species, the type of invaded habitat (e.g., coastal habitats), and its potential impact on biodiversity, ecosystem services and socio-economic impacts, a high rating of magnitude is given. The score is mainly related to impacts on biodiversity. This is further justified by the documented impact of similar mat forming species, e.g., *D. odorata*. The rating is further justified as risk assessments for the USA and the State of California rate the risk of *S. angulatus* as high risk (in a five-point rating scale or three-point?), and Victoria (Australia) rates the risk as very high risk, despite the lack of scientific evidence on impacts.

A moderate rating of uncertainty is given as the EWG has evaluated the literature and did not find any scientific evidence or detailed studies on *S. angulatus* negatively affecting biodiversity.

Rating of magnitude of impact in current area of distribution	Very low ☐	Low ☐	Moderate ☐	High X	Very high ☐
---	-----------------------------------	------------------------------	-----------------------------------	---------------	------------------------------------

Rating of uncertainty	Low ☐	Moderate X	High ☐
-----------------------	------------------------------	-------------------	-------------------------------

13. Potential impact in the PRA area

Will impacts be largely the same as in the current area of distribution? **Yes**

13.1 Current and potential impacts on biodiversity in the PRA area

The EWG did not find scientific studies that have examined the impact of *S. angulatus* on biodiversity within the PRA area. There is documentation in the literature of the invasive growth habit of the species within the PRA area.

- Iamónico (2017) remarked that *S. angulatus* “easily grows in the Mediterranean maquis where it is strictly associated and could potentially compete with native species” (Italy).
- Stinca et al. (2021) monitored in Reggio Calabria a large population of *Senecio angulatus* that occupies the entire valley floor “for several hundred meters” (Italy).
- *Senecio angulatus* is established on Capraia Island (Tuscan Archipelago) (Misuri et al., 2024) and is considered a serious threat to the narrow endemic species *Centaurea gymnocarpa* Moris & De Not. (Catoni & Gratani, 2013) (Italy). Importantly, *Centaurea gymnocarpa* is included, by the Mediterranean Islands Plant Specialist Group (IUCN / SSC), in the list of the Top 50 Mediterranean Island Plants - Wild plants at the brink of extinction (<https://top50.iucn-mpsg.org/species/19>) (Pasta et al., 2017).
- Gómez-Bellver et al. (2025) describes the species as “one of the most problematic plants in Mediterranean Spain with rapid and aggressive spread”. *Senecio angulatus* can cover the whole ground and climb over other vegetation and poses a severe threat to native species, such as *Pistacia lentiscus* (Spain).
- In France, Greece, Spain, it is reported to form dense mats ranging from 10 to 1000 m² (García de Lomas et al., 2011; Tan et al., 2025; de Solan, et al., 2026).
- The literature and observations in the field in North African countries (Miara et al. 2018, El Mokni & Iamónico 2018; Khamar & El Bakhouch 2024), particularly Morocco, indicate that *Senecio angulatus* is presenting challenges for local plant species. This plant impedes growth and regeneration, thereby impacting the wildlife that relies on it. *S. angulatus* mats diminish the availability of appropriate nesting areas for birds while creating dense "curtains" that may undermine the stability of the forest canopy. These compact vines also impede the photosynthesis of especially native herbaceous plants.

Numerous images from the PRA area show dense mats, interfering with native plant species, emphasising the competitive ability of plants, e.g.,

- <https://lifemedcliffs.org/en/context/invasive-flora/creeping-groundsels-senecio-angulatus/> (Mediterranean area)
- https://dryades.units.it/floritaly/index.php?procedure=taxon_page&tipo=all&id=5811 (Italy)
- <https://gd.eppo.int/taxon/SENAN> (EPPO region)

Using an EICAT-based (Environmental Impact Classification for Alien Taxa) assessment integrating experts' field observations, de Solan et al. (2026) classified *S. angulatus* as having a major impact in France. Rationale for major impact includes repeated observations of large mat populations in areas of conservation value (de Solan et al., 2026).

The EWG concludes that *S. angulatus* can change community structure, alter species composition, reduce regeneration of native species, and is likely to threaten rare species in the natural environment. Further impacts are likely to be seen on biodiversity in habitats where the species can invade.

13.2 Current and potential impact on ecosystem services in the PRA area

There is no information on *S. angulatus* negatively affecting ecosystem services within the PRA area.

Senecio angulatus has a potential impact on ecosystem services within the EPPO region. For provisioning ecosystem services, coastal areas of the EPPO region are heavily utilised for recreation activities. *S. angulatus* can degrade areas of conservation value and restrict access to recreational sites due to the formation of mats and dense stands.

13.3 Current and potential socio-economic impact in the PRA area

There is no information that *S. angulatus* affects agricultural production within the PRA area. However, it cannot be ruled out that the species will encroach from outside into pastures or permanent crops, such as citrus and olive groves, especially in traditionally managed plots under extensive practices.

It is possible that PAs could enter the food chain through honey and milk derivatives in the same way as is reported with *Senecio* spp. (e.g., Gottschalk et al., 2020), but no evidence was found of this for *S. angulatus* in the PRA area. The risk of the plant entering the food and feed chain is considered low, as it does not regularly occur in crops. Direct ingestion of the plant by livestock is also unlikely, as due to the toxic compounds, the plant is not considered widely palatable. Honey produced in the flowering period of *S. angulatus* has a significant risk to be contaminated as the flowering period of *S. angulatus* in the EPPO area overlaps with only a limited number of other melliferous species in the PRA area.

The EWG rated the magnitude of impact in the area of potential establishment as high with a moderate uncertainty. A similar rating to that of the current area of establishment is predicted, as the potential habitats affected in the current area of distribution are likewise present in the PRA area and of equal importance. Observations of the species behaviour in the current area of distribution are similar to the observations in the EPPO region.

Rating of the magnitude of impact in the area of potential establishment	Very low ☐	Low ☐	Moderate ☐	High X	Very high ☐
Rating of uncertainty			Low ☐	Moderate X	High ☐

14. Identification of the endangered area

The EWG considered that the endangered area includes Atlantic coastal areas of southern Europe (especially northern Spain), Mediterranean, Black sea and Macaronesia biogeographic regions. The endangered area includes all Mediterranean islands. Habitats at risk in the coastal area are those listed in section 7.

15. Overall assessment of risk

***Senecio angulatus* has a high phytosanitary risk for the endangered area with a moderate uncertainty.**

Entry

Senecio angulatus is already present and established in the EPPO region. The overall likelihood of further entry of *S. angulatus* into the EPPO region is moderate with a moderate uncertainty.

Establishment

The likelihood of establishment outdoors is very high with low uncertainty. Habitats are widespread within the EPPO region, and further establishment is likely in regions where habitats and climatic conditions are conducive for growth. The likelihood of establishment in protected conditions is very low with moderate uncertainty.

Spread

The potential for spread within the EPPO region is high, with a moderate uncertainty. *S. angulatus* spreads naturally via plant fragments and via human assisted spread (e.g., horticulture trade, dumping of garden waste and fragmentation due to management practices).

Impact

The magnitude of impact in the current area of distribution (excluding the EPPO region) is high with a moderate uncertainty where the rating reflects its impact on biodiversity. Persistent populations can modify habitats, displacing native plant species. The EWG considered that the potential impact in the EPPO region will be the same as the current area of distribution. Habitats affected in the current area of distribution are likewise present in the PRA area and of equal importance. Observations of the species' behaviour in the current area of distribution are similar to the observations in the EPPO region. Based on the high magnitude of spread (moderate uncertainty) from existing established populations in the EPPO region, and high impact (moderate uncertainty), the overall risk appears correct.

Table 7. Summary of ratings and uncertainties

Section	Likelihood	Uncertainty
Entry (overall)	Moderate	Moderate
Plants for planting	Moderate	Moderate
Establishment outdoors in the PRA area	Very high	Low
Establishment in protected conditions in the PRA area	Very low	Low
Spread	High	Moderate
Impact in the current area of distribution	High	Moderate
Potential impact in the PRA area	High	Moderate

Stage 3. Pest risk management

16. Phytosanitary measures

The results of the risk assessment show that *S. angulatus* has a high phytosanitary risk to the endangered area with a moderate uncertainty.

Phytosanitary measures should be recommended for the pathway plants for planting.

Recommendations by the EWG are the following:

- *Senecio angulatus* should be recommended for regulation as a quarantine pest in the endangered area;
- *Senecio angulatus* should be banned for sale in the endangered area.

16.1 Measures on individual pathways to prevent entry

Possible pathways (<i>in order of importance</i>)	Measures identified
Plants for planting	Prohibition of import of <i>S. angulatus</i> into the endangered area within the EPPO region

16.2 Eradication and containment

National measures

Early detection is important to identify new occurrences of the species. *S. angulatus* should be monitored and eradicated, contained or controlled where it occurs in the endangered area. In addition, public awareness campaigns to prevent spread from existing populations in countries at high risk are necessary.

Management of *S. angulatus*

Eradication

Eradication measures provided in this section should be promoted where feasible with a planned strategy to include surveillance, containment (see the following paragraph), treatment and follow-up measures to assess the success of such actions. Regional cooperation is essential to promote phytosanitary measures and information exchange in identification, treatment and management methods. NPPOs should facilitate collaboration with all sectors to enable early identification including education measures to promote citizen science and linking with universities, land managers and government departments.

Eradication is possible for *S. angulatus* in the case of early detection of small populations, including digging up or uprooting individual plants; for further options, see the section on containment.

It is recommended that member countries eradicate this species where feasible to prevent further spread and impact.

Containment

NPPOs should provide land managers and stakeholders with identification guides, including information on preventive measures and control techniques.

Mechanical control

Slashing, mowing, rotary slashing and grubbing are manual control methods often recommended for the control of this species. Use of these methods, however, usually results in some regrowth occurring. Plant material should be carefully disposed of (e.g., bagging it in black plastic bags, left to rot in the sun) on plastic bags (Bergin, 2006; GISD, 2025; Weedbusters, 2025).

Herbicides

The active ingredients triclopyr and metsulfuron-methyl were effective against *S. angulatus* in a field trial (Newton, 1996). The following is recommended (Weedbusters, 2025):

- Cut the stem/trunk as close to the ground as possible and cover the entire stump with herbicide as soon as possible after cutting (e.g., glyphosate or metsulfuron-methyl gel);
- Foliar spray using a hand-held sprayer/knapsack to plants <1m tall infestations (glyphosate, metsulfuron-methyl).

The control of *S. angulatus* will not be a one-off task. Follow-up action must be undertaken regularly. The site should be checked for regrowth and seedlings, and further application of herbicides or mechanical measures should be carried out if necessary (Bergin, 2006).

17. Uncertainty

The EWG used the categories of main sources of uncertainties (under development) discussed by the Panel on Phytosanitary Measures in October 2023:

- *Key uncertainties*: likely to significantly affect the overall conclusions (including overall risk and overall uncertainty) of the PRA (i.e., the determination of whether the pest has the characteristics of a quarantine pest, and the pathways that should be managed);
- *Other main uncertainties*: not likely to affect the overall conclusions of the PRA but likely to impact conclusions of individual part(s) of the risk assessment or risk management.

Key uncertainties	Other main uncertainties
	Lack of data on seed viability in the EPPO region
	Lack of data on clonal spread
	Toxicity and contamination of food and feed
	Autecology of <i>S. angulatus</i> in the non-native range

18. Remarks

The EWG recommends:

- Study the mechanism of clonal spread and seed viability (see section 2.3.1.2);
- Monitor the rate of spread of *S. angulatus* from existing populations and check for the occurrence of seedlings in the EPPO region;
- Carry out scientific studies on the impact of *S. angulatus* in the EPPO region;
- Assess the toxicity and contamination of food and feed;
- Be aware of the risk of *S. angulatus* alkaloids for animals;
- Studying the autecology of *S. angulatus* in the non-native range;
- Promote awareness raising of *S. angulatus* in the EPPO region.

19. References

- Alavi SA (1983): Flora of Libya. 107, Asteraceae. Al Fateh University, Department of Botany, Tripoli, Libya.
- Alvarez ME, Cushman JH (2002): Community-level consequences of a plant invasion: effects on three habitats in coastal California. *Ecological Applications* **12**, 1434–1444.
- Alziar G (1984) Sur quelques plantes naturalisées de la Côte d'Azur. *Biocosme mésogéen* 1, 57–69.
- Atlas of Living Australia (2025) *Senecio angulatus* L.f.
<https://bie.ala.org.au/species/https://id.biodiversity.org.au/taxon/apni/51747586>
- Barina Z, Pifkó D, Mesterházy A (2011): Contributions to the flora of Albania, 3. *Willdenowia* **41**, 329–339.
- Barve N, Barve V, Jiménez-Valverde A, Lira-Noriega A, Maher SP, Peterson AT, Soberón J, Villalobos F (2011) The crucial role of the accessible area in ecological niche modeling and species distribution modeling. *Ecological Modelling*, **222**(11), 1810–1819. <https://doi.org/10.1016/j.ecolmodel.2011.02.011>
- Bergin D (2006) Options for restoration of Cape ivy (*Senecio angulatus*)-dominated sites using native coastal species. Ensis, New Zealand: Glinks Gully, Northland.
- Brandes D (2020a) Some contributions to the wall flora of North Cyprus. - *Braunschweiger Geobot. Arbeiten* 14, 11-33
- Brandes D (2020b): Some contributions to the wall flora of the French coastland between Antibes and Menton (Côte d'Azur). *Braunschweiger Geobotanische Arbeiten* **14**, 1–10.
- Bredenkamp CL (2019): A Flora of the Eastern Cape Province. *Strelitzia* **41**, 423–682.
- British Society of Britain and Ireland (2026) <https://bsbi.org/>
- Brugnerotto P, Seraglio SKT, Schulz M, Gonzaga LV, Fett R, Costa ACO (2021) Pyrrolizidine alkaloids and beehive products: A review. *Food Chemistry*, **342**. 128384.
- Brunel S, Tison J (2005): A method of selection and hierarchization of the invasive and potentially invasive plants in continental Mediterranean France. In: *Invasive Plants in Mediterranean Type Regions of the World. Proceedings of the International Workshop, 25–27 May 2005* (Ed. Brunel S), pp. 27–36.
- Bundesamt für Naturschutz (BfN). (2003). Map of natural vegetation of Europe. Web site: <http://www.bfn.de/>. National data included.
- Burrows GE, Tyrl RJ (2013) Toxic plants of North America. John Wiley & Sons.
- Calflora (2025) Search for Plants – *Senecio angulatus*. The Calflora Database, a non-profit organization <https://www.calflora.org/entry/psearch.html?namesoup=Senecio+angulatus&countylist=any&plantcomm=any&format=photos&orderby=taxon>.
- California Invasive Plant Council (2025) *Senecio angulatus* Risk Assessment. <https://www.cal-ipc.org/plants/risk/senecio-angulatus-risk/>
- Calvo J, Aedo C (2019) *Senecio* L. – In: Castroviejo S (ed.), *Flora Iberica* 19, 1506–1562. Real Jardín Botánico, CSIC, Madrid.
- Chapman D, Pescott OL, Roy HE, Tanner R (2019). Improving species distribution models for invasive non-native species with biologically informed pseudo-absence selection. *Journal of Biogeography*, **46**(5), 1029–1040. <https://doi.org/10.1111/jbi.13555>
- Clamote F, Silva V, Almeida JD (2017): *Senecio angulatus* L.f. - mapa de distribuição. Flora-On: Flora de Portugal Interactiva, Sociedade Portuguesa de Botânica. <http://www.flora-on.pt/#wSenecio+angulatus>
- Colautti, R. I. & MacIsaac, H. J. (2004). A neutral terminology to define “invasive” species. *Diversity and Distributions*, 10(2), 135–141. <https://doi.org/10.1111/j.1366-9516.2004.00061.x>
- Conservatoire botanique national méditerranéen (2025) SIMETHIS – module Flore [online]. <http://simethis.eu>.
- Consulta Plantas (2025) Care of the climbing plant *Senecio angulatus* or Creeping groundsel. <https://www.consultaplantas.com/index.php/en/plants-from-s-to-z/2714-senecio-angulatus-or-creeping-groundsel-care-and-growing>.
- Cron GV, van Wyk B-E, van Wyk B-E (2012) Asteraceae. *Bothalia* 24, 755, DOI: <https://doi.org/10.4102/abc.v24i1.755>.
- Dana ED, Verloove F, Alves P, Heiden G (2021) *Senecio brasiliensis* (Spreng.) Less. (Asteraceae), another potentially invasive alien species in Europe. *BioInvasions Records* **10**, 521–536.
- de Solan T, Fried G, Caillon A, Soubeyran Y, Albert A (2026) Integrating EICAT and EICAT+ assessments and expert knowledge to classify invasive alien plants in France, based on their ecological impact. *NeoBiota* **105**: 89-111. <https://doi.org/10.3897/neobiota.105.144928>
- Del Guacchio E, La Valva V (2017): The non-native vascular flora of Campania (southern Italy). *Plant Biosystems* **152**, 767–779. <https://doi.org/10.1080/11263504.2017.1338626>.

- Delucchi G, Bayón ND, Hurrell JA (2016): *Senecio angulatus* (Asteraceae, Senecioneae) naturalizada en la Argentina *Boletín de la Sociedad Argentina de Botánica* **51**, 169–177.
- Department of Sustainability and Environment (2001) Action Statement Flora and Fauna Guarantee Act 1988 No. 151. Late Helmet-orchid *Corysanthes* sp. Aff. *Dienenicus* (coastal)
- Domingues de Almeida J, Freitas H (2006) Exotic naturalized flora of continental Portugal – A reassessment. *Botanica Complutensis* **30**, 117–130.
- EFSA (European Food Safety Authority), 2016. Dietary exposure assessment to pyrrolizidine alkaloids in the European population. *EFSA Journal* **14**, 4572, 50 pp. doi:10.2903/j.efsa.2016.4572.
- EFSA Panel on Contaminants in the Food Chain (CONTAM); Scientific Opinion on Pyrrolizidine alkaloids in food and feed. *EFSA Journal* **2011**; **9**(11):2406, 134 pp. <https://doi.org/10.2903/j.efsa.2011.2406>. Available online: www.efsa.europa.eu/efsajournal
- EFSA CONTAM Panel (EFSA Panel on Contaminants in the Food Chain), Knutsen HK, Alexander J, Barregård L, Bignami M, Brüschweiler B, Ceccatelli S, Cottrill B, Dinovi M, Edler L, Grasl-Kraupp B, Hogstrand C, Hoogenboom LR, Nebbia CS, Oswald IP, Petersen A, Rose M, Roudot A-C, Schwerdtle T, Vleminckx C, Vollmer G, Wallace H, Gomez Ruiz JA and Binaglia M, 2017. Statement on the risks for human health related to the presence of pyrrolizidine alkaloids in honey, tea, herbal infusions and food supplements. *EFSA Journal* **2017**; **15**(7):4908, 34 pp. <https://doi.org/10.2903/j.efsa.2017.4908>
- El Mokni R, Iamónico D (2018) Three new records of Senecioneae (Asteraceae) for the allochthonous Tunisian flora: occurrence and taxonomic notes. *Flora mediterranea* **28**, 385–392.
- Elith J, Kearney M, Phillips S (2010) The art of modelling range-shifting species. *Methods in Ecology and Evolution*, **1**(4), 330–342. <https://doi.org/10.1111/j.2041-210X.2010.00036.x>
- EPPO (2026) EPPO Global Database. <https://gd.eppo.int/>
- EPPO (2025) *Senecio angulatus*. EPPO Global Database, <https://gd.eppo.int/taxon/SENAN>.
- EPPO (2024) Standard PM 3/98 (1) Inspection of growing media associated with consignments of plants for planting. *EPPO Bulletin* **54**, 289–305.
- EPPO (2023) EPPO Alert List – *Senecio brasiliensis* (Asteraceae) https://www.eppo.int/ACTIVITIES/plant_quarantine/alert_list_plants/senecio_brasiliensis
- EU (2019) Commission Implementing Regulation (EU) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation (EC) No 690/2008 and amending Commission Implementing Regulation (EU) 2018/2019. https://eur-lex.europa.eu/eli/reg_impl/2019/2072/oj/eng
- Flora of New Zealand (2004) *Senecio angulatus* L.f. <https://floraseries.landcareresearch.co.nz/taxa/7d6c92cd-3d0a-4991-9917-016255235ab6>.
- Flora of North America (2025) <https://floranorthamerica.org/Senecio>.
- Foden W, Potter L (2005) *Senecio angulatus* L. f. - National Assessment: Red List of South African Plants. <http://redlist.sanbi.org/species.php?species=3152-25>.
- Freeman EA, Moisen GG (2008) A comparison of the performance of threshold criteria for binary classification in terms of predicted prevalence and kappa. *Ecological Modelling*, **217**(1–2), 48–58. <https://doi.org/10.1016/j.ecolmodel.2008.05.015>
- Fried G (2010). Prioritization of potential invasive alien species in France. In: Brunel S, Uludag A, Fernandez-Galiano E, Brundu G (ed.) 2nd International Workshop Invasive Plants in the Mediterranean Type Regions of the World, 2010-08-02/06, Trabzon, Turkey, 120–138
- Fried G (2017). Guide des plantes invasives. Nouvelle Edition. Collection « L'indispensable guide des...Fous de Nature! (Ed. G. Eyssartier). Editions Belin, 302 p
- Fried G (2022). Inventaire de la flore spontanée du Jardin de la Villa Les Cèdres à Saint-Jean-Cap-Ferrat (Alpes-Maritimes, France). Evaluation des risques associés aux espèces exogènes et enjeux de conservation des espèces indigènes et des habitats. Rapport Anses – Laboratoire de la Santé des Végétaux, Montferrier-sur-Lez, 63 p.
- Galanos CJ (2015) The alien flora of terrestrial and marine ecosystems of Rodos island (SE Aegean), Greece. *Willdenowia* **45**, 261–278.
- Galasso G, Conti F, Peruzzi L, Ardenghi NGM, Banfi E, Celesti-Grapow L et al. (2018) An updated checklist of the vascular flora alien to Italy. *Plant Biosystems*, <https://doi.org/10.1080/11263504.2018.1441197>.
- Galasso G, Domina G, Andreatta S, Angiolini C, Ardenghi NMG, Aristarchi C et al. (2019) Notulae to the Italian alien vascular flora: 8. *Italian Botanist* **8**, 63–93.
- García-de-Lomas J, Sánchez-García I, Cózar A, Dana ED, Delgado AJ (2011) Nuevas aportaciones a la xenoflora de la provincia de Cádiz. *Lagascalia* **31**, 220–228.

- GBIF.org. (2025) Occurrence Download [Dataset]. The Global Biodiversity Information Facility. <https://doi.org/10.15468/DL.ENTZ83>
- GISD (2025) Global Invasive Species Database Species profile: *Senecio angulatus*. <http://www.iucngisd.org/gisd/species.php?sc=1603>.
- Gómez-Bellver C, Álvarez H, Sáez L (2016) New contributions to the knowledge of the alien flora of the Barcelona province (Catalonia, Spain). *Orsis* **30**, 167–189.
- Gómez-Bellver C, Nualart N, Bosch-Guiu A, Ibanez N, Lopez-Pujol J (2025) Cataloging the alien Flora of the Costa Brava (NE Iberian Peninsula): New findings and updates in a plant invasion hotspot. *Diversity* **17**, 160. <https://doi.org/10.3390/d17030160>.
- Goncalves E, Casimiro-Soriguer Solanas F, García-Caballero J, Hidalgo-Triana N (2023) Terrestrial alien flora of the Iberian Alboran Coast: Assessment, attributes, and future implications. *Diversity* **15**, 1120. <https://doi.org/10.3390/d15111120>.
- González Costales JA (2007) Plantas alóctonas invasoras en el Principado de Asturias. Consejería de Medio Ambiente, Ordenación del Territorio e Infraestructuras.
- Gottschalk C, Kaltner F, Zimmermann M, Korten R, Morris O, Schwaiger K, Gareis M (2020) Spread of *Jacobaea vulgaris* and occurrence of pyrrolizidine alkaloids in regionally produced honeys from northern Germany: inter- and intra-site variations and risk assessment for special consumer groups. *Toxins* **12**, 441. <https://doi.org/10.3390/toxins12070441>.
- Greuter W (2006+) Compositae (pro parte majore). – In: Greuter, W. & Raab-Straube, E. von (ed.), Compositae. Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity. <https://euoplusmed.org/>.
- Guéguen M, Blancheteau H, Lemaire-Patin R, Thuiller W (2012) biomod2: Ensemble Platform for Species Distribution Modeling (p. 4.3–4–3) [Computer software]. <https://doi.org/10.32614/CRAN.package.biomod2>
- Guillot Ortiz D, Laguna Lumbreras E, Rosselló Picornell JA (2013) Flora alóctona suculenta valenciana: el género *Senecio* L. *Bouteloua* **14**, 140–149.
- Hadjikyriakou GN, Charalambos RH, Christodoulou S, Makris M, Chrysostomou G, Iosif K, Kefalas K (2025) New noteworthy records of flowering plants in Cyprus (1996–2024) *Cypricola* **25** 1–13.
- Iamonico D (2017) Alien taxa of the tribe Senecioneae (Asteraceae) in Italy: a nomenclatural synopsis. *Hacquetia* **16**, 281–292.
- Iamonico D, Maglio M (2008) Notula 1504 - *Senecio angulatus* (p. 258). *Informatore Botanico Italiano* **40**, 294–264.
- IPPC (2021) International movement of growing media in association with plants for planting. FAO, Rome, IT.
- iNaturalist (2025) *Senecio angulatus*. <https://www.inaturalist.org/>.
- Jeanmonod D, Burdet H-M (1996) Notes et contributions à la flore de Corse XII. *Candollea* **51**, 515–557.
- Jeanmonod D, Gamisans J (2013) Flora Corsica, ed. 2. *Bulletin de la Société Botanique du Centre-Ouest* **39**, 1–1074.
- Jeanmonod D, Schlüssel A, Gamisans J (2011) Status and trends in the alien flora of Corsica. *EPPO Bulletin* **41**, 85–99, <https://doi.org/10.1111/j.1365-2338.2011.02440.x>
- Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder HP, Kessler M (2017) Climatologies at high resolution for the earth's land surface areas. *Scientific Data*, **4**(1), 170122. <https://doi.org/10.1038/sdata.2017.122>
- Khamar H, El Bakhouch H (2024) *Senecio angulatus* L.f. (Asteraceae) a new addition to the Moroccan flora *Acta Botanica Malacitana* **49**, DOI: <https://doi.org/10.24310/abm.49.2024.19692>.
- Kowalczyk E, Kwiatek K (2018) Pyrrolizidine Alkaloids in Honey: Determination with Liquid Chromatography-mass Spectrometry Method. *Journal of Veterinary Research*, **62**, 173–181.
- Kroatiens Fauna und Flora (2024) *Senecio angulatus* Linné f., 1782. https://kroatiens-fauna-und-flora.org/index.php?title=Senecio_angulatus_Linn%C3%A9_f._1782.
- Lapraz G (1970) Les groupements forestiers et les garrigues du Mont-Boron et du Mont-Alban (Alpes-Maritimes). Première partie: flore et phytosociologie. *Riviera scientifique* **57**, 51–64.
- Lapraz G (1974) Les vestiges de l'Oleo-Lentiscetum du Cap Ferrat. *Riviera scientifique* **4**, 81–94. <https://www.calameo.com/read/00508281365143cc6e3bc>.
- Lapraz G (1979) La végétation des rochers maritimes entre Nice et Menton: le Crithmo-Limonietum cordati, *Bulletin de la Société Botanique de France. Lettres Botaniques* **126**, 87 – 94
- Lazzaro L, Foggi B, Ferretti G, Brundu G (2016) Priority invasive alien plants in the Tuscan Archipelago (Italy): comparing the EPPO prioritization scheme with the Australian WRA. *Biol Invasions* (2016) **18**:1317–1333

- Manning JC, Goldblatt P (2012): Asteraceae: *Senecio* L. Plants of the Greater Cape Floristic Region 1: The Core Cape flora. *Strelitzia* **29**, 415–423.
- Manservigi L, Losi E, Gonzalez-Salazar M, Castorino GA, Spina PR, Venturini M (2024) Impact of climate change on solar PV potential in Europe. 37th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2024), 593–604.
<https://doi.org/10.52202/077185-0051>
- Marchante H, Morais M, Freitas H, Marchante E (2014) Guia prático para a identificação de Plantas Invasoras em Portugal. Coimbra. Imprensa da Universidade de Coimbra. 207 pp.
- McAlpine KG, Howell CJ (2024) List of environmental weeds in New Zealand 2024. Science for Conservation 340. Department of Conservation, Wellington. 37 p.
- Meinshausen M, Nicholls ZRJ, Lewis J, Gidden MJ, Vogel E, Freund M, Beyerle U, Gessner C, Nauels A, Bauer N, Canadell JG, Daniel JS, John A, Krummel PB, Luderer G, Meinshausen N, Montzka SA, Rayner PJ, Reimann S, Wang RHJ (2020) The shared socio-economic pathway (SSP) greenhouse gas concentrations and their extensions to 2500. *Geoscientific Model Development*, **13**(8), 3571–3605.
<https://doi.org/10.5194/gmd-13-3571-2020>
- Miara MD, Boutabia L, Salah T, Vêla E (2018) Apparition de *Senecio angulatus* (Asteraceae) en Algérie. *Flora Mediterranea* **28**, 111–118.
- Mifsud S (2007) Online Flora of the Maltese Islands (2002-2025): *Senecio angulatus* - datasheet published on Dec-2007. <https://www.MaltaWildPlants.com/ASTR/#ASTR>.
- Milović M, Mitić B, Alegro A (2010) New neophytes in the flora of Croatia. *Natura Croatica* **19**, 407–431.
- Misuri A, Mugnai M, Giunti M, Dell’Olmo L, Lazzaro L (2024) Invasive alien plants at Capraia Island (Italy): distribution and threats to Natura 2000 habitats. *Plant Sociology* **61**, 31–44,
<https://doi.org/10.3897/pls2024611/02>.
- Motti R, Esposito A, Stinca A (2018) New additions to the exotic vascular flora of Campania (southern Italy). *Annali di Botanica* (Roma) **8**, 75–85.
- New Zealand Plant Conservation Network (2025) *Senecio angulatus*.
<https://www.nzpcn.org.nz/flora/species/senecio-angulatus/>.
- Newton PM (1996) Effective control of creeping groundsel (*Senecio angulatus*). In: Proceedings of the 11th Australian Weeds Conference, Melbourne, Australia, 30 September - 3 October 1996 [ed. by Shepherd, R.C.H.]. Victoria, Australia: Weed Science Society of Victoria Inc. 444–445.
- Nikolić T (2015+) Flora Croatica Database. Department of Botany, Faculty of Science, University of Zagreb. <http://hirc.botanic.hr/fcd>.
- Otto R, Verloove F (2016) New xenophytes from La Palma (Canary Islands, Spain), with emphasis on naturalized and (potentially) invasive species. *Collectanea Botanica* **35**, e001,
<http://dx.doi.org/10.3989/collectbot.2016.v35.001>.
- Pasta S., Perez-Graber A., Fazan L. and Montmollin B. de (Eds). 2017. The Top 50 Mediterranean Island Plants UPDATE 2017. IUCN/SSC/Mediterranean Plant Specialist Group. Neuchâtel (Switzerland). E-book and on line. 141 pp. top50.iucn-mpsg.org
- Phillips S (2021) maxnet: Fitting “Maxent” Species Distribution Models with “glmnet” (Version R package version 0.1.4) [Computer software]. <https://CRAN.R-project.org/package=maxnet>
- Phillips SJ, Dudík M, Elith J, Graham CH, Lehmann A, Leathwick J, Ferrier S (2009). Sample selection bias and presence-only distribution models: Implications for background and pseudo-absence data. *Ecological Applications: A Publication of the Ecological Society of America*, **19**(1), 181–197.
<https://doi.org/10.1890/07-2153.1>
- Poggio L, De Sousa LM, Batjes NH, Heuvelink GB, Kempen B, Ribeiro E, Rossiter D (2021) SoilGrids 2.0: Producing soil information for the globe with quantified spatial uncertainty. *Soil*, **7**(1), 217–240.
- Portale della Flora d'Italia (2025) *Senecio angulatus* L.f.
https://dryades.units.it/floritaly/index.php?procedure=taxon_page&tipo=all&id=5811.
- Porter LA, Geissman TA (1962) Angularine, a new pyrrolizidine alkaloid from *Senecio angulatus* L. *Journal of Organic Chemistry* **27**, 4132–4134.
- POWO (2025) *Senecio angulatus* L.f. Plants of the World Online,
<https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:243791-1>.
- Randall RP (2007) A Global Compendium of Weeds, (3rd Edition) [ed. by Randall, R.P.]. Perth, Western Australia.
- Reinhard, A., Janke, M., von der Ohe, W. et al. Feeding Deterrence and Detrimental Effects of Pyrrolizidine Alkaloids Fed to Honey Bees (*Apis mellifera*). *J Chem Ecol* **35**, 1086–1095 (2009).
<https://doi.org/10.1007/s10886-009-9690-9>

- Robison R, DiTomaso JM (2010) Distribution and community associations of Cape Ivy (*Delairea odorata*) in California. *Madroño* **57**, 85–94.
- Rossini Oliva S, Raimondo FM, Valdés B (2003) The ornamental flora of Western Sicily. *Boccone* **16**, 1171–1176.
- Roy B, Popay I, Champion P, James T, Rahman A (1998) An Illustrated Guide to Common Weeds of New Zealand. Canterbury, New Zealand: New Zealand Plant Protection Society.
- SANBI (2025) *Senecio angulatus* L.f. <https://biodiversityadvisor.sanbi.org/search/detail/607bcf12-afe9-4b5e-b2e7-b878bb232e98#>.
- Sánchez Gullón E, Verloove F, Silva V (2017) New records of interesting xenophytes in the Iberian Peninsula.VII. *Folia Botanica Extremadurensis* **11**, 39–50.
- Schrader G, MacLeod A, Mittinty M, Brunel S, Kaminski K, Kehlenbeck H, Petter F, Baker R (2010) Enhancements of pest risk analysis techniques. *EPPO Bulletin* **40**, 107–120.
- Scott P (2001) The reproductive strategies of scandent groundsels *Senecio angulatus* and *Senecio mikanioides* (Asteraceae, Senecioneae). <https://ir.wgtn.ac.nz/handle/123456789/21427>.
- Šegota V Rimac A, Alegro A, Radosavljević P (2021) New localities of alien plant species *Senecio angulatus* (Asteraceae) in Croatia. 4th Croatian Symposium on Invasive Species. Zagreb: Hrvatsko ekološko društvo, 2021, p. 73.
- Scholz, H., Betancort, J. A. R., de la Torre, W. W., & Scholz, S. (2004). Adiciones a la flora vascular de Fuerteventura (Islas Canarias). *Botánica Macaronésica*, (25), 165–174.
- Silva V, Figueiredo E, Smith GF (2015) Alien succulents naturalized and cultivated on the central west coast of Portugal. *Bradleya* **33**/2015, 58–81.
- Sohrabi S, Gherekhloo J, Hassanpour-Bourkheili S, Ghaderi-Far F, Siahmarguee A, Taheri M, Atashii S (2025) Allelopathic potential impact of *Senecio angulatus* L.F. on native plants. *Plant Signaling & Behavior* **20**, 2526886.
- Son SH, Jo AR, Kim DE (2021) Current status of alert alien species management for the establishment of proactive management systems in Korea. *Journal of Ecology and Environment*. <https://doi.org/10.1186/s41610-021-00204-y>
- Stegelmeier BL, Edgar JA, Colegate SM, Gardner DR, Schoch TK, Coulombe RA, Molyneux RJ (1999) Pyrrolizidine alkaloid plants, metabolism and toxicity. *Journal of Natural Toxins* **8**, 95–116
- Stinca A, Musarella CM, Rosati L, Laface VLA, Licht W, Fanfarillo E, Wagensommer RP, Galasso G, Fascetti S, Esposito A, et al. (2021) Italian vascular flora: new findings, updates and exploration of floristic similarities between regions. *Diversity* **13**, 600. <https://doi.org/10.3390/d13110600>.
- Tan K, Kofinas G, Zarkos G (2025) Taxonomy and distribution of three alien species of *Senecio* s.l. (Asteraceae) in Greece. *Phytologia Balcanica* **31**, 75–80.
- The Australasian Virtual Herbarium (2025) Map of *Senecio angulatus*. https://avh.ala.org.au/occurrences/search?taxa=Senecio+angulatus#tab_mapView.
- Thompson IR (2006) A taxonomic treatment of tribe Senecioneae (Asteraceae) in Australia. *Muelleria* **24**, 51–110.
- Thuiller, W., Georges, D., Gueguen, Engler, R., Breiner, F., Lafourcade, B., & Patin, R. (2024). biomod2: Ensemble platform for species distribution modeling (Version R package version 4.2-5-2) [Computer software]. <https://CRAN.R-project.org/package=biomod2>
- Tison J-M, de Foucault B (2014): Flora Gallica. Flore de France. Editions Biotope, Mèze, 1196 p.
- Tison J-M, Jauzein P, Michaud H (2014): Flore de la France méditerranéenne continentale. Naturalia Publications, 2080 p.
- Ugarte E, Lira F, Fuentes N, Klotz S (2011) Vascular alien flora, Chile. Check List **7**, 365–382.
- USDA PLANTS Database (2025): <https://plants.usda.gov/>.
- USDA-APHIS (2013) Weed Risk Assessment for *Senecio angulatus* L. f. (Asteraceae) - Cape-ivy. https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra/Senecio_angulatus_WRA.pdf USDA-ARS-GRIN, 2023. <https://npgsweb.ars-grin.gov/gringlobal/taxon/taxonomydetail?id=447151>.
- Venter O, Sanderson EW, Magrach A, Allan JR, Beher J, Jones KR, Possingham HP, Laurance WF, Wood P, Fekete BM, Levy MA, Watson JEM (2016) Sixteen years of change in the global terrestrial human footprint and implications for biodiversity conservation. *Nature Communications* **7**(1), 12558. <https://doi.org/10.1038/ncomms12558>
- Verloove (2024) An update on the non-native flora of Crete (Greece). *Phytologia Balcanica* **30**, 315–326.
- Vilatersana R, Sanz M, Galian A, Castells E (2016) The invasion of *Senecio pterophorus* across continents: Multiple, independent introductions, admixture and hybridization. *Biological Invasions* **18**, 2045–2065.

- Webb CJ, Sykes W, Garnock-Jones PJ (1988) Flora of New Zealand. Vol. IV. Naturalised Pteridophytes, Gymnosperms, Dicotyledons. Botany Division DSIR, Christchurch.
- Weber E (2017) Invasive plant species of the world: a reference guide to environmental weeds. CABI Wallingford and Boston, 581 pp.
- Weber E, Gut D (2004) Assessing the risk of potentially invasive plant species in central Europe. *Journal for Nature Conservation*. **12**, 171-179.
- Weedbusters (2025) Weed Information Sheet - Cape ivy. <https://www.weedbusters.org.nz/what-are-weeds/weed-list/cape-ivy/>
- Weeds of Australia (2016) Fact Sheets of *Senecio angulatus*. https://keyserver.lucidcentral.org/weeds/data/media/Html/senecio_angulatus.htm.
- Williams PA, Hayes L (2007) Emerging weed issues for the West Coast Regional Council and their prospects for biocontrol. Landcare Research New Zealand Ltd.
- Yıldız K, Haşayacak H (2025) A new alien species record for the Flora of Türkiye: [*Senecio angulatus* (Kap Sarmaşığı) / Asteraceae]. *Bağbahçe Bilim Dergisi* **12**, 1–7.
- Zizka A, Silvestro D, Andermann T, Azevedo J, Duarte Ritter C, Edler D, Farooq H, Herdean A, Ariza M, Scharn R, Svantesson S, Wengström N, Zizka V, Antonelli A (2019). CoordinateCleaner: Standardized cleaning of occurrence records from biological collection databases. *Methods in Ecology and Evolution*, **10**(5), 744–751. <https://doi.org/10.1111/2041-210X.13152>

Appendix 1. Climatic suitability modelling for *Senecio angulatus* establishment in the EPPO region

Aim

To project the climatic suitability for potential establishment of *Senecio angulatus* in Europe and the Mediterranean region, under current and predicted future climatic conditions.

Distribution data

Species occurrence data were primarily obtained from the Global Biodiversity Information Facility (GBIF.org, 2025), with additional occurrence records obtained from the Atlas of Living Australia, Integrated Digitized Biocollections (iDigBio), Conservatoire Botanique National Méditerranéen (CBNMed), and other reliable records of established populations provided by the Expert Working Group performing the risk assessment.

The records were scrutinized to remove any considered of dubious quality (e.g., known or suspected casual or cultivated occurrences, imprecise or bad coordinates, no date or older than 1980, co-located with herbaria or botanic gardens, country or province centroids), including use of R package CoordinateCleaner to remove dubious records (Zizka et al., 2019). During this process it was noted that nearly all inland records of the species in Europe come from GBIF via the Pl@ntNet Automatically Identified Occurrences dataset. As these have no human verification and we suspected many or most inland European records were cultivated plants, all data from Pl@ntNet were omitted from the modelling.

Based on the PRA and Plants of the World Online (<https://powo.science.kew.org/>), records were assigned as being native if occurring inside South Africa, excluding a single isolated record in the north of the country that we assumed was an introduction. All other records were considered non-native.

The records were gridded at a 1/12-degree resolution for modelling (5 arcminutes, approximately 6 x 9 km in central Europe) (Figure 1a). This resulted in 1010 grid cells containing valid occurrence records of *S. angulatus* (Figure 1a), which is considered sufficient for distribution modelling.

Additionally, as a proxy for spatial recording effort bias, the recording density of vascular plants (phylum Tracheophyta) on the Global Biodiversity Information Facility was obtained (Figure 1b).

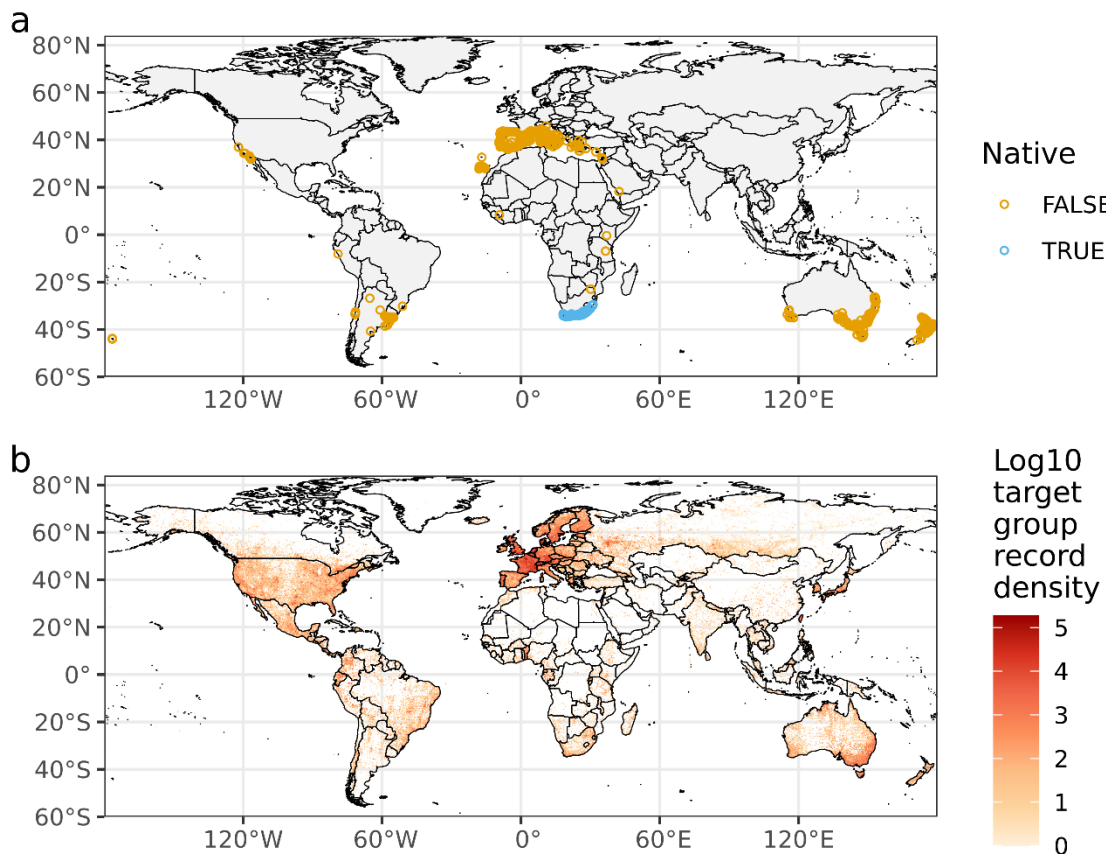


Figure 1. (a) Occurrence records used for modelling *Senecio angulatus*, showing the native and non-native records (an interactive version is at <https://rpubs.com/dc55/1389741>). (b) A proxy for recording effort – the number of post-1980 vascular plant (Tracheophyta) records held by the Global Biodiversity Information Facility, displayed on a log10 scale. White areas have no Tracheophyte records.

Predictor variables

Predictor variables were selected based on the life history and habitat requirements of *S. angulatus* and likely limiting factors for establishment in Europe.

There was little available data on these, but based on the PRA, we selected a set of variables on the premise that the species had an affinity for warm and arid coastal climates such as those in the Mediterranean region. All climate predictors were derived from Chelsa V2.1 (Karger et al., 2017), and soil predictors at 5-15 cm depth were from SoilGrids 2.0 (Poggio et al., 2021). Highly right-skewed variables were log transformed to reduce the leverage of very extreme values on the models.

- **Growing degree days heat sum above 10 °C** (gdd10 °C) as a measure of growing season thermal regime.
- **Solar irradiance** (solar MJ m⁻² yr⁻¹) as the species prefers full sun exposure.
- **Mean temperature of the coldest quarter** (bio11 °C). *S. angulatus* is sensitive to prolonged exposure to low temperatures and frost.
- **Mean precipitation of the warmest quarter** (bio18, mm month⁻¹ log(x+1) transformed).
- **Mean precipitation of the coldest quarter** (bio19, mm month⁻¹ log(x+1) transformed) during which period *S. angulatus* flowers.
- **Soil pH** (soil_pH) in water.
- **Soil coarse fragments** (soil_coarse) as the volumetric fraction of fragments > 2 mm.
- **Soil sand content** (soil_sand) as the % sand in the fine earth fraction.
- **Soil organic carbon** (soil_carbon g kg⁻¹) as the organic carbon content of fine earth.

- **Distance to coastline** (coast km) derived from OpenStreetMap (<https://osmdata.openstreetmap.de/data/coastlines.html>), reflecting availability of preferred coastal habitats.
- **Human footprint index** ($\log(x+1)$ transformed) (Venter et al., 2016) estimating the direct and indirect human pressures on the environment, including built-up environments, population density, electric power infrastructure, crop lands, pasture lands, roads, railways, and navigable waterways.

Overall these variables had low collinearity ($VIF < 8$) except `bio_11` which had $VIF = 11.6$. However, this variable was retained for modelling because of its clear biological significance.

To estimate the effect of climate change on the potential distribution, equivalent modelled future climate conditions for 2041-2070 were obtained for two IPCC Coupled Model Intercomparison Project 6 (CMIP6) scenarios, or Shared Socioeconomic Pathways (SSPs) (Meinshausen et al., 2020):

- **SSP1-2.6** is an optimistic low-emissions scenario in which atmospheric CO_2 concentration peaks below 450 ppm in the mid-21st century and then falls slightly. The estimated warming by around 2050 is 1.7°C.
- **SSP3-7.0** is a high emissions scenario for a world that fails to act to limit warming. Atmospheric CO_2 concentrations rise to approximately 850 ppm by 2100. The estimated warming by around 2050 is 2.1 °C.

For both SSPs, the climate variables for modelling were obtained as averages of outputs of five Global Climate Models (NOAA's GFDL-ESM4, UK Met Office's UKESM1-0-LL, Max Planck Institute's MPI-ESM1-2-HR, Institut Pierre Simon Laplace's IPSL-CM6A-LR, and Meteorological Research Institute's MRI-ESM2-0), downscaled and calibrated against the Chelsa baseline.

There was no available future projection for solar irradiance, and so current day values were used for the future projections. This was deemed acceptable since current projections suggest climate change impacts on solar irradiance will be very small and spatially heterogeneous (decreasing by 1.4% in Europe; Manservigi et al., 2024).

Species distribution model

The modelling methodology was a modification of standard presence-background (presence-only) ensemble distribution modelling developed for emerging invasive non-native species at a global scale (Chapman et al., 2019). This method attempts to account for dispersal constraints on non-equilibrium invasive species' global distributions. It does this by excluding locations that may be environmentally suitable but where the species has not been able to disperse to.

To achieve this, background samples (pseudo-absences) were sampled from two distinct background regions:

- An **accessible background** includes places close to *S. angulatus* populations, in which the species is likely to have had sufficient opportunity to disperse to (Barve et al., 2011). The accessible background was defined as a 200 km buffer around the native range (minimum convex polygon bounding native occurrences) and a 15 km buffer around non-native occurrences. Sampling was more restrictive from the invaded range to account for stronger dispersal constraint over a shorter residence time. In previous testing, the buffer radii did not substantively affect the model projections (Chapman et al., 2019).
- An **unsuitable background** includes places expected to be physiologically unsuitable for the species, so that absence will be irrespective of dispersal constraints. There was little available ecophysiological data from the literature, so extreme values at the occurrence locations were used to define unsuitable conditions as:
 - Growing degree days **gdd10** < 750 or > 4000 , reflecting growing seasons too cold or with too much heat stress.
 - Solar irradiance **solar** $< 1600 MJ m^{-2}$, reflecting low light availability at high latitudes.
 - Mean temperature of the coldest quarter **bio11** < 6 °C, reflecting prolonged exposure to low temperature.

- Precipitation of the warmest quarter **bio18** < **10 mm month⁻¹**, reflecting an avoidance of very arid summers.
- Precipitation of the coldest quarter **bio19** < **70 mm month⁻¹**, reflecting an avoidance of very arid winters.

Of the 1010 occurrences, 57 (5.6%) fell in the unsuitable background, which was deemed acceptable since the occurrence data probably contained some cultivated records in unsuitable areas.

For modelling, two replicate random background samples were obtained as follows:

- From the **accessible background** 5000 samples were drawn. Sampling was performed with realistic recording bias using the target group approach (Phillips et al., 2009) in which sampling was weighted by GBIF Tracheophyte recording density (Figure 1b).
- From the **unsuitable background** 5000 simple random samples were taken. Sampling was not adjusted for recording biases as we are more confident of unsuitability in these regions.

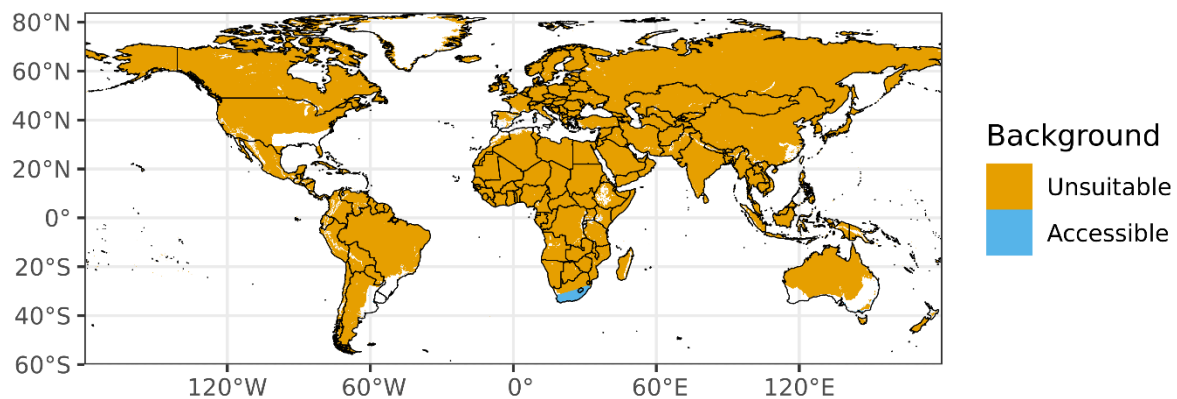


Figure 2. The background regions from which ‘pseudo-absences’ were sampled for modelling. The accessible background is assumed to represent the range of environments the species has had chance to sample. The unsuitable background is assumed to be environmentally unsuitable for the species.

Using these data, a presence-background (presence-only) ensemble modelling workflow was implemented using the BIOMOD2 R package v4.3-4-3 (Guéguen et al., 2012; Thuiller et al., 2024). Each of the two replicate datasets (presences and each individual background sample) was randomly split into 80% for model training and 20% for model evaluation. Then the following statistical algorithms were fitted with the default BIOMOD2 ‘bigboss’ algorithm settings, changed where indicated:

- **ANN:** Artificial neural network
- **GAM:** Generalized additive model, with a fixed smoothing parameter of $k=4$.
- **GBM:** Generalized boosting model
- **GLM:** Generalized linear model
- **Maxnet:** Maximum Entropy (Maxent) in the maxnet R package (Phillips, 2021).
- **XGBOOST:** eXtreme Gradient Boosting Training.
-

Prevalence weights were applied to give equal overall importance to the occurrences and the background. Normalized variable importance was assessed, and variable response functions were produced using BIOMOD2’s default procedure.

Model predictive performance was assessed by calculating the True Skill Statistic (TSS, i.e., sensitivity + specificity - 1) and Area Under the Receiver-Operator Curve (AUC, i.e., probability a background point has a lower suitability than an occurrence point) for model predictions on the evaluation data reserved from model fitting.

An ensemble model was created by weighting each algorithm by its TSS and averaging over the model replicates.

Global model projections of the ensemble model were then made for the current climate and for the two climate change scenarios. These projections were partitioned into suitable and unsuitable regions using a threshold that ensured a required sensitivity of 0.9 (i.e. 90% of occurrences predicted as suitable). This was done so that there was high confidence that the areas highlighted as suitable could support the occurrence of the species (Freeman & Moisen, 2008).

Limiting factor maps were produced for the native range and the EPPO region following Elith et al. (2010). Limiting factors for each grid cell were estimated as the predictor giving the greatest increase in suitability when it was changed to a near-optimal value (median value in the occurrence grid cells).

Results and Discussion

The model suggested that *S. angulatus* suitability was strongly determined by climate and availability of coastal and anthropogenic habitats (Table 1). The strongest climatic predictors were winter temperature (bio_11) and growing degree days (gdd10) (Table 1), with suitability strongly restricted by low winter temperatures and excessively high GDD (Figure 3). Coastal and anthropogenically impacted areas were also preferred (Figure 3). Of the remaining predictors, solar irradiance and soil organic carbon had appreciable effects in the model, with the other variables having very small effects (Table 1, Figure 3).

Table 1. Cross-validation predictive performance (AUC = Area Under the Receiver-Operator Curve and TSS = True Skill Statistic) and variable importances (%) of the model algorithms and ensemble. Importance values are normalised to sum to 100%.

Algorithm	AUC	TSS	Variable importance (%)									
			Growing degree days (gdd10)	Temperature of coldest quarter (bio_11)	Solar irradiance (solar)	Precipitation of warmest quarter (log_bio_18)	Precipitation of coldest quarter (log_bio_19)	Soil pH	Soil coarse fragments	Soil sand content	Soil organic carbon	Human footprint
ANN	0.861	0.587	19.3	42.9	3.5	0.2	0.9	0.5	0.6	1.0	6.0	8.2
GAM	0.864	0.603	27.7	43.3	9.4	0.3	1.4	1.6	0.9	0.3	4.8	4.7
GBM	0.858	0.593	6.2	15.9	6.0	0.3	1.7	0.5	0.2	1.1	2.8	18.5
GLM	0.863	0.618	16.2	49.7	10.7	0.2	2.9	1.5	0.7	0.4	5.8	4.8
MAXNET	0.865	0.617	11.6	25.7	6.8	0.7	1.1	1.2	0.6	0.7	9.7	17.2
XGBOOST	0.849	0.587	5.5	33.7	3.2	0.0	0.4	0.0	0.0	0.0	0.8	20.0
Ensemble	0.865	0.613	14.2	38.1	5.1	0.1	0.8	0.8	0.4	0.4	5.1	13.7

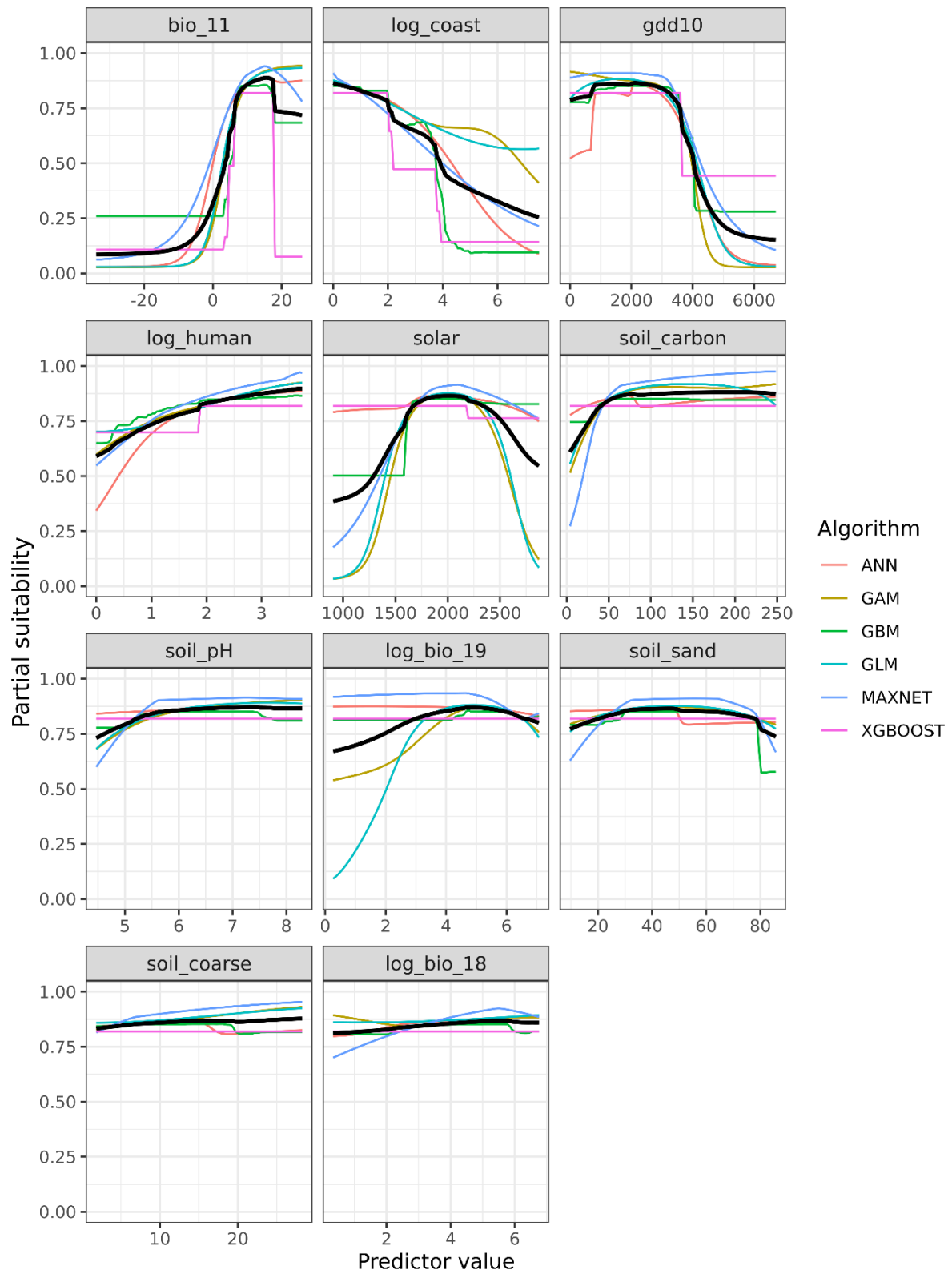


Figure 3. Partial response curves from the individual algorithms and ensemble model (thick black lines), ordered from most to least important. In each plot, other model variables are held at their median value in the training data. Variable codes are as in Table 1.

Global projection of the ensemble model in current climatic conditions using a 90% sensitivity suitability threshold showed very low suitability in most inland areas globally (Figure 4). The native region in South Africa was well delineated (Figure 4). Limiting factor analysis suggested that the native range was most strongly determined by availability of coastal habitat (distance to the coast in Figure 6a), although northward expansion up the eastern coast of South Africa was limited by high temperature (high GDD).

The non-native range was also relatively well captured in the model. Invaded areas of Australasia and South America were suitable (Figure 4). However, it predicted suitability in coastal Japan, where the species is not yet known to occur. In the EPPO region, the model predicts a suitable area spanning most of the Mediterranean coastline as well as along the southern Black Sea and western Atlantic coastlines (Figure 5). This encompasses the region where the species is already recorded but suggests potential for further invasion of coastal areas in regions such as North Africa, the Middle East, Türkiye and France. There are also small pockets of marginal suitability on the southern coast of Great Britain.

Cold winter temperatures limit suitability in most inland parts of Europe (Figure 6b). The main exception to this is inland parts of Iberia and France, where availability of coastal habitats is the limiting factor. Additionally, low solar radiation is the model's limiting factor in much of Great Britain.

Predictions for 2041-2070, under both the moderate SSP1-2.6 and more extreme SSP3-7.0 climate change scenarios, suggest relatively little change in the suitability maps (Figures 7 and 8). There are slight northwards shifts in suitability around the coastline so that marginally suitable conditions appear further north in Great Britain and around the Black Sea. Conversely, there are reductions in suitability in North Africa and the southernmost parts of Mediterranean Europe.

These results are reflected in the suitability of different European Biogeographical Regions (Bundesamt für Naturschutz (BfN), 2003). Regions highly suitable for establishment in the current climate are Macaronesia, Mediterranean, the Black Sea and the Atlantic (Figure 9). By 2041-2070, overall modelled suitability remains similar in all of these, but with slight reductions in Macaronesia and slight increases in the Atlantic and Black Sea (Figure 9).

Table 2 provides a similar breakdown by EPPO member countries, showing relatively little change in projected suitability for most countries. Small island EPPO members are highlighted as most suitable overall (e.g., Jersey, Guernsey, Malta), though this reflects that the majority of their land area is coastal. Larger countries with highly suitable coastlines are also ranked highly in Table 2, e.g., Greece, Portugal, Italy, Albania and Spain.

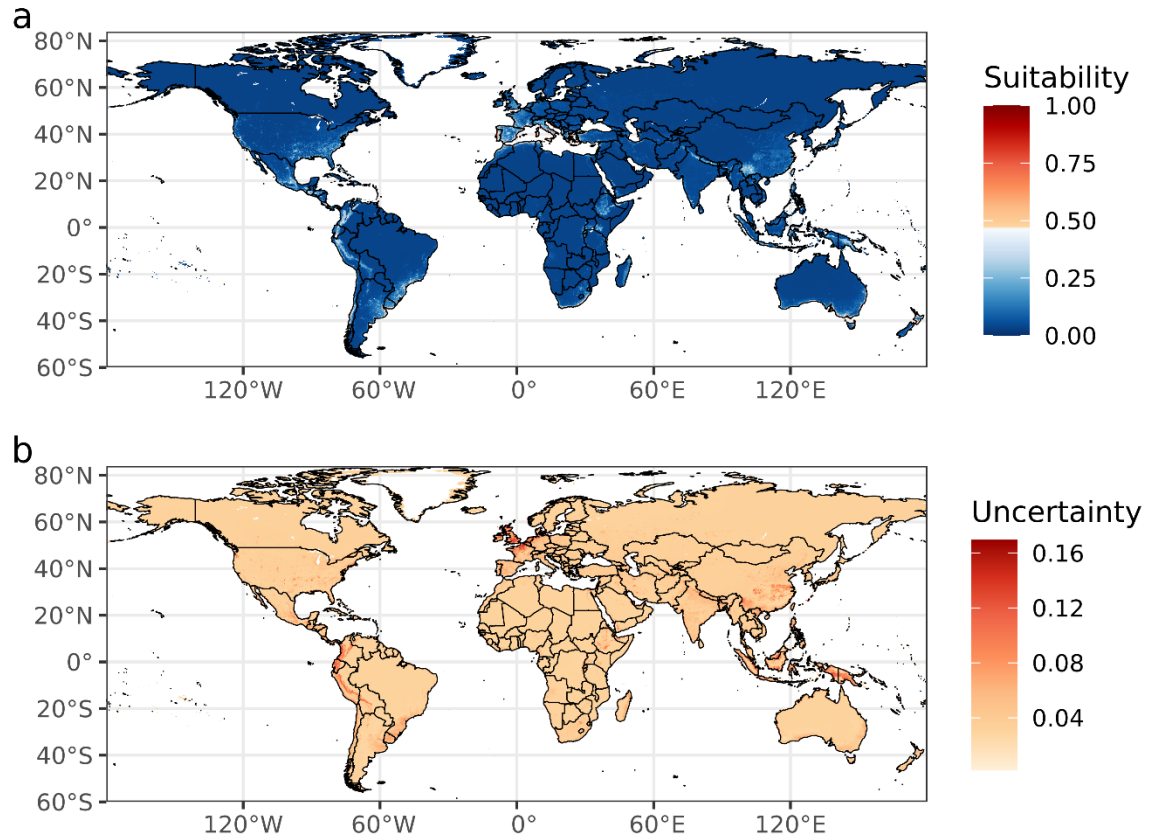


Figure 4. (a) Projected global suitability for *Senecio angulatus* establishment in the current climate. For visualisation, the projection has been aggregated to a 0.25 x 0.25 degree resolution, by taking the maximum suitability of constituent higher resolution grid cells. Red shading indicates suitability, according to the selected threshold. A full resolution interactive version is at <https://rpubs.com/dc55/1389739>. (b) Uncertainty in the suitability projections, expressed as the coefficient of variation (standard deviation / mean) among projections from different algorithms.

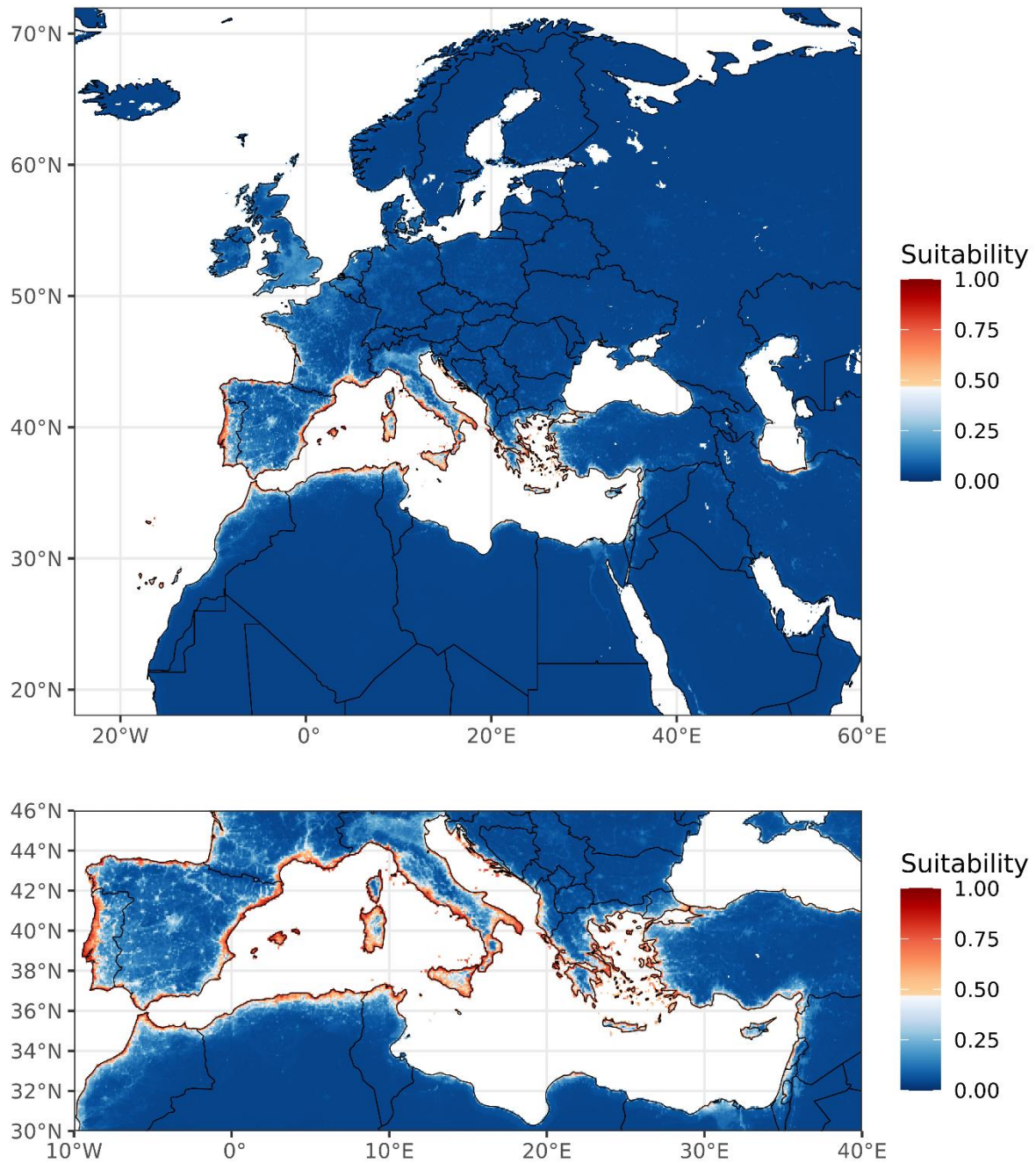


Figure 5. Projected current suitability for *Senecio angulatus* establishment in Europe and the Mediterranean region, with a zoomed in view of the Mediterranean coast (see interactive version at <https://rpubs.com/dc55/1389739>).

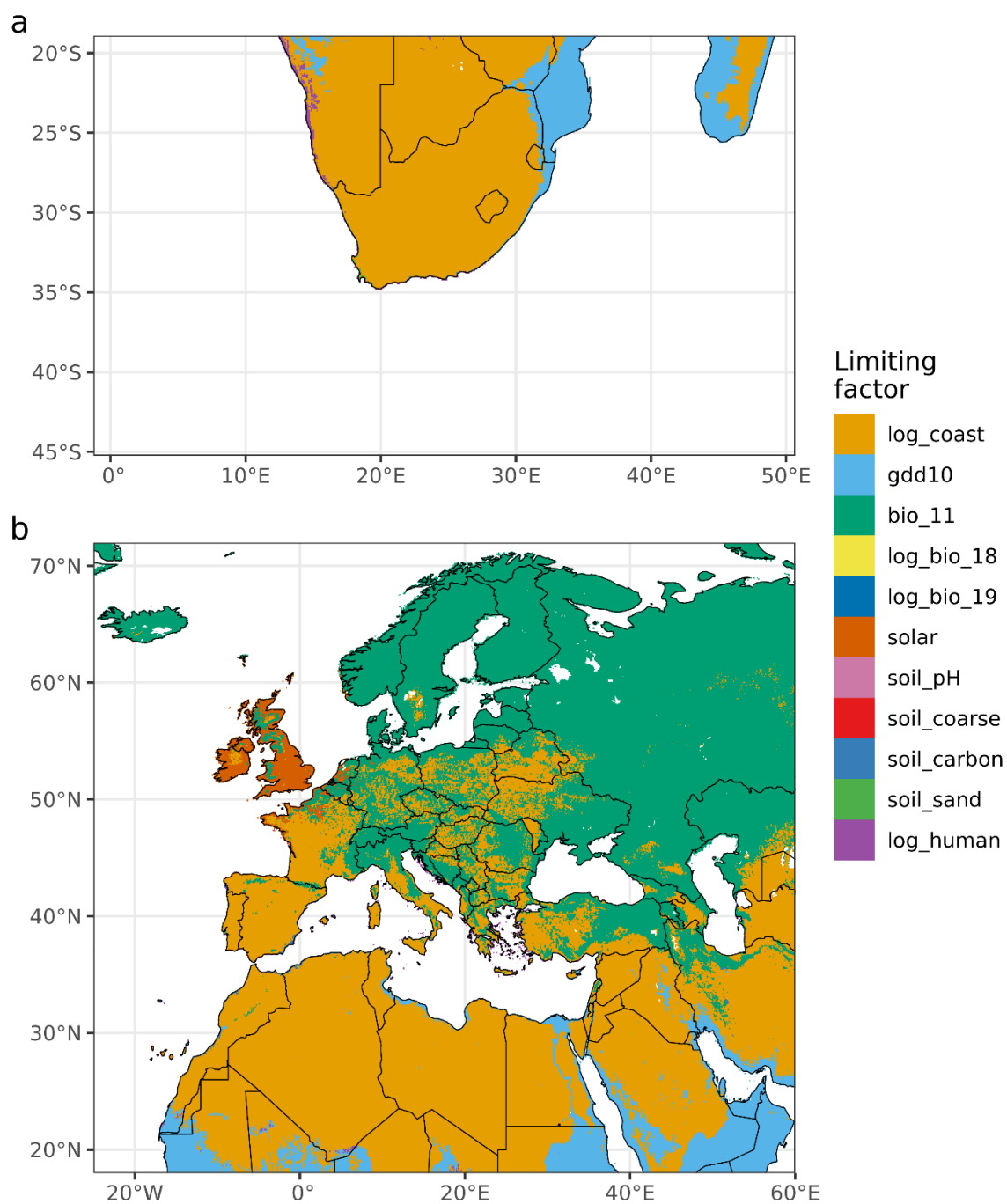


Figure 6. Limiting factor maps projected by the model for *Senecio angulatus* in (a) its native range and (b) the Europe and the Mediterranean region, under the current climate and land use. Colours show the variable most strongly limiting suitability in the model.

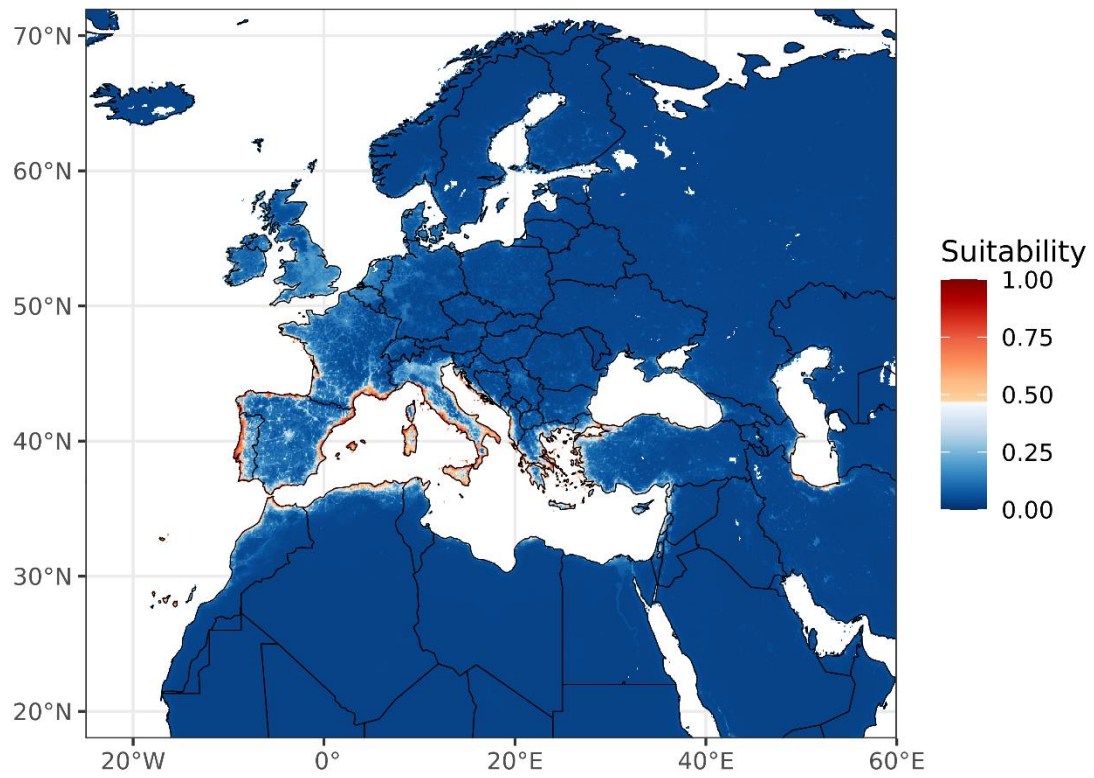


Figure 7. Projected suitability for *Senecio angulatus* for 2041-2070 under the ‘best case’ climate change scenario SSP1-2.6 (interactive version at <https://rpubs.com/dc55/1389739>).

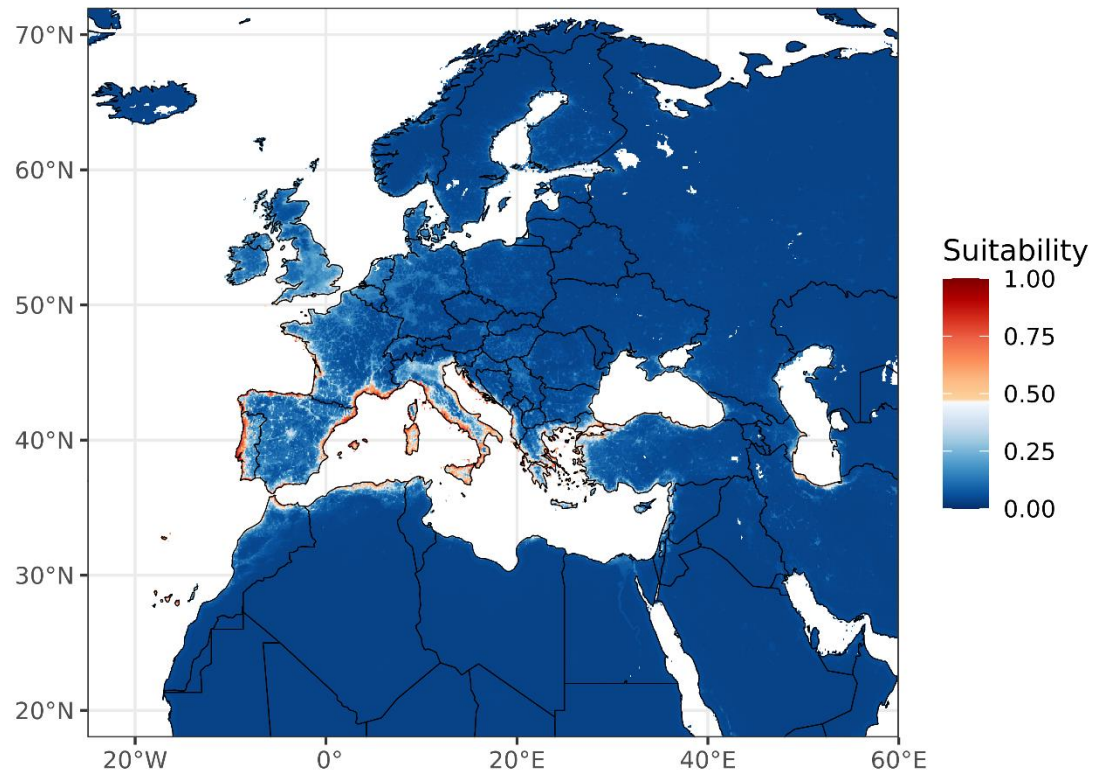


Figure 8. Projected suitability for *Senecio angulatus* for 2041-2070 under the climate change scenario SSP3-7.0 (interactive version at <https://rpubs.com/dc55/1389739>).

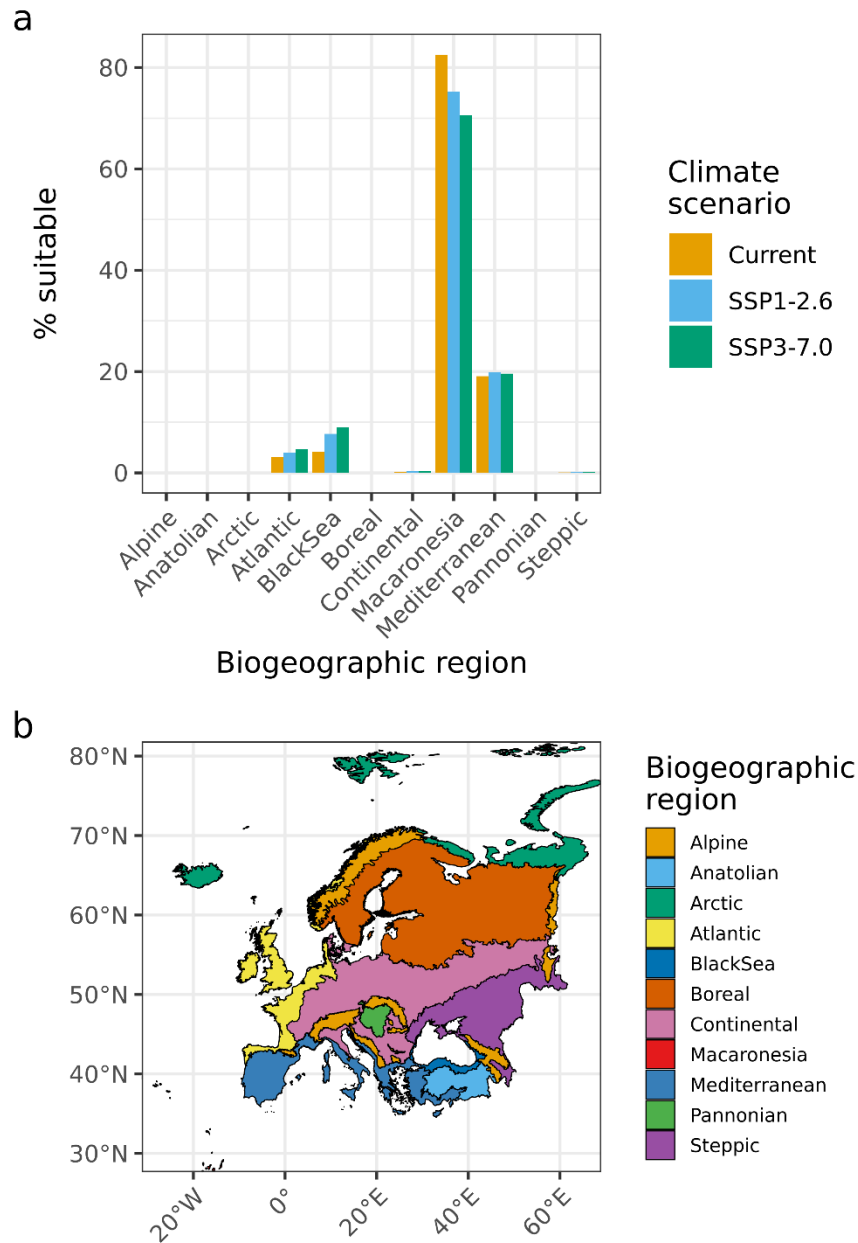


Figure 9. Variation in projected suitability among Biogeographical regions of Europe (Bundesamt für Naturschutz (BfN), 2003). Bar plots show the proportion of grid cells in each region classified as suitable in the current climate (1981-2010) and projected climate for 2041-2070 under scenarios SSP1-2.6 and SSP3-7.0. The coverage of each region is shown in the map below.

Table 2. Projected % suitability among EPPO member countries, sorted from high to low in the current climate. Values are the % of grid cells in each country classified as suitable in the current climate (1981-2010) and projected climate for 2041-2070 under scenarios SSP1-2.6 and SSP3-7.0.

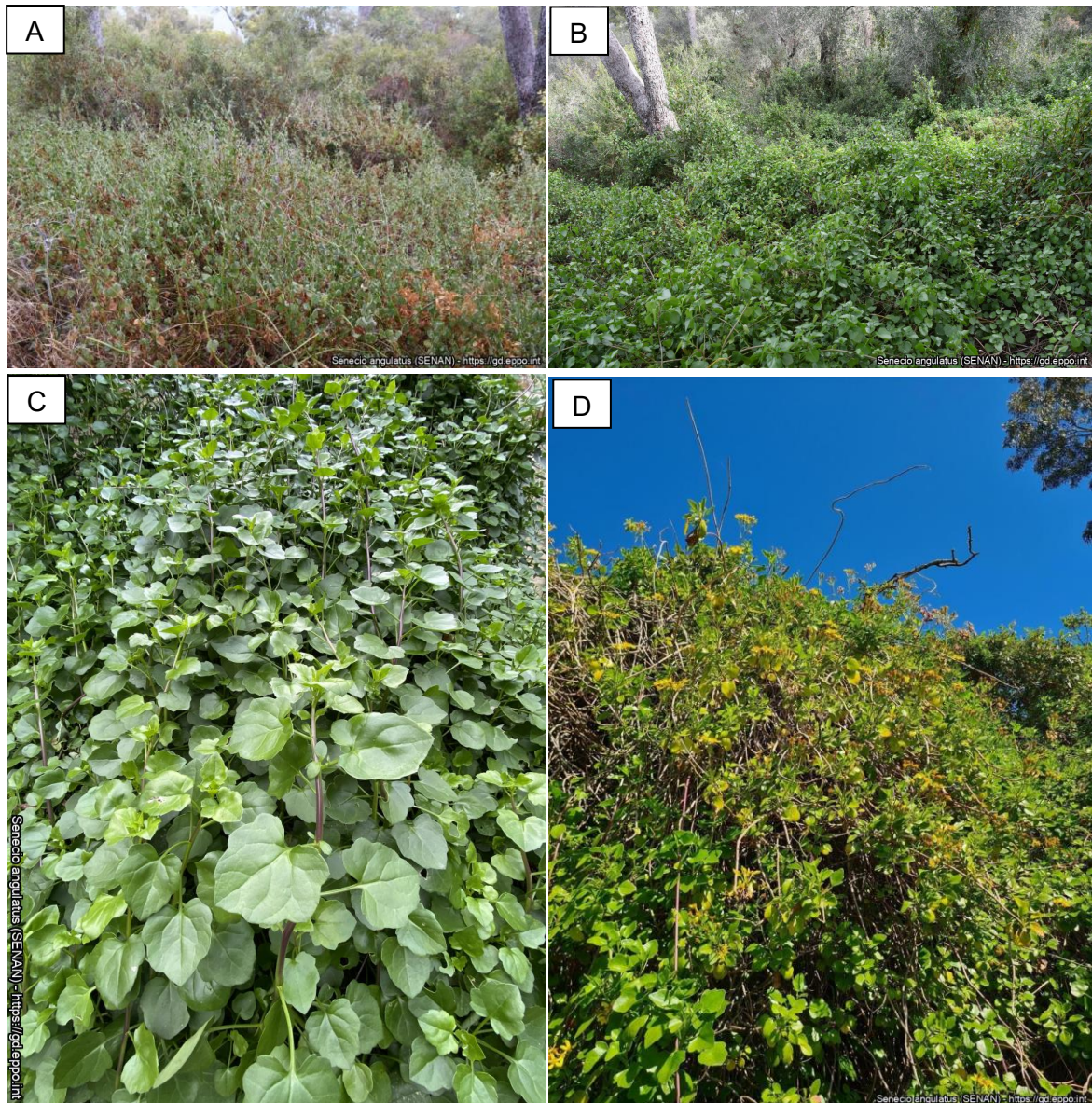
EPPO country (ISO3)	Current	SSP1-2.6	SSP3-7.0	EPPO country (ISO3)	Current	SSP1-2.6	SSP3-7.0
JEY	78	78	78	BLR	0	0	0
GGY	75	75	75	CHE	0	0	0
MLT	48	0	0	CZE	0	0	0
GRC	32	32	29	DEU	0	0	0
PRT	32	33	33	DNK	0	0	0
ITA	26	31	32	EST	0	0	0
CYP	24	7	4	FIN	0	0	0
ALB	14	14	13	HUN	0	0	0
ESP	10	10	9	IRL	0	0	0
HRV	9	12	13	JOR	0	0	0
TUN	6	3	2	KAZ	0	0	0
ISR	6	1	0	KGZ	0	0	0
FRA	5	6	7	LTU	0	0	0
MNE	4	4	5	LUX	0	0	0
TUR	4	4	4	LVA	0	0	0
MAR	3	2	2	MDA	0	0	0
AZE	2	3	3	MKD	0	0	0
DZA	1	1	1	NLD	0	0	0
GEO	0	1	1	NOR	0	0	0
BIH	0	0	1	POL	0	0	0
GBR	0	1	2	ROU	0	0	0
SVN	0	1	1	SRB	0	0	0
BGR	0	0	1	SVK	0	0	0
RUS	0	0	0	SWE	0	0	0
AUT	0	0	0	UKR	0	0	0
BEL	0	0	0	UZB	0	0	0

Caveats and uncertainties

Modelling the potential distributions of range-expanding species is always difficult and uncertain. In this case study, uncertainty arises because:

- There is uncertainty about the status of occurrence records. Most inland Europe records were excluded as coming from sources that may be dominated by cultivated records. However, this may have excluded cases of early naturalization in inland areas, causing the model to under-estimate inland suitability in Europe, especially in northern Italy and central Spain.
- Furthermore, among the records used for modelling it is not clear whether substantial numbers of cultivated records remained, which could lead to over-estimating the suitable area.
- Global GIS landcover databases do not represent coastal habitats well, so distance from coastline was used as a proxy. Therefore, within the coastal zone represented as climatically suitable, there may be locations where the specific type of habitat is not suitable for the species to establish.
- There was not time to test the sensitivity of the modelling to all methodological choices (e.g., sizes of accessible background, definition of unsuitable background, use of target group bias correction, choice of suitability threshold).

Appendix 2. Images of *Senecio angulatus*



Plant 1. Images of *Senecio angulatus*. (A) and (B) showing invasive behaviour in France. (C) Leaves forming mats (France) and (D) forming mats in New Zealand.