Australian Swamp Stonecrop (*Crassula helmsii*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, May 2015
Revised, January 2018, February 2018
Web Version, 6/26/2018

Photo: Malcolm Storey. Licensed under Creative Commons BY-NC-SA. Available: http://eol.org/data_objects/22814574. (January 30, 2018).

1 Native Range and Status in the United States

Native Range

GISD (2018) lists *Crassula helmsii* as native in Australia and New Zealand.

From CABI (2018):

"*C. helmsii* is native to New Zealand and Australia, including the territories of New South Wales, South Australia, Tasmania, Victoria, and Western Australia (OEPP/EPPO, 2007). […] In New Zealand, it is reported as being naturally uncommon, and is known only from the west coast of the South Island from Karamea south to Haast (NZPCN, 2005). Randall (1999) also reports *C. helmsii* as being native to Papua New Guinea."

Status in the United States

From USDA (2013):

"*Crassula helmsii* does not occur in the United States outside of cultivation (Kartesz, 2013; ODA, 2007). Reports of *C. helmsii* naturalized in the United States (ISSG, 2013) are erroneous: they mistake the states that regulate this plant for occurrence of it. *Crassula helmsii* is regulated as a noxious weed by Florida, Indiana, Minnesota, North Carolina, and Washington (NGRP, 2013). Additionally, the Ornamental Aquatic Trade Association (OATA) has advised its members to stop selling *C. helmsii* and avoid recklessly disposing [of] plants (Appleby, 2010; Friday, 2013; OEPP/EPPO, 2007). *Crassula helmsii* is available for sale online as an aquarium plant (Java Aquatic Plants, 2013) but we found no evidence in numerous botanical and garden databases that this plant is cultivated or commercially traded in the United States. Therefore, we believe that this plant is perhaps only cultivated at a very minor scale in the United States, if at all, and may only be traded and propagated by hobbyists."

From CABI (2018):

"There are reports of *C. helmsii* occurring in Florida and North Carolina in the southeastern United States (OEPP/EPPO, 2004; 2006; Minchin, 2008), but the extent of distribution and current status of these populations is unknown."

GISD (2018) lists *Crassula helmsii* as alien, established, and invasive in Florida, North Carolina, and Washington.

From Fusaro et al. (2018):

"This species has been found for sale at large outdoor stores (e.g., Lowe's Hardware mistakenly sold it under another name in Florida), as well as recommended for hobbyists online. It is unknown, however, if it is being bought and sold in the Great Lakes region."

"Wisconsin prohibits the transport, possession, or introduction of *C. helmsii* (Wisconsin Chapter NR 40). Minnesota also lists *C. helmsii* as prohibited meaning that a person may not possess, import, purchase, sell, propagate, transport, or introduce *C. helmsii* (Minnesota Rule 6216.0250). There are no regulations on *C. helmsii* in Ontario, New York, Pennsylvania, Ohio, Michigan, Indiana, or Illinois."

Means of Introductions in the United States

There are no known introductions of *Crassula helmsii* to the wild in the United States.

Remarks
No additional remarks.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing
From ITIS (2018):

"Taxonomic Status:
Current Standing: accepted"

"Kingdom Plantae
Subkingdom Viridiplantae
Infrakingdom Streptophyta
Superdivision Embryophyta
Division Tracheophyta
Subdivision Spermatophytina
Class Magnoliopsida
Superorder Saxifraganae
Order Saxifragales
Family Crassulaceae
Genus *Crassula*
Species *Crassula helmsii* (Kirk) Cockayne"

Size, Weight, and Age Range
From Dawson and Warman (1987):

"[…] forming dense stands or swards of *c.* 100 mm in height."

From CABI (2018):

"The submersed form grows from a basal rosette with well-anchored roots, and can reach 1.3 m in height."

Environment
From Dawson (1996):

"The plant has an amphibious habit with growth forms adapted to a wide range of habitats from drying soils surrounding temporary pools to submerged growing from depths of 3 m in Britain. Maximum biomasses were found in emergent stands at the margins of nutrient-rich static waters (Dawson 1994)."

From Dawson (1994):

"Preliminary trials show that the growth of shoots progressively declines with increasing salinity to approximately 15 000 ppm or approximately half that of sea water; […]"

From CABI (2018):

"*C. helmsii* can colonize a variety of waters, from static to gradually-flowing systems, and is able to withstand periods of extended drying. It colonizes waters ranging from acidic to alkaline, and has also been recorded in semi-saline water bodies (OEPP/EPPO, 2007). *C. helmsii* is associated with soft sediments and possibly also with iron-rich waters (Dawson and Warman, 1987)."

From Fusaro et al. (2018):

"*Crassula helmsii* inhabits freshwater areas, with a range of nutrient levels. It is found in waters with pH from 4.29-7.83, and alkalinity from 0-0.92 m.eq/L. *Crassula helmsii* can tolerate drying for extended periods (Kirby 1965), survive in poor phosphorus conditions (3.4 µg/L) and in rich phosphorus conditions (529 µg/L) (Brunet 2002), survive in poor potassium conditions (0.16 µg/L) and rich potassium conditions (8.56 µg/L) (Brunet 2002). […] *C. helmsii* can withstand warm water temperatures, so climate change may benefit. However, climate change may also hinder this species, as it is adapted to take advantage of low CO2 conditions."

Climate/Range

From Dawson (1994):

"Shoots were observed to survive for several hours in ice and air temperatures of –7°C after which only crushed leaves were lost from the plant; stems were blackened, but apical growth continued."

From CABI (2018):

"In its native range, *C. helmsii* appears to be confined to areas where summer [air] temperatures are 20-25°C with 100-550 mm precipitation, and winter [air] temperatures are 0-15°C with 200-3000 mm precipitation, including extended periods under snow (Leach and Dawson, 1999; OEPP/EPPO, 2007). *C. helmsii* can survive a wide range of climatic variation, from [air temperature] averages of 30°C in the summer to less than -6°C [air temperature] in winter (OEPP/EPPO, 2007). It is a lowland plant, occurring in altitudes from sea level up to 345 m (Lockton, 2009)."

Distribution Outside the United States

Native

GISD (2018) lists *Crassula helmsii* as native in Australia and New Zealand.

From CABI (2018):

"*C. helmsii* is native to New Zealand and Australia, including the territories of New South Wales, South Australia, Tasmania, Victoria, and Western Australia (OEPP/EPPO, 2007). […] In New Zealand, it is reported as being naturally uncommon, and is known only from the west coast of the South Island from Karamea south to Haast (NZPCN, 2005). Randall (1999) also reports *C. helmsii* as being native to Papua New Guinea."

Introduced

From Dawson and Warman (1987):

"*Crassula helmsii*, swamp stonecrop, […], was first found naturalised in Britain in a pond at Greenstead in Essex, SE Britain, in 1956 by both E. B. Bangerter, P. and J. Hall; and by C. Bignall-Pratt and D. McClintock (Lousley, 1957; Laundon, 1961). It is believed to have been introduced before 1914 (Swale & Belcher, 1982) but was only commercially available from 1927 (Perry's Hardy Plant Farm, Enfield, Middlesex; Laundon, 1961)."

"*C. helmsii* has now been found to be quite widely distributed throughout England, although there are areas in which it has yet to be recorded (Fig. 3a [in source material]). It is less frequent in Wales and Scotland. […] The first record of its naturalisation in mainland Europe may be for 1982 in the Meerdael forest, Belgium (Margot, 1983). It has also been recorded by the Baikalo-Amur Highway and in the Baikal Region of the USSR (Asovsky, 1981, 1984)."

GISD (2018) lists *Crassula helmsii* as alien and established in Belgium, Denmark, France, Ireland, Italy, Netherlands, Portugal, Russian Federation, Spain, Channel Island, Northern Ireland, Scotland, and Wales.

GISD (2018) lists *Crassula helmsii* as alien, established, and invasive in Germany, and England.

From GISD (2018):

"*Crassula helmsii* was intentionally introduced to Germany for ornamental trade in the 1980s. It has since established in the wild and can be found in Hessen, Lower Saxony, North Rhine-Westphalia, Bavaria, Rhineland-Palatinate, Schleswig-Holstein, Baden-Wuerttemberg (DAISIE, 2009; Hussner et al., in press)."

"*Crassula helmsii* was first recorded in Ireland in 1984 in Gosford Forest Park, County Armagh and was first recorded in the wild in 1985 in Glastry Clay Pits in Ards Peninsula, County Down."

"*Crassula helmsii* was first found in the Netherlands in 1995 and 1996 in a nature reserve near Breda. It has since spread locally in ponds in the provinces Noord-Brabant and Zeeland (EPPO, 2007)."

"*Crassula helmsii* was introduced to England from Tasmania in 1911. It was not reported in the wild until 1956 in Essex. It has become quite widely distributed, with expansion in the 1980s doubling every 3-5 years."

"*Crassula helmsii* is reported as occuring [sic] relatively infrequently in Scotland. It occurs in several ponds and lakes usually close to centers of population."

From CABI (2018):

"*C. helmsii* is currently naturalized in several areas of Europe, including the United Kingdom, Germany, Belgium, Ireland, the Netherlands, Denmark, France, Spain, Italy, Austria, and the Baikal region of Russia (OEPP/EPPO, 2004; 2007; NOBANIS, 2005; Afferni and Tavormina, 2007; Minchin, 2008). *C. helmsii* has been reported as being present in Portugal (OEPP/EPPO, 2004); however, this has since been invalidated (OEPP/EPPO, 2007)."

From NOBANIS (2018):

"Species found in one localisty [sic] [in Sweden] which was eradicated 2016-2017"

Means of Introduction Outside the United States

From Dawson (1994):

"Primary invasion [in Britain] seems to have been almost entirely by planting in the early 1050s and 1960s whereas secondary spread from these sites is now more common. Suppliers of aquatic plants have provided the plant both directly by name, and indirectly as an unnamed "oxygenator"."

From GISD (2018):

"*Crassula helmsii* was intentionally introduced to Germany for ornamental trade in the 1980s."

Short Description

From GISD (2018):

"*Crassula helmsii* is an aquatic or semiterrestrial succulent perennial herb 10–130 cm long, with round stems of floating or creeping with roots forming at the nodes. Leaves are opposite, sessile and succulent. They are 4–20 mm long, 0.7–1.6 mm wide, linear-lanceolate to ovate-lanceolate, and acute. It has white or pinkish flowers that are borne singly in the axils of leaves. Inflorescences have a diameter of 3–3.5 mm and are 4-merous. Petals are slightly longer than the sepals. Fruits are follicles containing 2–5 elliptical and smooth seeds about 0.5 mm long. It grows in three forms. The terrestrial form has creeping or erect stems and aerial leaves which are yellowish-green in colour and succulent in appearance. The emergent form usually grows as stands of short densely packed stems in water of 0.6 m or less in depth. The submerged form grows from a basal rosette, well rooted at the base, with long sparsely leaved stems that may reach the water surface (EPPO, 2007; DAISIE, 2008)."

From Dawson (1994):

"*Crassula helmsii* (T. Kirk) Cockayne (*Tillaea recurve* (Hook f.) to the water gardener or aquatic supplier) is identifiable in the field […] by its short dense stands and mid- to yellowish-green,

stiff, succulent-like appearance. Pairs of unstalked opposite leaves (4–24 mm) are borne on rigid stems which also bear single small white four-petalled aerial flowers on short stalks in their axils during summer. The joining of the leaf bases into a collar of approximately 1 m id [sic] a distinctive character and allows the plant to be readily distinguished from other species, such as *Callitriche* spp., especially when growing at low density in its more flaccid under-water form. Leaf form varies from oblong-lanceolate to oblong-elliptical, acute to acuminate, rarely cuspidate and entire. The leaf tip is entire, which readily distinguishes this plant from species of *Callitriche* which have notched leaf tips."

Biology

From CABI (2018):

"*C. helmsii* has a reported chromosome number of 2n=36 (Stace et al., 2005; Lockton, 2009). Studies of genetic variation show that it is likely there was only one introduction of *C. helmsii* into Britain, with the probable source population being the plants growing along the River Murray in Australia (OEPP/EPPO, 2007).

Genetic studies of New Zealand plants show a difference in chromosome number, with Australian plants being diploid (2n=14), and the smaller, more delicate plants from New Zealand being hexaploid (2n=42) (NZPCN, 2005). A more recent study by De Lange et al. (2008) refers to Australian material with a chromosome number of 2n=42 and New Zealand material with 2n=14."

"*C. helmsii* has the ability to prolifically reproduce vegetatively through fragments, which can be as small as a single node on a 5 mm stem being capable of producing a new plant (CAPM-CEH, 2004). In addition, apical turions are produced in the autumn (in the United Kingdom), which then float on the waters' surface (OEPP/EPPO, 2007). *C. helmsii* also can reproduce sexually, though production of viable seeds is uncertain in Europe (OEPP/EPPO, 2007)."

"In its native range, *C. helmsii* flowers in November and December, with flowering continuing to February in New Zealand (OEPP/EPPO, 2007). In Europe, flowers appear between July and September, though the viability of seeds in Europe is uncertain (OEPP/EPPO, 2007). *C. helmsii* is able to grow throughout the year without a dormant period (CAPM-CEH, 2004)."

Human Uses

From GISD (2018):

"*Crassula helmsii* is sold as a pond oxygenator and ornamental and may be purchased from many garden centers and other retailers (Berwick, 2009)."

"It [*Crassula helmsii*] has also recently been added to Schedule 9 of the Wildlife and Countryside Act (1981), as amended, making it an offence to deliberately introduce this species to the wild."

Diseases

No information on diseases of *Crassula helmsii* was found.

Threat to Humans

From CABI (2018):

"In addition, unsightly mats of vegetation decrease aesthetic values, and can be mistaken as dry land which can present significant danger to animals and humans (Sheppard et al., 2006)."

3 Impacts of Introductions

From Dawson and Warman (1987):

"Competition between *C. helmsii* and other species was intense and resulted in the almost total suppression of native plants within a few years or the elimination of other dominant invading species in managed ponds. The dominant submerged plant of one artificial managed lake (Priors Down Lake, Stalbridge, Dorset) changed totally within two years from *Elodea* spp. to *C. helmsii*. The changes in unmanaged ponds have been equally drastic but less obvious to the casual observer, for they superficially resemble the normal successional changes (by, for example, the invasion of mosses, e.g. at Corfe Common). Evidence to establish this reductions [sic] in species can be scarce but data from Dorset Environmental Record Centre (1936, R. Good; 1982 part of list by A. E. Newton and I. Cross) indicate that there has not only been the decrease (50%) in the typical numbers of species expected for this site, probably caused by an increase in grazing by horses, but a further similar reduction by an increase in the dominance of *C. helmsii*. Similar changes are thought to have occurred in the New Forest ponds where, for example, in one pond, *C. helmsii* now dominates to the virtual exclusion of other plants including *Ludwigia palustris* and *Galium debile* (A. Byefield, pers. comm.)."

From GISD (2018):

"*Crassula helmsii* establishes dense populations that can decrease biodiversity, displace native flora, increase oxygen levels, cause flooding, obstruct water flow, and reduce recreational value of lakes or ponds. Submerged and floating populations can grow in depth up to 10m and displace macrophytes in depths up 8 m with densities reaching 1 kg dw/m2, emerged populations can reach densities up to 45kg fresh weight/m². It is extremely competitive and significantly reduces the germination of native plants. It can completely suppress native species within few years of its introduction. Such reduction and displacement of native species can result in reduced conservation value of nature reserves. *C. helmsii* may cause reduction of diatom populations as in the case of *Synedta delicatissima* in England. It can increase oxygen levels, change pH, and alter light transmission in lakes and ponds which may in turn cause decline in invertebrates, frogs, newts, and fishes. The increase in biomass in water bodies caused by *C. helmsii* populations can raise water levels and result in flooding. Dense mats of *C. helmsii* harm the attractiveness and recreational potential of ponds and lakes by reducing accessibility for angling or boating. Its growth may also clog waterways and drainages (Berwick 2009, Dawson and Warman 1987, Dawson 1996, Hussner 2008, Hussner 2009, Langdon et al. 2004, Linton and Goulder 2000, Minchin 2008, SNH 2009)."

From CABI (2018):

"*C. helmsii* has been found to limit water flow in irrigation channels and flood-control systems (Kelly and Maguire, 2009). In addition, the loss of recreational and aesthetic value associated with *C. helmsii* can also cause a decline in waterfront property values, as well as possible declines in tourism related revenue for communities. One recent estimate puts control costs of *C. helmsii* between 1.45 and 3 million euros (US $2.1-4.4 million) to manage 500 sites over 2-3 years (Leach and Dawson, 1999)."

"A thin covering of *C. helmsii* can cause significant germination suppression in some plant species (Langdon et al., 2004). Dense mats suppress native flora and create a poor ecosystem for invertebrates, amphibians, and fish (CAPM-CEH, 2004; Minchin, 2008). Decomposing mats of *C. helmsii* also have the ability to cause fish kills by creating severe fluctuations in dissolved oxygen levels in the water (OEPP/EPPO, 2007).

Several rare or threatened species in the United Kingdom may be negatively impacted by the spread of *C. helmsii* (OEPP/EPPO, 2007). Reduced breeding success of a protected species, the great crested newt (*Triturus cristatus*), has been attributed to invasion of ponds by *C. helmsii* (Langdon et al., 2004). The rare starfruit plant, *Damasonium alsima*, is thought to be threatened by *C. helmsii* (Watson, 2001). *C. helmsii* may smother *Callitriche* spp., and outcompete charophytes (stoneworts) for space (Habitas, 2009). In addition, a study in England shows a significant reduction in the diatom *Synedra delicatissima* caused by the introduction of *C. helmsii* (Habitas, 2009)."

"*C. helmsii* can form dense mats that impede recreational activities such as boating, fishing, swimming, water skiing, canoeing, and kayaking. In addition, unsightly mats of vegetation decrease aesthetic values, and can be mistaken as dry land which can present significant danger to animals and humans (Sheppard et al., 2006)."

From Ewald (2014):

"Dominance of *C. helmsii* was shown to have a significant effect on the availability of bare ground and the abundance of native plant species. For every 10% increase in the amount of *C. helmsii* the amount of bare ground decreased by 6% and the amount of native vegetation by 5%. We could find no evidence that dominance of *C. helmsii* alone had caused the extinction of any plant species. There was anecdotal evidence at one site where native plant species of conservation importance were no longer recorded, but this could not be attributed solely to the presence of *C. helmsii*, but to an overall deterioration in conditions at the site from poor water quality."

From Dean (2015):

"*C. helmsii* was not found to be significantly negatively correlated with the variables of the subordinate plant community; those relating to overall abundance, species diversity, and functional diversity. Thus these results did not provided a basis for evidence that *C. helmsii*

invasion was having a negative impact on the subordinate plant community. This was in concurrence with Langdon et al. (2004), who found no significant change in plant species richness in ponds invaded by *C. helmsii* over a four to seven year period, although results were not provided for changes in species abundance over that time."

4 Global Distribution

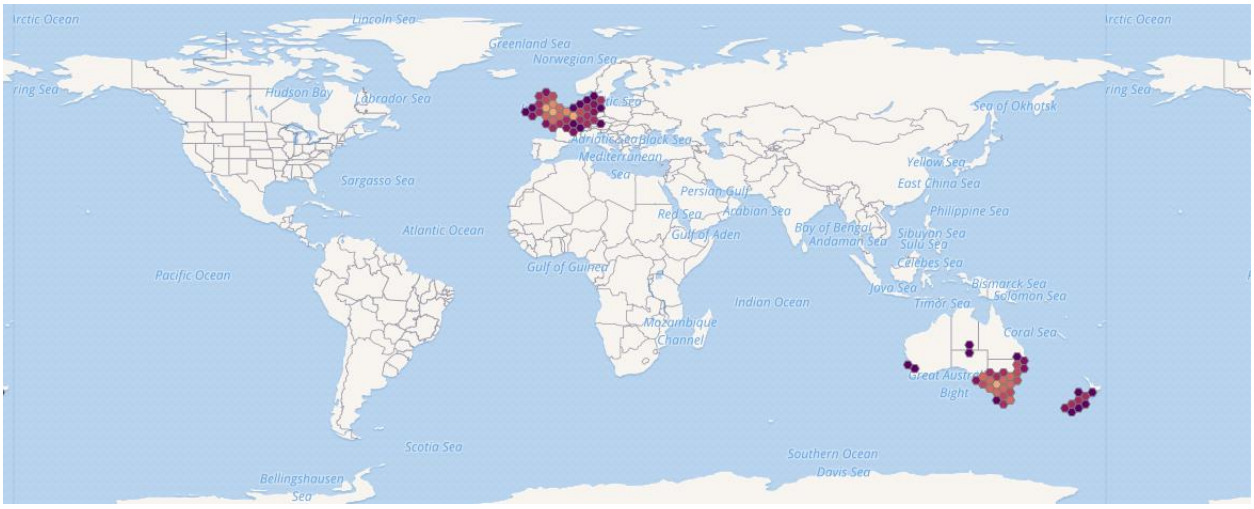

Figure 1. Known global distribution of *Crassula helmsii*. Map from GBIF Secretariat (2018).

The location in Sweden was not used as a source location for the climate match because it does not represent an established population (NOBANIS 2018).

5 Distribution Within the United States

Some sources list *Crassula helmsii* as established and invasive in the United States (CABI 2018; GSID 2018) but this could not be verified elsewhere. Contrarily, the USDA (2013) reports that references to wild populations of *C. helmsii* in the United States are in error, that it does not exist outside of cultivation. There are no verified established wild populations of *C. helmsii* in the United States, therefore no distribution map is available and there are no source points in the United States for the climate match.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Crassula helmsii* was high in Texas, the southwest, most of California, and small areas of the Pacific Northwest, Great Lakes Basin, and Appalachian Mountains. The match was low in areas of New England, pockets in the southeastern United States, along the Louisiana and Alabama portion of the Gulf Coast, upper Midwest, Great Plains, and mid to northern Pacific coast. All other areas had a medium climate match. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the contiguous United States was 0.197, high. The following states had individually high climate scores: Arizona, California, Delaware, Indiana, Maryland, Massachusetts, Michigan, New Jersey, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, Texas, Virginia, Washington, and West Virginia.

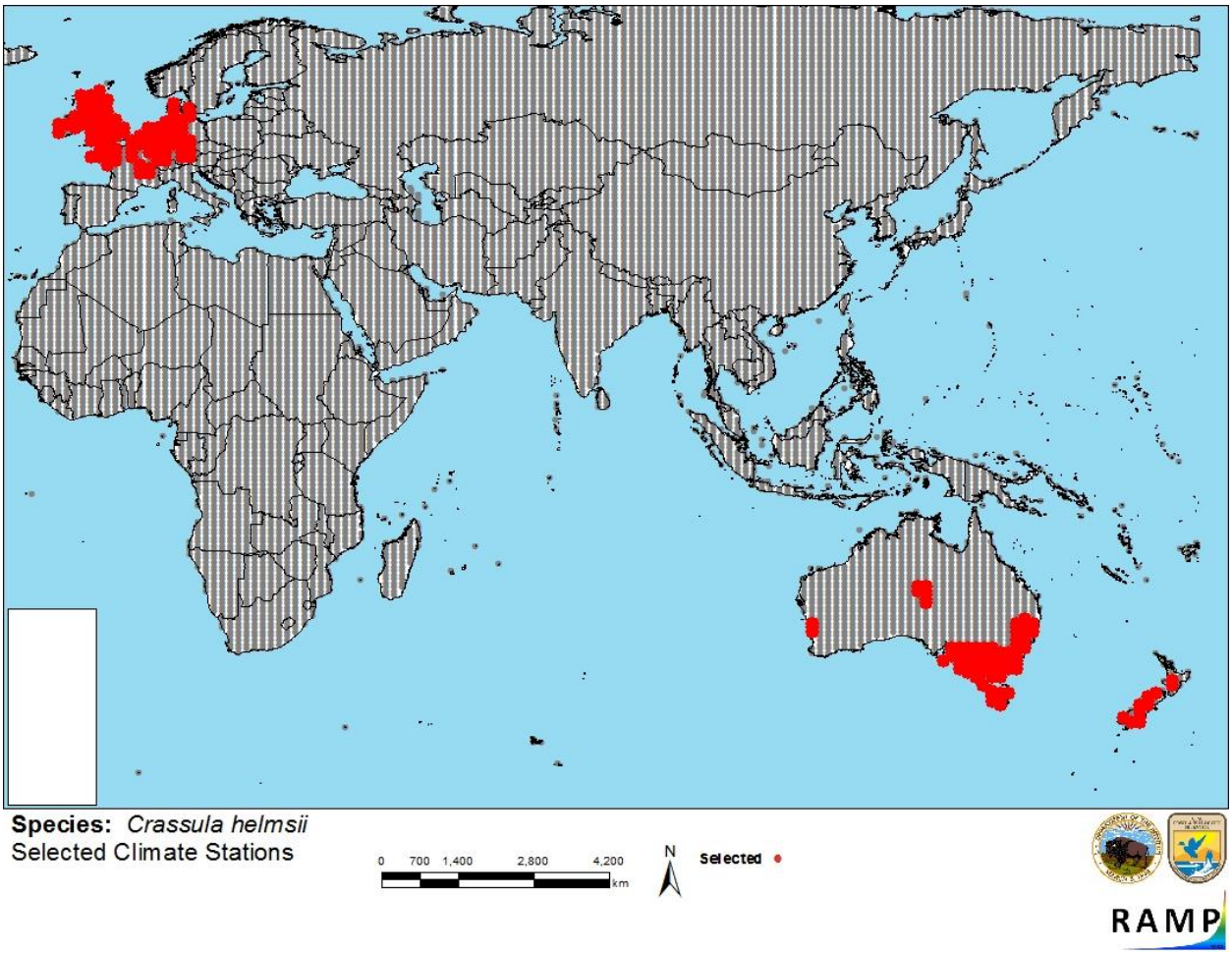

Figure 2. RAMP (Sanders et al. 2014) source map showing weather stations in Europe, Australia, and New Zealand, selected as source locations (red) and non-source locations (gray) for *Crassula helmsii* climate matching. Source locations from GBIF Secretariat (2018) and NOBANIS (2018).

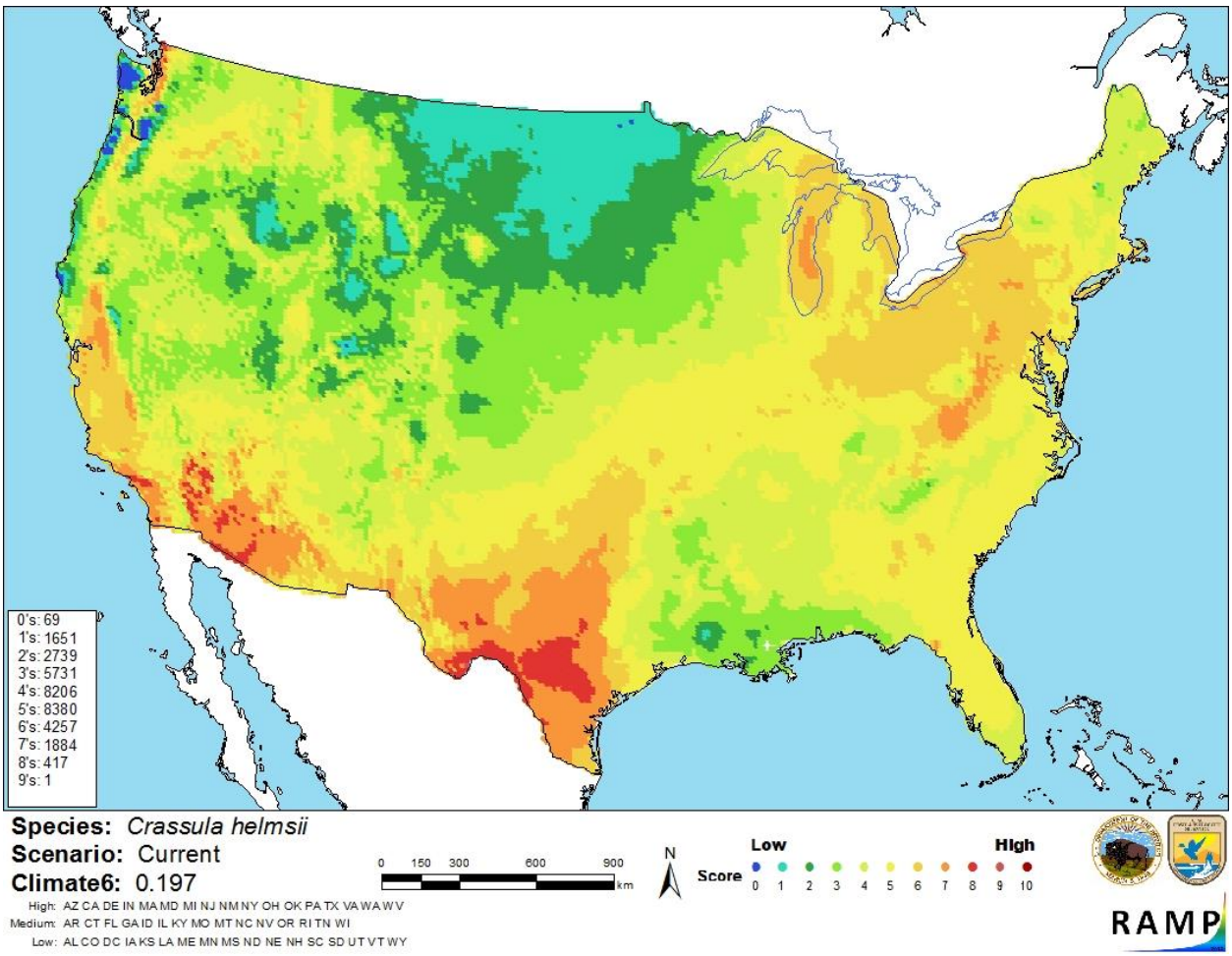

Figure 3. Map of RAMP (Sanders et al. 2014) climate matches for *Crassula helmsii* in the contiguous United States based on source locations reported by GBIF Secretariat (2018) and NOBANIS (2018). 0 = Lowest match, 10 = Highest match. Counts of climate match scores are tabulated on the left.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

Certainty of this assessment is medium. Information on the biology, invasion history and impacts of this species is available, with some peer-reviewed literature. Peer-reviewed literature provided information that introduced populations of *Crassula helmsii* had both negative and no impacts.

8 Risk Assessment

Summary of Risk to the Contiguous United States

The history of invasion of *Crassula helmsii* is high. *C. helmsii* has caused problems in Europe since being introduced. This species has supplanted native vegetation in a number of different cases (Dawson 1994, Dawson 1996). *C. helmsii* is a listed noxious weed in several U.S. states. Substantial resources have been invested to reduce its impact in some environments. Climate matching indicated the contiguous United States has a high climate match. The certainty of assessment is medium. The overall risk assessment category is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Medium**
- **Remarks/Important additional information** No additional information
- **Overall Risk Assessment Category: High**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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