Crassula helmsii **System:** Terrestrial

Kingdom	Phylum	Class	Order	Family
Plantae	Magnoliophyta	Magnoliopsida	Rosales	Crassulaceae

Common name Watercrassula (Dutch), Helms Dickblatt (German), Australian swamp stonecrop (English), Australian stonecrop (English), New Zealand pygmyweed (English), swamp stonecrop (English), Crassule des étangs (French)

Synonym *Crassula recurva* , (Hook. f.) Ostenf.
Tillaea recurva , (J.D. Hook.)
Tillaea helmsii , Kirk
Bulliarda recurva , (Hook. f.)

Similar species *Crassula aquatica*

Summary *Crassula helmsii* is a macrophyte native to Australia and New Zealand. It has become an especially problematic invasive in the United Kingdom and has established troublesome populations throughout western Europe and in southeastern United States. It establishes dense, floating or submerged populations that displace native aquatic plants, decrease biodiversity, alter water conditions, and harm the asethetic and recreational of bodies of water. It rapidly spreads and recolonizes via vegetative reproductions from plant fragments.

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Species Description
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).

Notes
Crassula helmsii acquired a score of 19 out of a possible 25 from stage 1 of the risk assessment process because of its potential impact on protected habitats and species leading to non-compliance with EU legislative obligations under the Water Framework and Habitats Directives (Kelly & Maguire, 2009)

Lifecycle Stages
Once germinated *Crassula helmsii* appears as a small, light green tussock which grow and spread rapidly to form dense mats of vegetation. It grows throughout most of the year with minimal winter die back (Kelly & Maguire, 2009; Minchin, 2008).

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

Habitat Description
Crassula helmsii is tolerant to a wide range of habitats. Aquatic populations may grow in oligotrophic and acidic, as well, as eutrophic and alkaline lakes and streams. *C. helmsii* may grow within in temperatures of -6°C to 30°C, maximum gas exchange values of emergent plants has been observed at 23-30°C (Hussner 2009). It is frost tolerant and typically does not die back in the winter. It does require high light (although according to the photosynthetic studies by Newman & Raven (1995) and Hussner (2009) light saturation point of emerged plants is only at 250-300µmol photons m-2s-1, which is not really high) levels and doesn't do well in very soft, easily disturbed silts (Kelly & Maguire, 2009; Klavsen & Maberly, 2009).

Reproduction
Crassula helmsii reproduces mainly through vegetative propagation. It reproduces rapidly from small stem fragments. Seeds are not known to be produced in Europe (DAISIE, 2008; Berwick, 2009; Dawson & Warman, 1987)

Nutrition
Crassula helmsii is tolerant to poor nutrient conditions but requires high light levels. It absorbs carbon dioxide by night and photosynthesizes by day (Hussner, 2009; Kell & Maguire, 2009)

General Impacts
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 intvertebrates, 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 & Warman, 1987; Dawson 1996, Hussner 2008, Hussner, 2009; Langdon et al, 2004; Linton & Goulder, 2000; Minchin, 2008; SNH, 2009).\r\n
C. helmsii utilizes Crassulacean acid metabolism (CAM) which enables it to take up CO2 during the night and gives it a significant competitive advantage over other macrophytes. This is especially beneficial as aquatic environments generally have limited inorganic carbon (Klavsen &Maberly, 2009; Dawson & Warman, 1987).

Management Info
Preventative measures: Several measures can be taken to prevent the establishment of *Crassula helmsii*. Its sale should be restricted in gardens centers, supermarkets, aquarists, and other retailers. Public awareness campaigns should provide information on the environmental and economic impacts of *C. helmsii* with focus on key groups associated with its import and sale. Removal of domestic plantings in ponds and aquariums and replacement with native species should be encouraged. If established, mesh netting can be used to prevent the spread of *C. helmsii* to uninvaded bodies of water (Kelly & Maguire, 2009; Berwick, 2009).
Physical removal: Hand pulling of *Crassula helmsii* is considered to be ineffective as regrowth is very rapid. Mechanical removal of *C. helmsii* is not recommended because small fragments released into the water column can travel downstream to colonize new sites or recolonize the treated area. Dredging material can be effective for emergent and submerged material as *C. helmsii* is shallow rooted however it could potentially damage the natural seed bank. Creating shaded areas by covering with black plastic of UV sheeting for up to 6 months has been successful and is very effective when combined with herbicide treatment. Burial with more than 20 cm of soil can result in 100% mortality but is labor intensive and causes much disturbance (Berwick, 2009; CEH, 2004; Bridge, 2005).
Biological control: Grass carp (*Ctenopharyngodon idella*) feed on *C. helmsii*, although it is not their preferred food source. A large scale trial confirmed the some control of *C. helmsii* accompanied by an increase in macrophyte species diversity. However, *C. idella* are reported to not survive well in waters with a high fluctuations of dissolved oxygen, which is associated with dense *C. helmsii* populations. Additionally *C. idella* is also an invasive species that may establish and cause a ecological impacts of its own (Berwick, 2009; Dawson & Warman, 1987). Chrysomelid and curculionid beetles have also been suggested as potential biological controls (Gassman et al, 2006).
Chemical control: Diquat alginate (Midstream) has been found to be the most effective chemical control of *C. helmsii* with a 95% kill rate and is the only chemical that can effectively kills submerged plants. However, it has been removed from the EU list of acceptable herbicides and has been determined unsafe for aquatic use. Dichlobenil (Casoron G or Midstream GSR) is also recommended but it too will soon be withdrawn from the market. Glyphosate (Roundup biactive) has a 50% kill rate and is the recommended method of treating emergent *C. helmsii*. Glysophate is most successful when treating before and after mechanical removal or on a new infestation and can be combined with adjuvant TopFilm to increase effectiveness (Berwick, 2009; CEH, 2004; Kelly & Maguire, 2009).The use of Waipuna hot foam, a biodegradable organic compound of coconut and corn sugar which breaks down the cellular structure of the plant, has a 50% kill rate, but primarily kills only the top layers of the plant. Waipuna foam has several advantages over herbicides. It is not weather dependent and can be used in breezy conditions and light rain. Unlike herbicide treatments there is no requirement for special safety equipment. The foam can be applied with accuracy and without damage to adjacent plants. It is also non-toxic to other wildlife (Berwick, 2009; Bridge, 2005).
Integrated management: The combination of methods physical removal, shading, and herbicide treatment has been found to be the most effective means for controlling *C helmsii* populations. The spraying of plant material with herbicide followed by covering with black or UV sheeting or physical removal are both effective and may be repeated until eradication is obtained (CEH, 2004; Kelly & Maguire, 2009).

Pathway
Crassula helmsii is traded in horticulture and has been introduced to many new countries and locations as a result (Kelly & Maguire, 2009).

Principal source: European and Mediterranean Plant Protection Organization (EPPO), 2007b. *Crassula helmsii* (Kirk) Cockayne Report of a Pest Risk Analysis
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Compiler: National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)

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ALIEN RANGE

[1] BELGIUM
[1] FRANCE
[1] IRELAND
[1] NETHERLANDS
[1] RUSSIAN FEDERATION
[5] UNITED KINGDOM
[1] DENMARK
[1] GERMANY
[1] ITALY
[1] PORTUGAL
[1] SPAIN
[3] UNITED STATES

Red List assessed species 1: NT = 1;

Pilularia globulifera **NT**

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