European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

**Data sheets on quarantine pests**
**Fiches informatives sur les organismes de quarantaine**

# *Crassula helmsii*

## Identity

**Scientific name:** *Crassula helmsii* (Kirk) Cockayne
**Synonyms:** *Tillaea helmsii* Kirk
**Taxonomic position:** Crassulaceae
**Common names:** New Zealand pigmy weed, Australian swamp stonecrop (English), Watercrassula (German)
**Notes on taxonomy and nomenclature:** In trade, *Crassula helmsii* is also known under the incorrect name of *Tillaea recurva* and as *Crassula recurva*
**EPPO code:** CSBHE
**Phytosanitary categorization:** EPPO A2 List no. 340

## Geographical distribution

**EPPO region:** Belgium, Denmark, France, Germany, Netherlands, United Kingdom (Great Britain, Northern Ireland, Guernsey)
**Oceania:** Australia (New South Wales, South Australia, Tasmania, Victoria, Western Australia), New Zealand.

*Note on geographical distribution*: information reporting the presence of *C. helmsii* in Portugal has been invalidated.

### History of introduction and spread

*C. helmsii* is a native species of Australia and New Zealand and is reported to be invasive or potentially invasive in Florida and North Carolina. *C. helmsii* is locally present in Belgium, Denmark (reported in Denmark in 2003; NOBANIS, 2005), France, Germany (first reported in the early 1980s, now found locally in Hessen, Mecklenburg-Vorpommern, Niedersachsen, Nordrhein-Westfalen, Rheinland-Pfalz, Schleswig-Holstein), the Netherlands (first found in 1995 and 1996 in a nature reserve near Breda, now found locally in ponds in the provinces Noord-Brabant and Zeeland). *C. helmsii* is widespread in the United Kingdom where the plant has been the most studied (first found in the 1950s in Greensted Pond, Essex). This includes Alderney (first noted in 1986), Guernsey (1989) and Northern Ireland (1984, in a pool at Gosford). In England, it was introduced from Tasmania in 1911 and was sold in the 1920s, but was only reported in the wild in 1956. Since its initial introduction into the United Kingdom, the number of sites invaded by the plant has been doubling every two years (Centre for Ecology and Hydrology Dorset, 2002). It is currently known in over 1000 sites in the British Isles (Watson, 2001). Dawson (1994) predicted that the majority of temporary and permanent ponds and that some drainage channels and streams in the UK and northern Europe would be rapidly invaded. Studies of genetic variation of isoenzymes suggest that only one introduction was made into Britain, and that plants growing along the River Murray are the likely source of the British population (Dawson, 1994).

## Morphology

### Plant type

*C. helmsii* is an aquatic and semiterrestrial plant, herbaceous and perennial.

### Description

*C. helmsii* is an aquatic or semiterrestrial succulent perennial herb, with round stems of 10–30 cm long, floating or creeping (with roots forming at the nodes) (Figs 1 & 2). Leaves are opposite, sessile and succulent (4–20 mm long, 0.7–1.6 mm wide), linear-lanceolate to ovate-lanceolate, acute. White or

**Fig. 1** Leaves and stems of *C. helmsii* near Wageningen (Netherlands), April 2007. With kind permission of Johan Valkenburg.

 

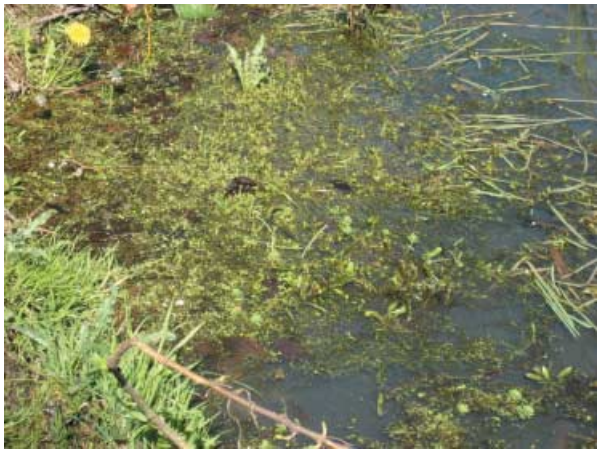

**Fig. 2** *C. helmsii* near Wageningen (Netherlands), April 2007. With kind permission of Johan Valkenburg.

pinkish flowers are borne singly in the axils of leaves (diameter 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 (0.5 mm long).

## Similarities to other species

A close relative of *C. helmsii* is *Crassula aquatica*. The two species are easily distinguished by the size and position of their flowers. *C. aquatica* is the smaller of the two, rarely exceeding 6 cm in height, with leaves 4–6 mm long and flowers sessile in the leaf axils. *C. helmsii* is frequently seen at sizes of up to 40 cm in length and its flowers are produced on pedicels (Dawson & Warman, 1987).

The submerged stems of some *Callitriche* species may be mistaken for *C. helmsii* but stems of the former are often waterborne and are never emergent. Leaves of *C. helmsii* are connate at the base and acute at the tip, whereas in *Callitriche* spp. leaves are not connate, with emarginate to spanner-shaped leaf-tips (Dawson & Warman, 1987).

## Biology and ecology

### General

*C. helmsii* occurs in different growth forms (Dawson & Warman, 1987). 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 which may reach the water surface. The three forms change according to prevailing conditions.

The plant assimilates $CO_2$ for 20 h of the day when submerged due to the possession of crassulacean acid metabolism and can therefore grow throughout the year (Centre for Aquatic Management, 2004). There is no dormant period. Such a metabolic adaptation confers an advantage for plants growing where the supply of inorganic carbon for photosynthesis is deficient or limited during the day (Dawson & Warman, 1987).

In Australia and New Zealand, *C. helmsii* flowers in November and December, while in New Zealand the flowering continues to February. In Europe, flowers appear between July and September. Whether or not *C. helmsii* produces viable seeds in Europe is uncertain.

Local dispersal is mainly ensured by vegetative reproduction. Small fragments (as small as a single node on 10 mm of stem) can produce new plants. These small fragments are readily transported by water, mud or wildlife to new sites. In addition, asexual reproduction is achieved via the production in autumn (in the United Kingdom) of short shoots with very short internodes called turions. The turions are produced apically, and float around the water surface. *C. helmsii* has the ability to produce roots and lateral shoots from many of its nodes, particularly when stressed. The plant forms a 100% cover and is winter green, enabling it to outpace native species which die back each winter (Huckle, 2005).

### Habitat

This aquatic plant colonizes inland wetlands (marshes, peat bogs), coastal wetlands, continental waters (water courses, water bodies), banks of continental water, riverbanks/canal sides (dry river beds) and muddy margins of ponds. Within its native range, *C. helmsii* inhabits marginal situations in many riverine habitats; however, within the United Kingdom the plant has not effectively made the transition from static or slow-flowing systems to more demanding habitats such as river margins. Studies have shown that the biomass production of *C. helmsii* in artificial stream systems is greater than for other species, including the invasive plant *Elodea canadensis* (Dawson & Warman, 1987), highlighting the potential of this plant to colonize river systems (Leach & Dawson, 1999).

### Environmental requirements

The distribution of *C. helmsii* in Australia and Europe shows that the species is suited to a wide variety of freshwater habitats. It grows on damp ground from 0.5 m above water level down to depths of 3 m. *C. helmsii* has been found in ponds and lakes with natural water chemistry ranging from acid to alkaline, and the plant has also been recorded in semisaline sites (Centre for Ecology and Hydrology Dorset, 2002). In its native area, *C. helmsii* inhabits water bodies over a wide range of climates.

### Climatic and vegetational categorization

*C. helmsii* seems to be confined to areas that have levels of precipitation from 100 to 550 mm in summer (November–April) and 200–3000 mm in winter (May–October). Its temperature requirements are restricted to a summer range of 20–25°C and a winter range of 0–15°C including extended periods under

snow. In its native range it inhabits a wide range of climatic variation, from a mean temperature of 30°C in summer to –6°C in winter (Huckle, 2005), and can tolerate drying for extended periods. The climate in the British Isles falls well within these limits, providing the plant with optimal growing conditions. In the United Kingdom, the plant has been found at a range of altitudes from sea level to 278 m (Leach & Dawson, 1999).

## Uses and benefits

*C. helmsii* is sold in garden centres and nurseries as a submerged oxygenating plant for aquaria and ponds.

## Pathways of movement

### Natural dispersal

Local dispersal is mainly ensured by vegetative reproduction. Plant parts (even single nodes on stem fragments of 10 mm in length) can generate new plants and are transported by flowing water and mud. It can also be spread by attaching to animals (cattle). The possibility that the species can be dispersed by wading birds remains unproven.

The plant can be accidentally dispersed by human activities by escaping from garden centres, by transfer from pond to pond by anglers and their equipment (on fishing kit, waders, etc.), by boats, by children pond dipping (Leach & Dawson, 1999) and on people's boots (Watson, 2001).

### Movement in trade

The key pathway is its intentional introduction as an ornamental plant for aquaria and garden ponds. Plants are transferred by human activities from these intended habitats to unintended habitats. In addition, *C. helmsii* is often found as a 'contaminant' with other traded water plants (Environment Agency, 2003).

## Impact

Being an aquatic plant, *C. helmsii* mainly threatens the natural environment and biological diversity.

### Environmental and social impact

It causes major problems in nature reserves and recreation areas by forming a 100% cover and smothering other plants.

Its impact on flora is not easily predictable. A study in North-West England suggests that there is no net reduction in the numbers of plant species, but there is a reduction in germination rates of native species, an increase in the proportion of emergent or marginal species and a reduction in aquatic species of open water. Smaller marginal plants such as some water *Callitriche* spp. seem likely to be smothered, and competition for space seems likely to cause a reduction in green algae of the class Charophyceae (Huckle, 2005).

The starfruit *Damasonium alisma*, one of the rarest plants in the United Kingdom, is thought to be threatened by *C. helmsii* (Watson, 2001). Leach & Dawson (1999) state that in an artificially managed lake (Priors Down Lake, Stalbridge, Dorset, UK), evidence suggests that changes in floral dominance have occurred, with *C. helmsii* excluding *Ludwigia palustris* and *Galium debile* (Dawson & Warman, 1987).

A recent investigation at a well-monitored pond on Castlemorton Common Site of Special Scientific Interest, near Malvern in Worcestershire (England) found evidence that *C. helmsii* was also affecting the breeding success of the specially protected great crested newt *Triturus cristatus* (Watson, 1999).

There are other possible implications for wildlife. One study in England has shown a significant reduction in the population of the diatom *Synedra delicatissima* caused by *C. helmsii*, although the precise mechanism of this impact is unclear. As freshwater algae provide food for many invertebrates, this kind of effect may have a serious impact on freshwater invertebrate populations (Huckle, 2002; Centre for Ecology and Hydrology Dorset, 2002).

The mats formed by the plant choke ponds and drainage ditches. Strongly invaded waters lose their attractiveness for recreation and flooding may be caused. The mats can be dangerous to pets, livestock and children who mistake them for dry land.

One recent estimate puts the cost of control of *C. helsmii* at between 1.45 and 3 million EUR based on the treatment of 500 sites over a period of 2–3 years (Leach & Dawson, 1999).

## Summary of invasiveness

The characteristics that indicate its invasiveness are typical of many aquatic weeds: high growth rates, adaptability to prevailing nutrient conditions, very effective vegetative propagation, plasticity in growth response and absence of specific pests and diseases in introduced environments. *C. helmsii* is able to survive in a variety of different aquatic habitats and it can withstand a wide range of climatic variations. Therefore establishment of *C. helmsii* after introduction is very likely. Dense vegetation mats reduce the attractiveness of recreation areas as well as the natural value of nature reserves by displacement of native (and possibly rare) species. Removal of *C. helmsii* from invaded waters is very costly and, in addition, follow-up monitoring and action will increase regular management costs.

## Control

*C. helmsii* is still sold even though no essential interest is served by continuing the trade. Its overall value is minor, and other suitable noninvasive aquarium and pond plant species are available. Continuation of trade, introduction and movement will have negative and irreversible economic and environmental impacts.

The Ornamental Aquatic Trade Organization (OATO, 2003) recommends to its members that the plant should not be sold anymore.

Control is more effective at early stage of infestation. Sites should be monitored regularly at intervals of 3–6 months for at least five years following an apparent elimination of *C. helmsii*. Treated and adjacent areas must be carefully examined for developing shoots or small buried rhizomes.

The choice of methods depends on the growth form and extent of the *C. helmsii* stand but also on the extent of native vegetation that remains within the site.

#### Environmental control

As *C. helmsii* is tolerant to shade over long periods, to frost and to desiccation, it cannot easily be controlled.

Early and effective treatment saves efforts and preserves native species. The natural seed bank of native species should be considered a resource for their re-establishment (Centre for Ecology and Hydrology Dorset, 2002).

On small areas (1–20 $m^2$), covering with black plastic or carpet can effectively eliminate small patches, but the shading material should remain in place for at least eight weeks, and preferably for six months (Centre for Aquatic Plant Management, 2004).

#### Mechanical control

Mechanical control should be avoided as it produces more fragments which are able to disseminate the plant downstream or re-infest the treated area. Flame-throwers do not provide sufficient heat to kill the roots (Dawson & Henville, 1991), but freezing with liquid nitrogen has been effective on small areas.

Fragments should be removed from footwear and other equipment – e.g. spades, excavators' buckets – before leaving the site.

On medium surfaces (20–1000 $m^2$), the risk of spread can be greatly reduced by the use of a fence with fine wire mesh (5 mm) to enclose the area to be treated. This area should be about twice as large as the stand of *C. helmsii* to allow for the inclusion of areas in which the plant has probably already spread but is not yet visible. Any fine wire-mesh fence placed around the stand should not be removed until all regrowth has been eliminated.

Dredging of marginal and emergent material throughout the year can be effective (Environment Agency, 2003).

#### Chemical control

On sites with large stands (> 1000 $m^2$), chemical control may prove to be a practical alternative, but would need to be used with great care in the natural environment. *C. helmsii* is susceptible to herbicide formulations containing diquat and glyphosate. Diquat has been withdrawn from aquatic use in the EU. In place of this, it is possible to use dichlobenil applied in February or March when the plant is still completely submerged. Glyphosate can be applied to any emergent material, either on the bank or in the water, as long as it is dry. Only formulations of glyphosate which are specifically recommended for use in aquatic situations should be used. Glyphosate should be applied from April to the end of November, when the majority of the plant is emergent (Centre for Aquatic Plant Management, 2004).

Mechanical removal of dead plant material which has been treated with herbicides is recommended to reduce oxygen depletion by decomposing plant material (Centre for Aquatic Plant Management, 2004).

#### Biological control

There are no known control agents for this plant. It can be eaten by grass carp when the infestation is small, but *C. helmsii* is not its preferred food (Dawson & Warman, 1987). Dense infestations cause severe fluctuations in dissolved oxygen contents of the water and fish will not survive (Centre for Aquatic Plant Management, 2004; Centre for Ecology and Hydrology Dorset, 2002).

## Regulatory status

*C. helmsii* is listed as a noxious weed in Florida (prohibited aquatic plant, Class 1) and North Carolina (Noxious aquatic weed for which importation, sale, use, culture, collection, transportation, and distribution are regulated) (USDA, 2006) and is also a prohibited invasive species in Minnesota (Minnesota Department of Natural Resources, 2006) although it does not occur in these states. In the EPPO region, the species is reported to be invasive or potentially invasive in the United Kingdom, the Netherlands and Germany. In 2006, *C. helmsii* was recommended for regulation in the EPPO region as an A2 pest. Suggested measures are contained in EPPO Standard PM 3/67 (OEPP/EPPO, 2006) with a particular emphasis on: the obligation to report findings, publicity, surveillance, establishment of an action plan for eradication when the plant is found.

## References

Centre for Aquatic Plant Management (2004) *Information sheet 11: Australian swamp stonecrop*. Centre for Ecology and Hydrology, Natural Environment Research Council (GB). http://www.ceh.ac.uk/sections/wq/CAPMInformationsheets.htm [accessed in February 2006]

Centre for Ecology and Hydrology Dorset (2002) *Crassula helmsii focus on control – an update*. Natural Environment Research Council (GB). http://dorset.ceh.ac.uk/River_Ecology/Botany_Research/Botany_Research_Pictures/Crassula_Helmsii.pdf [accessed in February 2006]

Dawson FH (1994) Spread of *Crassula helmsii* in Britain. In *Ecology and Management of Invasive Riverside Plants* (ed. de Waal, LC, Child, LE, Wade, PM & Brock, JH), pp. 1–13. John Wiley and Sons Ltd, Chichester (GB).

Dawson FH & Henville P (1991) An investigation of the control of *Crassula helmsii* by herbicidal chemicals (With Interim Guidelines on Control) Report to the Nature Conservancy Council (GB).

Dawson FH & Warman EA (1987) *Crassula helmsii* (T. Kirk) Cockayne: Is it an Aggressive Alien Aquatic Plant in Britain? *Biological Conservation* **42**, 247–272.

Environment Agency (2003) *Guidance for the Control of Invasive Weeds in or Near Fresh Water*. http://www.environment-agency.gov.uk/commondata/105385/booklet_895604.pdf [accessed in February 2006]

Huckle J (2002) *Crassula helmsii* Australian swamp stonecrop. University

of Liverpool (GB). http://138.253.199.114/IAAP %20Web/IAAPwebsite/Aqplantecologicaldetails.asp?ID=1 [accessed in November 2006]

Huckle J (2005) *Crassula helmsii* New Zealand Pygmyweed. Invasive Aliens in Northern Ireland. University of Liverpool (GB). http://www.habitas.org.uk/invasive/species.asp?item=4639 [accessed in November 2006]

Leach J & Dawson H (1999) *Crassula helmsii* in the British Isles – an unwelcome invader. *British Wildlife* **10**, 234–239.

Minnesota Department of Natural Resources (2006) *Minnesota Invasive Species Laws*. http://www.dnr.state.mn.us/ecological_services/invasives/laws.html [accessed in February 2006].

North European and Baltic Network on Invasive Alien Species (NOBANIS) (2005) Crassula helmsii *(Crassulaceae) in Denmark*. http://www.nobanis.org/NationalInfo.asp?countryID=DK&taxaID=3959 [accessed in November 2006]

OATO (2003) Invasive Plants. http://www.ornamentalfish.org/aquanautconservation/invasiveplants.php [accessed in February 2006]

OEPP/EPPO (2006) PM 3/67 Phytosanitary Procedures. Guidelines for the management of invasive alien plants or potentially invasive alien plants which are intended for import or have been intentially imported. *Bulletin OEPP/EPPO Bulletin* **36**, 417–418.

USDA (2006) *Plants Profile* Crassula helmsii *A Berger*. Natural Resources. Conservation Service, http://plants.usda.gov/cgi_bin/plant_profile.cgi?symbol=CRHE5 [accessed in February 2006]

Watson WRC (1999) Amphibians and *Crassula helmsii*. Froglog. *Newsletter of the Declining Amphibian Task Force*, no. 31. http://www.open.ac.uk/daptf/froglog/FROGLOG-31 –3.html [accessed in November 2006]

Watson WRC (2001) An unwelcome aquatic invader! *Worcestershire Record*, issue 10. http://www.wbrc.org.uk/WorcRecd/Issue10/invader.htm [accessed in November 2006]

## Appendix

### References for geographical distribution

*Australia*

Australia's Virtual Herbarium (2001 onwards) http://www.rbg.vic.gov.au/cgi-bin/avhpublic/avh.cgi [accessed in February 2006]

*Belgium*

Margot J (2003) La vegetation aquatique des Spingputten en forêt de Meerdael. Evolution et présences floristiques. *Naturalistes Belges* **64**, 199–221.

*Denmark*

North European and Baltic Network on Invasive Alien Species (NOBANIS) (2005) http://www.artportalen.se/nobanis [accessed in February 2006]

*France*

OEPP/EPPO (2006) *Crassula helmsii* found in France. *EPPO Reporting Service* no. 2006/023. http://archives.eppo.org/EPPOReporting/2006/Rse-0601.pdf [accessed in November 2006]

*Germany*

Starfinger U & Kowarik I (2006) *Crassula helmsii* (Kirk) Cockayne (Crassulaceae), Nadelkraut. *Neoflora*, Bunbesamt für Naturschutz. http://www.floraweb.de/neoflora/handbuch/crassulahelmsii.html [accessed in November 2006]

*Netherlands*

Buscher D (1990) *Crassula helmsii* (T. Kirk) Cockayne in Westfalen. *Floristische Rundbriefe*, **24**, 8–9.

Mang FWC (1991) [New and old in Hamburg Flora.] *Ber. Bot. Vereins Hamburg* **12**, 41–56.

*New Zealand*

Manaaki Whenua Landcare Research (2002–2006) Ngâ Tipu o Aotearoa – New Zealand Plants. http://nzflora.landcareresearch.co.nz/ [accessed in February 2006]

*Northern Ireland*

Hackney P (2005) Invasive Aliens in Northern Ireland. *Crassula helmsii*. National Museums and Galleries of Northern Ireland. http://www.habitas.org.uk/invasive/species.asp?item=4639 [accessed in November 2006]

*Russia*

Asovsky MG (1981) Rare finds for east Siberia and Littoral-aquatic plants on the Baikalo-Amur Route. *Bot. Zh.* (Leningr.) **66**, 1218–20

Asovsky MG (1984) New findings of rare species of aquatic plants in the Baikal Region USSR. *Izv Sib Otd Akad Nauk SSSR Ser Biol Nauk.* **13**, 17–19.

*United Kingdom*

Leach J & Dawson H (1999) *Crassula helmsii* in the British Isles – an unwelcome invader. *British Wildlife* **10**, 234–239.