EPPO Datasheet: *Hakea sericea*

Last updated: 2020-04-23

IDENTITY

Preferred name: *Hakea sericea*
Authority: Schrader & J.C. Wendland
Taxonomic position: Plantae: Magnoliophyta: Angiospermae: Basal eudicots: Proteales: Proteaceae: Grevilleoideae
Other scientific names: *Hakea acicularis* (Smith ex Ventenat) Knight, *Hakea tenuifolia* (Salisbury) Britten
Common names: needlebush, prickly hakea, silky hakea (ZA), silky wattle
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EPPO Categorization: A2 list
view more categorizations online...
EU Categorization: IAS of Union concern
EPPO Code: HKASE

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GEOGRAPHICAL DISTRIBUTION

History of introduction and spread

Hakea sericea is native to South-Eastern Australia. Specifically, it is found in South-Eastern Queensland (Mt Barney, Mt Maroon and Mt Mee) and South-Eastern New South Wales, with non-native occurrences in South Africa, New Zealand and South-West Europe (Barker, 1996; CABI, 2017).

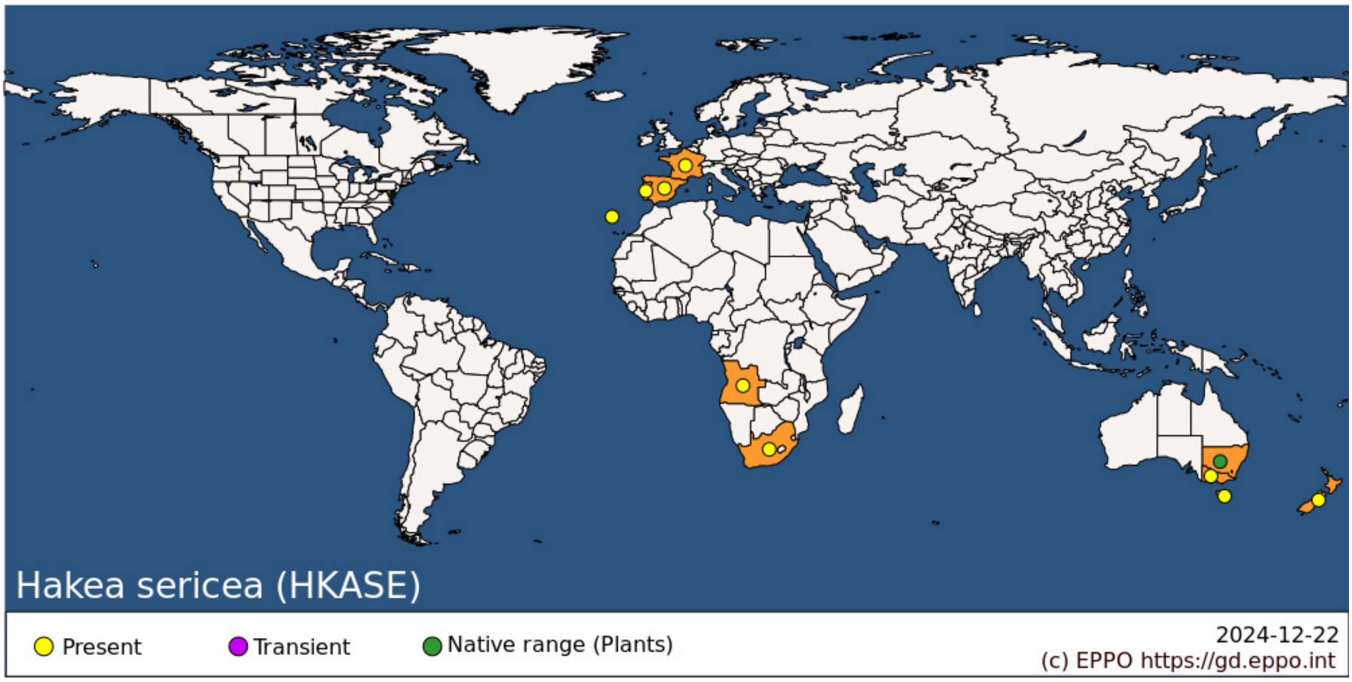
In South Africa, *H. sericea* was first recorded in 1858 (Shaughnessy, 1986). Dense stands now occur in the Western and Eastern Cape Provinces (Richardson *et al.*, 1987). CABI (2017) details that following its introduction into South Africa the plant became naturalized in nearly all the major coastal mountain ranges of the Western and Eastern Cape Provinces. In the Bathurst district, Eastern Cape, some farmers recognized the plant as a potential threat as early as 1863. The Knysna Farmers Union (Western Cape) requested that *H. sericea* be declared a noxious weed in 1925 as it was invading valuable pasture land (Phillips, 1938). The species has also been collected from Angola, although the current status is not known (Instituto de Investigacão Científica Tropical, 2008-2017a, b).

In Europe, *H. sericea* has been cultivated as a hedge plant in Portugal (including Madeira) since the 1930s (Espírito Santo & Arsénio, 1999). Early records exist for the introduction of the species into European botanical gardens; for example, according to *Hortus Kewenis H. sericea* was introduced in the UK around 1790. In addition, *H. sericea* is listed in the volume *Hortus Nympheburgensis* dated 1821, in the catalogue of the Royal Botanic Garden of Glasgow (1825).

The species has been known to have naturalized in the environment in the EPPO region since 1940 and has since become highly invasive in some areas (Espírito Santo & Arsénio, 1999; Marchante *et al.*, 2014; Martins *et al.*, 2016). In Spain, *H. sericea* is known only from Galicia (Sañudo, 2006; Xunta de Galicia, n.d.). In France, *H. sericea* is present in the south-east of the country (Provence-Alpes-Côte d'Azur; EPPO, 2015) in the Esterel Mountains, in both the Var and the Alpes-Maritimes departments (A. Albert, pers. comm., 2017; Fried, 2010). Fried (2010) states that it is naturalized in France. It is reported to have been first recorded in France in 1917.

H. sericea is native to South-Eastern Australia (Barker, 1996). *H. sericea* is recorded in New Zealand as a non-native species which invades native plant communities (*Leptospermum* and gumland communities; Beever, 1988).

Distribution



EPPO Region: France (mainland), Portugal (mainland, Madeira), Spain (mainland)
Africa: Angola, South Africa
Oceania: Australia (New South Wales, Tasmania, Victoria), New Zealand

MORPHOLOGY

Plant type

Evergreen shrub or small tree.

Description

H. sericea is an erect, single-stemmed, woody shrub or small tree, 0.6–4.5 m in height, with somewhat angular stems. It has simple, needle-like leaves, which are terete (i.e. circular in cross-section), spiny and moderately appressed silky-hairy when young, but quickly becoming glabrous; these leaves are (1.3)2–4.3(5.3) cm long and 0.7–1(1.1) mm wide, with a longitudinal groove on the lower side (Barker, 1996). The inflorescence is an axillary umbel, consisting of (1)4–5(6) cream-coloured flowers, each with a moderately to densely white-hairy pedicel (2.2–5.0 mm long). One to two woody follicles or fruits, sometimes also referred to as capsules, are formed in each axil; the fruits are (2)2.5–3(4) cm long and 2–2.5 cm in diameter (Kluge & Neser, 1991; Barker, 1996). The seeds are elliptic to obovate-elliptic, (16)19–25(31) mm long, (6)7–10(11.5) mm wide, each with a wing, either completely encircling the seed (although of unequal width on each side) or along one side only (Barker, 1996).

H. sericea can be distinguished from the other main *Hakea* species naturalized outside of Australia (i.e. *Hakea gibbosa*, *Hakea drupacea* and *Hakea salicifolia*) according to the following key, adapted from the flora by Webb *et al*. (1988) of the non-native plants of New Zealand. In Australia, 149 species (all endemic) are currently recognized by *Hakea* experts; see Barker (1996) for guidance on distinguishing these. Also note that, in some cases, the genus *Hakea* may be hard to distinguish from some morphologically similar *Grevillea* species (Barker, 2010).

BIOLOGY AND ECOLOGY

General

H. sericea has a canopy-stored seed bank from which seeds are typically released from woody follicles (fruits) following the death of the plant, frequently caused by fire (Bradstock, 1991). In its native range (South-Eastern Australia), flowering occurs from winter to early spring (June–September) and produces woody fruits that can persist for several years (Brown & Whelan, 1999). Fruit development begins in October soon after flowering, and fruits have been found to rapidly contribute to the availability of germinable seeds in the canopy seed bank (Brown & Whelan, 1999). Seeds are released following the death of a branch; however, seeds can also be released from a small percentage of fruits that are on living branches (E. Marchante, pers. comm. 2017). The decline in the germinability of *H. sericea* canopy seed banks has been found to be relatively slow, leading to a gradual increase in the size of seed banks over time (Brown & Whelan, 1999). The flowering period in part of its European invaded range (France and Portugal) is given as December to April, i.e. as for the native range, winter to early spring (Paiva, 1997).

Habitats

In its native range, *H. sericea* is a widespread species in dry sclerophyll forests and heaths of South-Eastern Australia (Brown & Whelan, 1999). The heathlands of South-Eastern Australia, including the Hawkesbury area in which *H. sericea* was studied by Brown & Whelan (1999), are described by Specht (1994) as having a warm temperate climate. According to Australian native plant gardening advice, *H. sericea* also has good drought resistance, although very restricted watering or heavy soil may lead to stunting (ANBG, 2017). Other gardening sources also report that the plant is resistant to drought and frost to -7°C when established (Moore, 2004).

The native range mapped by Barker (1996) corresponds mainly to Köppen–Geiger climate zone Cfb (warm temperate, fully humid, warm summer), with a small overlap with Cfa, that is, the same, but with a 'hot' rather than warm summer (Kottek *et al*., 2006). The Hawkesbury area is characterized by nutrient-deficient sandstone soils, typical of those on which heathland plant communities are found (Specht, 1994). *H. sericea*, like other Proteaceae, is well adapted to the acidic, highly weathered soils of such areas (Lambers *et al*., 2008). Richardson (1984) also found quartzite and sandstone substrates to be correlated with the occurrence of *Hakea* spp. in South Africa. In its European invaded range, Martins *et al*. (2016) showed that, at a gridded 1 km x 1 km scale, schist was an important predictor of the distribution of *H. sericea*; it was not important at the larger scale of a 10 km x 10 km regional grid. In general, in its European invaded range, disturbed areas (particularly road margins), forest margins, coastal grasslands and pine forest are all highlighted as additional habitats (Fried, 2010; Marchante *et al*., 2014).

In South Africa, *H. sericea* is reported as primarily a problem in the sclerophyll vegetation type known as mountain fynbos (Kluge & Neser, 1991). Here there are various characteristics of the local habitat that enhance the invasiveness of *H. sericea* (Kluge & Neser, 1991). These include the virtual absence of competition from native tree species (Macdonald & Richardson, 1986), the frequent occurrence of fire which is an important natural phenomenon in the Cape region (Kruger & Bigalke, 1984), various kinds of human disturbance (e.g. altered fire regimes; Macdonald, 1984) and the lack of specialized natural enemies of the plant (Neser, 1968).

Environmental requirements

Fire is a key part of the life cycle of *H. sericea*, with the heat-resistant fruits accumulating on a plant throughout its lifetime. The plant itself is 'absolutely fire sensitive' (Morrison & Renwick, 2000). However, after plant death, typically through fire, the fruits release their seeds (Kluge & Neser, 1991). The strategy of storing seeds in the canopy in fire-resistant woody fruits is not unusual in fire-prone ecosystems (Cowling *et al*., 1987), and has been referred to as 'serotiny' (Lamont *et al*., 1991) or 'bradyspory' (Whelan, 1995). The strategy has been viewed as an adaptation to fire by some authors (Bradstock *et al*., 1994), although it is found in many parts of the world and is not always associated with fire (Bond & van Wilgen, 1996). Fire frequency, seasonality and intensity are all important for the natural regeneration of *H. sericea* (e.g. Brown & Whelan, 1999); for example, frequent fires may kill seedlings after the initial stimulation of seed release and germination. Fire dynamics are therefore important determinants of community composition in any ecosystem which is burnt at a frequency that regularly influences the regeneration cycles of any of its constituent species (Bond & van Wilgen, 1996). For example, Brown & Whelan (1999), studying *H. sericea* in its native Australia in the context of fire seasonality and community diversity, found that fire too early in the fruit ripening process could reduce the supply of viable seeds due to the unripe fruits still containing enough moisture to make heating lethal to young tissue. *H. sericea* has been identified as influencing fire regimes both positively and negatively (Mandle *et al.,* 2011), increasing fuel loads and intensity, but decreasing spread and frequency (Van Wilgen & Richardson, 1985; Holmes *et al*., 2000; van Wilgen *et al*., 2007).

Natural enemies

There are no known natural enemies in the EPPO region.

Uses and benefits

The species has been used for a range of purposes, including ornament and hedging (including use as a windbreak; Marchante *et al*., 2014). Henderson (2001) lists shelter, shade and ornament as its main uses. Reva *et al*. (2010) reviewed the possibility of promoting its use as biofuel, partly as means of control, in Portugal. Huryn & Moller (1995) report that in New Zealand the plant is used by honey bees (*Apis mellifera* Linnaeus, 1758) for both nectar and pollen. Use for honey production is also noted by Vieira (2002) in Madeira.

There is little information on the value of the species in trade within the EPPO region. The UK Royal Horticultural Society list only one supplier (RHS, 2018). The species is also available from five suppliers via the German PPP Index http://www.ppp-index.de/. A further Internet search did not detail any additional suppliers within the European Union (EU).

PATHWAYS FOR MOVEMENT

Plants for planting have been the main pathway for entry into the EPPO region. The plant is known to be used as an ornamental and hedging species, and therefore could be imported as seeds or plants for this purpose (Henderson, 2001; Marchante *et al*., 2014). Human-assisted spread has played a role in the spread of the species within the pest risk analysis (PRA) area, and further use for ornamental, windbreak or honey-producing services is likely (Vieira, 2002; Marchante *et al.*, 2014).

IMPACTS

Effects on plants

In South Africa, dense *H. sericea* infestations threaten the biodiversity of the Cape Floral Kingdom, which is one of the six Floral Kingdoms of the world (Goldblatt, 1997). Dense stands of *H. sericea* have brought about significant reductions in species richness in the unique and floristically rich mountain fynbos of the Western and Eastern Cape provinces of South Africa (Richardson *et al*., 1989). Dense thickets of *H. sericea* are not unusual in the species' invaded range, with Van Wilgen & Richardson (1985) estimating densities of 8900 plants ha^{-1} at one study site. The effects of such invasions on the local environment are complex, and they may not always alter fire regimes (Van Wilgen & Richardson, 1985). However, Van Wilgen & Richardson (1985) also considered that an increased fire risk was likely under certain circumstances, for example when extreme (i.e. hot, dry) weather might allow for the ignition of *H. sericea* canopies, resulting in more intense fires than those seen in native vegetation.

Van Wilgen & Richardson (1985) note the low cover of native *Protea* L. shrub species within stands of *Hakea*. Dense thickets of *Hakea* suppress the natural vegetation, make access difficult or impossible, increase fire risk and are suspected of adversely reducing water run-off (Fugler, 1982). Richardson *et al.* (1989) reviewed existing data and recorded new quadrats in invaded and uninvaded fynbos, including five *H. sericea* sites, demonstrating lower native plant diversity in invaded stands on average (although the statistical analysis also included sites invaded by *Acacia saligna* (Labill.) Wendl., *Acacia melanoxylon* R.Br., *Pinus pinaster* Aiton and *Pinus radiata* D.Don). The lower cover and richness of native species after the burning of sites invaded by *Hakea*, contrasted with burnt uninvaded sites, also implies impacts of *H. sericea* on native plant communities (Richardson & van Wilgen, 1986). Breytenbach (1986) also cites unpublished survey data regarding the impacts of *H. sericea* on native fynbos species, ascribing these to changes in light regimes in invaded stands. Given the similar structure and size of *H. sericea* and many native Proteaceous shrubs in South Africa, it is perhaps not surprising that dense stands of *Hakea* shrubs tend to exclude native species, although we note that much of the existing evidence in the literature is indirect. This may be due, at least in part, to the difficulty of access associated with stands of the plant, and the challenges associated with experimental work in this area.

Breytenbach (1986) reports impacts of low-density *H. sericea* populations on native *Protea* species, reporting reduced leaf durations in *Protea lorifolia* Fourc. and *Leucadendron salignum* R.Br. along gradients of increasing *Hakea* cover; changes in leaf duration may also influence soil nutrient dynamics (Breytenbach, 1986). Breytenbach (1986) speculates that this may be due to increased competition for water in invaded communities.

In Portugal, *H. sericea* forms extensive dense monospecific stands which can exclude native plant species and/or change community composition, including associated fauna. Areas highly susceptible to invasion by *H. sericea* in the north of Portugal, are coincident with the distribution area of *Succisa pinnatifida* Lange, a rare endemic of the Iberian Peninsula (J. Vicente, pers. comm. 2017). The high spread potential of the species acts to threaten and reduce the biodiversity of the Esterel Mountains in France, by eliminating less competitive native species of maquis and forest.

In Portugal, several NATURA 2000 sites are to some extent invaded by *H. sericea*, for example PTCON0001 (Serras da Peneda e Gerês), PTCON003 (Alvão/Marão), PTCON0024 (Valongo), PTCON0039 (Serra D'Arga), and PTCON0060 (Serra da Lousã). In France, one NATURA 2000 site, FR9301628 (Esterel), is invaded.

These priority habitats contain rare and endangered species.

Environmental and social impact

Thickets of *H. sericea* increase fire hazard, particularly fire intensity (Van Wilgen & Richardson, 1985). Van Wilgen & Richardson (1985) found that invasion of *H. sericea* in two fynbos sites resulted in a 60% increase in fuel loads and lowered the moisture content of live foliage. Statements concerning the impacts of *H. sericea* on water availability are also regularly encountered (e.g. van Wilgen *et al.*, 1996; Richardson & van Wilgen, 2004), although these mostly appear to be reliant on indirect links between alien plants, wildfire, soil erosion and the resulting hydrological impacts (e.g. Scott & van Wyk, 1990; Scott, 1993) rather than studies on stands of *H. sericea per se* (van Wilgen *et al.*, 1996). The work of Breytenbach (1989) demonstrated links between increased fire intensity and soil runoff for *H. sericea,* although this was specifically in the context of a particular management technique for control (cutting the plant, and then subsequently burning the stacked stems in order to kill off the next generation of seedlings), rather than an impact of *H. sericea* in itself. This study, relating as it does to a specific management action, appears to be the main evidence for an impact of *H. sericea* on hydrological processes (e.g. Van Wilgen *et al.*, 2001). Dense thickets of *H. sericea*, with its spiny leaves, may also affect cultural ecosystem services.

Socio-economic impacts have been reported from the EPPO region where up to EUR 300 000 was spent in 2016–17 managing a population of approximately 12 ha in the Esterel Natural Park in the south of France which included costs of transporting removed plants by helicopter (A. Albert, pers. comm., 2017). In Portugal, control costs are estimated at EUR 1500 ha^{-1} (E. Marchante, pers. comm. 2017).

Dense thickets of the plant are likely to restrict access for livestock, grazing, hunting and recreation in Mediterranean regions, thus having a potential economic impact. As with any spiny shrub, *H. sericea* can injure people with its sharp leaves. CABI (2017) states that *H. sericea* poses a threat to the USD 40 million industry exporting ornamental *Protea* spp. from South Africa. It should be noted that there may also be indirect, but considerable, costs from impacts on water resources, biodiversity (in a socio-economic context) and amenities, but these are difficult to determine.

CONTROL

The most successful method for the control of *H. sericea* in South Africa has been the 'fell and burn' technique, where adult plants are cut down and left for 12–18 months before they are burnt (Esler *et al.*, 2010). This allows time for seed germination, meaning that the follow-up burn destroys seedlings before they become reproductively mature. One or two follow-up operations are necessary after the burn to eradicate any regenerating or coppicing plants. Although this is a very effective control method, the increased fire intensities using this technique can have a negative effect on sensitive ecosystems (Breytenbach, 1989). The manual eradication of seedlings is both time-consuming and expensive (Beever, 1988).

Chemical control has not played a large role in the control of *H. sericea* in South Africa as it can have a negative effect on native vegetation. The costs of chemical control are also high as *H. sericea* occurs in dense thickets and inaccessible areas.

A biological control programme against *H. sericea* was initiated in South Africa in 1962 and is ongoing. Priority was given to seed-attacking insects, and the first insect releases were made in 1970 (Kluge & Neser, 1991). A number of agents have been released to date. *Erytenna consputa* (Curculionidae: Erirhininae) has drastically reduced the annual seed production of *H. sericea* at some sites (Neser & Kluge, 1985; Kluge & Neser, 1991; Gordon, 1999).

Carposina autologa (Lepidoptera: Carposinidae) has reduced the mean number of accumulated seeds on *H. sericea* by up to 80% (Gordon, 1999). Despite these promising results, several factors are limiting its effectiveness. Firstly, an indigenous fungus, *Colletotrichum acutatum* J.H. Simmonds f.sp. *hakeae* Lubbe, Denman, P.F. Cannon, J.Z. Groenew., Lampr. & Crous (*Incertae sedis*: Glomerellaceae), causes death and die-back of *H. sericea* in some areas and the fruits on infected trees split open and seeds fall to the ground resulting in larval mortality as the *C. autologa* larvae are unable to move to new fruits (Gordon, 1993; Fourie *et al.*, 2012; Gordon & Lyons, 2017). Secondly, the moths are unable to distinguish between healthy and previously attacked fruits for oviposition, resulting in larval mortality. Thirdly, regular wild fires in the Western Cape cause local extinction of *C. autologa* and the moths take a long time to recolonize regenerating plants (Gordon & Lyons, 2017).

Cydmaea binotata (Curculionidae: Erirhininae) was released at 36 sites throughout the range of the weed but weevils have only since been recovered at four sites (Kluge & Neser, 1991). The impact of the weevil on *H. sericea* has not been investigated in South Africa because their effect on the density of seedlings has been considered to be negligible (Fourie *et al.*, 2012).

Aphanasium australe (Coleoptera: Cerambycidae) larvae tunnel gregariously at the base of stems and in the subsurface roots of the plant, leading to stem bases developing a characteristic thickening due to the formation of scar tissue. Although *A. australe* does not kill mature plants growing under natural conditions, it is envisaged that trees subjected to additional stress, for example drought or strong winds, may be killed by larval damage (Fourie *et al.*, 2012). The first releases of this agent were made during January 2000.

Dicomada rufa is a promising agent that is being considered for release to negate perceived weaknesses in the programme for biological control of *H. sericea*. The effectiveness of *E. consputa* and *C. autologa* is being hampered by periodic wildfires. Regenerating *H. sericea* plants only set seed 2–3 years after a burn, causing local extinction of *E. consputa* and *C. autologa* as both agents require fruits for development. As *D. rufa* feeds on buds, flowers and succulent growth it is believed *D. rufa* could make a significant contribution by limiting fruit production at this critical stage (Gordon, 1999).

The ‘Working for Water’ programme in South Africa has been key for the mechanical control of *H. sericea* but has identified biological control as the only long-term solution to prevent further spread of the weed and the re-invasion of cleared areas (Esler *et al.*, 2010). Biological control needs to be in place to prevent re-invasion of the weed and to limit the need for follow-up operations. However, largescale eradication of *H. sericea* can lead to the local extinction of established biocontrol agents. The seed-feeding agents are particularly at risk because seedlings recolonizing burnt areas take a number of years before they set fruit. It is therefore essential that insect refuges or reserves are established in areas to be cleared. These insect refuges can then act as foci from which recolonization of re-invading *H. sericea* populations can occur and collections of agents for redistribution can be made. These reserves should be 1–5 ha in size, 10 km apart and consist of reproductive plants (Gordon, 1999).

REGULATORY STATUS

H. sericea was added to the EPPO Alert List in 2007 and transferred to the EPPO List of invasive alien plants in 2012. In 2016, *H. sericea* was identified as a priority for risk assessment within the requirements of Regulation 1143/2014 (Branquart *et al*., 2016; Tanner *et al*., 2017). A subsequent PRA concluded that *H. sericea* had a high phytosanitary risk to the endangered area (EPPO, 2018) and was added to the EPPO A2 List of pests recommended for regulation. At the time of publishing, *H. sericea* is being considered for inclusion on the list of Union concern (EU Regulation 1143/2014).

In Spain, *H. sericea* is included in the Annex II list of the Real Decreto (Royal Decree) 1168/2011. This is a list of potentially invasive species. Inclusion on this list means, among other things, that the introduction of the species listed is prohibited and that necessary measures should be taken for management, control and eradication (translated and abridged from Article 8 of Real Decreto 1168/2011). In France, although there is no national regulation covering *H. sericea* specifically, at the department level, individual applications have been made for control orders against this species. *H. sericea* is also included on a regional 'black list'. In Portugal, legislation was passed in 1999 (Decreto-Lei 565/99) to address the issue of invasive alien species. Associated with the legislation is a list of invasive alien species. *H. sericea* was included in this list, meaning that cultivation, use as an ornamental plant, release, sale, exchange and transport are all prohibited.

In Israel, the species is considered to be a potential future risk, and is included in a recent list of 'Israel's Least Wanted Alien Ornamental Plant Species'. Although this 'black list' does not currently appear to have any legislative basis, it is being used by the Israel Ministry of Environmental Protection to advise planners on non-native species to avoid in planting schemes (Dufour-Dror, 2013).

The species has been included on many weed lists in New Zealand (Howell, 2008), including the 'consolidated list' of Howell (2008). It should be noted, however, the consolidated list itself does not have regulatory status.

In South Africa, the control of the species was enabled by the Conservation of Agricultural Resources (CARA) Act 43 of 1983, as amended, in conjunction with the National Environmental Management: Biodiversity (NEMBA) Act 10 of 2004. *H. sericea* was specifically defined as a Category 1b 'invader species' on the NEMBA mandated list of 2014 (Government of the Republic of South Africa, 2014). Category 1b means that the invasive species 'must be controlled and wherever possible, removed and destroyed. Any form of trade or planting is strictly prohibited' (www.environment.gov.za).

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