NOBANIS – Invasive Alien Species Fact Sheet

Lupinus nootkatensis

Author of this fact sheet: Borgthor Magnusson, Icelandic Institute of Natural History, P.O.Box 5320, IS-125 Reykjavik, Iceland. Tel.: +354 5 900 500; E-mail: borgthor@ni.is

Bibliographical reference – how to cite this fact sheet:
Magnusson, B. (2010): NOBANIS – Invasive Alien Species Fact Sheet – ***Lupinus nootkatensis***. – From: Online Database of the European Network on Invasive Alien Species – NOBANIS www.nobanis.org, Date of access x/x/201x.

Species description

Scientific name: *Lupinus nootkatensis* Donn ex Sims, Fabaceae
Synonyms: None
Common names: Nootka lupin (GB), sandlupin (NO, SE), alaskalúpína (IS), alaskalupin (DK).

Fig. 1. Inflorescence and leaves, photo by Bjarni Diðrik Sigurðsson.

Fig. 2. *Lupinus nootkatensis* spreading on a mountain site in NE Iceland following land reclamation, photo by Borgþór Magnússon.

Fig. 3. *Lupinus nootkatensis* overtaking a *Vaccinium myrtillus* heathland in NE Iceland, photo by Borgþór Magnússon.

Species identification
Lupinus nootkatensis is a tall perennial herb, dying back annually to a subterranean, branched, woody caudex (top of root); stems 50 – 120 cm tall in favourable locations; basal leaves short petiolated, with several oblong-obovate to oblanceolate leaflets, blunt or mucronate, more or less densely white to brownish pubescent on both sides, or glabrous above; flowering stem densely pubescent; racemes large; flowers blue, rarely white; calyx lobes broad, entire or usually more or less cleft, dentate or lobed. (Dunn and Gillett 1966, Hultén 1968).

Lupinus nootkatensis may be confused with *Lupinus perennis* L. (see Karlsson 1981).

Native range
Coastal distribution: Aleutian Islands, Alaska from the Arctic coast southwards to Queen Charlotte Island and Vancouver Island, British Columbia, Canada (Dunn and Gillett 1966).

Alien distribution

History of introduction and geographical spread
Lupinus nootkatensis was introduced to Europe from North America late in the 18th century. It was grown as an ornamental plant in England in 1795 where it became a popular garden plant (Karlsson 1981, Fremstad and Elven 2004). England is probably the original source of seeds of the species in Scandinavia. The first introduction to Sweden is not known but it may have been as early as in the 1840s, where it also became a popular garden plant in the late 19th and early 20th century with some spread into natural habitats (Karlsson 1981, Fremstad and Elven 2004). At that time it was probably introduced into Norway, where it was sown along roads and railways to stabilize soil and later naturalized. According to Fremstad and Elven (2004) the label of the oldest herbarium specimen from south-western Norway shows that the species was found in large quantities along railroad shoulders. The species is very rare in Finland but is known as a garden escape from one site in southeast Finland since 1986 (Fremstad and Elven 2004). The first records of *L. nootkatensis* in Iceland are from 1885, when it was sown with several other lupin species in plant trials (Schierbeck 1886). The seeds were probably provided from growers in Norway or Sweden. In 1945 seeds of *L. nootkatensis* were collected on the shores of College fjord, Prince William Sound, Alaska and brought to Iceland, leading to the introduction of the plant to several afforestation sites and subsequent naturalization of the species in the mid 1950s (Bjarnason 1946, 1981). *L. nootkatensis* was introduced to Greenland from Iceland around 1970 and has become naturalized in several localities in SW Greenland (Kenneth Høegh, pers. comm.). From Iceland the species was also introduced to the Faroe Islands shortly after 1970 (Tróndur Leivsson, pers.comm.).

Pathways of introduction
Lupinus nootkatensis is very rare in southernmost Sweden (Karlsson 1981, Fremstad and Elven 2004), but in Norway it has been introduced to several parts of the southern and central part of the country. The stronghold of its distribution is in Rogaland but it has a scattered distribution north to Nord-Trøndelag. The northernmost localities where it is known to be naturalized are in Lofoten and in Tromsø (Lid & Lid 2005). The highest known locality is at about 800 m a.s.l in southern Norway. The species has been naturalized on sandy beaches in the Jæren district of southwest Norway for at least 50 years. *L. nootkatensis* is still spreading in Norway, mainly along roads and railways, and there does not appear to be climatic restrictions to its further spread in Norway (Fremstad and Elven 2004). The species is found in all lowland districts of Iceland and some of the lower highland areas in the southwest and northeast where it is naturalized (Hörður Kristinsson,

pers. comm.). Active spreading of the plant started after 1960 by the Icelandic Forestry Service, gardeners and cottage owners, and since 1986 it has been cultivated and sown increasingly in land reclamation areas by the Soil Conservation Service. The species is naturalized in most areas where it has been sown or planted, and is spreading very actively, especially in areas where sheep grazing no longer exists (Magnússon *et al.* 2004, Svavarsdóttir *et al.* 2004). From Iceland *L. nootkatensis* was introduced to Upernaviarsuk Agricultural Station in southwest Greenland around 1970. From there it has been distributed to several neighbouring towns and farms and become a popular garden ornamental. It has also been used for reclamation of eroded areas. The species is now (2005) found on several locations between 60 and 64 degrees N in the fjords and coastal areas of SW Greenland, where it is able to produce mature seeds every summer and spread. It is expected to extend its range considerably in the region in the near future (Kenneth Høegh, pers. comm.). *L. nootkatensis* was also introduced to the Faroe islands from Iceland shortly after 1970. It is found there mainly as a garden ornamental but has not spread much beyond that, probably due to extensive and heavy sheep grazing. In one location (Havnardal), which is not accessible for sheep, the lupin has been growing for about 25 years on scree soil but has not spread extensively (Tróndur Leivsson, pers.comm, Sigga Rasmussen, pers. comm., Rasmussen 1989).

Alien status in region

Lupinus nootkatenis is found naturalized throughout the lowlands of Iceland (Hörður Kristinsson, pers. comm.), several places in southern and central Norway with a few localities to the north (Fremstad and Elven 2004, Lid & Lid 2005), rare in a few localities in SW Småland, S Sweden (Karlsson 1981, Fremstad and Elven 2004), and is known as a garden escape at one site in southeast Finland (Fremstad and Elven 2004); see also Table 1. The species is found naturalized at several sites between 60 and 64 degrees N in coastal areas of southwest Greenland (Kenneth Høegh, pers. comm.). *L. nootkatensis* has been introduced and is naturalized on river shingle in NE Scotland, Orkney and NW Ireland in the UK (Clapham *et al.*1987).

Country	Not found	Not established	Rare	Local	Common	Very common	Not known
Austria	X						
Belgium	X						
Czech republic							X
Denmark	X						
Estonia	X						
European part of Russia	X						
Finland			X				
Faroe Islands		X					
Germany	X						
Greenland				X			
Iceland						X	
Ireland		X					
Latvia	X						
Lithuania	X						
Netherlands	X						
Norway					X		
Poland	X						
Slovakia							X
Sweden			X				

Table 1. The frequency and establishment of *Lupinus nootkatensis*, please refer also to the information provided for this species at www.nobanis.org/search.asp. Legend for this table: **Not found** - The species is not found in the country; **Not established** - The species has not formed self-reproducing populations (but is found as a casual or incidental species); **Rare** - Few sites where it is found in the country; **Local** - Locally abundant, many individuals in some areas of the country; **Common** - Many sites in the country; **Very common** - Many sites and many individuals; **Not known** - No information was available.

Ecology

Habitat description

In its native range *Lupinus nootkatensis* is found on gravel bars along the coast and rivers and on dry slopes (Hultén 1968). In its alien range it is found in similar habitats, *e.g.* sandy beaches, edges of railways and roads and gravely river shores in Fennoscandia (Karlsson 1981, Fremstad and Elven 2004). In Iceland it is found in similar habitats and in extensive barren landscapes of vegetation destruction and soil erosion. It has also invaded dwarf shrub-heathlands. Its growth and performance is best in areas of relatively high precipitation in Iceland (Magnússon, Magnússon and Sigurðsson 2004).

Reproduction and life cycle

Self-fertilization is common among many lupin species. Research in Iceland indicates that *Lupinus nootkatensis* depends to a large extend on self-fertilization (70%), but cross-pollination by bumble bees also occurs (Baldursson 1995). Seed production is the main way of dispersal as lateral shoot expansion is rare. After germination of seeds in the spring only one stem is formed in the first season reaching about 10 cm in height. In the third season the plants have 3 – 5 stems and are about

60 cm in height. At this age they usually bloom and produce seeds for the first time, which they do annually thereafter. The plants increase their number of stems and general size for a number of years. The largest plants encountered have over 100 stems and are about 10 years old. The life-span of individual plants can probably be over 20 years under favourable conditions (Magnússon *et al.* 1995). Individual plants of 25 flowering stems can produce over 2000 seeds in a season (Baldursson 1995), and a seed production of up to 1800 seeds/m^2 has been recorded within lupin patches in Iceland (Sigurðsson and Magnússon 2004). *L. nootkatensis,* like many lupin species, is able to establish a persistent seed bank in the soil that may last for many years after the plants have degenerated (Sigurðsson and Magnússon 2004).

Dispersal and spread

Seeds of *Lupinus nootkatensis* are relatively large, 4 mm long, 3 mm broad, 15 – 20 mg in weight, and seed dispersal is within 3 m of mother plants (Sigurðsson and Magnússon 2004). The seeds are commonly dispersed 1 – 3 meters from the mother plants along the edges of patches which therefore may expand by 1 – 2 meters annually on level ground, but expansion rate of patches can be considerably higher in sloping ground and along watercourses (Björnsson 1997). Seeds may, however, be carried long distances along rivers and melting watercourses, which are common routes of more distant spread, as well as landslides (Björnsson 1997, Svavarsdóttir *et al.* 2004). Dispersal may also occur with the aid of strong winds in fall and winter, blowing pods with seeds over considerable distances. There are strong indications in Iceland that seeds may be dispersed long distances by birds (*e.g. Turdus iliacus,* Hálfdan Björnsson, pers. comm.).

A study of lupin colonization and expansion on a river plain in Skaftafell National Park in southern Iceland has shown an exponential population increase of lupin patches from 17.000 m^2 in 1988 to 230.000 m^2 in 2000 (Svavarsdóttir *et al.* 2004). In some areas in Iceland the lupin has started to degenerate and die back in the centre of patches after 15 – 25 years, while in others it still maintains high density after 30 years of growth (Magnússon *et al.* 2004).

The main dispersal agent in the region is human activity. The spread of the plant has occurred through its use as a garden plant, on roadsides to prevent erosion and through very extensive sowing for land reclamation. *Lupinus nootkatensis* is cultivated on a large scale in Iceland. Most of the seeds are used there but seeds have also been exported on a small scale to *e.g.* Greenland, Finland, Sweden, Germany, UK, Alaska and India (Magnús Jóhannsson, pers. comm.).

Impact

Affected habitats and indigenous organisms

As most other lupin species *Lupinus nootkatensis* is light-demanding, adapted to open habitats where natural disturbance is frequent such as sand and gravel bars along the coastline or rivers and mountain slopes. In its new range, the species is therefore primarily found, or has the potential to invade, the same habitats and similar habitats of human disturbance, such as road shoulders and open areas with scattered vegetation in towns (Karlsson 1981, Fremstad and Elven 2004, Kenneth Høegh, pers. comm.). The vast eroded areas, volcanic sands and floodplains in the lowlands of Iceland are primary habitats for *L. nootkatensis,* as well as some of the dwarf-shrub heathlands which the species will invade and overtake if the spread is not hampered by sheep grazing (Magnússon *et al.* 2004, Svavarsdóttir *et al.* 2004). Studies of the ecology of *L. nootkatensis* in Iceland have shown that the high nitrogen fixation of the species and the dense patch formation enables it to play a role as a key species in the ecosystem that greatly affects soil properties and

biota, plant establishment and overall succession (Aradóttir 2004, Magnússon *et al.* 2004, Sigurðardóttir 2004). In old lupin patches the vegetation development is towards a forb-rich grassland. Species diversity is usually greatly reduced within lupin patches as compared to adjacent control areas (Magnússon *et al.* 2004). In recent years another introduced species in Iceland, *Anthriscus sylvestris*, has started to invade old lupin patches which, with their nitrogen rich soils, provide excellent conditions for *Anthriscus*, see also fig. 4 (Magnússon *et al.* 2003).

Fig. 4. A patch of *Lupinus nootkatensis* being invaded by the alien species *Anthriscus sylvestris*. A common scene in SW Iceland in recent years, photo by Borgþór Magnússon.

As many other wild lupins, *L. nootkatensis* has a relatively high alkaloid content (Magnússon and Sigurðsson 1995, Thórsson and Hlíðberg 1997). Sheep that have limited access to other fodder than *L. nootkatensis* are known to be affected by toxicity which temporarily affects the nervous system and causes paralysis. The growth performance of sheep on lupine is also very poor (Guðmundsson *et al.* 1992).

In recent years some lupin areas on sands in Iceland have become infested with the Broom moth (*Melanchra pisi)* which defoliates the lupin in late summer and affects its growth (Sigurðsson *et al.* 2003). Another moth species (*Euxoa ochrogaster*) has in early summer been found feeding on lupin seedlings in sandy areas in southern Iceland affecting lupin establishment considerably (Erling Ólafsson, pers. comm.).

Genetic effects
None (see also the Fact Sheet for *Lupinus polyphyllus* on this NOBANIS web site (Fremstad 2006)).

Human health effects
The seeds of *Lupinus nootkatensis* are poisonous, causing inflammation of the stomach and intestines (Hultén 1968), which probably is attributable to the high alkaloid content and composition (Thórsson and Hlíðberg 1997). Roots of *L. nootkatensis* were in former days harvested by native people of Alaska and Canada and eaten raw or boiled, sometimes causing sickness (Heller 1953, Turner 1973, Kuhnlein 1990).

Economic and societal effects (positive/negative)
In most of the region, with the exception of Iceland, the lupin has been introduced as a garden ornamental and to a lesser extent for erosion control (Karlsson 1981, Fremstad and Elven 2004, Kenneth Høegh, pers. comm.). The economic importance or effects have been very limited. In Iceland, on the other hand, *Lupinus nootkatensis* has played an important role in reclamation of severely degraded areas, and it has been used extensively in the last 20 years. Dense plant cover and soil fertility can be gained within a relatively short time at a very low cost as no fertilizer applications are required. The lupin is therefore well suited for reclamation of large, barren areas and is a very economical option in the short term. The ability of the species to invade heathlands which it can take over and displace native vegetation as well as special habitats like river beds, however, calls for strict management guidelines (Arnalds and Runólfsson 2004, Magnússon *et al.* 2004).

Management approaches

Prevention methods
It is important to limit the use and distribution of the species in the region, especially in Iceland, Norway and Greenland where the species may expand its range considerably in the future if no measures are taken. In Iceland, lupin guidelines have been put forward by the Soil Conservation Service and the legislation on nature conservation bans the use of the species within protected areas and above 500 m a.s.l in the highlands. However, the effectiveness of these measures may be questioned considering the extensive use and spread of the lupin in the country.

Eradication, control and monitoring efforts
If *Lupinus nootkatensis* colonizes an area where it is not wanted, it is important to take action early, before it forms patches and a seed bank is built up in the soil. Measures in Iceland to eradicate the lupin from certain areas have proven rather unsuccessful due to the need for hard labour, high costs and lack of endurance. Methods that are considered most promising are opening lupin areas to sheep grazing, cutting of lupin and herbicidal applications.

L. nootkatensis will generally not establish itself in areas which are grazed by sheep, as the seedlings are grazed, preventing further growth of the plants. There are also examples of old lupin areas which have been opened up to sheep grazing. In such areas considerable degeneration of lupin has occurred due to defoliation and trampling. However, the grazing must be continued for several years to repress regeneration from the seed bank (Sigurðsson, pers. comm., Sigurðsson and Magnússon 2004). In 2005 sheep grazing was reintroduced into a confined area of Skaftafell National Park in southern Iceland in an attempt to limit the spread of the lupin within the park. The park had not been grazed by sheep since 1974 leading to an explosion in the spread of lupin (Svavarsdóttir *et al.* 2004).

In Iceland there have been experiments on the effects of cutting the lupin at sward height at different times throughout the growing season. The lupins regenerated after cutting in early summer and autumn. They were, however, very sensitive to cutting from the 20th of June to the middle of July when the root store of the plants was limited. Most of the plants cut during that period were killed. The lupin will on the other hand regenerate from the seed bank. Therefore, cutting must be continued for several years (Sigurðsson *et al.* 1995).

In New Zealand weed control of perennial Russell lupins (*L. arboreus* x *polyphyllus*) has been carried out on riverbed gravels. Ground application of herbicides is the main method used. The preferred spray is Grazon, a broadleaf herbicide containing triclopyr and pricloram as active ingredients. Advice on weed control of Russell lupin is available at the New Zealand Department of Conservation.

Information and awareness
In the first decades after the introduction of *Lupinus nootkatensis* to Iceland directly from Alaska in 1946 the species was generally considered positively by the public and specialists. With the increasing spread of the plant in the last 20 - 30 years and greater impact on vegetation and landscape, views have started to change somewhat. Considerable knowledge about the species has been gained through research. This has lead to better understanding and awareness on the use of the plant and its spread.

Knowledge and research
In the region the ecology of *Lupinus nootkatensis* and the impacts of the species have mainly been studied in Iceland. At the 10th International Lupin Conference, held in Iceland in 2002, considerable knowledge on *L. nootkatensis* as well as other perennial lupins in Scandinavia, North America and New Zealand was presented (Aradóttir 2004, Arnalds and Runólfsson 2004, del Moral 2004, Fremstad and Elven 2004, Friend *et al.* 2004, Magnússon *et al.* 2004, Pickart 2004, Riege 2004, Sigurðardóttir 2004, Sigurðsson and Magnússon 2004, Sprent 2004, Svavarsdóttir *et al.* 2004).

Recommendations or comments from experts and local communities
The main spread of *Lupinus nootkatensis* in the region is facilitated by humans. Therefore it should be possible to limit further spread into new areas where the species is not desirable. It is very important to inform the public and people working within the field of horticulture and land reclamation about the ecology of the plant and its invasive character and thus raise general awareness. Early action is necessary if plants should be eradicated from an area. It has proven very difficult to manage the species after it has started to spread in an area and formed a seed bank.

References and other resources

Contact persons
Franz Essl (AT)**,** Umweltbundesamt, Naturschutz, Spittelauer Lände 5, 1090 Wien, Austria
E-mail: franz.essl@umweltbundesamt.at

Borgthor Magnusson (IS), Icelandic Institute of Natural History, P.O.Box 5320, IS-125 Reykjavik, Iceland. Tel.: +354 5 900 500; e-mail: borgthor@ni.is

Eli Fremstad (NO), Norwegian University of Science and Technology, Museum of Natural History and Archaeology, Department of Natural History, NO-7491 Trondheim, Norway. E-mail: eli.fremstad@vm.ntnu.no

Tróndur Leivsson (FO), landsskógarvørður, Skógrøkt landsins, Hvítanesvegi 3, Postrúm 1174, FO-110 Tórshavn, Føroyar, Phone: +298 310922, E-mail: trondur@skogroktin.fo

Kenneth Høegh (GL), Upernaviarsuk Agricultural Station, P.O.Box 152, DK-3920 Qaqortoq, Greenland. E-mail: savacon@greennet.gl

Colette O'Flynn (IE), National Biodiversity Data Centre, WIT West campus, Carriganore, Waterford, Ireland. E-mail: coflynn@biodiversityireland.ie

Melanie Josefsson (SE), Swedish Environmental Protection Agency, SE-106 48 Stockholm, Tel. +48 18 67 31 48. Fax: +46 18 67 31 56. E-mail: Melanie.Josefsson@snv.slu.se

Links

Flora of Iceland
Den Virtuella Floran - *Lupinus nootkatensis*
See also link on the Russell lupin in New Zealand which in many ways has a strong resemblance with *L. nootkatensis* in the North European and Baltic region

References

Aradóttir, A.L. 2004. Does the Nootka lupin facilitate or impede colonization and growth of native birch in Iceland? In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 184 – 190.

Arnalds, A. and Runólfsson, S. 2004. The role of Nootka Lupin (*Lupinus nootkatensis*) for revegetation in Iceland. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 94 – 96.

Baldursson, S. 1995. Fertilization and seed set in Nootka lupine. In: Magnusson, B. (ed.): Biological studies of Nootka lupine (*Lupinus nootkatensis*) in Iceland. Growth, seed set, chemical content and effect of cutting. Rala Report 178: 38 – 43.

Bjarnason, H. 1946. Alaskaför haustið 1945. Ársrit Skógræktarfélags Íslands 13: 5 – 48.

Bjarnason, H. 1981. Lúpínan frá Alaska. Lesbók Morgunblaðsins, 33 tbl. 3. október: 6 – 7.

Björnsson, D. 1997. Útbreiðsluhættir alaskalúpínu í Heiðmörk raktir eftir loftmyndum. Fjölrit Rala nr. 192. 24 pp.

Clapman, A.R., Tutin, T.G. and Moore, D.M. (1987). Flora of the British Isles. Cambridge University Press. Third edition, 688 pp.

del Moral, R. 2004. How *Lupinus lepidus* affects primary succession on Mount St. Helens. In: E. van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 208 – 215.

Dunn, D.B and Gillett, J.M. 1966. The Lupines of Canada and Alaska. Canada Department of Agriculture, Research Branch. Monograph No. 2, 89 pp.

Fremstad, E. (2006). NOBANIS – Invasive Alien Species Fact Sheet – *Lupinus polyphyllus*. From: Online Database of the North European and Baltic Network of Invasive Alien Species – NOBANIS www.nobanis.org. Date of access 14/09/2006.

Fremstad, E. and Elven, R. 2004. Perennial lupins in Fennoscandia. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 178 – 183.

Friend, A.P., Hill, G.D. and Sanders, M.D. 2004. Seed recruitment and loss of Russell lupin seed in a Canterbury riverbed. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 226 – 231.

Guðmundsson, Ó., Thórsson, J. and Thórhallsdóttir, A.G. 1992. Sheep grazing on lupine (*Lupinus nootkatensis)* under humid northern conditions. In: Scott Smith, C.A. (ed.): Proceedings of the 1st Circumpolar Agricultural Conference, Whitehorse, Yukon, Canada, September 1992, pp. 17 – 18.

Heller, C.A. 1953. Edible and Poisonous Plants of Alaska. Cooperative Extension Service, University of Alaska and USDA, pp. 156 – 157.

Hultén, E. 1968. Flora of Alaska and Neighbouring Territories. Stanford University Press, 1008 pp.

Karlsson, T. 1981. Den gammaldags lupinen in Sunnerbo. Svensk Bot. Tidskr. 75: 265 – 278.

Kuhnlein, H.V. 1990. Nutrient values in indigenous wild plant greens and roots used by the Nuxalk People of Bella Colla, British Columbia. Journal of Food Composition and Analysis 3: 38 – 46.

Lid, J. and Lid, D.T. 2005. Norsk flora. (7. ed. by Reidar Elven.) Det Norske Samlaget, Oslo. 1230 pp.

Magnússon, B., Magnússon, S.H. and Sigurðsson. B.D. 2003. Effects of introduced Nootka lupin (*Lupinus nootkatensis)* on plant succession in Iceland. Náttúrufræðingurinn 71: 98 – 111.

Magnússon, B., Magnússon, S.H. and Sigurðsson, B.D. 2004. Plant succession in areas colonized by the introduced Nootka lupin in Iceland. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 170 – 177.

Magnússon, B. and Sigurðsson, B.D. 1995. Protein, mineral, fibre and alkaloid content of Nootka lupine. In: Magnusson, B. (ed.): Biological studies of Nootka lupine (*Lupinus nootkatensis*) in Iceland. Growth, seed set, chemical content and effect of cutting. Rala Report 178: 44 - 65.

Magnússon, B., Sigurðsson, B.D., Magnússon, S.H. and Baldursson, S. 1995. Growth and yield of Nootka lupine. In: Magnusson, B. (ed.): Biological studies of Nootka lupine (*Lupinus nootkatensis*) in Iceland. Growth, seed set, chemical content and effect of cutting. Rala Report 178: 9 - 27.

Pickart, A.J. 2004. Introduced yellow bush lupin (*Lupinus arboreus*) in coastal dunes of Northern California. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 216 – 222.

Rasmussen, S., 1989. Yvirlit yvir urtir í føroyskum gørðum (An inventory of herbaceous plants in Faroese gardens). In: Højgaard, A., Jóhansen, J., and Ødum, S. (eds.) A century of tree-planting in the Faroe Islands. An. Soc. Scient. Færoensis. Sup. XIV. Tórshavn: 67-79.

Riege, D.A. 2004. The use of Lupinus nootkatensis in a revegetation and afforestation program in southwest Iceland. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 206 – 207.

Schierbeck, G. 1886. Skýrsla um nokkrar tilraunir til jurtaræktunar á Íslandi. Tímarit Hins Íslenska Bókmenntafélag VII, pp. 1 – 66.

Sigurðardóttir, H. 2004. Earthworm activity in a lupin patch in Heiðmörk, Southern Iceland. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 191 – 194.

Sigurðsson, B.D., Halldórsson, G. and Heiðarsson, L. 2003. Broom moth causes problems on afforestation sites in S and SE Iceland. Skógræktarritið 2003, 1 tbl., pp. 87 – 92.

Sigurðsson, B.D. and Magnússon, B. 2004. Seed ecology of the Nootka lupin (*Lupinus nootkatensis)* in Iceland. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 195 – 198.

Sigurðsson, B.D., Magnússon, B. and Magnússon, S.H. 1995. Regrowth of Nootka lupine after cutting. In: Magnusson, B. (ed.): Biological studies of Nootka lupine (*Lupinus nootkatensis*) in Iceland. Growth, seed set, chemical content and effect of cutting. Rala Report 178: 28 - 37.

Sprent, J.I. 2004. *Lupinus:* Diversity of nutrient acquisition systems. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 164 – 179.

Svavarsdóttir, K., Pétursdóttir, Þ. and Gísladóttir, G. 2004. Distribution dynamics of exotic Nootka lupin (*Lupinus nootkatensis*) on a braided river plain in Skaftafell National Park, Iceland. In: van Santen, E. and Hill, G.D. (eds.): Wild and Cultivated Lupins from the Tropics to the Poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19 – 24 June 2002. Publ. International Lupin Association, Canterbury, New Zealand, pp. 199 – 202.

Thórsson, J. and Hlíðberg, K. 1997. Alkaloids in Nootka lupine. Icel. Agr. Sci. 11: 75 -89.

Turner, N.J. 1973. The ethnobotany of the Bella Coola Indians of British Columbia. Syesis 6: 193 – 220.

Date of creation/modification of this fact sheet: 25-10-2010