NOBANIS – Invasive Alien Species Fact Sheet

Lupinus polyphyllus

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Species description

Scientific name: *Lupinus polyphyllus* Lindley. Described 1827 in Botanical Register 13: 1096. Belongs to the family *Fabaceae.*
Synonyms: None
Common names: Garden Lupin (GB), mangebladet lupin (DK), hulgalehine lupiin (EE), komaelupiini (FI), Vielblättrige Lupine, Stauden-Lupine (DE), daudzlapu lupīna (LV), gausialapis lubinas (LT), hagelupin (NO), łubin trwaly (PL), люпин многолистный (RU), blomsterlupin (SE).

Fig. 1a and b. Inflorescence and fruits (right), photo by Uwe Starfinger.

Fig. 2. *Lupinus polyphyllus* in a ruderal site in Central Norway, photo by Eli Fremstad.

Fig. 3. A large stand of *Lupinus polyphyllus* of unknown origin in a roadside slope in Central Norway, photo by Eli Fremstad.

Species identification
Herbaceous, 50-150 cm high, tuft-forming perennial (biennial or short-lived perennial, Preston *et al.* 2002) with unbranched stems with alternate, palmate leaves with long petioles and 10-15 narrowly oblong (lanceolate), 1-2 cm broad leaflets. Stems and petioles with rather sparse, short hairs. Flowers (up to 80) in one terminal, erect raceme, in shades of blue. Pink and white flowers are also found. In Lithuania, the average number of flowers in terminal racemes is 120, and 200 has been recorded as a maximum (Z. Gudžinskas, pers. comm.).

L. polyphyllus may be confused with the Russel Lupin *Lupinus x regalis* (*L. arboreus x polyphyllus)* which usually has slightly branched stems, one or several rather dense racemes with flowers in blue, purple, pink, white, yellowish and shades of orange. This taxon is a garden hybrid (or hybrid complex).

Native range
Western parts of North America with an oceanic climate: Canada (British Columbia), United States (Alaska, west Oregon, west Washington, north California).

Alien distribution

History of introduction and geographical spread
L. polyphyllus is introduced in the eastern parts of North America and is introduced, cultivated and naturalised in many countries in Europe. In Flora Europaea (Amaral Franco and Pinto da Silva 1968) it is recorded from Denmark, Finland, Germany, Norway, Poland, the central part of European Russia and Sweden, however, not from the United Kingdom. Today, Estonia, Latvia and Lithuania should be added.

L. polyphyllus was introduced to England in 1826 (by the famous Scottish plant hunter David Douglas) and was quickly introduced to Central Europe as a garden plant (Krausch 2003). Already in the 1840s, nurseries and botanical gardens offered a variety of colour forms. The cultivation and commercial spread of the species increased around 1900 and it was known to occur in the wild in the UK at the same time (Preston *et al.* 2002). The hybrid Russel lupine was introduced to the European market in 1935 as an ornamental.

In Sweden *L. polyphyllus* was first recorded as a garden escape in Scania (Skåne), published in 1870 (Hylander 1971). In Norway it was mentioned in a plant list in 1831 but recorded as escaped from cultivation as late as the 1940s (Nordhagen 1940, Lid 1944, cf. Elven and Fremstad 2000). In Finland, it was first recorded as escaped from cultivation in 1895 (A. Kurtto, pers. comm.). In Germany, the first wild stands were observed in Bavaria in 1890 (Hegi 1964).

L. polyphyllus was introduced to Estonia in 1807 to Tartu Botanical Garden. It has escaped from field cultivation and is naturalised in several regions (Kukk 1999). The first record of *L. polyphyllus* as a naturalised plant is from 1921 in Latvia and from 1931 in Lithuania (Gudžinskas 1999). It was introduced to Poland around 1877 and has become invasive since 1950 (Tokarska-Guzik 2003).

In Russia *L. polyphyllus* was recorded as escaped from cultivation in Moscow district from the 1960s (Ворошилов и др. 1966) and as naturalized from the 1970s (Игнатов и др. 1990).

L. polyphyllus is an important crop and research object on an international basis (amino acids and protein synthesis, oils and alkaloid content etc.) and escapes from cultivation are the reason for its

distribution and frequency in several countries, and this is much more important than escapes from gardens. Even if the use of *L. polyphyllus* as a stabilising plant (see below) should come to an end, it is probably inevitable that it escapes from cultivation from time to time.

Pathways of introduction

In all north European countries *Lupinus polyphyllus* has been introduced intentionally, initially and primarily as an ornamental (garden) plant. Later, it has been introduced and bred also for other purposes but especially for soil improvement and stabilisation and as fodder for domestic animals and wildlife.

L. polyphyllus grows in symbiosis with a nitrogen-fixing bacterium, *Bradyrhizobium* sp., which causes growth of root nodules. The bacterium acquires molecular nitrogen from the atmosphere. Soils where *L. polyphyllus* grows are enriched with nitrogen, which may be used by other plants as well. This ability to increase soil fertility is the main reason for the diverse and widespread use of the plant. In Germany the main pathway of introduction was for soil amelioration or improvement, especially the poor, acid soils in mountain regions (Rhön, Bayerischer Wald, Fichtelgebirge, Schwarzwald). There it has been (and still is) planted for stabilisation of open soils after construction works (roads, forest roads) or after cutting of trees. It has also been planted as a "green manure" (intercrop) on cultivated fields and as a game fodder. It was used in fire-protection belts in forests in Lithuania (Gudžinskas 1999). The species is also used for breeding hybrids with other lupines.

Alien status in region

In the UK *Lupinus polyphyllus* is less grown in gardens now than earlier and has been replaced by the *L. x regalis*. Garden escapes are usually recorded as *L. polyphyllus,* but is most probably *L. x regalis*, except in Scotland, where *L. polyphyllus* seems to be prevalent (Stace 1997). It is not clear if the distribution map of Preston *et al.* (2002) shows the distribution in UK and Ireland of *L. polyphyllus* only, or if it includes *L. x regalis*.

In Norway, the cultivation of *L. x regalis* in gardens is however increasing, *L. polyphyllus* is still very common in gardens, and garden escapes are *L. polyphyllus*. *L. x regalis* seems to be less hardy and has so far not established itself outside of gardens (Lid and Lid 2005). *L. polyphyllus* is common in South Norway, more scattered in the north but has been recorded in all counties (i.e. north to 70^{o} N). It is a well established, common alien in Norway.

In Sweden, *L. polyphyllus* has probably been underrecorded for a long time. In the web-site 'Den virtuella floran' the distribution is described as 'southern and middle Sweden' but the map of Mossberg and Stenberg (2004) indicates a wider distribution, reaching north of the shores of the Bothnian Bay.

In Finland *L. polyphyllus* is a common, established alien in the south, and an established but rare species in the Åland archipelago and in the provinces northwards to the Arctic Circle (Hämet-Ahti *et al.* 1998). Further south, in Estonia, *L. polyphyllus* occurs locally, being rather common in SE Estonia and very rare or absent on the western islands (Kukk and Kull 2005). There are no problems with garden escapes. Escapes from cultivated fields are established on road verges and in open pine forests where they may have an adverse effect on native species. Some of the Estonian plants may have spread from Latvia. *L. polyphyllus* is 'rather frequent' in Latvia as well as in Lithuania (Kuusk *et al.* 1996). In Latvia it is found throughout the territory (N. Kabuce pers. comm.). It is invasive in Lithuania where it occupies large areas. Therefore, it has been included in the Lithuanian list of species which should be eradicated (Z. Gudžinskas pers. comm.).

In Russia *L. polyphyllus* is common and established in the north-western, central, western and eastern part of European Russia (Флора европейской части 1987).

In Poland *L. polyphyllus* is found throughout the country, in more than 1000 localities. In the SW, E and NE it is locally common (Tokarska-Guzik 2003, Solarz *et al.* 2005).

In Germany, the plant is established and very common, being one of the 15 most widespread alien plants on acid to slightly acid soils, being rare only on calcareous soils and in areas with low precipitation in summer (cf. the web-site NeoFlora, with links to distribution map), see also table 1.

L. polyphyllus is found in several places in Reykjavik in Iceland, as relics from abandoned gardens or in ruderal places. In Vaðlaskógur in the district Eyjafjorður in North Iceland, *L. polyphyllus* was, several years ago, found at the roadside, surrounded by hybrids with *L. nootkatensis*. The progenies seem to have been absorbed in the *L. nootkatensis* population.

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 polyphyllus*, 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 area *L. polyphyllus* grows on shores, in meadows and roadsides and other disturbed habitats; the species is weedy even in its native area (Scoggan 1978). The native habitats are also characterized as 'shady, moderately dry, well-drained, sandy-loam soil' (cf. the web-site of Madison Botanical Garden).

This ecology is reflected in countries where it is alien. In Europe it is 'widely naturalized' (Amaral Franco and Pinto da Silva 1968) along rivers and railways, sometimes in waste places (Stace 1997); on road and railroad verges, ruderal places and alluvial shores (Fremstad and Elven 2004), even in some sandy seashores (Fremstad *et al.* 2005); in forests, near forest edges, in Epilobietea in Poland (cf. the web-site Alien species in Poland) and Rhoen-Biosphere Reserve, nutrient-poor mineral soils: road and railway verges, gravel quarries, ruderal areas in Scandinavia as a whole (Mossberg and Stenberg 2004). In Germany, it also occurs in more natural vegetation, such as poor acid grasslands and tall-herb vegetation (Hochstaudenvegetation, Otte *et al.* 2002, Otte and Maul 2005). This is still not the case in Norway, where tall herb vegetation is found along many roads where *L. polyphyllus* is growing. In Russia it is very common not only in ruderal places and along roads but in meadows, pine forests and near forest edges (Флора европейской части 1987; Игнатов и др. 1990).

The Baltic flora (Kuusk *et al.* 1996) reports *L. polyphyllus* from pine forests on sandy podzols, acidic dry meadows, cultivated fields of different kinds (fallows, crop fields), and a diversity of ruderal habitats: field and road verges, railway slopes, quarries, banks of canals, ditches etc., and disturbed woodlands. In Latvia, *L. polyphyllus* is often cultivated, and it has escaped to forests and fallows, road verges and waste places (N. Kabuce, pers. comm.).

Reproduction and life cycle

L. polyphyllus flowers in May– June (July in the northernmost regions). It produces seeds freely. The hairy pods contain 4-10 (12) seeds which are spread a short distance around the mother plants when the pods open explosively. Seeds are mature in late summer or early autumn.

Being a perennial herb, *L. polyphyllus* dies back in autumn and emerges in spring by means of dormant buds in the soil surface (hemicryptophyte). It can spread by means of creeping rhizomes below ground. Information on the individual life expectancy has not been found. Plants may be propagated by division or raised from seeds. The seed longevity may be more than 50 years (Otte *et al.* 2002).

Dispersal and spread

L. polyphyllus is spread mainly by means of seeds. Outside cultivation, the seeds are transported by vehicles, soil transports and other human activity. When *L. polyphyllus* occurs in large quantities (as in many places in south Norway, Elven and Fremstad 2000) it has been sown intentionally to stabilise new or unstable substrates.

Impact

Affected habitats and indigenous organisms
L. polyphyllus has been recorded from a wide range of European habitats, most of them having some features in common: ample light, nutrient-poor mineral soils, disturbance and limited competition from other plants. The habitats in its native range are described as 'shores, meadows and roadsides and other disturbed habitats' (Scoggan 1978). The description covers, to a large degree, also its habitats in Europe. However, in Germany *L. polyphyllus* also grows in grasslands on soils which are rich in organic material.

The effect on indigenous plants is most obvious where *L. polyphyllus* occurs in extensive, rather dense stands which suppress native species. It can outcompete native species occurring in road verges, ruderal areas, gravelly floodplains and other open habitats, see above. Although many species in such habitats are of little nature conservation concern, some rare or threatened (at least locally) poor competitors may be found even here. Due to the nitrogen-fixing nodules *L. polyphyllus* changes the soil chemistry in favour of nitrogen-demanding species. Thus, *L. polyphyllus* causes a change in nutrient content of soil and, eventually, in plant communities. Eutrophication of nutrient-poor sites and consequent changes in community structure and diversity is the main problem when *L. polyphyllus* invades an area.

In several countries *L. polyphyllus* is, in general, not considered as a problem, although it may occur in masses. In Poland it seems to cause no serious problems, but it affects forest herbs (Solarz *et al.* 2005), which is probably an underestimation of its effect. But the *Lupinus polyphyllus* problem may become obvious when former land use will be changed in a way which enables *Lupinus polyphyllus* to produce and spread ripe seeds. In Lithuania, it is spreading rapidly and threatens the biodiversity of meadows and sands (Gudžinskas 1999).

Fig 4. During the last decades, *Lupinus polyphyllus* has invaded gravelly or stony river banks (alluvial sites) along several of the largest rivers in Central Norway. The species may have escaped from gardens, or spread from road verges near the rivers, photo by Eli Fremstad.

Genetic effects
The NOBANIS area (northwest and northeast Europe) has no native lupins. Consequently, there is no danger that *L. polyphyllus* should hybridise with native species. The hybrid *L. nootkatensis x L. polyphyllus* is reported from two vice-counties in Scotland (Stace 1997), Norway (Lid and Lid 2005), Sweden (Karlsson 1981) and Iceland (J. Pállson pers. comm.).

Human health effects
In Norway and Sweden there are no records of health hazards connected with the growing of *L. polyphyllus* (Strandhede 2000); handling of the plants is not harmful.

The plant and its seed contain alkaloids, and consumption may be harmful to sheep and cattle. The content of alkaloids may be 3.5% in the seeds, up to 2% in the vegetative parts. The main alkaloid is lupanin, $C_{15}H_{24}N_2O$. Strains lacking alkaloids are grown for producing seeds used for forage; alkaloid-free seeds may also be used for human consumption (cf. contributions in van Santen and Hill 2004).

Economic and social effects (positive/negative)
L. polyphyllus is an important agricultural plant with a wide variety of cultivars differing in chemical characters, growth potential, use etc. Hay from fields with an intermixture of *L. polyphyllus* may be less valuable due to the alkaloid content of the plant, and the fields may become more difficult to harvest (cf. the web-site NeoFlora).

Management approaches

Prevention methods
It is hardly realistic to prohibit the growing of *L. polyphyllus* as an ornamental plant, and this source of spread is probably not the most problematic one. The largest stands originate from the mass sowings by road authorities and their subcontractors, or from agriculture or wildlife management.

Locally in Norway the use of *L. polyphyllus* along road verges has been banned in order to protect the native species for which road verges have become important refuges. However, there is no national policy to prevent or forbid the use of *L. polyphyllus*, even if the ratification of the Rio convention obligates the country to prevent the introduction and use of alien species, as is the case for other NOBANIS countries. The German Federal Agency for Nature Conservation (in web-site NeoFlora) recommends that *L. polyphyllus* should not be sown for soil stabilisation and improvement etc. in the vicinity of species or habitats of nature conservation interest.

Eradication, control and monitoring efforts
In many locations, eradication is not necessary. The effect on other plants may be limited, or there are no species of nature conservation concern present. Individuals can easily be removed by weeding (cutting or removal of the whole plant). Where *L. polyphyllus* occurs in masses and threatens native wildlife, and where reduction in numbers or eradication is the aim, the herbicide Round-up will probably give the best and quickest result, but may not be allowed nor recommended due to the effect on native species. Also grazing with extensive sheep races (e.g. Rhoen sheep) will give quick results (after 2 years of grazing).

Regular mowing or grazing (depending on if it is a pasture or a meadow) gradually reduces the number of populations and individuals. Otte *et al.* (2002) recommend that it should be mown and eventually grazed. Mowing should occur twice a year for 3-5 years, before flowering and two months later. Then, the mowing can be reduced to once a year, before flowering or at least before the seeds are ripe, to prevent further spread.

In some sites *L. polyphyllus* will decline in competition with native species, but it will probably not disappear completely.

Information and awareness
Nature management authorities should inform about the potential negative effects of the species, especially to those authorities and institutions (agriculture, road and railroad authorities etc.) which are responsible for the massive use and spread of the species. Several countries (for example Germany and Poland) have web-sites on alien species.

In Estonia the Ministry of Environment has published two booklets (in 2001 and 2005) about invasive alien species of local importance. An invasive species database has also been created. The Norwegian Species Data Bank published a fact sheet on *L. polyphyllus* in 2006 (in Norwegian).

Knowledge and research
No specific research is known to take place in the region.

Recommendations or comments from experts and local communities
None of relevance.

References and other resources

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Links

Den virtuella floran, Naturhistoriska riksmuseet, Stockholm (species description in Swedish)

NeoFlora. - Invasive gebietsfremde Pflanzen in Deutschland

Homepage on poisonous plants

References

Amaral Franco, J. do and Pinto da Silva, A.R. 1968. 28. Lupinus L. – pp. 105-106 in Tutin, T.G. *et al.* (eds.) Flora Europaea. 2. Rosaceae to Umbelliferae. Cambridge University Press, Cambridge.

Elven, R. and Fremstad, E. 2000. Fremmede planter i Norge. Flerårige arter av slekten lupin *Lupinus* L. – Blyttia 58: 10-22.

Fremstad, E. and Elven, R. 2004. Perennial lupins in Fennoscandia. – pp. 178-183 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. International Lupin Association, Canterbury, New Zealand.

Fremstad, E., Hanssen, O. and Aagaard, K. 2005. Botanikk og invertebrater på Langøra nord, Stjørdal. – NTNU Vitenskapsmuseet Rapport botanisk Serie 2005,7: 1-16.

Gudžinskas, Z. 1999. Conspectus of alien plant species of Lithuania. 10. *Fabaceae*. – Botanica Lithuanica 5,2: 103-114.

Hämet-Ahti, L., Suominen, J., Ulvinen, T. and Uotila, P. (eds) 1998. Retkeilykasvio. – Luonnontieteellinen keskusmuseo, Kasvimuseo, Helsinki. 656 pp.

Hegi, G. 1964. Illustrierte Flora von Mitteleuropa. 4-3. Dicotyledones 2. Leguminosae – Tropaeolaceae. 2. Aufl. – Parey Verlag, Hamburg. 1750 pp.

Hylander, N. 1971. Prima loca plantarum vascularium sueciae. Plantae subspontaneae vel in tempore recentiore adventitiae. – Svensk botanisk Tidskrift 64, Suppl. 332 pp.

Karlsson, T. 1981. Den gammaldags lupinen i Sunnerbo. – Svensk botanisk Tidskrift 75: 265-278.

Krausch, H.-D. 2003. Kaiserkron und Päonien rot...' Entdeckung und Einführung unserer Gartenblumen. – Dölling und Galitz Verlag, Hamburg. 536 pp.

Kukk, T. 1999. Eesti taimestik. - TA Kirjastus, Tartu, Tallinn. 464 pp. (In Estonian.)

Kukk, T. and Kull, T. (eds.) 2005. Atlas of the Estonian flora. – Tartu. 528 pp.

Kuusk, V., Tabaka, L. and Jankeviciene, R. (eds.) 1996. Flora of the Baltic countries. 2. – Eesti Loodusfoto AS, Tartu. 372 pp.

Lid, J. 1944. Norsk flora. – Det Norske Samlaget, Oslo. 637 pp.

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

Mossberg, B. and Stenberg, L. 2004. Den nya nordiska floran. – Wahlström and Widstrand. 928 pp.

Nordhagen, R. 1940. Norsk flora. – H. Aschehoug and Co., Oslo. 766 pp.

Otte, A., Obert, S., Volz, H. and Weigand, E. 2002. Effekte von Beweidung auf *Lupinus polyphyllus* Lindl. in Bergwiesen des Biosphärenreservates Rhön. – Neobiota 1: 101-133.

Otte, A. and Maul, P. 2005. Verbreitungsschwerpunkte und strukturelle Einnischung der Stauden-Lupine (*Lupinus polyphyllus* Lindl.) in der Bergwiesen der Rhön. – Tuexenia 25: 151-182.

Preston, C.D., Pearman, D.A. and Dines, T.D. (eds.) 2002. New atlas of the British and Irish flora. – Oxford University Press, Oxford. 910 pp.

Santen, E. van and Hill, G.D. 2002. (eds.) Wild and cultivated lupins from the tropics to the poles. Proceedings of the 10th International Lupin Conference, Laugarvatn, Iceland, 19-24 June 2002. International Lupin Association, Canterbury, New Zealand.

Scoggan, H.J. 1978. The flora of Canada. 3. Dicotyledonae (Saussuraceae to Violaceae). – National Museum of Natural Sciences, Publications in Botany 7-3. 1115 pp.

Solarz, W., Tokarska-Guzik, B., Zając, K., Chmura, D., Cierlik, G. and Król, W. 2005. Zasady postępowania z gatunkami roślin i zwierząt obcymi rodzimej faunae i florze. [Principles of management of alien species in native fauna and flora.] – Institute of Nature Conservation, Kraków. 118 pp.

Stace, C. 1997. New flora of the British Isles. 2nd ed. – Cambridge University Press, Cambridge. 1130 pp.

Strandhede, S.-O. 2000. Vennlige og uvennlige planter i vårt nærmiljø. – Norges Astma- og Allergiforbund, Sør-Trøndelag fylkeslag, Klæbu. 123 pp.

Tokarska-Guzik, B. 2003. The expansion of some alien plant species (neophytes) in Poland. – pp. 147-167 in Child, L.E. *et al.* (eds.): Plant invasions. Ecological threats and management solutions. Backhuys Publishers, Leiden, The Netherlands.

Ворошилов В.Н., Скворцов А.К., Тихомиров В.Н. 1966. Определитель растений Московской области. М. Наука. 367 pp.

Игнатов М.С., Макаров В.В., Чичев А.В. 1990. Конспект флоры адвентивных растений Московской области. В сб.: Флористические исследования в Московской области. М. Наука. pp. 5-105.

Флора европейской части России. 1987. Т. VI. М. Наука. 254 pp.

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