EU NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

Name of organism: *Lupinus polyphyllus*
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Risk Assessment Area: Europe

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Draft: July 2016

EU CHAPPEAU	
QUESTION	**RESPONSE**
1. In how many EU member states has this species been recorded? List them.	23 countries: Austria, Bulgaria, Belgium, Croatia, Czech. Rep., Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Ireland, Italy, Latvia, Lithuania, Poland, Moldova, Netherlands, Sweden, Romania, Slovakia, Spain, Sweden, (DAISIE; EPPO; Oprea et al. 2011)
2. In how many EU member states has this species currently established populations? List them.	At least in 16: Austria, Belgium, France, Italy, Poland, Slovakia, Great Britain, Germany, Netherlands, Czech. Rep. Croatia, Estonia, Lithuania, Finland, Sweden, Denmark, Latvia (DAISIE)
3. In how many EU member states has this species shown signs of invasiveness? List them.	In all where the species is naturalized (Fremstad 2010).
4. In which EU Biogeographic areas could this species establish?	The species is already present in majority of available regions in Europe (DAISIE; Nobanis). The species is tolerant to harsh conditions and can grow even in Northern regions of Europe (Fremstad 2010).
5. In how many EU Member States could this species establish in the future [given current climate] (including those where it is already established)? List them.	The species is already present in majority of available regions in Europe (DAISIE; Nobanis). The species can be limited by high temperatures and drought seasons in southern part of EU. Nevertheless according to ecology and biology of the species, it can be present and establish in mountainous regions of countries like Spain.
6. In how many EU member states could this species become invasive in the future [given current climate] (where it is not already established)?	as above

SECTION A – Organism Information and Screening		
Stage 1. Organism Information	**RESPONSE** **[chose one entry, delete all others]**	**COMMENT**
1. Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	*Lupinus polyphyllus* and *Lupinus* x *pseudopolyphyllus*	Lupinus is a genus of ca 200 species mostly from N and S America (Kurlovich 2002; https://sites.google.com/site/biodiversityoflupins/home). There are other closely related species grouped under hybrid name *Lupinus* x *pseudopolyphyllus*. Suggestion is to assess all simmilar the taxa in same way as *L. polyphyllus*. Additionally, there is wide range of horticultural varieties (e.g. Moerheimii, Albiflorus, Albus, Caeruleus, Carmineus, Roseus) which should be also included due to high rish of introgression and unclear labelling in the trade. **This definition of species included within this RA clearly excludes taxa like *L. arboreus*, *L. luteus* , *L. arboreus* and other. *L. nootkatensis, L. burkei, L.. >×regalis*, hybridizing with *L. polyphyllus*, may be problematic in other parts of Europe, but separate RAs needs to be done in order to catch different distribution and possible impacts. Therefore this RA includes *L. polyphyllus*, and hybrids of this species which can be sheltered under name *L. × pseudopolyphyllus.*** *L. polyphyllus* encompasses various genotypes, subspecies and varieties and has been subject to extensive breeding (https://sites.google.com/site/biodiversityoflupins/home) due to its use (i) for ornamental (garden) purposes (Fremstad 2010), (ii) as a fodder for domestic and game animals, associated with specific crossing for low-alkaloid or sweet cultivars (Aniszevski 1993, Payne 2004) and also (iii) for soil enrichment and stabilization (Fremstad 2010).

		In the native range (western North America), the genus Lupinus contains several species that are morphologically similar to *L. polyphyllus*, such as *L. burkei* (by some considered a subspecies or variety of *L. polyphyllus*;), *L. latifolius, L. arcticus* or *L. nootkatensis*. Some of these closely related species are known to hybridize (Dunn & Gillett 1966). *Lupinus polyphyllus* was hybridized for ornamental purposes with at least *L. arboreus*, a species native to California. This is thought to have led to the origin of the so-called "Russell cultivar" [(*Lupinus ×regalis*; see for example Harvey et al. (1996), Fremstad (2010)]. It has been suggested that *L. ×regalis* is the taxon invasive in New Zealand, whereas both *L. polyphyllus* and *L. ×regalis* are reported from Europe (Fremstad 2010). However, the two (notho)taxa are morphologically similar and might be easily confused.
2. If not a single taxonomic entity, can it be redefined? (if necessary use the response box to re-define the organism and carry on)		
3. Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	no	
4. If there is an earlier risk assessment is it still entirely valid, or only partly valid?	no	
5. Where is the organism native?	North America	The lupine originates in western North America (Fremstad 2010). *Lupinus polyphyllus* Lindl. constitutes a wide range of genotypes and natural varieties. It is found in N America from Alaska to California. In the native range (western North America), the genus *Lupinus* contains several species that are morphologically similar to *L. polyphyllus*, such as *L. burkei* (by some considered a subspecies or variety of *L. polyphyllus*; e.g.

		Lesica et al. 2012), *L. latifolius, L. arcticus* or *L. nootkatensis*. Some of these closely related species are known to hybridize (Dunn & Gillett 1966).
6. What is the global distribution of the organism (excluding Europe)?	N. America, New Zealand, S. America, southern Australia	(Harvey et al. 1996; Fremstad 2010; Meier et al. 2013; Global Invasive Species Database – http://www.issg.org; New Zealand Plant Conservation Network - http://nzpcn.org.nz/flora_details.aspx?ID=3144).
7. What is the distribution of the organism in Europe?	as above, widespread	Lupinus is widespread also in other European (non EU) countries: Norway, Central Russia, e.g. in 2014 *L. polyphyllus* is listed in the Black List of IAS in Switzerland (www.infoflora.ch).
8. Is the organism known to be invasive (i.e. to threaten organisms, habitats or ecosystems) anywhere in the world?	yes	E.g. in Finland is reported that the *Lupinus* is spreading rapidly not only along road verges and other disturbed habitats, but also to semi-natural grasslands and natural environments such as groves of trees (The Finnish Environment Institute). The species is able to form dense stands and is associated with local declines of vascular plant species richness (Ramula & Pihlaja 2012).
9. Describe any known socio-economic benefits of the organism in the risk assessment area.	used as a fodder for game animals, ornamental plant, restoration	*Lupinus* fixes nitrogen and its litter fertilizes the nutrient poor soil (Davis 1991). Due to its ability to form a symbiosis with nitrogen-fixating bacteria, plants of the *Lupinus* genus are successfully used to enrich and restore fire-exhausted soils (Miller et al. 2011) and gives *Lupinus* (and also other legumes) an advantage under low soil N conditions if other factors are favourable for growth (Andrews et al. 2011, 2013). In Europe this species has been planted as a fodder crop and as an ornamental, and is now widely naturalized (Dickie et al. 1985). Lupin seed have been used since ancient times as human food and animal feed (Kurlovich, 2002). Green mass of low-alkaloid (sweet) varieties of lupin is also excellent forage. Bitter forms (due to a mixture of alkaloids) are undesirable in animal feed and human food. Of several hundred lupin species existing in nature, only a few are used in agriculture. Other species, e.g. L. angustifolius are planted in agricultural

		land to attract pollinators (Eriksson & Rundlöf).

SECTION B – Detailed assessment

PROBABILITY OF ENTRY

Important instructions:

- Entry is the introduction of an organism into Europe. Not to be confused with spread, the movement of an organism within Europe.
- For organisms which are already present in Europe, only complete the entry section for current active pathways of entry or if relevant potential future pathways. The entry section need not be completed for organisms which have entered in the past and have no current pathways of entry.

QUESTION	RESPONSE [chose one entry, delete all others]	CONFIDENCE [chose one entry, delete all others]	COMMENT
1.1. How many active pathways are relevant to the potential entry of this organism? (If there are no active pathways or potential future pathways respond N/A and move to the Establishment section)	very few	high	Pathways of introduction, reasons for introduction: intentional - horticulture, landscaping, game animals, and unintentional - soil transport 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 (Fremstad 2010). Nowadays the introductions from primary distribution range is not probable. Higher frequency of introductions is due to intentional spread of the species for landscaping and feeding game animals. High confidence is selected as the species is widespread in Europe and the transport pathways are clearly known.
1.2. List relevant pathways through which the organism			

could enter. Where possible give detail about the specific origins and end points of the pathways. For each pathway answer questions 1.3 to 1.10 (copy and paste additional rows at the end of this section as necessary).			
Pathway name:			
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)			
1.4. How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.			
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.			
1.6. How likely is the organism to survive existing management practices during passage along the pathway?			

1.7. How likely is the organism to enter Europe undetected?			
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?			
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?			
1.10. Estimate the overall likelihood of entry into Europe based on this pathway?			
End of pathway assessment, repeat as necessary.			
1.11. Estimate the overall likelihood of entry into Europe based on all pathways (comment on the key issues that lead to this conclusion).			

PROBABILITY OF ESTABLISHMENT

Important instructions:

- For organisms which are already well established in Europe, only complete questions 1.15 and 1.21 then move onto the spread section. If uncertain, check with the Non-native Species Secretariat.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
1.12. How likely is it that the organism will be able to establish in Europe based on the similarity between climatic conditions in Europe and the organism's current distribution?			
1.13. How likely is it that the organism will be able to establish in Europe based on the similarity between other abiotic conditions in Europe and the organism's current distribution?			
1.14. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Europe? Subnote: gardens are not considered protected conditions			
1.15. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Europe?	widespread	very high	The species grows along road verges and in unmanaged or late-mown grasslands (Otte & Maul 2005; Vyšniauskienė et al. 2011). It rapidly spreads from forest borders and roadside verges into an open, deserted, abandoned fields and

			meadows (Gudžinskas 1999). Therefore suitable habitats are widespread distributed. As the species is able to colonize nutrient poor soils, it can found in abandoned land and in soil depositions. Very high confidence was chosen as there is a wide range of information based on many detailed studies from its native and alien range.
1.16. If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in Europe?			
1.17. How likely is it that establishment will occur despite competition from existing species in Europe?			
1.18. How likely is it that establishment will occur despite predators, parasites or pathogens already present in Europe?			
1.19. How likely is the organism to establish despite existing management practices in Europe?			
1.20. How likely are management practices in Europe to facilitate establishment?			
1.21. How likely is it that biological properties of the organism would allow it to survive eradication campaigns in Europe?	moderately likely	high	The species is already widespread in Europe and two life traits can affect its management. The species primarily reproduces from seed (Fremstad 2010; Ramula 2014), although clonal reproduction is also possible at least in the invaded range (Rapp 2009). As the production of easily dispersed seeds is quite high the management should be reaching flowering plants. Vegetative growth minimizes the

			efficiency of mechanical methods, therefore if possible, application of herbicides is recommended (Pergl et al., in press). Seeds have physical dormancy and can survive for several years (ca 1 % after two years) (Moravcová, pers. communication). High confidence was chosen as there is a wide range of information based on many detailed studies from its native and alien range. However, information on interaction between traits and management methods are limited.
1.22. How likely are the biological characteristics of the organism to facilitate its establishment?			
1.23. How likely is the capacity to spread of the organism to facilitate its establishment?			
1.24. How likely is the adaptability of the organism to facilitate its establishment?			
1.25. How likely is it that the organism could establish despite low genetic diversity in the founder population?			
1.26. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Europe? (If possible, specify the instances in the comments box.)			
1.27. If the organism does not establish, then how likely is it that transient populations will continue to occur? Subnote: Red-eared Terrapin, a species which cannot re-			

produce in GB but is established because of continual release, is an example of a transient species.			
1.28. Estimate the overall likelihood of establishment (mention any key issues in the comment box).			

PROBABILITY OF SPREAD

Important notes:

- Spread is defined as the expansion of the geographical distribution of a pest within an area.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
2.1. How important is the expected spread of this organism in Europe by natural means? (Please list and comment on the mechanisms for natural spread.)	moderate	high	Natural spread of *Lupinus* is based on spread of seeds. Seeds of *Lupinus* are heavy and without appendages. Therefore their dispersal by wind over long distance is unlikely (http://www.ogtr.gov.au/internet/ogtr/publishing.nsf/Content/biologylupin2013-toc/$FILE/biologylupin2013-2.pdf). Lupinus spreads unintentionally mainly along water courses, and transport corridors from areas of intentional planting. Long distance dispersal is possible mainly human activities (e.g. soil transportation). Usually an individual *L. polyphyllus* plant can produce hundreds of seeds which are dispersed ballistically up to a few metres from the parent plant (Aniszewski et al. 2001; Ramula et al. 2015). Ramula et al. (2015) found that propagule pressure contributed significantly to the invasion success of *L. polyphyllus*, and lesser roles of disturbance. High confidence was chosen as there is a wide range of information based on many detailed studies from its native distribution range.
2.2. How important is the expected spread of this organism in Europe by human assistance? (Please list and comment on the mechanisms for human-assisted	major	high	Dispersed intentionally in the urban, suburban and (semi-)natural habitats as landscaping ornamental and for food for wild animals (Fremstad 2010). From

spread.)			these sites it spreads further away (Lahti et al. 1995; Gudžinskas 1999; Vyšniauskienė et al. 2011; Meier et al. 2013). High confidence was chosen as there is a good information on its dynamics at landscape scale from Europe. L. polyphyllus can be considered as crop species (amino acids and protein synthesis, oils and alkaloid content etc.) and escapes from cultivation are the causes of its frequent presence in the nature (Fremstad 2010). 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 (Fremstad 2010). *L. polyphyllus* encompasses various genotypes, subspecies and varieties and has been subject to extensive breeding and sale in garden shops and availability of seeds in various markets within EU. High confidence is selected as there is enough evidence for its intentional spread.
2.3. Within Europe, how difficult would it be to contain the organism?	difficult	high	Mechanical methods are not enough efficient, therefore application of herbicides is recommended. Seedlings and small plants may be pulled or digged out (recommended approach only for small populations). Containment of *Lupinus* depends mainly on management (suppression) of seed rain and banning further release into landscape. Special attention must be took to reinvasion of already cleared sites. In New Zealand several plant pathogens which could serve as biological control agents for the invasive *L. polyphyllus* have been identified (Harvey

			et al. 1996, but see Morin et al 2000). However, this management approach was not yet tested in Europe. The species is not well adapted to regular mowing but mowing will not kill the plant. High confidence was chosen as there is a wide range of information based on many detailed studies from its native distribution range.
2.4. Based on the answers to questions on the potential for establishment and spread in Europe, define the area endangered by the organism.	central and northern Europe	very high	see 7 and 1.15. Very high confidence was chosen as there is a relatively good information on ecology, biology and distribution in Europe.
2.5. What proportion (%) of the area/habitat suitable for establishment (i.e. those parts of Europe were the species could establish), if any, has already been colonised by the organism?	25%	low	This area is difficult to assess because of lack of detailed distribution data all over Europe. Using as estimate phytosociologic releves for small scale and occupied grids for large scales gives following values. In phytosociologic releves the species can form dominant stands with up to 80-90% cover (4m2 squares; Hejda et al. 2016). When upscaling to occupied grid cells the available information range between 8 and 43%; in the Czech Republic is occupied 1136 cells (3'×6') out of 2600 (43%, www.florabase.cz) and in UK: England 215 squares of 10 km2 out of 2810 (8%; www.brc.ac.uk). Scoring is provided with low certainty because of lack of accurate distribution and coverage data all over Europe especially for different scales.
2.6. What proportion (%) of the area/habitat suitable for establishment, if any, do you expect to have been invaded by the organism five years from now (including any current presence)?	35%	low	As the species has fast turnover and is able to produce seeds in relatively short period and can spread and reproduce easily (see justification for Q2.1, 2.2 and 2.7), the timeframe of change is relatively short. Scoring is provided with low certainty because of lack of accurate data all over Europe to be used to define baseline distribution (see

			question 2.5).
2.7. What other timeframe (in years) would be appropriate to estimate any significant further spread of the organism in Europe? (Please comment on why this timeframe is chosen.)	10	high	*Lupinus polyphyllus* is iteroparous, perennial herb with an expected lifespan under 20 years (Ramula 2014). There are reports of its rapid expansion; in two decades the species had spread almost 400 km (Lahti et al. 1995). As the species has short generation time and can disperse easily the timeframe is short.
2.8. In this timeframe what proportion (%) of the endangered area/habitat (including any currently occupied areas/habitats) is likely to have been invaded by this organism?	45%	low	As the species has fast turnower and is able to produce seeds in relatively short period and can spread and reproduce easily (see justification for Q2.1, 2.2 and 2.7 and Williamson et al. 2005), the timeframe of change is relatively short and already occupied areas are quite high, the conservative estimate of the distribution change can be 45%. Scoring is provided with low certainty because of lack of accurate data all over Europe to be used to define baseline distribution (see question 2.5).
2.9. Estimate the overall potential for future spread for this organism in Europe (using the comment box to indicate any key issues).	rapidly	high	Species is highly overlooked and there is almost no public awareness. Therefore its intentional spread by e.g. hunters continues. Thus the spread, if not banned, will continue in future. High confidence was chosen as there is a good information on its ecology, biology and current distribution in Europe. Furthermore information on rates of spread is available in the literature for some countries, e.g. Williamson et al 2005.

PROBABILITY OF IMPACT

Important instructions:

- When assessing potential future impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.
- Where one type of impact may affect another (e.g. disease may also cause economic impact) the assessor should try to separate the effects (e.g. in this case note the economic impact of disease in the response and comments of the disease question, but do not include them in the economic section).
- Note questions 2.10–2.14 relate to economic impact and 2.15–2.21 to environmental impact. Each set of questions starts with the impact elsewhere in the world, then considers impacts in Europe separating known impacts to date (i.e. past and current impacts) from potential future impacts. Key words are in bold for emphasis.

QUESTION	RESPONSE	CONFIDENCE	COMMENTS
2.10. How great is the economic loss caused by the organism within its existing geographic range, including the cost of any current management?	minimal	medium	Occurring in pastures, some ecotypes not suitable for grazing due to content of chemicals. Naturally occurring forms are mildly toxic due to the presence of alkaloids (may cause vomiting, difficulty in swallowing, circulatory disturbance), but there are also alkaloid-poor variants, which are used as fodder for wildlife and domestic animals (Aniszewski 1993; Schuster 2002; Payne et al. 2004). Known lupine-related costs and benefits are marginal (Reinhardt et al. 2013). In Germany the annual costs of management (mechanical) are estimated to ca 30,000 Euro (Reinhardt et al. 2013). Medium confidence was chosen as there can be large amount of reports in grey inaccessible literature and that the estimates can largely differ between regions and by used methods.
2.11. How great is the economic cost of the organism	minimal	low	as above. Low confidence was chosen as there is no

currently in Europe excluding management costs (include any past costs in your response)?			clear estimate of the economic costs in Europe available for the assessor.
2.12. How great is the economic cost of the organism likely to be in the future in Europe excluding management costs?	minimal	low	as above
2.13. How great are the economic costs associated with managing this organism currently in Europe (include any past costs in your response)?	moderate	low	In Germany the costs of management are estimated to ca 30,000 Euro (Reinhardt et al. 2013). But if species specific management win protected areas is taken, then the costs per m2 can be high. Low confidence was selected as the existing data are based on limited numbers from one study.
2.14. How great are the economic costs associated with managing this organism likely to be in the future in Europe?	moderate	low	Depends on the level of management. If significant action will be done, than costs in first years (reducing the seed set) will be relatively high compare to current costs. Low confidence was selected as the future distribution due to global change is speculative.
2.15. How important is environmental harm caused by the organism within its existing geographic range excluding Europe?	major	high	Impact on biodiversity, and soil environment. Reports on *Lupinus* impact outside Europe comes mainly from N Zealand. It was found that *L. polyphyllus* often colonizes frequently disturbed and rocky terraces of rivers (Holdaway & Sparrow 2006) and e.g. reach dominance even in oligotrophic vegetation (Scott 2007). *Lupinus* fix nitrogen and their litter fertilizes the nutrient poor soil (Davis 1991; Muzquiz et al. 2004; Akritidu et al. 2013; Boinik et al. 2015; Loydi et al. 2015) which alters interactions between the species, by rapid growth shades growing species and thus reduce plant species richness (Maron & Connors 1996; Gosling 2005) as well as other trophic groups (Valtonen et al. 2006). It has also negative impact on native species

			there (Hejda 2013). On the other hand, in native range, the impact was not so high as in alien ranges in Europe or New Zealand (Hejda et al. 2016; Hejda 2013). Therefore high confidence was chosen.
2.16. How important is the impact of the organism on biodiversity (e.g. decline in native species, changes in native species communities, hybridisation) currently in Europe (include any past impact in your response)?	major	high	Same as in 2.15. Additionally there are reports on change of behaviour of pollinators (Jacobsson & Padrón 2014; Jacobson et al. 2015). *Lupinus* fix nitrogen and their litter fertilizes the nutrient poor soil (Davis 1991) which alters interactions between the species, by rapid growth shades growing species and thus reduce plant species richness (Maron & Connors 1996; Gosling 2005) as well as other trophic groups (Valtonen et al. 2006). The species is clearly associated with a decline in vascular plant species richness (Hejda et al. 2009; Ramula & Pihlaja 2012). Litter leaches are toxic and cause delayed and reduced germination of native species (Muzquiz et al. 2004; Loydi et al. 2015). . High impact of the species is particularly in nutrient poor habitats in mountainous areas and nordic countries. Documented impact on species diversity was also found from central Europe. High confidence was chosen as there is a good information on its ecology and biology in Europe.
2.17. How important is the impact of the organism on biodiversity likely to be in the future in Europe?	major	high	as above. High confidence was selected as the future impact regardless of the distribution will remain the same per unit area.
2.18. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism currently in Europe (include any past impact in your response)?	major	high	The role of *Lupinus* on ecosystem is significant as it is nitrogen fixing plant and producer of allepathic compounds (Muzquiz et al. 2004; Akritidu et al. 2013; Boinik et al. 2015; Loydi et al. 2015). *Lupinus* fix nitrogen and their litter fertilizes the nutrient poor soil (Davis 1991) which alters interactions between the species, by rapid growth shades growing species and

			thus reduce plant species richness (Maron & Connors 1996; Gosling 2005) as well as other trophic groups (Valtonen et al. 2006). High impact of the species is particularly in nutrient poor habitats in mountainous areas and nordic countries. High confidence was chosen as there is a good information on its ecology and biology in Europe.
2.19. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism likely to be in Europe in the future?	major	high	as above. High confidence was selected as the future impact regardless of the distribution will remain the same per unit area.
2.20. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism currently in Europe?	massive	high	*Lupinus* is present in many protected areas in Europe as well as in e.g. New Zealand (Otte & Maul 2005; Pyšek et al. 2013). In these areas *Lupinus* is a threat to native flora due to its alteration of soil conditions and direct competition (Maron & Connors 1996; Gosling 2005; Hejda et al. 2009; Ramula & Pihlaja 2012). High confidence was chosen as there is a good information on its ecology and biology in Europe.
2.21. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism likely to be in the future in Europe?	massive	high	as above
2.22. How important is it that genetic traits of the organism could be carried to other species, modifying their genetic nature and making their economic, environmental or social effects more serious?	minimal	high	not known

2.23. How important is social, human health or other harm (not directly included in economic and environmental categories) caused by the organism within its existing geographic range?	minimal	high	Not known significant effects, therefore high confidence in this widely studied species. Jappe & Vieths (2010) report that a small percentage of people have food sensitivity to Lupin (allergy).
2.24. How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	minimal	high	not known
2.25. How important might other impacts not already covered by previous questions be resulting from introduction of the organism? (specify in the comment box)	minimal	high	no other impacts than those mentioned above
2.26. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Europe?	minimal	high	There is no efficient biocontrol of *L. polyphyllus* now in Europe. Therefore the impacts refer mainly to 2.11, 2.15, 2.16 and 2.18.
2.27. Indicate any parts of Europe where economic, environmental and social impacts are particularly likely to occur (provide as much detail as possible).	in all occupied area	high	The assessed species is primarily an environmental threat impacting soil environment and ecosystem function with massive impacts on protected sites (particularly nutrient poor environments; see 2.18). Beside these areas it is threat also in grassland communities where it can develop large scale and dense monospecific stands.

RISK SUMMARIES			
	RESPONSE	**CONFIDENCE**	**COMMENT**
Summarise Entry	very likely	very high	already present in Europe
Summarise Establishment	very likely	very high	already present in Europe
Summarise Spread	rapidly	high	depends on the management and awareness
Summarise Impact	major	high	impact on diversity, not known impact on socio-economy
Conclusion of the risk assessment	high	high	

ADDITIONAL QUESTIONS – CLIMATE CHANGE			
3.1. What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?	not clear	low	The species occurs mainly in central and northern Europe, therefore change of distribution due to climate change is not clear. But e.g. higher temperatures are likely to enhance or accelerate both the natural N cycle as well as rates of N2 fixation (e.g. Thomas et al. 2006; Magnusson et al. 2014; Schaeffer et al. 2013).
3.2. What is the likely timeframe for such changes?			
3.3. What aspects of the risk assessment are most likely to change as a result of climate change?	distribution	high	Depends on the rate of climate change. Distribution and with the distribution also the sum of the impact
ADDITIONAL QUESTIONS – RESEARCH			
4.1. If there is any research that would significantly strengthen confidence in the risk assessment please summarise this here.	[insert text]	low medium high very high	

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