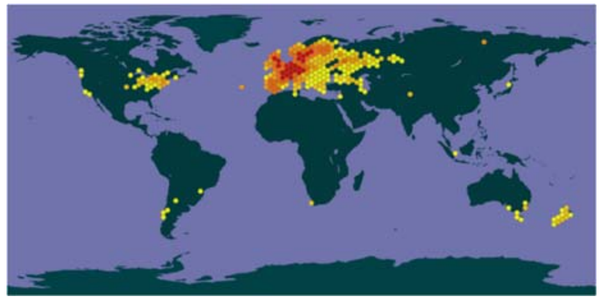
Risk Analysis Report

Taxon: *Alnus glutinosa*	***Area:*** *South Africa*
Compiled by: Jan-Hendrik Keet	**Approved by:**
Picture of *Taxon*  Photo credit: Jan-Hendrik Keet	**Alien distribution map**  Reference: https://www.gbif.org/species/2876213
Risk Assessment summary: *Alnus glutinosa* is not yet well established in South Africa, and has only been recorded from a few localities, one of which, is an infestation already targeted for eradication. At least 34.5% of South Africa is potentially climatically suitable to the establishment of *Alnus* glutinosa. *Alnus glutinosa* has numerous environmental impacts, which include competition with and displacement of native species, chemical (soil nitrogen elevation) and physical (river flow alteration), and disease transmission (*Phytophthora alni* root rot complex).	**Risk score:** High
Management options summary: Small seedlings can be hand pulled if the ground is soft enough to remove entire plants. For larger plants, a combination of physical and chemical methods should be used. Herbicide, such as glyphosate, should be applied to cut stumps of felled trees in order to prevent coppicing. For foliar application, triclopyr triethylamine is recommended, and napropamide is recommended as a pre-emergence herbicide. The reported best time for herbicide application is during autumn. Control methods should be implemented for at least five years, since densities can increase (via regrowth) if any of these methods are implemented only once. No biological control agents are currently available for Black Alder.	**Ease of management:** Medium (5)
Recommendations: The taxon scored a High risk, is present in the area, and ease of management is Medium. Although the taxon has benefits (e.g. forestry, bioremediation), such benefits are unlikely to be realized within a South African context. As such, the taxon is not recommended for listing under category 2. The recommendation is 1a.	**Listing under NEM:BA A&IS lists of 2014 as amended 2016:** Not listed **Recommended listing category:** 1a

1. Background

BAC1 Name of assessor(s)		
Name of lead assessor	**Jan-Hendrik Keet**	
Additional assessor (1)		
Additional assessor (2)		
BAC2 Contact details of assessor (s)		
Lead assessor	Organisational affiliation: Centre for Invasion Biology, Stellenbosch University	
	email: jhkeet@hotmail.com	
	Phone: 0714514853	
Additional assessor (1)	Organisational affiliation:	
	email:	
	Phone:	
Additional assessor (2)	Organisational affiliation:	
	email:	
	Phone:	
BAC3 Name(s) and contact details of expert(s) consulted		
Expert (1)	Name: Lydia van Rooyen	
	email: lydiavR@wildtrust.co.za	
	Phone: 060 500 0823	
Expert (2)	Name:	
	email:	
	Phone:	
Comments:		
BAC4 Scientific name of *Taxon* under assessment		
Taxon name: *Alnus glutinosa*		Authority: (L.) Gaertn.
Comments: Taxonomic level is species. Current name is accepted.		
References: http://www.theplantlist.org/tpl1.1/record/kew-6364 (Accessed 2020/04/01)		
BAC5 Synonym(s) considered		
Synonyms: *Betula alnus* var. *glutinosa* L.		
Comments: This is the most used synonym which was considered.		
References: http://www.theplantlist.org/tpl1.1/record/kew-6364 (Accessed 2020/04/01)		
BAC6 Common name(s) considered		
Common names: Black-, European-, or Common Alder		
Comments: Only English names were considered here.		
References: Jaworski B. 1995. *Silviculture characteristics of forest trees*. Kraków, Poland: Gutenberg.		
BAC7 What is the native range of the *Taxon*?		
Response: Europe and parts of Siberia and North Africa		Confidence: High
Comments: In its native range, Black Alder is scattered across the whole of Europe, from Ireland in the West to western Siberia in the East, and also extends South to parts of North Africa to a latitude of 65° North, except Egypt.		

References:

Gtari M, Dawson JO. 2011. An overview of actinorhizal plants in Africa. *Functional Plant Biology* 38: 653–661.

Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*)*. Rome, Italy: International Plant Genetic Resources Institute.

Russel T, Cutler C, Walters M. 2007. *Tree of the world: an illustrated encyclopaedia and identifier*. London: Anness Publishing Ltd.

BAC8 What is the global alien range of the *Taxon*? (add map in Appendix BAC8)	
Response: Argentina Australia Azores Canada Chile India Japan La Reunion New Zealand Portugal Russia South Africa United Kingdom United States of America	Confidence: High
Comments: Black Alder is invasive in Chile, New Zealand, and the United States of America. Black Alder is naturalised in Argentina (Isla Victoria, and northern Patagonia where it potentially hybridizes with *A. incana*), Australia (New South Wales and Victoria), Azores, Canada, Portugal, and South Africa. Black Alder has been recorded as a weed in India, Japan, La Réunion, and Russia, and been introduced into the Azores.	

References:
Bogar LM, Dickie IA, Kennedy PG. 2015. Testing the co-invasion hypothesis: Ectomycorrhizal fungal communities on *Alnus glutinosa* and *Salix fragilis* in New Zealand. *Diversity and Distributions* 21: 268–278.
Calviño CI, Edwards P, Fernández M, Relva MA, Ezcurra C. 2018. Not one but three: undetected invasive *Alnus* species in northwestern Patagonia confirmed with cpDNA and ITS sequences. *Biological Invasions* 20: 2715–2722.
Cao L, Larson J, Berent L, Fusaro A. 2020. Alnus glutinosa *(L.) Gaertn.: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI*. https://nas.er.usgs.gov/queries/GreatLakes/FactSheet.aspx?SpeciesID=2696. 23 Mar. 2020.
Eckel PM. 2003. Two problems in Betulaceae along the Niagara River: *Alnus glutinosa* and *Betula cordifolia*. *Clintonia* 18: 3–4.
Herron PM, Martine CT, Latimer AM, Leicht-Young SA. 2007. Invasive plants and their ecological strategies: prediction and explanation of woody plant invasion in New England. *Diversity and Distributions* 13: 633–644.
Hosking J, Conn B, Lepschi B. 2003. Plant species first recognised as naturalised for New South Wales over the period 2000–2001. *Cunninghamia* 8: 175–187.
Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*)*. Rome, Italy: International Plant Genetic Resources Institute.
Keet J-H & Richardson D.M. (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa
McClay A, Sissons A, Wilson C, Davis S. 2010. Evaluation of the Australian weed risk assessment system for the prediction of plant invasiveness in Canada. *Biological Invasions* 12: 4085–4098.
Mills EL, Leach JH, Carlton JT, Secor CL. 1993. Exotic Species in the Great Lakes: A History of Biotic Crises and Anthropogenic Introductions. *Journal of Great Lakes Research* 19: 1–54.
Randall RP. 2017. *A Global Compendium of Weeds* (3rd, Ed.). Perth, Western Australia.
Rejmánek M, Richardson DM. 2013. Trees and shrubs as invasive alien species - 2013 update of the global database (P Pysek, Ed.). *Diversity and Distributions* 19: 1093–1094.
Simberloff D, Relva MA, Nuñez M. 2002. Gringos en el bosque: Introduced tree invasion in a native Nothofagus/Austrocedrus forest. *Biological Invasions* 4: 35–53.

BAC9 Geographic scope = the *Area* under consideration

Area of assessment: South Africa

Comments: The whole of South Africa is considered for this assessment

BAC10 Is the *Taxon* present in the *Area*?

Response: Yes	Confidence: High

Comments: The taxon has been recorded in four provinces in South Africa, namely Eastern Cape, KwaZulu-Natal, Mpumalanga, and Western Cape, the latter of which houses the greatest number of observations (see map in BAC8b).

References:
Henderson L. 2007. Invasive, naturalized and casual alien plants in southern Africa: A summary based on the Southern African Plant Invaders Atlas (SAPIA). *Bothalia* 37: 215–248.
iNaturalist, https://www.inaturalist.org/home, accessed 01 February 2020.
Keet J-H & Richardson D.M. (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa
South African Plant Invaders Atlas, accessed 01 February 2020

BAC11 Availability of physical specimen

Response: Yes	Confidence in ID: High

Herbarium or museum accession number:
Herbarium – Pretoria; Barcode – PRE 0593117-0; Accession – 0593117; Collected by De Beer in March 1955

References:
South African National Biodiversity Institute. 2016. Botanical Database of Southern Africa (BODATSA) [dataset]

BAC12 Is the *Taxon* native to the *Area* or part of the *Area*?		
The *Taxon* is native to (part of) the *Area*.	No	Confidence: High
The *Taxon* is alien in (part of) the *Area*.	Yes	Confidence: High
Comments: The taxon is only native to the northern hemisphere, with no native occurrences in the southern hemisphere. Thus, the taxon is alien to the entire area considered here.		
References: Gtari M, Dawson JO. 2011. An overview of actinorhizal plants in Africa. *Functional Plant Biology* 38: 653–661. Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*)*. Rome, Italy: International Plant Genetic Resources Institute. Russel T, Cutler C, Walters M. 2007. *Tree of the world: an illustrated encyclopaedia and identifier*. London: Anness Publishing Ltd.		

BAC13 What is the *Taxon*'s introduction status in the *Area*?		
The *Taxon* is in cultivation/containment.	Yes	Confidence: High
The *Taxon* is present outside of cultivation/containment.	Yes	Confidence: High
The *Taxon* has established/naturalised.	Yes	Confidence: High
The *Taxon* is invasive.	Yes	Confidence: High
Comments: The assessor has personally observed the taxon in cultivation in the Stellenbosch Botanical Garden and at Algeria Uitkyk Cottage in the Cederberg Wilderness Area. The assessor has also personally observed numerous instances of the taxon occurring naturally along the banks of the Berg River (Western Cape) as well as visiting the biggest known invasive population along the banks of the Dwarsriver near Kylemore (Western Cape).		
References: Henderson L. 2007. Invasive, naturalized and casual alien plants in southern Africa: A summary based on the Southern African Plant Invaders Atlas (SAPIA). *Bothalia* 37: 215–248. Keet J-H & Richardson D.M (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa Record sources: iNaturalist, The Global Biodiversity Information Facility (GBIF), the South African Plant Invader Atlas (SAPIA), Cape Nature, Wildlands Trust™, and all South African Herbaria.		

BAC14 Primary (introduction) pathways		
Release	No	Confidence: Low
Escape	Yes (Forestry, Horticulture, Bioremediation)	Confidence: High
Contaminant	Yes (Seeds on clothing)	Confidence: Low
Stowaway	No	Confidence: Low
Corridor	Yes (Waterways)	Confidence: Low
Unaided	No	Confidence: Low
Comments: The taxon has many uses (e.g. Silviculture, forest and alluvial ecosystem restoration, windbreak, potential biofuel crop, feed crop for cattle) and as such has been introduced deliberately into many regions but has also escaped some of these regions of introduction. The taxon has been identified as a contaminant due to its seed being spread by clothing.		
References: Ansong M, Pickering C. 2014. Weed seeds on clothing: A global review. *Journal of Environmental Management* 144: 203–211. Callender KL, Roy S, Khasa DP, Whyte LG, Greer CW. 2016. Actinorhizal alder phytostabilization alters microbial community dynamics in gold mine waste rock from northern Quebec: A greenhouse study. *PLoS ONE* 11: e0150181.		

Cao L, Larson J, Berent L, Fusaro A. 2020. Alnus glutinosa *(L.) Gaertn.: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI.* https://nas.er.usgs.gov/queries/GreatLakes/FactSheet.aspx?SpeciesID=2696. 23 Mar. 2020.

Carter CT, Ungar IA. 2002. Aboveground vegetation, seed bank and soil analysis of a 31-year-old forest restoration on coal mine spoil in southeastern Ohio. *The American Midland Naturalist* 147: 44–59.

Claessens H, Oosterbaan A, Savill P, Rondeux J. 2010. A review of the characteristics of Black Alder (*Alnus glutinosa* (L.) Gaertn.) and their implications for silvicultural practices. *Forestry* 83: 163–175.

Davis AS, Cousens RD, Hill J, Mack RN, Simberloff D, Raghu S. 2010. Screening bioenergy feedstock crops to mitigate invasion risk. *Frontiers in Ecology and the Environment* 8: 533–539.

Funk DT. 1990. *Alnus glutinosa* (L.) Gaertn. European Alder In: Burns RM, Honkala BH, eds. *Silvics of North America: 2. Hardwoods. Agriculture Handbook 654.* Washington, DC: U.S. Department of Agriculture, Forest Service, 105–115.

Genys JB. 1988. Intraspecific variation among 28 different sources of Black Alder, *Alnus glutinosa* (Betulaceae). *Castanea* 53: 71–79.

Housley RA, Ammerman AJ, Mcclennen CE. 2004. That Sinking Feeling: Wetland Investigations of the Origins of Venice. *Journal of Wetland Archaeology* 4: 139–153.

Houston Durrant T, de Rigo D, Caudullo G. 2016. Alnus glutinosa in Europe: distribution, habitat, usage and threats In: San-Miguel-Ayanz J, de Rigo D, Caudullo Giovanni, Houston Durrant Tracy, Mauri A, eds. *European Atlas of Forest Tree Species*. Publication Office of the European Union, 64–65.

Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*)*. Rome, Italy: International Plant Genetic Resources Institute.

Keet J-H & Richardson D.M (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa

Klaassen RKWM, Creemers JGM. 2012. Wooden foundation piles and its underestimated relevance for cultural heritage. *Journal of Cultural Heritage* 13S: S123–S128.

Kuznetsova T, Lukjanova A, Mandre M, Lõhmus K. 2011. Aboveground biomass and nutrient accumulation dynamics in young Black Alder, silver birch and Scots pine plantations on reclaimed oil shale mining areas in Estonia. *Forest Ecology and Management* 262: 56–64.

McVean DN. 1956. Ecology of *Alnus glutinosa* (L.) Gaertn: IV. Root System. *Journal of Chemical Ecology* 44: 219–225.

Plass WT. 1977. Growth and survival of hardwoods and pine interplanted with European Alder. *Forest Service, USDA Forest Service Research Paper NE-376.*: 1–10.

Russel T, Cutler C, Walters M. 2007. *Tree of the world: an illustrated encyclopaedia and identifier*. London: Anness Publishing Ltd.

Wenneker M, Heijne B, van de Zande JC. 2005. Effect of natural windbreaks on drift reduction in orchard spraying. *Communications in Agricultural and Applied Biological Sciences* 70: 961–969.

2. Likelihood

LIK1 Likelihood of entry via unaided primary pathways	
Response: Probable (p = 1)	Confidence: High
Rationale: Black Alder is already present in South Africa. The seeds of the taxon are dispersed by water and can remain buoyant for up to 12 months. Thus, seeds can spread significant distances in waterways. However, the seeds do not have a long-life span and usually do not survive long after the first germination season. Furthermore, the propagules do not contain spines/bars and are not readily consumed by animals. However, there is some evidence that water-fowl can disperse propagules, but bird dispersal in general is not regarded as reliable mechanism since birds extract the seed embryos, thus killing the seeds. The taxon does not therefore rely much on animal dispersal capabilities. The taxon is native to Europe and is unlikely to disperse unaided from there. Furthermore, the taxon is not recorded from any of the area's neighbouring countries, and as such there is no way in which the taxon could disperse unaided into the area from these countries.	
References: Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*).* Rome, Italy: International Plant Genetic Resources Institute. Keet J-H & Richardson D.M (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa McVean DN. 1955. Ecology of *Alnus glutinosa* (L.) Gaertn.: II. Seed Distribution and Germination. *British Ecological Society* 43: 61–71. McVean DN. 1956. Ecology of *Alnus glutinosa* (L.) Gaertn: III. Seedling Establishment. *Journal of Ecology* 44: 195–218.	

LIK2 Likelihood of entry via human aided primary pathways	
Response: Probable (p = 1)	Confidence: High
Rationale: Black Alder is already present in South Africa. It has many uses, including forestry, horticulture, ecosystem and mine restoration, windbreaks, potential biofuel crop, and feed crop for cattle. Thus, there are multiple opportunities for deliberate human introduction.	
References: Callender KL, Roy S, Khasa DP, Whyte LG, Greer CW. 2016. Actinorhizal alder phytostabilization alters microbial community dynamics in gold mine waste rock from northern Quebec: A greenhouse study. *PLoS ONE* 11: e0150181. Cao L, Larson J, Berent L, Fusaro A. 2020. Alnus glutinosa *(L.) Gaertn.: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI.* https://nas.er.usgs.gov/queries/GreatLakes/FactSheet.aspx?SpeciesID=2696. 23 Mar. 2020. Carter CT, Ungar IA. 2002. Aboveground vegetation, seed bank and soil analysis of a 31-year-old forest restoration on coal mine spoil in southeastern Ohio. *The American Midland Naturalist* 147: 44–59. Claessens H, Oosterbaan A, Savill P, Rondeux J. 2010. A review of the characteristics of Black Alder (*Alnus glutinosa* (L.) Gaertn.) and their implications for silvicultural practices. *Forestry* 83: 163–175. Davis AS, Cousens RD, Hill J, Mack RN, Simberloff D, Raghu S. 2010. Screening bioenergy feedstock crops to mitigate invasion risk. *Frontiers in Ecology and the Environment* 8: 533–539. Funk DT. 1990. *Alnus glutinosa* (L.) Gaertn. European Alder In: Burns RM, Honkala BH, eds. *Silvics of North America: 2. Hardwoods. Agriculture Handbook 654.* Washington, DC: U.S. Department of Agriculture, Forest Service, 105–115. Genys JB. 1988. Intraspecific variation among 28 different sources of Black Alder, *Alnus glutinosa* (Betulaceae). *Castanea* 53: 71–79. Housley RA, Ammerman AJ, Mcclennen CE. 2004. That Sinking Feeling: Wetland Investigations of the Origins of Venice. *Journal of Wetland Archaeology* 4: 139–153. Houston Durrant T, de Rigo D, Caudullo G. 2016. Alnus glutinosa in Europe: distribution, habitat, usage and threats In: San-Miguel-Ayanz J, de Rigo D, Caudullo Giovanni, Houston Durrant Tracy, Mauri A, eds. *European Atlas of Forest Tree Species*. Publication Office of the European Union, 64–65. Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*).* Rome, Italy: International Plant Genetic Resources Institute. Klaassen RKWM, Creemers JGM. 2012. Wooden foundation piles and its underestimated relevance for cultural heritage. *Journal of Cultural Heritage* 13S: S123–S128.	

Kuznetsova T, Lukjanova A, Mandre M, Lõhmus K. 2011. Aboveground biomass and nutrient accumulation dynamics in young Black Alder, silver birch and Scots pine plantations on reclaimed oil shale mining areas in Estonia. *Forest Ecology and Management* 262: 56–64.
McVean DN. 1956. Ecology of *Alnus glutinosa* (L.) Gaertn: IV. Root System. *Journal of Chemical Ecology* 44: 219–225.
Plass WT. 1977. Growth and survival of hardwoods and pine interplanted with European Alder. *Forest Service, USDA Forest Service Research Paper NE-376.*: 1–10.
Russel T, Cutler C, Walters M. 2007. *Tree of the world: an illustrated encyclopaedia and identifier*. London: Anness Publishing Ltd.
Wenneker M, Heijne B, van de Zande JC. 2005. Effect of natural windbreaks on drift reduction in orchard spraying. *Communications in Agricultural and Applied Biological Sciences* 70: 961–969.

LIK3 Habitat suitability	
Response: Fairly probable (p = 0.5)	Confidence: High

Rationale: The taxon grows naturally in wetland areas and riparian zones, both of which are abundant habitat types in South Africa. Indeed, the taxon has already invaded such habitats. The taxon does, however, require specific conditions for germination (e.g. high humidity), and since its establishment is closely linked to the availability and abundance of water, the taxon would likely not invade other habitats. It must be noted though that the taxon can tolerate a wide range of temperatures and soil conditions.

References:

Claessens H, Oosterbaan A, Savill P, Rondeux J. 2010. A review of the characteristics of Black Alder (*Alnus glutinosa* (L.) Gaertn.) and their implications for silvicultural practices. *Forestry* 83: 163–175.
Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*).* Rome, Italy: International Plant Genetic Resources Institute.
Keet J-H & Richardson D.M. (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa
Russel T, Cutler C, Walters M. 2007. *Tree of the world: an illustrated encyclopaedia and identifier*. London: Anness Publishing Ltd.

LIK4 Climate suitability	
Response: Probable (p = 1)	Confidence: High

Rationale: Species-distribution modelling predicted large areas of South Africa to be potentially suitable for the establishment of Black Alder. Regions of high suitability include the southern and eastern parts of South Africa, extending into the high-elevation interior in parts of the Free State, Mpumalanga, Gauteng and Limpopo provinces (see appendix LIK4). Large areas of the Western Cape, Eastern Cape and KwaZulu-Natal provinces are also potentially highly climatically suitable. The arid interior of the country is largely unsuitable, but surprisingly a region of high suitability is predicted in the Northern Cape.

It must be noted that Black Alder requires high atmospheric humidity and the presence abundant moisture for at least 20 days to complete its reproductive cycle. As such, aridity seems to be a major limiting factor in the establishment of Black Alder. The species is likely to be limited by water availability and will largely be confined to riparian areas, especially in the drier areas of South Africa. Indeed, most South African occurrence records are from areas where the annual rainfall exceeds 500 mm per annum. In its native range Black Alder primarily occupies wet zones (riparian zones, ponds, wetlands etc.), and as such is unlikely to invade areas that are not close to water since its successful establishment is closely linked to the availability and abundance of water. Thus, even though large parts of the area are climatically suitable, the restriction on habitat requirements makes it unlikely that it could ever establish in all climatically suitable areas.

References:

Keet J-H & Richardson D.M. (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa

LIK5 Unaided secondary (dispersal) pathways	
Response: Unlikely (p = 0.027)	Confidence: High

Rationale: The main dispersal pathway for the taxon's propagules are water pathways, such as rivers and streams, and to a lesser degree, wind. Although seed spread by waterfowl is documented, bird dispersal in general is not regarded as an important mechanism since the birds open seeds and eat the embryos. Thus, the

taxon could easily disperse > 50 km in a decade via seed. Moreover, seeds are released in mass (± 700 000 seeds kg^{-1}) which greatly aids dispersal as well as establishment potential. The fact that the taxon is already invasive along riverbanks of the Dwars River (Kylemore Western Cape), together with scattered individuals downstream in the Berg River, proves its ability to spread unaided.
References: Funk DT. 1990. *Alnus glutinosa* (L.) Gaertn. European Alder In: Burns RM, Honkala BH, eds. *Silvics of North America: 2. Hardwoods. Agriculture Handbook 654.* Washington, DC: U.S. Department of Agriculture, Forest Service, 105–115. McVean DN. 1955. Ecology of *Alnus glutinosa* (L.) Gaertn.: II. Seed Distribution and Germination. *British Ecological Society* 43: 61–71. McVean DN. 1956. Ecology of *Alnus glutinosa* (L.) Gaertn: III. Seedling Establishment. *Journal of Ecology* 44: 195–218.

LIK6 Human aided secondary (dispersal) pathways	
Response: Fairly probable (p = 0.5)	Confidence: High
Rationale: Although the taxon is not used extensively in forestry activities in the area, it is used primarily for horticultural purposes, and can thus be intentionally spread by humans within the area. The taxon can also be unintentionally spread by humans, since its seeds are known to hitchhike on human clothing.	
References: Ansong M, Pickering C. 2014. Weed seeds on clothing: A global review. *Journal of Environmental Management* 144: 203–211. Keet J-H & Richardson D.M. (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa.	

3. Consequences

IMP1 Environmental impact	
IMP1a: Competition	
Response: Moderate (MO)	Confidence: High
Rationale: No study has yet investigated the competitiveness of the taxon on native species in the area. However, studies elsewhere (USA) have specifically identified the taxon as an invader that is able to displace native plant species.	
References: Herron PM, Martine CT, Latimer AM, Leicht-Young SA. 2007. Invasive plants and their ecological strategies: prediction and explanation of woody plant invasion in New England. *Diversity and Distributions* 13: 633–644.	
IMP1b: Predation	
Response: Data Deficient (DD)	Confidence: High
Rationale: The taxon is a tree, and thus does not prey on other biota.	
References:	
IMP1c: Hybridisation	
Response: Minimal Concern (MC)	Confidence: Medium
Rationale: The taxon is only known to hybridize in its native range with other members of the genus. Furthermore, no members of the genus or the family (Betulaceae) are native to the area, so there is no chance for hybridization with natives in the area.	
References: Funk DT. 1990. *Alnus glutinosa* (L.) Gaertn. European Alder In: Burns RM, Honkala BH, eds. *Silvics of North America: 2. Hardwoods. Agriculture Handbook 654.* Washington, DC: U.S. Department of Agriculture, Forest Service, 105–115.	
IMP1d: Transmission of disease	
Response: Data Deficient (DD)	Confidence: Medium
Rationale: Although the *Phytophthora alni* root rot complex is associated with the taxon and known to have decimated native populations of the taxon during the 1990's, there is currently no known evidence that any diseases associated with taxon has been transmitted to any native species in its global alien range. Moreover, no members of the genus or the family (Betulaceae) are native to the area, so there is no chance for such diseases to be transmitted to closely related native species within the area. A score of Data Deficient (DD) is given since there is not enough evidence to confidently conclude that no disease can be transmitted from the taxon to other, non-related native species; it has just not been recorded.	
References: Brasier CM, Cooke DEL, Duncan JM. 1999. Origin of a new *Phytophthora* pathogen through interspecific hybridization. *Proceedings of the National Academy of Sciences of the United States of America* 96: 5878–5883. Brasier CM, Kirk SA, Delcan J, Cooke DEL, Jung T, Man In't Veld WA. 2004. *Phytophthora alni* sp. nov. and its variants: designation of emerging heteroploid hybrid pathogens spreading on *Alnus* trees. *Mycological Research* 108: 1172–1184. Gibbs JN, Lipscombe MA, Peace AJ. 1999. The impact of Phytophthora disease on riparian populations of common alder (*Alnus glutinosa*) in southern Britain. *European Journal of Forest Pathology* 29: 39–50.	
IMP1e: Parasitism	
Response: Data Deficient (DD)	Confidence: High
Rationale: The taxon is not known to parasitize any other species.	
References:	
IMP1f: Poisoning/toxicity	
Response: Data Deficient (DD)	Confidence: Low
Rationale: The taxon is not known to release any toxic or poisonous substances that would cause harm to native species.	
References:	
IMP1g: Bio-fouling or other direct physical disturbance	
Response: Data Deficient (DD)	Confidence: High
Rationale: The taxon is a tree and cannot bio-foul.	
References:	

IMP1h: Grazing/herbivory/browsing	
Response: Data Deficient (DD)	Confidence: High
Rationale: The taxon is a tree, and therefore cannot browse or graze other plants.	
References:	
IMP1i: Chemical, physical or structural impact on ecosystem	
Response: Moderate (MO)	Confidence: High
Rationale: Black Alder is known to increase soil nitrogen levels as a result of associating with the nitrogen fixing bacterial genus *Frankia*, leading to a high concentration of nitrogenous compounds in roots and nodules, which leaches into soil, thus enriching it. Black Alder leaves are also rich in nitrogen, and rapidly releases water-soluble organic substances upon decomposition. Moreover, Black Alder stands are known to accumulate large amounts of litter. Other parts of Black Alder (e.g. branches, bole bark, bole wood etc.) also accumulate considerable amounts of nitrogen, and even young plants can significantly add to the amount of soil nitrogen. Such soil nitrogen enrichment can be particularly detrimental in nutrient poor systems, such as fynbos (where the taxon is invading), where plants are specifically adapted to low nutrient conditions. Black Alder potentially also elevates stream nitrogen content, a phenomenon called nitrogen pollution. Although it has not specifically been investigated for Black Alder, it has been shown for its congener *Alnus rubra* (Red Alder), where the amount of Red Alder cover positively correlates with the amount of nitrate and dissolved organic nitrogen in streams. Given the significant amount of soil nitrogen enrichment associated with Black Alder, there is enough reason to suspect it would also significantly pollute stream/river water with nitrogen. Black Alder also has the ability to de-oxygenate water where it grows. Finally, Black Alder is able to disrupt the physical structure of riparian systems. This is due to its ability to alter water flow as a result of trapping sediments via its dense root system.	
References: Cao L, Larson J, Berent L, Fusaro A. 2020. Alnus glutinosa *(L.) Gaertn.: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI.* https://nas.er.usgs.gov/queries/GreatLakes/FactSheet.aspx?SpeciesID=2696. 23 Mar. 2020. Compton JE, Church MR, Larned ST, Hogsett WE. 2003. Nitrogen export from forested watersheds in the Oregon coast range: the role of N_2-fixing Red Alder. *Ecosystems* 6: 773–785. Franche C, Lindström K, Elmerich C. 2009. Nitrogen-fixing bacteria associated with leguminous and non-leguminous plants. *Plant and Soil* 321: 35–59. Funk DT. 1990. *Alnus glutinosa* (L.) Gaertn. European Alder In: Burns RM, Honkala BH, eds. *Silvics of North America: 2. Hardwoods. Agriculture Handbook 654.* Washington, DC: U.S. Department of Agriculture, Forest Service, 105–115. McVean DN. 1956. Ecology of *Alnus glutinosa* (L.) Gaertn: IV. Root System. *Journal of Chemical Ecology* 44: 219–225. Mikola P. 1958. Liberation of nitrogen from alder leaf litter. *Acta Forestalia Fennica* 67: 1–10. Põlme S, Bahram M, Kõljalg U, Tedersoo L. 2014. Global biogeography of *Alnus*-associated *Frankia* actinobacteria. *New Phytologist* 204: 979–988. Virtanen AI, Miettinen JK. 1952. Free amino-acids in the leaves, roots and root nodules of the Alder. *Nature* 170: 283–284.	
IMP1k: Indirect impacts through interactions with other species	
Response: Moderate (MO)	Confidence: High
Rationale: Although little is known about the impacts of Black Alder on soil microbial communities where it invades, studies of afforestation have shown that Black Alder impacts on soil microbial communities by significantly increasing total microbial biomass and altering community composition, especially for fungi. Moreover, overwhelming evidence exists that nitrogen fixing species (which includes Black Alder) in general have the capacity to significantly alter native soil microbial communities, both in terms of diversity and composition. Such native soil community alterations can in turn have large effects on native plant communities. Black Alder also co-invades with its native ectomycorrhizal fungal communities. Furthermore, Black Alder seems to associate with *Frankia* assemblages typical of its native range, again supporting co-invasion. Finally, others pests have been co-introduced with Black Alder, such as striped alder sawfly, *Hemichroa crocea*, which is native to Europe but now widespread in northern USA and Canada, and European alder leaf miner, *Fenusa dohrnii*, which is also now widespread in USA and Canada.	
References:	

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Kamutando CN, Vikram S, Kamgan-Nkuekam G, *et al.* 2017. Soil nutritional status and biogeography influence rhizosphere microbial communities associated with the invasive tree *Acacia dealbata*. *Scientific Reports* 7: 1–9.

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Le Roux JJ, Ellis AG, van Zyl L-M, Hosking ND, Keet J-H, Yannelli FA. 2018. Importance of soil legacy effects and successful mutualistic interactions during Australian acacia invasions in nutrient-poor environments. *Journal of Ecology* 106(5): 2071-2081.

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Yelenik SG, Stock WD, Richardson DM. 2004. Ecosystem level impacts of invasive *Acacia saligna* in the South African Fynbos. *Restoration Ecology* 12: 44–51.

IMP1 Maximum environmental impact (Figure S2)

Response: Moderate (MO)	Confidence: High

Rationale: Studies have shown the taxon to compete with and replace native species, to hybridize with other congeners, to be associated with *Phytophthora* root rot complex, to cause chemical and structural impacts in recipient environments (elevation of soil nitrogen levels and alteration of river structures), and to interfere with soil microbial communities.

References:

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IMP2 Socio-economic impact	
IMP2a: Safety	
Response: Data Deficient (DD)	Confidence: Low
Rationale:	
References:	
IMP2b: Material and immaterial assets	
Response: Data Deficient (DD)	Confidence: Low
Rationale:	
References:	
IMP2c: Health	
Response: Minor (MN)	Confidence: Medium
Rationale: Black Alder pollen is known to cause allergic reactions in people that are sensitive to such pollen. Furthermore, it is suggested that alder pollen can prime pollen-sensitive individuals for reactions towards other types of pollen, such as birch (*Betula*), beech (*Fagus*) and chestnut (*Castanea*).	
References: Biedermann T, Winther L, Till SJ, Panzner P, Knulst A, Valovirta E. 2019. Birch pollen allergy in Europe. *Allergy* 74: 1237–1248. D’Amato G, Cecchi L, Bonini S, *et al.* 2007. Allergenic pollen and pollen allergy in Europe. *Allergy* 62: 976–990.	

Jantunen J, Saarinen K, Rantio-Lehtimäki A. 2012. Allergy symptoms in relation to alder and birch pollen concentrations in Finland. *Aerobiologia* 28: 169–176.
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IMP2d: Social, spiritual and cultural relations	
Response: Data Deficient (DD)	Confidence: Low
Rationale:	
References:	

IMP2 Maximum socio-economic impact (Figure S2)	
Response: Minor (MN)	Confidence: High
Rationale: Although the literature is generally depauperate on socio-economic impacts of the taxon, there is evidence showing that the taxon poses a health risk such as causing allergic reactions in people that are pollen sensitive.	

References:
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D'Amato G, Cecchi L, Bonini S, *et al.* 2007. Allergenic pollen and pollen allergy in Europe. *Allergy* 62: 976–990.
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IMP3 Closely related species' environmental impact	
Response:	Confidence:
Rationale:	
References:	

IMP4 Closely related species' socio-economic impact	
Response:	Confidence:
Rationale:	
References:	

IMP5 Potential impact	
Response: Moderate (MO)	Confidence: High

Rationale: Following is a list of undesirable traits of the taxon:

- The taxon has the ability to displace native plants, and thereby potentially has the ability to decrease native plant species richness and diversity, and influence composition and structural attributes. It can thus potentially significantly change the composition of local flora in invaded areas.
- Changes soil pH by lowering it, which could lead to irreversible damage to native ecosystems.
- Significantly enriches soil nitrogen, mainly as a result of its association with nitrogen-fixing *Frankia* bacteria. This can be particularly detrimental to ecosystems that are naturally nutrient poor, such as fynbos.
- The taxon accumulates large amounts of leaf litter, which can disrupt nutrient cycling rates.
- Has the ability to grow on and in a wide variety of soils and temperatures due to is pioneering nature, which means that it could potentially easily colonise and invade disturbed sites.

- Has the ability to de-oxygenate water where it grows, which would almost certainly impact on the native water biota.
- Has the ability to disrupt the physical structure of riparian systems as a result of trapping sediments via its dense root system.
- Impacts on soil microbial communities by significantly increasing total microbial biomass and altering community composition, especially for fungi, and is not restricted to rhizosphere modification, since the taxon stimulates the entire soil microbial population
- The taxon's pollen is known to cause allergic reactions in pollen-sensitive human individuals, and can even prime such individuals for allergic sensitization towards other types of pollen
- The taxon can act as vectors for the spread of alien pests and diseases, such as root and crown rot from *Phytophthora alni*, as well as the striped alder sawfly, *Hemichroa crocea*, alder leaf miner, *Fenusa dohrnii*.
- Has the potential ability to elevate stream nitrogen content, a phenomenon called nitrogen pollution, as has been shown for its congener *Alnus rubra* (Red Alder).
- Although there is no information regarding the water usage of the taxon, it is a riparian tree species and as such has the potential to uptake large quantities of water from rivers where it invades. This could limit water available for use to other native species, and could also potentially indirectly impact human well-being by reducing the amount of water available for consumption (e.g. drinking water, irrigation water for agriculture), as has been demonstrated for other invasive riparian species (e.g. *Eucalyptus*).

By the far the most important of the taxon's impacts is its ability to significantly alter soil properties, both chemically and microbiologically. Such species (especially nitrogen fixers) are considered to be drivers of regime shifts, and usually irreversibly impact the ecosystems they invade. Thus, the species is scored as having a Massive potential impact, since the changes of such taxa often persists even decades after their removal.

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4. Management

MAN1 What is the feasibility to stop future immigration?	
Response: High	Confidence: High
Rationale: Currently the taxon is not yet widely recorded within the area, and is not popular in forestry within the area, even though the taxon itself is a popular forestry specimen. Moreover, the taxon is not documented to occur in neighbouring countries so there not a high possibility of it being reintroduced from there. Since the taxon is native to Europe, it could only be introduced via well-regulated pathways. Although the seeds of the taxon can be dispersed large distances by water and can remain buoyant for up to 12 months, they do not have long life span and usually do not survive long after the first germination season. Seeds are known to hitchhike on human clothing.	
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MAN2 Benefits of the Taxon	
MAN2a Socio-economic benefits of the *Taxon*	
Response: High	Confidence: High
Rationale: The taxon has numerous socio-economic benefits. Firstly, the taxon is primarily used in silviculture and forestry, thus present a high economic value. Black Alder timber is waterproof, and has been used in the making of boats and waterpipes, is used in the making of furniture, woodenware, cooperage, charcoal and wood fibre, and has even been used in the making of wooden clogs (type of footwear used in the Netherlands region). The deep root system of Black Alder has led it to be used as a windbreak specifically for orchards and croplands. Finally, Black Alder has been considered as potential biofuel crop and a feed crop for cattle.	
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MAN2b Environmental benefits of the *Taxon*

Response: Low	Confidence: High

Rationale: The taxon is an important species used in forest and alluvial ecosystem restoration, as well as restoring mining spoil sites (e.g. the reclamation of strip-mines) since it promotes the growth of adjacent trees due to its nitrogen fixing ability as well as its fast growth rate. Also, the fact that Black Alder can reduce soil pH is beneficial for remediating high pH (i.e. alkaline) soils resulting from mining activities. However, although the above-mentioned uses can be considered as significant environmental benefits, they do not constitute benefits to native ecosystems, but only for disturbed systems. The only potential benefits to native ecosystems are the provision of good cover (e.g. for pheasants) and food the form of seeds (e.g. for birds) for wildlife.

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MAN3 Ease of management

MAN3a How accessible are populations?

Response: 1 (moderately accessible)	Confidence: High

Rationale: Currently the only verified invasive population of the taxon occurs near Kylemore, Western Cape, on the banks of the Dwars River (though there are numerous other records of the species in South Africa, these records have not been verified as being invasive populations and constitute information based on single observations or arboreta). The fact that the taxon occurs on river banks, which can sometimes be quite steep and inaccessible, gives the species a score of "moderately accessible". Thus, although the taxon can be can somewhat difficult to reach, it does not require specialist clearing teams, e.g. as for high altitude invaders.

References:

Keet J-H & Richardson D.M. (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa

MAN3b Is detectability critically time-dependent?

Response: 2 (yes)	Confidence: High

Rationale: Although the taxon is a large tree (usually up to 25 m in height; rarely up to 40 m), and in that sense easily detectable, it is deciduous. Thus, the tree is not readily identifiable for half of the year (winter) when all of its leaves are shed. It is only when the species is in leaf that it can be identified as *Alnus*. Moreover, it can be difficult to distinguish the taxon from other related species without flowers/fruits, which are only produced during spring/summer.

References:

Jaworski B. 1995. *Silviculture characteristics of forest trees*. Kraków, Poland: Gutenberg.

Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*).* Rome, Italy: International Plant Genetic Resources Institute.

McVean DN. 1955. Ecology of *Alnus glutinosa* (L.) Gaertn.: I. Fruit Formation. *Journal of Ecology* 43: 46–60.

Russel T, Cutler C, Walters M. 2007. *Tree of the world: an illustrated encyclopaedia and identifier*. London: Anness Publishing Ltd.

MAN3c Time to reproduction

Response: 1 (1–3 years)	Confidence: High

Rationale: Black Alder can flower as early as the second growing season (i.e. 2 years).

References:
Funk DT. 1990. *Alnus glutinosa* (L.) Gaertn. European Alder In: Burns RM, Honkala BH, eds. *Silvics of North America: 2. Hardwoods. Agriculture Handbook 654.* Washington, DC: U.S. Department of Agriculture, Forest Service, 105–115.

MAN3d Propagule persistence

Response: 1 (1–5 years)	Confidence: High

Rationale: The seeds of Black Alder do not have a long life, and few survive beyond the first germination season (even though the tree itself can live up to 100 years). Furthermore, the seeds also require specific conditions to be met for successful germination.

References:
Jaworski B. 1995. *Silviculture characteristics of forest trees*. Kraków, Poland: Gutenberg.
McVean DN. 1955. Ecology of *Alnus glutinosa* (L.) Gaertn.: II. Seed Distribution and Germination. *British Ecological Society* 43: 61–71.

MAN3 Ease of management (SUM from Table S3)

Response: 5	Confidence: High

Rationale: Two factors specifically complicate management efforts: 1) the deciduous nature of the species, leading to potential difficulty in identification during a large period of the year, and 2) early reproductive maturity and consequent release of massive amounts of seeds. The riparian preferences of Black Alder add moderate difficulty to the accessibility of invasive populations; however, as mentioned, this does not require the operation of specialist clearing teams. Another factor complicates management, which is not required as information in the previous sections, and that is the vigorous resprouting nature of the species. This requires timeous follow up treatments of any clearing efforts and is of critical importance.

References:
Jaworski B. 1995. *Silviculture characteristics of forest trees*. Kraków, Poland: Gutenberg.
Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*).* Rome, Italy: International Plant Genetic Resources Institute.
McVean DN. 1955. Ecology of *Alnus glutinosa* (L.) Gaertn.: I. Fruit Formation. *Journal of Ecology* 43: 46–60.
Russel T, Cutler C, Walters M. 2007. *Tree of the world: an illustrated encyclopaedia and identifier*. London: Anness Publishing Ltd.

MAN4 Has the feasibility of eradication been evaluated?

Response: No	Confidence: High

Rationale: Although clearing efforts are underway at the known invasive population near Kylemore, there has not been an evaluation of the feasibility of eradication in the country.

References:
Keet J-H & Richardson D.M. (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa

MAN5 Control options and monitoring approaches available for the *Taxon*

Response: Current recommendations for Black Alder control are as follows: small seedlings can be hand pulled if the ground is soft enough to remove entire plants. For larger plants, a combination of physical and chemical methods should be used. This is because Black Alder can coppice vigorously when cut down. Thus, similar to other coppicing species (e.g. *Acacia saligna*, *Robinia pseudoacacia* etc.), mechanical control is not a viable option on its own and must be used in conjunction with a systemic herbicide that kills the entire root system.

Herbicide, such as glyphosate, should be applied to cut stumps of felled trees in order to prevent coppicing. For foliar application, triclopyr triethylamine is recommended, and napropamide is recommended as a preemergence herbicide. Although more time consuming, girdling (bark and phloem removal) can also be applied, but should again be used in conjunction with herbicide treatment to prevent coppicing. The reported best time for herbicide application is during autumn. Control methods should be implemented for at least five years, since densities can increase (via regrowth) if any of these methods are implemented only once. Currently no biological control method exists. However, Black Alder is susceptible to a natural hybrid pathogen *Phytophthora alni* (consisting of a complex of three subspecies*: P. alni* subs. *alni*, *P. alni* subsp. *multiformis*, and *P. alni* subsp. *uniformis*), which decimated populations of Black Alder in Europe during the 1990s. This could potentially serve as a biocontrol agent in future, should Black Alder become a widespread invader. At the currently known invasive population, an invasive species team has cleared a total of 29.4 hectares in 9 months (August 2018 to April 2019; average of 3.6 hectares per month) at a cost of approximately R 82 011.15 per month excluding once off annual training fees. The approximate extent of this population is likely not much larger, with a conservative estimate given here of about 50 hectares. Currently, eradication might be feasible since no other invasive populations have been observed in South Africa, and only scattered individuals having been recorded elsewhere.

References:

Anderson H. 2013. *Invasive European Black Alder (*Alnus glutinosa*) Best Management Practices in Ontario*. Peterborough, ON: Ontario Invasive Plant Council.

Brasier CM, Cooke DEL, Duncan JM. 1999. Origin of a new *Phytophthora* pathogen through interspecific hybridization. *Proceedings of the National Academy of Sciences of the United States of America* 96: 5878–5883.

Brasier CM, Kirk SA, Delcan J, Cooke DEL, Jung T, Man In't Veld WA. 2004. *Phytophthora alni* sp. nov. and its variants: designation of emerging heteroploid hybrid pathogens spreading on *Alnus* trees. *Mycological Research* 108: 1172–1184.

Cao L, Larson J, Berent L, Fusaro A. 2020. Alnus glutinosa *(L.) Gaertn.: U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI.* https://nas.er.usgs.gov/queries/GreatLakes/FactSheet.aspx?SpeciesID=2696. 23 Mar. 2020.

Champion PD, James TK, Carney EC. 2008. Evaluation of triclopyr triethylamine for the control of wetland weeds. *New Zealand Plant Protection* 61: 374–377.

Gibbs JN, Lipscombe MA, Peace AJ. 1999. The impact of Phytophthora disease on riparian populations of common alder (*Alnus glutinosa*) in southern Britain. *European Journal of Forest Pathology* 29: 39–50.

Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*)*. Rome, Italy: International Plant Genetic Resources Institute.

Keet J-H & Richardson D.M. (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa

Kelly A, Southwood RR. 2006. Restoration of the littoral margin by removing trees from the lake edge at Cockshoot Broad, Norfolk, England. *Conservation Evidence* 3: 71–72.

Martin GD. 2019. Addressing geographical bias: A review of *Robinia pseudoacacia* (black locust) in the Southern Hemisphere. *South African Journal of Botany* 125: 481–492.

Willoughby I, Dixon FL, Clay D V, Jinks RL. 2007. Tolerance of broadleaved tree and shrub seedlings to preemergence herbicides. *New Forests* 34: 1–12.

MAN6 Any other management considerations to highlight? (if yes, fill in Appendix MAN6)	
Response	Yes

5. Calculations

Likelihood = 0.5 (Fairly probable)

Parameter	**Likelihood**	**Stages**	**Final assessment**
LIK1	Probable (p = 1)	P(entry) = 1	P (invasion) = 0.5
LIK2	Probable (p = 1)		
LIK3	Fairly probable (p = 0.5)	P(establishment) = 1	

LIK4	Probable (p = 1)		
LIK5	Unlikely (p = 0.027)	P (spread) = 0.5	
LIK6	Fairly probable (p = 0.5)		

Consequence = Moderate (MO)

Parameter	**Mechanism/sector**	**Response**
IMP1a	Competition	Moderate (MO)
IMP1b	Predation	Data Deficient (DD)
IMP1c	Hybridisation	Minimal Concern (MC)
IMP1d	Disease transmission	Data Deficient (DD)
IMP1e	Parasitism	Data Deficient (DD)
IMP1f	Poisoning/toxicity	Data Deficient (DD)
IMP1g	Bio-fouling or other direct physical disturbance	Data Deficient (DD)
IMP1h	Grazing/herbivory/browsing	Data Deficient (DD)
IMP1i	Chemical, physical, structural impact	Moderate (MO)
IMP1k	Indirect impacts through interactions with other species	Moderate (MO)
IMP1	**Maximum environmental impact**	**Moderate (MO)**
IMP2a	Safety	Data Deficient (DD)
IMP2b	Material and immaterial assets	Data Deficient (DD)
IMP2c	Health	Minor (MN)
IMP2d	Social, spiritual and cultural relations	Data Deficient (DD)
IMP2	**Maximum socio-economic impact**	**Minor (MN)**
IMP3	Environmental impact of closely related taxa (only score if IMP1a-k are all DD, otherwise NA)	NA
IMP4	Socio-economic impact of closely related taxa (only score if IMP2a-g are all DD, otherwise NA)	NA
IMP5	Potential impact based on traits, experiments, or models	Moderate (MO)

Table S2: Risk score = High

		Consequences				
		MC	MN	MO	MR	MV
Likelihood	Extremely unlikely	low	low	low	medium	medium
	Very unlikely	low	low	low	medium	high
	Unlikely	low	low	medium	high	high
	Fairly probable	medium	medium	high	high	high
	Probable	medium	high	high	high	high

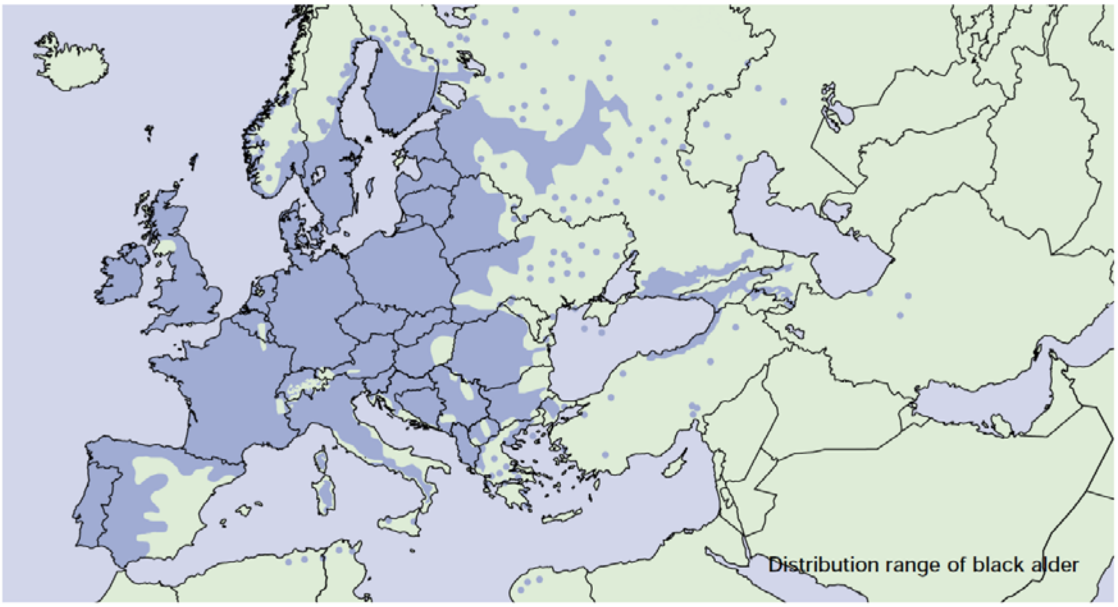
Table S3: Ease of management

Parameter	**Question**	**Response**
MAN3a	How accessible are populations?	1
MAN3b	Is detectability critically time-dependent?	2
MAN3c	Time to reproduction	1
MAN3d	Propagule persistence	1

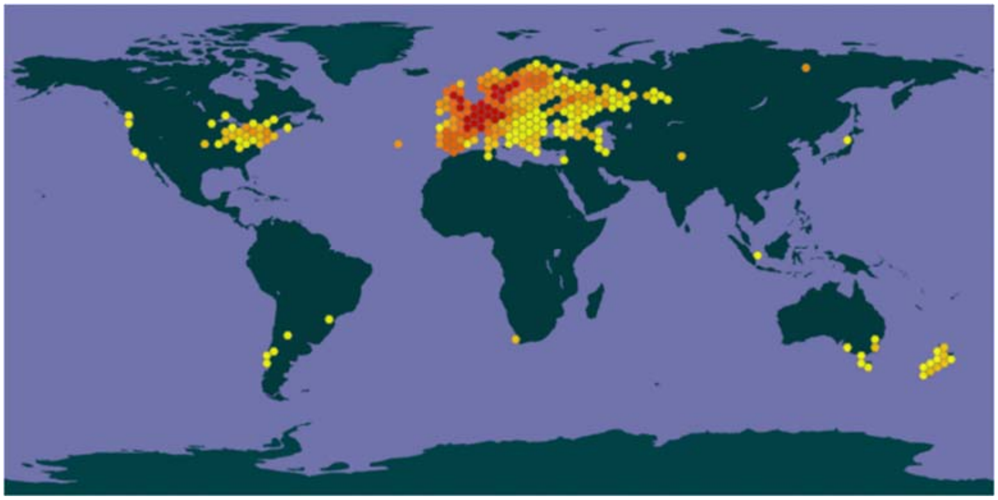
MAN3	**SUM**	5

Appendix BAC7: Native range of Black Alder (*Alnus glutinosa*).

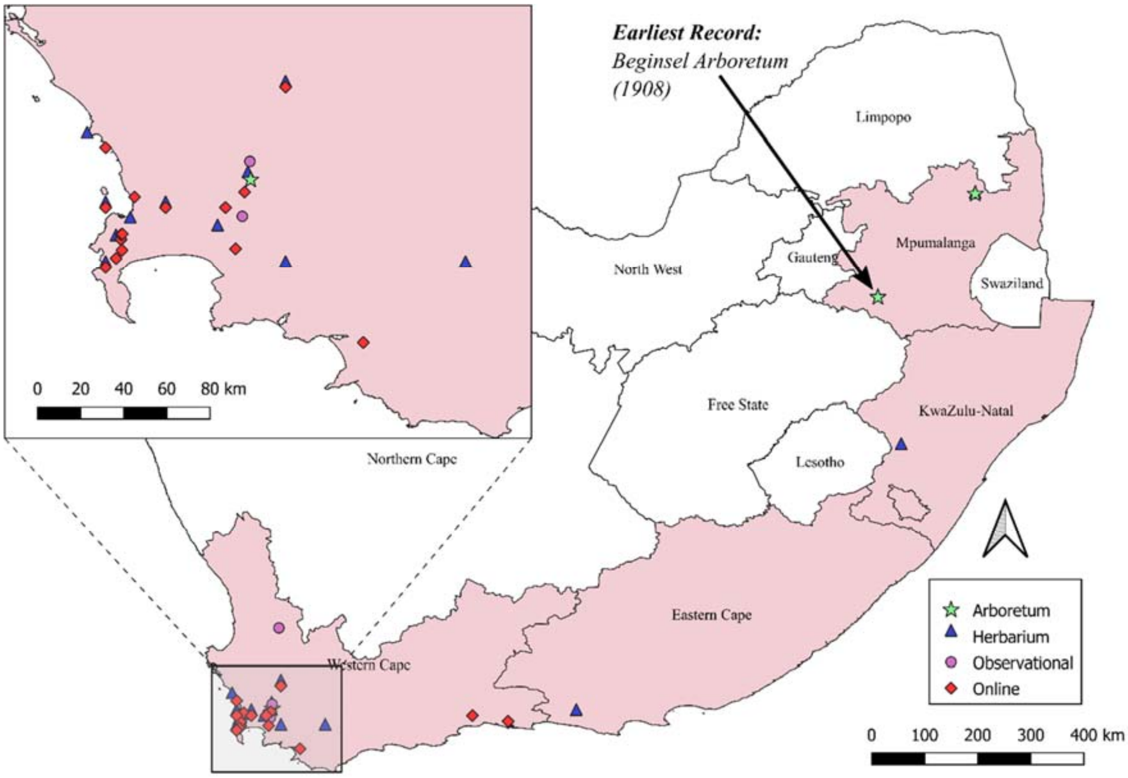
Image from Kajba, D., Gračan, J., 2003



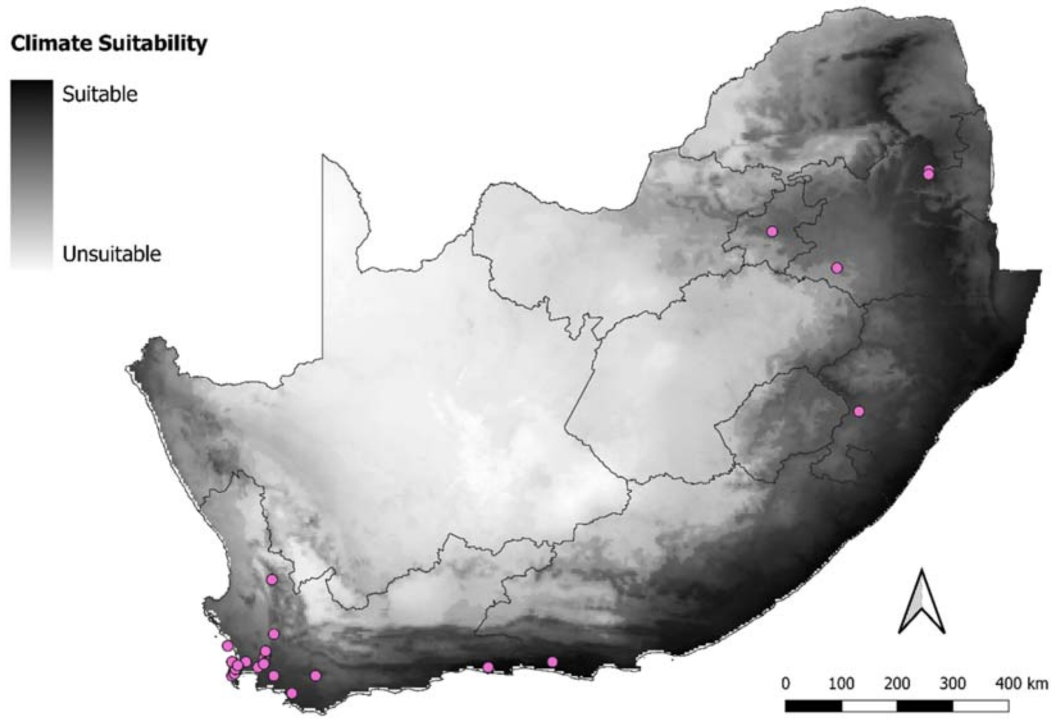
Appendix BAC8(a): Global distribution range (native and alien) of *Alnus glutinosa* (from GBIF).



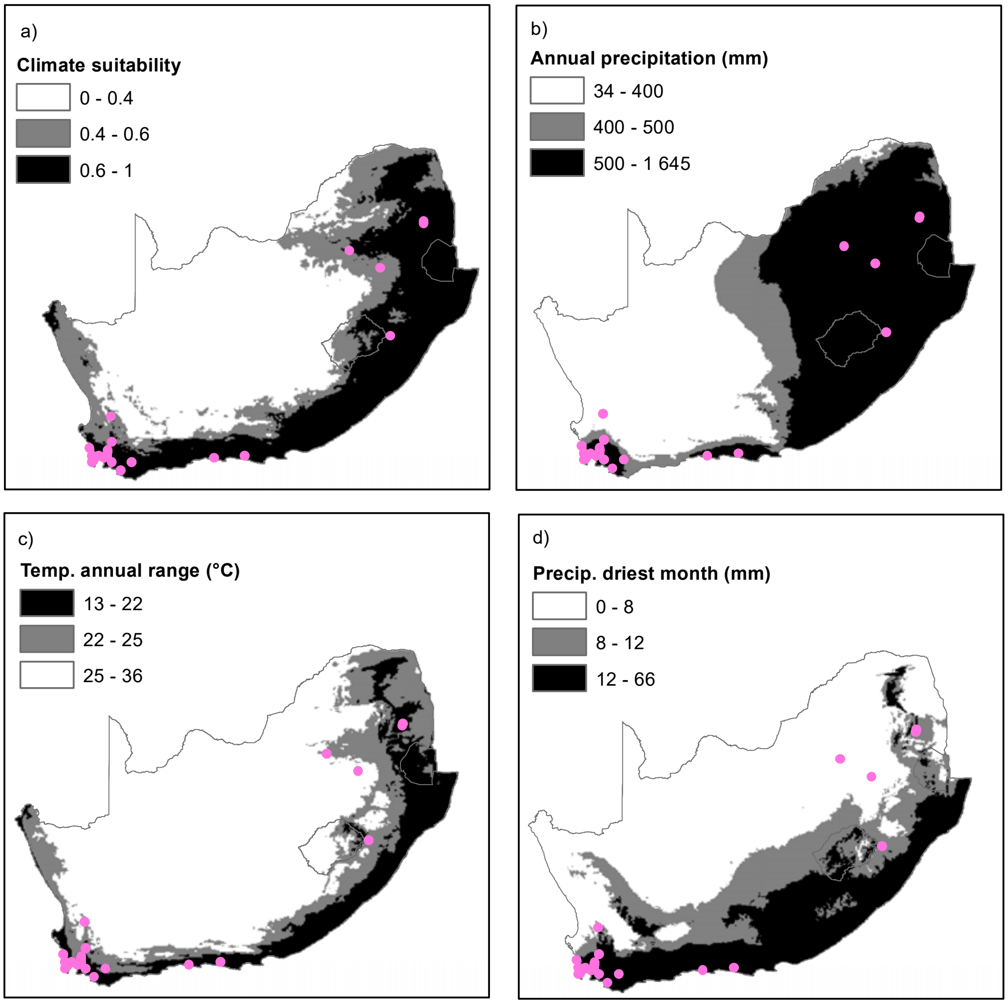
Appendix BAC8(b): Alien range of *Alnus glutinosa* within South Africa.



Appendix LIK4: Bioclimatic suitability of Black Alder in South Africa based upon global invasive records



Predicted climate suitability for Black Alder (*Alnus glutinosa*) in South Africa. Darker shades represent areas predicted to be highly suitable, while lighter shades represent areas predicted to be less suitable. Known occurrence points are indicated by the pink dots.



Climate suitability and climatic variable maps for Black Alder (Alnus glutinosa) in South Africa: a) climatic suitability reclassified into three classes; b) annual precipitation; c) temperature annual range; and d) precipitation in driest month. Regions that are most suitable for the species have the darkest shading. Locations where Black Alder has been recorded in South Africa are indicated by pink dots.

Appendix MAN6: Management considerations of *Alnus glutinosa*.

A couple of management factors should be considered. Firstly, Black Alder is a pioneer species, and can colonise raw soil material, establishing itself in early successional stages (Funk, 1990), enabling it to thrive on a wide variety of soils (Claessens et al., 2010). Secondly, Black Alder is a vigorous resprouter (Kajba and Gračan, 2003). Thus, mechanical control is not a viable option on its own and must be used in conjunction with a systemic herbicide (Martin, 2019). Thirdly, Black Alder is a fast-growing species, with early reproductive maturity and seed set (Funk, 1990). Thus, clearing efforts of invasive stands should be followed up timeously. Fortunately, advantage can be taken from the fact that seeds of Black Alder do not have a long life (McVean, 1955). Lastly, Black Alder could potentially spread significant distances downstream of established populations (McVean, 1955).

References:

Claessens H, Oosterbaan A, Savill P, Rondeux J. 2010. A review of the characteristics of Black Alder (*Alnus glutinosa* (L.) Gaertn.) and their implications for silvicultural practices. *Forestry* 83: 163–175.

Funk DT. 1990. *Alnus glutinosa* (L.) Gaertn. European Alder In: Burns RM, Honkala BH, eds. *Silvics of North America: 2. Hardwoods. Agriculture Handbook 654.* Washington, DC: U.S. Department of Agriculture, Forest Service, 105–115.

Kajba D, Gračan J. 2003. *EUFORGEN Technical Guidelines for genetic conservation and use for Black Alder (*Alnus glutinosa*).* Rome, Italy: International Plant Genetic Resources Institute.

Keet J-H & Richardson D.M. (in prep) *Alnus glutinosa* (L.) Gaertn. (Black Alder): an emerging invader in South Africa.

Martin GD. 2019. Addressing geographical bias: A review of *Robinia pseudoacacia* (black locust) in the Southern Hemisphere. *South African Journal of Botany* 125: 481–492.

McVean DN. 1955. Ecology of *Alnus glutinosa* (L.) Gaertn.: II. Seed Distribution and Germination. *British Ecological Society* 43: 61–71.