

# NOBANIS – Invasive Alien Species Fact Sheet

## *Pinus mugo*

**Author of this fact sheet:** Henrik Jørgensen, Danish Forest and Nature Agency, Ministry of the Environment, Haraldsgade 53, DK-2100 Copenhagen Ø; Denmark, Tel.: +45 3947 2523; E-mail: [hjg@sns.dk](mailto:hjg@sns.dk)

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### Species description

**Scientific name:** *Pinus mugo* Turra (1765), Pinaceae.

**Synonyms:** *P. montana* Mill. (1768), *P. mughus* Scop. (1772), *P. montana* subsp. *mughus* (Scop.) Willk. (1872), *P. pumilio* Haenke (1791), *P. montana* subsp. *pumilio* (Haenke) Celak. (1867), *Pinus montana* subsp. *pumilio* (Haenke) Willk. (1872), *Pinus mugo* subsp. *pumilio* (Haenke) Zenari (1921), *Pinus mugo* var. *mughus* (Scop.) Zenari.

*Pinus mugo* is a very variable species with several subspecies. The most important subspecies is, however, *Pinus mugo* subsp. *mugo*. According to Christensen (1987) the species also contains the subspecies *Pinus mugo* subsp. *uncinata* (Ramond) Domin and the nothosubspecies *Pinus mugo* nothosubsp. *x rotundata* (Link) Janch. and H. Neumayer, cf. also Jonsell (2000). The present fact sheet focuses on the subspecies *Pinus mugo* subsp. *mugo* which is the more invasive in Northern Europe – for the purpose of this fact sheet the name *Pinus mugo* is used for *Pinus mugo* subsp. *mugo*.

**Common names:** Dwarf Mountain-Pine (GB), Bergkiefer, Gewöhnliche Krummholz-Kiefer, Gewöhnliche Legföhre, Gewöhnliche Latsche (DE), Almindelig Bjerg-Fyr (DK), Mägimänd (EE), Vuorimänty (FI), Dwarf mountain pine (IE), Fjallafura (IS), kalninė pušis (LT), Kalnu priede (LV), Bergfuru (= *P. mugo* ssp. *uncinata*), Bergden (NL), Buskfuru (NO), Kosodrzewina (PL), сосна горная (RU), Bergtall (SE).



**Fig 1.** *Pinus mugo* in dune habitat in Denmark, photo by Henrik Jørgensen.



**Fig 2 and 3.** *Pinus mugo*, showing paired needles on reddish twigs, male flowers and cones, photo by Henrik Jørgensen.

### **Species identification**

*Pinus mugo* is a shrub or a small tree with many curved trunks originating from the base. The height does not usually exceed 10 m. The paired, dark green needles vary in length from 23 to 75 mm and persist for about 5 years. The reddish twigs have dense foliage with cylindrical, acute, resinous buds. The bark is dark reddish grey and split into angular, scaly plates. The male flowers are borne separate from the female flowers. The cones give the primary distinguishing characters between the subspecies; they are symmetrical or oblique and vary between 17 and 67 mm (Jonsell 2000).

### **Native range**

*Pinus mugo* is native to Central and South East Europe, ranging from the Swiss-Austrian border in the Alps to the Erzgebirge (eastern Germany, Czech Republic), the Tatra and Carpathian Mountains (Slovakia, Poland, west of Ukraine) and southeast through Croatia and Romania to Bulgaria, with western outliers to the Vosges and French Alps and an isolated population in the central Italian Apennines (Richardson 1998). It grows mostly in subalpine regions above the timberline (1400-2700 m), but also at lower altitudes in peat bogs and frost hollows (down to 200 m in SE Germany and S Poland; Christensen 1987). A crude [distribution map](#) may be seen on the pages from the gymnosperm database of the University of Bonn.

## Alien distribution

### History of introduction and geographical spread

*Pinus mugo* was introduced in Denmark in 1798. Since the mid-1800s the species has been common in forestry in North and West Jutland, northern Zealand and Bornholm, especially near the sea where it often escapes and naturalises. The species is also found as an ornamental in other parts of Denmark. In Norway *P. mugo* is used as an ornamental throughout the country. The first plantations were established in Jæren early in the 1860s based on seedlings produced in Germany. From the 1870s the species has been extensively used in coastal areas in Western Norway and northwards. Later introductions have mainly been based on material from Denmark, predominantly Central Jutland, with smaller imports of seeds from Austria and Switzerland (Gløersen 1882, Øyen 1999). The first plantation in mountainous areas is reported from 1901 in Storelvdal (970 m a.s.l.; Sollien 1923). Some scattered attempts have later been made to use this species in alpine areas, e.g. the Norwegian State Railway has tried to establish *Pinus mugo* along the railway in Central Norway (Wilse 1953). Most of these plantation attempts, however, have had only limited success. *Pinus mugo* is now commonly naturalised in heathland and coastal sand dunes in Norway from the Swedish border in the southeast to Nordland County. It has also been found naturalised in scattered places inland up in mountain forests and as far north as Eastern Finnmark (Lid and Lid 2005). In the west and southwest, it is now an aggressive invader of coastal heath. In Sweden the species is often used in dune and heath plantations in the south and is common as an ornamental throughout and often escapes (north to Kiruna). It was first observed as naturalised in 1927 (Jonsell 2000). In Finland the species is very common as ornamental, but very rarely escapes (Jonsell 2000). In Iceland the species occurs occasionally in plantations and as an ornamental but is not recorded as escaping (Þorbergur Hjalti Jónsson, pers. comm.).

Outside the natural range of the subspecies in south eastern Germany, no escapes have been observed e.g. in coastal areas in north Germany. In Estonia *P. mugo* has been used as an ornamental in parks and gardens (Eichwald 1960) and to stabilise sand dunes on the Hiiumaa Island (Laas 1987). It has become naturalised occasionally in the western part of the Baltic countries (Cinovskis *et al.* 1993).

In southwestern Lithuania and the Kaliningrad region *P. mugo* has a quite special history since it was planted throughout the Curonian spit (Kuršių nerija) in the 1800s to protect sandy dunes from rapid deterioration. At that point in time, the Curonian spit was turning into a desert-like, rapidly deteriorating landscape after nearly all native forests had been harvested during the two preceding centuries (Strakauskaite, 2004a, 2004b). The first person to suggest saving dunes by restoring conifer forests was professor Johan Daniel Titius from University of Wittenberg, in 1768. In 1825 Georg David Kuwert started planting *P. mugo* trees in the Nida area (central-southern Curonian spit) after seven villages were destroyed by moving sands, and some settlements were relocated for the same reason. When the settlement of Naujieji Nagliai was completely destroyed by moving sands in 1854 and some cemeteries started drifting and uncovering their contents, authorities increased efforts to plant the trees and in 1904 the project was completed with 2/3 of dunes covered with forests and the drifting dunes were stabilised (Strakauskaite, 2004a, 2004b).

In Russia *P. mugo* is very common as ornamental in some regions (Leningradskaya oblast', Kirovskaya oblast') (Деревья и кустарники 1949, Цвелев 2000), but rarely escapes and is not established. In Moscow region (Moskovskaya oblast') there are unique cases of naturalization (Сырейщиков 1927).

### Pathways of introduction

*Pinus mugo* is widely used to protect soil against erosion and especially to stabilise sandy soils along coastlines. Furthermore, the species in Denmark was massively used as a forerunner for more

valuable trees by the large-scale establishment of inland and later coastal plantations on the heaths of Jutland during the 1800 and 1900s. The strategy of establishing plantations under often very harsh conditions was to literally “roll out a blanket of Mountain Pine” and later, when the pines had established a sufficient forest climate, to introduce more productive species of *Pinus*, *Picea* and *Abies* etc. Also on Zealand and Bornholm *Pinus mugo* was used in this manner in coastal dune areas. At its maximum around 1900, 44,000 hectares were afforested with *Pinus mugo* plantations, of which almost half have remained until today.

In Norway the species was partly used to re-establish a forest in deforested areas along the coast from Vest-Agder to Troms, as well as to establish shelter near habitations. It was popular due to its ability to grow on shallow and nutrient-poor soils, and great wind tolerance. In total about 30 mill. *Pinus mugo* have been planted in Norway. Damages due to *e.g.* snow scree, wind, forestry, grazing and development projects have reduced the area with *Pinus mugo* along the Norwegian coast, and today it is estimated that the plantations of this species cover an area of about 6000-7000 ha (Øyen 1999). Measurements have shown that the annual growth of *Pinus mugo* in plantations in western Norway have been around 2 to 5 cubic metres per ha (Paulson 1932), which is comparable to Danish measurements (Møller 1965).

Planting of *P. mugo* for shelter and as an ornamental in summer residence areas has also acted as a pathway of introduction. This has often been of significant importance for its spread in places without forest plantations. In the areas where it is planted dispersal takes place via seeds and self-reproducing populations are established.

### **Alien status in region**

In Denmark (most importantly Jutland), approximately half the heath- and dunelands outside the directly afforested areas are affected by invasion of *Pinus mugo*. The degree varies from scattered specimens to a dense cover (Henrik Jørgensen, pers. obs.). This is in close correspondence with its former very intensive use and the delay of counteractive management. Although used on a smaller scale, the situation is comparable in Sweden and Norway, where dune-areas and coastal heathlands are invaded. The first reports of *Pinus mugo* naturalising from the plantations in western Norway are from the early 1900s (Wisth 1923, Fremstad, E. and Elven, R. 1997), particularly in deforested areas, heathlands and dried bogs. However, no systematic studies of the extent of naturalisation of this species in Norway have been undertaken. In Finland *Pinus mugo* is used for gardening purposes and is occasionally found naturalised, but the species is not regarded invasive (Hämet-Ahti *et al.* 1992, Kurtto and Helynranta 1998; see also table 1).

In Estonia it naturalises occasionally (Malle Leth, pers. comm.). In Lithuania some of the *P. mugo* trees planted in the Curonian Spit are now nearly 200 years old (Strakauskaite 2004a, 2004b). Some of these old growths of *P. mugo* are severely damaged due to forest fires in the area, *e.g.* 250 ha of a *P. mugo* forest was destroyed by a large fire in May 2006 (Viktoras Didziulis, pers. comm.). After forest fires *P. mugo* does not regrow naturally in Lithuania and remnants are usually outcompeted by birch groves (Strakauskaite, 2004a, 2004b). However, seeds of *P. mugo* are being blown by wind over the Curonian Lagoon into the continental part and groves of various densities are formed in raised bogs along the eastern coast of the lagoon (Gudžinskas 2000).

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

**Table 1.** The frequency and establishment of *Pinus mugo*, please refer also to the information provided for this species at [www.nobanis.org/search.asp](http://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; **Native** - when a species is native in a country this is indicated in the table under the relevant frequency category.

## Ecology

### Habitat description

*Pinus mugo* has its natural occurrence near the timberline in the Middle- and East European mountainous areas described above. It reaches higher altitudes than any other conifer (to 2400 m). Towards its upper limit it gradually becomes lower and more prostrate in growth and eventually gives way to alpine vegetation. Being a shrub, it cannot be said to form the timberline as such. It rather occupies patches of unstable, more heavily eroded ground intersected along the timberline. With its base lying on the ground and ascending shoots emerging as far as 10 meters from the root it is able to withstand downsliding snow and stones, where trees with erect trunks would burst.

In Denmark, Norway and Sweden *P. mugo* is a well established alien in extensively managed areas where poor, sandy and leached soils predominate. In Denmark the invaded habitats are dunes and dune heaths especially along the coast, but also inland dunes and further outwash plains and extra marginal hills with soils leached since the Saale glaciation.

With respect to the “naturalness” of these habitats it should be remembered that dune formation was often during history enhanced by the activities of man, especially tree-felling and overgrazing, and that most heathland was originally covered by deciduous forest. The invaded, predominantly semi-natural, habitats have undergone a decline in the intensity of management, *i.e.* cessation or very low intensity of grazing, mowing and burning. In regularly managed biotopes, where especially *Calluna vulgaris* is kept thriving, *Pinus mugo* is only a minor problem. Similarly, *Pinus mugo* is not invasive in other, more intensively managed areas. Because of low tolerance towards shade, it is not invasive in well established forests, but can be so in forest clearings on poor soils.

Observations in Norway also indicate that the species will not easily establish itself in areas with rather dense forest growth or on thick humus layers. In forested areas damaged by wind-felling, naturalised specimens of *Pinus mugo* tend to be outcompeted by *Populus tremula*, *Salix caprea*, *Sorbus aucuparia* and *Betula pubescens* (Øyen 1999).

### **Reproduction and life cycle**

*Pinus mugo* is wind pollinated and exclusively sexually reproducing. Each cone produces between 50 and 70 mature seeds, and the number of cones counts in tens or hundreds according to the size of individuals. In Western Norway it seems that each individual of *Pinus mugo* produces some cones every year. Flowering and seed production takes place from the age of 3-5 years.

Populations of the species are low producing compared to other trees used in forestry, but they are with their branching and prostrate growth nevertheless able to cover the ground to a degree that excludes most other vegetation (except shade tolerant mosses) within a span of few decades (Abrahamsen 2002). Single, even-aged stands, with known year of establishment, rarely exceed 100 years of age, whereupon they slowly disintegrate. When light becomes sufficient, old stands can renew themselves, but often other tree species will appear and initiate a succession towards a mixed coniferous/deciduous shrub or forest. Only under the harshest conditions with respect to soil, wind and salt spray, can *Pinus mugo* be expected to form a permanent vegetation cover over centuries.

There are no species specific pests on *Pinus mugo* recorded from Denmark, but a number of fungi and insects that attack pines generally (and sometimes also other conifers) are known. Among the fungi *Gremmeniella abietina*, *Lophodermium pinastri* and *Heterobasidion annosus s.s.* (pine type) are most noted (I.M. Thomsen, pers. comm.). Among the insects the most important are *Ryacionia (=Evetria) bouliana*, *Neodiprion certifer* and *Tomicus piniperda* (H.P. Ravn, pers. comm.). None of these pests are known to have such damaging effects that they could be regarded as possible controlling agents.

### **Dispersal and spread**

The seeds of *Pinus mugo* are dispersed by wind. In Norway seeds are released from the cones during dry periods in the winter. With unreliable snow cover in coastal areas, dispersal over snow-covered ground (which is the natural dispersal way in the native range of this species) is difficult, although strong winds may carry a seed a few hundred metres away from the mother plant (Øyen 1999).

Resprouting from cut stumps or dispersal by root-suckers does not take place, but individuals may survive cutting, if the stumps are not set sufficiently close to the ground, that is, if living branches are left on the stumps.

*Pinus mugo* is no longer used in forest plantings in Denmark or Norway, but it is available at plant nurseries, garden suppliers etc., and is still planted near human dwellings to some extent.

## Impact

### **Affected habitats and indigenous organisms**

*Pinus mugo* is invading dunes and heathland habitats. For example, lichen-heathlands, which are rare habitats in Scandinavia, are threatened by *Pinus mugo* invasion. The encroachment by this and other woody species alters the microclimate and hence the conditions for the native biodiversity in the affected habitats.

A large number of valuable habitats described in the listings of the European NATURA 2000 network, are reduced in quality, or even locally eradicated, in areas up to several tens of hectares. Naturally, along with this, a large number of red-listed and other species worthy of protection are reduced in population size or become locally extinct.

### **Genetic effects**

Hybrids are recorded frequently with *P. sylvestris*, and sometimes with *P. nigra* and *P. heldreichii* (Christensen 1987).

### **Human health effects**

No human health effects are reported.

### **Economic and societal effects (positive/negative)**

Today the main use of *Pinus mugo* in commercial forestry is for wood-chip production. The density of dry wood-chips is about 450 kg per cubic m, and effective heat value is about 2200 kWh per cubic m (Øyen 1999). Furthermore the species is used as a garden ornamental.

One of the early arguments in the late 1800s to establish plantations of the species on sand dunes was its ability to stabilise such habitats against wind erosion (Øyen 1999). In Lithuania *P. mugo* is considered useful for protection of sandy dunes and human settlements and it does not spread and occurs only in locations where it was deliberately planted.

## Management approaches

### **Prevention methods**

According to the Danish Nature Protection Act, §3, planting of trees in biotopes under special protection is not allowed. The paragraph is not directed specifically towards *Pinus mugo*, but rather states generally that alteration of the natural state of protected biotopes is not allowed without special permission. Since the act entered into force in 1992, public landowners are obliged to manage their protected areas so as to prevent them from "leaving their natural state"; in most cases to preserve them in an open state. From 2005 this obligation also applies to private landowners. Other use of *Pinus mugo* is not restricted.

### **Eradication, control and monitoring efforts**

In Denmark *Pinus mugo* and other tree species are being removed and dune heath habitats restored in a LIFE project (LIFE02 NAT/DK/008584) that comprises the western coast of Jutland, the islands in the Wadden Sea and the islands Læsø and Anholt in Kattegat.

The total project area includes 3400 hectares with scattered *Pinus mugo*, 540 hectares with dense stands and 260 hectares with planted stands. Management methods include crushing with flail-mowers or burning of infested patches in the case of populations of small *Pinus mugo*, and manual felling with chainsaw followed by removal and chipping in the case of stands with larger individuals.

In Norway it is not known that stands of *Pinus mugo* actively have been removed or controlled. In Jæren and Lista proposals have however, been made to remove plantations of this species. According to Øyen (1999), the general impression in Norway has been that the speed of naturalisation from the *Pinus mugo* plantations is sufficiently slow to make control feasible.

The general viewpoint among experienced nature managers is that if areas cleared of *Pinus mugo* are kept well managed, *i.e.* with follow-up clearings, grazing, mowing or burning if necessary, the areas will soon appear as original heathland to the general visitor. But the full re-establishment of the original biodiversity takes much longer. As an example, a 100 hectare inland heath that was restored after an accidental fire in the plantation that covered it until 1968, after 35 years had on the average only half the number of typical heathland vascular plants as compared to a number of smaller, original heaths in close proximity (Jørgensen 2004).

### **Information and awareness**

The Danish LIFE project mentioned above has been accompanied by an information campaign including large sign posts in many areas where larger felling have taken place, leaflets, newspaper articles, radio and television. There is generally much interest from the media in describing the problems with invasive aliens, and public awareness is clearly increasing.

### **Knowledge and research**

There is not much scientific knowledge on the invasions of *Pinus mugo* or the results of attempts at restoration, but at least one report (Abrahamsen 2002) has described the results of earlier clearings and the successions of up to 10 years after restoration. The general conclusion of this report is that with time the vegetation of restored dune heathland approaches that of the original vegetation.

### **Recommendations or comments from experts and local communities**

The basic recommendation is that natural habitats invaded by *Pinus mugo* can be successfully restored if sufficient funding for first-time clearings as well as for the appropriate follow-up management regimes is secured. In this respect, it is a very helpful fact that re-growth from stumps or roots after clearing of *Pinus mugo* does not take place, which makes control much easier than in the case of other invasive species in the same habitats like *Rosa rugosa* or *Prunus serotina*, that shoot repeatedly from the stumps.

*Pinus mugo* may reinvade the restored areas if a seed-source is present. It is therefore important to raise awareness among owners of summer cottages in the vicinity, since *Pinus mugo* is widely, and legally, used as shelter and an ornamental. Advice on alternatives to *Pinus mugo* is thought to be more feasible than a ban of its use.

Also, where it is the wish to preserve an often long existing state of forest, this should gradually be replaced by natural species, especially *Quercus* spp., *Betula* spp., *Sorbus aucuparia*, *Populus tremula*, *Salix* spp. and *Pinus sylvestris*, or at least by none - or less-invasive species (other *Pinus* spp., *Picea* spp., *Abies* spp. and *Larix* spp.).

## **References and other resources**

### **Contact persons**

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

Knud Ib Christensen (DK) Botanical Garden, University of Copenhagen, Øster Farimagsgade 2 B, DK-1353 København K, Denmark, Phone: +45 35322224, E-mail: [knudib@bot.ku.dk](mailto:knudib@bot.ku.dk)

Iben M. Thomsen (DK) Skov and Landskab, KVL, Hørsholm Kongevej 11, DK-2970 Hørsholm, Phone +45 35281664, E-mail: [imt@kvl.dk](mailto:imt@kvl.dk)

Hans Peter Ravn (DK), Forest and Landscape Denmark, Hørsholm Kongevej 11, DK-2970 Hørsholm, Denmark, E-mail: [hpr@kvl.dk](mailto:hpr@kvl.dk)

Frank Klingenstein (DE) Federal Agency for Nature Conservation, Konstantinstr. 110, DE-53179 Bonn, Germany, E-mail: [frank.klingenstein@bfn.de](mailto:frank.klingenstein@bfn.de)

Henry Väre (FI) Finnish Museum of Natural History, Botanical Museum, P.O.Box 7, FI-00014 University of Helsinki, Finland, E-mail: [henry.vare@helsinki.fi](mailto:henry.vare@helsinki.fi)

Malle Leht (EE) Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Riia 181, EE-Tartu 51014, Estonia, E-mail: [malle@zbi.ee](mailto:malle@zbi.ee)

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

Andrejs Svilāns (LV) National Botanic Garden, Dendroflora Department, Miera 1, LV- 2169, Salaspils, Latvia, E-mail: [andrejs.svilans@nbd.apollo.lv](mailto:andrejs.svilans@nbd.apollo.lv)

Viktoras Didžiulis (LT) Coastal Research and Planning Institute, Klaipėda University, Lithuania, H.Manto - 84, LT-91210, Klaipėda, Phone: +370 46 380905, E-mail: [viktoras@ekoinf.net](mailto:viktoras@ekoinf.net)

Zigmantas Gudžinskas (LT) Institute of Botany, Žaliųjų Ežerų Str. 49, LT-08406 Vilnius, Lithuania, E-mail [zigmantas.g@botanika.lt](mailto:zigmantas.g@botanika.lt)

Svein Båtvik (NO) Directorate for Nature Management (Direktoratet for naturforvaltning) NO-7485 Trondheim, Norway, Phone: + 47 73 58 07 36, E-mail: [svein-t.batvik@dirnat.no](mailto:svein-t.batvik@dirnat.no)

Damian Chmura (PL) Institute of Nature Conservation Polish Academy of Sciences, 33 Mickiewicza Str., PL-31-120 Kraków, Poland, Phone: +48 12 632 05 49, Fax: +48 12 632 24 32, . E-mail: [chmura@iop.krakow.pl](mailto:chmura@iop.krakow.pl)

Melanie Josefsson (SE) Swedish Environmental Protection Agency, SE-10648 Stockholm, Sweden, Phone: +46 18 67 31 48, E-mail: Melanie [Josefsson@snv.slu.se](mailto:Josefsson@snv.slu.se)

Olga Morozova (RU), Institute of Geography Russian Academy of Sciences, Laboratory of Biogeography, Staromonetny, 29, Moscow, 119017, Russia. E-mail: [biogeo@igras.geonet.ru](mailto:biogeo@igras.geonet.ru)

## Links

The virtual flora of Sweden – [fact sheet on \*Pinus mugo\*](#) (in Swedish)

Gymnosperm database of the University of Bonn – [Fact sheet on \*Pinus mugo\*](#)

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