

Key Words: Evaluate, Naturalized, Christmas Tree, Dense Stands, Wind-dispersed

**Family:** *Pinaceae*

**Taxon:** *Abies procera*

**Synonym:** *Abies nobilis* (Douglas ex D. Don) Lindl.  
*Abies nobilis* var. *prostrata* Hornibr.  
*Abies nobilis* var. *robusta* Beissn.  
*Abies nobilis* var. *robustifolia* Sudw.  
*Abies procera* f. *prostrata* (Hornibr.) Rehder

**Common Name:** Noble fir  
 Christmastree  
 Red fir

<b>Questionnaire :</b>	current 20090513	<b>Assessor:</b>	Chuck Chimera	<b>Designation:</b> EVALUATE
<b>Status:</b>	Assessor Approved	<b>Data Entry Person:</b>	Chuck Chimera	<b>WRA Score 1</b>
101	Is the species highly domesticated?		y=-3, n=0	n
102	Has the species become naturalized where grown?		y=1, n=-1	
103	Does the species have weedy races?		y=1, n=-1	
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"		(0-low; 1-intermediate; 2-high) (See Appendix 2)	Low
202	Quality of climate match data		(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)		y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates		y=1, n=0	n
205	Does the species have a history of repeated introductions outside its natural range?		y=-2, ?=-1, n=0	y
301	Naturalized beyond native range		y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed		n=0, y = 1*multiplier (see Appendix 2)	n
303	Agricultural/forestry/horticultural weed		n=0, y = 2*multiplier (see Appendix 2)	n
304	Environmental weed		n=0, y = 2*multiplier (see Appendix 2)	
305	Congeneric weed		n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs		y=1, n=0	n
402	Allelopathic		y=1, n=0	
403	Parasitic		y=1, n=0	n
404	Unpalatable to grazing animals		y=1, n=-1	n
405	Toxic to animals		y=1, n=0	n
406	Host for recognized pests and pathogens		y=1, n=0	
407	Causes allergies or is otherwise toxic to humans		y=1, n=0	n
408	Creates a fire hazard in natural ecosystems		y=1, n=0	
409	Is a shade tolerant plant at some stage of its life cycle		y=1, n=0	n

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	n
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	y
604	Self-compatible or apomictic	y=1, n=-1	y
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	>3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	n
706	Propagules bird dispersed	y=1, n=-1	n
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	
801	Prolific seed production (>1000/m2)	y=1, n=-1	
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides	y=-1, n=1	
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	

Designation: EVALUATE

WRA Score **1**

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**Supporting Data:**

101	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Is the species highly domesticated? No] No evidence
102	2012. WRA Specialist. Personal Communication.	NA
103	2012. WRA Specialist. Personal Communication.	NA
201	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Species suited to tropical or subtropical climate(s) 0-Low] "A. procera is restricted to a relatively small area of north-western Oregon and south western Washington, USA. Considering it can be very dominant in forests where it does occur, its range is smaller than that of its other coniferous associates, from the McKenzie River in the Oregon Cascades to Stevens Pass in the Washington Cascades. In addition, there are around 12 discontinuous populations in the Coast Range of extreme south-west Washington and north-west Oregon." ... "Latitude between 48°S and 44°S"
202	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Quality of climate match data 2-High]
203	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Broad climate suitability (environmental versatility)? Yes] "Noble fir is generally found at elevations between 1070 and 1680 m (3,500 and 5,500 ft) in the Cascade Range in Oregon and 910 and 1520 m (3,000 and 5,000 ft) in the Cascade Range in central Washington. In the Coast Ranges of Oregon, it generally grows above 910 m (3,000 ft). It is occasionally found at much lower elevations, however, and shows excellent growth on such sites." [Potential elevation range exceeds 1000 m, suggesting species possesses environmental versatility]
203	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Broad climate suitability (environmental versatility)? Yes] "Climatic amplitude (estimates) - Altitude range: 60 - 2700 m - Mean annual rainfall: 1390 - 4740 mm - Rainfall regime: winter; uniform - Dry season duration: 0 - 3 months - Mean annual temperature: 4 - 7°C - Mean maximum temperature of hottest month: 13 - 16°C - Mean minimum temperature of coldest month: -5 - -1°C - Absolute minimum temperature: -25 - 0°C" [Potential elevation range exceeds 1000 m, suggesting species possesses environmental versatility]
204	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Native or naturalized in regions with tropical or subtropical climates? No] "Noble fir lies entirely within a moist, maritime climatic region. Since it grows primarily at higher elevations within the <i>Abies amabilis</i> zone (10) high precipitation and relatively cool temperatures are characteristic."
204	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Native or naturalized in regions with tropical or subtropical climates? No] "Climate throughout the range of <i>A. procera</i> is distinctly moist and maritime. Summers are cool, with mean daily temperatures in July of 13.3-16.1°C. Winter temperatures are also relatively mild, with mean January temperatures ranging from -4.4 to -1.1°C. The mean number of frost-free days ranges from 55 near the tree line to more than 240 within the Oregon Coast Range. Mean annual precipitation varies greatly, ranging from 4740 mm on the south-west slopes of Cedar Butte in the Oregon Coast Range to a low of 1390 mm on ridges east of the Cascade Crest. Mean annual snowfall is in the range 1500 12,500 mm, and winter snowpacks can be as much as 6 m deep, but persistent snowpacks are commonly 1-3 m deep. A summer dry season is characteristic of this region, with only around 5% of the annual precipitation falling in July to September."
205	1993. Cope, A.B.. <i>Abies procera</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html">http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html</a>	[Does the species have a history of repeated introductions outside its natural range? Yes] "It is cultivated in Hawaii [50]."
205	2000. Jonsell, B. (ed.). Flora Nordica. Volume 1. Lycopodiaceae to Polygonaceae. The Bergius Foundation, The Royal Swedish Academy of Sciences, Stockholm	[Does the species have a history of repeated introductions outside its natural range? Yes] "Escaped" in Sweden
205	2001. Vance, N.C./Borsting, M./Pilz, D./Freed, J.. Special forest products: species information guide for the Pacific Northwest. en. Tech. Rep. PNW-GTR-513. USDA, Forest Service, Pacific Northwest Research Station, Portland, OR	[Does the species have a history of repeated introductions outside its natural range? Yes] "Noble fir was introduced into Denmark in the mid 19th century and is now common throughout the country. Boughs are harvested commercially for decorative uses in Scandinavian countries."

205	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Does the species have a history of repeated introductions outside its natural range? Yes] Planted & naturalized in the UK
205	2006. Krivanek, M./Pysek, P./Jarosik, V.. Planting History and Propagule Pressure as Predictors of Invasion by Woody Species in a Temperate Region. Conservation Biology. 20(5): 1487–1498.	[Does the species have a history of repeated introductions outside its natural range? Yes] "Not escaped" in the Czech Republic
301	2000. Jonsell, B. (ed.). Flora Nordica. Volume 1. Lycopodiaceae to Polygonaceae. The Bergius Foundation, The Royal Swedish Academy of Sciences, Stockholm	[Naturalized beyond native range? Listed as "escaped" in Sweden]
301	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Naturalized beyond native range? Yes] "Appendix List of naturalized or invasive (in bold)" ... "A. procera (Great Britain)" [Listed as bold, so considered invasive in Great Britain]
301	2006. Krivanek, M./Pysek, P./Jarosik, V.. Planting History and Propagule Pressure as Predictors of Invasion by Woody Species in a Temperate Region. Conservation Biology. 20(5): 1487–1498.	[Naturalized beyond native range? No evidence from Czech Republic] "Table 1. Alien tree species planted in the Czech Republic for forestry purposes and included in the study" [Abies procera listed as "not escaped"]
301	2010. Carrillo-Gavilan, M.A./Vila, M.. Little evidence of invasion by alien conifers in Europe. Diversity and Distributions. 16: 203–213.	[Naturalized beyond native range? Yes] "It was only possible to identify the invasion status for 72 of the 212 records. Fifty-seven records (27%) corresponded to non-established conifers, 11 (5%) to established and four (2%) to invasive. All records on invasive conifers referred to P. strobus in the Czech Republic (Hanze 'lyova' , 1998; Pysek et al., 2002; Krivanek et al., 2006; Hadincova' et al., 2008). Most cases of establishment were found in the UK and referred to A. grandis, Abies procera, Cupressus macrocarpa, L. kaempferi, P. radiata, P. strobus and P. menziesii (Crook, 1997)."
302	2007. Randall, R.P.. Global Compendium of Weeds - Abies procera. <a href="http://www.hear.org/gcw/species/abies_procera/">http://www.hear.org/gcw/species/abies_procera/</a>	[Garden/amenity/disturbance weed? No] No evidence
303	2007. Randall, R.P.. Global Compendium of Weeds - Abies procera. <a href="http://www.hear.org/gcw/species/abies_procera/">http://www.hear.org/gcw/species/abies_procera/</a>	[Agricultural/forestry/horticultural weed? No] No evidence
304	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Environmental weed? Possibly] "Appendix List of naturalized or invasive (in bold)" ... "A. procera (Great Britain)" [Listed as bold, so considered invasive in Great Britain, but impacts unspecified]
304	2007. Randall, R.P.. Global Compendium of Weeds - Abies procera. <a href="http://www.hear.org/gcw/species/abies_procera/">http://www.hear.org/gcw/species/abies_procera/</a>	[Environmental weed? No evidence]
305	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Congeneric weed? Yes] "The 15 non pine conifers (out of 507 species; 3%) known to be invasive (seven in the Pinaceae; six in Cupressaceae, one in Araucariaceae, one in Podocarpaceae) are: Abies grandis , Abies procera , " ... "Appendix List of naturalized or invasive (in bold) conifers (Pinopsida), based on hundreds of published and unpublished sources and the unpublished data and personal observation of the authors over more than a decade." ... "Abies alba (Great Britain; Ireland; New Zealand); A. cephalonica (Great Britain); A. concolor (USA (New England)); A. grandis (Great Britain, Ireland; Sweden); A. nordmanniana (Great Britain; New Zealand); A. procera (Great Britain); A. sibirica (Finland)"

401	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Produces spines, thorns or burrs? No] "Young trees have an open spire-shaped crown; the crown lifts after crown closure, and at maturity the trees have a long, relatively clean bole with a short, rounded crown. Mature trees reach 45-60 m tall on nearly all sites and heights of 75 m are common on good sites. The tallest tree known is 89.9 m. The diameter of mature trees is commonly 120 150 cm on most sites and often over 200 cm on good sites. The largest known diameter is 290 cm. The stem form of <i>A. procera</i> is remarkable in that it is consistently a straight and tall tree. It characteristically has high form factor (very low taper) and a long, clean stem. The bark on young trees is smooth and light grey with the horizontal resin blisters common on many species of <i>Abies</i> . Large vertical fissures develop in this smooth stem as the trees mature, eventually leading to a tight, checked or flaky bark. The bark on mature trees develops into a reddish-grey to purplish colour, in contrast to the blue green foliage. Forked or multiple stemmed trees are uncommon. As with many Pacific Northwest conifers, the root system is largely lateral, yet the trees are fairly wind firm and have the ability to root in loose volcanic tephra, which is fairly common at higher altitudes in the Cascade Mountains. The twigs are finely pubescent and reddish brown. Buds are non-resinous, tan, ovoid, small, with a rounded apex. Basal scales are short, broad, equilaterally triangular, non resinous, with a sharp-pointed apex. Leaves 1.3(-3.5) cm x 1.5-2 mm, single-ranked, with the proximal portion often appressed to the twig for 2-3 mm before diverging away from the twig (best seen on the underside of the twig). The cross sections of shade leaves are flat, with a prominent raised midrib on the lower surface, with or without grooves on the upper surface. Sun leaves have a four-sided cross section. The lower surface of leaves has 2-4 glaucous bands, each band with (4)-6-7 stomatal rows, the upper leaf surfaces with 0-2 glaucous bands, each with 0-7 stomatal rows at midleaf. Leaves are bluish-green, and with stomatal bands on all surfaces give the tree a distinctive, bluish bluish as seen from a distance. The leaf apex is rounded to notched, with leaves on fertile branches 4-sided with four bands of stomata below. The resin canals are small and near the leaf margins and lower leaf surface epidermal layer. Leaves have a faint odour of turpentine."
402	1971. Del Moral, R./Cates, R.G.. Allelopathic Potential of the Dominant Vegetation of Western Washington. <i>Ecology</i> . 52(6): 1030-1037.	[Allelopathic? Possibly] "Abstract. Forty plant species common in western Washington were investigated for the presence of allelopathic chemicals capable of influencing the distribution of subordinate species. Under laboratory conditions most species contained inhibitory volatile compounds and many contained effective water-soluble compounds" [ <i>Abies procera</i> demonstrated allelopathic potential in experimental conditions]
403	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Parasitic? No] Pinaceae
404	1990. Burns, R.M./Honkala, B.H.. <i>Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654.</i> U.S. Department of Agriculture, Forest Service, Washington, DC.	[Unpalatable to grazing animals? No] "Early growth of planted seedlings is variable, depending on site conditions and stock. In one study, growth was slow; noble fir seedlings were only 8.4 cm (3.3 in) tall at the end of the first growing season in the field, half the height of Douglas-fir seedlings planted at the same time. Damage from browsing was much less on noble fir than on Douglas-fir, however." {Possibly less palatable than Douglas fir, but still apparently browsed}
404	2000. Jonsell, B. (ed.). <i>Flora Nordica. Volume 1. Lycopodiaceae to Polygonaceae.</i> The Bergius Foundation, The Royal Swedish Academy of Sciences, Stockholm	[Unpalatable to grazing animals? No] "often damaged by grazing"
405	2000. Jonsell, B. (ed.). <i>Flora Nordica. Volume 1. Lycopodiaceae to Polygonaceae.</i> The Bergius Foundation, The Royal Swedish Academy of Sciences, Stockholm	[Toxic to animals? No] "often damaged by grazing" [No evidence]
406	1993. Cope, A.B.. <i>Abies procera</i> . In: <i>Fire Effects Information System</i> , [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html">http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html</a>	[Host for recognized pests and pathogens? Possibly] "Generally, noble fir does not suffer major losses from pests [13,16,17]. Noble fir bark beetle ( <i>Pseudohylesinus nobilis</i> ) is often associated with root-diseased trees and can kill the tree [12,16]. Dwarf mistletoe may be a problem requiring management action in some areas [11,12,16,17,41]."

406	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Host for recognized pests and pathogens? Potentially] "There are relatively few insect problems associated with <i>A. procera</i> . Seed chalcid ( <i>Megastigmus pinus</i> ) can infect up to 25% of the seeds within the cones during a good seed year. The cone maggots, <i>Earomyia barbara</i> and <i>E. longistylata</i> , and the cone moth, <i>Eucosma siskiyouana</i> , have also been known to infest a significant proportion of cones during good seed years. Another insect, <i>Dioryctria abietavorella</i> , has been known to mine buds and shoots as well as cones. The bark beetles <i>Pseudohylesinus nobilis</i> and <i>P. dispar</i> and the fir root bark beetle <i>P. granulatus</i> are the most common and damaging beetles. The root bark beetle can be very destructive when associated with root rotting fungi. An imported pest, the balsam woolly adelgid, <i>Dreyfusia piceae</i> does not infect natural populations to any significant degree, although (with <i>Dreyfusia nusslini</i> ) it has been known to cause damage to ornamental populations and Christmas tree plantations. Affected trees often swell at the branch nodes with large, bulbous cankers that destroy their ornamental value. The most common root and butt rots are <i>Phaeolus schweinitzii</i> , <i>Inonotus tomentosus</i> and <i>Poria subacida</i> . These are not usually responsible for mortality, although they can contribute to weakened resistance to other factors including trunk failure in windstorms. Older stands of <i>A. procera</i> are prone to a variety of heart rots, primarily by the Indian paint fungus, <i>Echinodontium tinctorium</i> , and others including <i>Phellinus pini</i> , <i>Fomes nobilissimus</i> , <i>F. robustus</i> , <i>Fomitopsis officinalis</i> , <i>F. pinicola</i> and <i>Polyporus abietinus</i> . Central Oregon Cascade populations of <i>A. procera</i> are occasionally infected by the hemlock dwarf mistletoe, <i>Arceuthobium tsugense</i> , and although damage is rarely significant, it can kill individual branches."
407	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Causes allergies or is otherwise toxic to humans? No] No evidence
407	2008. Wagstaff, D.J.. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	[Causes allergies or is otherwise toxic to humans? No] No evidence
407	2012. Pollen Library. Noble Fir ( <i>Abies procera</i> ). IMS Health Incorporated, <a href="http://www.pollenlibrary.com/Specie/Abies+procera/">http://www.pollenlibrary.com/Specie/Abies+procera/</a>	[Causes allergies or is otherwise toxic to humans? No evidence] "Allergenicity: No allergy has been reported for Noble Fir ( <i>Abies procera</i> ) species"
408	1993. Cope, A.B.. <i>Abies procera</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html">http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html</a>	[Creates a fire hazard in natural ecosystems? Possibly. Foliage is highly flammable, but fine fuels beneath stands are lowered] "The bark of young noble fir is relatively thin [35]. Fire resistance of larger, thicker barked trees is reported to be low [6,35] to moderate [6,25,49]. The foliage of noble fir is moderately to highly flammable [35]. Noble fir prunes well in closed, dense stands [1,18]. Stands dominated by noble fir have the smallest quantities of forest floor material (compared with stands dominated by other western conifers that occur in its range), and accumulation of fuel is low [9,47]."
409	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Is a shade tolerant plant at some stage of its life cycle? No] "Reaction to Competition- Noble fir has the most intolerance for shade of American true firs. Regeneration cannot be established under a closed forest canopy."
409	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Is a shade tolerant plant at some stage of its life cycle? No] "It is not shade tolerant and is self pruning from an early age, often leaving a relatively long section of the main bole free of branches." ... "Atypical of most of its associated species, <i>A. procera</i> is shade intolerant and it therefore often assumes a pioneer role in snowy environments." ... " <i>A. procera</i> is the least shade tolerant of the North American <i>Abies</i> , although seedlings have been seen to establish under partial shade in the Oregon Coast Range."
410	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Tolerates a wide range of soil conditions? Yes] "Noble fir can grow on a wide range of soils if ample moisture is available; water supply appears to be of more critical importance than soil quality. Spodosols and Inceptisols are most common."
410	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Tolerates a wide range of soil conditions? Yes] " <i>A. procera</i> grows on a wide variety of soils developed from various parent materials. Populations in the Cascades are often found on sites with successive deposits of volcanic tephra. <i>A. procera</i> can occupy all slope positions from ridge top to valley bottom, although slope forests are the most common. The greatest known growth rates occur at relatively low altitudes on lower slopes with fine-textured volcanic soils. Growth is reduced on poorly drained or shallow, water-deficient soils, and on higher altitude sites."

411	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Climbing or smothering growth habit? No] "Young trees have an open spire-shaped crown; the crown lifts after crown closure, and at maturity the trees have a long, relatively clean bole with a short, rounded crown. Mature trees reach 45-60 m tall on nearly all sites and heights of 75 m are common on good sites."
412	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Forms dense thickets? Yes] "It does grow in nearly pure stands, however, and is capable of producing high standing volumes and good growth over a wide range of ages and site qualities (7,14)."
412	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Forms dense thickets? Yes] "A. procera grows in the subalpine forests of the Cascade Mountains, USA where it often forms pure forests of large trees." ... "A. procera is a large to very large tree dominating large areas of upper altitude forests in the Cascade Mountains of Washington and Oregon, USA. Usually a pioneer species forming nearly pure stands, its fairly long life allows it to persist in many older forests dominated by shade tolerant species."
412	2007. Van Pelt, R.. Identifying Mature and Old Forests in Western Washington. Washington State Department of Natural Resources, Olympia, WA	[Forms dense thickets? Yes] "It also can form pure, incredibly dense stands that can rival Douglas fir stands in total volume."
501	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Aquatic? No] Terrestrial
502	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Grass? No] Pinaceae
503	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Nitrogen fixing woody plant? No] Pinaceae
504	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "Young trees have an open spire-shaped crown; the crown lifts after crown closure, and at maturity the trees have a long, relatively clean bole with a short, rounded crown."
601	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Evidence of substantial reproductive failure in native habitat? No] "A. procera is a large to very large tree dominating large areas of upper altitude forests in the Cascade Mountains of Washington and Oregon, USA. Usually a pioneer species forming nearly pure stands, its fairly long life allows it to persist in many older forests dominated by shade-tolerant species."
602	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Produces viable seed? Yes] "At nearly all sites pollen is released during June. Female cones grow throughout the summer, with growth generally concluded by mid-August; the cones begin to dry and open by September, with seed disseminated in late September or early October."
603	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Hybridizes naturally? Yes] "Noble fir has been artificially crossed with several other true firs. It interbreeds readily with California red fir, and reciprocal crossings have high yields of viable seed. Some noble fir parents yield nearly as much seed from pollen of California red fir as from local noble fir pollen. Other crossings reported in the literature are <i>Abies concolor</i> (supposedly "confirmed"), <i>recurvata</i> , <i>sachalinensis</i> , <i>balsamea</i> , and <i>lasiocarpa</i> . None of these have been repeated, however, and all are seriously questioned as to validity."
603	2001. Vance, N.C./Borsting, M./Pilz, D./Freed, J.. Special forest products: species information guide for the Pacific Northwest. en. Tech. Rep. PNW-GTR-513. USDA, Forest Service, Pacific Northwest Research Station, Portland, OR	[Hybridizes naturally? Yes] "Monoecious, outcrosser and hybridizes with other <i>Abies</i> species."
603	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Hybridizes naturally? Yes] "A. procera x A. magnifica hybrids are present in wild populations between Crater Lake National Park and the McKenzie River in the Oregon Cascades (43°N-44°10'N), USA. These two species also readily hybridize in greenhouse experiments. Hybridization with <i>Abies balsamea</i> , <i>A. concolor</i> , <i>A. lasiocarpa</i> , <i>A. recurvata</i> and <i>A. sachalinensis</i> has been reported in the literature but no hybrids have been verified and there is serious doubt as to the validity of any of these claims. <i>Abies procera</i> is diploid with a chromosome number of 2n=24."
604	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Self-compatible or apomictic? Yes] "Noble fir has a high self-fertility (27). Selfing produced 69 percent of the sound seeds produced by outcross pollination; there was no difference between selfed and outcrossed progeny in weight and germination of seeds or in survival after 3 years."

604	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Self-compatible or apomictic? Yes] "As with most <i>Abies</i> , <i>A. procera</i> is monoecious, with male and female cones produced in the upper third of the tree, female cones generally on exposed branches above the zone of male cone production." ... "Seed viability is however, typically low, with results from one long term study indicating a mean viability of only 10%. This may increase to 50%, but all values above 10% occurred in years that had high cone production. Possible explanations include poor pollen dispersal, poor synchronicity between male and female cones, selfing, or insect damage." [However, selfing may result in reduced seed viability]
605	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Requires specialist pollinators? No. Wind-pollinated] "Firs have unspecialized pollen mechanisms, long periods of pollen dormancy, a short time after germination when pollen tubes must develop and penetrate the long nucellar tip, and archegonia that abort quickly if unfertilized. These traits, plus a low number of archegonia, may cause the low percentage of viable seeds."
606	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Reproduction by vegetative fragmentation? No] "Vegetative Reproduction- Noble fir is not known to reproduce vegetatively."
606	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Reproduction by vegetative fragmentation? No] "As <i>A. procera</i> does not reproduce vegetatively by either sprouting or layering under natural conditions, propagation by seed is the only contemporary method for regeneration."
607	1993. Cope, A.B.. <i>Abies procera</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html">http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html</a>	[Minimum generative time (years)? 25+] "Noble fir begins producing seed at 25 to 30 years of age, but large-volume crops are not produced until age 35 to 50 [14,17,45]. Good seed crops are produced at 3- to 6-year intervals [7,14,17,45]."
607	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Minimum generative time (years)? 20+] "Cones are generally not produced until the tree is at least 20 years old, but few cones are produced until trees are older and larger, and commercial seed production is generally considered to begin at about 50 years."
701	1993. Cope, A.B.. <i>Abies procera</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html">http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html</a>	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? No] "Seed dissemination requires wind action or other branch movement to disturb the cone [7,21]. Height growth is greatest in July [27]." [No evidence, and seeds lack means of external attachment]
702	1993. Cope, A.B.. <i>Abies procera</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html">http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html</a>	[Propagules dispersed intentionally by people? Yes] "Noble fir brings a substantial price as a Christmas tree [1,16,22]. It is also utilized as ornamental greenery [16,18]."
702	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Propagules dispersed intentionally by people? Yes] " <i>A. procera</i> is a major Christmas tree species, accounting for 10-25% of the Pacific Northwest Christmas tree trade. Also, boughs are used for decorative greenery and plantations are sometimes grown for this purpose. Like many other species of <i>Abies</i> , the trees are commonly available in nurseries for ornamental planting."
703	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Propagules likely to disperse as a produce contaminant? No] "Noble fir seeds are not widely dispersed because of their weight, which averages 29,750 seeds per kilogram (13,500/lb) (25). Wind is the major agent of dispersal. Although the seeds can fly over 600 in (2,000 ft) (22), most actually fall within one or two tree heights of the seed trees (1)." [No evidence. Relatively large seeds and long time to reproductive maturity make contamination of produce highly unlikely]
704	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Propagules adapted to wind dispersal? Yes] "Seeds are 12 x 6 mm with the body reddish-brown and the wing slightly longer than the body, light brown to straw coloured." ... "The seeds are heavier than seeds of other Pacific Northwest conifers. Each seed contains a single wing but often fall from the upright cone axis in pairs on ovuliferous scales as the scales break off from the cone on drying, a process that does not require wind. Seeds are dispersed by wind, with most falling within two tree heights of the seed tree but some have been found up to 600 m away, and seeds blowing around on the snow surface during winter have been found up to 2 km away."

705	2007. Van Pelt, R.. Identifying Mature and Old Forests in Western Washington. Washington State Department of Natural Resources, Olympia, WA	[Propagules water dispersed? No] "An important physical adaptation is its large cones, which are sparsely produced at the top of trees at maturity (Figure 77, Figure 15, left). These cones contain very large seeds, which can provide a young sprout with nutrients for up to a year while its roots are trying to find a favorable spot to grow." ... "While large seeds commonly limit seed dispersal distances, the snowy and icy environment of high-elevations can allow seeds to blow around to sometimes great distances." [This and other references refer to wind and gravity as the primary dispersal vectors of <i>Abies procera</i> ]
706	1993. Cope, A.B.. <i>Abies procera</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html">http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html</a>	[Propagules bird dispersed? No] "Seed dissemination requires wind action or other branch movement to disturb the cone [7,21]. Height growth is greatest in July [27]."
707	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Propagules dispersed by other animals (externally)? No evidence] "Noble fir seeds are not widely dispersed because of their weight, which averages 29,750 seeds per kilogram (13,500/lb) (25). Wind is the major agent of dispersal. Although the seeds can fly over 600 in (2,000 ft) (22), most actually fall within one or two tree heights of the seed trees (1)."
708	2012. WRA Specialist. Personal Communication.	[Propagules survive passage through the gut? Unknown] Consumption would likely result in seed predation, as seeds are not adapted for internal dispersal
801	2001. Vance, N.C./Borsting, M./Pilz, D./Freed, J.. Special forest products: species information guide for the Pacific Northwest. en. Tech. Rep. PNW-GTR-513. USDA, Forest Service, Pacific Northwest Research Station, Portland, OR	[Prolific seed production (>1000/m2)? Possibly No] "Seed: Trees begin producing cones after 20 years old. Seed quality is typically poor, with an average as low as 10 percent viable seeds."
801	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Prolific seed production (>1000/m2)? Possibly] "The current record of cone production is 3000 cones by a single tree in a single year and such a tree might produce up to 1,500,000 seeds. Although some seeds are generally produced each year, cycles of medium to good cone production occur at 3-4 (-6) year intervals. Seed viability is however, typically low, with results from one long-term study indicating a mean viability of only 10%. This may increase to 50%, but all values above 10% occurred in years that had high cone production."
802	1990. Burns, R.M./Honkala, B.H.. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Evidence that a persistent propagule bank is formed (>1 yr)? No. Not greater than 1 year] "Noble fir seeds are of transient viability under natural conditions, and most germinate in the first growing season after dispersal. They remain viable for only one season in the forest floor."
802	1993. Cope, A.B.. <i>Abies procera</i> . In: Fire Effects Information System, [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html">http://www.fs.fed.us/database/feis/plants/tree/abipro/all.html</a>	[Evidence that a persistent propagule bank is formed (>1 yr)? No. Not greater than 1 year] "Seeds usually germinate in the spring after they are shed [1,19]. Seeds remain viable for only 1 year."
802	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Evidence that a persistent propagule bank is formed (>1 yr)? No. Not greater than 1 year] "- Seed storage intermediate"
803	2012. WRA Specialist. Personal Communication.	[Well controlled by herbicides? Unknown] No evidence of herbicide efficacy or chemical control of this species
804	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Tolerates, or benefits from, mutilation, cultivation, or fire? Yes] "A. procera is easily killed by fire because of its thin bark and tendency to grow on slopes."
805	2012. WRA Specialist. Personal Communication.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown]

## **Summary of Risk Traits**

### **High Risk / Undesirable Traits**

- Naturalized in Great Britain
- Potentially allelopathic
- Possibly increased fire risks
- Tolerates many soil conditions (and potentially able to exploit many different habitat types)
- Forms dense thickets
- Hybridizes with other Abies species
- Self-compatible
- Wind-dispersed seeds

### **Low Risk / Desirable Traits**

- Despite ability to spread, no negative impacts have been documented
- Browsed by animals (which could limit its ability to spread)
- Non-toxic and non-allergenic
- Shade intolerant
- Long time to reproductive maturity (25+ years)
- Does not spread vegetatively
- Used for Christmas trees
- Large, wind-dispersed seeds unlikely to be inadvertently dispersed