

**Family:** *Pinaceae*

**Taxon:** *Abies fraseri*

**Synonym:** *Pinus fraseri* Pursh

**Common Name:** Fraser fir

Questionnaire :	current 20090513	Assessor:	Chuck Chimera	Designation:	EVALUATE
Status:	Assessor Approved	Data Entry Person:	Chuck Chimera	WRA Score	3
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)		
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)		n
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		
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		n
409	Is a shade tolerant plant at some stage of its life cycle		y=1, n=0		y
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	
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	y
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	
708	Propagules survive passage through the gut	y=1, n=-1	n
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	n
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)	y=-1, n=1	

Designation: EVALUATE

WRA Score 3

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**Supporting Data:**

101	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 the species highly domesticated? No evidence]
102	2012. WRA Specialist. Personal Communication.	NA
103	2012. WRA Specialist. Personal Communication.	NA
201	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.	[Species suited to tropical or subtropical climate(s) 0-Low] "Fraser fir has a disjunct distribution, restricted to high elevations in the southern Appalachian Mountains of southwestern Virginia, western North Carolina, and eastern Tennessee. Climate Fraser fir grows in a cold, moist climate characterized as a cool temperate (microthermal) rain forest with a well distributed mean annual precipitation of 1900 to 2540 mm (75 to 100 in) and average summer temperatures of 16° C (60° F) or less. Average annual temperature varies from 6° C (43° F) at the summit of Mount Mitchell in North Carolina to 9° C (48° F) at the 1524 m (5,000-ft) level in the Great Smoky Mountains National Park. At Mount Mitchell, average January-February temperature varies from 2° C (28° F) to -1° C (30° F), with 147 days below 0° C (32° F). Average July temperature is 15° C (59° F). The frost-free period is 130 to 140 days. Fog is a very important environmental factor, reducing transpiration and adding measurably to precipitation as fog drip (21). During the growing season, fog may be present on 65 percent or more of the days."
202	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.	[Quality of climate match data 2-High]
203	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Broad climate suitability (environmental versatility)? Yes] "- Altitude range: 550 - 2040 m - Mean annual rainfall: 1190 - 2410 mm - Rainfall regime: uniform - Mean annual temperature: 11 - 19°C - Mean maximum temperature of hottest month: 20 - 28°C - Mean minimum temperature of coldest month: -6 - -4°C - Absolute minimum temperature: > -30°C" [Elevation range within temperate climates exceeds 1000 m]
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] "Fraser fir has a disjunct distribution, restricted to high elevations in the southern Appalachian Mountains of southwestern Virginia, western North Carolina, and eastern Tennessee. Climate Fraser fir grows in a cold, moist climate characterized as a cool temperate (microthermal) rain forest with a well distributed mean annual precipitation of 1900 to 2540 mm (75 to 100 in) and average summer temperatures of 16° C (60° F) or less. Average annual temperature varies from 6° C (43° F) at the summit of Mount Mitchell in North Carolina to 9° C (48° F) at the 1524 m (5,000-ft) level in the Great Smoky Mountains National Park. At Mount Mitchell, average January-February temperature varies from 2° C (28° F) to -1° C (30° F), with 147 days below 0° C (32° F). Average July temperature is 15° C (59° F). The frost-free period is 130 to 140 days. Fog is a very important environmental factor, reducing transpiration and adding measurably to precipitation as fog drip (21). During the growing season, fog may be present on 65 percent or more of the days."
204	2007. Randall, R.P.. Global Compendium of Weeds - <i>Abies fraseri</i> . <a href="http://www.hear.org/gcw/species/abies_fraseri/">http://www.hear.org/gcw/species/abies_fraseri/</a>	[Native or naturalized in regions with tropical or subtropical climates? No evidence]
205	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Does the species have a history of repeated introductions outside its natural range? Yes] Widely planted within North America outside of its natural distribution
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? No evidence]
301	2012. DAISIE. Species Factsheet - <i>Abies fraseri</i> [Accessed 22 Aug 2012]. <a href="http://www.europe-alien.org/speciesFactsheet.do?speciesId=411#">http://www.europe-alien.org/speciesFactsheet.do?speciesId=411#</a>	[Naturalized beyond native range? Yes] "Alien/Established" [Estonia]

301	2012. Randall, R.P.. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	[Naturalized beyond native range? Yes] Europe
302	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Garden/amenity/disturbance weed? No evidence]
302	2007. Randall, R.P.. Global Compendium of Weeds - <i>Abies fraseri</i> . <a href="http://www.hear.org/gcw/species/abies_fraseri/">http://www.hear.org/gcw/species/abies_fraseri/</a>	[Garden/amenity/disturbance weed? Possibly] Listed as a weed of unspecified impacts
303	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions. 10: 321–331.	[Agricultural/forestry/horticultural weed? No evidence]
303	2007. Randall, R.P.. Global Compendium of Weeds - <i>Abies fraseri</i> . <a href="http://www.hear.org/gcw/species/abies_fraseri/">http://www.hear.org/gcw/species/abies_fraseri/</a>	[Agricultural/forestry/horticultural weed? 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? No evidence]
304	2007. Randall, R.P.. Global Compendium of Weeds - <i>Abies fraseri</i> . <a href="http://www.hear.org/gcw/species/abies_fraseri/">http://www.hear.org/gcw/species/abies_fraseri/</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: <i>Abies grandis</i> , <i>Abies procera</i> , " ... "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." ... " <i>Abies alba</i> (Great Britain; Ireland; New Zealand); <i>A. cephalonica</i> (Great Britain); <i>A. concolor</i> (USA (New England)); <i>A. grandis</i> (Great Britain, Ireland; Sweden); <i>A. nordmanniana</i> (Great Britain; New Zealand); <i>A. procera</i> (Great Britain); <i>A. sibirica</i> (Finland)"
305	2010. Poindexter, D.B.. <i>Abies firma</i> (Pinaceae) naturalize in North America. Phytoneuron. 41: 1–7.	[Congeneric weed> Potentially] "In North Carolina, <i>Abies firma</i> , an introduced fir from Japan, is reported as escaping and establishing for the first time in North America. Momi Fir is an infrequently introduced taxon that has been proposed as a highly suitable ornamental tree, particularly in the southeastern United States. This recent discovery of its ability to naturally produce viable progeny suggests that widespread horticultural use of this coniferous species needs further evaluation. A description and photographs are provided to aid in identification of this taxon."
401	1993. Sullivan, J.. <i>Abies fraseri</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Produces spines, thorns or burrs? No] "Fraser fir is a native, evergreen coniferous tree. It is small to medium sized; the largest on record is 87 feet (26.5 m) tall and 34 inches (86 cm) d.b.h. The usual range is from 50 to 60 feet (15-18 m) tall and less than 12 inches (30 cm) d.b.h. Average age at death is 150 years [2]."
402	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Allelopathic? Unknown] " <i>A. fraseri</i> grows in admixture with red spruce ( <i>Picea rubens</i> ) at elevations above 1370 m, but occurs in relatively pure stands above 1830 m. "
402	2012. WRA Specialist. Personal Communication.	[Allelopathic? Unknown]
403	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Parasitic? No] Pinaceae
404	1988. Conover, M.R./Kania, G.S.. Browsing Preference of White-Tailed Deer for Different Ornamental Species. Wildlife Society Bulletin. 16(2): 175-179.	[Unpalatable to grazing animals? Possibly] "Table 1. Shoots or leaves of ornamental plant species browsed by deer during winters of 1982-1984 at the Greenwich Landscaping Company, Greenwich, Connecticut" [ <i>Abies fraseri</i> - % browsed = 0; n = 7]

404	1991. Fargione, M.J./Curtis, P.O./Richmond, M.E.. Resistance of Woody Ornamental Plants to Deer Damage. Wildlife Damage Management Deer-resistant Ornamentals Fact Sheet. Cornell Cooperative Extension, Cornell University, Ithaca, NY	[Unpalatable to grazing animals? Not according to this reference] "Plants Frequently Severely Damaged" [List includes <i>Abies fraseri</i> . Contradicts other information which states this tree is less palatable to deer]
404	1993. Sullivan, J.. <i>Abies fraseri</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Unpalatable to grazing animals? Possibly unpalatable] "Compared with other species used as ornamentals, Fraser fir is ranked low in preference for white-tailed deer [6]."
404	2012. TreesForMe. Fraser Fir, <i>Abies fraseri</i> (Pursh) Poir [Accessed 21 Aug 2012]. <a href="http://www.treesforme.com/fraser_fir.html">http://www.treesforme.com/fraser_fir.html</a>	[Unpalatable to grazing animals? Less palatable than other species] "In areas with high populations of white tailed deer, <i>Abies fraseri</i> is less likely to be browsed as it is less palatable than other food sources and may offer a solution to those with deer related landscape issues."
405	2008. Wagstaff, D.J.. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	[Toxic to animals? No evidence]
405	2012. Specialized Information Services, U.S. National Library of Medicine. TOXNET toxicology data network [online database]. National Institutes of Health, <a href="http://toxnet.nlm.nih.gov/">http://toxnet.nlm.nih.gov/</a>	[Toxic to animals? No evidence]
406	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.	[Host for recognized pests and pathogens? Potentially Yes] "In Christmas tree plantations, two spotted spider mite ( <i>Tetranychus urticae</i> ) can be particularly damaging, causing discoloration and needle loss. On soils with poor internal drainage, root rot caused by the fungus <i>Phytophthora</i> spp. becomes a major problem. All damaging agents are insignificant in comparison to the balsam woolly adelgid ( <i>Adelges piceae</i> ). It was discovered in North Carolina in 1957 on Mount Mitchell and has since spread to all areas of Fraser fir (1,2,3,4,9,17,18). Mortality progressed rapidly from 11,000 trees in 1958 to about 1.75 million by 1970. Fir mortality has been extensive in all areas except Mount Rogers in Virginia, where infestations dating back to the mid-1960's were first discovered in 1979. Adelgids attack branches, twigs, nodes, and bud bases of fir, but stem attack is the predominant form of infestation. Death usually follows 2 to 5 years after infestation of the bole because of direct translocation impairment. Further damage by other organisms is associated with attack by the balsam woolly adelgid (11, 12). Weakened trees are often attacked by bark beetles, wood wasps, and other wood-boring insects, which also may introduce fungal pathogens (12). Incidence of root rot caused by <i>Armillaria mellea</i> was shown to increase with increasing severity of adelgid damage. Damaged and weakened trees are also more susceptible to windthrow and top breakage."
406	2012. Missouri Botanical Garden. <i>Abies fraseri</i> [Accessed 21 Aug 2012]. <a href="http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/c202/abies-fraseri.aspx">http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/c202/abies-fraseri.aspx</a>	[Host for recognized pests and pathogens?] "No serious insect or disease problems. Balsam woolly adelgid has been responsible for killing a number of trees in the wild. Additional insect pests include bark beetles, spruce budworms, aphids, bagworms and scale. Spider mites may occur in hot conditions. Disease problems include root rots, needle rust and twig blight Trees are generally intolerant of urban pollution."
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 evidence of toxicity]
407	2012. Pollen Library. Fir ( <i>Abies</i> ). IMS Health Inc., <a href="http://www.pollenlibrary.com/GENUS/Abies/">http://www.pollenlibrary.com/GENUS/Abies/</a>	[Causes allergies or is otherwise toxic to humans? No evidence] "Firs produce very large amounts of pollen annually in the spring and early summer, but have been reported to have little allergenic importance."
408	1993. Sullivan, J.. <i>Abies fraseri</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Creates a fire hazard in natural ecosystems? No evidence] "Fraser fir occurs in habitats that are rarely subject to wildfire. Anecdotal evidence suggests that forest fires often stop when they reach the spruce-fir forest boundary [26]. In the southern Appalachians, fuel moistures and humidity are usually high, and therefore fires are not intense or widespread [26,29]."

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? Yes, but growth is stunted] "Once established, growth is best in full light. Under a dense canopy, Fraser fir may be only 0.6 to 0.9 in (2 to 3 ft) tall in 20 years. In old-growth, all-aged stands, it may take 40 years to attain sapling size. In the absence of shade, it grows much faster." ... "Fraser fir is classified as very tolerant to shade and is considered a climax species. It becomes established and survives for many years under a dense canopy, growing only 2.5 to 5.1 cm (1 to 2 in) per year. When released, it has a marked capacity for recovery. Trees suppressed for 50 years or more have grown rapidly for a time after release (23)."
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] "There is considerable variation in color, depth, and organic matter content in the soils that support Fraser fir. A typical profile has well-developed organic and A1 horizons and a B horizon differentiated by color but not by accumulations of clay or iron. Soils are shallow and rocky, with bedrock within 50 to 80 cm (20 to 32 in) of the mineral soils surface (23). The upper 5 to 10 cm (2 to 4 in) of the mineral soil are typically black and greasy, underlaid by a leached gray or yellowish-brown sandy subsoil. Organic surface layers are occasionally thick but usually quite thin, ranging from 2 to 7 cm (0.8 to 2.8 in). The soils are extremely acid; the A horizon pH is about 3.5 and the B horizon pH 3.8 to 4.2. Soil under fir stands above 1920 m (6,300 ft) may be very shallow, with only 15 to 20 cm (6 to 8 in) of a black A horizon lying directly on bedrock (7). Most soils on which Fraser fir grows are Inceptisols."
410	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Tolerates a wide range of soil conditions? Yes] "Soil descriptors - Soil texture: light; medium - Soil drainage: free - Soil reaction: very acid; acid - Special soil tolerances: shallow; infertile - Soil types: acid soils; granite soils; gravelly soils; mountain soils; cambisols; ultisols"
411	1993. Sullivan, J.. <i>Abies fraseri</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Climbing or smothering growth habit? No] "Fraser fir is a native, evergreen coniferous tree. It is small to medium sized; the largest on record is 87 feet (26.5 m) tall and 34 inches (86 cm) d.b.h. The usual range is from 50 to 60 feet (15-18 m) tall and less than 12 inches (30 cm) d.b.h. Average age at death is 150 years [2]."
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, at high elevations] "At the highest elevations where fir forms essentially pure stands, it is most frequently 9 to 12 in (30 to 40 ft) tall, and most canopy stems are 18 to 23 cm (7 to 9 in) in d.b.h. Stems as large as 31 cm (12 in) in d.b.h. are very rare in such stands (31)." ... "Fraser fir tends to form very dense stands which thin slowly and may stagnate in the pole stage (7)."
412	2009. Eckenwalder, J.E.. Conifers of the world: the complete reference. Timber Press, Portland, OR	[Forms dense thickets? Yes] "Forming pure stands or mixed with red spruce ( <i>Picea rubens</i> ) or other conifers and hardwoods on the wet subalpine zone; (1,200-)1,500-2,050 m."
501	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.	[Aquatic? No] "Fraser fir ( <i>Abies fraseri</i> ), also called southern balsam fir and she-balsam, is a small- to medium-size tree. It is the only fir endemic to the southern Appalachian Mountains. The largest tree on record measures almost 86 cm (34 in) in d.b.h., 26.5 m (87 ft) tall, and has a crown spread of 15.8 m (52 ft). Because of the high elevation at which Fraser fir grows, its primary value is for watershed protection and scenic attraction."
502	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Grass? No] Pinaceae
503	2012. USDA ARS National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). <a href="http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl">http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl</a>	[Nitrogen fixing woody plant? No] Pinaceae
504	1993. Sullivan, J.. <i>Abies fraseri</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)? No] "Fraser fir is a native, evergreen coniferous tree. It is small to medium sized; the largest on record is 87 feet (26.5 m) tall and 34 inches (86 cm) d.b.h. The usual range is from 50 to 60 feet (15-18 m) tall and less than 12 inches (30 cm) d.b.h. Average age at death is 150 years [2]."

601	1993. Sullivan, J.. <i>Abies fraseri</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Evidence of substantial reproductive failure in native habitat? Potentially Yes] "The worst problem, however, is the introduced balsam woolly adelgid, which weakens trees and makes them more susceptible to attack by other agents [2]. Infestation by balsam woolly adelgid was first noted in North Carolina in 1957. Extensive mortality caused by balsam woolly adelgid infestations has been noted since the 1960's; a large number of mature Fraser fir have died as a result of this infestation. Many seedlings and saplings have been killed or growth suppressed [10], although young Fraser fir have not been found to support reproducing adults (early instar stages only) [22]. Dominance of red spruce and birch ( <i>Betula</i> spp.) increases in spruce-fir stands in North Carolina that have been damaged by this pest [8]. The continuing presence of Fraser fir in natural forests will depend on a complex of survival, growth, and new reproduction. Current seedlings will need to survive infestations, compete with a dense understory of smooth blackberry, and reach reproductive age and height. At present, seedlings are infested but appear to be overcoming the effects. Smooth blackberry reduces the early survival of Fraser fir seedlings, and decreases the number of suitable microsites for seedling establishment [22]."
601	2012. Berry, Z.C./Smith, W.K.. Cloud pattern and water relations in <i>Picea rubens</i> and <i>Abies fraseri</i> , southern Appalachian Mountains, USA. <i>Agricultural and Forest Meteorology</i> . 162– 163: 27-34.	[Evidence of substantial reproductive failure in native habitat? Potentially Yes] "It has been estimated that the balsam woolly adelgid has killed between 40 and 90% of mature <i>A. fraseri</i> since the 1950s and regeneration of mature spruce-fir forest is still uncertain (Eagar, 1984; Pauley and Clebsch, 1990; Nicholas et al., 1992)."
602	1990. Burns, R.M./Honkala, B.H.. <i>Silvics of North America</i> . Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Produces viable seed? Yes] "Seed Production and Dissemination- Seed production may begin when trees are 15 years old. Good seed crops occur every other year with light crops in the intervening year. The number of seeds ranges from 119,000 to 174,000/kg (54,000 to 79,000/lb) and averages 134,500 (61,000). The combination of lightweight winged seeds, steep slopes, and high winds makes for good seed dispersal. Seeds may be moved as much as 1.6 km (1 mi), with 50 percent falling over 274 m (900 ft) from their source. Fruit ripens and is dispersed from September through mid October."
602	1993. Sullivan, J.. <i>Abies fraseri</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Produces viable seed? Yes] "Sexual reproduction: Seed production in Fraser fir begins at about 15 years of age. Good seed crops are produced every other year, with light crops in intervening years. "
603	1990. Burns, R.M./Honkala, B.H.. <i>Silvics of North America</i> . Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Hybridizes naturally? Possibly. Artificial hybrids are possible] "Artificial crosses of <i>Abies balsamea</i> x <i>A. fraseri</i> have been made successfully. A cultivar, <i>A. fraseri</i> cv. <i>prostrata</i> , is a dwarf shrub with horizontally spreading branches used for ornamental purposes (18)."
603	1993. Sullivan, J.. <i>Abies fraseri</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Hybridizes naturally? Possibly Yes] "Fir trees in Virginia and West Virginia are intermediate between balsam fir and Fraser fir; the putative hybrid is recognized as <i>Abies</i> x <i>phanerolepis</i> (Fern.) Liu (synonymous with <i>Abies intermedia</i> Full.) [18,20]."
603	2012. Plants for a Future Database. <i>Abies fraseri</i> [Accessed 21 Aug 2012]. <a href="http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+fraseri">http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+fraseri</a>	[Hybridizes naturally? Yes] "They hybridize freely with other members of this genus[200]."
604	1990. Burns, R.M./Honkala, B.H.. <i>Silvics of North America</i> . Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC.	[Self-compatible or apomictic?] "Fraser fir is monoecious. Flower buds usually open from mid-May to early June. Female flowers are borne mostly in the top few feet of the crown and on the outer ends of branches. Male flowers are borne below female flowers, but mostly in the top half of the crown. The fruit is an erect cone, 3.5 to 6 cm (1.4 to 2.4 in) long and 2.5 to 4 cm (1.0 to 1.6 in) wide. The strongly reflexed bracts, much longer than the scales, distinguish Fraser fir from balsam fir."
604	2012. Plants for a Future Database. <i>Abies fraseri</i> [Accessed 21 Aug 2012]. <a href="http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+fraseri">http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+fraseri</a>	[Self-compatible or apomictic? Yes, but performance is of seedlings is poor] "Plants are strongly outbreeding, self fertilized seed usually grows poorly[200]."
605	1990. Burns, R.M./Honkala, B.H.. <i>Silvics of North America</i> . 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."

605	2012. Plants for a Future Database. <i>Abies fraseri</i> [Accessed 21 Aug 2012]. <a href="http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+fraseri">http://www.pfaf.org/user/Plant.aspx?LatinName=Abies+fraseri</a>	[Requires specialist pollinators? No] "The flowers are monoecious (individual flowers are either male or female, but both sexes can be found on the same plant) and are pollinated by Wind."
606	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.	[Reproduction by vegetative fragmentation? Yes] "Vegetative Reproduction- Under natural conditions, layering may occur when lower branches come in contact with moist soil, but it is not an important reproductive mechanism."
606	2005. CAB International. <i>Forestry Compendium.</i> CAB International, Wallingford, UK	[Reproduction by vegetative fragmentation? Yes] "- Ability to sucker"
607	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.	[Minimum generative time (years)? 15+] "Seed production may begin when trees are 15 years old."
701	2009. Eckenwalder, J.E.. <i>Conifers of the world: the complete reference.</i> Timber Press, Portland, OR	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? Unlikely] "seed body 4-6 mm long, the wing about as long." [Seeds adapted for wind dispersal, and lack means of external attachment]
702	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.	[Propagules dispersed intentionally by people? Yes] "Growing and harvesting this species for Christmas trees and boughs is a multimillion dollar business in the southern Appalachians. Because of its thick green foliage, beautiful shape, fragrance, and needles that are retained unusually well, Fraser fir is unequaled as a Christmas tree (29,32). It is also used widely as an ornamental yard tree."
702	2012. Missouri Botanical Garden. <i>Abies fraseri</i> [Accessed 21 Aug 2012]. <a href="http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/c202/abies-fraseri.aspx">http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/plant-finder/plant-details/kc/c202/abies-fraseri.aspx</a>	[Propagules dispersed intentionally by people? Yes] "Specimen fir for the landscape. Ornamental yard tree. Popular commercially grown Christmas tree."
703	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.	[Propagules likely to disperse as a produce contaminant? Unlikely] "Seed production may begin when trees are 15 years old." [Grown commercially for Christmas tree production, but long time to maturity and relatively large seeds make inadvertent contamination of other agricultural crops or products unlikely]
704	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.	[Propagules adapted to wind dispersal? Yes] "The combination of lightweight winged seeds, steep slopes, and high winds makes for good seed dispersal. Seeds may be moved as much as 1.6 km (1 mi), with 50 percent falling over 274 m (900 ft) from their source."
705	1993. Sullivan, J.. <i>Abies fraseri.</i> In: <i>Fire Effects Information System.</i> [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Propagules water dispersed? No evidence] "Seeds are wind dispersed, with 50 percent falling at least 900 feet (274 m) from the source; seeds can be carried up to 1 mile (1.6 km) from the source [2]."
706	1993. Sullivan, J.. <i>Abies fraseri.</i> In: <i>Fire Effects Information System.</i> [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Propagules bird dispersed? No evidence] "Seeds are wind dispersed, with 50 percent falling at least 900 feet (274 m) from the source; seeds can be carried up to 1 mile (1.6 km) from the source [2]."
707	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.	[Propagules dispersed by other animals (externally)? Unknown, but Possibly] "Fraser fir seeds and terminal buds are eaten extensively by the red squirrel." [Seeds likely to be consumed by animals that are predators, rather than dispersers. Related species have seed that are presumably moved by seed caching rodents. Introduced <i>Rattus</i> species may serve a similar role in the Hawaiian Islands]
708	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.	[Propagules survive passage through the gut? No evidence] "Fraser fir seeds and terminal buds are eaten extensively by the red squirrel." [Seeds likely to be consumed by animals that are predators, rather than dispersers]
801	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.	[Prolific seed production (>1000/m <sup>2</sup> )? Potentially] "Seed production may begin when trees are 15 years old. Good seed crops occur every other year with light crops in the intervening year. The number of seeds ranges from 119,000 to 174,000/kg (54,000 to 79,000/lb) and averages 134,500 (61,000)."



802	1990. Pauley, E.F./Clebsch, E.E.C.. Patterns of <i>Abies fraseri</i> Regeneration in a Great Smoky Mountains Spruce-Fir Forest. Bulletin of the Torrey Botanical Club. 117(4): 375-381.	[Evidence that a persistent propagule bank is formed (>1 yr)? No evidence] "The near absence of germinal seedlings on Mt. Collins suggested that conditions for germination have not been suitable or that <i>Abies</i> has not maintained a significant seed bank. <i>Abies</i> establishment has been found to be quite sensitive to recent seed production (Sullivan and Pittillo 1988)."
803	2012. WRA Specialist. Personal Communication.	[Well controlled by herbicides? Unknown] No evidence of herbicide efficacy or chemical control of this species
804	1993. Sullivan, J.. <i>Abies fraseri</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> [2012, August 20]	[Tolerates, or benefits from, mutilation, cultivation, or fire? No] "-Fraser fir is probably easily killed by fire [9]. No specific information on the intensity of fire needed to kill Fraser fir is available."
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 Europe
- Elevation range exceeds 1000 m (environmental versatility)
- Possibly unpalatable
- Shade tolerant (could invade forest understory)
- Tolerates many soil conditions (and potentially able to exploit many different habitat types)
- Forms pure stands in native range
- Hybridizes with other *Abies* species
- Self-compatible (but with limited seed set)
- May sucker or spread vegetatively
- Winged seeds dispersed by wind

### Low Risk / Desirable Traits

- No negative impacts or reports of invasiveness have been documented
- Unarmed (no spines, thorns or burrs)
- Non-toxic
- Landscaping and ornamental value (Christmas Trees)
- Will not increase fire hazards or risks
- Long time to reproductive maturity (15+ years)
- Wind-dispersed seeds unlikely to be accidentally dispersed by other means
- Will not form a persistent soil seed bank