

<b>Taxon:</b> <i>Abies concolor</i>	<b>Family:</b> Pinaceae
<b>Common Name(s):</b> Colorado fir Colorado white fir silver fir white fir	<b>Synonym(s):</b> <i>A. concolor</i> f. <i>violacea</i> (A. Murray) <i>A. concolor</i> f. <i>wattezii</i> (Beissn.) <i>Picea concolor</i> Gordon

<b>Assessor:</b> Chuck Chimera	<b>Status:</b> Assessor Approved	<b>End Date:</b> 16 Jan 2015
<b>WRA Score:</b> 1.0	<b>Designation:</b> EVALUATE	<b>Rating:</b> Evaluate

**Keywords:** Naturalized, Christmas Tree, Dense Stands, Shade-Tolerant, Wind-Dispersed

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
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)	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		
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		
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	y

Qsn #	Question	Answer Option	Answer
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	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally	y=1, n=-1	y
604	Self-compatible or apomictic		
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)		
708	Propagules survive passage through the gut		
801	Prolific seed production (>1000/m <sup>2</sup> )	y=1, n=-1	n
802	Evidence that a persistent propagule bank is formed (>1 yr)	y=1, n=-1	n
803	Well controlled by herbicides		
804	Tolerates, or benefits from, mutilation, cultivation, or fire		
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

**Supporting Data:**

Qsn #	Question	Answer
101	Is the species highly domesticated?	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[No evidence] "A. concolor consists of two distinct and geographically separated varieties. The variety concolor is found to the east on isolated ranges in the Great Basin and widely in the central and southern Rocky Mountains, and var. lowiana extends over the western half of the species range in California and southern Oregon. Some recent authorities treat the latter as a distinct species, A. lowiana (Earle, 1999)."
102	Has the species become naturalized where grown?	
	Source(s)	Notes
	WRA Specialist. 2015. Personal Communication	NA
103	Does the species have weedy races?	
	Source(s)	Notes
	WRA Specialist. 2015. Personal Communication	NA
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	Low
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The natural range of A. concolor extends from the Cascade Range and coast ranges of southern Oregon south into California through the Siskiyou Mountains to the Sierra Nevada, southern California mountains and Sierra San Pedro Martir of Baja California. It has scattered disjunct populations in mountain ranges of the eastern Mojave Desert and Great Basin, and then becomes common in the central and southern Rocky Mountains, including extreme southeastern Idaho, Utah, southern Colorado, Arizona, New Mexico, and into northern Mexico."
202	Quality of climate match data	High
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	
203	Broad climate suitability (environmental versatility)	y
	Source(s)	Notes

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	<p>Climatic amplitude (estimates)</p> <ul style="list-style-type: none"> <li>- Altitude range: 600 - 3400 m</li> <li>- Mean annual rainfall: 500 - 1900 mm</li> <li>- Rainfall regime: summer; winter</li> <li>- Dry season duration: 3 - 5 months</li> <li>- Mean annual temperature: 4 - 16°C</li> <li>- Mean maximum temperature of hottest month: 25 - 30°C</li> <li>- Mean minimum temperature of coldest month: 20 - 0°C</li> <li>- Absolute minimum temperature: &gt; -30°C</li> </ul> <p>"Altitudinal ranges increase from north to south in response to temperature conditions. The lowest altitude at which it is found is about 600 m in central Oregon. <i>A. concolor</i> in the Sierra Nevada is generally found from 1200-2200 m, but it occurs at 3000 m in the San Bernardino Mountains of southern California. In the Rocky Mountains <i>A. concolor</i> is most common at 2100 2700 m, but reaches as high as 3400 in central Colorado." [Elevation range within temperate climates exceeds 1000 m]</p>

204	Native or naturalized in regions with tropical or subtropical climates	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The natural range of <i>A. concolor</i> is characterized by long, cold winters with moderate to heavy snowpacks and short growing seasons. Summer temperatures are moderate, reaching highs of 30-35°C. Winter low temperatures vary greatly over the range of the species from moderate in the Sierra Nevada and northern California to extremely low in the Rocky Mountains. The precipitation regime in California and Oregon is largely winter rain, with a mean annual range of about 900-1300 mm in the Sierra Nevada (mostly falling as snow), and up to 1900 mm in northern California. The majority of rainfall in this region occurs from October to March, with 3-5 months of summer drought. Years with low rainfall are often correlated with high growth rates, apparently because of early snow melt and thus a longer growing season. Rocky Mountain populations of <i>A. concolor</i> receive 500-900 mm of annual rainfall, with much of this falling in the summer."

205	Does the species have a history of repeated introductions outside its natural range?	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>A. concolor</i> has been widely planted outside its natural range, particularly in Europe. In England its use is largely decorative, but it has been tried in plantation forestry in other areas (Dallimore and Jackson, 1966)."

301	Naturalized beyond native range	y
	Source(s)	Notes

Qsn #	Question	Answer
	Nielsen, H., & Leverenz, J. W. 2002. Escaping, naturalized and native woody plant taxa around the Arboretum in Hørsholm. Dansk Dendrologisk Forenings Årsskrift 20: 39-59	"2 B. Woody taxa, which might be escapes near the Arboretum" [Abies concolor - notes = unconfirmed]
	Haines, A. 2011. New England Wild Flower Society's Flora Novae Angliae: A Manual for the Identification of Native and Naturalized Higher Vascular Plants of New England. Yale University Press, Yale, CT	"Abies concolor" ... "MA, ME, VT. Forests and thickets, often in areas of human habitation, though sometimes seen in remote areas (e.g. coastal islands of ME)."
	Richardson, D. M., & Rejmánek, M. 2004. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions, 10(5-6): 321-331	"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." [A. concolor (USA (New England)) - naturalized]

302	Garden/amenity/disturbance weed	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence
	Richardson, D. M., & Rejmánek, M. 2004. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions, 10(5-6): 321-331	No evidence

303	Agricultural/forestry/horticultural weed	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence
	Richardson, D. M., & Rejmánek, M. 2004. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions, 10(5-6): 321-331	No evidence

304	Environmental weed	n
	Source(s)	Notes
	Randall, R.P. 2012. A Global Compendium of Weeds. 2nd Edition. Department of Agriculture and Food, Western Australia	No evidence
	Richardson, D. M., & Rejmánek, M. 2004. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions, 10(5-6): 321-331	No evidence

305	Congeneric weed	y
	Source(s)	Notes

Qsn #	Question	Answer
	Richardson, D. M., & Rejmánek, M. 2004. Conifers as invasive aliens: a global survey and predictive framework. Diversity and Distributions, 10(5-6): 321-331	"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)"
	Poindexter, D.B. 2010. <i>Abies firma</i> (Pinaceae) naturalize in North America. Phytoneuron 41: 1–7	[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	Produces spines, thorns or burrs	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[No evidence] " <i>A. concolor</i> is a large forest tree, commonly reaching a height of 40-55 m, occasionally taller. Mature trees may have a d.b.h. of 100 to 160 cm, and may reach as much as 270 cm. Stem form: Canopy growth form of <i>A. concolor</i> is conical in younger trees, with numerous horizontal tiers of branches. Mature trees form a more cylindrical crown with a rounded top."

402	Allelopathic	
	Source(s)	Notes
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 16 Jan 2015]	[No evidence of allelopathy. This report documents allelopathic effects against <i>A. concolor</i> ] "Botanical associates of white fir that may affect its growth include snowbrush ceanothus, which contains allelopathic chemicals in its foliage that suppress radicle growth of white fir [66,178]. Mycorrhizal associations are thought to protect white fir roots from allelopathic chemicals produced by bracken fern [178]. "
	Rice, E.L. 1974. Allelopathy. Academic Press, New York, NY	[Possibly] "Grodzinsky and Gaidamak (1971) observed that concentric zones of specific herbs are formed around scattered trees of <i>Pinus silvestris</i> , <i>P. strobus</i> , <i>Picea excels</i> , <i>Larix decidua</i> , <i>Thuja occidentalis</i> , <i>T. plicata</i> , and <i>Abies concolor</i> in parks in the Kiev and Chernigov regions of the U.S.S. R. They suspected that allelopathy was responsible for the patterns, and tests of aqueous extracts of the soil confirmed their suspicion."

403	Parasitic	n
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Qsn #	Question	Answer
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"A. concolor is a large forest tree, commonly reaching a height of 40-55 m, occasionally taller." [Pinaceae]

404	Unpalatable to grazing animals	n
	Source(s)	Notes
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC	"Spring browsing of succulent growth by deer and other big game animals can retard height growth for many years. Normally, trees are not killed, and most can grow rapidly once browsing pressure is removed. In managed stands, however, reduced height growth can result in significant economic loss. Damage by big game can be severe in the Southwest. Damage from livestock grazing is limited primarily to trampling and appears to be decreasing as the number of cattle on the open range decreases (37)."
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 16 Jan 2015]	[Low palatability] "Because they contain resins, terpenes, and other substances that make the foliage irritating to the digestive tract, most conifers are not particularly palatable to grazing animals. White fir may be slightly palatable to goats [267]. Immature foliage is enjoyed by mule and black-tailed deer [119,189]."

405	Toxic to animals	n
	Source(s)	Notes
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 16 Jan 2015]	[No evidence. Browsed by a number of animals] "Mule and black-tailed deer generally eat small amounts of white fir during the spring, fall, and winter, and sometimes larger amounts during the summer [152,177,189]. Mule deer are especially fond of succulent, new white fir growth in the spring [114,178,185]. Spring browsing of white fir by deer can be particularly heavy when small white firs are the only green food available; all of the current or previous year's growth may be consumed [119]. Porcupines enjoy the bark of white fir, and may destroy saplings in their enthusiasm [138,185,201]. Rodents feed on the cambial tissue of white fir in preference to that of Douglas-fir. During the winter, mice feed on the leaders of small white firs near snow level. In the spring, they feed on seedlings, sometimes destroying a large proportion of the current year's seedlings [138,201]. Pocket gophers also feed on white fir seedlings in the winter and spring [157,178]. White fir needles are an important part of the diet of blue grouse [127,197]."

406	Host for recognized pests and pathogens	
	Source(s)	Notes

Qsn #	Question	Answer
	<p>CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK</p>	<p>[Potentially] "Insect pests The most damaging insect pest on <i>A. concolor</i> is the fir engraver, <i>Scolytus ventralis</i>. This bark beetle causes severe damage throughout the range of the species, with severe tree losses under epidemic conditions. The susceptibility of <i>A. concolor</i> to attack from fir engraver is increased significantly by any conditions that reduce tree vigour. Such conditions include Annosus root disease (<i>Heterobasidion annosum</i>), mistletoe infestation (<i>Phoradendron bolleanum</i> subsp. <i>pauciflorum</i> and <i>Arceuthobium abietinum</i> var. <i>concoloris</i>), and <i>Cytospora</i> canker (<i>Valsa abietis</i>), as well as drought stress, fire damage and overstocking. Other species of bark beetle (<i>Scolytus</i>) and one species of <i>Pseudohylesinus</i> may also attack <i>A. concolor</i>, as can the round-headed fir borer (<i>Tetropium abietis</i>), and the flat-headed fir borer (<i>Melanophila drummondi</i>). The maintenance of stand health and vigour is the only effective control for fir engraver damage (Furniss and Carolin, 1977). The Douglas-fir tussock moth, <i>Orgyia pseudotsugata</i>, is an extremely destructive defoliator of <i>A. concolor</i>, as well as <i>Pseudotsuga menziesii</i> and <i>Abies grandis</i>. Annual insect monitoring programmes and the development of microbial herbicides can be effective in mitigating damage from outbreaks (Mason and Wickman, 1991). Thinned commercial stands of <i>A. concolor</i> have been shown to recover more rapidly after an outbreak of Douglas-fir tussock moth than unthinned stands (Wickman, 1986, 1988). Another potentially destructive defoliator of <i>A. concolor</i> is the western spruce bud worm (<i>Choristoneura occidentalis</i>). Most outbreaks are short-lived, but some continue for up to 20 years and cause extensive mortality over large areas (Furniss and Carolin, 1977). The white fir needleminer (<i>Epinotia meritana</i>) may also be a significant foliage feeder on <i>A. concolor</i>. A diverse assemblage of phytophagous insects are associated with white fir cones in natural stands. Seed miners are the major cause of damage to seeds, periodically causing major damage. Fungal diseases Root rot from <i>Heterobasidion annosum</i> is present in all stands and spreads from tree to tree from disease pockets by root contact. This root rot only rarely kills <i>A. concolor</i> directly, but damage to roots increases water stress and reduces tree vigour and thus increases susceptibility to bark beetle infection. However, major damage to root systems and basal trunk areas may also increase the susceptibility of white fir trees to windthrow and stem breakage (Bega, 1978). The use of borax on freshly cut stumps provides some degree of control. Other heart rots of significance in losses of older growth trees include yellow cap fungus (<i>Pholiota limbonella</i>), Indian paint fungus (<i>Echinodontium tinctorium</i>), and white pocket rot (<i>Phellinus pini</i>)."</p>



Qsn #	Question	Answer
407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	Notes
	Pollen Library. 2015. White Fir ( <i>Abies concolor</i> ). <a href="http://www.pollenlibrary.com/Specie/Abies+concolor/">http://www.pollenlibrary.com/Specie/Abies+concolor/</a> . [Accessed 16 Jan 2015]	"Allergenicity: No allergy has been reported for White Fir ( <i>Abies concolor</i> ) species."
	Wagstaff, D.J. 2008. International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence

408	Creates a fire hazard in natural ecosystems	y
	Source(s)	Notes
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 16 Jan 2015]	"White fir seedlings, saplings and poles are thin-barked and resin blistered and are highly susceptible to fire damage and kill [178]. Additionally, young trees have low-growing branches that can easily ignite from burning undergrowth, providing a fuel ladder into the crown. Consequently, young white fir are usually killed by even low-intensity, surface fires [29,168,303]. As trees mature and bark thickens, and some self-pruning of lower branches occurs, they become more resistant to fire [345]. However, the tendency to retain some low branches, the moderately shallow roots, and heavy lichen growth on the branches of white fir make it only moderately fire resistant [55]. In larger trees, mortality results from crown scorch, girdled stems from cambial heating, or damage to moderately shallow roots from soil heating [303,328]."

409	Is a shade tolerant plant at some stage of its life cycle	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>A. concolor</i> is relatively shade- and drought- tolerant and reproduces well, and in the absence of frequent ground fires it increases its dominance in lower montane forests." ... "Although saplings are highly shade tolerant, they respond to release from suppression by rapid growth. This shade tolerance makes uneven stand management also possible but less productive."
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC	"In general, white fir becomes established best in partial shade, but once established grows best in full sunlight. It is less tolerant of shade than associated true firs (except red fir), is slightly more tolerant than Douglas-fir, and is much more tolerant than pines or oaks (37,41,56). Because white fir can survive and grow beneath heavy brush cover and eventually overtop the brush and dominate the site, many pure stands exist in otherwise mixed conifer areas (36)."
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 16 Jan 2015]	"White fir is an aggressive, shade-tolerant species that will seed into the understory of low-elevation ponderosa or Jeffrey pine stands or into mixtures of ponderosa pine, Douglas-fir, quaking aspen, and southwestern white pine [185]."

Qsn #	Question	Answer
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"A. concolor grows in montane habitats on a variety of soil types derived from a wide range of parent materials. These parent materials include granite, igneous, metamorphic, and sedimentary rock, including sandstone, shale and limestone. Unusual substrates include Pleistocene unconsolidated lakebeds and serpentines (Alexander, 1974; Laacke, 1990). Soils include those classified as Inceptisols, Alfisols Entisols, and Ultisols. The ecological range of A. concolor is thus more dependent on soil moisture conditions and temperature regimes than on soil pH or nutrient availability. Growth and development of A. concolor is best on moderately deep and well-drained sandy-loam to clay-loam soils. Higher altitude stands respond strongly to nitrogen fertilization."
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC	"White fir is generally tolerant of a wide range of soil conditions, nutrient availability, and pH values. It seems to be more dependent on moisture availability and temperature than on soil series."

411	Climbing or smothering growth habit	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"A. concolor is a large forest tree, commonly reaching a height of 40-55 m, occasionally taller."

412	Forms dense thickets	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[High elevations within native range] "A. concolor is an important forest tree that forms stand dominants over large areas of montane forest habitats in the Sierra Nevada, Cascade Range, and Siskiyou Mountains of California and southern Oregon and eastward into the central and southern Rocky Mountains." ... "The establishment of fairly pure stands of A. concolor is relatively easy in its natural range through either natural or artificial regeneration following logging."

501	Aquatic	n
	Source(s)	Notes
	Burns, R.M. & Honkala, B.H. 1990. Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC	[Terrestrial] "The species grows on various types of terrain, including the extremely steep and unstable slopes of the geologically young Coast Ranges in northwestern California. It develops best on gentle slopes and level ground."

Qsn #	Question	Answer
502	Grass	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	Pinaceae
503	Nitrogen fixing woody plant	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	Pinaceae
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"A. concolor is a large forest tree, commonly reaching a height of 40-55 m, occasionally taller. Mature trees may have a d.b.h. of 100 to 160 cm, and may reach as much as 270 cm."
601	Evidence of substantial reproductive failure in native habitat	n
	Source(s)	Notes
	Farjon, A. 2013. <i>Abies concolor</i> . The IUCN Red List of Threatened Species. Version 2014.3. <a href="http://www.iucnredlist.org">www.iucnredlist.org</a>	" <i>Abies concolor</i> is an extremely widespread species that occurs in numerous locations throughout much of the mountainous western North America and, more scattered, into Mexico. Whilst undoubtedly logged in past and present, this has little impact on the total population. It is therefore assessed as Least Concern."
	Burns, R.M. & Honkala, B.H. 1990. <i>Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654.</i> U.S. Department of Agriculture, Forest Service, Washington, DC	"Seed Production and Dissemination- Studies of white fir seed and cone production in Oregon, California, and the Rocky Mountains indicate that heavy crops are borne on a 3- to 9-year cycle (25,29,37). Adequate to good crops are produced more often, generally every 2 to 5 years. On extreme sites, cone production patterns may be different."
602	Produces viable seed	y
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The vegetative and reproductive growth phenology of <i>A. concolor</i> varies between populations in relation to latitude and altitude. Male cones reach maturity and shed pollen generally in May to June, although this may occur as late as July in high altitude populations. Female cones mature in late summer, and seeds are commonly dispersed from September to October. Adequate to good cone crops occur every 2-5 years and large crops occur at intervals up to 9 years."
603	Hybridizes naturally	y

Qsn #	Question	Answer
	<b>Source(s)</b>	<b>Notes</b>
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 15 Jan 2015]	"California white fir naturally hybridizes with grand fir ( <i>Abies grandis</i> ) in a belt extending from north-west California, across Oregon, and into central Idaho [146,178,186,347,348,349]. Under controlled conditions, white fir has successfully been crossed with other firs. Fertile hybrids were produced with the following crosses [278,283]: <i>Abies concolor</i> var. <i>lowiana</i> X <i>Abies grandis</i> <i>Abies concolor</i> var. <i>concolor</i> X <i>Abies religiosa</i> "
	Burns, R.M. & Honkala, B.H. 1990. <i>Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654.</i> U.S. Department of Agriculture, Forest Service, Washington, DC	"Interspecific crossbreeding is reasonably easy between fir species within the same group (e.g., <i>A. concolor</i> and <i>A. grandis</i> within Section <i>Grandes</i> ), but difficult to impossible between sections (15,35,55). In the northern portion of its range, California white fir intergrades and hybridizes freely with grand fir, both being in the Section or group <i>Grandes</i> (15). The species are morphologically, ecologically, and chemically distinct (20,31). They differ in stomatal number and reaction to moisture stress (63)."

604	Self-compatible or apomictic	
	<b>Source(s)</b>	<b>Notes</b>
	Burns, R.M. & Honkala, B.H. 1990. <i>Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654.</i> U.S. Department of Agriculture, Forest Service, Washington, DC	"White fir is monoecious. The reddish male strobili (cones) are generally less than 1.6 cm (0.6 in) long and are densely grouped on the underside of 1-year-old twigs about midcrown. Female cones are borne erect on 1-year-old branches, usually in the uppermost crown although both male and female cones are occasionally found on the same branch. California white fir flowers in May or June and fertilization occurs shortly thereafter."
	Bonner, F.T. & Karrfalt, R.P. (eds.). 2008. <i>The Woody Plant Seed Manual. USDA FS Agriculture Handbook 727.</i> Government Printing Office, Washington, D.C.	[Unknown. Other species are self-fertile] "As in noble fir in North America, relative self-fertility of European silver fir in Germany is very high (0.72) (Moulalis 1986)."

605	Requires specialist pollinators	n
	<b>Source(s)</b>	<b>Notes</b>
	Burns, R.M. & Honkala, B.H. 1990. <i>Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654.</i> U.S. Department of Agriculture, Forest Service, Washington, DC	"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	Reproduction by vegetative fragmentation	n
	<b>Source(s)</b>	<b>Notes</b>
	CAB International, 2005. <i>Forestry Compendium.</i> CAB International, Wallingford, UK	" <i>A. concolor</i> does not reproduce vegetatively by either sprouting or layering under natural conditions. Vegetative propagation from cuttings from juvenile trees is relatively easy, however, with or without the use of growth hormones."

Qsn #	Question	Answer
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 15 Jan 2015]	"White fir reproduction is by seed, and it shows no tendency to reproduce by sprouting or layering."

607	<b>Minimum generative time (years)</b>	>3
	<b>Source(s)</b>	<b>Notes</b>
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[40+ years] "Trees first produce cones at about about age 40 years; cone production continues in trees to at least 300 years old."

701	<b>Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The cylindrical female cones of <i>A. concolor</i> are 6-13 cm in length, and 3-5 cm wide. They are greenish violet-purple when growing and brown when mature. As with other firs, the cone scales dehisce while still attached to the branches, shedding the wind-dispersed seeds. The seeds are about 15-20 mm in length, with a single broad wing." [No evidence, and unlikely as seeds lack means of external attachment]

702	<b>Propagules dispersed intentionally by people</b>	y
	<b>Source(s)</b>	<b>Notes</b>
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	" <i>A. concolor</i> has been widely planted outside its natural range, particularly in Europe. In England its use is largely decorative, but it has been tried in plantation forestry in other areas (Dallimore and Jackson, 1966)." ... "In California, young <i>A. concolor</i> are widely harvested from both plantations and natural regeneration for sale as Christmas trees."

703	<b>Propagules likely to disperse as a produce contaminant</b>	n
	<b>Source(s)</b>	<b>Notes</b>
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The cylindrical female cones of <i>A. concolor</i> are 6-13 cm in length, and 3-5 cm wide. They are greenish violet-purple when growing and brown when mature. As with other firs, the cone scales dehisce while still attached to the branches, shedding the wind-dispersed seeds. The seeds are about 15-20 mm in length, with a single broad wing." ... "Trees first produce cones at about about age 40 years;" [Unlikely. Trees grown commercially for Christmas trees would be harvested long before reproductive maturity was reached]

704	<b>Propagules adapted to wind dispersal</b>	y
	<b>Source(s)</b>	<b>Notes</b>

Qsn #	Question	Answer
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"The cylindrical female cones of <i>A. concolor</i> are 6-13 cm in length, and 3-5 cm wide. They are greenish violet-purple when growing and brown when mature. As with other firs, the cone scales dehisce while still attached to the branches, shedding the wind-dispersed seeds. The seeds are about 15-20 mm in length, with a single broad wing.."

705	Propagules water dispersed	n
	Source(s)	Notes
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed ]	"Seed dispersal: White fir seeds are released and disseminated by wind as the cone disintegrates on the tree in the fall. Because white fir seed has a short, broad wing relative to its weight, it falls more rapidly and travels a shorter distance from the tree than many of its associated species. Downwind seed spread into an opening is about 1.5 to 2 times the height of the tree [119,178,203]. A small percentage of seeds may be transported greater distances by strong or gusty winds [218]." [Some secondary dispersal by water may be possible, but wind is the primary vector]

706	Propagules bird dispersed	n
	Source(s)	Notes
	Burns, R.M. & Honkala, B.H. 1990. <i>Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654.</i> U.S. Department of Agriculture, Forest Service, Washington, DC	"Seeds are released as cones disintegrate on the tree. The white fir seed has a relatively short, broad wing for its weight and falls more rapidly than a pine or spruce seed. Because most dissemination is by wind, the distance of seed spread is more limited than that of many associated species. Reliable downwind seed spread into an opening generally is limited to 1.5 to 2 times tree height (28)."
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 16 Jan 2015]	[Birds and other animals presumably act as seed predators rather than dispersers] "White fir seeds are eaten by several species of small mammals and birds including grouse [183,323], chipmunks and mice [324], flying squirrels [346], chickadees, crossbills, and Clark's nutcracker [127,197]."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	Notes
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 16 Jan 2015]	[Seeds may possibly be dispersed by seed-caching rodents in the Hawaiian Islands] "White fir seeds are palatable to numerous species of small rodents, although seeds of Douglas-fir, ponderosa pine, and sugar pine are preferred [106,250]."
	Burns, R.M. & Honkala, B.H. 1990. <i>Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654.</i> U.S. Department of Agriculture, Forest Service, Washington, DC	[Unknown. Possibly by seed caching rodents] "Locally, small rodents can cause significant loss of seed and occasionally girdle seedlings." [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 for <i>A. concolor</i> ]

Qsn #	Question	Answer
708	Propagules survive passage through the gut	
	Source(s)	Notes
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 16 Jan 2015]	"White fir seeds are eaten by several species of small mammals and birds including grouse [183,323], chipmunks and mice [324], flying squirrels [346], chickadees, crossbills, and Clark's nutcracker [127,197]." [Unknown. Consumption would likely result in seed predation, as seeds are not adapted for internal dispersal

801	Prolific seed production (>1000/m2)	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	[1.5 million seeds/ hectare = 150 seeds/m2] "Heavy seed crops are produced every 3-9 years, and in an exceptional year seed production can exceed 1.5 million seeds per hectare (Gordon, 1970; Franklin and Smith, 1974)."

802	Evidence that a persistent propagule bank is formed (>1 yr)	n
	Source(s)	Notes
	CAB International, 2005. Forestry Compendium. CAB International, Wallingford, UK	"- Seed storage recalcitrant"
	Zouhar, K. 2001. <i>Abies concolor</i> . In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). <a href="http://www.fs.fed.us/database/feis/">http://www.fs.fed.us/database/feis/</a> . [Accessed 15 Jan 2015]	"Under controlled conditions, white fir seeds may be stored for 5 or 6 years, but under natural conditions seeds do not remain viable over 1 year [108]. "

803	Well controlled by herbicides	
	Source(s)	Notes
	WRA Specialist. 2015. Personal Communication	Unknown. No evidence of herbicide efficacy or chemical control of this species

804	Tolerates, or benefits from, mutilation, cultivation, or fire	
	Source(s)	Notes

Qsn #	Question	Answer
	<p>Burns, R.M. &amp; Honkala, B.H. 1990. <i>Silvics of North America. Volume 1: Conifers. Agriculture Handbook 654.</i> U.S. Department of Agriculture, Forest Service, Washington, DC</p>	<p>"At low elevations California white fir is an aggressive, tolerant species that appears to have been held in check by frequent natural fires. Extensive fire control efforts, however, have reduced fire frequency. As a result, white fir is becoming a major stand component in California at elevations and on sites where originally it was minor (48). Dense fir regeneration beneath older stands of less tolerant trees is common and threatens a major change in species composition. In many places, especially with giant sequoia, such changes are undesirable, and control measures, including reintroduction of fire, are necessary." ... "White fir saplings and poles are susceptible to fire damage or kill, but trees become more resistant to both with age and size. White fir is considered more fire resistant than its associated species at high elevations (37,41), but less resistant than its associates at low elevations (47)."</p>
	<p>CAB International, 2005. <i>Forestry Compendium.</i> CAB International, Wallingford, UK</p>	<p>[Saplings killed by fire. Older trees resistant] "Saplings and poles of <i>A. concolor</i> are killed by ground fires, but older trees become resistant with age. Large basal fire scars in old growth stands, however, can expose trees various pathogens. Mechanical injury associated with logging operations may cause severe damage in remaining trees by opening wounds at ground level where heart rot fungal infections may enter."</p>

805	<p><b>Effective natural enemies present locally (e.g. introduced biocontrol agents)</b></p>	
	<p><b>Source(s)</b></p>	<p><b>Notes</b></p>
	<p>WRA Specialist. 2015. Personal Communication</p>	<p>Unknown</p>



**Summary of Risk Traits:**

## High Risk / Undesirable Traits

- Elevation range exceeds 1000 m in temperate climates, demonstrating environmental versatility
- Naturalized in New England; possible escape in Denmark
- Other *Abies* species are regarded as invasive
- Potentially allelopathic
- Flammable and may increase fire risk where grown
- Shade-tolerant
- Tolerates many soil types
- Forms pure stands within native range
- Hybridizes with other *Abies* species
- Produces wind-dispersed seeds
- Larger trees may be resistant to fire

## Low Risk Traits

- No reports of negative impacts where introduced or naturalized
- Unarmed (no spines, thorns or burrs)
- Palatable to grazing animals (although palatability may be low)
- Non-toxic
- Landscaping and ornamental value (Christmas Trees)
- Not reported to spread vegetatively
- Long time to reproductive maturity (40+ years)
- Will not form a persistent seed bank

## Second Screening Results for Tree/tree-like shrubs

(A) Shade tolerant or known to form dense stands? > Yes. Shade-tolerant and forms pure stands in native range

(B) Bird OR clearly wind-dispersed? > Yes. Wind-dispersed

(C) Life cycle <4 years? No (40+ years to maturity)

Outcome = Evaluate

