

Family: *Pinaceae*

Taxon: *Picea pungens*

Synonym: *Picea parryana* Sarg.
Picea pungens f. *argentea* Beissn.
Picea pungens f. *glauca* (Regel) Beissn.
Picea pungens var. *glauca* Regel

Common Name: blue spruce
Colorado blue spruce
Colorado spruce

Questionnaire :	current 20090513	Assessor:	Chuck Chimera	Designation: EVALUATE
Status:	Assessor Approved	Data Entry Person:	Assessor	WRA Score 1
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)	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	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	y
409	Is a shade tolerant plant at some stage of its life cycle		y=1, n=0	

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	
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	
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	y
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 1

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] "Blue spruce is widely used as an ornamental, not only in the United States, but in Europe, where it was introduced late in the 19th century. At least 38 cultivars of blue spruce have been named, based primarily on leaf coloration and crown form (3,19) (table 2). Although young blue spruce usually show a pronounced layering of stiff branches, which give it a distinct pyramidal form, the branches begin to droop and the crown becomes thin and irregular as the tree ages. The trunk tapers rapidly, and epicormic shoots commonly develop, giving the tree a ragged appearance. Blue spruce is prized as a Christmas tree, and plantations have been established in its native range and in north-central and northeastern United States." [Assessment refers to type species, and not cultivars]
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] "Blue spruce grows in a climatic zone that is generally cool and humid, with most of the annual precipitation occurring in the summer. Mean annual temperatures where blue spruce is most commonly found in Colorado and the Southwest range from 3.9° to 6.1° C (39° to 43° F), with a January mean of -3.9° to 2.8° C (25° to 27° F) and a July mean of 13.9° to 15.0° C (57° to 59° F). Mean minimum January temperatures range from 11.1° to 8.9° C (12° to 16° F) and mean maximum July temperatures range from 21.1° to 22.2° C (70° to 72° F). The frost-free period from June to August is about 55 to 60 days (5,69)."
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] "Blue spruce grows in a climatic zone that is generally cool and humid, with most of the annual precipitation occurring in the summer. Mean annual temperatures where blue spruce is most commonly found in Colorado and the Southwest range from 3.9° to 6.1° C (39° to 43° F), with a January mean of -3.9° to 2.8° C (25° to 27° F) and a July mean of 13.9° to 15.0° C (57° to 59° F). Mean minimum January temperatures range from 11.1° to 8.9° C (12° to 16° F) and mean maximum July temperatures range from 21.1° to 22.2° C (70° to 72° F). The frost-free period from June to August is about 55 to 60 days (5,69)."
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] "Blue spruce is characteristically found at elevations from 1830 to 2740 m (6,000 to 9,000 ft) in its northern range and from 2130 to 3050 m (7,000 to 10,000 ft) in its southern range (27,65)."
203	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Broad climate suitability (environmental versatility)? Yes] "The natural distribution of <i>P. pungens</i> ranges from 33°50' N to 48°54' N and from 104°45' W to 114°00' W. <i>Picea pungens</i> is found on cool and humid sites in the temperate zone. It typically occurs at altitudes from 1830 to 2740 m in its northern range and from 2130 to 3050 m in its southern range." Climatic amplitude (estimates) - Altitude range: 1830 - 3050 m - Mean annual rainfall: 460 - 610 mm - Rainfall regime: summer; bimodal - Dry season duration: 0 - 4 months - Mean annual temperature: 4 - 6°C - Mean maximum temperature of hottest month: 14 - 15°C - Mean minimum temperature of coldest month: -11 - 9°C - Absolute minimum temperature: > -40°C
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] "Blue spruce grows in a climatic zone that is generally cool and humid, with most of the annual precipitation occurring in the summer."
204	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Native or naturalized in regions with tropical or subtropical climates? No] " <i>P. pungens</i> is found on cool and humid sites in the temperate zone. It typically occurs at altitudes from 1830 to 2740 m in its northern range and from 2130 to 3050 m in its southern range (Fechner, 1990; Hess and Wasser, 1982). Generally, the climate is characterized by low summer temperatures and low winter precipitation (Fechner, 1985). It may grow on riparian areas in the southern end of its range. Precipitation is bimodal, with a dry spring (Pavek, 1993). Blue spruce is less sensitive to drought and low temperature and is more resistant to high insolation (light demanding tree) and frost damage than other species growing on the same sites."

205	1980. Skolmen, R.G.. Plantings on the forest reserves of Hawaii: 1910–1960. Institute of Pacific Islands Forestry, Pacific Southwest Forest & Range Experiment Station, US Forest Service, Honolulu, HI	[Does the species have a history of repeated introductions outside its natural range? Yes] "State Total = 2229" [Planted on the Big Island in 1958]
205	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Does the species have a history of repeated introductions outside its natural range? Yes] <i>Picea pungens</i> , known as blue or Colorado spruce, is often planted as an ornamental in gardens, parks, and in domestic gardens in North America and Europe.
301	2002. Simberloff, D./Relva, M.A./Nunez, M.. Gringos en el bosque: introduced tree invasion in a native <i>Nothofagus/Austrocedrus</i> forest. <i>Biological Invasions</i> . 4: 35–53.	[Naturalized beyond native range? No evidence in Argentina] "The non-pine conifers classed as invasive by Rejmanek and Richardson (2000) but failing to invade were <i>Sequoia sempervirens</i> , <i>Chamaecyparis lawsoniana</i> , <i>Cupressus lusitanica</i> , <i>C. macrocarpa</i> , <i>Larix decidua</i> , <i>L. leptolepis</i> , <i>Cryptomeria japonica</i> , <i>Thuja plicata</i> , <i>Taxodium distichum</i> , <i>Sequoiadendron giganteum</i> , <i>Tsuga canadensis</i> , <i>Picea sitchensis</i> , <i>P. pungens</i> , and <i>Platyclusus orientalis</i> ."
301	2002. Widrechner, M.P./Iles, J.K.. Geographic Assessment of the Risk of Naturalization of Non-native Woody Plants in Iowa. <i>Journal of Environmental Horticulture</i> . 20(1): 47–56.	[Naturalized beyond native range? No evidence] "Table 2. List of 72 non-native, woody plants cultivated in Iowa, but not known to naturalize" [Includes <i>Picea pungens</i>]
301	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Naturalized beyond native range? Yes] "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>P. pungens</i> (USA (New England, New York));"
301	2006. KrivanekK, M./PysekK, P./Jarosik, V.. Planting History and Propagule Pressure as Predictors of Invasion by Woody Species in a Temperate Region. <i>Conservation Biology</i> . 20(5): 1487–1498.	[Naturalized beyond native range? No evidence in Czech Republic] "Table 1. Alien tree species planted in the Czech Republic for forestry purposes and included in the study." ... [<i>Picea pungens</i> : Status = not escaped]
301	2010. Marco, A./Lavergne, S./Dutoit, T./Bertaudiere-Montes, V.. From the backyard to the backcountry: how ecological and biological traits explain the escape of garden plants into Mediterranean old fields. <i>Biological Invasions</i> . 12: 761–779.	[Naturalized beyond native range? No evidence] "Table 5 List of the perennial alien plant species escaped (=1) and not escaped (=0) in abandoned agricultural lands of Lauris village" [<i>Picea pungens</i> = Not escaped]
302	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Garden/amenity/disturbance weed? No] No evidence
302	2010. Carrillo-Gavilan, M.A./Vila, M.. Little evidence of invasion by alien conifers in Europe. <i>Diversity and Distributions</i> . 16: 203–213.	[Garden/amenity/disturbance weed? No] No evidence
303	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	[Agricultural/forestry/horticultural weed? No] No evidence
303	2007. Randall, R.P.. Global Compendium of Weeds - <i>Picea pungens</i> [Online Database]. http://www.hear.org/gcw/species/picea_pungens/	[Agricultural/forestry/horticultural weed? No] No evidence
303	2010. Carrillo-Gavilan, M.A./Vila, M.. Little evidence of invasion by alien conifers in Europe. <i>Diversity and Distributions</i> . 16: 203–213.	[Agricultural/forestry/horticultural weed? No] No evidence
304	2004. Richardson, D.M./Rejmánek, M.. Conifers as invasive aliens: a global survey and predictive framework. <i>Diversity and Distributions</i> . 10: 321–331.	Environmental weed? No evidence] "Table 2 Predicted invasiveness (Z scores; modified from Rejmánek & Richardson, 1996; see Rejmánek et al., 2004a) of selected non-Pinus conifers and numbers of countries (or regions/states within large countries) where the taxon is known to be naturalized (regenerating naturally) or invasive (Appendix 1; see text for criteria for labelling taxa as 'naturalized'/invasive)" ... [<i>Picea pungens</i> : Invasive records = 0]
304	2008. Adair, R./Cheal, D./White, M.. Advisory list of environmental weeds in the Ranges bioregions of Victoria. http://www.dse.vic.gov.au/	[Environmental weed? No evidence] "Final ranking scores for environmental weeds were grouped into five categories. The score range for each class is as follows: Ranking Score range: 121–243 Lower Risk Weeds" [<i>Picea pungens</i> = 156; Low Risk]
304	2010. Carrillo-Gavilan, M.A./Vila, M.. Little evidence of invasion by alien conifers in Europe. <i>Diversity and Distributions</i> . 16: 203–213.	Environmental weed? No] No evidence

305	2003. Smith, G.F./Kelly, D.L./Mitchell, F.J.G.. Establishing native woodlands in former upland conifer plantations in Ireland. Pp. 37-46 In J. Humphrey et al. (eds). The Restoration of Wooded Landscapes. Edinburgh Forestry Commission, Edinburgh, UK	[Congeneric weed? Yes. <i>Picea sitchensis</i>] "Because of land use change and the advent of sustainable forest policies, former upland conifer plantations may provide opportunities for native forest restoration at the landscape scale. To investigate the feasibility of restoring Irish oakwoods to such sites, we established, in 1999, 21 pairs of fenced and unfenced permanent plots in clearfelled conifer plantations in the Wicklow Mountains and Killarney National Parks, in the Irish Republic. Browsing damage from deer, sheep and other animals caused significant mortality to planted sessile oak (<i>Quercus petraea</i>) and downy birch (<i>Betula pubescens</i>) seedlings. Mortality at first sampling was 11.3% higher for oaks and 22.4% higher for birch planted in unfenced plots than in fenced plots. Damage from small herbivores, mostly hares, also caused significant mortality in the first year. While mortality of undamaged birch seedlings was 34.7%, mortality of seedlings damaged by small herbivores was 58.8%. A reduced cover of felling brush was associated with higher birch mortality and higher frequency of small herbivore damage. Brush may thus play an important role in sheltering trees from browsing from certain animals. Natural regeneration of tree species was highly variable across the sites and appeared to be limited mainly by dispersal. The most abundant species were the invasive exotics Sitka spruce (<i>Picea sitchensis</i>) and Rhododendron ponticum. The majority of Sitka spruce reseedling seems to be limited to a window of a few years before developing vegetation reduces recruitment opportunities."
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. <i>Picea sitchensis</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>P. sitchensis</i> (Great Britain; Ireland; New Zealand)"
305	2007. Randall, R.P.. Global Compendium of Weeds - Index [Online Database]. http://www.hear.org/gcw/	[Congeneric weed? Yes] <i>Picea abies</i> , <i>Picea engelmannii</i> , <i>Picea glauca</i> , <i>Picea mariana</i> , <i>Picea omorika</i> , <i>Picea rubens</i> , <i>Picea sitchensis</i> listed as naturalized and/or invasive
401	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Produces spines, thorns or burrs? No] "Habit and size: <i>P. pungens</i> is an evergreen tree with a dense, pyramidal to spire-shaped crown. It typically achieves a height of 21 to 35 m and a d.b.h. of 91 cm. The largest tree noted in the "1982 National Register of Big Trees" (USA) was from Colorado at 38.4 m tall and 154.4 cm d.b.h. (Fechner, 1990). The oldest known blue spruce achieved an age of about 600 years (Moir, 1992). Stem form, bark and branches, roots The stem is straight with a grey to red brown bark 1.9 to 3.8 cm thick. Young open grown trees are branched from the crown tip nearly to the ground surface; in older trees, the lower part of the stem is visible. Twigs are stout, hairless and deeply furrowed. Branches are horizontal to drooping (Tomanek, 1994). Bud ovoid-conic, 6 mm with long slender scales around base and papery pale brown scales often curving out in rosettes. Roots are shallow but the tree is windfirm (Goor and Barney, 1976). Foliage Needles are four-angled, erect, 1.5-2 cm long, stiff and very sharp (as the Latin specific epithet suggests). They are more or less blue (surface waxes), from clearly green (' <i>Viridis</i> ') to nearly silver (' <i>Glauca</i> ' and ' <i>Argentea</i> '). Stomata are situated on each needle surface; needles remain on the tree for 4-6 years."
402	1979. Rice, E.L.. Allelopathy: An Update. Botanical Review. 45(1): 15-109.	[Allelopathic? Potentially] "Thomas (1974) used aqueous extracts of blue spruce (<i>Picea pungens</i> Engelm.) to moisten filter paper on which seeds of grasses and cereals were placed and allowed to germinate. The extracts caused malformed roots, blackened root tips, and a lack of root hair development" [Demonstrates allelopathic potential in laboratory conditions]
403	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Parasitic? No] " <i>P. pungens</i> is an evergreen tree with a dense, pyramidal to spire-shaped crown." [Pinaceae]
404	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online].. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picp/un/all.html	[Unpalatable to grazing animals? No] "Blue spruce is not a highly preferred food for either wildlife or domestic animals [10,103]. Deer browse blue spruce infrequently [122]. In mixed-conifer forests, blue spruce is the least desired browse species by elk and deer [67]. White-tailed deer in Connecticut browsed ornamental blue spruce an average of 0.5 percent throughout the summer [18]. Blue spruce can be used an index of mule deer population size; young blue spruce are severely damaged by browsing during times of overpopulation [64]."
404	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Unpalatable to grazing animals? No] " Young <i>P. pungens</i> trees are severely damaged by browsing if the mule deer (<i>Odocoileus hemionus</i>) population is high; this can be used as an indicator of the size of the deer population (Hungerford, 1970). "

405	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online]. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Toxic to animals? No evidence] "Blue spruce is not a highly preferred food for either wildlife or domestic animals [10,103]. Deer browse blue spruce infrequently [122]. In mixed-conifer forests, blue spruce is the least desired browse species by elk and deer [67]. White-tailed deer in Connecticut browsed ornamental blue spruce an average of 0.5 percent throughout the summer [18]. Blue spruce can be used an index of mule deer population size; young blue spruce are severely damaged by browsing during times of overpopulation [64]."
405	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Toxic to animals? No evidence] " Young <i>P. pungens</i> trees are severely damaged by browsing if the mule deer (<i>Odocoileus hemionus</i>) population is high; this can be used as an indicator of the size of the deer population (Hungerford, 1970). "
406	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online]. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Host for recognized pests and pathogens? Potentially] "Damaging Agents: Insects and disease reduce growth, viability, and vigor of blue spruce [37,124]. Heart and root rots, cone rusts, nematodes, snow molds, canker, and tip blight have an impact on blue spruce [38,89]. Silvicultural methods that minimize pathologic and insect problems are discussed in detail [2,45,106]. Calibrated ecosystem models that correlate microclimate with blue spruce stand information are useful for predicting the behavior of forest pathogens [83]. Tree ring patterns of blue spruce have been used to construct past occurrence of insect attacks [69]. Blue spruce is a host of western spruce budworm (<i>Choristoneura occidentalis</i>); outbreaks and symptoms are discussed in detail [16,78]. Blue spruce is an infrequent host of mountain pine beetle (<i>Dendroctonus ponderosae</i>) and spruce beetle (<i>D. rufipennis</i>), which kill other conifers [5,62]. Trees surviving infestation are more susceptible to other pathogens, insects, and windthrow [45,57]. Blue spruce is the principal host of western spruce dwarf mistletoe (<i>Arceuthobium microcarpum</i>) and minor host of other dwarf mistletoe species [58,59,124]. Infected blue spruce seedling mortality under a heavily infested canopy was twice that of the control [79]."
406	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Host for recognized pests and pathogens? Potentially]"Various insects and fungi attack <i>Picea pungens</i> at every stage of its development. Pathogenic agents affect growth, vitality and vigour. However, the damage caused by most insects is not high in comparison with that caused by fungi. Fungal and other diseases: Seedlings, needles, stems and roots are infected by numerous species of fungi. <i>Chrysomyxa</i> spp. rusts infect needles. <i>Phytophthora cinnamomi</i> and <i>Cylindrocladium scoparium</i> attack young seedlings. Canker and tip blight have also had an impact on <i>P. pungens</i> . The fungus <i>Rhizosphaera kalkhoffii</i> attacks Christmas tree plantations in the Midwest and Eastern USA. <i>Armillaria mellea</i> , <i>Inonotus tomentosus</i> , <i>Phellinus pini</i> , <i>Fomitopsis pinicola</i> and <i>Climacocystis borealis</i> attack the roots. The root lesion nematode, <i>Pratylenchus penetrans</i> , reduces seedling vitality. Snow moulds may cause damage in nurseries."
407	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Causes allergies or is otherwise toxic to humans? No] " <i>Picea pungens</i> , known as blue or Colorado spruce, is often planted as an ornamental in gardens, parks, and in domestic gardens in North America and Europe." [No evidence]
407	2012. Pollen Library. Blue Spruce (<i>Picea pungens</i>). IMS Health Incorporated, http://www.pollenlibrary.com/Specie/Picea+pungens/	[Causes allergies or is otherwise toxic to humans? No] "Allergenicity: No allergy has been reported for Blue Spruce (<i>Picea pungens</i>) species"
408	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online]. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Creates a fire hazard in natural ecosystems? Yes] "Blue spruce foliage has moderately volatile oils [109]. Crowns are dense and highly flammable [106,109]. ..."In riparian areas where blue spruce occurs, intervals between fires are about 350 to 400 years. Severe fires occur infrequently, and succession back to the original community is often relatively rapid (15 to 35 years). Depending on the site, blue spruce may be the dominant seral tree [19]. " [Although fires are infrequent] ..."Blue spruce is not recommended for fire shelterbelts based on studies in Victoria, Australia. Fuel ladders form from persistent dead low branches [109]."
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? Potentially] "Sreaction to Competition- Blue spruce is classed as intermediate in tolerance of shade, the middle of five tolerance categories for western conifers. It is less tolerant than subalpine fir, Engelmann spruce, and white fir; it is similar in tolerance to, or slightly more tolerant than, Douglas-fir; it is more tolerant than southwestern white pine, ponderosa pine, lodgepole pine, Rocky Mountain juniper, quaking aspen, or its other moist-site hardwood associates (4,27,52,62)."
409	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Is a shade tolerant plant at some stage of its life cycle? Potentially] " <i>Picea pungens</i> is a light-demanding species and intermediate in shade tolerance. Light requirements become greater with the age of the tree. The seeds have the best conditions for germination on mineral soil with side shade and overhead light in the vicinity of seed trees"

410	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online].. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Tolerates a wide range of soil conditions? Yes] "Blue spruce grows on a variety of soil types. Usually, soils are young and undeveloped; however, soil textures may be deep sandy to gravelly loams that are well drained [37,61]. "
410	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)? Yes] "P. <i>pungens</i> grows on a range of soil types from inceptisols, cambisols, rendzinas, some fluvisols, anthrosols through mollisols, kastanozems, chernozems, some phaeozems, to histosols - organic soils, peat soils (Fechner, 1990; Bednarek and Prusinkiewicz, 1997). Soils are derived from fluvium, alluvium and colluvium, and they may have a litter layer up to 9 cm thick (Hess and Alexander, 1986; Steele and Pfister, 1991)."
411	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Climbing or smothering growth habit? No] "P. <i>pungens</i> is an evergreen tree with a dense, pyramidal to spire-shaped crown. It typically achieves a height of 21 to 35 m and a d.b.h. of 91 cm. The largest tree noted in the "1982 National Register of Big Trees" (USA) was from Colorado at 38.4 m tall and 154.4 cm d.b.h. (Fechner, 1990). The oldest known blue spruce achieved an age of about 600 years (Moir, 1992)."
412	1960. Kearney, T.H./Peebles, R.H.. Arizona Flora. University of California Press, Berkeley, CA	[Forms dense thickets? Yes] " <i>Picea pungens</i> ... sometimes in dense stands"
412	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online].. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Forms dense thickets? Yes] "Blue spruce occurs as dominant or codominant in small stands or as scattered individuals. In riparian settings, blue spruce is codominant with cottonwoods such as narrowleaf cottonwood (<i>Populus angustifolia</i>) or balsam poplar (<i>P. balsamifera</i>) [7,85,117]. Blue spruce is more important in habitat type series of the central Rocky Mountains. Blue spruce series are restricted to cool, moist areas throughout the southwestern mixed-conifer forests [1,26,120]. Common codominants are Engelmann spruce, white fir (<i>Abies concolor</i>), and Douglas-fir (<i>Pseudotsuga menziesii</i>) [3,26,88]."
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] "P. <i>pungens</i> is an evergreen tree with a dense, pyramidal to spire-shaped crown. It typically achieves a height of 21 to 35 m and a d.b.h. of 91 cm. The largest tree noted in the "1982 National Register of Big Trees" (USA) was from Colorado at 38.4 m tall and 154.4 cm d.b.h. (Fechner, 1990). The oldest known blue spruce achieved an age of about 600 years (Moir, 1992)."
601	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 of substantial reproductive failure in native habitat? No] "Natural reproduction is scanty, probably because the lightweight seed is prevented from coming into contact with mineral soil by the dense herbage, grass, or other ground-cover vegetation that is usually abundant in the habitat of the species (84). ..." "In most parts of the blue spruce range natural germination of seed takes place in the spring or summer following dispersal and is dependent on adequate precipitation (51)."
602	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Produces viable seed? Yes] <i>Picea pungens</i> is mainly reproduced by seed.
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? Potentially] "Much overlap between blue spruce and Engelmann spruce in cortical monoterpene content has also been observed, although species differences in the quantity of several of the compounds are statistically significant. Oleoresins of blue spruce contain higher levels of tricyclene, (a pinene, camphene, and bornyl acetate, whereas Engelmann spruce oleoresins contain higher levels of b-pinene, 3-carene, terpinolene, and several unknown compounds (80). These and other results (42) indicate that hybridization between blue spruce and Engelmann spruce is possible. This might account for the various intergrades between blue spruce, white spruce, and Engelmann spruce that have been reported in Montana (83)."

604	1984. Cram, W.H.. Some effects of self-, cross-, and open-pollinations in <i>Picea pungens</i> . Canadian Journal of Botany. 62:(2): 392-395.	[Self-compatible or apomictic? Yes] "Self fertility of <i>Picea pungens</i> Engelm. Ranged from 0 to 176 seeds per cone for 72 trees. Self pollinations reduced the average seed yields to 40 and 23% of the respective cross-, and open(wind)-pollinations. Selfing decreased the germination for nonstratified seed to 71% of that for cross-pollinated seed, whereas the germination of stratified selfed and crossed seed varied from 80 to 100%. Selfing also depressed the growth of 1- to 5-year-old seedlings."
605	1984. Cram, W.H.. Some effects of self-, cross-, and open-pollinations in <i>Picea pungens</i> . Canadian Journal of Botany. 62:(2): 392-395.	[Requires specialist pollinators? No] "Self fertility of <i>Picea pungens</i> Engelm. Ranged from 0 to 176 seeds per cone for 72 trees. Self pollinations reduced the average seed yields to 40 and 23% of the respective cross-, and open(wind)-pollinations. Selfing decreased the germination for nonstratified seed to 71% of that for cross-pollinated seed, whereas the germination of stratified selfed and crossed seed varied from 80 to 100%. Selfing also depressed the growth of 1- to 5-year-old seedlings." [Wind-pollinated]
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-Natural vegetative reproduction of blue spruce has not been reported. The species does not sprout from the stump or root, but the development of epicormic branches on the trunk is common. Grafting and air-layering have been practiced successfully for many years to perpetuate desired horticultural varieties (32,60,63, 74,91). Success has also been achieved through the rooting of hardwood or greenwood stem cuttings, especially in sand-peat-soil media, or hydroponically (56,79,81,93)."
606	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online].. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Reproduction by vegetative fragmentation? No] "Artificial vegetative propagation of blue spruce is possible using short cuttings, grafting, and air layering [28,38,123]. Breeding commercial stock has been successful; however, interspecific crosses rarely yield viable hybrids [34,46,90,105]. Blue spruce pollen used in artificial crosses is viable for almost 3 years when stored at cold temperatures [36]. Methods for cone harvesting and seed extraction are discussed in detail [32,103]." ..."Blue spruce reproduces sexually. Natural vegetative reproduction does not occur, although epicormic shoots sometimes sprout on the trunks [38]."
606	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Reproduction by vegetative fragmentation? No] " <i>Picea pungens</i> is mainly reproduced by seed. Vegetative reproduction from hardwood or greenwood stem cuttings and by hydroponic methods is also possible."
607	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.	[Minimum generative time (years)? 20+ years] "Seed production begins at approximately 20 years, and optimum seed-bearing age is reached between 50 and 150 years (88)."
701	2008. MobileReference. The Illustrated Encyclopedia of Trees and Shrubs: An Essential Guide To Trees and Shrubs of the World.	[Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)? No] "The seeds are black, 3-4 mm long, with a slender, 10-13 mm long pale brown wing." [Unlikely. Although theoretically possible, the seeds lack a means of external attachment and are adapted for wind dispersal]
702	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 intentionally by people? Yes] "It is a slow growing, long-lived tree of medium size that, because of its symmetry and color, is planted extensively as an ornamental. Because blue spruce is relatively scarce and the wood is brittle and often full of knots, it is not an important timber tree."
702	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online].. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Propagules dispersed intentionally by people? Yes] "Blue spruce is planted extensively as an ornamental in North America and Europe [13,77,104,]. Blue spruce are used as Christmas trees [38,65]. It is the state tree of Colorado and Utah [77,65]."
702	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Propagules dispersed intentionally by people? Yes] " <i>Picea pungens</i> , known as blue or Colorado spruce, is often planted as an ornamental in gardens, parks, and in domestic gardens in North America and Europe."
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] "The seed is wind disseminated, seedfall diminishing rapidly as distance from the source increases; most seeds fall within 90 m (300 ft) of the upwind timber edge (2)."
703	2008. MobileReference. The Illustrated Encyclopedia of Trees and Shrubs: An Essential Guide To Trees and Shrubs of the World.	[Propagules likely to disperse as a produce contaminant? No] "The seeds are black, 3-4 mm long, with a slender, 10-13 mm long pale brown wing." [Unlikely. No evidence in literature]
704	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 adapted to wind dispersal? Yes] "The seed is wind disseminated, seedfall diminishing rapidly as distance from the source increases; most seeds fall within 90 m (300 ft) of the upwind timber edge (2)."

704	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Propagules adapted to wind dispersal? Yes] Wind dispersed.
705	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 water dispersed? No] "The seed is wind disseminated, seedfall diminishing rapidly as distance from the source increases; most seeds fall within 90 m (300 ft) of the upwind timber edge (2)."
706	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Propagules bird dispersed? No] "In its natural habitat, forests with <i>P. pungens</i> are valuable for a wide range of wildlife species, and birds consume the seeds (Fechner, 1990)." [Birds act as seed predators, not dispersers]
707	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online].. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Propagules dispersed by other animals (externally)? Potentially] "Blue spruce cones are cached by red squirrels in Utah [128]." [Introduced rodents may serve a similar role in the Hawaiian Islands]
708	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online].. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Propagules survive passage through the gut? No] "Numerous birds eat blue spruce seeds [122]. Blue spruce cones are cached by red squirrels in Utah [128]." [Unlikely. Seeds are consumed by predators, and not adapted for internal dispersal]
801	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.	[Prolific seed production (>1000/m ²)? Potentially] "Seed Production and Dissemination- Blue spruce is generally considered to be from good to prolific in seed production, yielding full crops of cones every 2 or 3 years (77,84)."
801	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online].. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Prolific seed production (>1000/m ²)? Potentially] "Seed production begins at about 20 years and peaks at 50 to 150 years [38,122]. Blue spruce is a good to prolific seed producer, producing full cone crops every 2 to 3 years [32,38,122]. Cones mature in August of the first year and have 85 to 195 seeds per cone [37]."
802	2005. CAB International. Forestry Compendium. CAB International, Wallingford, UK	[Evidence that a persistent propagule bank is formed (>1 yr)? Yes] "Cones mature in August of the first year. Most of them drop after 2 to 3 years; some may drop during the first winter. Seeds are orthodox."
803	2012. WRA Specialist. Personal Communication.	[Well controlled by herbicides? Unknown] No information on herbicide efficacy or chemical control of this species
804	1993. Pavek, D.S.. <i>Picea pungens</i> . In: Fire Effects Information System, [Online].. USA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, http://www.fs.fed.us/database/feis/plants/tree/picpun/all.html	[Tolerates, or benefits from, mutilation, cultivation, or fire? No] "Blue spruce is easily killed by fire [67,126]. It has thin bark and shallow roots which make it susceptible to hot surface fires [14]. Blue spruce is slow to self-prune lower branches; therefore, surface fires can crown [19]." ... "Successive fires may prevent blue spruce from dominance because it is fire intolerant. Historical fire frequency in mixed-conifer forests was about 22 years, based on fire-scarred trees in the White Mountains of Arizona [27]. Fire suppression during the past 100 years has made the mixed-conifer forest in which blue spruce occurs more susceptible to fire; however, blue spruce may be dominant in some areas because of the longer fire-free intervals." ... "Fire kills blue spruce. Low severity fires will kill saplings and seedlings [2]. Slow burning of fine fuels will kill the shallow roots of blue spruce [14]." ... "Blue spruce does not sprout after fire [109]. Rates of establishment will vary depending on proximity of seed trees and moisture. Seed must be transported from off-site. Blue spruce will establish by wind-dispersed seed that readily germinates on the mineral soil exposed by fire. Small mammals and birds may also carry cones or seeds into a burn."
805	2012. WRA Specialist. Personal Communication.	[Effective natural enemies present locally (e.g. introduced biocontrol agents)? Unknown] No likely