Part IV. Plant Assessment Form

For use with "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association

Electronic version, February 28, 2003

Table 1. Species and Evaluator Information

Species name (Latin binomial)**:**	Pinus radiata D. Don var. radiata
Synonyms:	Pinus insignis, P. californiana, P. montereyensis, et al.
Common names:	radiata pine, Monterey pine, radiata, insignis pine, remarkable pine
Evaluation date (mm/dd/yy)**:**	08/10/05
Evaluator #1 Name/Title:	Peter J. Warner
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Evaluator #2 Name/Title:	enter text here
Affiliation:	enter text here
Phone numbers:	enter text here
Email address:	enter text here
Address:	enter text here

Section below for list committee use—please leave blank

List committee members:	Peter Warner, Joe DiTomaso, Cynthia Roye, Jake Sigg
Committee review date:	8/15/05
List date:	enter text here
Re-evaluation date(s):	enter text here

General comments on this assessment:
Pinus radiata is the most widely planted commercial timber tree in the world. However, in its native range, consisting of five populations in California and Baja California, Mexico, the species is threatened by a number of human-caused impacts: development, human-dispersed plant pathogens, non-native herbivores, etc. This assessment is specifically based only on populations, stands, or individuals of the species that have become established due to human introductions, or reasonably considered to have been dispersed from such human introductions of the species.

Table 2. Criteria, Section, and Overall Scores

1.1	Impact on abiotic ecosystem processes	**B**	**Other Pub. Mat'l**
1.2	Impact on plant community	**A**	**Other Pub. Mat'l**
1.3	Impact on higher trophic levels	**C**	**Other Pub. Mat'l**
1.4	Impact on genetic integrity	**B**	**Anecdotal**

"Impact"

Enter four characters from Q1.1-1.4 below:

BACB

Use matrix determine the score; enter below:

B

2.1	Role of anthropogenic and natural disturbance	**A**	**3**	**Observational**
2.2	Local rate of spread with no management	**A**	**3**	**Other Pub. Mat'l**
2.3	Recent trend in total area infested within state	**C**	**1**	**Other Pub. Mat'l**
2.4	Innate reproductive potential Wksht A	**B**	**2**	**Other Pub. Mat'l**
2.5	Potential for human-caused dispersal	**A**	**3**	**Observational**
2.6	Potential for natural long-distance dispersal	**A**	**3**	**Other Pub. Mat'l**
2.7	Other regions invaded	**C**	**1**	**Rev'd, Sci. Pub'n**

"Invasiveness"

For questions at left, recall that an A gets 3 points, a B gets 2, a C gets 1, and a D or U gets=0. Enter the sum total of all points for Q2.1-2.7 below:

16

Use matrix to determine score and enter below:

B

3.1	Ecological amplitude/Range	**A**	**Observational**
3.2	Distribution/Peak frequency Wksht C	**C**	**Observational**

"Distribution"

Use matrix determine the score; enter below:

B

"Plant Score"

Using matrix, determine the Overall Score and Alert Status from the three section scores and enter them below:

Medium

No Alert

Table 3. Documentation

Question 1.1 Impact on abiotic ecosystem processes B Other Pub. Mat'l back
Identify ecosystem processes impacted: Impacts on water availability, soil chemistry, fire susceptibility, nutrient quality of litter have been demonstrated in fynbos vegetation in S. Africa (1) and are suspected in Australia (2). Pine infestations can change the relative susceptibility of an ecosystem to fire and also increase fire frequency (3)..
Rationale: Impacts in California have not been demonstrated, although can be reasonably assumed from literature based on work in similar climates, plant communities abroad.
Sources of information: 1. Rabie, PA. 2005. Control of commercially important Pinus spp. in fynbos. Restoration and Reclamation Review (student online journal: http://horticulture.coafes.umn.edu/vd/h5015/00papers/rabie.htm). 2. Williams, M. 2004. Attack of the Pines! Pinus radiata as an invasive species. The Tasmanian Conservationist, Number 295, September 2004. (Online: http://www.tct.org.au/n34g.htm 3. Wardle, GM, M Williams, and J Ironside. The invasive potential of Pinus radiata: seed production, dispersal and the role of fire (abstract). 2005. Botany 2005 (website: http://www.2005.botanyconference.org/engine/search/index.php?func=detail&aid=251).
Question 1.2 Impact on plant community composition, structure, and interactions A Other Pub. Mat'l back
Identify type of impact or alteration: Competition for light, moisture, nutrients in suitable habitats, displacing native species of trees, shrubs, herbs (1, 2); displacement and shading out of native plants noted in California (3). Can also alter fire regimes, resulting in shifts in long-term successional trends (1).
Rationale:
Sources of information: 1. Rabie, PA. 2005. Control of commercially important Pinus spp. in fynbos. Restoration and Reclamation Review (student online journal: http://horticulture.coafes.umn.edu/vd/h5015/00papers/rabie.htm). 2. Williams, M. 2004. Attack of the Pines! Pinus radiata as an invasive species. The Tasmanian Conservationist, Number 295, September 2004. (Online: http://www.tct.org.au/n34g.htm 3. Warner, PJ. 1995-2005. Personal observations: San Mateo, Marin, Sonoma, Mendocino Counties. 707/937-2278; corylus@earthlink.net
Question 1.3 Impact on higher trophic levels C Anecdotal back
Identify type of impact or alteration: Noted as potentially beneficial to native birds in Nex Zealand (1); displacement of native species in CA likely to have negative impacts on wildlife that depend on the displace native plants (2).
Rationale: Impacts estimated to be minor to wildlife, by virtue of displacement, until otherwise demonstrated.
Sources of information: 1. Ogden, J, J Braggins, K Stretton, and S Anderson. 1997. Plant species richness under Pinus radiata stands on the central north island volcanic plateau, New Zealand. New Zealand Journal of Ecology

(1997) 21(1): 17-29. New Zealand Ecological Society.

2. Warner, PJ. 1995-2005. Personal observations: San Mateo, Marin, Sonoma, Mendocino Counties. 707/937-2278; corylus@earthlink.net

Question 1.4 Impact on genetic integrity B Anecdotal back

Identify impacts: Introduced genotypes of P. radiata could have a detrimental effect on fitness of native P. radiata and P. muricata populations, especially in light of the susceptibility of introduced genotypes to numerous pathogens and herbivores (1). Another concern about transgenic P. radiata is the potential for new invasions through introduction of new genetic material into a pre-existing weedy pine population (2).

Rationale: Pitch pine canker (Fusarium moniliforme var. subqlutinans f.sp.pini) is among the diseases spread chiefly by pruning of diseased ornamental P. radiata. The spread of this disease directly to individuals of P. radiata and P. muricata has been demonstrated. If resistance to this disease or other pathogens or pests is genetically controlled, then native genotypes would be further endangered when crossed with non-native genotypes (1). However, the converse could also be true, if introduced genotypes were less susceptible than native pines, some degree of fitness (resistance to the fungus) could be transferred to a more susceptible native population. At this time, I have not corroboration nor substantiated evidence for this hypothesis. However, and at least, Monterey pines planted outside their currently native range, in areas with native, pitch canker-susceptible trees (both P. radiata and P. muricata) have facilitated the spread of the disease locally from source infestations in introduced Monterey pines.

Sources of information: 1.Warner, PJ. 2005. Personal hypothesis and deduction.

2. Richardson, DM, and RJ Petit. 2005. Pines as invasive aliens: outlook on transgenic pine plantations in the southern hemisphere. In Williams, CG (ed.), Landscapes, Genomics and Transgenic Conifer Forests (Chapter 10). Springer Press, The Netherlands.

Question 2.1 Role of anthropogenic and natural disturbance in establishment A Observational back

Describe role of disturbance: Little or no disturbance necessary for establishment, although bare mineral soil and reduced competition for light are reported as requirements for germination. P. radiata seedlings observed in areas with little or no disturbance (coastal terrace prairie, closed cone pine, coastal scrub, and North Coast coniferous forests (1).

Rationale: I do not necessarily concur that P. radiata requires bare disturbed soil and full sunlight for germination, although denser infestations do appear to be more common in such areas.

Sources of information: 1. Rabie, PA. 2005. Control of commercially important Pinus spp. in fynbos. Restoration and Reclamation Review (student online journal: http://horticulture.coafes.umn.edu/vd/h5015/00papers/rabie.htm).

Question 2.2 Local rate of spread with no management A Other Pub. Mat'l back

Describe rate of spread: Individual trees grow and mature rapidly, some trees are self-compatible, and the light, winged seeds are easily wind-dispersed (1), traits which facilitate rapid local spread, as observed (2).

Rationale: enter text here

Sources of information: 1. Rabie, PA. 2005. Control of commercially important Pinus spp. in fynbos. Restoration and Reclamation Review (student online journal: http://horticulture.coafes.umn.edu/vd/h5015/00papers/rabie.htm).

2.Rabie, PA. 2005. Control of commercially important Pinus spp. in fynbos. Restoration and Reclamation Review (student online journal: http://horticulture.coafes.umn.edu/vd/h5015/00papers/rabie.htm).

Question 2.3 Recent trend in total area infested within state C Other Pub. Mat'l back

Describe trend: Historical records of attempts to grow P. radiata, as well as information on its native range climate and ecology, suggest that the species is highly constrained by climate, and does not survive or grow well in hot, damp, or cold climates (1). The chiefly coastal distribution of naturalized P. radiata populations in CA suggest that it will not survive in climates that differ substantially from its native ecological range along the central CA coast, Channel Islands, and Guadalupe and Cedros Islands of Baja California, Mexico (1, 2).

Rationale: Due to climatic constraints and limited ecological range, P. radiata does not appear likely to be capable of spreading much further from its current range for either native populations or those introduced through human activities.

Sources of information: 1. Lavery, PB, and DJ Mead. 1998. Pinus radiata: a narrow endemic from North America takes on the world. In Ecology and Biogeography of Pinus (DM Richardson, ed.). Cambridge University Press, Cambridge, UK, pp. 432-449.

2. CalFlora: Information on California plants for education, research and conservation. [web application]. 2005. Berkeley, California: The CalFlora Database [a non-profit organization]. Available: http://www.calflora.org/. (Accessed: Aug 10, 2005)

Question 2.4 Innate reproductive potential B Other Pub. Mat'l back

Describe key reproductive characteristics: Small winged seeds well adapted to long-distance dispersal (1, 2); rapid growth to reproductive maturity (9 years) (1); a short mean interval between large seed crops (1); serotinous cones (1, 2))

Rationale: enter text here

Sources of information: 1. Rabie, PA. 2005. Control of commercially important Pinus spp. in fynbos. Restoration and Reclamation Review (student online journal: http://horticulture.coafes.umn.edu/vd/h5015/00papers/rabie.htm).

2. Wardle, GM, M Williams, and J Ironside. The invasive potential of Pinus radiata: seed production, dispersal and the role of fire (abstract). 2005. Botany 2005 (website: http://www.2005.botanyconference.org/engine/search/index.php?func=detail&aid=251).

Question 2.5 Potential for human-caused dispersal A Observational back

Identify dispersal mechanisms: In California, widely planted for Christmas trees and grown for horticultural purposes, although the latter industry may be in decline due to the species' susceptibility to diseases and pests (1)

Rationale: enter text here

Sources of information: 1. Warner, PJ. 1995-2005. Personal observations: Alameda, Contra Costa, Santa Clara, Santa Cruz, San Mateo, Marin, Napa, Sonoma, Mendocino Counties. 707/937-2278; corylus@earthlink.net

Question 2.6 Potential for natural long-distance dispersal A Other Pub. Mat'l back

Identify dispersal mechanisms: Wind (1), birds (1, 2); fire can facilitate rapid spread (1, 2)

Rationale: Both wind and birds capable of dispersing seeds > 1 km.

Sources of information: 1. Rabie, PA. 2005. Control of commercially important Pinus spp. in fynbos. Restoration and Reclamation Review (student online journal: http://horticulture.coafes.umn.edu/vd/h5015/00papers/rabie.htm).

2. Wardle, GM, M Williams, and J Ironside. The invasive potential of Pinus radiata: seed production, dispersal and the role of fire (abstract). 2005. Botany 2005 (website: http://www.2005.botanyconference.org/engine/search/index.php?func=detail&aid=251).

Question 2.7 Other regions invaded C Doc'n level back

Identify other regions: Fynbos (S. Africa; 1); bush and eucalypt forests and woodlands (Australia; 2, 3); native conifer forests (Chile; 4); in all areas, invasiveness appears climatically constrained to summer cool & dry, Mediterranean-type climates with mild, damp winters (5).

Rationale: From available information on invasions of P. radiata outside North America, the species would not appear likely to spread beyond coastal scrub, prairie, closed cone pine forests, and coastal coniferous forests in California.

Sources of information: 1. Rabie, PA. 2005. Control of commercially important Pinus spp. in fynbos. Restoration and Reclamation Review (student online journal: http://horticulture.coafes.umn.edu/vd/h5015/00papers/rabie.htm).

2. Wardle, GM, M Williams, and J Ironside. The invasive potential of Pinus radiata: seed production, dispersal and the role of fire (abstract). 2005. Botany 2005 (website: http://www.2005.botanyconference.org/engine/search/index.php?func=detail&aid=251).

3. Williams, M. 2004. Attack of the Pines! Pinus radiata as an invasive species. The Tasmanian Conservationist, Number 295, September 2004. (Online: http://www.tct.org.au/n34g.htm

4. Bustamante, RO, and JA Simonetti. 2005. Is Pinus radiata invading the native vegetation in Central Chile? Demographic responses in a fragmented forest. Biological Invasions (2005) 7: 243-249.

5. Lavery, PB, and DJ Mead. 1998. Pinus radiata: a narrow endemic from North America takes on the world. In Ecology and Biogeography of Pinus (DM Richardson, ed.). Cambridge University Press, Cambridge, UK, pp. 432-449.

Question 3.1 Ecological amplitude/Range A Observational back

Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known: north coastal scrub, coastal terrace prairie, closed cone and north coast coniferous forests (1)

Rationale: Based on observations mostly from Santa Cruz Co. north; unsure of level of invasion south of Monterey Bay area.
Sources of information: 1. Warner, PJ. 1995-2005. Personal observations: Alameda, Contra Costa, Santa Clara, Santa Cruz, San Mateo, Marin, Napa, Sonoma, Mendocino Counties. 707/937-2278; corylus@earthlink.net
Question 3.2 Distribution/Peak frequency C Observational back
Describe distribution: Does not appear present in a large proportion of these types, but is common across larger expanses of these ecological types (1).
Rationale: Conservative estimate based on personal observations from Santa Cruz Co. north along Calif. coast
Sources of information: 1. Warner, PJ. 1995-2005. Personal observations: Alameda, Contra Costa, Santa Clara, Santa Cruz, San Mateo, Marin, Napa, Sonoma, Mendocino Counties. 707/937-2278; corylus@earthlink.net

Worksheet A

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Reaches reproductive maturity in 2 years or less	**No: 0 pt**
Dense infestations produce >1,000 viable seed per square meter	**Yes: 2 pts**
Populations of this species produce seeds every year.	**Yes: 1 pt**
Seed production sustained over 3 or more months within a population annually	**No: 0 pt**
Seeds remain viable in soil for three or more years	**No: 0 pts**
Viable seed produced with *both* self-pollination and cross-pollination	**Yes: 1 pt**
Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes	**No: 0 pt**
Fragments easily and fragments can become established elsewhere	**No: 0 pts**
Resprouts readily when cut, grazed, or burned	**No: 0 pt**
	4 pts Total Unknowns
	B (4-5 pts)

Note any related traits: Light, winged seeds easily wind-dispersed; self-compatibility; rapid growth rate to maturity

Worksheet C - California Ecological Types

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(*sensu* Holland 1986)

Major Ecological Types	Minor Ecological Types	Code*
Marine Systems	marine systems	**score**
Freshwater and Estuarine Aquatic Systems	lakes, ponds, reservoirs	**score**
	rivers, streams, canals	**score**
	estuaries	**score**
Dunes	coastal	**score**
	desert	**score**
	interior	**score**
Scrub and Chaparral	coastal bluff scrub	**score**
	coastal scrub	**C. 5-20%**
	Sonoran desert scrub	**score**
	Mojavean desert scrub (incl. Joshua tree woodland)	**score**
	Great Basin scrub	**score**
	chenopod scrub	**score**
	montane dwarf scrub	**score**
	Upper Sonoran subshrub scrub	**score**
	chaparral	**score**
Grasslands, Vernal Pools, Meadows, and other Herb Communities	coastal prairie	**C. 5-20%**
	valley and foothill grassland	**score**
	Great Basin grassland	**score**
	vernal pool	**score**
	meadow and seep	**score**
	alkali playa	**score**
	pebble plain	**score**
Bog and Marsh	bog and fen	**score**
	marsh and swamp	**score**
Riparian and Bottomland	riparian forest	**score**
	riparian woodland	**score**
	riparian scrub (incl.desert washes)	**score**
Woodland	cismontane woodland	**score**
	piñon and juniper woodland	**score**
	Sonoran thorn woodland	**score**
Forest	broadleaved upland forest	**score**
	North Coast coniferous forest	**D. prese**
	closed cone coniferous forest	**D. prese**
	lower montane coniferous forest	**score**
	upper montane coniferous forest	**score**
	subalpine coniferous forest	**score**
Alpine Habitats	alpine boulder and rock field	**score**
	alpine dwarf scrub	**score**

* A. means >50% of type occurrences are invaded; B means >20% to 50%; C. means >5% to 20%; D. means present but ≤5%; U. means unknown (unable to estimate percentage of occurrences invaded).