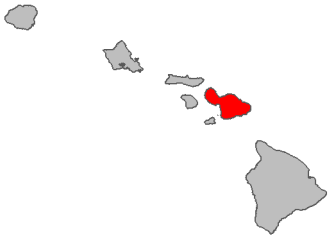
Fire risk report for *Pinus radiata*

Full Species Name *Pinus radiata* D.Don
Family: Pinaceae
Common names: Monterey pine
Synonyms:
Known occurrences (as of 2020) 
Year first documented as naturalized in Hawai'i: 1999
This species has been ranked by the Hawai'i Weed Risk Assessment program as High Risk with a score of 9.
View photos on Starr Environmental
View on Wikipedia
View occurrences on iNaturalist
View at Plants of Hawaii
View photos on Flickr

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Lowest risk ⇔ Highest risk

This species is likely a **high** fire risk in Hawai'i with a fire risk score of **0.61**.

This species was ranked by 49 managers on a scale of 'no risk', 'low risk', 'medium risk', or 'high risk'. The numerical score ranges from 0 to 1 with higher scores indicating more managers considered it a higher risk. A score of > .31 indicates high risk.

Summary of Fire ecology	
Native habitat fire proneness	Fire-prone
Fire promoting plant in its native range	No
Fire promoting plant in its introduced range*	Yes
Regenerates after fire	Yes
Promoted by fire	Yes
Reported flammable*	High
Relative is flammable*	Yes

*These values were used by the model to predict fire risk

Detailed summary of Fire Ecology

Native habitat fire proneness (In any part of the plant's native range is its habitat described as fire prone due to natural or human caused fires?)	Fire-prone	"High severity fire has been reported to be the main disturbance agent that initiates seedling establishment for this species... Average mean fire return intervals were 11.2–20.1 y." https://doi.org/10.1674/0003-0031(2004)152[0025:FRARFS]2.0.CO;2 Stephens, Scott, Douglas Piirto, and Domenico Caramagno. "Fire Regimes and Resultant Forest Structure in the Native Año Nuevo Monterey Pine (Pinus Radiata) Forest, California." The American Midland Naturalist 152, no. 1 (2004): 25–36. ---------- "Monterey pine (P. radiata), ... ranked in the upper half of most of the burn categories. These highly flammable species are prominent in communities for which fire return intervals are two to four decades." Fonda, R. W., Belanger, L. A., & Burley, L. L. (1998). Burning characteristics of western conifer needles. Northwest Science 7 (1): 1-9
Fire promoting plant in its native range (Does the species act as a major fuel source, increase fire severity, frequency, or modify fuel bed characteristics within its native range?)	No	
Fire promoting plant in its introduced range (Same as Fire Promoting Native but within the species introduced range)	Yes	"Dense thickets of self-sown Pinus radiata (wildings), which develop after thinning operations in mature P. radiata plantations in Western Australia, are an additional source of fuel and have been observed to promote crown Tire development during wildfires" https://doi.org/10.1080/00049158.1989.10674535 Burrows, N, Y Woods, B Ward, and A Robinson. "Prescribing Low Intensity Fire to Kill Wildings in Pinus Radiata Plantations in Western Australia." Australian Forestry 52, no. 1 (1989): 45–52. ----------

		"Consistent with Wyse and others (2016), shoots of P. radiata were among the least flammable species that we burned. However, Franzese and Raffaele (2017) found fire to be a key driver of serotinous Pinus invasions (such as P. radiata) in the Southern Hemisphere, and Pinus species are known to pro- mote fire in other ecosystems https://doi.org/10.1007/s10021-017-0195-z Cobar-Carranza and others 2014; Taylor and others 2017)" (Wyse, Sarah, George Perry, and Timothy Curran. "Shoot-Level Flammability of Species Mixtures Is Driven by the Most Flammable Species: Implications for Vegetation-Fire Feedbacks Favouring Invasive Species." Ecosystems 21 (2018): 886–900. ---------- "Pinus radiata stands are highly productive because of the mild climate in the area, but understory fuel accumulation is also high, and loads of 30–50 tonnes (t)/ha are frequent (Vega 1985; Vega et al. 1987). This situation, together with the low litter moisture content that may be reached in dry summer periods (Ruiz-González and Vega-Hidalgo 2005; Ruiz-González 2007), makes possible the occurrence of high-intensity surface fires, which may result in torching or crowning" https://doi.org/10.1139/x10-237 Ruiz-González, A. D., & Álvarez-González, J. G. (2011). Canopy bulk density and canopy base height equations for assessing crown fire hazard in Pinus radiata plantations. Canadian Journal of Forest Research, 41(4), 839–850.
Regenerates after fire (Does the plant regrow after fire by any means? This includes resprouters, reseeders, and recruiters which dispersed into the area within approximately one year post fire)	Yes	"Fifty-one percent of the Monterey pine trees in all openings regenerated within 5 y of three mixed severity fires. This was well below the predicted value of 75% that was based on the literature and life history characteristic of Monterey pine." Stephens, S. L., Piirto, D. D., & Caramagno, D. F. (2004). Fire regimes and resultant forest structure in the native Ano Nuevo Monterey pine (Pinus radiata) forest, California. The American midland naturalist, 152(1), 25-36.
Promoted by fire (Does the plant increase in abundance after a fire?)	Yes	"Monterey pine cones open and release seed after fire [19]. In California, White [in 52] reported a seedling density of 196 per acre (490/ha) the January following a spring wildfire." https://www.fs.fed.us/database/feis/plants/tree/pinrad/all.html#FIRE%20ECOLOGY

Reported flammable (Is the species described as being flammable, being a major wildfire fuel, or high fire risk?)	High	"Flammability category: moderate" https://doi.org/10.1007/s10021-017-0195-z Wyse, Sarah, George Perry, and Timothy Curran. “Shoot-Level Flammability of Species Mixtures Is Driven by the Most Flammable Species: Implications for Vegetation-Fire Feedbacks Favouring Invasive Species.” Ecosystems 21 (2018): 886–900. --- "Monterey pine (P. radiata), ... ranked in the upper half of most of the burn categories. These highly flammable species are prominent in communities for which fire return intervals are two to four decades." Fonda, R. W., Belanger, L. A., & Burley, L. L. (1998). Burning characteristics of western conifer needles. Northwest Science 7 (1): 1-9
Relative is flammable (Does a plant in the same genus meet the Reported Flammable criteria?)	Yes	"Its invasive capacity can vary depending on the type of vegetation and may be facilitated by fire (Richardson et al., 1994), which is commonly experienced in forests and woodlands dominated by P. pinaster due to its highly flammable resinous needles which accumulate under the canopy " https://doi.org/10.1016/j.foreco.2020.118042 Etten, Eddie van, C. Anne Belen, and María Calviño-Cancela. “Invasion Patterns of Pinus Pinaster in South-West Australia in Relation to Fire, Vegetation Type and Plantation Management.” Forest Ecology and Management 463 (2020): 118042.

Text in quotes are direct quotes from the source
Text in square brackets was added by the assessor to clarify something or to summarize from a figure.
Text preceded by a “#” is comment from the assessor

The data presented were assembled from literature and database searches for each species using as much data as could be collected regarding the plant’s fire ecology under natural conditions. Searches aimed to be exhaustive and consist of as much data as could be located in 2020. Our machine learning algorithm was trained on 49 species of plants which had their fire risk ranked by 49 managers in Hawai’i in November 2020. The model used a conditional random forest regression algorithm to predict scores for each species using the manager score as the response variable and the fire ecology traits of each plant as the predictor variables to generate a fire risk score. This trained model was then used to predict the fire risk for all species which were not ranked by managers. The model was calibrated such that it is 90% accurate at

predicting high fire risk plants and 79% accurate at predicting low fire risk plants. This research and the resulting fire risk model has been published in the journal Biological Invasions by Kevin Faccenda and Curt Daehler (both at the University of Hawai'i at Mānoa).

Note that the analysis doesn't account for a plant species' spatial distribution, population density, or distinct climate and ecosystem conditions (which can also influence fire risk). The fire risk of these species are mostly under "worst case" environmental conditions where the climate is dry enough to maintain fire, but wet enough to allow for plant growth and fuel accumulation. The fire risk ranking should not be taken as a stand-alone risk metric in prioritizing weed control efforts. Rather, this information may also be useful for determining if a newly discovered species poses a potential fire threat in wildland areas.

More general information on the weed risks and ecology of non-native plants in Hawai'i is available from the Hawai'i Invasive Species Committee's Weed Risk Assessment database.

View more fact sheets at https://www.pacificfireexchange.org/weed-fire-risk-assessments

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Fact sheet prepared by Kevin Faccenda (faccenda@hawaii.edu) in November 2021. Data were prepared by Ronja Steinbach and Kevin Faccenda in 2020.

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