

# *In situ* genetic conservation of Monterey pine (*Pinus radiata* D. Don): Information and recommendations

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# Foreword

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Monterey pine occupies a special niche in California. It is valued in its native forests for the scenic character it gives those environments. It is less well recognized for the ecosystem services it provides in those forest ecosystems. As an agroforestry crop in California, it is found in the Christmas tree trade and used in landscaping. Dwarfing this relatively small commercial value in California, however, is the value of Monterey pine as a plantation tree elsewhere in the world, especially in the southern hemisphere. Because most of the native Monterey pine forests are found in California, this means that, for better or worse, these California forests are the primary remaining reservoir for the native genetic diversity of the species upon which the long-term success of the commercial plantation enterprises may ultimately depend.

This situation is in striking contrast with the status of most California plant commodities and the sources of their genetic diversity. Of California's approximately 300 commercial plant commodities, only a very few derive from the native flora of the State or even from the rest of the nation's flora. California is gene-resource poor for the commodities that make it the number one state in agricultural production in the USA. Thus, Monterey pine is exceptional in that the genetic resources to sustain this species as a global commodity exist only in California and on two Mexican islands off the west coast of the Baja California peninsula.

Is California doing a good job with its stewardship of its native Monterey pine genetic resources? Unfortunately, the answer is negative because there are many factors which make California's stewardship very challenging. The entities that own and manage native Monterey pine forests are diverse—state, county, regional, and city governments; land trusts; universities; nonprofit organizations; companies; and private owners. This diversity complicates planning and management processes and has contributed to controversies concerning the status of the species.

To date there is no unified plan or process to sustain the conservation of Monterey pine in California. This report is a substantial contribution in support of Monterey pine stewardship which can lead to a plan for action. Included are details about the issues of Monterey pine forest and species management, biological aspects of growth and reproduction, and descriptions of the genetic and social issues which make the long-term survival of this species vulnerable. The recommendations pertinent for the *in situ* conservation of this species comprise a framework for action by the several institutions, organizations, and commercial and private interests that have a role in managing and conserving Monterey pine in California. At the forefront of the report are the genetic issues that provide the rationale for conserving the native genetic diversity and underlie the offered recommendations. It is critical that scientific considerations and evidence drive the debate and guide the actions impacting the forests at every level, whether under private or public ownership.

This document is an example of the UC Genetic Resources Conservation Program's efforts to fulfill its mission of facilitating the conservation of genetic resources of California commodities and native species. Many persons have participated and were consulted during the preparation of the report and participated in its review. We sincerely hope that the appropriate agencies, organizations, companies, and individuals will advance the cause of science-based conservation of Monterey pine, one of California's important and interesting species.

*Calvin O. Qualset  
Patrick E. McGuire*

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# Preface

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Monterey pine (*Pinus radiata* D. Don) is native to a narrow range and currently restricted to three populations along the central coast of California and one on each of two Mexican islands off Baja California. Seed collections from mainly two of these populations have formed the basis of breeding programs in Australia, Chile, New Zealand, Spain, South Africa, and other countries. The domesticated and commercially improved progeny from these programs are now of significant economic value, growing in plantations worldwide on over 4 million ha. In California, Monterey pine has commercial value as a Christmas tree and horticultural species. However, its greater value in California is best measured with other currencies—adding aesthetic value to coastal landscapes, defining a forest ecosystem with a diverse array of understory species, and harboring a gene pool that constitutes the species' evolutionary potential and traits possibly of future economic interest.

With the majority of its extant natural range in an increasingly populated and urbanized area, Monterey pine has lost considerable habitat and its genetic integrity may be compromised. Figures describing its loss of habitat vary, but most estimates converge on 50%. This loss, together with habitat fragmentation, continues with new housing and recreational developments. The majority of stands in the California populations occur on private property. Other concerns include genetic contamination from widely planted nonlocal Monterey pine throughout the natural California range of the species. Pitch canker disease, caused by the introduced fungus *Fusarium circinatum*, has been causing heavy mortality of Monterey pine in California within the last decade. Fire suppression throughout the California range of the species has likely affected natural regeneration and contributed to shifts towards oak-dominated forests in some areas. These threats to genetic diversity and integrity are cumulative, and exacerbated by the additional selective pressures of climate change. The Guadalupe Island population is on a trajectory towards extinction, suffering from lack of regeneration due to grazing by introduced goats. The second island population—on Cedros Island—may have fewer

threats, but comprehensive genetic information on this population is not available. It is within this context of both domestic and international values, and serious concerns for the long-term viability of the species in its native habitat, that this report is undertaken.

Genetic diversity underlies all biological diversity. It allows local populations of a species to adapt to a variety of niches. It provides evolutionary flexibility for the species to adjust in the long term in response to changing climates and other conditions. Thus, both spatially and temporally, genetic diversity provides a species with the potential to adjust to environmental changes.

The overall objective of *in situ* genetic conservation for Monterey pine is to provide the best opportunity, given current information and understanding of the species' biology, to maintain adaptive potential and patterns and levels of genetic diversity that are within the historical range for the species. Genetic conservation plans must be firmly based on the available scientific information if they are to be the basis of effective policies and practices.

Given the diverse ownership of Monterey pine forests, the array of influences and their relative significances across the five populations, and the dearth of basic planning tools such as accurate current descriptions of the remaining forests, this report is meant to provide support for *in situ* genetic conservation. This report summarizes the available science—primarily evolutionary, genetic, and ecological information—that relates to genetic conservation of Monterey pine; presents available information about the native populations, their genetic threats, and their *ex situ* reserves; and provides specific conservation principles and recommendations towards genetic conservation of the species.

The primary audience for whom this report has been prepared includes forest owners, managers, and educators: those in a position to directly practice or influence *in situ* genetic conservation. In a broader sense, it can provide support to those who value, manage, study, or administer the native forests of Monterey pine. It is also potentially of use to scientists, administrators, policy-makers, and regulators.

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Participants in an April 25–26, 2000 workshop near Big Sur, California, contributed to the development of the genetic conservation recommendations. Some of the recommendations reflect outcomes from discussions among the 25 participants (Appendix A). However, many recommendations were refined or developed after the workshop, and none are necessarily consensus statements. Participants in an October 10, 2001 workshop at Pebble Beach, California, contributed to the development of a list of invasive, exotic plant species in native Monterey pine forests in California.

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