

GENE CONSERVATION IN CALIFORNIA'S FORESTS

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The University of California's Wildland Resources Center has established a new program of forest gene conservation to ensure that California's rich and diverse forests maintain their vigor and productivity in the face of human activities. At an international level, conservation biologists recognize the importance not only of protecting rare species from extinction by safeguarding habitats, but of caring for the genetic diversity of estab-

lished forests. In some parts of the world past neglect, insufficient knowledge of genetics, and indiscriminate forestry practices have resulted in forests that are impoverished by a loss of genetic diversity. These practices include repeated harvesting of the best trees, leaving poorer specimens to reproduce; planting species and individuals that are poorly adapted to local soil and climatic conditions; allowing exotic weed trees to escape into forests; and excessively logging areas with steep slopes or unusual soils. All of these practices result in reduced levels of productivity and lowered long-term genetic adaptability, including greater susceptibility to infestations of pests. Recognizing this vulnerability of trees to man's interventions, forest geneticists have mounted a worldwide effort to protect threatened and sensitive forest areas and to prevent future misuse of forests still in wild condition.

In California we have benefited from knowledge gained in forests around the world. We are also fortunate in that many California forests retain the genetic diversity expected under natural conditions. Nevertheless, many forested areas in California are threatened by forestry practices that will erode their genetic quality.

Professional foresters and forest geneticists from private industry, the California Department of Forestry, and the USDA Forest Service's Tree Improvement Center and Institute of Forest Genetics are working together to protect the genetic diversity of our forests. Some of the techniques they use include reforesting areas, where possible, with locally collected seed; establishing breeding zones so that seeds are collected for a specific area only from areas with closely related elevations; and preserving an assemblage of species resembling that found under natural conditions. These groups have integrated guidelines for gene conservation into their forest management strategies and sponsor gene conservation research.

At least two private groups, the National Council on Gene Resources, a research and educational organization, and GenRec, a consulting firm, specialize in gene conservation analysis. The California Native Plant Society is dedicated to gene conservation through the protection of rare and endangered species and habitats.

Currently, gene conservation programs follow two

Sequoiadendron giganteum (giant sequoia) growing in King's Canyon National Park provides an example of a forest tree to be protected through the University of California gene conservation program.



main approaches: *ex situ* and *in situ* management. The former usually consists of collecting and storing seeds and pollen in long-term storage banks or of creating tree plantations by planting genetically identical specimens cloned by tissue culture or by cuttings. These approaches preserve genes in a static condition (as seeds or clones) and freeze natural evolutionary processes. In the future, if there is a need to return to the genetically diverse parent stock, the stored seeds or established clones can be grown into trees and the preserved genes integrated into ongoing forest management programs.

The *in situ* approach recognizes both that species exist in interbreeding communities subject to natural selection and that natural evolutionary processes tend to maintain genetic variability of individuals and species. Thus it emphasizes the value of preserving minimally managed areas where species are subject to natural processes, both physical and biological, and genetic diversity is more likely to be retained.

A new program of forest gene conservation was begun in summer 1985 on the Berkeley campus of the University of California. The project, under the direction of the Wildland Resources Center and financed by the California Environmental Protection Program (the automobile license plate fund), will provide information and resources to protect the genetic diversity of California's forest flora. The program consists of four projects, each of which will address a specific problem in gene conservation. The first will prepare a computer-based

Pinus radiata (Monterey pine) growing on Monterey peninsula provides an example of a forest tree to be protected through the University of California gene conservation program.



Hedges of *Pinus radiata*, used in *ex situ* cloning at the Russell Reservation, are clipped annually to produce genetically identical shoots that are easily rooted.

catalog of lands in California where *in situ* forest gene conservation can occur. Although many acres in California are allocated for preservation in national forests and national and state parks, the extent of protection of forest species and communities is unknown. The catalog will provide information on the adequacy and types of protection provided by existing preserves and will identify gaps in protection of forest gene resources.

The second project will restore valuable *ex situ* gene conservation collections that have suffered due to lack of funds for maintenance. Seed collections and clonal plantations of several important species, including Monterey pine, coast redwood, and giant sequoia, will be inventoried and renovated by new cloning and creation of new plantations. A long-term maintenance program will be established.

The third project will complete seed collections in California for long-term storage from the ranges of Douglas fir and ponderosa pine. These important timber species are among the most productive and valuable forest trees in the world and at present contain vast stores of genetic variation that should be protected for the future. An extensive seed collection also will be made for Brewer spruce, an endemic species limited to a few locations in northern California and southern Oregon.

The fourth project of the forest gene conservation program will undertake extensive studies of geographic patterns of genetic variation in ponderosa pine, Douglas fir, and Brewer spruce. Seeds will be analyzed with a standard laboratory technique of electrophoresis, which shows protein diversity, used as an indicator of genetic diversity. Such information will allow wise decisions to be made on the nature and adequacy of a gene protection program for these species.

It is anticipated that the University of California's gene conservation program will continue for several years and that it will provide the tools for genetic conservation of important tree species in California.