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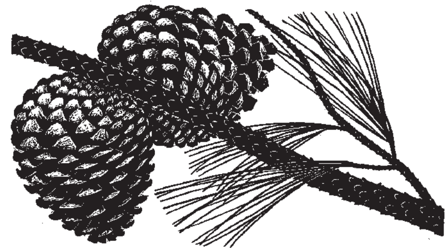
Models of genetic conservation plans



The United States does not have a comprehensive strategy for conserving forest genetic resources or a national program for long-term *ex situ* conservation of forest genetic resources (Riggs 1990; Ledig et al. 1998). Some European countries are more proactive and have some level of national planning for forest genetic conservation. Many European countries are members of a coordinated effort to ensure the effective conservation and the sustainable use of forest genetic resources in Europe. This organization—the European Forest Genetic Resources Programme (EUFORGEN)—was established in 1994 as an effective means of promotion and coordination of *in situ* and *ex situ* conservation of genetic diversity, exchange of reproductive materials, and monitoring progress in these areas (Turok et al. 1998). The organization is coordinated by the International Plant Genetic Resources Institute (IPGRI), in collaboration with the Department of Forestry of the FAO. Much of the work is conducted through smaller groups—known as networks—that focus on genetic conservation issues for a particular species (e.g., *Picea abies*, *Quercus suber*, *Populus nigra*) or groups of species. Through this coordination, complementary conservation activities can be undertaken and much or all of the natural range of a particular species can be considered.

A similar type of cooperative—the South Pacific Regional Initiative on Forest Genetic Resources (SPRIG)—aims to provide coordination and support for planning genetic conservation and management of forest tree species in this region. For example, general strategies for the conservation, management, and utilization of Highlands Yuka (*Dacrydium nausoriense*) in Fiji and Santo kauri (*Agathis silbæ*) and whitewood (*Endospermum medullosum*) in Vanuatu have recently been produced (Tuisese et al. 2000; Corrigan et al. 2000a; Corrigan et al. 2000b; respectively). All three are economically valuable species and more research has been recommended towards the development of comprehensive and scientifically sound conservation strategies.

Some European countries have overall plans for their forest tree species or plans for some species of particular economic importance. A strategy for the conservation of the genetic resources of 75 tree and shrub species in Denmark was prepared in the early 1990s (Graudal et al. 1995). This strategy was based on the recognition of the historical and continuing influences on genetic diversity in these species, and the need to make a focused and systematic effort to conserve the adaptability and utility of these species in the long term. A guide for planning national programs for conservation of forest genetic resources has been developed by geneticists in Denmark (Graudal et al. 1997). This is an excellent guide, particularly for situations when there are numerous species that are widespread in their natural ranges, thus requiring the setting of priorities and the selection of conservation opportunities such as determination of genecological zones, socioeconomic values, and conservation methods. Another example is the Finnish network of *in situ* gene reserve forests for their major commercial forest tree species (Koski 1991). In general, though, there are few comprehensive networks of reserves dedicated to *in situ* genetic conservation of forest tree species, although there are many examples, worldwide, of reserves to conserve the genetic resources of a particular population of a taxon (Kanowski and Boshier 1997).

Few cases exist that can serve as a direct and complete model for a genetic conservation plan for Monterey pine—concerning a single forest tree species, covering the entire natural range of the species, containing both *ex situ* and *in situ* elements, and focusing on the genetic structure, underlying principles, and opportunities for genetic conservation. Existing single-species conservation plans are more general and often do not include a comprehensive description of genetic variation or enunciate genetic principles. Many plans are concerned with a threatened or endangered species with little natural habitat and few opportunities for specific genetic conservation (e.g., species recovery plans of the U.S. Fish and Wildlife Service). Existing genetic conservation plans are often only concerned with *ex situ* resources (e.g., Spencer et al. 1998) or are restricted by jurisdiction (e.g., state or agency) and thus do not consider the full natural range of the species (e.g., Wilson 1990).

In North America, perhaps one of the highest-profile forest tree species with considerable attention provided to conservation of its genetic resources is Douglas-fir. Like Monterey pine, this is a commercially valuable species. But unlike Monterey pine, Douglas-fir has a wide natural range that extends from western Canada through many western states in the USA and into Mexico. Although there is no rangewide overall genetic conservation plan for Douglas-fir, particular reports and activities have been undertaken in specific regions. An assessment and conservation plan for the genetic resources of Douglas-fir in California were prepared in the early 1980s (California Gene Resource Program 1982). Another regionally focused effort is the establishment of gene pool reserves of Douglas-fir in the state of Washington (Wilson 1990). This *in situ* conservation plan is restricted to that part of the species' range that occurs on public (i.e., State of Washington Department of Natural Resources (DNR)) forests in Washington state and focuses on *in situ* reserves. These reserves were established in recognition of concern over genetic contamination of natural populations of Douglas-fir due to increasing areas planted with genetically improved seeds that were derived from a fraction of the species' natural genetic variation and concern for the largely unknown effects from selection pressure due to forest management practices. Reserves (areas protected from harvesting) were established according to elevation and seed zones—the latter reflecting genetic differentiation among populations. As of 1988 over 100 gene pool reserves had been located and designated, amounting to 1050 ha or 0.19% of DNR forest land. Although selection criteria favored the designation of old-growth areas, this was not always possible due to historical harvesting practices. Thus, some gene pool reserves, particularly those in lower-elevation and higher-access forest areas, were second generation. However, records were checked to ensure that the regeneration in these areas was natural. These reserves were designed and selected with the best available information. Ongoing concerns include genetic contamination from adjacent (and artificially regenerated) forests and loss of gene pools by natural disturbances such as fire.

The DNR gene pool reserves for Douglas-fir also provide experience on the challenges of maintaining an *in situ* genetic conservation program over time. Since implementation, approximately 25% of the reserves have been administratively lost—that is, traded or transferred to different ownership. Some of those reserves affected can still function as genetic reserves under the new ownership but the coordination and management necessary to achieve specific genetic outcomes have been lost or lessened. The DNR maintains a strong commitment to their genetic conservation policy. However, over time, decisions about land transfers and management necessarily consider the institutional values and responsibilities with which DNR is charged, which are broader than genetic concerns (J.D. DeBell, pers. comm.).

Internationally, there are examples of forest tree species that are of particular conservation concern and have attention focused on the conservation of their genetic diversity. A genetic conservation plan has been developed for *Leucæna salvadorensis*, a threatened tree species native to El Salvador, Honduras, and Nicaragua (Hellin and Hughes 1993). It has a largely contiguous distribution in the seasonally dry, deciduous tropical forest association on south-facing Pacific slopes. Its genetic resources have been severely degraded as a result of habitat loss to farming. *In situ* conservation methods are compromised because very little natural habitat remains. However, farmers have traditionally maintained some trees of this species around houses and in fields and fencelines, meaning that the species has more presence than would be indicated by the loss of forest cover. There is, therefore, an opportunity here to encourage the interest and traditional protection by farmers, involving them in seed collection, planting, and protection efforts. *L. salvadorensis* can grow on shallow soils and under drought stress, producing high-quality wood. Accordingly, its genetic resources are valued as a possible means of improving the widely cultivated congeneric species, *L. leucocephala*, as well as other species with domestication potential in their own right.

English yew (*Taxus baccata*) has a natural distribution throughout most of Europe, yet remains as part of a natural plant community in only a few stands and is generally considered to be a declining species. It is also cultivated for ornamental purposes. One of the largest protected areas—the Wierzchlas Reserve in Poland—has suffered a major loss in number of living yew trees in the last 80 years. Genetic analysis showed that this loss is not a direct result of low genetic diversity in this population (Lewandowski et al. 1995), as previously thought. In fact, there is apparently high genetic diversity within this species as compared with other conifers. The genetic study turned attention over the species' decline towards environmental factors that limit natural regeneration, such as soil pathogens. Thus, the value of the Wierzchals Reserve as a gene pool reserve and the need for a longer-term genetic strategy, including *ex situ* conservation, have been recognized.

The conservation of wild relatives (usually congeneric species) of agricultural crop varieties has become a shared priority of agricultural geneticists and conservation biologists (Frankel and Soulé 1981). Because the domestic use of improved germplasm far exceeds the census of the natural populations, conservation of the native populations of Monterey pine could be considered in this light. From this perspective, the value of conserving the native gene pools is not only to protect the genetic source of derived families, but to safeguard the opportunity to understand the web of ecological relationships and coevolved species and thus to provide unique (i.e., unavailable in *ex situ* repositories) opportunities to improve the breeding or management of domestic germplasm (Tewksbury et al. 1999).