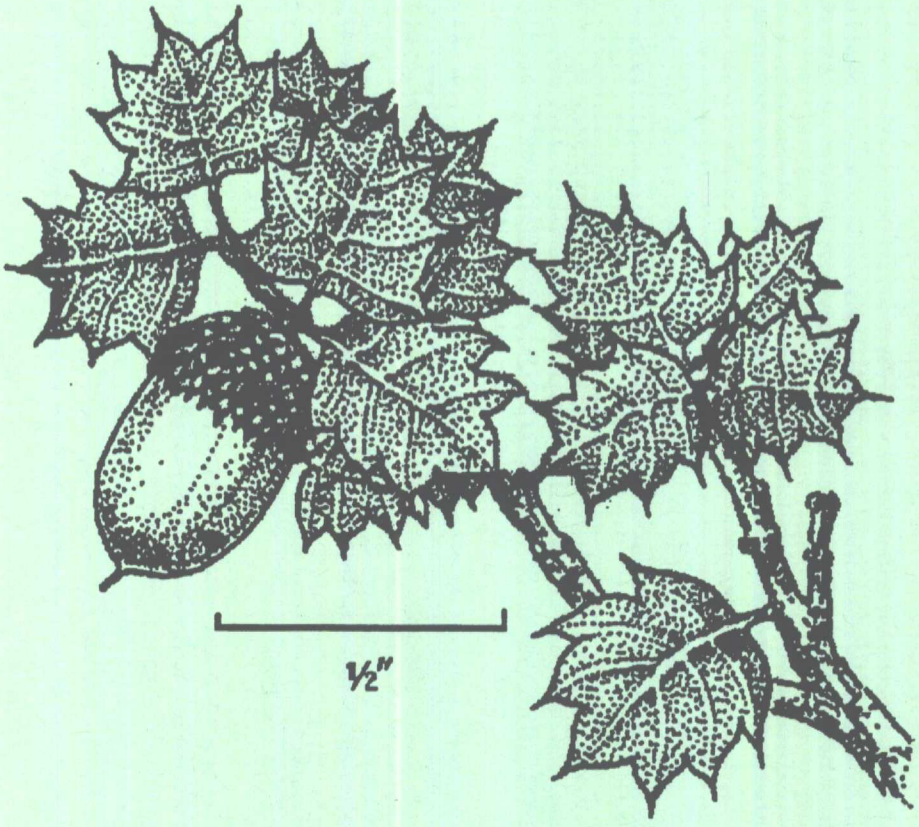
Hinckley Oak Recovery Plan
(*Quercus hinckleyi*)



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HINCKLEY OAK

(Quercus hinckleyi)

RECOVERY PLAN

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Approved: _____
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DISCLAIMER

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LITERATURE CITATION

Literature Citations should read as follows:

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EXECUTIVE SUMMARY OF THE HINCKLEY OAK RECOVERY PLAN

Current Species' Status: Quercus hinckleyi (Hinckley oak) is listed as threatened. It is known from 10 sites in Presidio County of western Texas. Nine of the sites are on the Big Bend Ranch State Natural Area, which was acquired by the State after the species was listed.

Habitat Requirements and Limiting Factors: Quercus hinckleyi grows on dry limestone slopes in the Chihuahuan desert. Evidence from fossil pack rat middens indicates the species was more common some 10,000 years ago when the regional climate was more mesic. The species has declined with changing climatic conditions, and today has a limited and fragmented distribution. Immediate threats include low numbers of populations with few individuals, wildlife and insect predation, possible hybridization with other oak species, and apparently poor regeneration from seed.

Recovery Objective: Delisting

Recovery Criteria: Attain at least 20 viable self-sustaining populations in at least 4 geographically distinct population centers and attain a total of at least 10,000 individual plants. Demonstrate population viability at recovery levels for 10 consecutive years.

Major Actions Needed:

1. Protect populations from present and future threats.
2. Establish a reserve seed bank and cultivated population.
3. Gather biological data necessary for management decisions.
4. Search for new populations.
5. Develop plans for reintroducing plants into suitable habitat.

Total Estimated Cost of Recovery ($000's):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Total
1993	45.3	2.5	51.5	11.0	17.0	127.3
1994	32.8	5.5	42.5	8.5	7.0	96.3
1995	32.8	3.0	39.0	5.0	7.0	86.8
1996	15.5	3.0	13.0	0.0	0.0	31.5
1997	15.5	3.0	13.0	0.0	0.0	31.5
1998-2012 (each)	15.5	0.0	0.0	0.0	0.0	15.5
Total	374.4	17.0	159.0	24.5	31.0	605.9

Date of Recovery: Populations at recovery levels should be attained in 10 years with a continuous effort. Delisting can be initiated in 20 years (2012) if populations can be sustained at recovery levels.

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PART I - INTRODUCTION AND BACKGROUND

Brief Overview

Quercus hinckleyi (Hinckley oak or chaparro) was Federally listed as threatened on August 26, 1988 (U.S. Fish and Wildlife Service 1988). No critical habitat was designated. Quercus hinckleyi is also listed as threatened by the State of Texas (Texas Parks and Wildlife Department, Executive Order no. 88-003, on December 30, 1988). Quercus hinckleyi has a recovery priority of 8. Recovery priorities for listed species range from 1 to 18 with species ranking 1 having the highest recovery priority. A recovery priority of 8 indicates that this is a full species, the degree of threat is considered moderate (does not face immediate extinction if recovery is temporarily held off), and it has high recovery potential (U.S. Fish and Wildlife Service 1983a, 1983b).

Quercus hinckleyi is an evergreen shrub with distinctive holly-like leaves that make it attractive to horticulturists. It was first described by Dr. C. H. Muller in 1951, and is known only from Presidio County, Texas, a part of the arid subtropical Trans-Pecos region. It is apparently a relict species declining in abundance with climatic change and becoming restricted in its present distribution (Muller 1951, Miller and Powell 1982).

Quercus hinckleyi is found on arid limestone slopes of moderate elevation that support a typical climax Chihuahuan Desert vegetation. Little is known about the biology of the species (Miller and Powell 1982, Poole 1988a).

Currently only ten populations are known. Nine of these are on the Big Bend Ranch State Natural Area, the other is near Shafter, Texas. Most populations consist of less than 100 individuals and cover an area of less than 5 acres.

Quercus hinckleyi is threatened by low numbers of populations and low numbers of individuals, possible hybridization with adjacent Quercus species, roadway construction and maintenance activities, taking by horticultural collectors, browsing of leaves and consumption of acorns by wildlife and livestock, and insect damage.

Taxonomy

Quercus hinckleyi is a narrowly endemic species of oak (family Fagaceae). The first known collection was made in 1950 from the Solitario (Presidio County, Texas), and is attributed to Dr. L. C. Hinckley. Dr. C. H. Muller, a noted systematist working on oaks, collected specimens from the same location a month later, and eventually described it as a new species, named

in honor of Dr. Hinckley (Muller 1951). He placed the species within his series Glaucoideae. The type specimen is located in Dr. Muller's herbarium at Santa Barbara, California.

Morphology

The most notable features of this species are its leaves, which are small, smooth, broadly oval, noticeably thickened, and markedly spiny on the margins (superficially holly-like). This, combined with its small stature, thicket-forming habit with intricate, multiple-branched stems, and gray-green color make it easily recognizable and distinctive within its group (series Glaucoideae).

Quercus hinckleyi is an evergreen shrub, most often forming patchy thickets that grow to a maximum height of 0.75 meters (2.5 feet). The plant usually has multiple stems, with relatively thin light brown twigs that may become waxy on second year growth. The buds are less than 1 millimeter (.04 inch) long, and reddish brown with short hairs on the margins. The leaves have rose-colored petioles 1-2 millimeters (.04-.08 inch) long, and hairy stipules at the base, 2 millimeters (.08 inch) long, that fall off later in the season. The leaf blades are very characteristic. They are thickened, gray-green, almost rounded, 5-15 millimeters (0.2-0.6 inch) long and broad, with a spiny tip and 2-3 spiny teeth on each margin. The flowers are unisexual, with the male flowers in 3-5 millimeters (0.12-0.2 inch) long catkins of only a few flowers each. The female flowers are tiny, inconspicuous, and densely hairy. Acorns are formed annually. They are oval, 8-12 millimeters (0.3-0.5 inch) broad, and usually only included in the cup at the base. The cup is shallow, up to 3 millimeters (0.12 inch) deep, and saucer-shaped.

Distribution, Abundance, and Land Ownership

Muller (1951) noted in his original species description that Quercus hinckleyi was a relict species, "likely not abundant anywhere". Later analysis of ancient pack rat middens (Van Devender, et al. 1978; Van Devender 1986) have shown that as much as 15,000 years ago the species was much more widespread over the area and comprised an element of a piñon-juniper woodland. The development of more arid climates is postulated to have resulted in restriction of the species to a few sites within its old range of distribution, resulting in a patchy distribution of a few populations with relatively few individuals.

Currently, only ten populations of Quercus hinckleyi are known. Estimates of numbers of individuals in the populations are difficult because the species often produces numerous vegetative root sprouts. Estimates of population size have been made for four of the populations and are 4, 37, 145, and around 500 plants (Poole 1984, 1986, 1988a, 1988b, 1989). Land area covered by each of the populations is less than 5 acres.

All of the populations known are in Presidio County (Fig. 1). One is on private land near Shafter, Texas, and nine are in the region of the Solitario, a unique geological feature located in Big Bend Ranch State Natural Area. The population on private land is being voluntarily protected by the landowner.

Five of the populations in the Solitario region have been reported only recently (Hilsenbeck, Sul Ross State University, Alpine, Texas, pers. comm.), and specific details (exact location, size, exact area, etc.) have not been received and verified, nor site descriptions done.

Other reports exist of additional populations in the area of Shafter, Texas, but these localities have not been recently verified.

Pack rat midden evidence (Van Devender 1986) and preliminary reports of similar vegetation and geology have resulted in speculation that Quercus hinckleyi might occur in Brewster County in Big Bend National Park, particularly the Dead Horse Mountains, but there are no confirmed records that the species has been found there in recent times, and surveys have not located it.

Habitat

Quercus hinckleyi occurs in an arid subtropical climate. Climatologists place it in the Trans-Pecos climatic area of Texas, which is extremely variable because of topographic differences. The area generally has great daily temperature fluctuations and an arid profile where evaporation exceeds precipitation. The closest climatic information available is from Presidio, located at a lower elevation and further south than the populations of Quercus hinckleyi, where temperatures are probably 3-4 degrees higher, and precipitation may be slightly lower. The average temperature is 30.4°C (86.8°F), with 178 days of 32.2°C (90°F) and above temperatures, and 44 days of temperatures below 0°C (32°F). The frost free season is 238 days, with average dates of the last and first freezes, respectively, being on March 10 and November 14. The average precipitation is

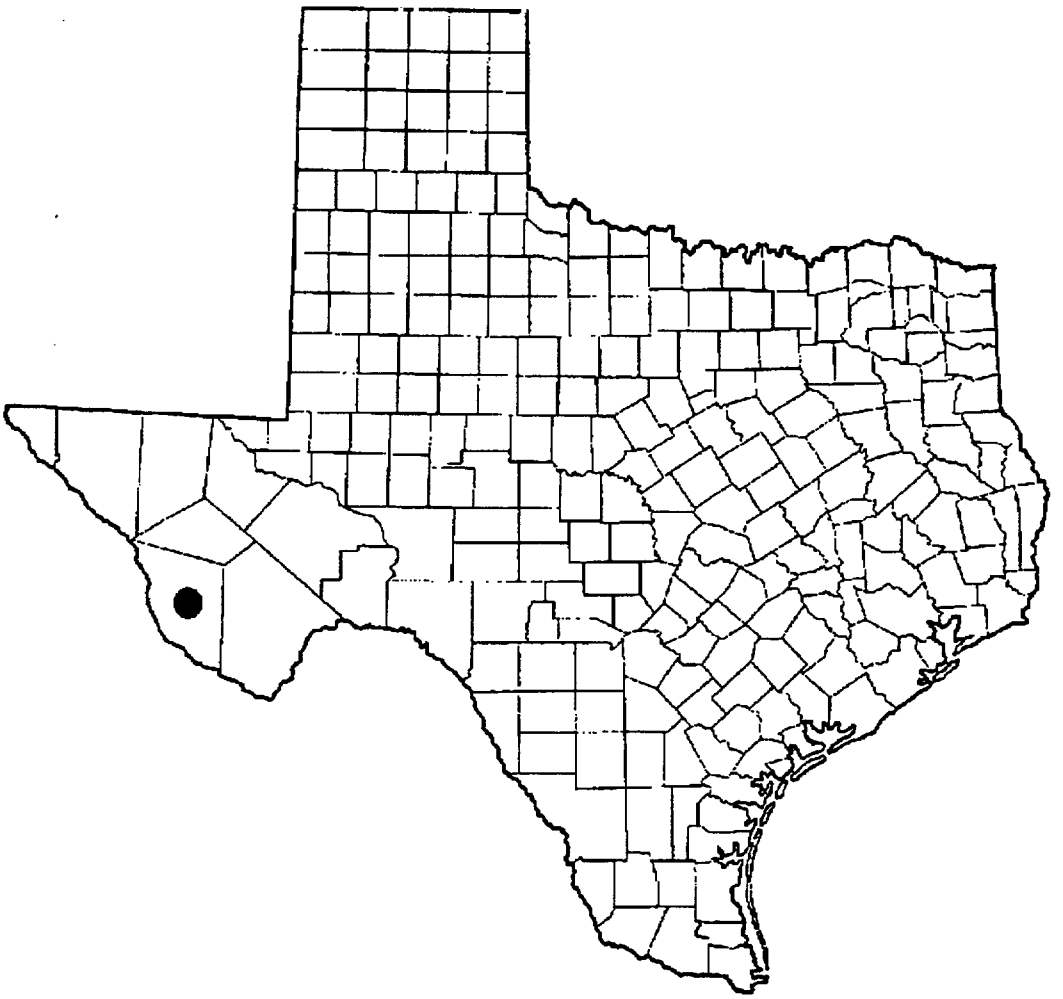

Figure 1. Distribution of Quercus hinckleyi.

23.4 cm (9.2 inches) with the lowest rainfall occurring in March (0.46 cm or 0.18 inch) and the highest occurring in September (4.19 cm or 1.65 inches) (Poole 1988a, University of Texas Natural Fibers Information Center 1987).

Quercus hinckleyi grows on dry limestone slopes between 1066.8 m and 1372 m (3,500 - 4,500 feet) elevation. Slopes where the species occurs are mostly north and west-facing. Geologic formations in its area of occurrence are all Cretaceous, including the Shafter Formation, Santa Elena Limestone, Sue Peaks Formation, Del Carmen Limestone, Telephone Canyon Formation, and Glen Rose Formation. The plants are found growing in cracks of solid rocks or extremely rocky soils (Poole 1988a). No detailed soil survey is available for Presidio County. Detailed characterization of the soils where populations of Quercus hinckleyi grow is needed.

Quercus hinckleyi populations occur in Chihuahuan Desert Vegetation, classified in Texas as a part of the Trans-Pecos shrub savannah of Kuchler (1964), and in the Creosote-Lechuguilla Shrub vegetation type of McMahon, Frye, and Brown (1984). The community is likely best placed in the Lechuguilla-sotol series characteristic of Chihuahuan desert slopes below 1372 m (4500 feet) (Diamond, Texas Parks and Wildlife Department, Austin, TX, pers. comm.) and grading into the Creosote bush-mariola series at lower elevations and flatter areas (Diamond, et al. 1987).

Associated Species

Complete characterization of the exact plant associations in the sites where populations of Quercus hinckleyi occur has not been done. Observers at the sites have noted that the vegetation appears to be a late-successional desert association, recovering from significant degradation due to past grazing (Diamond, pers. comm.).

A detailed plant list has been compiled for four sites in the Solitario, a unique geological feature in the Big Bend Ranch State Natural Area. Vegetation at the Solitario sites appears similar. Dominant shrubs include Agave lechequilla, Cowania ericifolia, Dasylirion leiophyllum, Forsellesia spinescens, Mortonia sempervirens ssp. scabrella, Rhus virens, and Viguiera stenoloba. Other shrubs include Acacia greggii, Acacia roemeriana, Bernardia obovata, Chrysactinia mexicana, Dalea greggii, Echinocereus stramineus, Ephedra sp., Euphorbia antisyphilitica, Fouquiera splendens, Larrea tridendata, Leucophyllum minus, Opuntia discata, Opuntia violacea, Parthenium incanum, Penstemon baccharifolius, Petrophytum caespitosum, Porlieria angustifolia, and Quercus pungens. No herb was noted to be a dominant, but herbs present included Aristida wrightii, Bouteloua curtipendula, Coryphantha echinus, Echinocereus

dasyacanthus, Eriogonum havardii, Gutierrezia sp., Menodora sp., Notholaena microphylla, Notholaena parvifolia, Polygala sp., Selaginella lepidophylla, Schizachyrium sp., Thelesperma longipes, and Zinnia acerosa (Poole 1984, 1987, 1988c, 1989).

The Shafter area site (near Shafter, Texas) has geological, edaphic (influenced by soil), and topographic differences, as well as differences in community composition, relative to the Solitario (Poole 1988b). A species list shows some similarity in species present. The dominant shrub is Agave lecheguilla. Other shrubs include Acacia roemeriana, Berberis trifoliolata, Bernardia obovata, Euphorbia antisyphilitica, Forestiera angustifolia, Fouquieria splendens, Mortonia sempervirens ssp. scabrella, and Zexmenia brevifolia. Herbs present included Bouteloua sp., Croton sp., and Thelesperma longipes (Poole 1988b).

Impacts and Threats

Climatic changes of the last 8,000-11,000 years, have resulted in the reduction of suitable habitat and fragmentation of populations. These are the primary reason the plant is rare today (Miller and Powell 1982). Where the species is found, it is fairly robust and does produce acorns. The species is vulnerable today because few populations are known, and each has a small number of individuals. The population centers are relatively widespread, limiting any potential gene flow. These conditions make the species vulnerable to catastrophic destruction and loss of genetic viability.

All observers report a very low level of regeneration in the stands of Quercus hinckleyi, with no juveniles reported, though in some years there have been heavy acorn yields (Bacon 1989, 1990). All reproduction appears to be vegetative. Populations may already have become so isolated, and the numbers of individuals fallen so low, that low genetic diversity has developed in the populations, reducing both fertility and the genetic ability to adapt evolutionarily to the changing environment (Hilsenbeck 1989).

Native deer are known to browse the plants and eat the acorns (Miller and Powell 1982). Small mammals and birds are also known to eat the acorns, and some epidermal damage caused by disease or insect predation (webs have been found on the branches) has been noted at the type locality (Miller and Powell 1982, U.S. Fish and Wildlife Service 1987, Poole 1988a).

One of the populations is very near a highway and roadway maintenance activities, or any further highway expansion or realignment, could constitute a threat to the species (Poole 1988a).

In the past, all of the populations were on private land. At least nine of these populations were subject to browsing and acorn consumption by livestock and wildlife, and the possible introduction of exotic game species. Overstocking of cattle or sheep and the introduction of goats or other browsing animals represented a potential threat to the small populations of plants (U.S. Fish and Wildlife Service, 1988). With the 1988 acquisition by the Texas Parks and Wildlife Department, 9 of the 10 known populations are now in the Big Bend Ranch State Natural Area where the species is protected by State Law. Although a specific management plan for Hinckley oak that addresses policies governing cattle grazing or the introduction of exotic species is not yet in place, the Texas Parks and Wildlife Department is currently developing a plan for the Natural Area that should include considerations for this species.

The rarity of the plant and its distinctive leaves have attracted the attention of collectors and horticulturists. Some taking of acorns in violation of State permit requirements and trespass laws has been reported (U.S. Fish and Wildlife Service 1988). In addition, acorns are reportedly collected legally every year at the Shafter population, reducing the possible recruitment to the natural population (Poole 1988a).

Oak species are known to hybridize freely, and hybridization with Quercus pungens var.vaseyana (Vasey oak) has been reported at one population of Quercus hinckleyi (U.S. Fish and Wildlife Service 1988). Genetic swamping by nearby native or introduced oak species is a potential problem, both for populations in the wild and any plants maintained under cultivation (Poole 1988a).

Conservation and Research Efforts

Conservation - Acquisition of the Big Bend Ranch State Natural Area by the Texas Parks and Wildlife Department resulted in the inclusion of 9 of the 10 known populations of Quercus hinckleyi on state land with conservation management objectives. The enforcement power against collecting is stronger in this situation and access for (and control of) research activities is improved. A specific management plan for Quercus hinckleyi populations on the natural area has not been developed.

The tenth population is located on private land, where it is voluntarily protected by the owner. Some collecting by scientists and horticulturists has been permitted. The extent and impact of this acorn depletion is unknown. Incidents of illegal taking of acorns have also been reported at this site, further depleting acorns available to the population for recruitment.

Research - Little is known about the specific habitat requirements of Quercus hinckleyi, nor its population biology and population ecology. This is a severe handicap in efforts to devise management plans for existing populations and recovery strategies for the species as a whole. It also makes difficult the prediction of necessary time and economic resources that must be allocated for recovery.

Several investigators, including Dr. Barton Warnock, Mr. Benny Simpson, and Dr. A. Michael Powell have for many years attempted to cultivate Quercus hinckleyi from acorns with some success (Poole 1988a). Attempts at cultivation have given rise to reported observations that the acorns germinate readily but have difficulty reaching establishment. Bacon (1989) conducted a preliminary study of propagation potential for Quercus hinckleyi, conducting trials using stem cuttings with and without a mist system, and tissue culture of meristematic tissue and green leaf tissue. Stem cuttings in a mist system and tissue culture of green leaf tissue showed some promise.

The San Antonio Botanical Center has initiated a cultivation program in cooperation with the Center for Plant Conservation, and has about 40 plants in cultivation at the present time. These plants have been grown from a collection of 60 acorns representing the Shafter area site only. They report success propagating cuttings from new growth as well, and are experimenting with air layering (Patty Leslie, San Antonio Botanical Center, pers. comm.). It has been reported that acorns cultivated from the Shafter site exhibit characters unlike the parents when cultivated, and there is suspicion of hybridization with neighboring Quercus pungens (Miller and Powell 1982, Poole 1988a, Bacon 1989).

Quantitative studies of cultivation requirements have not been published.

Bacon's work (1989) included qualitative observation of the phenology and reproduction of the species at two sites and heightens concern about population viability. No juvenile plants were ever seen. Plants appeared to flower normally but apparently fruit did not set at one site, and at the other site nearly all fruit aborted before reaching maturity.

Hilsenbeck (1989) has undertaken a multi-year study of genetic variability, hybridization, pollen fertility and morphology, reproductive phenology, and propagation techniques that will help address many questions concerning the species' reproductive biology.

PART II - RECOVERY

Objective and Recovery Criteria

The objective of this recovery plan is to determine if Quercus hinckleyi can be recovered, and if so to return the species to a condition where delisting is possible. Because the species is a relict of more mesic environments, it is unclear if the present habitat provides sufficient support for population viability. This fundamental lack of information about the practicality of full recovery is addressed in prescribed research activities in this plan.

If recovery is achievable for the species, then Quercus hinckleyi may be considered for delisting when there are enough populations established over a wide enough area that the threat of loss from a single catastrophic event is minimal. These populations should be in localities without exposure to hybridization from other oak species. In addition populations should contain enough individuals and variability to assure regeneration and viability. These populations should be demonstrated to be stable enough to survive a variety of seasonal conditions (wet and dry, high and low levels of predators, varying acorn production levels) and still have an age-class distribution that will support replacement of the mature plants. Estimates of numbers of individuals needed will necessarily be on the high side, to compensate for the problem of distinguishing distinct individuals in the field.

With our present level of understanding, the best estimate of when the previous conditions might be considered to have been achieved would be when at least 20 populations have been established in at least 4 geographically distinct population centers (metapopulations) in the southern half of Brewster and Presidio counties. The total number of individuals should be at least 10,000, and no occurrence with less than 5 distinct (non-clonal) individuals should qualify as a population. Further criteria for delisting should be that the populations have been self-sustaining with both sexual and vegetative reproduction for 10 consecutive years, without suffering introgression (gene exchange) from neighboring Quercus species.

Delisting criteria are preliminary. As more information about the species is accumulated and recovery tasks are accomplished, the criteria will be reevaluated and any necessary adjustments will be included in future revisions of the recovery plan.

Recovery Outline

The following is an outline of the recovery tasks needed to attain the objective of this plan. The following section includes more detailed information on the tasks.

1. Protect known and newly discovered (*Quercus hinckleyi*) populations from existing and future threats and develop management plans.

    11. Protect populations on the Big Bend Ranch State Natural Area. Develop and implement management plans for these populations

        111. Protect sites within the Natural Area
        112. Complete a site evaluation, and establish a short-term management plan
        113. Develop and implement a long-term management plan for each site
        114. Educate Natural Area staff about the presence and importance of Quercus hinckleyi

    12. Contact private landowner(s) offering assistance and advice. Enlist interested owners in a cooperative program

        121. Establish protected sites
        122. Work with landowner(s) to complete a site evaluation and to establish a short-term management plan
        123. Work with landowner(s) to develop and implement a long-term management plan for each site

    13. Maintain communication and cooperative work among the Texas Department of Transportation (TDOT), USFWS, and TPWD

        131. Inform highway design personnel about the presence and fragility of Quercus hinckleyi
        132. Contact the Area Engineer of the Texas Department of Transportation (TDOT) as well as appropriate Landscape Section staff for Presidi county

    14. Enforce applicable Federal and State laws and regulations

    15. Monitor populations for general condition, reproductive success, and to reveal needed revisions to management practices and plans

16. Evaluate and revise management plans regularly to address changes in the condition of the populations

2. Establish a reserve germ bank/cultivated population with a responsible agency/institution

21. Include maximum genetic diversity

22. Establish a monitoring and management plan

23. Coordinate the reserve cultivation program with cultivation/restoration research efforts, giving support and incorporating results

3. Initiate studies to gather information necessary for protective management and restoration

31. Determine exact habitat requirements

311. Geologic, edaphic, and hydrologic requirements
3111. Geology and soils
3112. Hydrology
312. Microclimate
313. Community structure
314. Community dynamics/ecology
3141. Response to disturbance, agricultural practices, and other land uses
3142. Interactions with other species (beneficial, neutral, and negative)

32. Study population biology

321. Evaluate present conditions and determine stability requirements for populations
3211. Assess present demographic conditions, evaluate needs to achieve stability, and develop recommendations for augmentation
3212. Assess present genetic viability, evaluate requirements to achieve stability, and develop recommendations for augmentation
3213. Assess incidence of (and potential threat from) hybridization with nearby Quercus species and develop management strategies to address any problems
322. Characterize phenology and assess most vulnerable stages of life cycle
323. Determine reproductive biology
3231. Determine types of reproduction and their contribution to populations
3232. Investigate pollination biology
3233. Investigate seed production and dispersal
3234. Seedling recruitment

33. Study cultivation requirements

    331. Seed biology
    332. Germination requirements
    333. Seedling biology
    334. Investigate other propagation techniques

4. Search/Inventory potential habitat

    41. Search for existing populations

    42. Search for potential reintroduction sites

5. Assess Reintroduction Feasibility

    51. Assess ability of the present habitat to support the species

    52. Examine reintroduction techniques available and develop initial reintroduction guidelines

    53. Establish a pilot program

    54. Assess feasibility of reintroduction program

6. Develop and implement a reintroduction plan, if feasible

7. Develop public concern and support for the preservation and study of Quercus hinckleyi

8. Develop a post-recovery monitoring plan

Narrative Outline of Recovery Actions

1. Protect known and newly discovered (*Quercus hinckleyi*) populations from existing and future threats and develop management plans. Prospects for the protection of Quercus hinckleyi have improved greatly with the State of Texas' acquisition of property containing 9 of the 10 confirmed populations, providing them the protection of State law governing endangered species on public land. Additional action is needed however, to insure the protection of these populations, as well as those on private land. Future land management practices for all known areas should be developed and implemented to prevent further decline and to optimize the regeneration of these populations.

   11. Protect populations on the Big Bend Ranch State Natural Area. Develop and implement management plans for these populations. Management plans should be developed cooperatively between the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service.

      111. Protect sites within the Natural Area. Sites containing Quercus hinckleyi represent special resources within the Big Bend Ranch State Natural Area. Immediate steps should be taken by whatever means are appropriate (physical barriers, limited access, patrol activities during fruiting season, control of livestock and wildlife populations, staff education, etc.) to protect the species from known threats.

      112. Complete a site evaluation and establish a short-term management plan. A simple site description and evaluation should be done for each known population detailing and evaluating its present condition (e.g. location, size, substrate of rock fissures or soil, whether plants are robust or stressed, evidence of browsing, insect infestation, acorn predation, any broken or damaged plants, exposed roots, strangling vines, etc.) and any obvious actions that could be taken to avert decline (e.g. care of damaged plants and any exposed roots, control of insects). Based on this evaluation, an interim or short-term management plan should be developed. This plan should provide for continued and improved protection against threats and maintenance of the populations until comprehensive recovery strategies can be developed. Implementation goals and responsibilities should be clear.

113. Develop and implement a long-term management plan for each site. The long-term management plan should incorporate the components of the short-term plan (protection and maintenance) and be modified and expanded to include tasks that will address the need for habitat conservation, preserving population integrity, and insure population viability and recovery, as determined by results of quantitative site analysis and research recommended in this plan.

114. Educate Natural Area staff about the presence and importance of Quercus hinckleyi. Managers and staff responsible for planning, management, and implementation of projects at the Big Bend Ranch State Natural Area should be informed about the plant, its appearance, requirements, and fragility so that inadvertent damage does not occur.

12. Contact private landowner(s) offering assistance and advice. Enlist interested owners in a cooperative program. Landowners of all existing natural populations should be informed of the presence and importance of the species, as well as the requirements of Federal and State law. Additionally they should be supplied with information about the biology of Quercus hinckleyi (including its apparent fragility) and recommended steps for its protection. There should be a continuous dialogue with landowners, keeping them informed of any new information obtained about the species, and the condition of other populations.

121. Establish protected sites. The FWS should work cooperatively with and assist private landowners in taking immediate steps using whatever means are appropriate (physical barriers, limited access, control of livestock and wildlife populations, staff education, etc.) to protect the species from known threats (grazing, browsing, illegal taking).

122. Work with landowner(s) to complete a site evaluation and to establish a short-term management plan. Landowners should be provided with a simple site description and evaluation for each known population detailing and evaluating its present condition and management actions needed to avert decline as in task 112 above. Based on this evaluation, in consultation with the landowner, recommendations for an interim or short-term management plan should be developed, with practices designed to protect against threats and maintain the populations. The private property

owner should be provided with as much assistance and support as possible to implement the plan.

123. Work with landowner(s) to develop and implement a long-term management plan for each site. The long-term management plan should incorporate the components of the short-term plan (protection and maintenance) and be modified and expanded to include tasks that will address species needs in the same manner as outlined in task 113 above. The private landowner should be provided assistance and support for implementing the long-term plan.

13. Maintain communication and cooperative work among the Texas Department of Transportation (TDOT), USFWS, and TPWD. One population is very near a state highway and could be damaged by certain roadway maintenance procedures or by highway widening.

131. Inform highway design personnel about the presence and fragility of Quercus hinckleyi. Maintain cooperation and coordination among FWS, TPWD, and TDOT in assessing and avoiding impacts of future roadway improvements.

132. Contact the Area Engineer of the Texas Department of Transportation (TDOT) as well as appropriate landscape section staff for Presidio county. Inform the Area Engineer (responsible for existing roadway maintenance in the area) and Vegetation Management Supervisor (responsible for roadway vegetation management and activities) of the presence and fragility of Quercus hinckleyi, and seek cooperation in conservation of the population near the right-of-way. While the Department of Transportation has been most cooperative and is committed to protection of the species, continuous communication is helpful. Changes in personnel, management plans and contractors, and seasonal scheduling make periodic contact and reminders desirable.

14. Enforce applicable Federal and State laws and regulations. Federal and State laws regarding commercial trade, permits, collecting and habitat destruction should be enforced. Landowners should be encouraged to enforce trespassing laws in areas where this will help protect populations.

15. Monitor populations for general condition, reproductive success, and to identify needed revisions to management

practices and plans. The condition of individual populations should be monitored frequently, initially at least at flowering and fruit maturation. Later research may refine ideas of needed monitoring, particularly regarding any periods found to be critical for reproductive success or recruitment, such as the initiation of seasonal growth, flowering, fruit maturation, dispersal, or seedling germination and establishment. Monitoring methods for all populations should be coordinated, and comparisons should be made between populations to help differentiate normal fluctuation from conditions revealing stress or decline.

16. Evaluate and revise management plans regularly to address changes in the condition of the populations. As new information becomes available (as from task 15 above and task 3 below and other sources), it should be incorporated into management strategies. Evaluation and revision of plans should be coordinated among all responsible parties to take advantage of all available information and expertise. If monitoring shows an unacceptable decline in the condition of populations, this should be brought to the attention of all parties involved in conservation planning. Coordinated and well thought out management strategies should be developed to respond quickly and effectively.

2. Establish a reserve germ bank/cultivated population with a responsible agency/institution. Preservation of Quercus hinckleyi in its natural environment is absolutely of first priority. Natural populations appear to be at critically low levels (Miller and Powell 1982, Poole 1988a) and occur over a relatively restricted geographical area. Such conditions make them vulnerable to loss of entire populations. To prevent total loss of the species, a germ bank and cultivated population maintained in more controlled and protected conditions is advised. It should also serve as a non-destructive source of material for research, restoration, education, and possible horticultural development. It is essential that this effort proceed responsibly and in a manner that does not threaten the reproductive capacity of existing populations. The San Antonio Botanical Center has done some promising work in cultivating the species, but the program needs to be expanded and concerns regarding hybridization and genetic variability need to be addressed.

21. Include maximum genetic diversity. Reserve materials should be collected and maintained in a manner that will represent and maintain the maximum possible genetic diversity to preserve species vigor and the ability of the species to respond to its environment.

22. Establish a monitoring and management plan. Cultivated and reserve material should be periodically monitored and assessed. This program should be guided by a formal management plan, coordinated among all growers. This plan should address such issues as collection guidelines (for documentation, genetic representation, and minimal impacts on wild populations), seed storage and propagation responsibilities and targets, data collection and sharing, and the proper distribution and disposal of plant materials as collections and plant stocks are started or closed down.

23. Coordinate the reserve cultivation program with cultivation/restoration research efforts, giving support and incorporating results. Quercus hinckleyi has been cultivated successfully from acorns in the past (Miller and Powell 1982; Poole 1988a; Patty Leslie, pers. comm.). Currently, separate research projects are underway investigating several methods of propagation (Hilsenbeck 1989). Successful cultivation will require additional investigation. Agencies vested with responsibility for maintaining reserve populations and germ banks should coordinate their activities with this work, contributing materials, incorporating findings into their cultivation program, and designing their own data collection and sharing to contribute as much as possible.

3. Initiate studies to gather information necessary for protective management and restoration. A basic lack of scientific information about the critical parameters of habitat, growth, and reproduction for Quercus hinckleyi is limiting the ability of conservation agencies to evaluate the potential for recovery and prescribe management activities. Most information available to date is based on qualitative observation or conjecture. Quantitative research is needed.

31. Determine exact habitat requirements. Observers note that it is not apparent why Quercus hinckleyi occurs on some slopes, but is absent from similar adjacent habitat (Bacon 1989). The habitats in the Solitario that support the species are very different from that of the site near Shafter (Poole 1984, 1987, 1988b, 1988c, 1989, 1990). Specific factors may be essential for the support of the species that have not been identified. Alternatively, existing populations may represent the last vestiges of the species, in an unavoidable decline due to a changed habitat in which it is not adapted to survive. Characterization of the habitat where the species is now growing will help in evaluating the potential for recovery, locating any additional existing

populations, and identifying necessary management activities to preserve the species.

311. Geologic, edaphic, and hydrologic requirements. Characterizing geology, soils, and hydrology in the areas where Quercus hinckleyi occurs may reveal unrecognized patterns that will help in locating additional populations and developing management plans.

3111. Geology and soils. Detailed descriptions of the landform, topography, and dynamic geological processes on the slopes where Quercus hinckleyi occurs, as well as a precise description of the soils in the area (including parameters critical for cultivation such as pH, texture, etc.) are needed. These studies are needed for management and restoration planning, as they may reveal critical factors helping support the species and will define its range of tolerance.

3112. Hydrology. Since the species is believed to have been more widespread during a more mesic climatic regime, hydrologic factors may well be critical to its distribution and survival. These need to be carefully characterized and considered in the development of management plans and recovery activities.

312. Microclimate. Local site factors may mediate the effects of the Chihuahuan Desert aridity, creating slightly more mesic environments that support Quercus hinckleyi. Understanding these factors could be critical to the proper management of the species.

313. Community structure. Understanding the features and variability of the vegetation in the areas where Quercus hinckleyi occurs may be helpful in locating additional populations, managing existing sites, and evaluating habitat for any future reintroduction efforts. Qualitative descriptions of associated species occurring in the area with Quercus hinckleyi have been done for five of the ten known sites (Poole 1984, 1987, 1988b, 1988c, 1989). More thorough documentation of plants present in the habitat through the year may reveal diagnostic features. Documentation of the relative dominance, density, and frequency is

important baseline information necessary for evaluating the status of the area and managing protected sites over time.

314. Community dynamics/ecology. Information about seasonal events, cyclic dynamic processes, positive and negative interactions between species (animal and plant), and how the communities including Quercus hinckleyi respond to various management activities and disturbances, is important in formulating appropriate management and recovery plans.

3141. Response to disturbance, agricultural practices, and other land uses. In designing maintenance and long-term management strategies for the species, it is necessary to anticipate the response of the plant to various management actions. Comparative observation of known populations and their history of disturbance, land use and management would be helpful, providing at least preliminary indications of the effects of different disturbances and land use practices.

3142. Interactions with other species (beneficial, neutral, and negative). Observations have indicated that some populations of Quercus hinckleyi have sustained insect damage (Poole 1988a) and that acorns are an attractive food source for wildlife (Miller and Powell 1982, USFWS 1987). This may be a significant threat, contributing to present reproductive failure. The positive, negative, or neutral impacts of other species in the community need study, and provision for these influences needs to be made in management plans.

32. Study population biology. The current status of populations in terms of stability, viability, contamination by hybridization, simple phenology (the relationship of climate and seasonality to the stages of the plant's life cycle), and reproductive biology are unknown. Studies are needed to evaluate the condition and stability of existing populations of Quercus hinckleyi and to permit the formulation of effective management strategies.

321. Evaluate present conditions and determine stability requirements for populations. The relative stability of known populations in terms of demographics (population structure) and genetic diversity is unknown. Information is needed to ascertain if manipulation or augmentation is needed. The demographic stability of the populations appears precarious. It is also possible that low genetic variability or introgression is impairing viability. These potential threats should be evaluated and recommendations for management developed if necessary.

3211. Assess present demographic conditions, evaluate needs to achieve stability, and develop recommendations for augmentation. The incidence of root sprouting in Quercus hinckleyi makes the identification of individuals difficult, and an evaluation of the demographics of the population (age classes, spatial relationships, etc.) may require techniques too destructive to be practical. Nevertheless, quantitative, multi-season studies of the presence or absence of new seedlings and root sprouts, with selective aging of shoots/stems through dendrological techniques, should be considered. Molecular and phytochemical (examination of plant compounds) techniques are also available. This study should produce information needed to evaluate the condition of the populations and recommendations for any needed management and recovery activities should be formulated as part of this task.

3212. Assess present genetic viability, evaluate requirements to achieve stability, and develop recommendations for augmentation. Low genetic variability within individuals and within populations can result in lowered vigor and fertility and may develop in areas where populations have few individuals and are geographically isolated from each other (Futuyma 1986). Hilsenbeck (1989) has initiated studies of genetic variability and fertility in Quercus hinckleyi. Studies should continue to assess the genetic condition of known populations of Quercus hinckleyi and its implications for population viability in

this species. Upon completion of these studies, recommendations regarding any needed manipulation of populations to improve genetic variability should be developed as part of this task.

3213. Assess incidence of (and potential threat from) hybridization with nearby Quercus species and develop management strategies to address any problems. Oaks are known to hybridize freely in some regions, and hybridization with neighboring Quercus pungens is suspected (Poole 1988a), which could present a threat of genetic swamping. This possibility needs to be investigated. Hilsenbeck (1989) has initiated studies that should reveal hybridization. These studies should be completed, the degree of threat evaluated, and management strategies developed as necessary.

322. Characterize phenology and assess most vulnerable stages of life cycle. Intermittent observations by botanists are the only indication of seasonal phenology for the species. A program of taking periodic phenological observations several times during the growing season should be conducted for several seasons (enough to cover a variety of climatic conditions), and the resulting record compared to local climatic data (rainfall, temperature) for correspondence. With a record of phenology, an evaluation should be made of any stages in the life cycle that are critical and consistently impaired, the known causes, and advisable management.

323. Determine reproductive biology. This information is needed before management of wild populations, a cultivation program, or restoration work can be expected to be successful. While some valuable studies are underway (Hilsenbeck 1989), additional information is needed.

3231. Determine types of reproduction and their contribution to populations. The types of reproduction (sexual and vegetative) and possible breeding systems (degree of out-crossing, barriers to use self-pollination) need to be investigated. Reproductive activity in the populations should be evaluated, and correlation with the relative vigor and growing conditions

should be examined. An evaluation of present reproductive success, optimum scenarios for sustainable reproduction, and the potential for recovery should be included in the product of this study.

3232. Investigate pollination biology. A detailed study of Quercus hinckleyi pollen, pollination phenology, pollen predation, pollen viability (including specific conditions that might allow or preclude successful pollination by other species of Quercus), and other aspects of pollination biology should be done. Hilsenbeck (1989) has initiated work on pollen morphology and viability, which is not yet complete. Additional study will be needed.

3233. Investigate seed production and dispersal. Variability in production of acorns has been noted from population to population and from season to season (Bacon 1989,1990). Factors influencing fruit set, abortion, and maturation should be determined. The present and potential role of acorns in stand regeneration and method(s) of dispersal also should be evaluated.

3234. Seedling recruitment. Successful seedlings have not been observed in natural conditions, and the reasons for this are unknown. The possibility of a mast-seeding reproductive strategy involving periodic heavy crop levels should be evaluated. These heavy yields satiate acorn predators and promote recruitment on a cyclic basis. The percentage of acorn production and masts lost to disease and predation and the percentage available for recruitment should be monitored. In addition, the conditions under which recruitment can occur (acorn age and viability, optimum field conditions, etc.) should be determined.

33. Study cultivation requirements. While biologists report some success at cultivation efforts (Bacon 1989, Poole 1988a), additional studies are needed for the establishment of a successful management program for both natural and cultivated populations.

331. Seed biology. Attributes such as average acorn production per plant, viability, longevity, degree of dormancy, and any factors inducing and breaking dormancy need to be determined. These factors should be examined for horticultural cultivation and also under actual or simulated field conditions.

332. Germination requirements. Some observers note that fresh acorns apparently germinate readily (Poole 1988a). Scientific studies of germination requirements have not been done. The optimum conditions and range of tolerance for germination under cultivated conditions and in the field (seasonality, soil temperature and moisture, light, etc.) should be determined.

333. Seedling biology. Light, temperature, moisture, and nutrient requirements for seedling establishment, as well as threats to seedling establishment (disease, predation), need to be understood, both for field conditions and cultivation, if plants will need to be reintroduced from cultivation to field conditions.

334. Investigate other propagation techniques. Propagation studies have been begun (Hilsenbeck 1989) and show promise. These studies should be continued and expanded. Propagation techniques should be investigated for use in possible restoration and/or reintroduction efforts. Propagation methods should also be investigated as a means to help meet horticultural demand, as providing readily available propagated plants may reduce collecting threats.

4. Search/Inventory potential habitat. As more information about the habitat and biology of Quercus hinckleyi becomes available, predictive abilities for determining areas capable of supporting the species may improve, and additional inventory work may be justified.

41. Search for existing populations. While surveys for the species have been conducted in some areas, the Service and Texas Department of Parks and Wildlife should continue to search for and verify the occurrence of new populations of Quercus hinckleyi on public and private lands.

Other federal, state, and local agencies have the potential to be helpful in this effort. Many agencies have field staff who should be educated about the

appearance and importance of Quercus hinckleyi. Knowledgeable agency employees working in suitable habitat may recognize new populations of the species. Field staff that discover new populations should be requested to encourage landowners to bring them to the attention of the State and the Service and cooperate in recovery. Personnel from other Federal, State, and local agencies should work closely with the Service in devising appropriate management strategies for areas supporting Quercus hinckleyi. Private landowners and other groups should be made aware that State and Service conservation biologists are available to provide assistance of many kinds in developing and implementing the best possible measures for the conservation of the species.

42. Search for potential reintroduction sites. If a determination is made to attempt reintroduction, suitable locations that meet likely distribution and natural habitat criteria must be found.

5. Assess Reintroduction Feasibility. An evaluation of the need and potential for reintroduction of the species can be made when more information is available about the possibility of overlooked populations, genetic vitality, population stability, habitat availability, long-term management requirements of the community, and success of cultivation. In the event that reintroduction is to be attempted, the following recovery actions (tasks 51-54) should be implemented.

51. Assess ability of the present habitat to support the species. Based on results of the research on habitat requirements and present condition of populations, an evaluation of the practicality of attempting to sustain the species in its present habitat should be made. The level of mediation or management of sites that will be necessary to recover existing populations and to reintroduce additional populations should also be determined.

52. Examine reintroduction techniques available and develop initial reintroduction guidelines. Evaluate the relative success of different cultivation, site preparation, planting, and management techniques available, based on past research and monitoring. Assess any additional information needs and readiness to attempt reintroduction. Develop initial guidelines for conducting reintroduction.

53. Establish a pilot program. Using the guidelines derived above (task 52), design and implement a pilot program to meet any additional information needs and test methods.

54. Assess feasibility of reintroduction program. Assess results of the pilot program, and evaluate the potential for reintroduction in natural habitat.

6. Develop and implement a reintroduction plan, if feasible. Based on the assessment of the pilot program, a reintroduction plan should be developed and implemented that provides for all phases of reintroduction, including cultivation of plant material, site selection, site preparation, plant introduction, plant establishment (to independent living), site monitoring, and implementation of short- and long-term management strategies for the sites.

7. Develop public concern and support for the preservation and study of Quercus hinckleyi. A broad-based awareness of the species and support for efforts to save it need to be developed. This is most important among adults in the local area whose support is critical to the success of recovery efforts. A variety of methods including personal contacts, informational meetings, interpretive materials at the Big Bend Ranch State Natural Area, news articles and releases, testimonials by influential opinion leaders, and opportunities to participate in fund-raising and recovery activities should be explored. The species should be included in other statewide and nationwide initiatives to increase understanding of endangered species issues among groups of all ages. Because of the aesthetic appeal of the plant, greater awareness is expected to create a demand for horticultural use. This may increase collection pressures. Public education efforts should fully consider this possible threat. A provision should also be made to meet horticultural demand.

8. Develop a post-recovery monitoring plan. If recovery is determined to be feasible, a coordinated post-recovery monitoring plan should be developed that will track the condition of natural and introduced populations for at least 5 years. Responsibilities for implementation and reporting should be clear. This plan should specify types and levels of decline that would trigger changes in management strategies to ensure recovery accomplishments are maintained.

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PART III. IMPLEMENTATION SCHEDULE

The following implementation schedule outlines actions and estimated costs for the Quercus hinckleyi recovery program. It is a guide for meeting the objectives discussed in Part II of this Plan. The schedule indicates task priorities, task numbers, task descriptions, duration of tasks, responsible agencies, and estimated costs. These actions, when accomplished, should bring about the recovery of Quercus hinckleyi and protect its habitat. It should be noted that the estimated monetary needs for all parties involved in recovery are identified for the first three years only. The costs estimated are intended to assist in planning. This recovery plan does not obligate any involved agency to expend the estimated funds. Though work with private landowners is called for in the recovery plan, private landowners are also not obligated to expend any funds.

Task Priorities

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to meet the recovery objective.

Abbreviations Used

CoEx - County Agricultural Extension Service(s)
DOT - Texas Department of Transportation
FWS - Fish and Wildlife Service
- ES - Ecological Services
- LE - Law Enforcement
SCS - Soil Conservation Service
TDA - Texas Department of Agriculture
TPWD - Texas Parks and Wildlife Department

HINCKLEY OAK RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)			COMMENTS
				FWS		OTHER	YEAR 1	YEAR 2	YEAR 3	
				REGION	PROGRAM					
1	111	Protect sites within the Big Bend Ranch State Natural Area (BBRSNA).	continuous			TPWD	1.0	1.0	1.0	
1	112	Complete a site evaluation and short-term management plan.	3	2	ES	TPWD	2.0 2.0	2.0 2.0	2.0 2.0	
1	114	Educate Natural Area staff about the presence and importance of Hinckley oak.	ongoing			TPWD	0.5	.25	0.25	After year 3 should be integrated into standard TPWD training & operations.
1	121	Establish protection for private land sites w/appropriate mechanism.	3	2	ES		5.0	5.0	5.0	
1	122	Complete a site evaluation and establish short-term management plans for private land sites.	3	2	ES		4.0	2.0	2.0	
1	131	Inform highway design personnel about the presence and fragility of Hinckley oak.	ongoing	2	ES	DOT TPWD	1.0 1.0 0.25			After year 1 training and management, needs would be incorporated into standard DOT training and procedures.
1	132	Periodically contact DOT Area Engineer and Landscape Section.	continuous	2	ES	DOT	0.25 0.25	0.25 0.25	0.25 0.25	
1	3141	Study response to disturbance agricultural practices, and other land uses.	5	2	ES	DOT TPWD	2.0 1.0 2.0	2.0 0.5 1.5	2.5 0.5 1.0	Necessary to tasks 113, 123, 132, 16, 313, 41, 52, 53, and 6.

HINCKLEY OAK RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)			COMMENTS
				FWS		OTHER	YEAR 1	YEAR 2	YEAR 3	
				REGION	PROGRAM					
2	334	Study propagation techniques.	3	2	ES		3.0	3.0	3.0	Necessary to tasks 21, 52, 53 & 6. May be needed for 113, 123 & 132.
2	52	Examine potential reintroduction techniques.	1	2	ES		2.0			Dependant on outcome of task 5.1 above.
2	53	Establish a small scale reintroduction pilot program if feasible.	to be determined	2	ES	TPWD	4.0 1.0	1.5 0.5	1.5 0.5	Depending on results of previous studies & task 5.1.
2	7	Develop public concern and support.	ongoing	2	ES	TPWD	4.0 1.0	2.0 0.5	2.0 0.5	
3	54	Reevaluate feasibility of reintroduction.	1	2	ES		1.0			Dependant on pilot results.
3	6	Develop and implement reintroduction plan if feasible.	to be determined	2	ES	TPWD	8.0 2.0	4.5 0.5	4.5 0.5	Depends on assessment of recovery potential.
3	8	Develop a post-recovery monitoring plan.	1	2	ES	TPWD DOT				Dependent on achieving recovery levels.

HINCKLEY OAK RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)			COMMENTS
				FWS		OTHER	YEAR 1	YEAR 2	YEAR 3	
				REGION	PROGRAM					
1	3142	Study interactions with other species.	5	2	ES	TPWD	4.0 1.0	2.5 0.5	2.5 0.5	Necessary to tasks 113, 123, 132, 16, 313, 41, 52, 53, and 6.
1	3211	Assess present demographics & needs.	3	2	ES	TPWD	4.0 1.0	4.0 1.0	4.0 1.0	Necessary to tasks 113, 123, 132, 15, 16, 53, and 6.
1	3212	Assess genetic viability & needs.	3	2	ES	TPWD	4.0 1.0	4.0 1.0	4.0 1.0	Necessary to tasks 113, 123, 132, 15, 16, 53, and 6. Ongoing Section 6 studies.
1	3213	Assess threat of hybridization.	3	2	ES	TPWD	4.0 1.0	4.0 1.0	4.0 1.0	Necessary to task 113, 123, 132, 41, 53, & 6. Section 6 studies.
1	3231	Determine types of reproduction and contribution to population.	5	2	ES	TPWD	2.0 0.5	2.0 0.5	2.0 0.5	Necessary to task 113, 123, 132, 15, 16, 51, 52, 6, 8.
1	3232	Investigate pollination biology including receptivity to other Quercus species.	3	2	ES	TPWD	2.0 0.5	2.0 0.5	2.0 0.5	Necessary to task 113, 123, 132, 21, 51, 52, 53, 6.
1	3233	Investigate seed production and dispersal.	5	2	ES	TPWD	1.0 0.25	1.0 0.25	1.0 0.25	Necessary to task 113, 123, 132, 22, 52, 53, 6.
1	3234	Determine seedling recruitment.	5	2	ES	TPWD	1.0 0.25	1.0 0.25	1.0 0.25	Necessary to task 113, 123, 132, 15, 16, 52, 53, 6, 8.
1	41	Search for existing populations.	3	2	ES	TPWD SCS TDA CoEx	7.0 2.0 0.5 0.5 0.5	6.0 2.0	5.0 2.0	SCS, TDA, CoEX Liaison to landowners. See paragraph 2 of task 41.

HINCKLEY OAK RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)			COMMENTS
				FWS		OTHER	YEAR 1	YEAR 2	YEAR 3	
				REGION	PROGRAM					
1	51	Assess ability of present habitat to continue to support species and recovery potential.	3	2	ES	TPWD	5.0 2.0	1.0 0.5	1.0 0.5	
2	113	Develop long-term management plans for BBRSNA sites.	to be determined	2	ES	TPWD	5 5	2.5 2.5	2.5 2.5	Depends on study results of task 3.
2	123	Work with landowners to develop and implement long-term management plans.	to be determined	2	ES		3.0	1.0	1.0	Depends on study results of task 3.
2	14	Enforce the ESA and State endangered plant laws.	continuous	2	ES LE	TPWD	2.0 1.0 2.0	2.0 1.0 2.0	2.0 1.0 2.0	
2	15	Monitor all populations.	continuous	2	ES	TPWD	5.0 5.0	2.5 2.5	2.5 2.5	Necessary to tasks 113, 123, 132, 16, 313, & 8. Will be useful to tasks 322 & 323.
2	16	Evaluate and revise management plans regularly.	continuous	2	ES	TPWD	0 0	2.0 2.0	2.0 2.0	
2	21	Establish a cultivated population and seed bank with maximum genetic diversity.	5	2	ES		1.0	5.0	2.5	
2	22	Establish a cultivated collection monitoring and management plan.	1	2	ES		1.0			

HINCKLEY OAK RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)			COMMENTS
				FWS		OTHER	YEAR 1	YEAR 2	YEAR 3	
				REGION	PROGRAM					
2	23	Coordinate cultivation program with research efforts, providing support & incorporating results of task 33.	5	2	ES		0.5	0.5	0.5	
2	3111	Study geologic & edaphic requirements.	2	2	ES	TPWD	2.0 0.25	0.5 0.125		Necessary to tasks 41, 42, 53, & 6. Site-specific study.
2	3112	Study hydrologic requirements.	2	2	ES	TPWD	2.0 0.25	0.5 0.125		Necessary to tasks 41, 42, 53, & 6. Site-specific study.
2	312	Study microclimate.	3	2	ES	TPWD	3.0 0.75	2.0 0.5	2.0 0.5	Necessary to tasks 41, 42, 53, & 6.
2	313	Study community structure.	2	2	ES	TPWD	0.5 0.5	0.25 0.25		Nessary to tasks 113, 123, 132, 41 & 42. Cost assumes study coordinated with other work/ visits to sites.
2	42	Search for potential reintroduction sites.	2	2	ES	TPWD	2.0 0.5	2.0 0.5		
2	322	Characterize Phenology and most vulnerable stage(s).	3	2	ES	TPWD	3.0 1.0	2.0 0.5	1.0 0.5	Necessary to tasks 113, 123, 132, 15, 16, 53, 6 & 8.
2	331	Study seed biology (viability, longevity, etc.).	5	2	ES		2.0	1.0	1.0	Necessary to tasks 21, 52, 53 & 6.
2	332	Study germination requirements.	2	2	ES		2.0	1.0		Necessary to tasks 21, 52, 53 & 6.
2	333	Study seedling biology.	3	2	ES		2.0	2.0	2.0	Necessary to tasks 21, 52, 53 & 6.

Appendix

Principal Comments Received On The Hinckley Oak Technical/Agency Draft Recovery Plan

This recovery plan was sent out for technical review to the advisors on the Texas Plant Recovery Team in January of 1992. No substantive changes were recommended. In July and August the Service distributed 62 copies of the draft recovery plan to agencies and individuals, as well as 15 letters notifying county judges, and local and national organizations that the plan was available for public review and comment. Comments were received from the six individuals or agencies listed below:

Ms. Jackie Poole, Montana Natural Heritage Program
Mr. Manual Flores
Dr. Michael J. Warnock, Department of Biological Sciences, Sam Houston State University
U. S. Soil Conservation Service
Texas Wildlife Association

One comment was postmarked and received after the August 31 closing of the public comment period. This comment was reviewed before the plan was finalized, but arrived too late for inclusion in the following response section. This letter was from:

Barbara Marshall, Marshall Cattle Company

All comments were considered when revising the draft plan. The Service appreciates the time that each of the commenters took to review the draft and to submit their comments.

The comments discussed below represent a composite of those received prior to the close of the public comment period. Comments of a similar nature are grouped together. Substantive comments that question approach, methodology, or financial needs called for in the draft plan, or suggest changes to the plan are discussed here. Comments received that related to the original listing decision, general comments about the Endangered Species Act that did not relate to Hinckley Oak are not discussed here. Comments regarding simple editorial suggestions such as better wording or spelling and punctuation changes were incorporated as appropriate. Favorable, supportive comments were also received, but are not summarized here.

All comments received are retained as a part of the Administrative Record of recovery plan development in the Austin, Texas, Ecological Services office.

Comment: It appears this species is declining solely due to natural causes and is unlikely to be recovered.

Service Response: While it is true that the distribution of the species has been reduced and that habitat has become fragmented as a result of long-term climatic change, this change proceeds very gradually and the ultimate result of this fluctuation is uncertain. There are still several populations in good health, and additional suitable habitat does exist. The existing small populations are vulnerable to threats that could destroy entire populations of the remaining plants. Some of these threats are natural, but others are influenced, at least in part, by human activities. The plants appear to be reproducing only vegetatively by root sprouts, though they do produce acorns, which germinate easily in cultivation. The reason(s) why acorns are not germinating in nature and producing new individuals is unclear, but most possible causes are believed to be manageable. No factors are known at present that would preclude recovery, though population viability may be a problem. The plan states in the first paragraph of Part II that the primary objective is to determine <u>if</u> Hinckley oak can be recovered, and if so to return the species to a condition where delisting is possible.

Comment: Preparing a Recovery Plan for a species about which so little is known is a futile exercise, making the plan nothing more than a recitation of research needs, and causing severe lack of credibility for recovery cost figures.

Service Response: It is not unusual for research to be the primary need for recovery in the early stages of conservation work. The importance of research in devising effective management techniques should not be underestimated. Recovery Plans have always been intended as simple planning documents to guide the Service and other agencies and individuals in recognizing the information and management needs for conserving species, so that work activities and budgets can be planned to provide for implementing the recovery plan. As noted in the plan disclaimer, costs listed are intended as estimates. Total costs are uncertain as the feasibility of several tasks in the plan are dependant on the results of other tasks. Recovery planning is a continuous process, and plans are amended and revised as necessary to incorporate research results and include more site-specific, management-oriented tasks as they are devised.

Comment: Detailed characterization of the soils where populations of Hinckley Oak grow seems like an expensive academic exercise when horticulturists know that the plant is not picky. It is being cultivated in Blackland Prairie and Balcones Escarpment Soils, as well as artificial media.

Service Response: The performance of a species under cultivation by humans and under wild conditions varies considerably. Information is needed that will allow a determination of the habitat requirements that will support a vigorous, reproducing, and stable population of Hinckley Oak capable of surviving and prospering on its own in the wild. Analysis of soils where the plant is found naturally may give valuable information about habitat requirements that will be needed if reintroduction is attempted.

Comment: With only 10 populations known, why haven't the soils already been determined?

Service Response: As noted in the plan, five of these populations have only recently been discovered. In addition, no soil survey exists for Presidio County. While general qualitative observations have been made at several sites, detailed characterization will require special planning and funding. The recovery plan addresses the need for this information.

Comment: Why not offer incentives to landowners to encourage new populations and management? At a minimum the Service should pay for fencing and physical barriers, as well as other management.

Service Response: Incentive programs may offer promise as an approach to endangered species management on private lands in general. The plan calls for this in its recommendation to provide as much assistance and support as possible to landowners under tasks 122 and 123. The exact nature of this support will vary with individual site needs, landowners, and Service budget constraints. It is not anticipated that in the short-term Service budgets will support more than technical assistance and assistance with some site-specific material needs.

Comment: Under task 3141, since nine of the known populations occur on the same property it would be somewhat unusual if the land use was much different between them.

Service response: This task does not relate only to land use, but to disturbance and site history in general. While general land management may be the same on a particular property, site-specific profiles may vary considerably in such factors as accessibility to wildlife and livestock, soil erodability, aridity, occurrence of small fires, incidence of insect predation, etc. Comparative observation of such sites can be very valuable. In addition, it is noted in the plan that there are great site differences between the Big Bend Ranch State

Natural Area populations and the population near Shafter. These differences merit observation as well.

Comment: Why has the Big Bend National Park not been searched for populations?

Service Response: The Texas Parks and Wildlife Department's Heritage Program botanists have conducted some surveys in Big Bend National Park, as have other investigators, but Hinckley oak has not been found there.

Comment: It was suggested that the Service simply cultivate the species at a site approximating its Pleistocene habitat.

Service Response: Service policy regarding cultivation of listed plants as a recovery activity is that while cultivation may be a useful tool to facilitate recovery of a species in the wild, it is not a substitute for reestablishment of viable wild populations. Cultivation programs are to be considered only if there is likelihood that other available techniques to maintain or improve conditions of the species' status in the wild might fail. Because of the uncertainty of the feasibility of recovery for this species, the recovery plan recommends a cultivation program in task number 2. The plan does not support cultivation alone as a conservation mechanism. The purpose of the Endangered Species Act is to conserve not only endangered and threatened species but also the ecosystems on which these species depend. Cultivation and relocation alone do not address the need for habitat preservation, though they may be used as conservation techniques in combination with other actions.

Comment: It was suggested that the Service simply relocate plants out of areas possibly threatened by highway expansion.

Service response: See response to comment above.

Comment: Propagating Hinckley oak from seed by commercial nurseries is perhaps the most cost-effective means of perpetuating the species.

Service Response: See the response to the two comments above.

Comment: If acorns are not producing seedlings in nature anyway, it would seem that when horticulturists collect acorns they are rescuing them from certain death and cannot be harming the wild populations.

Service Response: The acorns that Hinckley oak produces are apparently viable and will germinate. It is unclear why seedlings are not found in nature. One reason could be that the plants are not producing sufficient numbers in most seasons to overcome limiting factors in their environment, such as predation by insects and small mammals. Collecting acorns in any great quantity at any one site could be making establishing new seedlings even more difficult. It has been reported that many acorns are collected by horticulturists. Until the process of germination in nature is better understood and a safe level of harvesting can be determined, it is undesirable to lower the number of acorns available to establish new seedlings (recruitment) unnecessarily.

Comment: The Soil Conservation Service requested that they be removed from the implementation schedule under task 41 as an involved party, noting that they will not be conducting surveys for Hinckley Oak, though they will assist agricultural producers in protecting the species if it should be encountered.

Service Response: The SCS designation as an involved party in the implementation schedule in task 41 arises from the comment that acknowledges the potential that trained field staff of other agencies working in the area might be helpful in recognizing new populations of the species. The Plan is recommending that if any populations are noted in the course of other agencies' work that field staff encourage landowners to bring them to the attention of the Service, and that management plans for these populations be coordinated with the Service. The Service desires close cooperation with other agencies in providing the best possible management for any known populations of Hinckley Oak and to enhance the Service's ability to coordinate the overall recovery for the species. It is believed this will involve minimal costs to the agency in terms of staff consultation regarding species needs and considerations in management recommendations. The wording of task 41 has been changed to clarify this requested coordination and comments have also been added to the implementation schedule to clarify this potential role for other agencies.

Comment: It is stated that one population is very near a highway and roadway maintenance activities, or any further highway expansion or realignment could constitute a threat to the species. How much will it cost to rescue the species at that site from that possible threat?

Service response: The Texas Parks and Wildlife Department has established a cooperative agreement with the Texas Department of Transportation to design maintenance plans that protect species of conservation concern along highway right-of-way. These maintenance plans are then incorporated into the training and

specifications of actions to be followed by local maintenance personnel. These are the expenses noted on the implementation schedule under tasks 131 and 132. The Department of Transportation would also work to design any future construction in the area so that it would not impact the population. No future highway projects in the area are known at present. Expenses for any necessary design work in the future cannot be estimated at the present time.

Comment: The Texas Parks and Wildlife Department is listed as a responsible party for investigations of genetic heterogeneity and viability and assessing the threat of hybridization, though they do not have the facilities for, or normally conduct this sort of research.

Service Response: A comment was added to the implementation schedule clarifying that Texas Parks and Wildlife Department involvement has been (and will likely continue) through Section 6 studies administered by the Texas Parks and Wildlife Department.

Comment: The Texas Parks and Wildlife Department would be expected to be a responsible party for additional surveys for Hinckley Oak.

Service Response: The Service agrees. This omission was inadvertent and they were added to the list of responsible parties in the implementation schedule.