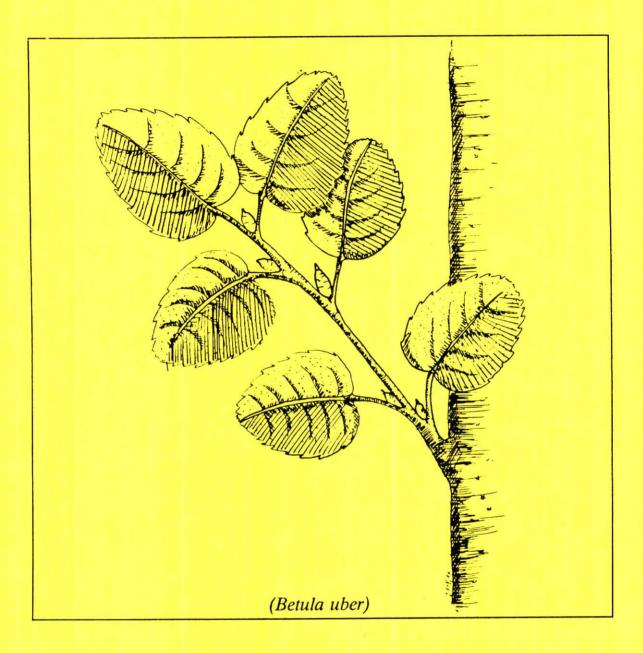
Virginia Round-Leaf Birch



Recovery Plan

REGION FIVE, U.S. FISH AND WILDLIFE SERVICE

VIRGINIA ROUND-LEAF BIRCH

(Betula uber)

REVISED RECOVERY PLAN

UPDATE

(Original approved March 3, 1982) (Revision approved September, 1985)

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for:

Region 5 U.S. Fish and Wildlife Service Newton Corner, Massachusetts

MC

Approved:

Regional Director, U.S. Fish and Wildlife Service

estember 24, 1990

Date:

* * *

This is an update of the first revision of the Virginia Roundleaf Birch Recovery Plan, which was approved in September It delineates reasonable actions which are believed to 1985. be required to protect and recover this endangered species. It was prepared by Dr. Terry L. Sharik for publication by the U.S. Fish and Wildlife Service. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. This plan does not necessarily represent the views, official positions, or approval of any individual or agencies involved in plan formulation, other than the U.S. Fish and Wildlife Service. The recovery plan is subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1990. Virginia Round-leaf Birch Recovery Plan. Newton Corner, MA. 43 pp.

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EXECUTIVE SUMMARY OF THE VIRGINIA ROUND-LEAF BIRCH RECOVERY PLAN

<u>Current Status</u>: The Virginia round-leaf birch is listed as endangered. The single known population in the wild dwindled from 41 individuals in 1975 to its current (1990) level of 11 individuals. Twenty additional populations of 96 individuals each of round-leaf birch and the closely related sweet birch were established from plantings in the same watershed between 1984 and 1987. Of the 1459 round-leaf birches established, 1181 remained alive in late 1989.

Habitat Requirements and Limiting Factors: Round-leaf birch requires exposed mineral soil under partially shaded conditions within 60 meters of multiple seed sources to reproduce itself. Vandalism and related human activity are the chief threats to its continued survival. Other significant limiting factors include a limited number of small forest openings with exposed mineral soil in the immediate vicinity of seed sources, herbivory, long distances between pollen sources, and a breeding system which may be developmentally retarded and permits heavy gene exchange with sweet birch.

<u>Recovery Objective</u>: Delisting.

<u>Recovery Criteria</u>: Establishment of 10 self-sustaining populations, defined of the basis of having each produced through natural regeneration 500-1000 individuals > 2 m tall.

Actions Needed:

- 1. Maintain and expand the single wild population.
- 2. Retain existing germplasm through cultivation.
- 3. Determine systematic relationships.

4. Establish and maintain additional populations.

5. Implement educational programs.

<u>Year</u>	<u>Need 1</u>	Need 2	<u>Need 3</u>	<u>Need 4</u>	<u>Need 5</u>	<u>Total</u>	
1991 1992	40.5 11.5	2.5 0	24.0 24.0	9.0	5.0 5.0	81.0 49.5	
1993 1994 - 2005	12.5 48.0	0	4.0	9.0 24.0	5.0	30.5	
2006 2007-2010	14.0	0	0 40.0	2.0	0.5	16.5 66.0	
T <u>otal</u>	2000	·					
Cost	142.5	2.5	92.0	61.0	23.5	321.5	
<u>Date of R</u>	ecovery:	Delisti	ng shoul	d be poss	sible in	the year	

<u>Costs (\$000s)</u>:

2010.

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<u>Betula uber</u> (Ashe) Fernald, the Virginia round-leaf birch, was officially listed as an endangered species under protection of the Federal Endangered Species Act of 1973 on April 26, 1978 (U.S. Fish and Wildlife Service 1978) and the Commonwealth of Virginia's Endangered Plant and Insect Species Act approximately one year later (Virginia Department of Agriculture and Consumer Services 1979). After having been considered extinct for over 60 years, the species was rediscovered in 1975 along the banks of Cressy Creek in southwest Virginia. Its occurrence is now represented by a single wild population consisting of 11 individuals, and 20 additional populations, with a 1989 total of 1181 individuals, which were established between 1984 and 1987.

The original recovery plan was approved by the U.S. Fish and Wildlife Service on March 3, 1982, and revised in September, 1985. The primary objective of the original and revised plans was to increase the number of individuals in the wild to a level where the species could be removed from endangered status: a recovery level of 1000 individuals of the <u>Betula</u> <u>uber - B. lenta</u> complex in each of 10 populations is still considered to be a reasonable objective.

Description

The Virginia round-leaf birch was originally described as a variety of the common sweet birch or black birch (<u>Betula lenta</u> L.) by W.W. Ashe (1918). The taxon was subsequently elevated to the species level by M.L. Fernald (1945) and transferred from series <u>Costatae</u> (dark-barked tree birches) to series <u>Humiles</u> because of presumed affinities to the shrub birches.

Round-leaf birch is a moderate-sized tree, up to 15 m in height, with smooth dark-brown to black, aromatic bark and a compact crown (Ogle and Mazzeo 1976, Sharik and Ford 1984). The alternately arranged, simple leaves are round to slightly oblong in outline, 3.3-5.3 cm long, heart-shaped at the base, rounded to obtuse at the tip, with 4-5 pairs of lateral veins and 21-33 coarse teeth along each margin. The fruiting structures, termed catkins, are 1.7-2.8 cm long and possess nearly smooth, 4.8-6.0 mm long scales with three broadly divergent lobes. At the base of each scale are borne three winged nutlets or samaras, ranging in length from 1.7-2.0 mm (Sharik and Ford 1984).

Anatomical studies of the wood (Hayden and Hayden 1984) and observations of overall form (Ogle and Mazzeo 1976, Sharik and Ford 1984) support a closer alliance of round-leaf birch with the dark-barked tree birches than with the shrub birches. The former group includes sweet birch and yellow birch (\underline{B} . alleghaniensis Britton), both of which are found growing with round-leaf birch in its native habitat. Detailed statistical analyses of leaves and fruits indicate that round-leaf birch is more similar to sweet birch than to yellow birch, that intermediates between round-leaf birch and sweet birch do not occur, and that leaves are necessary for absolute separation of round-leaf birch from sweet birch (Sharik and Ford 1984). Individuals of the latter species from the same area have leaves which are generally egg-shaped, 7.5-11.6 cm in length, pointed at the tip, with 9-16 pairs of lateral veins and 50-93 fine teeth along the margin (Sharik and Ford 1984). Branching is also coarser in sweet birch than in round-leaf birch.

The absence of the compound rhododendrin in the bark of sweet birch, in contrast to its presence in round-leaf birch, indicates some chemical differences between the two taxa (Santamour and Vettel 1978). In contrast, scanning electron

microscopy of surface features of leaves indicates no discernible differences between round-leaf birch and sweet birch (Hardin and Bell 1986).

Several lines of evidence suggest a close evolutionary relationship between round-leaf birch and sweet birch. Both taxa are apparently diploids, with 28 pairs of chromosomes (Santamour pers. comm.). Isozymes (peroxidases) extracted from the cambium of both species show similar patterns The taxa overlap completely in (Santamour pers. comm.). flowering times and they are interfertile (Sharik 1984). The offspring of crosses between the two typically possess either round leaves, characteristic of round-leaf birch, or egg-shaped leaves, typical of sweet birch. Preliminary analysis of the progeny of first-generation crosses suggests that this difference in leaf shape may be controlled by a single gene (Feret and Sharik unpubl. data). The evolutionary relationships between the two taxa are discussed in more detail under "Conservation Efforts."

Distribution

The single natural population of round-leaf birch is confined to a 700 m stretch of highly disturbed, second-growth forest less than 100 m wide along the banks of Cressy Creek, near the town of Sugar Grove, in Smyth County, Virginia (latitude 36°46'N, longitude 81°23' W, elevation 820 m; see Figure 1) (Ogle and Mazzeo 1976, Sharik 1980, Ford <u>et al</u>. 1983). Part of the Tennessee River hydrologic unit (Bailey and Cushwa 1982), Cressy Creek drains into the South Fork of the Holston River near the town of Sugar Grove -- 2 km northwest of the round-leaf birch population. The population extends over

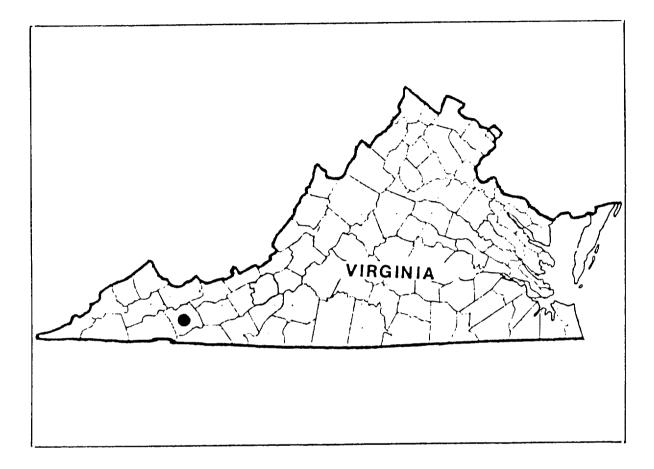


Figure 1. Location of <u>Betula</u> <u>uber</u>

three contiguous ownerships, including the U.S. Forest Service (Mount Rogers National Recreation Area, Jefferson National Forest) and two private tracts.

Ashe (1918) provided no account of the number of individuals in the population in his original description of round-leaf birch. Having not been observed for several decades, round-leaf birch was assumed to have become extinct, until it was rediscovered in 1975 (Ogle and Mazzeo 1976). There were an estimated 41 individuals in the natural population in 1975, including 18 reproductively mature adults and 23 subadults (seedlings and saplings) (Sharik <u>et</u> <u>al</u>. 1990). Two adults were located on public land, while the remainder of the population was on two adjacent private land holdings. One of the private ownerships (hereafter referred to as "A") contained one adult and seven subadults, while the second ("B") contained 15 adults and 16 subadults. The original population declined to 26 individuals by 1977 and to 11 individuals (four adults, seven subadults) by 1984, where it has remained. All the mortality has occurred on ownership B.

Although originally reported from along the banks of Dickey Creek, 2 km to the west of the Cressy Creek location, inspection of property descriptions on herbarium specimens suggests that Ashe (1918) was apparently in error with respect to the Dickey Creek location (Sharik and Ford 1984). Thus, the general consensus is that round-leaf birch probably occurred only along Cressy Creek. Extensive searches in the same and adjacent watersheds since 1975 have failed to reveal any other natural populations.

Due to recovery efforts initiated in 1982, there now exist 20 additional populations of round-leaf birch in the Cressy Creek watershed established from plantings between 1984 and 1987.

These efforts are described in more detail under "Conservation Measures."

<u>Habitat</u>

Following is a description of the habitat conditions at the site of the natural population of round-leaf birch as it existed in 1975. Optimum conditions are not known at the present. However, this information should become available over the next two decades from analysis of the recently established additional populations.

The climate in the Cressy Creek watershed is relatively cool and moist, with a mean July temperature of 20.6° C and mean annual precipitation of 1219 mm (Rice 1959). The adult segment of the natural population is almost entirely within that part of the floodplain of Cressy Creek which receives coarse alluvial deposits almost annually (Sharik 1984). The part of the juvenile population originating prior to 1975 (now seven individuals) occurs on an artificially-created dike-like mound of earth which once enclosed a tailings pond. No individuals in the round-leaf birch population are more than 30 m from the present streambed of Cressy Creek.

Soils have little profile development and are classified locally as stony colluvium (Lietzke and Porter 1978, Lietzke undated). They are very flaggy, strongly acid, and exhibit rapid permeability. Soil profiles generally consist of sandy loam material with variable concentrations of gravels, cobbles, and boulders (Lietzke and Porter 1978). Thus, they are droughty, and trees occupying these sites probably exhibit high levels of moisture stress during the growing season -especially in years of low precipitation. The continual influx of coarse alluvium (with the exception of the

artificial mound area on tract A) appears to create an especially droughty, exposed condition at the soil surface, which in turn probably has a substantial effect on rates of germination and establishment of birch seedlings (Sharik 1984). These rates appear to be highest where soils are largely free of litter and continually moist and well drained at the surface. Such conditions are probably best met where there is partial shade coupled with the incorporation to organic matter into the surface mineral horizons (Sharik 1980, 1984).

The highly disturbed second-growth forest consists of canopy trees which are generally less than 80 years old (Sharik 1984). No less than 20 species occupy the canopy (Ogle and Mazzeo 1976). According to the classification of Garrison <u>et</u> <u>al</u>. (1977), the potential vegetation appears to be transitional between the oak-pine and maple-beech-birch associations, with some tendencies toward the elm-ash-cottonwood association because of the riparian setting (Sharik 1984).

The narrow strip of disturbed forest which contains the round-leaf birch population is bordered mainly by large expanses of actively grazed pasture and, to a lesser degree, by residential dwellings.

Life History/Ecology

Individuals of round-leaf birch have an average life span under forested conditions of about 50 years, and seldom exceed 60 years (Sharik 1984). This relatively short life span indicates that round-leaf birch, like most birches, is a pioneer species which invades recently disturbed areas and subsequently succumbs to competition from longer-lived species

more tolerant of closed canopies. Although reproduction in round-leaf birch is predominantly sexual, seedlings and saplings are capable of sprouting from the base of the stem following severance by mechanical means (Sharik 1984). Sprouting response to fire has not been investigated. Likewise, the ability of older, relatively healthy individuals to resprout following damage to the stem is largely unknown.

Age at initial flowering in the wild is not known. However, four-year-old trees originating from cuttings of saplings have been known to flower and fruit heavily following transplanting (Sharik pers. obs.). Flowering occurs from late April to early May, when the leaves emerge from the winter buds (Sharik Male and female flowers are borne separately on the 1984). same plant. Although dispersal distances have not been determined, it is probably reasonable to assume that, like most wind-pollinated tree species, 90 percent of the pollen is deposited within 100 m of the source (Wright 1976). Laboratory tests indicate that pollen viability and germination rates are high (Sharik and Feret unpubl. data). Plants are largely self-sterile and thus require cross-fertilization (Feret and Sharik unpubl. data). Stigmas are short relative to those of sweet birch, which may account in part for the relatively low seed viability levels noted below.

The samaras or winged nutlets, containing a single seed, are likewise wind-dispersed. Differences in wind speed and direction account for a substantial amount of the variation in the temporal, directional, and distance components of dispersal (Ford <u>et al.</u> 1983). Most seeds are dispersed to the east and southeast of fruiting trees. The overall profile of dispersal away from source trees is negatively exponential, with nearly two-thirds of the seeds falling within 30 m of the source. Less than 5 percent of the seeds are dispersed beyond 100 m.

Seed production varies greatly from year to year and appears to be cyclic, with abundant fruits and seeds produced every 3-4 years (Sharik 1984). In good fruiting years, seed density may exceed $40/m^2$ on the forest floor within 100 m of a single fruiting tree, and more than $100/m^2$ within 40 m of the source (Ford <u>et al.</u> 1983). Seed viability ranges from 6 to 52 percent among fruiting trees, and averages 26 percent (Sharik 1984, Sharik <u>et al.</u> 1990). Under laboratory conditions, nearly all seeds which are viable will germinate within one month of incubation following cold (5° C), moist stratification for 30 days. The seasonality of seed germination in nature is not well known, but is believed to start no earlier than early to mid-June (Sharik 1984).

Seed germination and seedling emergence appear to occur optimally in small gaps (400-1,000 m²) in the forest where mineral soil has been exposed (Sharik 1984, Sharik <u>et al.</u> in prep.). However, even in good seed years under these site conditions, less than one seedling/m² survives to the end of the first growing season (Sharik 1984, Sharik <u>et al.</u> in prep.). Beyond the first growing season, seedlings exhibit fairly rapid growth, often approaching a quarter of a meter in height by the end of the second growing season (Sharik <u>et al.</u> in prep.).

Indiscriminate browsing of seedlings of round-leaf birch by deer and mice has been observed (Sharik 1984). Although usually not causing direct mortality because of their capacity to resprout, the browsing may render the seedlings less competitive with other plants and ultimately lead to the death of individuals.

No serious insect pests or diseases of round-leaf birch have been observed in the natural population. However, in the 1989 growing season three diseases were first noted on individuals

of round-leaf birch in the recently established additional populations (R. J. Stipes pers. comm.). These diseases include a canker caused by <u>Botryosphaeria dothidea</u>; anthracnose, caused by <u>Glomeralla cingulata</u>; and a putative foliar virus. As of May 1990 few individuals had seemingly died as a result of the diseases. However, several trees exhibited fairly extensive areas of necrosis which, given enough time, could conceivably result in their death. <u>B</u>. <u>dothidea</u>, in particular, is an opportunistic disease, causing increased mortality of trees under stress from other factors.

At the time of rediscovery the population exhibited a bimodal age and size distribution, with the 18 reproductively mature adults and 23 subadults occurring in adjacent areas, the former a closed canopy and the latter an exposed embankment bordering the second-growth forest. This condition suggests two separate waves of invasion following disturbance. Although flooding of Cressy Creek was directly responsible for some of the mortality in the adult plants, most of the 14 individuals which died by 1984 appeared to succumb to competition with later successional species (Sharik et al. 1990). Mortality was heightened in years of drought. It is important to note that at the time of rediscovery the majority of adult round-leaved birches were in a subcanopy position and exhibited signs of reduced vigor, as did many of the sweet birches and yellow birches intermingled with them (Sharik 1980, 1984).

An understanding of natural mortality rates and other demographic features in the seedling and sapling stages of population development has been hampered by acts of vandalism, which are addressed under "Reasons for Listing".

The frequency of round-leaf birches in the Cressy Creek area is partly dependent on the distance between pollen sources, coupled with gene flow involving sweet birch. With increased distance between individuals, round-leaf birches are more likely to be pollinated by the more abundant sweet birches in the area and give rise to progeny having ovate-shaped leaves typical of sweet birch (Sharik 1984). As the minimum distance between the four remaining fertile round-leaf birches in the population is about 170 m, the probability of sweet birch-round-leaf birch crosses is high relative to crosses between round-leaf birches. However, an unknown number of fertile sweet birches in the Cressy Creek population apparently carry the gene for round leaves and thus provide pollen which, when it fertilizes the female flowers of round-leaf birch or other sweet birches carrying the roundleaf gene(s), produces plants with round leaves. The biosystematic relationships between round-leaf birch and sweet birch are detailed under "Conservation Measures."

Reasons for Listing

Round-leaf birch has apparently always been rare (Sharik 1980). This means that chance events are likely to have a large impact on the single existing population (Shaffer 1981), and, in the extreme case, could cause its extinction from the wild. As round-leaf birch requires moist, exposed mineral soils and moderate levels of incoming solar radiation to regenerate itself, the maintenance of closed forest canopies in the immediate vicinity of fruiting trees and of pasture land and rural residences beyond largely precludes the recruitment of individuals to the population (Sharik 1980, 1984).

Periodic flooding along Cressy Creek has adverse effects on the round-leaf birch population, both directly and indirectly. One adult (in 1977) and several one-year-old seedlings (in

1983) were lost when high water washed away the underlying substrate (Sharik 1984). Continual deposition of coarse alluvium over the soil surface creates a droughty condition, which may adversely affect both the growth and survival of adults, and the germination and establishment of seedlings (Sharik 1984).

The impacts of grazing on the round-leaf birch population are difficult to assess. Prior to its rediscovery in 1975, most of the population was exposed to grazing and browsing by domestic livestock and wildlife (chiefly deer and rabbits). By 1977, most of the area had been surrounded by fences; only the private tract (B) containing most of the adult trees remained accessible to native browsers (Sharik 1980). Of the 30 two-year-old seedlings existing in the fall of 1983 following induced disturbance on tract B (see "Conservation Measures" below), a third showed evidence of browsing by large herbivores (Sharik 1984).

Vandalism and collection for scientific purposes are responsible for the loss of 10 of the original 41 individuals in the population (Sharik 1980), while vandalism alone accounts for an additional loss of 30 seedlings originating from the planned disturbance in 1981. Private landowner A transplanted three seedlings on his property from their natural habitat to his yard (Sharik 1980). One of the trees on Forest Service land was inadvertently cut back to near ground level during normal maintenance of a transmission corridor prior to any knowledge that round-leaf birch occurred in the area (Sharik 1980). Likewise, routine road maintenance may have accounted for the loss of several additional seedlings (Sharik 1980).

Finally, inherent reproductive characteristics must be considered as offering some threat to the natural population

(Sharik 1984, Sharik <u>et al.</u> 1990). Recent studies have shown that seed viability is significantly lower in round-leaf birch than in other dark-barked birches in the Cressy Creek area, and that round-leaf birch does not reproduce its own kind with as high a frequency as do the other birches (Sharik 1984, Sharik <u>et al</u>. 1990).

In summary, the occurrence of round-leaf birch in nature appears to be threatened by a number of factors, including a limited number of small forest openings with exposed mineral soil in the immediate vicinity, periodic flooding and droughty soils, vandalism and other human activity, herbivory, long distances between pollen sources, and a breeding system which may be developmentally retarded and permits heavy gene exchange with sweet birch.

Conservation Measures

In the early spring of 1976 the two private landowners erected fences around their segments of the population, thereby representing the first protective measures to be taken for round-leaf birch (Sharik 1980). Later that same year, the U.S. Forest Service wrote a plan to facilitate protection of the two individuals located in the Jefferson National Forest (Beaver and Brock 1976). This plan recommended: (1) constructing a chain-link fence around the individuals, (2) implementing erosion control measures along Cressy Creek, (3) notifying public utilities of the location of trees in the area of their rights-of-way and requiring approval of Forest Service personnel for maintenance work, (4) contacting adjacent landowners to make them aware of the importance of the trees and to caution them on the use of fire and chemicals in the area, (5) cessation of stocking of hatchery trout in Cressy Creek, (6) notifying local industry of the location and

importance of the trees, (7) remarking Forest Service property lines adjacent to the location of the trees, (8) submission of a request to designate the site as a Botanical Area, (9) covering the area with a Forest Supervisor's closure order to prevent trespass, (10) constructing visitor information facilities adjacent to the large tree on Forest Service property, and (11) conducting a meeting to facilitate the development of a research plan. Most of these recommendations had been carried out by the time the protection plan was released in late 1976.

In May 1977, a group of 10 persons representing five agencies and institutions, together with the two private landowners, met to develop a plan of research for round-leaf birch. In its initial discussions the group concluded that development of a management plan would be more appropriate than a research plan. Such a plan was developed in outline form to include: (1) protection of the existing natural population, (2) propagation of the population and broadening the genetic base to the extent possible, (3) search for new populations, (4) basic research on the biology of the species, (5) public relations, (6) solicitation of financial support for management and research, and (7) provision of a mechanism for effective gene pool management (Sharik 1980).

The group's recommendations led to the creation of the <u>Betula</u> <u>uber</u> Protection, Management and Research Coordinating Committee in May 1977, spearheaded by the U.S. Forest Service, Jefferson National Forest (Sharik 1980). The committee, comprising members from Federal and state government, conservation organizations, universities, and the private sector, has met annually or semi-annually since 1977 (excluding 1981) and continues to function as an <u>ad hoc</u> recovery team.

The original and revised Virginia Round-leaf Birch Recovery Plans contained a number of research and management objectives, along with their priority ratings, where a rating of 1 was highest, as follows: maintenance and expansion of the natural population (priority 1), establishment of additional populations in the wild (priority 2), continued searches for other natural populations (priority 2), determination of systematic relationships (priority 3), retention of existing germplasm through cultivation (priority 3) and implementation of educational programs (priority 4). Accomplishments relative to each of these objectives are summarized below under the same headings appearing in the original version (1982) and the first revision (1986) of the Recovery Plan.

Maintenance and Expansion of the Natural Population

<u>Provide immediate protection for existing habitat</u> (Task 1.1). Many of the measures designed to protect the original habitat have been implemented and maintained where necessary. Most of this effort has taken place on Forest Service land. The chain-link fences enclosing the two round-leaf birches on public land have been repaired when trees have fallen across them. Nearby Forest Service boundaries have been re-marked periodically. Erosion control devices, including riprap and water control bars, have been installed and maintained along Cressy Creek. The transmission corridor passing over one of the round-leaf birches has been rerouted.

In contrast, far less has been done to maintain the population segment on private land. Landowner A has denied the recovery team access to his property since 1982 for reasons which are partly unknown and are too complex to discuss here. He has, however, maintained a 10-foot-high fence around seven saplings, which prevents deer and livestock from entering.

Landowner B erected a barbed wire fence around the 31 individuals on his property, which kept livestock from entering. It is here that all the vandalism has occurred, together with the only natural mortality. The original draft and first revision of the Recovery Plan provided for the construction of a high chain-link fence around this segment of the population. This recommendation would have been implemented had not landowner A contested landowner B's ownership of tract B in 1984, claiming that the boundary between their properties had been incorrectly interpreted over the last several decades. For many of the same reasons, erosion control efforts have not been implemented on ownership B as planned.

A local community leader was added to the <u>ad hoc</u> recovery team in 1986 as a means of increasing awareness of the significance of round-leaf birch and of gaining additional local assistance and cooperation for its protection.

Monitor individuals for general condition and incidence of disease and insect infestation (Task 1.2). Of the approximately 650 dark-barked birches (41 round-leaf birches, 610 sweet birches, and 11 yellow birches) recorded in the Cressy Creek population in 1975, about 200 have been monitored closely since 1978 for vigor, fecundity, and incidence of disease and insect infestation. This monitoring effort has been aided more recently by the development of a computerized data management system which provides annual summaries of flowering, fruiting, and growth rates of individuals by taxon. In addition, there has been increased surveillance of the population by Federal and state personnel.

Round-leaf birches on private property A have been monitored from a distance. If decline of these individuals had been noted, the Virginia Department of Agriculture and Consumer

Services was prepared to issue a court order to gain access to the trees through provisions in Virginia's Endangered Plant and Insect Species Act.

Removal of competing canopy trees from around round-leaf birches on public and private land in the fall of 1981 had no apparent effect on the vigor of these trees. This lack of response is typical of individuals of pioneer species that have been suppressed for an extended period of time prior to attempted release.

Expand zone of management adjacent to existing population (Task 1.3). Gains were made in the expansion of the zone of management for round-leaf birch in July 1984 when The Nature Conservancy acquired through public auction 36 acres (14 ha) of agricultural land adjacent to the natural population. The land was, in turn, purchased by the U.S. Forest Service in October 1986, and, at the recommendation of the Coordinating Committee, was divided into the following three zones paralleling Cressy Creek: (1) lower zone (9 ac), "critical habitat" for round-leaf birch; (2) middle zone (17 ac), buffer area; and (3) upper zone (10 ac), non-essential. Starting in 1987, the upper and middle zones were leased to landowner A for grazing and haying, respectively. The lower zone was fenced off from grazing.

<u>Consider purchase of private property should it become</u> <u>available</u> (Task 1.4). In 1989 the Committee agreed to have the U.S. Forest Service approach landowner A on exchanging the 10 ac upper zone of the former Nature Conservancy tract for land within and adjacent to the natural population. The Committee has also expressed an interest in purchasing similar lands from owner B should they become available.

<u>Determine essential habitat</u> (Task 1.5). Efforts aimed at determining habitat conditions essential to the long-term maintenance of round-leaf birch are summarized below under 1.6 and 4.1. This is an ongoing effort that is part of the experimental manipulations being conducted at the sites of the natural population and the recently established additional populations.

Encourage natural regeneration (Task 1.6). By 1981 the round-leaf birch population had declined to 17 individuals (nine adults and eight subadults), the more recent decline due exclusively to natural causes. Given this heavy mortality, the decision was made to implement a planned disturbance adjacent to seed sources with the intent of obtaining natural regeneration. The disturbance treatment was preceded by a dispersal study in 1978-1979, which provided information on the direction, distance and timing of dispersal relative to seed sources (Ford <u>et al.</u> 1983).

In November 1981, two areas were cleared and the mineral soil exposed within 60 m of seed sources, one of about 1000 m^2 on public land and the second of about 400 m² on private tract B. Birch seed production was the highest recorded since monitoring began. At the end of the first (1982) growing season following the disturbance approximately two-thirds of the seedling regeneration was birches (Sharik et al. 1990). Of the birch regeneration, about 8 percent consisted of round-leaf birches, about 92 percent were sweet birches, and less than 1 percent were yellow birches. This contrasts with round-leaf birches comprising about 6.8 percent of the dark-barked birches in 1975 and 4.6 percent in 1981. In all, 81 round-leaf birch seedlings were recorded, all on the private tract. The fact that no round-leaf birch seedlings occurred in the disturbed area on public property was attributed to the absence of a pollen source for the

relatively isolated round-leaf birch mother trees growing there (Sharik <u>et al</u>. 1989).

The 37 percent first-year survival of round-leaf birch seedlings in cleared areas was twice that of sweet birch seedlings. There was no difference in height of seedlings among the two taxa after two growing seasons (Sharik et al. 1989). Four seedlings of round-leaf birch showed evidence of browsing by deer in the 1983 growing season. Six seedlings were clipped back to ground level, apparently by rabbits, in the winter of 1983; all resprouted the following growing season (Sharik 1984). All seedlings had wire cages placed around them in the fall of 1984 to exclude browsers. However, because of the current property boundary dispute discussed earlier, a chain-link fence preventing human access could not be erected. All of the 30 round-leaf birch seedlings remaining after the end of the second growing season (1983) were gone by the spring of 1986, the apparent result of vandalism, as whole plants (roots and shoots) were missing. Wire cages were also pulled from around the plants. An intensive investigation of the vandalism through the cooperative efforts of the U.S. Fish and Wildlife Service and the Virginia Department of Agriculture and Consumer Services was unsuccessful in apprehending perpetrators.

Given the 1989 resolution of the property boundary dispute in favor of landowner B, the same area was cleared of brush and mineral soil exposed in the late fall of 1989 to again promote natural regeneration. Although only one round-leaf seed tree remained within possible dispersal distance of the treated area (compared to four at the time of the initial treatment in 1981), at least two of the sweet birches adjacent to the area are known to carry the round-leaf gene in the heterozygous condition and thus provide the potential for the production of round-leaf birch seedlings.

By the end of the 1987 growing season there were in excess of 30 sweet birch saplings on Forest Service property as a result of the 1981 treatment. These seedlings were released from competing vegetation in 1988 and 1989 to ensure the maintenance of the sweet birch-round-leaf birch complex in the area. There is a very high probability that a number of these saplings are progeny of the large round-leaf birch located on the edge of the cleared area.

Scarification was performed in 1985 to break up sod cover and expose mineral soil on a 2.5-acre area in the lower zone of the Nature Conservancy tract along Cressy Creek. Recruitment the following growing season was confined to a single sweet birch. This general lack of recruitment of birches was probably due in large part to high levels of incoming solar radiation and their desiccating effects on surface soils in the absence of partial canopy cover (Sharik pers. obs.).

Retention of Germplasm through Cultivation

<u>Distribute vegetatively propagated materials to private and</u> <u>public sectors</u> (Task 2.1). Efforts aimed at retention of round-leaf birch germplasm began in 1975 when the U.S. National Arboretum transplanted three seedlings from the wild to their grounds in Washington, D.C. Approximately 50 plants were produced from rooted cuttings and grafted scions of these three genotypes (Sharik 1980). By 1984 the National Arboretum reported having distributed 28 seedlings of vegetative origin to 12 arboreta, botanical gardens, and nurseries in the United States and Europe (P. Mazzeo pers. comm.).

Attempts made at vegetative propagation of round-leaf birch from cuttings of saplings have met with mixed success, and have not provided large numbers of genetically diverse materials. Likewise, micropropagation techniques have been

worked out recently, whereby plantlets can be produced from vegetative buds (Vijayakumar <u>et al</u>. in press). Although the latter techniques may aid in genetic studies and in the conservation of individual rare trees, they do not provide an opportunity for the efficient generation of a wide array of genotypes. Thus, in 1981, researchers turned to sexual propagation of round-leaf birches from seed collected in the wild (Sharik and Porter 1983). Refined schedules of fertilization with nutrients and watering under greenhouse and subsequently lath house conditions at the Reynolds Homestead Research Center in Critz, Virginia have resulted in the production of seedlings of sufficient size to permit transplanting after only a single growing season in cultivation (R. Kreh pers. comm.).

The first 10,000 birch seedlings produced by germination of open-pollinated seeds in 1982 were used to assess systematic relationships and to provide plants for establishment of additional populations in the Cressy Creek watershed, as discussed below under these respective topics.

In 1988, approximately 2,000 seedlings were produced from controlled crosses the previous year. A notice was placed in the Newsletter of the American Association of Arboreta and Botanical Gardens announcing the availability of round-leaf birch seedlings to arboreta and non-profit botanical gardens for the purposes of teaching and research. The release program was developed through the Virginia Agricultural Experiment Station, working in cooperation with the Virginia Department of Agriculture and Consumer Services. A requesting organization received three seedlings for a fee of \$10 to cover costs of packaging, handling, and postage. A note was sent with the flyer specifying the female parent of each seedling. Recipients were required to sign a waiver indicating they would not sell the plants or their offspring.

Through early 1990, 60 requests were filled, with 200 seedlings going to 12 states and two foreign countries (Feret and Kreh pers. comm.). Twenty of the seedlings were sent to the USDA Agricultural Research Service's Plant Introduction Lab in Ames, Iowa for genetic conservation purposes.

In 1989 private nurseries were contacted to explore interest in commercial propagation and sale of plants. Except for those specializing in native plants, few were interested (Feret pers. comm.). In addition to increasing the number and geographical distribution of round-leaf birches in cultivation, making the plants available to the public was viewed as a way of heightening awareness of endangered species and possibly reducing vandalism to the natural population as the plant would no longer be perceived as rare.

Establish pollen and seed banks (Task 2.2). No pollen or seeds of round-leaf birch have been placed in official repositories to date, mostly because this task is a low priority relative to whole-plant propagation and distribution efforts.

Determination of systematic relationships

<u>Conduct morphological, anatomical and chemical studies on</u> <u>existing individuals of round-leaf birch and closely related</u> <u>taxa</u> (Task 3.1). The results of these studies are reported in the "Description" section.

<u>Conduct studies of the reproductive and genetic systems of</u> <u>round-leaf birch and closely related taxa</u> (Task 3.2). These studies were designed to provide estimates of the degree of gene exchange between round-leaf birch and other birches, and of the mechanisms of inheritance of the characteristics considered unique to round-leaf birch. As noted elsewhere in the introduction, several lines of evidence point to a closer evolutionary relationship of round-leaf birch to sweet birch than to other birches. Thus, major emphasis in the recovery effort has been placed on understanding this relationship.

About 10,000 open-pollinated progeny, originating in 1982 from six mother trees of round-leaf birch and four of sweet birch, were analyzed for morphological differences (Sharik and Porter 1983). Over 99 percent of the progeny exhibited either round leaves, typical of round-leaf birch, or ovate leaves, characteristic of sweet birch. Less than 1.0 percent of the seedlings had leaves intermediate between the two taxa. Round-leaf mother trees averaged 3.0 percent round-leaved progeny and ranged from 0-11.7 percent. In contrast, sweet birch mother trees produced an average of 0.3 percent round-leaved progeny, ranging from 0-0.9 percent. Another sweet birch, assessed for the first time in 1985, produced 4.4 percent round-leaved progeny. The frequency of round-leaved progeny among round-leaf birch mother trees was inversely related to distance from the closest pollen source.

The observations reported above lead to the hypothesis that the round leaf shape is a case of simple inheritance, resulting from the mutation of a single gene in the sweet birch population (Sharik <u>et al</u>. 1989). The hypothesis specifies that the ovate leaf shape, characteristic of sweet birch, exhibits complete dominance over the round leaf shape, with some modifier effects to account for the low frequency of progeny with intermediate leaf shapes. This hypothesis was tested recently with controlled crosses and was not rejected (Feret and Sharik unpubl. data). However, because of the demanding conditions for making crosses in the natural population, sample sizes were insufficient for making definitive statements about the breeding systems of round-leaf birch and sweet birch, and the origin of the round-leaf trait.

Likewise, grafting of fertile material from adult trees in the natural population onto saplings in cultivation, on which controlled pollinations were then made, proved largely unsuccessful (Feret and Sharik pers. obs.). Thus, a one-acre breeding orchard was established at the Reynolds Homestead Research Center in Critz, Virginia, in which were planted over 100 genotypes of round-leaf birch, sweet birch, and bog birch (<u>B. pumila</u> L.), the latter a shrubby species of northern habitats with roundish leaves. Upon their becoming fertile, crosses will be made between these genotypes to provide a better understanding of the genetic and evolutionary affinities of round-leaf birch.

Based on existing information, the situation with round-leaf birch appears very similar to that with simple-leaved white ashes (Fraxinus americana L.) reported from northern Lower Michigan (Wagner et al. 1988). Most plant taxonomists would treat such local variants of widespread species as forms of these species, and we see no reason not to do such in the case of the Virginia round-leaf birch. However, we also see no reason to discontinue conservation efforts for this taxon. From a legislative standpoint, the Federal Endangered Species Act of 1973 (Sec. 3-11) was designed to accommodate intraspecific taxa as threatened or endangered, at least down to the level of variety. Furthermore, it is scientifically interesting to examine the role that single-gene mutations play in structuring plant populations and communities, and in the evolution of higher plants (Wagner et al. 1988). Indeed, Hilu (1983), based on a review of the literature, argued that we have substantially underestimated the magnitude of changes in higher plants as a result of such mutations.

Establishment of Additional Natural Populations

Establish permanent sites containing numerous genotypes (Task 4.1). Given the results obtained from regeneration experiments with the natural population, it was concluded that additional populations could be established and that they would be self-sustaining given periodic disturbance. Twenty sites were selected for establishment of additional populations. This was twice the number of self-sustaining populations specified in the primary objective of the Recovery Plan to permit delisting of the species, thus allowing for a substantial margin of failure in the establishment program.

Establishment of additional populations was limited to the approximately 20 km² Cressy Creek watershed in Smyth and Grayson counties, because round-leaf birch was not known outside this watershed and because confinement to a single watershed would facilitate population maintenance. In addition, the watershed represented a natural landscape boundary. The 20 sites were chosen to represent the full range of conditions over which sweet birch occurs in the watershed, thus providing the opportunity to define optimal and suboptimal habitat for the species (see 4.2 below).

Seeds were collected from six round-leaf birch mother trees and four sweet birch mother trees within the area of the natural population, germinated in the greenhouse in 1982, and held in cultivation for two to three growing seasons before transplanting in the field in 1984 and 1985. Additional seeds were germinated in 1985 for transplanting in 1986 and 1987. Five populations per year were established over the four-year period. All populations are on public (U.S. Forest Service) lands and extend over a distance of approximately five km, with an average distance of 0.7 km between populations. Exclusive of the one additional population which largely

failed, the minimum distance between the natural population and an additional population is 0.5 km.

Each additional population consisted of 96 individuals established on a 3.2 x 3.2 m spacing. Sweet birch progeny were included in the planting to allow comparisons in growth rates and fecundity with round-leaf birch progeny. Nearly 76 percent of the 1920 transplants had round leaves; 74 percent were from round-leaf birch mother trees.

<u>Maintain sites to reduce competition and retain vigor</u> (Task 4.2). Heavy browsing of planted birches by deer was noted after one year in the field, as animals were attracted to the succulent regrowth of woody plants in general following clearcutting. Thus, it became necessary to enclose all planted birches in five-foot-high cylinders of chicken wire. Competing vegetation was removed from around individual transplants annually.

At the beginning of the 1989 growing season, survival averaged 81 percent over all additional populations, and ranged from 13-98 percent. All populations exhibited greater than 40 percent survival, except for the one located in the open field adjacent to the natural population. This site was used only because one of the 20 original sites was rejected for reasons of access. However, its incorporation in the study did confirm that round-leaf birches will not establish easily in the open, even when planted.

There was no difference in survival associated with species of mother tree, leaf shape of transplants, or their location within plots. Likewise, height growth was not affected by species of mother tree or leaf shape of transplants. However, there were significant differences in height growth among populations and among locations within populations.

Populations located at the base of slopes and in floodplain positions exhibited greater height growth than those situated on side slopes. Likewise, within populations, border trees grew slower than interior trees.

The slower growth of birches in the outside rows in each plot, compared to trees in the interior positions, led to the decision in late 1987 to remove competing vegetation from the forests bordering the 10 populations established in 1984 and 1985. The width of removal averaged 5-10 m, but varied as a function of plot orientation and height of the surrounding vegetation. All stumps were injected with a systemic herbicide to prevent resprouting. The 10 remaining populations were similarly treated in 1988 and 1989 at the rate of five per year. Wire cages were removed from around individual plants when crowns developed beyond the reach of deer.

Vandals removed wire cages from around all 96 plants in one population in late 1984. Three plants were missing and two others were damaged in the process. A total of 14 plants were taken from four other populations between late 1987 and early 1989.

Implementation of Educational Programs (Task 5.0)

Early in the recovery effort, the decision was made to allow the public access to the round-leaf birches on public land. This was seen as a way of increasing awareness of endangered species in general and of minimizing human impact on the majority of the natural population of round-leaf birch, located on private property. Thus, a sign was erected by the U.S. Forest Service, giving the location of the largest round-leaf birch in the population. A ramp provided a close-up view of the tree, which was enclosed by a chain-link fence. Round-leaf birch was included in evening campground talks given by Forest Service naturalists. In 1979, a slide-tape program was developed for viewing at the Mount Rogers National Recreation Area (NRA) headquarters, telling the round-leaf birch story from its discovery through current recovery efforts. At the same time, plans were completed for an inside exhibit at NRA headquarters, which made reference to a round-leaf birch planted within viewing distance, and for an outside exhibit on the viewing ramp at the site of the natural population. None of the three interpretive components had been implemented by early 1990, due in part to a change in administrations and the low priority of this task relative to others specified in the Recovery Plan.

Continued searches for other natural populations (Task 6.0)

A coordinated search for other natural populations of round-leaf birch was conducted in 1977, utilizing personnel from the U.S. Forest Service trained in identification of the species. Searches in Cressy Creek and adjacent watersheds over a three-county area failed to reveal other locations where round-leaf birch grows. No further searches were scheduled.

Recovery Objective and Criteria

The primary objective of the round-leaf birch recovery plan is to increase the number of individuals in the wild to a level where the species can be delisted, currently estimated at 500-1000 individuals in each of 10 self-sustaining populations. The populations may include individuals of sweet birch which carry the round-leaf trait in a cryptic (heterozygous) state.

The number of individuals required in each population for the maintenance of the round leaf and associated traits of round-leaf birch cannot be determined with a high degree of certainty, given the fact that the allelic frequency at a particular gene locus determining these traits in the dark-barked birch population is not known. The 500-1000 individuals per population represents a conservative estimate (Namkoong 1980), given the assumptions based on previous studies that only a single gene locus is involved and that the frequency of the rare allele in the dark-barked birch population is at least 5 percent.

Any population of round-leaf birch, whether established naturally or through plantings, will be considered self-sustaining when it produces through natural regeneration 500-1000 individuals greater than 2 m tall. Given the present status of round-leaf birch and current knowledge of its life history, this is estimated to occur by the year 2010 in both the original and additional populations.

Narrative Outline of Recovery Tasks

1. <u>Manage existing individuals and habitat for maintenance</u> and expansion of the single wild population.

- 1.1 <u>Provide immediate protection for existing habitat</u>. A high fence should be placed around the segment of the natural population on private tract B as a way of deterring further vandalism. In addition, erosion control devices, including water control bars and riprap, should be installed along the section of Cressy Creek adjacent to this segment of the population. Routine maintenance of fences, property boundaries, and erosion control devices that are now in place will be continued. In light of the history of vandalism, surveillance of this population will be conducted on a regular basis.
- 1.2 <u>Monitor individuals for general condition and incidence of disease and insect infestations.</u> Monitoring of the natural population will be continued on a semi-annual to annual basis to include estimates of vigor, fecundity, and incidence of disease and insect infestation. The existing computerized data management system will be updated annually and the results summarized in the minutes to the annual meetings of the <u>ad hoc</u> recovery team. In light of the history of vandalism, surveillance of the population by law enforcement officers will be conducted on a weekly or biweekly basis.
- 1.3 Expand zone of management adjacent to existing population. The habitat adjacent to the natural population, being chiefly privately owned pasture and rural residential areas, strongly limits lateral

expansion of the natural population. Thus, steps must be taken to allow this land, estimated at less than 40 ha (100 ac), to revert to more suitable habitat for round-leaf birch. Given the limits to protection of endangered species on private land inherent in Federal and state legislation, purchase of this land and incorporation into the public domain is highly desirable for effective management of round-leaf birch. As the Jefferson National Forest now borders these lands, incorporation from a management standpoint should be relatively easy.

- 1.4 <u>Consider purchase of private property should it</u> <u>become available</u>. Current efforts by the U.S. Forest Service to exchange the 10-acre segment of the former Nature Conservancy tract for land in and immediately adjacent to the existing population will be continued. Should additional lands become available, they will be purchased.
- 1.5 <u>Determine essential habitat</u>. Determination of essential habitat is an ongoing task tied to experimental manipulations, which are designed to secure natural regeneration at the site of the original population and at the additional populations (see Tasks 1.6 and 4.2 below).
- 1.6 Encourage natural regeneration. If natural regeneration is not secured as a result of the 1989 induced disturbance on private tract B, the disturbance treatment will be repeated in subsequent years with adequate seed crops. Individual seedlings will be released from competing vegetation. Trees will be caged only in the case of

extreme browsing, as the cages render the seedlings more vulnerable to vandalism.

The sapling sweet birches resulting from the 1981 induced disturbance on national forest lands, which are likely to carry the round-leaf gene(s), will be released from competition periodically.

The lower zone of the former Nature Conservancy tract adjacent to the natural population will be allowed to continue to revert from pasture to forested conditions. Natural regeneration will be encouraged by scarification of the substrate, but only in a narrow (ca. 10 m wide) belt immediately adjacent to existing forest cover.

2. Retain existing germplasm through cultivation.

2.1 Distribute propagated materials to public and private sectors. The ongoing program which provides seedlings to arboreta and non-private botanical gardens will be continued for at least another year to ensure that all requests are met. With approximately 2,000 round-leaf birch seedlings remaining in cultivation and available for distribution, a mechanism should be established for immediate release of plants to the public. Citizens in the immediate vicinity of the natural population and in surrounding communities will be given first priority in selection of seedlings as this is likely to have the greatest impact on reducing current vandalism to the original population and the additional populations now established in the Cressy Creek watershed.

2.2 <u>Establish pollen and seed banks</u>. This task does not seem very important given the wide distribution of round-leaf birch as a result of recent propagation efforts. However, persons at the established U.S. Forest Service pollen and seed repositories for rare plants will be contacted to determine if they still desire such materials.

3. <u>Determine the systematic relationships of round-leaf</u> <u>birch</u>.

- 3.1 <u>Conduct morphological, anatomical, and chemical</u> <u>studies on existing individuals of round-leaf birch</u> <u>and closely related taxa</u>. These analyses have been completed and results are reported in the "Description" section. Any future studies of the morphology, anatomy, and chemistry of round-leaf birch should be conducted in the context of understanding the reproductive and genetic systems of round-leaf birch and closely related species (Task 3.2).
- 3.2 <u>Conduct studies of the reproductive and genetic</u> <u>systems of round-leaf birch and closely related</u> <u>taxa</u>. Studies of several isoenzyme systems should be conducted to determine if the round-leaf gene is detectable. Such a methodology would permit the identification of this gene in its cryptic (heterozygous) state and thus provide an accurate delineation of its distribution in the Cressy Creek dark-barked birch population.

The breeding orchard established at the Reynolds Homestead Research Center in Critz, Virginia will be maintained in such a way as to encourage flowering

of round-leaf birch and other birches at the earliest possible date so that controlled breeding experiments can be conducted.

4. Establish and maintain additional natural populations.

- 4.1 <u>Establish several sites containing numerous</u> <u>genotypes</u>. This task has been accomplished.
- 4.2 <u>Maintain sites to reduce competition and retain</u> <u>vigor</u>. Current maintenance of the additional populations will be continued. Specifically, competing vegetation will be cleared from around individual birches, and wire cages will be mended where damaged or removed where crowns of trees have grown beyond the reach of deer. Regular surveillance will be conducted at these sites to discourage vandalism. Data on mortality, size of individuals, and fecundity will be collected annually or biannually (fecundity) and included in the data base management system.

In cooperation with the Virginia Department of Agriculture and Consumer Services, pesticides will be applied to round-leaf birch populations that have been diagnosed as having individuals infected with a canker caused by <u>Botryosphaeria dothidea</u> and anthracnose caused by <u>Glomerella cingulata</u>. Pesticides should also be applied to control insects that may be providing an infection court for <u>B</u>. <u>dothidea</u>. During the growing season, samples will be collected for clinical analysis and subsequent isolations, including identification of a known putative virus infection. The incidence of these diseases will be examined in relation to various attributes of the planted birches included in the data base management system.

- 5. <u>Implement educational programs to facilitate management</u> of round-leaf birch. Round-leaf birch should be included in any campground talks given by volunteer naturalists. The slide-tape program should be revised, and inside and outside displays of round-leaf birch put in place at the Mount Rogers National Recreation Area.
- 6. <u>Continue search for additional natural populations</u>. No further searches for additional natural populations of round-leaf birch are warranted at this time, given the fact that past searches have been unsuccessful. However, if a method becomes available to detect round-leaf birch in its cryptic state, populations of sweet birches in various locations throughout the Cressy Creek watershed and in adjacent watersheds will be assayed for the round-leaf gene.

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The following implementation schedule outlines actions and estimated costs for the recovery program. It is a guide for meeting the objective discussed in Part II of this plan. The schedule indicates task priorities, task numbers, task descriptions, duration of tasks, the responsible agencies, and, lastly, estimated costs. These actions, when accomplished, should bring about the recovery of the round-leaf birch and protect its habitat. It should also be noted that the estimated funding needs for all parties involved are identified and that, therefore, Part III reflects the total estimated budgetary requirements for recovery. Tasks are listed in order of priority, as follows:

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

<u>Priority 2</u> -- 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.

<u>Priority 3</u> -- An action that complements priority 1 and 2 actions, but is not likely to prevent a significant decline in species population/habitat quality in the immediate future.

VIRGINIA ROUND-LEAF BIRCH IMPLEMENTATION SCHEDULE

First Revision (Update)

September, 1990

		Task		Responsible Agencies		Cost Estimates (\$000)		(\$000)	
Priority	Task	Number	Duration	USFWS*	Other	FY91	FY92	FY93	Comments
1	Protect existing habitat	1.1	Ongoing	R5/SE	USFS** VDACS	1 15	1	1	
1	Monitor individuals in original population	1.2	Ongoing	R5/SE	VDACS** USFS	2 3	2 4	2 5	
1	Encourage natural regeneration	1.6	Ongoing	R5/SE	VDACS** USFS	2 2	2 2	2 2	
1	Maintain additional populations	4.2	Ongoing	R5/SE	VDACS** USFS	8 1	8 1	8 1	
2	Expand management zone	1.3	Ongoing		USFS	.5	.5	.5	
2	Consider purchase of private property	1.4	1 year		USFS	15			
2	Distribute propagated materials	2.1	1 year		VDACS	2			
3	Establish pollen and seed banks	2.2	1 year	R5/SE	VDACS	.5			
3	Study reproductive and genetic systems	3.2	Ongoing	R5/SE	VDACS	24	24	4	
3	Implement educational programs	5.2	3 years		USFS	5	5	5	

* USFWS = U.S. Fish and Wildlife Service R5/SE = Region 5, Endangered Species Program USFS = U.S. Forest Service

VDACS = Virginia Department of Agriculture and Consumers Services

** Lead Agency