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United States Department of the Interior
FISH AND WILDLIFE SERVICE
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ATLANTA, GEORGIA 30303

FISHERIES, WILDLIFE & RANGE

May 10, 1984

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Lois I would like a copy please
gave LP a copy
5/29/84
mh

Lewister,
Lets discuss.
Pat — say when

Lewister
Sometime on the 11th of July.

Mr. John E. Alcock
Regional Forester
U.S. Forest Service
1720 Peachtree Road, NW.
Atlanta, Georgia 30367

Dear Jack:

The draft recovery plans for the hairy rattleweed and persistent trillium, which were recently reviewed by cooperating agencies and various experts on the species, have been given final approval by the Fish and Wildlife Service. We are pleased to provide the enclosed copies for your information and guidance. Any assistance which you can provide in implementing these plans will be appreciated.

Sincerely yours,

James W. Pulliam, Jr.

James W. Pulliam, Jr.
Regional Director

Enclosures

Persistent Trillium (*Trillium persistens*) Recovery Plan

Prepared by

Douglas A. Rayner, Ph.D.
Field Botanist

South Carolina Wildlife and Marine Resources Department
Heritage Trust Program

For

U.S. Fish and Wildlife Service

Atlanta, Georgia

March 1984

Approved: _____ (John I. Christian)
Acting Regional Director, Southeast Region

Date: March 27, 1984

THIS IS THE COMPLETED PERSISTENT TRILLIUM RECOVERY PLAN. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF COOPERATING AGENCIES, AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS WHO PLAYED A KEY ROLE IN PREPARING THIS PLAN. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES, AND OTHER BUDGETARY CONSTRAINTS.

ACKNOWLEDGMENTS SHOULD READ AS FOLLOWS:

U.S. Fish and Wildlife Service. 1984. Persistent Trillium Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 69 pp.

ADDITIONAL COPIES MAY BE OBTAINED FROM:

Fish and Wildlife Reference Service
1776 East Jefferson Street
Rockville, Maryland 20852
Telephone: 1/800/582-3421
1/301/468-1737 (in Maryland)

TABLE OF CONTENTS

		Page
Part I.	INTRODUCTION	1
	Taxonomic Background and History of Knowledge of Taxon	1
	Current and Historic Distribution	3
	Species Biology	7
	Population Status and Trends	10
	Habitat Description	15
	Land Use and Threats to the Species	18
	Conservation Efforts	24
	Land Ownership	32
	Figure 1. Map Showing Distribution of Trillium persistens.	33
	Table 1. Herbarium records and other sources concerning the distribution of Trillium persistens	34
	Table 2. Size class distribution of known populations or population segments of Trillium persistens	37
Part II.	RECOVERY	39
	Recovery Objectives	39
	Recovery Outline	41
	Narrative Outline	43
	Literature Cited	59
Part III.	IMPLEMENTATION SCHEDULE	64
APPENDIX -	List of Reviewers	68

PART I. INTRODUCTION

The persistent trillium (Trillium persistens) is restricted to the Tallulah-Tugaloo River system in Rabun, Habersham, and Stephens Counties, Georgia, and Oconee County, South Carolina. The species is very restricted in distribution, as indicated by the fact that the maximum distance between any of the four populations is 5.3 miles.

Persistent trillium was among the 1,738 plant species proposed as endangered by the U.S. Fish and Wildlife Service (FWS) (1976). It was listed officially as a nationally endangered species on April 26, 1978 (FWS, 1978). The species was listed because of its very restricted distribution and potential threats from development and lumbering operations. The Georgia Department of Natural Resources lists persistent trillium as endangered in its official list of "Georgia's Protected Plants" (McCollum and Ettman, 1977), and the species is listed as "of national concern - endangered" by the South Carolina Advisory Committee on Endangered, Threatened, and Rare Plants (Rayner et al., 1979).

TAXONOMIC BACKGROUND AND HISTORY OF KNOWLEDGE OF TAXON

W. H. Duncan, J. F. Garst, and G. A. Neece described Trillium persistens as a new species in 1971 (Duncan et al., 1971). Fruiting specimens of T. persistens were first collected from the Tallulah Gorge by Duncan in 1950 but were not identified. In 1966 some of the Tallulah Gorge Trillium specimens were sent to Vanderbilt University and were

identified as T. catesbaei Ell. In 1969 additional specimens from the same Tallulah Gorge collection were identified as T. catesbaei by Robert G. Johnson at the University of West Virginia (Duncan et al., 1971). Duncan et al. (1971) noted that fruiting specimens of T. persistens are very difficult to distinguish from closely related species.

John D. Freeman (personal communication, 1982) identified the specimens sent to Vanderbilt University in 1966. Because he apparently was unsure of his identification of Duncan's fruiting material, Freeman visited Tallulah Gorge in early April of 1967 and collected several specimens in flower. Freeman indicates that he was convinced after seeing the species in flower that the Tallulah Gorge Trillium was a new species, but he did not immediately publish a description of the species.

On March 28, 1970, John and Edna Garst found an unusual Trillium in flower along Battle Creek in Oconee County, South Carolina, and along Moccasin Creek in Habersham County, Georgia. Collections of this plant were compared to Duncan's 1950 Tallulah Gorge collection, and it was decided that this was a new Trillium. Plants from all three known localities were examined for measurements necessary for the description of the species in 1971 (Duncan et al., 1971).

As indicated by Duncan et al. (1971), T. persistens resembles T. pusillum Michx., T. catesbaei, T. nivale Riddell, and some individuals of T. grandiflorum (Michx.) Salisb. However, only T.

catesbaei is known to be sympatric with T. persistens. Trillium persistens blooms earlier (mid-March to mid-April) than T. catesbaei (early April to late May) and is generally a smaller plant. Trillium catesbaei also differs in having sepals and petals which are strongly recurved. Sterile specimens of T. catesbaei usually can be distinguished by the broader, longer petioled (3 to 12 mm) bracts (leaves).

CURRENT AND HISTORIC DISTRIBUTION

The known distribution of Trillium persistens is shown in Figure 1 (page 33) and includes three populations in Habersham, Rabun, and Stephens Counties, Georgia, and one population in Oconee County, South Carolina. Population boundaries, shaded areas on Figure 1, are based on extensive survey efforts in March and April 1983 by Georgia Power Company (GPC) (Battle Creek, Moccasin Creek, Moody Branch, population segments along the Tallulah River, north of Black Branch and south of the Incline Railway and Tallulah Gorge proper), GPC and D. A. Rayner (Panther Creek), D. A. Rayner and Nora Murdock (Black Branch), and L. L. Gaddy, J. F. Garst, and J. Fish (Moody Branch). Numbers in Figure 1 correspond to herbarium records and other historic sources relating to the distribution of T. persistens (Table 1, page 34).

The 1983 survey efforts by GPC were coordinated by Gary A. Breece with the approval of Dr. W. Robert Woodall, Jr. William J. Candler served as field supervisor; and Wayne Stevens, Senior Land Forester, Northeast Georgia

Area, GPC, was present to ensure that the Lands Department would be aware of the known boundaries of T. persistens populations. Several additional GPC personnel also assisted with the survey effort. The author served as consultant for the first GPC survey effort (Panther Creek). The purpose of the GPC survey was to determine the boundaries and age-class distribution of the known populations and to search for additional populations. Boundaries of distribution were determined for all of the Panther Creek, Moccasin Creek, and Battle Creek populations and for most of the population in the Tallulah Gorge. Four additional population segments were found along the Tallulah River north of Black Branch and south of the Incline Railway. More work is needed to determine the distributional limits and age-size class distribution of these newly discovered population segments. Unsuccessful searches for additional populations were made: (1) along Bad Creek, Worse Creek, and the Chattooga River, upstream from where they feed into Tugaloo Lake; (2) along Camp Creek upstream from its juncture with the Chattooga River; and (3) along Bad Branch, the stream leading out of Camp Chattooga, and an unnamed intermittent stream between Camp Chattooga and Bad Branch, upstream from their juncture with Tallulah Falls Lake.

The survey efforts of Garst, Gaddy, Fish, Murdock, and Rayner were not as thorough or as extensive as the GPC survey effort. New population segments were located along Moody Branch and Black Branch—two major feeder streams of the Tallulah River between Tugaloo Lake and the Tallulah Gorge. Additional survey efforts are needed to determine the boundaries of these population segments and to determine the age-size class distribution.

Additional unsuccessful survey efforts by this team were made: (1) along Rothwell Creek upstream from its juncture with the Tugaloo River (ca.1.5 miles below the Yonah Lake Dam); (2) along several intermittent streams north and south of Rothwell Creek; and (3) along steep north-facing bluffs along Davidson Creek, about 2.7 miles east of Hollywood. Garst and Fish also searched the following areas near Tallulah Falls Lake: (1) near the south side of Tallulah Falls near an unnamed road, (2) along Slaughter Pen Branch, and (3) along the stream above and below Camp Chattooga. The additional voluntary efforts of Dr. John Garst deserve special mention. Between 1970 and 1982 Garst found the Battle Creek, Moccasin Creek, and Panther Creek populations, and searched (1) all coves leading into Yonah Lake, (2) the proposed Panther Creek Natural Landmark, (3) a north-facing cove along Rocky Branch (south of Panther Creek), and (4) numerous localities within Tallulah Gorge.

Although the search efforts in the spring of 1983 have added tremendously to our knowledge of the distribution, size, and stability of populations of T. persistens, additional surveys are needed to complete our knowledge about the distribution of the species. New population segments that were discovered in the 1983 survey were all between known populations of the species, and searches outside the immediate area were limited in scope. Additional searches are needed outside the immediate area where the species is known (i.e., above Tallulah Gorge, along branches off Panther Creek, and along the Georgia side of the Chattooga River), as well as within the vicinity of known populations.

The Natural Landmark Brief prepared by Dr. Ross Clark for the Panther Creek Cove Hardwoods, Stephens County, Georgia (Clark, 1979), includes T. persistens as one of the noteworthy plants within the area. This report, however, is not substantiated by a voucher specimen, and searches by J. F. Garst, J. F. Garst and W. Butler, and W. Butler and B. A. Sanders have been unsuccessful. Clark's report was based on a single plant that he and Steve Bowling saw in fruit in the summer of 1979 (personal communication between J. F. Garst and R. C. Clark, 1980). Bowling (personal communication, 1982) indicates that he has not seen T. persistens at the Panther Creek Cove Hardwoods site. Moreover, Bowling suggests that the site is probably too calcareous for T. persistens. It is likely that the plant seen was T. catesbaei.

W. H. Duncan reported a small, sterile colony of what he thought was T. persistens near the mouth of an unnamed creek entering Tugaloo Lake about 1.8 miles north, 10 degrees west of the Battle Creek population (S. M. Jones, personal communication, 1981). No voucher specimen was collected. Unsuccessful attempts to relocate this population have been made by S. M. Jones in 1979 and L. L. Gaddy in 1981.

The maximum distance between known plants (upper Tallulah Gorge and Lower Panther Creek) is only 5.3 miles. Prior to the damming of the Tugaloo River to form Tugaloo and Yonah Lakes there probably was a single, large, contiguous population of T. persistens. Gene flow, theoretically at

least, involved all population segments of the entire population. With the advent of Tugaloo and Yonah Lakes, some parts of the populations were isolated by physical barriers that probably restricted gene flow. In defining four separate populations of T. persistens, it is assumed that gene flow between these former segments of a single population now is minimal.

Whether or not there is gene flow between any two areas depends on the distance between the areas, the nature of the distance between the areas, and the habits and flight ability of effective pollinators. There is no way to know for certain at this time whether or not there is any gene flow between the populations of T. persistens as delineated in Figure 1. Whether or not there is gene flow is important in deciding which areas are critical to the preservation of maximum genetic diversity. This, of course, is of no concern if protection is to be afforded to all populations.

SPECIES BIOLOGY

The life history of T. persistens has not been studied in detail, but Trillium experts (J. D. Freeman, T. S. Patrick, and V. G. Soukup, personal communications, 1981) agree that it probably follows the life cycle pattern of most Trillium species. T. persistens blooms from mid-March through mid-April and generally matures fruit and sheds seed in July. If T. persistens follows the life cycle pattern of T. grandiflorum (Patrick, 1973), then seed shed in July should overwinter and germinate the

first spring, producing the primary root, but no stem. The second spring the seed coat is shed and an above ground cotyledon leaf and petiole is produced. A single, simple leaf is produced each of the third, fourth, and fifth springs, and a three-leaved plant is produced the sixth spring. If conditions are ideal, a mature flowering-fruiting plant is produced the seventh spring. Under less than ideal conditions it may take up to ten years to produce a mature plant.

The seeds of T. persistens, like all Trillium species, have a fleshy appendage (elaiosome) which is attractive to ants. Ants apparently are the primary means of seed dispersal (Gates, 1940). Ants collect the seeds and bring them back to their nests. After the elaiosome is eaten, the seeds are carried outside the nest. Seedlings of Trillium species often are seen in close association with ant nests in old, rotten stumps and at the base of trees they also are often seen in groups rather than singly (V. G. Soukup, personal communication, 1982). S. Bowling (personal communication, 1982) has noted in other Trillium species that ants often will climb the peduncle, cut off the capsule, open the capsule, and carry off the seeds. Bowling also notes that ants often drop and fail to recover seeds as they are carrying them to their nests.

In March 1979 S. Bowling and A. F. Robinson, Jr. (personal communication, 1982) hand pollinated (using a camel hair brush) individuals of T. persistens in Tallulah Gorge and in July 1979 collected seeds from ripe capsules. A total of 36 capsules were collected from four different

colonies, and an average of 5.5 seeds were found in each capsule. No attempt was made to determine differences in the number of seeds per capsule in hand pollinated versus naturally pollinated plants. Most of the seeds collected are now in storage at the National Tree Seed Laboratory near Macon, Georgia.

Little is known about the pollination biology of T. persistens. During an April 1, 1983, survey of T. persistens in the Tallulah Gorge south of the Wallenda cable, the author and Ms. Nora Murdock, a biologist with the Asheville Field Station of the FWS, made some observations and collections of insect visitors to flowering T. persistens. Only a few insect visitors were seen on plants that were in small, widely scattered colonies; visitors included two wasps, two ants, one green lynx spider, and a mosquito. Insect visitors were more numerous in a single large colony of 102 flowering plants. The following insect visitors were noted: ants (17), small flies (two different species, 6 total), mosquito (1), and an unknown insect (possibly a thrip, 1). Based on findings and criteria presented by Patrick (1975), the wasps, small flies, and an unknown insect are probably effective pollinators, the mosquitos are accidental visitors, the spider is a predaceous associate, and the ants are phytophagous associates. Collections of all insect visitors were made, but most were inadvertently lost before positive identification could be made. The green lynx spider was identified by L. L. Gaddy. During GPC's 1983 survey efforts, their biologists observed the following insects in association with T.

persistens: (1) honeybees, (2) ants, (3) a butterfly, (4) midges, and (5) small bees (GPC, 1983).

Patrick (1975), in a study of pollination activity in five species of Trillium in middle Tennessee, categorized insects of 24 families in five orders as potential effective pollinators of the five trilliums observed. Beetles were the most common pollinators. In a recent personal communication (April 1983), Patrick suggests that numerous insects are probable effective pollinators of T. persistens, and that "based on very preliminary observations of five middle Tennessee species, the most prevalent appear to be the nitidulids or sap beetles."

POPULATION STATUS AND TRENDS

Size class distribution data gathered in 1983 are presented in Table 2 (page 37). Age classes are defined as follows: small juvenile - single leaf, less than two cm long, probably 2 to 3 years old; large juvenile - single leaf, more than two cm long, probably 4 to 5 years old; juvenile - single leaf, any size, 2 to 5 years old; sterile - three-leaved, non-reproductive, probably 6 to 9 years old; flowering - reproductive, 7 to 30 plus years old. Most of the data in Table 2 was gathered by GPC. The author accompanied GPC in their initial survey effort (Panther Creek) and provided assistance in defining size classes and in distinguishing flowering, sterile, and juvenile plants. Because the larger size classes (flowering and sterile) were easier to locate, the numbers for these classes

probably are more accurate than for the smaller size classes. Likewise, the numbers for the large juvenile size class are probably more accurate than the numbers for the small juvenile size class. Because initial searches for the youngest juveniles, first-year seedlings (two years old), proved to be extremely time-consuming, no extra effort (i.e., turning over of leaf litter) was made to locate the youngest juveniles. First-year seedings were noted (and counted as young juveniles) only when their presence was obvious. This usually was true only in the few places where leaf litter was not present. The author noted the obvious presence of first-year seedlings in only three instances in the half of the Panther Creek area he surveyed. Thus, the number of young juveniles noted probably was considerably lower than the number actually present.

A reasonably complete survey now has been made for most of the Tallulah Gorge proper. Data available to date indicate that at least 1,626 flowering plants were present in the Gorge in 1983. (Note: This number takes into account probable overlap between different surveys. Complete size class distribution data (Tallulah Gorge[4]--see Table 2, page 37, for an explanation of this and the following superscripts) is available for about three-quarters of the flowering plants seen in the gorge. Comparing size class distribution data for Panther Creek, Moccasin Creek, and Battle Creek with Tallulah Gorge[4], and assuming a comparable survey effort for all four areas, it is obvious that reproduction at present is much lower in the Tallulah Gorge than in the other three areas for which complete data are available. In the Tallulah Gorge[4] there are nearly twice as many

flowering individuals as compared to sterile individuals and more than three times as many flowering individuals as compared to juveniles. In the Panther Creek and Battle Creek areas there are more than twice as many sterile individuals as compared to flowering individuals and nearly twice as many total juveniles as compared to flowering individuals. In the Moccasin Creek area there are more than one and one-half times more sterile individuals and one and one-half times more juveniles as compared to flowering individuals.

In a recent personal communication (August 4, 1983) William J. Candler gave assurance that the survey effort by GPC in Tallulah Gorge was about as thorough as the surveys for Battle Creek, Moccasin Creek, and Panther Creek. The size class data for Tallulah Gorge[6] indicate fewer juveniles than flowering individuals and only slightly more sterile than flowering plants. Moreover, the author noted during his survey of Tallulah Gorge[7] a single, large population of 102 flowering individuals that contained very few sterile or juvenile individuals.

Thus, the lower reproductive success of T. persistens in Tallulah Gorge at this time apparently is real. Of course, several poor fruiting years in the past six years could account for the present situation. The years 1977 through 1981 have been considerably drier than usual in the Southeast as a whole. Dr. Robert Kral (personal communication, 1982) reported finding no evidence of any T. persistens plants at all during an August visit to Tallulah Gorge during one drought year (1979?).

Plants, at least in parts of the gorge, may not have produced any viable seeds that year. It may be that the Tallulah Gorge population segment is more susceptible to drought than the other nearby populations, or that the population in the gorge may have received less rainfall over the past few years than other populations. The reasons for the present lower reproductive success of T. persistens in plants of the Tallulah Gorge need to be ascertained.

In spite of the apparently lower reproductive success of T. persistens in the Tallulah Gorge as compared with other nearby areas, it is not possible to say at this time whether the population segment there is stable, increasing or declining. Because of the probable longevity of individuals of T. persistens (30 or more years), it is possible that the population is stable or even increasing.

An obvious conclusion to draw from the large numbers of sterile, large juvenile, and small juvenile individuals at Battle Creek, Moccasin Creek, and Panther Creek is that these populations are increasing at present. This apparently is true now but may not be true over a longer time interval.

The presence of T. persistens in a wide variety of habitat types, at a wide range of elevations, in all possible exposures, and in an apparently wide range of light and moisture conditions (see Habitat Description for more details) suggests that T. persistens has been in the area as a whole for a long time, long enough to have expanded into some

less desirable habitats at the fringes of its distribution. A comparison of reproductive success in "fringe" habitats versus ideal, core habitats would be helpful in determining the stability of the present populations.

The size class distribution data presented in Table 2 suggest in general that good reproduction from seed is taking place and that pollination, seed germination, and seedling establishment apparently are not weak links in the biology of the species.

The only attempt to estimate plant vigor in the various populations and population segments surveyed in 1983 consisted of noting the number of double plants (i.e., two flowering stems arising from a single rhizone) in each area. Since only three or four double plants were noted in the entire survey, the number of double plants in a populations obviously is not an adequate measure of population vigor. Observations by the author in the Tallulah Gorge in 1983 suggest that any attempts to relate plant vigor, as indicated by plant size, to habitat "quality" should be approached with extreme caution. In a single, large population of 102 flowering plants, covering an area about 30 feet by 15 feet, were seen by far the largest and perhaps the smallest plants seen by the author. Plant size probably is determined by a complex interplay of numerous factors, including both past and present environmental conditions.

HABITAT DESCRIPTION

Duncan et al. (1971) describe the habitat of T. persistens as "deciduous or conifer-deciduous woods of ravines or gorges, under or near Rhododendron maximum L. or R. minus Michx., rooted in well-decomposed litter and/or loose loam." Kral (1977) and U.S.D.A. (1979) give more specifics about T. persistens habitat in the Tallulah Gorge, particularly associated species, and Gaddy (1981) provides specific information about the habitat at the Battle Creek, South Carolina, station. None of these references really adequately describes the wide variety of habitat conditions that T. persistens occurs in. In the spring of 1983 in the Panther Creek population, the author found T. persistens under open or nearly closed canopies dominated by hemlock, hemlock-white pine, hemlock-beech, white pine, chestnut oak-white oak, or black oak-chestnut oak; under open or nearly closed shrub covers of Rhododendron minus, Rhododendron maximum, Leucothoe axillaris, all combinations of the above, or with no shrubs or deciduous shrubs only; generally with few herbaceous associates but occasionally adjacent to thick mats of Galax; on all exposures except due south; and on slopes of 0 to 60 degrees. Additional different habitat conditions seen at or near Black Branch included deciduous woods on slopes with an exposure of due south and in shortleaf pine-Virginia pine woods near a ridge top.

T. persistens apparently is restricted to gorges and steep ravines. Although most of the Tallulah Gorge is steep (45 degrees or more), most of

the plants occur on bouldery slopes that are less than 45 degrees. Most of the plants in the other populations or population segments also occur on slopes less than 45 degrees, although steeper slopes are present in most populations.

At the Tallulah Gorge station plants occur all the way from the gorge rim (1,500 feet) to the ravine bottom (1,000 feet). At the Panther Creek station plants are found from near the ravine bottom (700 feet) upslope to an elevation of 1,100 feet. Known elevation ranges for other stations include: Moccasin Creek, 780 to 1,000 feet; Battle Creek, 750 to 1,100 feet; Black Branch, 1,000 to 1,300 feet; and Moody Branch, 900 to 1,400 feet.

Kral (1977) indicates that the Tallulah Gorge population occurs on acidic, humidified sands derived from metamorphosed granites. Other knowledgeable individuals agree that, based on associated plants, the soils of the Tallulah Gorge must be highly acidic (V. G. Soukup and F. W. Case, personal communications, 1982). Apparently no soil samples have been analyzed from this area. Gaddy (1981) analyzed soil samples from within two colonies at the Battle Creek station and reported a sandy loam texture and a pH between 5.2 and 5.3. Gaddy also analyzed a soil sample taken in similar woods along the East Fork of the Chattooga River and noted a pH of 4.0. Gaddy (1981) generally found T. persistens at the Battle Creek station in deep soils, but a few plants were found in soils less than four inches

deep, and one plant was growing in soil only one and one-half inches deep. Soil analysis is needed at the Georgia stations.

At all four stations T. persistens generally occurs under a well developed overstory. However, it generally blooms before deciduous species have put out new spring leaves. Understory and shrub layers generally are sparce but may be quite dense. Plants in deep shade generally are smaller than plants in light shade, but are not less healthy in appearance (J. D. Freeman, V. G. Soukup, personal communications, 1982). In areas of deepest shade non-reproductive plants only, or few flowering plants, are usually found. Research is needed into the relationship between canopy closure (light intensity) and reproductive success.

Soil moisture probably is the primary determinant of T. persistens distribution at each station. Although some T. persistens are found on apparently dry, exposed slopes, most plants at each station occur on mesic slopes. The effect of site soil moisture on T. persistens reproduction, establishment, maintenance, and dispersal needs to be examined.

It is unknown whether or not there are any habitat factors that are limiting. Moreover, there probably are no unusual habitat features that have limited T. persistens to the Tallulah-Tugaloo River system. Localized distributions are common in the genus Trillium (J. D. Freeman, T. Patrick, personal communications, 1982) and probably are related to the fact that Trillium seeds normally are dispersed by ants. Dissemination

downslope and downstream over larger distances, however, is theoretically possible by means of heavy rainstorms (J. D. Freeman, personal communication, 1982; Gaddy, 1981).

LAND USE AND THREATS TO THE SPECIES

The damning of the Tugaloo River to form Yonah and Tugaloo Lakes and of the Tallulah River to form Tallulah Falls Lake very likely destroyed some colonies of T. persistens. Since T. persistens was unknown to science prior to the development of these lakes, it is difficult to ascertain the negative impacts of these projects on T. persistens. An examination of topographic maps of these areas prior to lake development (if available) would make possible some plausible estimates.

Evidence of selective logging is present in all of the known populations. There is no way to assess the impact this logging has had on populations of T. persistens. All that can be said with certainty is that T. persistens is still present in the areas that have been selectively logged. However, Kral (1977) notes, for the Tallulah Gorge, that "areas where clearing has been done as to provide power line rights of way, etc., show heavy erosion, together with a dense overgrowth of Rubus, Hydrangea, Sambucus, Lonicera japonica, and Pueraria. Where these clearings have been made through Trillium populations, no Trillium is in evidence." V. G. Soukup (personal communication, 1982) notes that T. persistens apparently has disappeared from a small area near the rim of

the gorge that was cutover several years ago; two years following the cut there were no T. persistens plants visible, and in 1982 there were still no plants. This area was quite xeric to begin with, and the removal of cover may have made it too xeric for T. persistens. Also, a good bit of surface damage took place and the rhizomes may have been irreversibly damaged. Recovery of the T. persistens plants, however, may still be possible. This area should be searched for several more years. Kral (1977), in a draft of a publication published in 1982, indicates that thinning the overstory will damage and cutting the overstory probably will destroy T. persistens. Kral (personal communication, 1980) also suggests that single tree selection or group selection might not be too detrimental. Soukup (personal communication, 1982) likewise suggests that T. persistens may be better able to withstand selective cutting in more mesic areas. Timber removal on steep slopes, because of the erodibility of the soils, may have disastrous effects on T. persistens. Research is needed concerning the effects of past disturbances, such as logging and powerline construction, on T. persistens.

John Garst (personal communication, 1982) indicates that there also are indications of past fires in some habitats of T. persistens. Kral (1977) estimates that prescribed burns would probably damage T. persistens. Wildfires are likely to be more intense than prescribed burns. Research is needed concerning past fire history and the effects of fire on T. persistens.

GPC owns the vast majority of the known habitat of T. persistens. Of the 3,141 flowering plants found during the 1983 survey, only 195 were on lands not owned by them. Concern about future timbering activities is lessened considerably because of statements made in a recent letter from T. E. Byerley, Manager of Environmental Affairs for GPC, to Mr. James W. Pulliam, Jr., Regional Director for the FWS. Mr. Byerley states that "GPC Land Department foresters have said that the four areas can be protected from timbering by providing appropriate information concerning location, area size, and buffer area boundaries in our timber management for the areas." The author assisted GPC in 1983 in flagging locations of colonies in the Panther Creek population. GPC also flagged colonies in all other populations that they surveyed in 1983 with the exception of Tallulah Gorge. No flagging was done in the gorge because of (1) the potential for increasing collection pressure and (2) the fact that there are no plans to log the gorge. Adequate buffer boundaries need to be determined and permanent unobtrusive markers need to be placed along the boundaries.

Tallulah Gorge has been a major attraction to outdoor enthusiasts since the 1800s (Coulter, 1963). Tallulah Falls and several other falls were the major attractions prior to 1913 when the Tallulah River was dammed just above Tallulah Falls and the water diverted around the gorge as part of a hydroelectric project. Although resort development slowly came to a halt following 1913, Tallulah Gorge still receives many visitors a year, and visitation is likely to increase in the future. Increased interest in Tallulah Gorge was particularly strong in the mid-1970s. Tallulah Gorge was

featured in an article in Brown's Guide to Georgia in 1975 (Tucker, 1975). In 1976 an ad hoc multi-disciplinary study team completed a study of the Tallulah Gorge area which included an analysis of the gorge's scenic, historic, and recreational values (ad hoc multi-disciplinary study team, 1976). This study was undertaken by GPC in compliance with Article 40 of the Federal Power Commission issued November 7, 1975. GPC, the major landowner (90 percent or so) in the Tallulah Gorge area subsequently expanded the existing project boundary to include most of their landholdings in the gorge (658 acres). There are only two or three reasonable access trails into the gorge, but access into the gorge through GPC lands as a whole is not restricted. Part of the T. persistens population in the gorge occurs in the vicinity of these trails and, therefore, is vulnerable because of its accessibility. The extent of this threat needs to be examined, and a thorough search for additional populations, particularly in areas not readily accessible by trails, needs to be made.

The Moccasin Creek and Battle Creek populations of T. persistens both begin just above the mouths of the streams at Yonah Lake. Yonah Lake is part of GPC's North Georgia Development, and all the lands surrounding Yonah Lake, including the entire known habitat of T. persistens along Moccasin Creek and Battle Creek, are owned by GPC. Twenty-nine percent of the shoreline along Yonah Lake presently is leased for residential use and 68 percent is considered undesirable (mountainous, inaccessible, etc.), including the mouths of Battle and Moccasin Creeks (GPC, Exhibit R-2, 1978 b). The Yonah Boat Club is the only public (or private) access to most

of the lake. However, GPC eventually may want to build roads into the area in order to open up new areas for leased lots (J. E. McGuffey, personal communication, 1982). Increased residential use could negatively impact T. persistens either directly, through construction activities, or indirectly, through increased hiker activity.

The Panther Creek station of T. persistens apparently is not presently within an area of focused recreational or residential activity.

The GPC surveys in the spring of 1983 found 195 flowering plants in the upper part of the Tallulah Gorge on lands not owned by GPC. Most of these plants probably occur in the Tallulah Gorge Park. Tallulah Gorge Park is a private park with an admission fee that has operated since World War II. According to Mrs. Frank Dye, who was the ticket taker for many years (personal communication, 1982), spectacular wildflowers, including T. persistens, are a major attraction at the park. Mr. Tom Moss, who sold the park in about 1980, moved (date unknown) some T. persistens to an area near some rocks behind the admission booth so that visitors could see the species without descending into the gorge proper. As long as the park is not allowing exploitation of the species (i.e., selling, digging, or picking of plants), the existence of the park generally should be beneficial to T. persistens. However, it may increase the interest in T. persistens and thus the need for commercially available T. persistens plants.

Larry McClure, the owner of Tallulah Gorge Park, recently announced plans to build a small chair lift into the gorge from Tallulah Gorge Park (personal communication, May 1983). The city planning board has given their approval for the project. Mr. McClure felt that the project could be built without any direct impact on any T. persistens, and asked for assistance in locating T. persistens. I referred him to Ms. Nora Murdock in the Asheville Field Station of the Fish and Wildlife Service. Mr. McClure never contacted Ms. Murdock, and in a recent personal communication (August 3, 1983) indicated that although he still wanted to proceed with the project, he, at present, was unable to get all the necessary permits. The chair lift probably could be built without directly impacting persistent trillium. However, it could indirectly impact persistent trillium if it increased access to the gorge as a whole.

There is evidence to indicate that T. persistens is under at least some collection pressure. Three well known Trillium researcher-enthusiasts (V. G. Soukup, F. W. Case, and J. L. Lambert, personal communications, 1982) all have at least one plant in cultivation (F. W. Case has six to eight plants) and all would like to have more. All three are very concerned about the status of T. persistens and indicate that their collections were made prior to the formal listing of the species in 1978. Another well known Trillium enthusiast, Roger Riffle (personal communication, 1982) does not have any plants in cultivation, but would like to. Riffle visited the Tallulah Gorge area in 1981 and is very concerned that many of the T. persistens plants he saw are so close to well used

trails. Riffle suggested, because of the great number of wildflower enthusiasts and the easy accessibility of at least some of the Tallulah Gorge T. persistens, that the Tallulah Gorge population is seriously threatened. Andrew F. Robinson, Jr., former endangered species specialist with the FWS in Atlanta (personal communication, 1982) has direct evidence of the digging of at least one plant from Tallulah Gorge in 1979.

There is no way to know how many T. persistens plants have been collected for herbarium specimens or for garden cultivation. Collection pressure is not likely to lessen, especially in light of the likelihood that accessibility of all known populations probably will increase in the future. Therefore, it is important that methodology for cultivation of T. persistens is developed as soon as possible and that the availability of cultivated plants be made known to wildflower enthusiasts.

CONSERVATION EFFORTS

Important efforts to protect persistent trillium have been made by a variety of state, Federal, and private organizations beginning with the listing of the species as federally endangered on April 26, 1978. Significant steps toward the long-term protection of T. persistens have been taken recently.

In the spring of 1979 the South Carolina Advisory Committee on Endangered, Threatened, and Rare Plants listed T. persistens as "of

national concern - endangered" (Rayner et al., 1979). Although this is an unofficial listing and does not provide any real protection, it is used by the South Carolina Heritage Trust Program (SCHTP), to determine protection priorities. Trillium persistens was listed as a plant protection priority by the SCHTP in June of 1979, and in September of 1979 the Heritage Trust Advisory Board approved the Battle Creek habitat of T. persistens as a Priority Area for protection. This approval enabled the SCHTP staff to officially begin investigating protection options for the area. The South Carolina Nature Conservancy (SCNC) works closely with the SCHTP to protect areas the SCHTP has documented as significant unprotected natural areas. Soon after designation as a Priority Area for protection, landowner negotiations concerning the Battle Creek Trillium persistens site were turned over to the SCNC. In March of 1980 personnel with the SCHTP surveyed the Battle Creek site in order to determine boundaries for a potential preserve. In October of 1980 the SCNC called and then sent a letter to Dr. Robert Woodall, with the Environmental Affairs Division of GPC. The SCNC telephone call and letter discussed SCNC's interest in working with GPC to protect the South Carolina population of Trillium persistens. Included with the letter was a draft of a possible easement/lease agreement with The Nature Conservancy for this site. Between October of 1980 and October of 1982 several telephone calls and letters were exchanged between the SCNC and Dr. Robert Woodall of GPC. GPC officials always have expressed their interest and intent in protecting the Battle Creek, South Carolina, population of T. persistens. In a recent letter to the FWS (GPC, 1983), they stated that they wished to enter into a

cooperative agreement with South Carolina similar to the one developed for the Georgia populations.

In 1981 Mr. L. L. Gaddy completed a status review of T. persistens in South Carolina. This review included an analysis of the Battle Creek population and extensive searches for additional populations. No additional South Carolina populations were located. This work was made possible by a Section 6 (Endangered Species Act) grant-in-aid between the SCHTP and the FWS. Gaddy and SCHTP personnel returned in 1982 and gathered additional age-size class distribution data on the South Carolina population. In 1983 GPC staff biologists conducted an additional survey of the Battle Creek population.

In 1977 the Georgia Department of Natural Resources (GDNR) listed persistent trillium as endangered in its official list of "Georgia's Protected Plants" (McCollum and Ettman, 1977). Georgia's legislation concerning protected plants (Wildflower Preservation Act, 1973) prohibits (1) digging, cutting, taking, selling, etc., from public lands and (2) intrastate transport without a certificate from GDNR indicating that permission for collection was granted by the landowner. Transport of protected species into or out of Georgia without a certificate issued by GDNR is a violation of the recently amended Lacey Act. The 1981 amendments to the Lacey Act provide protection for plants by providing substantial Federal penalties for violations of state plant conservation legislation.

The Protected Plants/Natural Areas section of the GDNR has worked to develop a management agreement with GPC for the Georgia population of T. persistens since 1979. There has been a verbal agreement between the Protected Plants/Natural Areas section (through Mary Anne Young) and GPC (through Wade Manning, Vice President, Land Department) since 1979. In this verbal agreement both parties agree to work together to facilitate the management and conservation of T. persistens. Mary Anne Young has been discussing a written memorandum of understanding with GPC (through James E. McGuffey, Supervisor, Land Resources) since 1980. The last discussion of a written agreement was on November 19, 1982. On June 30, 1983, a letter was sent from four GPC vice presidents to Mr. Joe D. Tanner, Commissioner of the GDNR. This letter summarizes past cooperative efforts concerning the persistent trillium and requests that the GDNR, through the Protected Plants Program, provide technical aid and suggestions for successful planning and implementation of a management plan for persistent trillium. This more formal arrangement will facilitate the conservation of the species.

Personnel with Protected Plants/Natural Areas are planning to work with Callaway Gardens and GPC to transplant some T. persistens to a proposed wildflower garden at GPC's Terrora Park. It is hoped that this will help keep people from going into the Tallulah Gorge to look for persistent trillium (M. A. Young, J. E. McGuffey, personal communications, 1982).

Personnel with Protected Plants/Natural Areas have cooperated with U.S. Forest Service (FS) personnel (B. A. Sanders and L. Pendergrass) and FWS

personnel (A. F. Robinson, Jr.) in searches for exact locations of present populations and in limited searches for additional populations in Georgia. In cooperation with the FWS they also have done hand pollination of some Tallulah Gorge colonies (March 27, 1979) prior to collection of seed (July 25, 1979) to be used for germination studies and for long-term storage. Unfortunately, no data was collected concerning seed production in hand pollinated versus naturally pollinated colonies (S. Bowling, personal communication, 1982).

The seeds collected on July 25, 1979, were stored in barely moistened sand in plastic bags and subjected to warm (three months at 65 to 70 degrees F.) then cold (four months at 40 degrees F.), then warm (four months at 65 to 70 degrees F.) temperature regimes and then were sent to the National Tree Seed Laboratory near Macon, Georgia for cold storage at 40 degrees F. (A. F. Robinson, Jr., personal communication, 1982). At the author's request, stored seeds were examined recently. According to Robert Karrfalt (personal communication, 1982), the seeds appeared to be in good condition (i.e., there was no mold or obvious decay). In a more recent personal communication (June 6, 1983), Karrfalt made the following report: "On December 12, 1982, ten seeds were placed in a germination chamber set at 20° C. with an eight-hour photoperiod. No germination was obtained after four weeks. Six seeds were tested with tetrazolium and judged to be viable. The remaining four seeds were left in the germination room for another eight weeks. By this time, three had radicles protruding about two to three

mm. These were transplanted into a mixture of peat, perlite, and vermiculite. No further growth was observed. The trial was closed."

Although the number of seeds involved in the above germination test was very limited, the results are very encouraging. The previously described techniques for collection, pre-treatment and storage, apparently are effective in providing long-term storage (at least four years) of viable seeds.

In addition to the above activities, both the FWS and the FS have produced brief description/management guides for T. persistens (U.S.D.I., 1978; U.S.D.A., 1979; Kral, 1982). The FS also has produced a field identification card for T. persistens to assist field personnel in identifying T. persistens (Robinson, 1979).

Callaway Gardens has a Memorandum of Agreement with the GDNR to propagate plants listed in "Georgia's Protected Plants" (M. A. Young, personal communication, 1982). Callaway Gardens has had about six T. persistens plants in cultivation for the past three years. The plants apparently are easy to keep, and they produce flowers and fruits every year. Attempts to germinate seeds and to vegetatively propagate the species by notching the rhizome have been unsuccessful (Randy Allen, personal communication, 1982). According to Allen, Callaway Gardens will continue their efforts to propagate T. persistens.

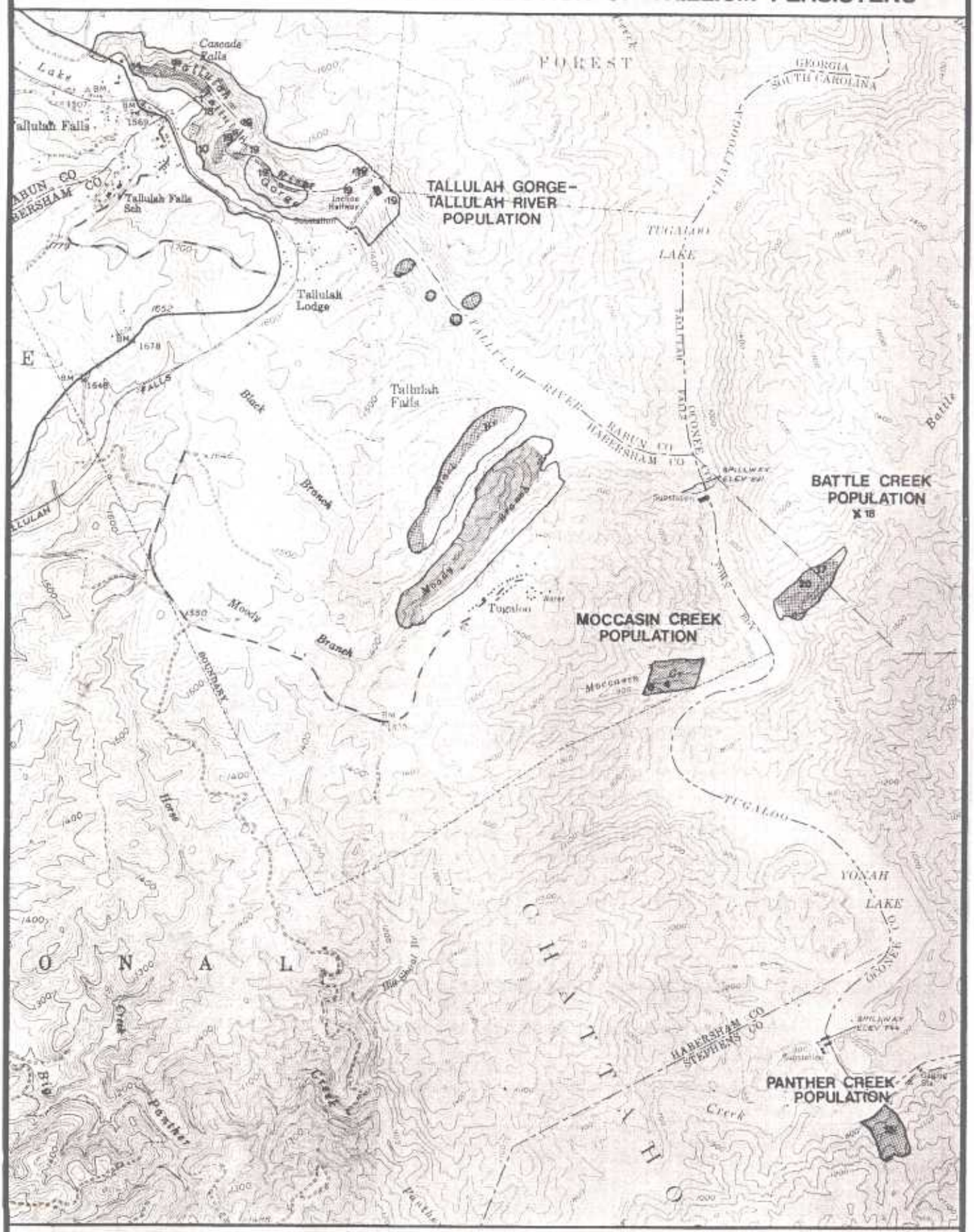
Surveys in the spring of 1983 by GPC and others (see Table 2, page 37) resulted in the discovery of 3,141 total flowering plants of T. persistens, including 1,431 flowering plants on GPC lands in the Tallulah Gorge. Since neither the surveys inside the gorge nor surveys outside the gorge were complete, there probably are more plants both inside and outside the gorge. Available data, however, indicate that about 46 percent of the known flowering individuals of T. persistens occur on GPC lands in the Tallulah Gorge. GPC is licensee for the constructed North Georgia Hydroelectric Development, Federal Power Commission (FPC) Project No. 2354. Prior to 1970 only about 58 acres within Tallulah Gorge were included within the FPC project boundary. Pursuant to Article 29 of its license, Georgia Power Company submitted in April 1970 a revised Exhibit R showing recreational development. An additional 300 acres or so were included for recreational development in the Tallulah Falls project boundary. On November 7, 1975, the FPC issued an order (Article 40) requiring GPC to consult with the Bureau of Outdoor Recreation and other Federal, state, and local agencies in undertaking an analysis of the scenic, historic, and recreational values of the Tallulah Gorge. The report of this multi-disciplinary study team was published in 1976 (ad hoc multi-disciplinary study team, 1976). In response to this study, GPC added approximately 300 acres to the Tallulah Falls project boundary.

The vast majority of GPC's Tallulah Gorge landholdings, including the vast majority of the T. persistens in the gorge, are now within FPC project boundaries. The FPC [now known as the Federal Energy Regulatory

Commission (FERC)], as a Federal agency, is required by Section 7 of the Endangered Species Act of 1973, as amended, to ensure that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify their critical habitat. Federal agencies also are required to promote and carry out programs for the conservation of endangered or threatened species. Since the majority of the Tallulah Gorge population of T. persistens is now within FERC project boundaries, the conservation of the species here is assured--as long as the FERC carries out its requirements pursuant to the Endangered Species Act. The FERC should be reminded of its Section 7 requirements and encouraged to promote activities to conserve T. persistens.

The plight of persistent trillium has been publicized in a number of ways. Articles have been published in magazines (Enviro South, August 1978; Outdoors In Georgia, 1979) and newspapers (The Atlanta Journal and Constitution, June 10, 1979), and T. persistens was included in a block of commemorative postage stamps issued by the U.S. Postal Service on June 7, 1979. According to John F. Garst (personal communication, 1979) the Junior Ladies Garden Club of Athens, Georgia, has adopted T. persistens as their species to protect. They have had a water color of T. persistens made and are issuing it on a post card.

FIGURE I. MAP SHOWING DISTRIBUTION OF TRILLIUM PERSISTENS



LAND OWNERSHIP

According to the official listing of T. persistens (FWS, 1978), most plants are found on private land, but a few plants occur in the Sumter National Forest. Description/management guides on T. persistens prepared by the FS (1980) and the FWS (1978) also suggest that T. persistens occurs on FS land. There presently are no known colonies of T. persistens on FS land. Part of the Battle Creek, South Carolina, population is within the general boundary for the Sumter National Forest, but the population actually is on an inholding owned by GPC.

The vast majority (93.8 percent) of the known individuals of T. persistens that flowered in 1983 are on land owned by GPC. The remaining 6.2 percent are on private lands within the Tallulah Gorge. Most of the plants probably occur in Tallulah Gorge Park, a private park owned by Larry McClure of Dillard, Georgia. Some plants may occur on small adjacent tracts. Land ownership of all plants in Tallulah Gorge needs to be determined.

Table 1. Herbarium records and other sources concerning the distribution of Trillium persistens.

1. Habersham Co., Ga. J. T. Barrick. 125. April 25, 1974. County line, Tallulah Gorge, Tallulah Falls. Rich hardwood forest; halfway down gorge; moist, rich humus; flowers lavender (in late flower). Auburn University 32622.

2. _____. John C. Chitwood. s.n. April 27, 1969. Tallulah Gorge. Found in lower level of gorge approx. 75 ft. from river; area shaded and rocky; lavender flower (in flower). Auburn University. 14947.

3. _____. W. H. Duncan. 11245. July 6, 1950. Rich, mesic, steep slopes in deciduous woods near bottom of Tallulah Gorge, elev. ca. 950 ft. (in fruit). University of Georgia, Vanderbilt University, and Auburn University.

4. _____. W. H. Duncan 23462 with J. Garst. September 12, 1970. Between scattered R. maximum plants in forest on north facing slope about 50 ft. above Moccasin Creek and 0.1 mile from Yonah Lake. Elev. about 830 ft. (fruits dehisced). University of Georgia.

5. _____. W. H. Duncan 23549 with J. Garst and G. Neece. March 23, 1971. Under scattered R. maximum plants on S. side of Tallulah Gorge. Elev. about 980 ft. (in flower). University of Georgia.

6. _____. J. D. Freeman. 702. April 23, 1970. Western side of Tallulah Falls Gorge, at Rabun Co. line. Growing under Rhododendron and Tsuga in acid soil. Flowers white, becoming pink and then carmine with age (in flower). Auburn University. 24118.

7. _____. J. D. Freeman. s.n. April 22, 1971. Slopes on western side of Tallulah Falls Gorge near the Rabun County line; growing under Rhododendron and Tsuga in acid soil; flowers white at anthesis, becoming pink, then carmine with age (in late flower). Auburn University. 24088.

8. _____. G. Neece and J. Garst. s.n. April 24, 1970. Under or near Rhododendron maximum plants on terrace and slopes along Moccasin Creek from edge of Yonah Lake (at about 750') to an elevation of ca. 900 ft. (petals withered). University of Georgia, and Valdosta State College.

9. _____. R. Kral. 59485. March 20, 1977. Humified acid, moist to rather dry sands under hemlock - hardwood - Rhododendron; steep-sided ravine just N. of Tallulah Gorge outlook by and below U. S. Hwy. above gorge; petals white, aging pink (in flower). Vanderbilt University.

10. _____. J. T. Owen. 145. July 25, 1973. East side of U. S. Hwy. 23 at Tallulah Falls; west end of Wallenda's Walk. Side of gorge, mixed woodlands with wet, rocky soil (in fruit). Auburn University. 30870.

11. _____. B. J. Roberson. 115. April 27, 1969. Bottom of Tallulah Gorge. Relatively rich hardwoods; rare; flowers purple to maroon (in flower). Auburn University. 15045.

12. _____. Levester Pendergrass and Andy Robinson. 4024. April 8, 1977. Tallulah Gorge basin at falls, along trail beside Tugaloo River, down from power plant (in flower, turning purple). Forest Service Southern Regional Herbarium. 4399.

13. _____. Victor G. Soukup. s.n. March 26, 1980. Flower rather turbular, not flaring widely. On steep hillside near stream in mixed coniferous and hardwoods under Rhododendron maximum and Kalmia latifolia. Sizeable colony at this location. Several plants with all flower parts replaced by various numbers of bracts, and many seedlings. About 200 m. across the road and down the hill from the entrance to the Georgia Power Co. Tallulah Falls picnic area; about 1 km east of US 23/441 (in flower). University of Cincinnati.

14. Rabun Co., Ga. W. H. Duncan 23547 with G. Neece and J. Garst. March 23, 1971. Under R. maximum in deciduous woods in small ravine near top of Tallulah Gorge and ESE of dam to Tallulah Falls Lake. Elev. about 1500 ft. (in flower). University of Georgia, U. S. National Herbarium, Chicago Field Museum of Natural History, Gray Herbarium, New York Botanical Garden, and Vanderbilt University.

15. _____. Levester Pendergrass and Andy Robinson. 4026. April 8, 1977. Off Highway 441, at Tallulah Gorge, along nature trail, by Stuckey's, just prior to bridge (in flower). Forest Service Southern Regional Herbarium. 4400.

16. Stephens Co., Ga. Ben Sanders and Will Butler. s.n. April 2, 1982. Chattahoochee Forest, near junction of Panther Creek and Tugaloo River, on side of Black Mountain 1,000 feet SW of Yonah Park on lower slope of Black Mt.; altitude 800-1200 ft.; slope 40-60%; exposure NE-NW; soil loamy; associated plants Rhododendron, Virginia pine; clumps fairly common; height 0.5 ft. (in flower, turning purple). Forest Service Southern Regional Herbarium. 8893 and 8894.

17. Oconee Co., SC. J. Garst. s.n. April 12, 1970. Under R. maximum on wooded terrace in steep ravine; Battle Creek, about 1/3 mile from Lake Yonah. elev. about 850 ft. (petals withered). Unviersity of Georgia.

18. Personal communication, J. F. Garst; reported to Garst by G. A. Neece.

19. Georgia Dept. of Natural Resources, Protected Plants/Natural Areas, unpublished maps in files.

20. Gaddy (1981) and Gaddy and Rayner (1982); distribution maps in files of S. C. Heritage Program, Columbia, SC.

Table 2. Size class distribution of known populations or population segments of Trillium persistens.

Location	Flowering	Sterile	Large juvenile	Small juvenile	Juvenile
Panther Creek[1]	408	943	148	212	402
Moccasin Creek[2]	344	634	320	170	51
Battle Creek[3]	287	850	213	118	208
Tallulah Gorge[4]	1265	694	77	65	228
Tallulah Gorge[5]	207	---	---	---	---
Tallulah Gorge[6]	191	248	---	---	168
Tallulah Gorge[7]	301	---	---	---	---
Moody Branch[8]	218	291	---	---	---
Moody Branch[9]	542	---	---	---	---
Black Branch[10]	184	---	---	---	---
Black Branch[11]	71	120	---	---	---
Black Branch[12]	33	3	---	---	---
Unnamed Branch #1[13]	25	---	---	---	---
Unnamed Branch #2[14]	66	---	---	---	---
S. side of Tallulah R.[15]	4	---	---	---	---
N. side of Tallulah R.[16]	29	---	---	---	---

Table 2. (Continued)

[1] Survey by Georgia Power Company and Douglas Rayner.

[2] Survey by Georgia Power Company.

[3] Survey by Georgia Power Company.

[4] Survey made from trail at Wallenda cable into the gorge and S to just beyond Horseshoe Bend. Survey by Georgia Power Company.

[5] Survey made from top of Tallulah Gorge to Wallenda cable. Survey by Georgia Power Company.

[6] Survey made from trail at Wallenda cable down to Tallulah River ca. 100 yards above Horseshoe Bend. Survey by Douglas Rayner and Nora Murdock.

[7] Survey made from 100 yards above Horseshoe Bend and along river down to incline railway. Survey by Douglas Rayner and Nora Murdock.

[8] Survey made on SE facing slope from mouth of Moody Branch to second powerline crossing. Survey by Chick Gaddy, John Garst and Jeremy Fish.

[9] Survey made on SE facing slope of Moody Branch; not a complete survey. Survey by Georgia Power Company.

[10] Survey made on SE facing slope from mouth of Black Branch to third powerline crossing. Survey by Douglas Rayner and Nora Murdock.

[11] Survey made on upper SE facing slopes of Black Branch for ca. 1500 feet SW from the Tallulah River. Survey by Douglas Rayner and Nora Murdock.

[12] Survey made on north slope along easternmost powerline crossing Black Branch and along the dirt road between Black Branch and Moody Branch. Survey by Douglas Rayner and Nora Murdock.

[13] Survey made along north facing bank of the Tallulah River at first major unnamed creek northwest of Black Creek; survey brief and incomplete. Survey by Georgia Power Company.

[14] Survey made along north facing bank of the Tallulah River at second major unnamed creek northwest of Black Creek; survey brief and incomplete. Survey by Georgia Power Company.

[15] Survey made on north facing bank of the Tallulah River between Unnamed Creek #1 and Unnamed Creek #2; survey brief and incomplete. Survey by Georgia Power Company.

[16] Survey made on north side of Tallulah River opposite Unnamed Creek #1; survey brief and incomplete. Survey by Georgia Power Company.

PART II. RECOVERY

A. RECOVERY OBJECTIVES

The primary objective of the persistent trillium (Trillium persistens) Recovery Plan is to provide permanent protection for sufficient populations to ensure the continued survival of the species. Four populations, with a combined total of at least 3,141 flowering individuals, are known to date. The Tallulah Gorge - Tallulah River population, in Rabun and Habersham Counties, Georgia, contains at least four population segments. The Moccasin Creek population (Habersham County, Georgia), the Panther Creek population (Stephens County, Georgia), and the Battle Creek population (Oconee County, South Carolina) all consist of a single population segment. [Note: A population segment is here defined as a group of individuals that are related by their relative physical proximity (i.e., individuals occupying the same cove), and that are physically separate enough from other population segments so that most gene flow occurs within the population segment rather than among population segments.] Because of the very restricted distribution of the species, the small number of known populations and population segments, and the relatively small number of known flowering plants, permanent protection of habitat of at least 75 percent of the known individuals probably is necessary to ensure the survival of the species. If this protection includes maximal spacial distribution and at least part of all populations, then it should assure the

protection of an adequate amount of genetic diversity, an objective that is implicit in any attempt to ensure the survival of a species.

An important objective of this Recovery Plan is to determine the overall population size and distribution of T. persistens. If data on age class distribution of T. persistens is gathered in the course of comprehensive, systematic surveys to determine overall population size and distribution, then objective decisions can be made concerning which populations (habitats) are most essential to the conservation of the species. Because of the number of plants present, the extent of T. persistens habitat, and the likelihood that T. persistens originated in the gorge, protection of the Tallulah Gorge population segment is essential to the preservation of the species. In the absence of complete data on distribution, number, and size of populations, it is not possible at this time to make additional decisions on population priority.

Protection of its habitat alone may not be sufficient to ensure the survival of the species. Demographic and ecological studies are needed to determine management conditions that will provide for long-term maintenance and vigor.

Additional objectives of this Recovery Plan are to develop a commercial source of T. persistens, to provide for long-term seed storage, to enforce laws protecting the species and its habitat and to develop materials to inform the public about the species and the Recovery Plan objectives.

If permanent protection is provided for the habitat of at least 75 percent of the known plants of persistent trillium and appropriate management guidelines are developed and implemented and commercial sources of T. persistens are made available, and long-term seed storage is provided, and laws protecting the species are enforced, then complete recovery will have been accomplished and T. persistens can be considered for downlisting or delisting.

B. RECOVERY OUTLINE

1. Protect the essential habitat of at least 75 percent of known individuals, populations or population segments.

1.1. Search for additional populations.

1.2. Determine population size and age-size class distribution.

1.3. Determine population protection priorities.

1.4. Evaluate protection alternatives.

1.5. Implement the most appropriate protection measures.

2. Determine and implement management conditions necessary for long-term reproduction, establishment, maintenance and vigor.

2.1. Select study sites.

2.2. Conduct habitat analysis within each study site.

2.3. Conduct long-term demographic studies.

2.4. Determine the effects of past disturbances.

2.5. Conduct additional in-depth studies on microclimate or species biology as needed.

2.5.1. Determine annual regimes of relative humidity in exposed and sheltered habitats.

2.5.2. Determine annual regimes of soil moisture in exposed and sheltered habitats.

2.5.3. Determine the relationship between light intensity, establishment, reproduction, and seed germination.

2.5.4. Determine the vectors of seed dispersal and assess their effectiveness under different ecological and spatial conditions.

2.5.5. Determine major pollinators and assess their effectiveness under different ecological and spatial conditions.

2.6. Develop appropriate habitat management guidelines based upon the data obtained from Tasks 2.1 through 2.5.

2.7. Implement appropriate habitat management techniques.

3. Develop a commercial source of plants and provide for long-term seed storage.

4. Enforce laws protecting the species and/or its habitat.

5. Develop materials to inform the public about the status of the species and the Recovery Plan objectives.

5.1. Prepare and distribute news releases.

5.2. Prepare articles for popular and scientific publications.

C. NARRATIVE OUTLINE

The primary objective of the persistent trillium (Trillium persistens) Recovery Plan is to provide permanent protection for sufficient

populations to ensure the continued survival of the species. The first priority in meeting this objective is to determine total population size, distribution, and stability. Once this has been completed, then population priorities can be determined and land protection efforts can be initiated. GPC owns more than 93 percent of the known habitat. Their willingness to negotiate agreements to provide permanent protection almost certainly will be increased if there is convincing evidence as to the protection priority of their populations.

To ensure the survival of T. persistens, efforts also are needed to (1) determine and implement management conditions necessary for long-term maintenance and vigor, (2) develop a commercial source of plants, (3) enforce laws protecting the species and its habitat, and (4) inform the public about the status of the species and the Recovery Plan objectives.

1. Protect the Essential Habitat of at Least 75 Percent of the Known Flowering Plants.

   1.1. Search for additional populations. Presently there are four known populations of persistent trillium; three in Georgia and one in South Carolina. Although there have been some recent surveys, a thorough, systematic effort to locate additional populations is still needed. Ground searches for additional populations should be preceeded by an examination of soil and topographic maps to determine potential habitat and to develop

a priority list of sites to search. Although T. persistens does not appear to be associated with unusual soil types, it does appear to be associated with moist, sheltered locations. Shallow ravines in South Carolina do not harbor T. persistens. Searches should be focused in the Tallulah-Tugaloo River system, especially in coves adjacent to Tugaloo Lake and Tallulah Falls Lake. Additional searches are needed outside the immediate area where the species is known; i.e., above Tallulah Gorge, along branches off Panther Creek and along the Georgia side of the Chattooga River. A thorough search of appropriate habitat should be made in the adjacent National Forest lands. Searches should be made when the species is in flower, because the species is very difficult to positively identify in fruit.

1.2. Determine population size and age-size class distribution. Population size and age-size class distribution data need to be gathered for parts of the Tallulah Gorge, for the new population segments discovered in 1983, and for new populations discovered in the course of additional surveys. The following age-size classes were used in the 1983 surveys and should prove useful in future surveys: small juvenile (single leaf, up to two cm long, probably 2 to 3 years old); large juvenile (single leaf, more than two cm long, probably 4 to 5 years old); sterile (three-leaved, non-reproductive, 6 to

9 years old); and flowering (three-leaved, reproductive, 7 to 30 plus years old).

Because the determination of population size and age-class distribution is so time-consuming, it should be done separately from searches for additional populations (Task 1.1).

1.3. Determine population protection priorities. Based on the information presently available, the following protection priorities can be made:

a. The Tallulah Gorge segment of the Tallulah Gorge-Tallulah River population is absolutely essential to the preservation of Trillium persistens. Tallulah Gorge harbors the largest population of T. persistens and encompasses the greatest acreage. Individuals of T. persistens in Tallulah Gorge occur in a wide variety of ecological conditions of light, elevation, slope, and aspect. Moreover, all available evidence suggests that T. persistens originated in Tallulah Gorge.

b. The Panther Creek population is the second largest known population and occurs over a fairly wide range of ecological conditions. It is separated by almost two air

miles from the closest population and is probably the most genetically isolated of the four populations.

c. The Battle Creek population is the only population east of what used to be the Tugaloo River. Because it is separated from the other populations by a fairly broad expanse of water (Yonah Lake) it probably is quite genetically isolated from the other four populations.

d. The Moccasin Creek population is the smallest population and plants occur within a fairly narrow range of ecological conditions.

If additional populations are found (Task 1.1) or present populations turn out to be much larger than present estimates (Task 1.2), then a reevaluation of population priorities would be necessary. It is unlikely that any new findings would greatly lower the significance of the Tallulah Gorge population segment.

1.4. Evaluate protection alternatives. The greatest possible protection should be obtained for the habitat of at least 75 percent of the known flowering plants. Land ownership and landowner attitude toward protection already are known for most of the four known populations. GPC owns the habitat of

more than 93 percent of the known flowering plants of T. persistens. Land ownership and landowner attitude are not known for the 7 percent of T. persistens habitat not owned by GPC.

Fee simple ownership or conservation easements provide protection in perpetuity and, therefore, the greatest degree of protection. Protection through management agreements or short-term lease may provide adequate short-term protection, but only should be considered to be intermediate steps in the process of ultimately providing for permanent protection. Such short-term protection strategies may be necessary when stronger protection is not amenable to the landowner or when monies are not available for fee simple acquisition.

Several of the known populations are adjacent to National Forest lands; the possibility of a land exchange should be investigated between GPC and the FS.

The Nature Conservancy recently received a pledge of $5 million for a national Katherine Ordway Endangered Species Conservation Program. Trillium persistens habitat certainly fulfills all the requirements for consideration for partial funding under this program and probably has an

excellent chance of receiving some funding. Project proposals should be developed and submitted to The Nature Conservancy.

Most of the Tallulah Gorge population is now within the project boundaries of the constructed North Georgia Hydroelectric Development, FPC Project No. 2354. As licensor for this power project, the FPC (now known as FERC) has control over many activities within the project boundaries. The FERC should be informed about the presence and importance of Trillium persistens within its project boundaries in the Tallulah Gorge. The FERC also should be reminded of its requirements pursuant to Section 7 of the Endangered Species Act and encouraged to promote activities to conserve T. persistens in the Tallulah Gorge project area.

1.5. Implement the most appropriate protection measures. The GDNR is the obvious organization to work with GPC to develop the most appropriate long-term protection strategy. The GDNR Plant Protection Program also is the most appropriate organization to work with other Georgia owners of T. persistens habitat. The South Carolina Nature Conservancy has negotiated with GPC in the past and probably is the most appropriate South Carolina organization to negotiate with GPC concerning the protection of the South Carolina population.

2. Determine and implement management guidelines necessary for long-term reproduction, establishment, maintenance and vigor. Protection of the species' habitat alone may not be sufficient to ensure the survival of the species. Management of the habitat of the species may be necessary to allow the species to successfully complete its life cycle on a long-term basis. Information on the population biology and ecology of the species is necessary before management guidelines can be formulated and implemented.

Surveys in the spring of 1983 indicate the presence of T. persistens in a wide variety of habitat types, at a wide range of elevations, in all possible exposures, and in an apparently wide range of light and moisture conditions. Persistent trillium apparently has a relatively broad ecological amplitude and probably is not restricted in its distribution by exacting habitat requirements. The occurrence of the species in apparently less than ideal habitats also suggests that the species has been in the area for a long time, since dispersal by ants would be expected to be a long, slow process.

Although the age-size class data gathered in 1983 suggest that reproduction, establishment, and maintenance probably are not factors limiting the distribution of the species, there is no way to tell from available data whether the present populations are stable, increasing, or declining. The stability of present populations

probably can be determined best by (1) determining what constitutes ideal habitat conditions and (2) by comparing age-size class distribution over time (reproduction success) in "ideal" habitats versus habitats representing the extremes of ecological conditions. Light and moisture are the habitat conditions generally believed to be most important in the ecology of T. persistens.

If sufficient time and money were available, it would be possible to examine in depth the full range of microclimatic and habitat features affecting all stages in the life cycle of T. persistens. The aim of the following study is to obtain a maximum amount of information with a minimum amount of effort. The need for in-depth studies of specific microclimatic or habitat features or of any life cycle stage should become obvious as Tasks 2.1, 2.2, and 2.3 are completed.

2.1. Select study sites. The most useful ecological information probably can be obtained with the least effort by selecting study sites in "ideal" habitats and in habitats representing (1) extremes of light (especially low light) and (2) extremes of moisture (especially low moisture). In order to separate the effects of light and moisture, ideally the low moisture study sites should have relatively high light levels, and the low light study sites should have relatively high moisture levels. Although the a priori selection of study sites

must, of course, be somewhat subjective, the following guidelines or assumptions should prove useful: (1) Sites with the greatest abundance of flowering plants probably can be considered to be ideal habitats. (2) Sites in sheltered locations, near streams, and under a thick, evergreen canopy probably can be considered low light - adequate moisture sites. Such sites often will be found downslope from "ideal" T. persistens habitats. (3) Sites in exposed locations, at or near the upper elevational limits of the species, and under a hardwood canopy probably can be considered low moisture - adequate light sites. Such sites often occur upslope from "ideal" T. persistens habitats. It may be possible in some areas to locate all three types of study sites along transects extending from the stream bottom toward the top of a ridge.

Location of study sites should be selected by analyzing data obtained in Tasks 1.1 and 1.2. Since each of the known populations is important to the recovery of the species, a complete series of study site types ("ideal," low moisture, and low light) should be selected in each population. Because the Tallulah Gorge population segment has an apparently different ratio of age-size classes than the other populations, it should be the location of the study sites for the Tallulah Gorge - Tallulah River population.

2.2. Conduct habitat analysis within each study site. At least two permanent plots should be selected and established in each selected study site. The size of plots should be large enough to adequately sample each stratum. Plots should be selected so that a colony of T. persistens is near the central portion of the plot. For each plot the species composition should be determined and cover measures for the canopy, subcanopy, shrub, and herb layers should be made. Any disturbance in or adjacent to the plots should be noted. The depth of the litter, duff, and soil should be determined. Soil samples should be collected and analyzed for pH, texture, organic content, mineral composition, and moisture content.

2.3. Conduct long-term demographic studies. Long-term demographic studies should be conducted in permanent (five by five meters) plots located within each study plot established for habitat analysis (Task 2.2). Plots should be visited in the spring at the peak of flowering (late March) and once in the summer (mid-July) during the peak fruiting period. Visits should be made for at least five consecutive years. The location of each individual plant of all age classes should be mapped and data should be collected for each mapped plant (as applicable) on height, leaf length, petal length, and capsule length. Measurement of these four characters should give a

reasonable indication of plant age and vigor. The relationship between capsule length and number of seeds per capsule should be determined by prior examination of plants outside the study plots. Capsules on plants within the study plots should not be removed. Larger plots (ten by ten meters) surrounding each five by five meter plot should be monitored for seed germination and seedling establishment; seedlings should be mapped and measured. Seed germination and establishment are critical life cycle stages that, because of the fondness of ants for the elaiosome on the seed, may not be observable within a plot as small as five by five meters. Any changes in the habitat within each ten-by-ten plot (soil disturbance, tree fall, increases or decreases in shade, etc.) should be noted at each visit.

2.4. Determine the effects of past disturbances. Important information on the ecological requirements and potential habitat management considerations for persistent trillium may be obtained by research into the effects of past disturbances, especially powerline construction, logging, and fire on T. persistens. Selection, establishment, and long-term, monitoring of permanent plots may be the most effective means of assessing the effects of past disturbances. The most appropriate methodology needs to be determined and implemented.

2.5. Conduct additional in-depth studies on microclimate and species biology as needed. The data obtained in Tasks 2.1 through 2.4 may suggest the need for additional in-depth studies on microclimate or species biology.

2.5.1. Determine annual regimes of relative humidity in exposed and sheltered habitats.

2.5.2. Determine annual regimes of soil moisture in exposed and sheltered habitats.

2.5.3. Determine the relationship between light intensity, establishment, reproduction, and seed germination.

2.5.4. Determine the vectors of seed dispersal and assess their effectiveness under different ecological conditions.

2.5.5. Determine major pollinators and assess their effectiveness under different ecological and spatial conditions.

2.6. Develop appropriate habitat management guidelines based upon the data obtained from Tasks 2.1 through 2.5.

2.7. Implement appropriate habitat management techniques.

3. Develop a commercial source of plants and provide for long-term seed storage. Propagation from seeds may be the most viable means of commercial propagation. The major disadvantage is the long time (seven years) necessary for development of the first flowering plants. A major advantage would be the large number of plants that eventually could be made available. Although Callaway Gardens has not been successful in germinating seeds in the past, the recent success of the National Tree Seed Laboratory in germinating seeds that had been stored for more than four years should be helpful in facilitating efforts by Callaway Gardens. Since Callaway Gardens has a Memorandum of Understanding with the GDNR to propagate T. persistens, they would be the most appropriate organization to develop a commercial source of plants. Ripe seeds should be collected from different populations and population segments in the wild.

Vegetative propagation as a possible commercial source of plants should not be overlooked. Techniques have been developed for the vegetative propagation of several species of Trillium. Similar techniques should be tried with T. persistens but using only plants already in cultivation.

Since T. persistens is restricted to such a small area, a single catastrophic event, such as a severe fire or a tornado, could destroy a large part of the genetic diversity of the species. Methodology for long-term storage of seeds apparently has been determined (see Part I, page 28). Seeds should be collected from numerous plants in all populations, pretreated following the methods of Robinson and Bowlings (page 28), and stored at the National Tree Seed Laboratory in Dry Branch, Georgia. Some seeds should be tested for viability every two to three years.

4. Enforce laws protecting the species and/or its habitat. The Endangered Species Act is the most important law protecting T. persistens. Although no T. persistens presently is known on Federal lands, most of the Tallulah Gorge population is within FERC project boundaries. FERC should be informed about the presence and significance of T. persistens within one of their project boundaries and should be reminded of their requirements pursuant to Section 7 of the Endangered Species Act. FERC should be encouraged by appropriate Federal agencies to promote activities to conserve T. persistens within project boundaries in the Tallulah Gorge.

The State of Georgia's Wildflower Protection Act of 1973 prohibits (a) digging, cutting, taking, selling, etc., from public lands and (b) intrastate transport without a certificate from the GDNR indicating that permission for collection was granted by the

landowner. Transport of the species into or out of Georgia without a certificate issued by GDNR is a violation of the recently amended Lacey Act. Federal agents whose jurisdiction includes the known distribution of T. persistens should be made aware of the applicability of the Lacey Act to Trillium persistens. Federal agents should be encouraged to make spot checks, especially in the most accessible areas (i.e., Tallulah Gorge), during the spring flowering season. Local businesses should be made aware of the existing laws relating to T. persistens and signs advising visitors of pertinent laws should be posted at conspicuous trails and entrance points into the habitat of Trillium persistens.

5. Develop materials to inform the public about the status of the species and the Recovery Plan objectives. Public support for the conservation of T. persistens, particularly in South Carolina and Georgia, could play an important part in encouraging landowner assistance in conservation efforts.

5.1. Prepare and distribute news releases. News releases concerning the status of the species and the recovery plan objectives should be prepared and distributed to major newspapers through South Carolina and Georgia, to smaller newspapers in the vicinity of the species' habitat, and to large newspapers in the eastern and southeastern states.

5.2. Prepare articles for popular and scientific publications. The need to protect the species in its native habitat and the cooperation between local, state, and Federal organizations and individuals should be stressed. Articles in scientific publications should stress additional research that is needed and solicit research assistance from colleges and universities.

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PART III. IMPLEMENTATION SCHEDULE

KEY TO IMPLEMENTATION SCHEDULE COLUMNS 1 AND 4

General Category (Column 1):

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Priority (Column 4):

1 - Those actions absolutely necessary to prevent extinction of the species.

2 - Those actions necessary to maintain the species' current population status.

3 - All other actions necessary to provide for full recovery of the species.

Persistent trillium (Trillium persistens)

Part III Implementation Schedule

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs *2			Comments/Notes
					FWS Region	FWS Program	Other *1	FY 1	FY 2	FY 3	
I1	Search for additional populations	1.1.	2	1 year	4	SE	South Carolina Wildlife and Marine Resources Department, Georgia Department of Natural Resources, Georgia Power Company, U.S. Forest Service, and Georgia and South Carolina Nature Conservancy	$1,500	------	------	*1. Other agencies' responsibilities would be of a cooperative nature on projects funded under a FWS contract or grant program. In some cases contracts may be let to universities or private enterprises. *2. NOTE: ALL COST ESTIMATES FOR FWS FUNDS ONLY.
I1, I2	Determine population size and age-size class distribution	1.2.	2	1 year	4	SE	Same as above	$3,000	------	------	
I14	Determine population protection priorities	1.3.	2	1 year	4	SE	Same as above	$500	------	------	
R4	Evaluate protection alternatives	1.4.	1	Unknown	4	SE	Same as above	------	------	$500	
M7, A1-7	Implement the most appropriate protection measures	1.5.	1	Unknown	4	SE	Same as above	Unknown	------	------	
I2	Select study sites	2.1.	2	1 year	4	SE	Same as above	$500	------	------	
Q2, R3	Conduct habitat analysis within each study site	2.2.	2	3 years	4	SE	Same as above	$2,000	------	------	
R6	Conduct long-term demographic studies	2.3.	2	3 years	4	SE	Same as	$2,000	------	------	
R14	Determine effects of past disturbances	2.4.	3	2 years	4	SE	Same as above	$3,000	$1,000	------	

Persistent trillium (Trillium persistens)

Part III Implementation Schedule

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	Program	Other	FY 1	FY 2	FY 3	
R3	Determine annual regimes of relative humidity in exposed and sheltered habitats	2.5.1.	2	3 years	4	SE	Same as above	Unknown			
R3	Determine annual regimes of soil moisture in exposed and sheltered habitats	2.5.2.	2	3 years	4	SE	Same as above	Unknown			
R3, 6, 10	Determine the relationship between light intensity, establishment, reproduction, and seed germination	2.5.3.	2	3 years	4	SE	Same as above	Unknown			
R6	Determine the vectors of seed dispersal and assess their effectiveness under difficult ecological conditions.	2.5.4.	2	3 years	4	SE	Same as above	Unknown			
R6	Determine major pollinators and assess their effectiveness under different ecological and spatial conditions	2.5.5.	2	3 years	4	SE	Same as above	Unknown			
R4	Develop appropriate habitat management techniques as determined through Tasks 2.1. - 2.5.	2.6.	1	3 years	4	SE	Same as above	Unknown			
M1-7	Implement appropriate habitat management techniques.	2.7.	1	3 years	4	SE	Same as above	Unknown			
M1-M7	Develop a commercial source of plants and provide for long-term seed storage	3.0.	3	3 years	4	SE	Same as above	$1,000	$200	$200	

Persistent trillium (*Trillium persistens*)

Part III Implementation Schedule

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	Program	Other	FY 1	FY 2	FY 3	
02	Enforce laws protecting the species and/or its habitat	4.0.	1	Continuous	4	SE SAC	Same as above	$1,000	$1,000	$1,000	
01	Prepare and distribute news releases	5.1.	2	Continuous	4	SE PAO	Same as	$1,000	$500	$500	
01	Prepare articles for popular and scientific publications	5.2.	2	Continuous	4	SE PAO	Same as above	$1,000	$500	$500	

APPENDIX

LIST OF REVIEWERS

John E. Alcock
Regional Forester
U.S. Forest Service
1720 Peachtree Road, N.W.
Atlanta, GA 30309

The Georgia Conservancy, Inc.
3110 Maple Drive, Suite 407
Atlanta, GA 30305

Dr. James A. Timmerman, Jr.
Executive Director
Wildlife and Marine Resources
Department
P.O. Box 167
Columbia, SC 29202

Arthur L. Lightsey
Superintendent, Land Management
Georgia Power Company
P.O. Box 4545
Atlanta, GA 30302

U.S. Fish and Wildlife Service
Ecological Services Field Office
P.O. Box 12559
217 Ft. Johnson Road
Charleston, SC 29412

Ms. LaBruce Alexander, Director
South Carolina Nature Conservancy
P.O. Box 5475
Columbia, SC 29250

Michael Creel
S.C. Wildlife and
Marine Resources Department
P.O. Box 167
Columbia, SC 29202

Dr. John F. Garst, Professor
Department of Chemistry
The University of Georgia
Athens, GA 30602

Randy Allen
Callaway Gardens
Pine Mountain, GA 31822

Ms. Mary Anne Young
Specialist - Protected Plants/Natural Areas
Georgia Department off Natural Resources
270 Washington Street
Atlanta, GA 30334

Joe D. Tanner, Commissioner
Department of Natural Resources
270 Washington, Street, S.W.
Atlanta, GA 30334

James E. McGuffey
Supervisor, Land Resources
Georgia Power Company
P.O. Box 4545
Atlanta, GA 30302

L.L. Gaddy
Route 1, Box 223
Walhalla, SC 29691

Steven M. Jones
College of Forestry and Recreation
Clemson University
Clemson, SC 29631

Steven Bowing
5890 Long Island Drive N.W.
Atlanta, GA

Dr. George Folkerts
Department of Zoology and
Entomology
Auburn University
Auburn University, AL 36849

Dr. Robert Kral
Department of General Biology
Vanderbilt University
Nashville, TN 37235

Roger F. Riffle
602 Charlton Avenue
Massillon, OH 44646

Dr. W. Robert Woodall, Jr.
Power Supply
Laboratories Manager
Georgia Power Co.
P.O. Box 4545
Atlanta, GA 30302

Dr. Levester Pendergrass
U.S. Forest Service
1720 Peachtree Road, N.W.
Atlanta, GA 30309

Dr. Victor G. Soukup
338 Compton Road
Cincinnati, OH 45216

Dr. Earl W. Belcher
National Tree Seed Lab.
Route 1, Box 182B
Dry Branch, GA 31020

Gary A Breece
Georgia Power Environmental
791 Dekalb Industrial Way
Decatur, GA 30030

John C. Lambert
Mountain Fork River Arboretum
Route 4, Box 665
Mena, AR 71953

Thomas S. Patrick
Department of Botany
The University of Tennessee
Knoxville, TN 37916

Ben A. Sanders, Wildlife Biologist
Chattahoochee-Oconee
National Forest
601 Broad Street
Gainesville, GA 30501

Nora Murdock, Wildlife Biologist
Endangered Species
U.S. Fish and Wildlife Service
Room - 5
50 South French Broad River
Asheville, NC 22801

Dr. Andrew F. Robinson, Jr.
U.S. Fish and Wildlife Service
Lloyd 500 Building
500 N.E. Multnomah Street
Portland, OR 97232

Dr. James Massey
Curator of the Herbarium
Department of Biology
The University of North Carolina
Chapel Hill, NC 27541

Dr. Wilbur H. Duncan, Professor Emeritus
Department of Botany
The University of Georgia
Athens, GA 30602

Dr. John D. Freeman
Botany Department
Auburn University
Auburn University, AL 36849

Rudy Mancke
Curator of Natural History
S.C. Museum Commission
Box 11296
Columbia, SC 29211