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ENDANGERED AND THREATENED PLANT SPECIES ON THE DEPARTMENT OF ENERGY OAK RIDGE RESERVATION—AN UPDATE[1]

PATRICIA DREYER PARR
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831

ABSTRACT

Plant species considered endangered or threatened on the Department of Energy-Oak Ridge Reservation (DOE-ORR) were identified through a review of pertinent literature and evaluation of herbarium voucher specimens. Thirteen plant species are on the official Tennessee list of endangered and threatened plants. Three of those species have been proposed for inclusion on the Federal list as rare in Tennessee. These rare plants will be given careful consideration in land-use planning. Protection of endangered and threatened species in their native habitat is considered the best method of ensuring their survival. In addition to habitat preservation, natural history studies of the rare species is important in determining best habitat management procedures necessary to maintain the species.

INTRODUCTION

With the species diversity present on the 14,980 ha (37,000 acres) of the Oak Ridge Reservation, it is not surprising to find a number of plants considered rare throughout Tennessee. In 1979 a list was published (Parr and Taylor 1979) of nine plant species on the Reservation that were rare, threatened, or of special concern. Since that time an official list of Tennessee Rare Plants has been signed by the Governor (Tennessee Department of Conservation 1982) and the inventory of plant species on the Oak Ridge Reservation has been updated (Mann and Patrick 1983). Additional species have also been reported particularly in areas thoroughly inventoried for environmental impact reports. In comparing a checklist of vascular plants occurring on the Reservation (Mann and Patrick 1983) with Federal (USDI 1980) and State (Tennessee Department of Conservation 1982) lists, a total of 13 endangered or threatened plant species have been identified as being present on Reservation land (Table 1).

Plant species currently under review for inclusion on the Federal list fall into two categories. Category 1 are taxa for which the U. S. Fish and Wildlife Service currently has sufficient information on hand to support the biological appropriateness of their being listed as Endangered or Threatened species. Because of the large number of such species, and because of the necessity of gathering data concerning the environmental and economic impacts of listings and designations of Critical Habitats, it is anticipated that the development and publication of proposed and final rules concerning such species will require several years. In some cases, although adequate data are now available to the USFWS to support re-proposal of species originally included in the withdrawn 1976 proposal, such species cannot be proposed for listing pending the receipt of sufficient new information warranting such action, as required by Section 4(f)(5) of the Act (USDI 1980).

Category 2 are taxa for which information now in the possession of the U. S. Fish and Wildlife Service indicates the probable appropriateness of listing as Endangered or Threatened, but for which sufficient information is not presently available to biologically support a proposed rule. Further biological research and field study will usually be necessary to determine the status of the taxa included in this category. Some taxa included in this catagory are of doubtful taxonomic validity and require further taxonomic research before their status can be clarified. The fact that many of these taxa have previously been proposed and withdrawn for procedural reasons largely reflects changes in informational standards applied to listing procedures in recent years (USDI 1980).

There are four categories of plant status on the official list of Tennessee Rare Plants (Tennessee Department of Conservation 1982). Endangered species (E) are those now in danger of becoming extinct in Tennessee because of their rarity throughout their range or their rarity in Tennessee as a result of sensitive habitat or restricted area of distribution. Threatened species (T) are those likely to become endangered in the immediately foreseeable future as a result of rapid habitat destruction or commercial exploitation. Species of special concern (S) are those requiring particular attention because they are rare or distinctive in Tennessee

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TABLE 1. *Rare plant species on the Department of Energy Oak Ridge Reservation.*

Genus species authority	Family	Common name	List status Federal	State
Aureolaria patula (Chapm) Pennell	Scrophulariaceae	False foxglove	1	T
Cimicifuga rubifolia Kearney	Ranunculaceae	Bugbane	2	T
Delphinium exaltatum Ait.	Ranunculaceae	Tall larkspur		E
Fothergilla major (Sims) Lodd	Hamamelidaceae	Witch alder		T
Hydrastis canadensis L.	Ranunculaceae	Goldenseal		T
Liatris cylindracea Michx.	Asteraceae	Blazing star		E
Lilium canadense L.	Liliaceae	Canada lily		T
Panax quinquefolius L.	Araliaceae	Ginseng		T
Plantanthera flava (L.) Lindley	Orchidaceae	Southern rein-orchid		S
Saxifraga careyana Gray	Saxifragaceae	Carey's saxifrage	2	S
Solidago ptarmicoides (Nees) Boivin	Asteraceae	Goldenrod		T
Spiranthes ovalis Lindley	Orchidaceae	Lesser ladies' tresses		S
Tomanthera auriculata (Michx) Raf.	Scrophulariaceae	Auricled gerardia		E

[1]Taxa currently under review for inclusion on Federal list (USDI 1980): Category 1—Taxa for which USFWS currently has sufficient information on hand to support the biological appropriateness of their being listed as Endangered or Threatened species. Category 2—Taxa for which information now in the possession of the USFWS indicates the probable appropriateness of listing as Endangered or Threatened, but for which sufficient information is not presently available to biologically support a proposed rule.

[2]Status as listed on the Official List of Tennessee's Rare Plants (Tennessee Department of Conservation 1982):

E - Endangered
T - Threatened
S- Special Concern
P - Possibly Extripated

because the state represents the limit or near-limit of their geographic range or their status is undetermined because of insufficient information. Possibly extirpated species (P) have not been seen in Tennessee within the past 20 years.

Three of the plant species, false foxglove [*Aureolaria patula* (Chapman) Pennell], bugbane (*Cimicifuga rubifolia* Kearney), and Carey's saxifrage (*Saxifraga careyana* Gray) have been proposed for inclusion on the Federal list of threatened and endangered plants (USDI 1980).

All 13 plant species are included on the official State list of Tennessee's rare plants (Tennessee Department of Conservation 1982). The official list was adapted from the Tennessee Committee for Rare Plants List (TCRP 1978). Included with false foxglove, bugbane, and Carey's saxifrage are: tall larkspur (*Delphinium exaltatum* Ait.), witch alder [*Fothergilla major* (Sims) Lodd], goldenseal (*Hydrastis canadensis* L.), blazing star (*Liatris cylindracea* L.), Canada lily (*Lilium canadense* L.), ginseng (*Panax quinquefolius* L.), Southern rein-orchid [*Plantanthera flava* (L.) Lindley], goldenrod [*Solidago ptarmicoides* (Nees) Boivin], lesser ladies' tresses (*Spiranthes ovalis* Lindley), and auricled gerardia [*Tomanthera auriculata* (Michx.) Raf.].

According to Section 7 of the Endangered Species Act (U.S. Congress 1973) ". . . Federal departments and agencies shall . . . utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species . . . and by taking such action necessary to insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of such endangered species and threatened species. . . ."

These rare plants and their critical habitats will be given careful consideration in environmental and land-use planning. In order to ensure protection of additional species, continuing efforts are being made to locate species that have been seen at one time but not verified by voucher specimens or species whose habitat requirements suggest there is a high probability they occur on the Reservation (Parr and Taylor 1979).

Species and habitat descriptions for the rare plants present on the Oak Ridge Reservation are compiled from information from herbarium specimens at Oak Ridge National Laboratory and the University of Tennessee, Knoxville, personal observations of others, and floristic reference manuals and articles.

General Species and Habitat Descriptions

Aureolaria patula

False foxglove, *Aureolaria patula,* is a large, branched, herbaceous plant with opposite leaves and large, yellow, solitary, pediceled flowers. Small (1933) reports it as growing on wooded river bluffs of the Appalachian Valley and Interior low plateaus from Georgia to Tennessee. One small population has been located on the Reservation growing at the base of a wooded, limestone river bluff, out over the bank of the Clinch River (TSA 1982). It has been proposed for inclusion on the Federal list and is listed by the State as threatened. It is also listed by the USDA Soil Conservation Service (1975) as threatened in Tennessee.

Cimicifuga rubifolia

Bugbane, *Cimicifuga rubifolia,* is a perennial herb with five to nine prominent veins arising at the base of a deeply cordate terminal leaflet. White flowers are in elongate virgate racemes and seeds are scaly and cylindrical. Small (1933) reports the bugbane as growing on wooded bluffs along the Tennessee River in the Appalachian Valley of East Tennessee. On the Reservation it grows in a habitat of rich, mature forests at the base of steep, sheltered limestone bluffs. Small populations of bugbane have been found at three sites on the Reservation. It has been proposed for inclusion on the Federal list and is on the State list as threatened in Tennessee. It is also listed by the USDA Soil Conservation Service (1975) as threatened in Tennessee.

Delphinium exaltatum

Tall larkspur, *Delphinium exaltatum,* is a perennial herb with smooth, erect stems growing up to 2 m tall. Its large leaves are divided into a few cuneate to lanceolate segments, these with one to four coarse sharp lobes above the middle. The spurred blue-purple flowers appear on an often-branched, elongate raceme. It is reported to grow in woods and rocky soil (Small 1933). It is found in a dry, calcareous open woodland habitat on the Reservation. Tall larkspur has been found in two areas on the Reservation. Two populations are located on northwest-facing slopes. The population of the second area consists of about 15 flowering plants scattered throughout an open cedar barrens area (TSA 1982).

The tall larkspur has been reported in Tennessee as occurring in Anderson and Roane counties on the Reservation and has been reported in one other Tennessee County.

It is included on the State list as endangered in Tennessee.

Fothergilla major

Witch alder, *Fothergilla major,* is a medium-sized shrub 0.5 to 1.5 m tall with stiff, upright branches. Leaves are usually 5 to 10 cm long, suborbicular, broad-elliptic or obovate, and the white catkin-like flowers are in clusters to 5 cm long. Although Small (1933) reports it as growing in rich, moist woods, the one population located on the Reservation grows at midslope of a west-facing, open, wooded area.

In addition to Anderson County, this species has been reported from four other counties in East Tennessee. The witch alder is included as threatened on the State list and is listed by Sharp (1974) and the USDA Soil Conservation Service (1975) as rare in Tennessee.

Hydrastis canadensis

Goldenseal, *Hydrastic canadensis,* is a perennial herb 2 to 5 dm high bearing one basal leaf and two cauline leaves near the summit. The leaves are rounded cordate at the base with 5 to 7 lobes, doubly serrate and veiny. The white flowers are about 15 mm wide and the distinctive fruit is a head of dark red berries. Small (1933) reports it as growing in rich woods and on shaded banks. It is found in rich, mature forests in narrow coves and north-facing lower slopes, also on limestone outcroppings in more open cedar-oak woods on the Reservation. Goldenseal has been found in at least three locations on the Reservation and likely occurs in more. One population is in a mesic area of rich woods at the base of a north-facing slope and another occurs in a limestone sinkhole.

Goldenseal has been widely extirpated because of its proclaimed medicinal qualities. It is included as threatened on the State list and was listed by Sharp (1974) as rare in Tennessee.

Liatris cylindracea

Blazing star, *Liatris cylindracea,* is an erect, perennial herb about 30 to 45 cm tall. The leaves are linear 8 to 15 cm long. It has numerous discoid heads of purple flowers. It grows in a dry, clacareous soil and is typically a prairie species but also occurs in cedar glade habitats. Blazing star was found on the Reservation in an open cedar barren. Until it was found on the Oak Ridge site, blazing star had been reported only from Rutherford County in Tennessee. It is listed by the State as endangered.

Lilium canadense

The Canada lily, *Lilium canadense,* is a perennial with a slender, erect stem, 1 to 15 dm tall. The leaves are mainly in whorls of 4 to 12. Flowers are showy of yellow or orange-yellow to red marked with purple spots within. Small (1933) reports the lily growing in wet thickets and meadows. On the Reservation it grows in wet meadows, low thickets, or open woods and has been located at three sites. At two locations where the lilies grow at the edge of the woods, natural encroaching of the woods could affect light requirements of the species. Beneficial maintenance through selective removal of some of the trees is under consideration.

The Canada lily is listed by the State as threatened in Tennessee.

Panax quinquefolius

Panax quinquefolius, more familiarly known as ginseng or "sang," is a perennial herb 2 to 6 dm tall. It most commonly has three to four leaves with three to five leaflets. The inconspicuous flower is greenish-white, but the showy fruit is bright red. Ginseng grows in a rich, cool, moist woodland habitat. Once found in large populations, now single plants may be found scattered throughout the Reservation.

Ginseng has been collected extensively for its supposed medicinal qualities and this commercial exploitation has led to the State listing of threatened in Tennessee. It is listed by Sharp (1974) and the USDA Soil Conservation Service (1975) as rare in Tennessee.

Plantanthera flava

The Southern rein-orchid *(Plantanthera flava)* is an erect orchid growing up to 50 cm tall with 1-5 dark green, lanceolate leaves. The inflorescence is spicate with 10-40 yellow-green flowers. This orchid flowers from May to August (Luer 1975).

The Southern rein-orchid population on the Reservation consists of scattered individuals over a large floodplain area. It is listed by the State as a species of special concern. The USDA Soil Conservation Service (1975) lists it as threatened in Tennessee.

Saxifraga careyana

Saxifraga careyana, Carey's saxifrage, is a perennial herb 1 to 5 dm tall. It has basal leaves which are ovate to slightly obvate. The small flowers are white. It grows in a habitat of wooded, limestone bluffs. On the Reservation it is found in rich woods on bluffs. It occurs in several counties, all in East Tennessee. It has been proposed for inclusion on the Federal list and is on the State list as a species of special concern in Tennessee. The USDA Soil Conservation Service (1975) lists the saxifrage as threatened in Tennessee.

Solidago ptarmicoides

Solidago ptarmicoides, a goldenrod, is a perennial herb 30 to 60 cm tall. Its slender, rigid stem is corymbosely branched near the summit. Leaves are linear-lanceolate, and the white flowers have 10 to 20 rays about 1 cm long. On the Reservation it grows in a prairie-like barren with thin, eroded cherty soil over limestone (Patrick et al. 1983). Prior to the discovery of this small population on the Reservation, this goldenrod was known from only one other location in Tennessee. The plant was collected once from Roane County and had not been seen again until this discovery (TSA 1982). It is included on the State list as threatened in Tennessee.

Spiranthes ovalis

Lesser ladies' tresses, *Spiranthes ovalis,* is a perennial herb 1.5 to 4 dm high. Its leaves are basal and cauline, deep green, tapering to a long petiolar base. The slender spike has several ranks of small, white flowers 4 to 5 mm long. It grows in a habitat of moist, rich, shady woods. Very small populations of this orchid have been found in two locations on the Reservation. Both areas are rich, shady woods dominated by second growth *Liriodendron tulipifera.* A potential threat to the orchids may be natural succession. Both locations where these plants occur are disturbed sites

and as the areas "recover," the habitat could potentially be altered enough to eliminate them. This is an area where life history information could be useful in determining beneficial habitat maintenance.

Spiranthes ovalis has been reported in only two other Tennessee counties besides Anderson and Roane. It has been included as a species of special concern on the State list and is listed by USDA Soil Conservation Service (1975) as rare in Tennesseesee.

Tomanthera auriculata

Auricled gerardia, *Tomanthera auriculata,* is an annual herb growing 30 to 60 cm tall. The opposite leaves are lanceolate or ovate-lanceolate, mostly rounded at the base. It has solitary sessile, purple flowers in the upper axiles. The species is believed to be a root parasite (TSA 1982). The recorded habitat of the gerardia is moist, open soil (Gleason 1952). One population of the auricled gerardia was found in a cedar barren where, based on habitat and/or historical records, it was not expected to occur. Auricled gerardia is a prairie species believed to have been introduced into Alabama and Tennessee (Small 1933). Prior to discovery on the Reservation, the only known Tennessee locations were Madison and Carroll counties (TSA 1982). It is included on the State list as endangered in Tennessee.

SPECIES AND HABITAT PRESERVATION

It has been recommended that the preservation of critical habitats be adopted as a major management practice to ensure the survival of endangered and threatened plant species (USDI 1976). One of the purposes of the Endangered Species Act of 1973 (U.S. Congress 1973), as stated in Section 2, is ". . . to provide a means whereby the ecosystems upon which Endangered species and Threatened species depend may be conserved." Section 7 of the Act states that ". . . Federal departments and agencies shall, in consultation with and with the assistance of the Secretary (Secretary of Commerce and/or Secretary of Interior), utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species . . . and by taking such action necessary to insure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of such endangered species and threatened species or result in the destruction or modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with the affected States, to be critical."

Indiscriminant modification or destruction of habitat could not only cause a reduction of the population but could also result in a restriction of the population's exapansion and recovery. Many species, however, are rare because they occupy unusual, often temporary habitats and may be dependent on some types of interference. Natural history studies and propagation of sensitive species are important in determining the plants' environmental requirements. Careful management of the habitat might be necessary to maintain the species, but before any habitat can be managed to protect a species, it is necessary to determine whether the species is reproducing and its reproductive potential. Once propagules are dispersed, it is essential to know the processes active in establishing the species. Thus, the species autecology information must be evaluated to plan for scientific and beneficial management of the habitats where the species survive (Parr and Taylor 1978).

Specific recommendations for effective protection of endangered and threatened plant species occurring on the Reservation include four major actions: (1) Increased reconnaissance to verify species that have been seen at one time but not supported by voucher specimens and increased efforts to locate species whose habitat requirements suggest there is a high probability they occur on the Reservation, (2) Species autecology evaluations through a review of information available on the species combined with field studies and controlled experiments (including propagation techniques), (3) Initial habitat preservation through establishment of natural areas, (4) Determination of habitat maintenance requirements based on autecology information and, if beneficial, management of the habitat. These actions would not only provide protection and information necessary for species and habitat preservation, they would lead to assessment guidelines important for interaction with various land-use practices.

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