REPORT ON THE CONSERVATION STATUS OF *ALLOTROPA VIRGATA* (CANDYSTICK) ON THE NEZ PERCE NATIONAL FOREST

I. FIELD SURVEY AND FIRST- AND SECOND-YEAR MONITORING RESULTS

by

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INTRODUCTION

Allotropa virgata (candystick) is a US Forest Service Sensitive Plant Species (Regions 1 and 4). Its known range in Idaho is almost exclusively restricted to the Nez Perce National Forest where it is highly associated with the lodgepole pine/beargrass community type. Due to the remoteness of much of its range, Allotropa was unknown in the Rocky Mountains until the 1970s. It is considered a disjunct coastal species in Idaho (Lorain 1988) occurring some 300 miles from the main range of the species in the Cascade and Sierra Mountains. The isolation of Allotropa in the Rocky Mountains gives it biogeographic significance. Within its disjunct range it is rare, mostly occurring in scattered, small subpopulations.

Allotropa is a biologically interesting and visually striking plant. A non-green, somewhat succulent perennial, it lives through a unique type of parasitic relationship requiring a conifer host. The common name candystick refers to its prominently red and white striped flowering stalks.

As with most rare plant species, our knowledge of Allotropa comes primarily from field surveys. Survey methods yield information on a species' geographic range, habitat and abundance, and help us predict where conflicts might occur between rare plant conservation and land-use activities. However, land managers have begun to recognize a need for more detailed information than that based solely on survey methods.

Managing for the long-term viability of a rare species requires knowledge of the species' life history traits such as birth (germination) and death rates, growth, size, age structure and distribution. These characteristics of a population determine abundance and persistence, which are central to all conservation efforts (Harper 1977). They also allow us to predict how populations might react to environmental perturbation. To obtain this information, various monitoring methods are used in which individuals are mapped and followed over time.

Monitoring of rare plant populations has become increasingly important as the efforts of natural resource agencies have evolved from an emphasis on inventory and status determination to active protection efforts. Such is the case with Allotropa. In Idaho, Allotropa frequently occupies gently sloping uplands of lodgepole pine suited to timber harvest and road building, and protection efforts have increasingly come into conflict with these land uses.

The proposed Sibling timber sale on the Nez Perce National Forest provided an opportunity to set up a monitoring study. The area, just north of Red River Ranger Station, was found to have a high density of Allotropa, and an effects analysis of the sale stipulated that if it proceeded, monitoring plots should be established to obtain demographic data on Allotropa and observe responses of the population to logging activities (Shelly et al.1991). Plans for logging the area continue, with some mitigation planned for protection of localized concentrations of plants.

This report documents methods used to monitor Allotropa, and presents the first 2 years of data. It also summarizes our present knowledge of the distribution of Allotropa including 2 years of survey work on the Nez Perce National Forest. It is hoped that knowledge gained from this study will assist managers in making decisions to ensure the long-term viability of this unique Idaho plant species.

ALLOTROPA VIRGATA

Current status USFS: Regions 1 and 4 Sensitive Species
Idaho Conservation Data Center (ICDC): G4S1
Idaho Native Plant Society: Category 2
USFWS: not ranked

Taxonomy: Latin name: Allotropa virgata T. & G. This is the only species in the genus Allotropa. The Greek roots allos (other) and tropos (direction) refer to the fact that the flowers are not reflexed as in its widespread relative Indian pipe (Monotropa uniflora).

Family: Ericaceae (Heath family)
Common name: candystick, sugarstick, allotropa
Citation: T. & G. ex Gray, Proc. Am. Acad. 7:368. 1867. (Wilkes Expedition, Cascade Mts., WA)
Synonyms: none

Allotropa is sometimes termed a "monotrope", referring to its affiliation with the Monotropoideae--the subfamily of plants within the Ericaceae that lack chlorophyll.

Nontechnical description: Fleshy, non-green plants with single or more often clustered, unbranched stems bearing the flowers and small, pointed leaves (Appendix 1). The thick, brownish-red stems stand up to 40 cm tall. Stems are striped vertically with red and white, this feature being most obvious toward the base of the stem (small stems may be solid red). Flowers are similar in color to the stem and round in outline. An important feature of the flowers is that they open outward, directly away from the stem, as opposed to turning down as in closely related species (see below). Standing dead stems from previous years are almost always present. Old stems are dark reddish-brown with no white, and hollow.

Technical description: Achlorophyllous, simple-stemmed herbs with single to numerous stems, originating from a diffuse, deep-seated root system bearing branch roots and adventitious buds at intervals along its length (Wallace 1975); stems 1-4 dm tall, white and pink (red) striped, 5-10 mm thick, enlarged below ground (Appendix 1); leaves reduced, scale-like, pinkish to yellow-brown, linear lanceolate; inflorescence a terminal, elongate, spikelike raceme, 5-20 cm long; flowers axillary and exceeded by the subtending bract, often with 1-2 bracteoles below the calyx; sepals 5, distinct, white or pinkish to brownish, about 5 mm long; corolla lacking; stamens 10, purplish, opening by basal (falsely terminal) pores, from about equal to, to twice as long as, the sepals; pistil 5-carpellary, styles very short, stigma shallowly 5-lobed; ovary superior, 5-celled, with axile placentation; fruit a capsule (Hitchcock et al. 1959).

Similar species: Allotropa may be confused with other non-green members of the heath family which often share the same habitat. Pinedrops (Pterospora andromedea) has sticky, brown flowering stems that also dry and persist a long time after dying. Unlike Allotropa, its flowers face downward, born at the ends of delicate, reflexed pedicels. It is generally much taller than Allotropa (3 dm to over a meter). Pinesap (Hypopitys monotropa), is similar in height to Allotropa, but is uniformly pinkish to straw-colored, drying to black. In flower the main stem bends over (nods) distinctly, but straightens again as fruits develop.

Some non-green orchids, especially coralroot (Corallorhiza spp.), are sometimes mistaken for Allotropa. Coralroot has slender stems, rather variable in color from purplish to reddish-brown to albino. However, stems do not bear the small, pointed leaf blades always present on Allotropa (Appendix 1).

Distribution: In the Rocky Mountains, Allotropa is considered a disjunct coastal species, although it does occur along the east side of the Cascade Mountains. The main range of the species extends from Southeastern British Columbia, southward in the Cascades to the southern Sierra Nevada Mountains, where it inhabits low-elevation coniferous forests (Hitchcock et al. 1959, Appendix 2, Map A). It was unknown in the Rocky Mountains until 1974 when it was collected in the Bitterroot Mountains of western Montana by Peter Stickney, a botanist with the USFS Forest and Range Experiment Station (Steele and Stickney 1974). Like other Idaho disjuncts, its range in the Rocky Mountains is thought to be a remnant of a much larger distribution that at one time linked it with the coast (Lorain 1988).

In just the last couple years Allotropa has been found to be more widespread than previously thought. Its range straddles the Bitterroot Divide between Idaho and Montana, extending into parts of six different mountain ranges (Appendix 2, Map B). However, within this area the species is rare and Montana locations are widely dispersed. To date, all records of Allotropa in the Rocky Mountains are on Forest Service lands in Idaho County, Idaho and in Ravalli, Beaverhead, and Granite Counties, Montana. In Idaho, it occurs on the Nez Perce National Forest and adjacent parts of the Payette and Bitterroot National Forests.

Habitat: In the Northern Rockies, Allotropa typically occurs on gentle to moderate slopes with southeast to southwest aspects, in grand fir and subalpine fir series, 5000-7000-ft elevation (Cooper et al. 1987). Populations often occur on, or just below, a ridge crest or shoulder. Soils are typically coarse textured, granitic, and often shallow. Simpson (1991) observed that Allotropa occurred on soils derived from granitic rock, but not on adjacent soils derived from metamorphic rock types.

Allotropa is commonly found in mature lodgepole pine/beargrass communities with low understories of grouse whortleberry and/or huckleberry and only sparse regeneration of climax tree species. This long-lasting successional community is characteristic of granitic soils of the Idaho Batholith in central Idaho. While about 70% of the known Idaho populations of Allotropa occupy the lodgepole/beargrass community type, the species has also been found under ponderosa pine, Douglas fir, subalpine fir, and western red cedar (ICDC).

Allotropa is usually found where beargrass cover is not very high, often on shallow soils dominated by grouse whortleberry. Understory diversity is low, typically limited to a small group of highly constant species (Table 1). A number of other members of the heath family are typically present in lodgepole/beargrass communities including grouse whortleberry (Vaccinium scoparium), globe huckleberry (V. globulare), prince's pine (Chimophila umbellata), and bearberry (Arctostaphylos uva-ursi); and frequently the monotropes pinedrops (Pterospora andromedea), and pinesap (Hypopitys monotropa).

The most extensive areas of the lodgepole/beargrass community type, and likewise the most Allotropa populations found in the Northern Rockies, occur on the Red River Ranger District of the Nez Perce National Forest. The area is unique for the extent and continuity of the lodgepole/beargrass community type. Stand exam data for the Nez Perce indicate almost 80,000 acres of lodgepole-dominated cover on southeast to southwest aspects (Thompson, pers. comm., Table 2).

Table 1. Species associated with Allotropa virgata in Red River monitoring plots. The first figure is the number of plots in which the species occurred (total =9), the second number is mean cover class among plots in which the species was present. Species arranged in order of increasing constancy and increasing cover within constancy.

Common name	Latin name	Constancy	Average cover (%)[1]
Trees:			
Lodgepole pine	Pinus contorta	9	70
Douglas fir	Pseudotsuga menziesii	9	10
Grand fir	Abies grandis	9	3
Ponderosa pine	Pinus ponderosa	4	10
Western larch	Larix occidentalis	1	3
Subalpine fir	Abies lasiocarpa	1	3
Shrubs :			
Grouse whortleberry	Vaccinium scoparium	9	30
Birch-leaved spirea	Spirea betulifolia	9	3
Bearberry	Arctostaphylos uva-ursi	8	10
Globe huckleberry	Vaccinium globulare	8	3
Wintergreen	Pyrola ascarifolia	8	1
Rose	Rosa spp.	8	1
Prince's pine	Chimophila umbellata	7	3
Serviceberry	Amelanchier alnifolia	6	1
Oregon grape	Berberis repens	4	3
Boxwood	Pachistima myrsinites	3	3
Fool's huckleberry	Menziesia ferruginea	3	3
Twinflower	Linnaea borealis	1	3
Scouler's willow	Salix scouleriana	1	1
Snowberry	Symphoricarpos albus	1	1
Herbaceous plants:			
Beargrass	Xerophyllum tenax	9	60
Bracken fern	Pteridium aquilinum	9	3
Ross' sedge	Carex rossii	9	3
Piper's anemone	Anemone piperi	9	1
Hawkweed	Hieracium albiflorum	8	1
Golden banner	Thermopsis montana	5	3
Pinegrass	Calamagrostis rubescens	5	3
Matted wintergreen	Gaultheria ovatifolia	4	3
Dogbane	Apocynum androsaemifolium	4	1
Elephant head	Pedicularis racemosa	4	1
Pinesap	Hypopitys monotropa	3	1
Harebells	Campanula rotundifolia	3	1
Rein orchid	Habenaria unalascensis	3	1
Woodrush	Luzula sp.	3	1
Violet	Viola spp.	2	1
Sword fern	Polystichum munitum	1	3
Pinedrops	Pterospora andromadea	1	1

Pussytoes	Antennaria racemosa	1	1
Strawberry	Fragaria virginiana	1	1
Twayblade	Listera sp.	1	1
Wintergreen	Pyrola sp.	1	1
Rattlesnake plantain	Goodyera repens	1	1

[1]A cover value is the midpoint of a 10% coverage class (for cover >5%); coverages less than 5% were broken into <1 % (1)or 1-5 % (3).

Table 2. Acreages of lodgepole pine cover type on slopes with southerly aspects, by district, as indicated by stand exam data from the Nez Perce National Forest, ID, 1991.

Ranger District[1]	Acres
Red River	44,240
Elk City	22,398
Salmon River	8,048
Clearwater	2,092
Selway	2,018
Total	78,796

[1]Moose Creek RD, which encompasses 500 to 600 thousand acres--entirely wilderness--has no stand exam information.

Lodgepole pine is a successional tree species that does not tolerate shade and comes to dominance only after a stand-killing fire. The prevalence of lodgepole on the Nez Perce NF is related to the extent and frequency of past fires that may have nearly eliminated seed sources of climax conifers from large areas (Cooper et al. 1987). Allotropa is characteristically found in 80 to 100-yr-old lodgepole stands that are still in early stages of succession. It appears to be less common in later seral stages even where lodgepole still dominates. The lodgepole pine/grouse whortleberry habitat type in which Allotropa sometimes occurs, is the only lodgepole type recognized as climax. It occurs on sites that are unsuited for regeneration of other conifers due to shallow, moisture-deficient soils (Cooper et al. 1987). This relationship with lodgepole pine apparently does not hold true for Allotropa in in its main range where, at least in the Cascade Mountains, it commonly occurs under mature Douglas fir (Luoma 1987).

Natural history: Although often referred to as a saprophyte, Allotropa, like its non-green relatives, is actually a mycotroph--a plant that obtains necessary nutrients and carbon compounds from a fungus associated with its roots. The filamentous body of the fungus (mycelium) is shared with a photosynthesizing plant that indirectly "feeds" the mycotroph via the fungus. Such "mycorrhizal" fungi are commonly associated with the roots of conifers. The mycotroph appears to be parasitic on the fungus, but there could exist a much more complex interaction which all three partners benefit. Castellano and Trappe (1985) point out that if the mycotroph were to produce some sort of growth factor that stimulated fungal growth it would result in a larger network for uptake of nutrients and water by the tree.

Achlorophyllous monotropes are thought to be more highly evolved than other members of the Ericaceae, partly because of this specialized relationship with a dual host. Allotropa appears to represent an intermediate form combining the extensive, fibrous root system of a green plant with much-reduced achlorophyllous leaves (Copeland 1938). In comparison, the root systems of the related monotropes Hypopitys, Monotropa and Pterospora are reduced to tight root balls (Furman and Trappe 1971).

In the case of Allotropa, the host plant is a conifer, often lodgepole pine or Douglas fir. The requirement of mycorrhizal fungi for particular host tree species may explain the close association between Allotropa and lodgepole pine. However, it has been demonstrated that Allotropa roots can be colonized by fungal associates of various conifers as well as several hardwood species (Castellano and Trappe 1985).

Because of its dependent nature, the habitat in which Allotropa is found may primarily be a function of the requirements of the fungus, with important factors being those of the soil environment and the availability of host trees. Buried, rotten wood is one important aspect of Allotropa habitat, probably because it retains moisture and provides organic substances essential to the associated fungus (Luoma, pers. comm.).

Dependence of mycotrophic plants on the conifer host suggests that anything that destroys the tree component or severs the mycorrhizal relationship (Furman and Trappe 1971) will result in death of the mycotroph. Because Allotropa spreads by underground, perennating buds, it can survive a ground fire that does not affect the overstory (i.e., the host trees). Plants on the margins of canopy openings produced by fire or logging may be adversely affected by the increased insolation. Other monotropes have been observed to recede from the edges of logged or burned areas (Castellano, pers. comm.).

Population biology: Allotropa is a clonal species that spreads by rhizomes, bearing adventitious buds on an extensive root system (Luoma 1987, Wallace 1975). When one of these buds develops into a new root crown the connection with the old one is severed (Castellano, pers. comm.). Each new "plant" propagated in this way is genetically identical to the one before and can therefore be referred to as a ramet (Harper 1977) to distinguish it from an individual propagated by seed, or genet. Each successive ramet apparently maintains ties to an established network of fully colonized mycorrhizal roots until such time that flowering can occur. Successive ramets may be as far as 1 m apart (Castellano, pers. comm.).

No data is available on flowering frequency, but a roughly biennial flowering pattern has been observed (Castellano, pers. comm.). A biennial flowering cycle would allow the plant to pour its resources into seed production one year, and the next year into developing buds--presumably those in the best growing conditions. In one case where there was a linear pattern of old stems, excavation revealed that the growth of the plant followed a buried log (Castellano, pers. comm.).

Pollination of Allotropa flowers is accomplished by bumblebees (Bombus) which are rewarded by big nectar pools that accumulate at the base of the ovary (Wallace 1977). Flowers may be autogamous because seed set is abundant, even when plants were covered by screens to keep pollinators out (Wallace 1975).

Seeds of Allotropa are minute and linear, about 1 mm long (Wallace 1975) and probably composed of less than 20 cells. Seeds are abundant, more than 100 per capsule, and wind-dispersed. Because of their small size they drift very slowly to the ground, kept aloft by air currents (Shelly, pers. comm.). The small seeds lack nutrient reserves and must therefore establish a mycorrhizal association immediately upon germinating--possibly even before. All attempts at germinating seeds in the lab, in the presence of a suitable fungus, have failed (Castellano, pers. comm.).

METHODS

Study site: The Sibling timber sale is located on the Red River District of the Nez Perce National Forest, 1.5 mi due north of Red River Ranger Station, along both sides of road 1183 (Appendix 3). Lower elevations support open stands of ponderosa pine, but most of the area is characterized by extensive, continuous stands of mature lodgepole pine with beargrass understory. A low shrub layer is formed by huckleberry, whortleberry, bearberry, and subshrubs. There is very little species diversity, and forbs are poorly represented (Table 1). Some of the largest lodgepole pine trees are 95-115 yrs old. Shallow, coarse-textured soils are derived from Idaho batholith granites.

A 1990 survey of the area both within and near proposed cutting units found Allotropa plants in units 5, 5a, 6 and 7 (Appendix 3). No plants were found in ponderosa pine stands. In all, approximately 480 current-year's flowering stems were counted making it the largest population documented to date in the northern Rockies (Shelly et al.1990). Localized subpopulations of often less than 2 acres, occur on south-trending ridges and dry-aspect slopes north of Blanco Creek above 4800 ft.

The timber sale will result in clearcutting of the units shown in Appendix 3, and building of spur roads within the range of this population. To mitigate the effects of logging, sale unit boundaries were adjusted and some uncut "leave-tree islands" were designated where particularly high concentrations of Allotropa plants occurred.

Description of plots: In September of 1990, after preliminary survey work, nine permanent monitoring plots were established in the vicinity of the Sibling timber sale, on either side of road 1183 (Appendix 3). Plots were located in subpopulations representing three different "treatments" associated with proposed logging activities:

1) undisturbed (control)
2) to be logged (overstory removal)
3) edge effect (immediately adjacent to logged area)

Plots were sited to maximize the number of plants included, to represent each unit of the sale equally, and to coincide as much as possible with plots established earlier that year by Jane Schumacher of Red River RD, who did the first survey of the population (Table 3). Limitations were imposed by the layout of the timber sale. We had the least amount of flexibility in selecting "edge effect" plots (nos. 4, 5, and 6) because of the limited number and size of "leave-tree islands"--localized concentrations of Allotropa exempted from cutting.

Permanent monitoring plots are 25 x 25 m--a size large enough to include a significant portion of the plants in a local population and to encompass a 0.1-ac ECODATA plot. Each corner of a plot is marked by a steel fence post and the center marked either by a fence post (plots 5-9) or rebar stake (approx. 2 dm exposed; plots 1-4). All corner and center posts were painted yellow, and corner posts were inscribed with the plot number. Plot corners were designated A, B, C and D, in counter-clockwise order beginning with the northeast corner, and the letter was inscribed into the post (Appendix 4). Azimuths were recorded from the A corner to the B and D corners. If necessary then, a plot can be reconstructed as long as one post remains. Plots 1 and 2, representing logged and edge-effect treatments respectively, are continuous with one side in common.

1990 Data Collection: Each cluster of Allotropa stems (hereafter referred to as "plants") within a plot was mapped by reading its coordinates, to the nearest decimeter, from meter tapes stretched along two adjacent plot sides. Plant locations were recorded on a diagram of the plot superimposed on a grid with each square equal to 1 square meter (Appendix 4). The number of flowering stems was recorded alongside each mapped location. The location of each plant was marked by driving a short length of yellow rebar into the ground, 0.5 m due north from the center of the cluster (often only a single stem). Plants with only the previous year's stems were not marked or mapped.

Table 3. Allotropa virgata monitoring plots in the vicinity of the Sibling timber sale, and projected treatments.

Plot #	Cutting Treatment	Unit	Notes
1	To be logged	6	Superimposed on Schumacher's plot 315
2	Edge effect	6	A side in common with plot 1
3	To be logged	5	Same center as Schumacher's plot 320
4	Edge effect	5a	
5	To be logged	7	"C" corner is plot center of Schumacher's plot 311
6	Edge effect	7	
7	Undisturbed	-	south of unit 5
8	Undisturbed	-	west of plot 6
9	Undisturbed	-	northwest of plot 6

Plants were usually quite distinct, but to accommodate situations where stems were spread out, we used a distance of 3 dm to designate separate plants. This somewhat arbitrary criteria is an unfortunate result of our inability to know where a flowering stem originates. However, since all stems were mapped, we can refine our criteria as we learn more about how the species propagates.

Each site was described by recording slope, aspect and vegetation, and taking photographs. Plant community composition was described using the ECODATA Ocular Macroplot Method and Form 4 (USDA Forest Service 1987; Appendix 7). The center of the monitoring plot was used as the center of a circular macroplot with radius 11 m. Four photographs were taken of each plot , one from each corner looking diagonally across to the opposite corner (A to C, B to D, C to A, and D to B).

1991 Data Collection: In 1991 all nine plots were resampled on August 20-22. Plants that had been recorded in 1990 were mapped onto new plot diagrams as solid dots, then each location was examined for new flowering stems. A "d" was used to indicate that only last year's stems were present (Appendix 4). If new stems were found, the dot was circled ( ) and the number of new stems was recorded on the map. The plot was then surveyed for any new plants and these were mapped as an open circle ( ), along with the number of stems. Each new plant was marked with a red rebar stake placed 3 dm (12 in) due north from the center of the cluster. A flowering stem more than 3 dm away from the nearest old stem, or from the location of a 1990 plant (as indicated by a yellow rebar stake), was considered a new plant and marked with a red stake. When the plots are resampled in 1992, plants from years '90 and '91 can be distinguished on the ground by the color of their stakes and on the map by their symbols.

A drawback to this marking system is that a plant can effectively "move away" from the stake by producing new stems to the opposite side. Some new stems were in fact observed more than 0.3 dm away from the yellow stake marking that plant. In two instances we repositioned the stake so that it would remain clear which plant it was marking (this change is noted on the plot diagram). There was usually little question as to which plant a new stem belonged.

No ECODATA was taken in 1991, but we encountered two species missed in 1990, Tway blade (Listera sp.), and rein orchid (Habenaria unalascensis) and added them to the

ECODATA Form PC.

RESULTS

Since no logging had been done on the Sibling timber sale as of August, 1991, second-year data reflect natural variation in flowering, and not the effects of any treatment. Clearing had begun for construction of a spur road adjacent to plot 4 and the "C" post closest to the road was missing (Appendix 3). Other than the missing post, plot 4 was not visibly affected by road building activities.

Table 4 summarizes data collected at the beginning of the experiment and shows differences in flowering between 1990 and 1991. Plots naturally varied initially in number of plants and number of stems. Higher numbers of plants in the undisturbed treatments (plots 7,8,9) are the result of having more latitude in plot selection. In 1990 most plants consisted of only one or two flowering stems. Of the 102 plants mapped in 1990, only 11 flowered in 1991. Seven of these produced the same number of stems as in the previous year, three produced fewer stems, and only one produced more stems in 1991. Two plants that were mapped in 1990 could not be relocated by old stems, nor could a yellow stake be found.

In 1991 we observed 21 "new plants" (i.e., flowering stems emerging more than 3 dm away from any dead stem or from any plant location mapped in 1990). Almost all consisted of only a single stem (Table 4). It is not known whether these new plants emerged from seed, from the rhizome of a nearby plant, or from a plant that had not flowered the year before. It would not be unexpected for two flowering stems as much as 1 m apart to be part of the same plant (Luoma, pers. comm.). Of the 21 new plants observed, 9 were less than 2 m from a previously mapped plant, 8 were from 2 to 5 m away, and 4 were from 5 to 8 meters away. Stems can persist for two years, or possibly more, after flowering. However, it is not known how many years a root crown may remain dormant before flowering again, nor is anything known about the rate of establishment by seed. This makes it impossible, after only 2 years, to speculate whether new plants represented seedling establishment or vegetative propagation.

All maps, data sheets, ECODATA forms, and photographs pertaining to this study are on file at the Idaho Dept. of Fish and Game, Conservation Data Center; PO Box 25, Boise, ID 83707.

Table 4. Summary of first and second-year data from Allotropa virgata monitoring plots on the Nez Perce National Forest, Idaho[1].

	1990			1991					
Plot #	No. of clusters	Total no. stems	Stems /plant (range)	No. of 1990 clusters located	Total stems	Not re-flowering	New clusters #	New clusters #stems	No. of flowering stems
1	5	5	1	1	1	-	1	1	2
2	12	20	1-3	1	1	-	3	3	4
3	11	17	1-4	0	0	-	0	0	0
4	5	11	1-5	0	0	-	0	0	0
5	5	5	1	0	0	-	6	7	7
6	15	23	1-4	1	1	1	2	2	3
7	18	33	1-6	1	1	-	1	1	2
8	19	39	1-7	5	6	-	5	6	12
9	12	44	1-9	2	3	1	3	3	6
Total	102	197		11	13	2	21	23	36

[1]A "cluster" of flowering stems was used as the basis for monitoring even though 2 clusters may be attached below ground. A cluster may consist of only one flowering stem. Stems more than 3 dm apart were considered part of separate clusters.

ALLOTROPA SURVEY ON THE NEZ PERCE NATIONAL FOREST

Field surveys for Allotropa were conducted on the Red River Ranger District in 1990, and on both the Red River and Elk City Districts in 1991. An attempt was made to relocate all historical occurrences, and new areas were searched. Many new records were found as a result of ICDC survey, timber clearance work, and an increased awareness of the species resulting from sensitive plant training sessions. Precise locations of Allotropa in the areas surveyed are shown in Appendix 5. Areas searched are summarized in Appendix 9.

Most new subpopulations are small (<10 plants). It was not uncommon to find only a single plant (possibly with numerous stems). However, numerous small groups found in some areas seem to indicate several extensive, discontinuous populations made up of small subpopulations (see Appendix 5, Maps A, B and E). The South Fork Red River population is unusual in that it occurs in a dense stand of "doghair" lodgepole (Appendix 5, Map D).

The first known occurrences of Allotropa on Elk City Ranger District were discovered in 1991. The lodgepole/beargrass community type is not as extensive on the Elk City District (Table 2), and the understory is often dominated by young firs. Allotropa was found at six widely scattered locations on Elk City RD (Appendix 6). At two of these, no plants had flowered in 1991 (sites 1 and 3). One large population was found near the town of Elk City (see also Appendix 5, Map F) and two populations were discovered in timber sale areas (sites 4 and 5). All of the new sites are in lodgepole-dominated stands.

In 1991 Red River RD personnel turned in many new records for Allotropa, including eight that were well outside its previously know distribution on the Forest (mostly to the east; Appendix 2, Map C). Large, remote areas where the species is likely to occur remain unsurveyed. Aerial photos have good potential for use in identifying areas of potential habitat (Shelly, pers. comm.).

DISCUSSION

Our ability to obtain demographic data for Allotropa is limited by its clonal and mycotrophic nature. Above-ground stems that can be easily counted and followed are only temporary reproductive structures. Even with autotrophic plants the ramets of a clone commonly remain vegetative through a growing season. A mycotrophic plant such as Allotropa could conceivably enter some sort of reproductive dormancy and still thrive and continue to grow below ground, provided nothing disturbs its mycorrhizal association. This phenomenon has been observed in mycorrhizal orchids (Tamm 1972). Such behavior can be detected if individuals are repeatedly mapped.

While sexual reproduction can be quite limited in clonal plants, it appears that flowering and seed production are important aspects of the life cycle of Allotropa. The factors that trigger flowering in Allotropa and the duration for which a genet might remain strictly vegetative (below ground) are not presently known. A biennial flowering cycle would be compatible with our first two years of data, but does not explain the apparently synchronous nature of flowering (i.e., many plants flowering in 1990 and few in 1991). We know that a few plants flowered in both years because new stems were so close to the old--presumably from buds produced right at the root crown.

It is also possible that some "new plants" were actually new ramets of plants that flowered in 1990. Two other possibilities are that 1) they originated from seed or 2) they originated from plants that had not flowered in either year of the study. It is obvious that at least several years data will be required before we can assess demographic patterns.

Seed production is important to the viability of a population because of its role in genetic recombination, dispersal, and dormancy. Seeds have the potential to travel far from the parent plant into unexplored habitat and to fill-in where local extinction has occurred. While it is doubtful that the tiny seeds of Allotropa can persist long in the soil, those that encounter the necessary mycorrhizal associate probably remain in a vegetative state for a certain amount of time before some critical size or vigor is reached at which flowering can occur.

Allotropa differs from typical clonal plants in that connections between ramets do not persist (Castellano, pers. comm.). Where the species existed on a site for along time, even widely separated individuals could be members of the same genet. The only way to estimate the number of genets in a population (related to rate of seedling establishment and genetic variation) would be through genetic studies. The number of genets that make up a population is an important indicator of genetic variation. The less variability there exists within a local population, the more populations needed to assure viability of the species (Huenneke et al. 1986).

MANAGEMENT IMPLICATIONS

Land managers on the Nez Perce NF, where Allotropa is most common, are currently faced with decisions that could impact the continued viability of large populations that exist there. It appears that timber production will continue to be a major land use in areas of Allotropa habitat. Now that more is known about the distribution and abundance of Allotropa on the Forest, management of the species should be incorporated into long-range Forest planning. More knowledge will be gained from observation of monitoring plots following logging of the Sibling timber sale area. The following points regarding the ecology of Allotropa seem to be particularly pertinent to planning for its preservation:

- On the Nez Perce NF, Allotropa is unusually specific to a particular and limited type of habitat generally (although not exclusively) defined by:
  a) mature stands of lodgepole pine with only sparse regeneration of climax conifers and an understory of beargrass and grouse whortleberry or huckleberry.
  b) the drier aspects of south-trending ridges, at elevations between 5000 and 7000 ft, and
  c) well-drained, shallow, granitic soils.

  This relatively narrow environmental amplitude does not mean that other stand types should not be carefully surveyed for Allotropa. It does mean that any drastic reduction in the abundance or continuity of this habitat can be expected to reduce abundance of the species and possibly alter gene flow among local populations. Because subpopulations are small, they represent relatively little of the genetic variation of the species. The possibility for genetic recombination when pollen is shared between subpopulations is important to the survival of rare species (Huenneke 1986).

  In terms of conservation priorities, the focus should be on maintaining areas of extensive habitat linking numerous subpopulations, such as those occurring primarily on the Red River RD. Such metapopulations (groups of interacting subpopulations, Murphy et al. 1990) probably harbor a large amount of genetic variation and are buffered against extinction resulting from natural fluctuations in numbers.

- Occurrence of Allotropa appears to be tied not just to a particular habitat, but often to lodgepole pine specifically. Because Allotropa cannot exist without a conifer associate, any activity that entails the loss of trees can be expected to kill associated plants, reduce the total amount of habitat available for colonization, and possibly isolate nearby populations. Results from monitoring plots will give us more insight into the effects of clearcutting on plants in adjacent, uncut stands.

- While Allotropa is quite common in some of the drainages south of the Red River, populations become scarcer and smaller as you move away from this area. It is likely that small, local colonies die out regularly and the sites are subsequently recolonized by seed from others nearby. This is evidenced by three new sites in the Elk City District where no flowering had occurred in 1991; at two of these we found evidence of only a single plant. The Red River RD continues to be the center of Allotropa abundance in the disjunct range of the species.

- Since Allotropa can exist on a site without flowering or bolting in a given year, a single-year clearance survey is not an accurate evaluation of the species' abundance or even existence on the site.

RECOMMENDATIONS

Based on current knowledge of the distribution and abundance of Allotropa, and on our observations of the plant and its habitat, we recommend the following measures be taken in the interest of protecting this regionally rare plant species:

- Maintain Allotropa as a Sensitive Plant Species in Regions 1 and 4. We feel this designation is warranted due to the species' restricted distribution and the likelihood of continued habitat loss from logging. Unless more populations are found in wilderness areas, the Red River Ranger District will remain the center of distribution of Allotropa in its disjunct range.

- Develop a management plan for Allotropa to give managers guidelines for making decisions about impacts to the species and its habitat.

- Continue yearly monitoring of plots established in the Sibling timber sale area. Coordinate with crews to avoid removal, during logging operations, of posts marking the plots. Future data collection should include ECODATA Forms GF and LL for more complete physical site descriptions and tree data.

- Consider expanding the experiment to one of the other large populations overlapping a timber sale area (e.g., Jack Creek sale) or possibly to another Forest.

- Keep all field personnel informed about sensitive species and forms available for recording sightings.

- Expand survey into Moose Creek Ranger District and other wilderness areas, using aerial photos to locate likely habitat.

- Minimize impacts of logging, road building and trail work on Allotropa populations. Impacts of projects should be evaluated not simply on how many plants are directly affected, but on how much habitat would be lost and/or fragmented.

- Examine large-scale patterns of Allotropa distribution and of lodgepole/beargrass habitat to identify important corridors linking population centers.

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