CHRIST'S PAINTBRUSH MONITORING ON THE SAWTOOTH NATIONAL FOREST: THIRD-YEAR RESULTS

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ABSTRACT

Christ's paintbrush (*Castilleja christii*) is Idaho's rarest plant, consisting of a single population on Mount Harrison at the north end of the Albion Mountains, Cassia County. Due to its extreme rarity and the numerous disturbances that take place on the summit plateau of Mount Harrison, a Conservation Agreement was signed between the Sawtooth National Forest and the U.S. Fish and Wildlife Service that specifies conservation actions that will be implemented to protect habitat for Christ's paintbrush, including establishing a monitoring program to assess impacts to the population associated with recreational uses. The monitoring program was established by the Idaho Department of Fish and Game's Conservation Data Center in 1995 (Moseley 1996) and resampled in 1996 (Moseley 1997).

The objectives for 1997 were to: (1) continue to collect density and frequency data for Christ's paintbrush at the 20 transects established in 1995 and (2) continue monitoring habitat recovery where a buried electronic cable was laid through a small portion of paintbrush habitat in late 1995. Results of the 1997 population monitoring show that the total number of plants and stems increased for the second year, but in only three transects was that increase statistically significant for plant density. Seven transects showed significant increases in stem production. Population and habitat recovery monitoring should continue annually for at least two more years to assure that some annual variability in the population is accounted for in any management recommendations generated from this long-term monitoring program.

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INTRODUCTION

Christ's paintbrush (*Castilleja christii*) is Idaho's rarest plant, consisting of a single population, covering approximately 200 acres on Mount Harrison, the highest peak at the north end of the Albion Mountains, Cassia County. More precisely, the southern limit of the population begins approximately 250 feet north of the lookout and continues north for approximately 0.75 mile. The east-west extent of the population is somewhat over one mile in width. The population is entirely on public land, managed by the Burley Ranger District of the Sawtooth National Forest (NF). See Moseley (1993) for more information on the distribution, abundance, and conservation status of Christ's paintbrush.

Due to its extreme rarity and the numerous disturbances that take place on the summit plateau of Mount Harrison, a Conservation Agreement was signed between the Sawtooth NF and the U.S. Fish and Wildlife Service that specifies conservation actions to be implemented to protect habitat for Christ's paintbrush (U.S. Fish and Wildlife Service 1995). One of the proposed conservation actions under this agreement (VI.A.14) states that the Forest Service shall:

> Establish a monitoring program in 1995 for Christ's paintbrush. A primary objective of this program should be to monitor impacts to the Christ's paintbrush population associated with recreational uses. As part of the monitoring schedule, conduct inventories of existing habitat to determine if the population is expanding or contracting. Accommodate needed changes if monitoring determines that deleterious impacts are taking place. Monitoring will be conducted on an annual basis for at least the first five years of this agreement.

A rigorous monitoring program will help separate the "signal" of a long-term population fluctuation from the "noise" of inherent, short-term variability. A non-rigorous program will not separate the noise from the signal. Another conservation action related to this states (VI.A.15):

> Delimit Christ's paintbrush populations on a large scale map by the three community types present. Monitoring plots should be established in each of these community types. Establish permanent photoplots; photos will be retaken each year and evaluated for apparent changes in density or distribution of *Castilleja christii*.

To fulfill these requirements, the Forest Service retained the services the Idaho Department of Fish and Game's Conservation Data Center (CDC) in 1995 to establish permanent monitoring transects. A comparison of results of the population monitoring between 1995 and 1996 showed that the total number of plants and stems increased in 1996, but in only one transect was that increase statistically significant for plant density. Three transects showed significant increases in stem production (Moseley 1997). See my earlier reports for a summary of the 1995 and 1996 results (Moseley 1996; 1997).

Similar to last year, the two objectives for 1997 were:

1. Population monitoring - For the third year, continue to collect density and frequency data for Christ's paintbrush at the 20 transects established in 1995.

2. Electronic Line Habitat Recovery - For the second year, continue monitoring habitat recovery where a buried electronic cable was laid through a small portion of paintbrush habitat in late 1995.

POPULATION MONITORING

Refer to Moseley (1996) for a detailed discussion of methods for transect establishment, population sampling, photo points, and ecological sampling. Also, the locations of the transects and monuments are mapped in that report. A brief summary of the methods follows:

Twenty permanently-marked transects were established in the habitat of Christ's paintbrush. The transects were 20 meters long and the beginning and ending points were marked with rebar. An objective was to place plots in each of the three habitats identified by Moseley (1993): graminoid, snowbed, and *Artemisia tridentata vaseyana/Festuca idahoensis*. Seven monuments were established to aid in relocation of the 20 transects.

The 20 meter-long transect was divided into 20 one-meter-square "stations" or plots, forming what is actually a continuous one-meter-wide belt transect. In each station, I recorded: (1) the number of Christ's paintbrush plants, and (2) the number of stems (sterile and reproductive were combined) for each plant. I used the number of stems as a surrogate for above-ground production and, to a lesser degree, fecundity.

In 1995 only, ecological data were collected for Christ's paintbrush habitat at each transect. A 10 x 10 m macroplot was established, with one corner of the plot the same point as the beginning of the transect. Data collected in each plot include location, environmental features and general site description, as well as the estimated cover for every plant species in the plot.

In 1995 only, two photos were taken at each transect. One photo was taken down the belt from just behind the beginning stake. Another photo was taken of the ecological plot.

During early August 1997, the population data were sampled at the transects. Moseley (1993) recommended that population data be sampled annually for at least five years and the habitat data and photo points be sampled every five years.

The population data for the three years of monitoring were entered into Lotus 1-2-3 and summary statistics were produced (averages and standard deviations) for the data. Also, mean plant density and stem values for 1995 - 1997 and for 1996 - 1997 were tested for significant differences using a Student's t-test.

1997 Population Data

Table 1 shows the population data and Table 2 the stem data for Christ's paintbrush in the 20 transects during 1995 - 1997. Some important points to recognize in these data are as follows:

- The total number of plants recorded in the 20 transects increased over the three-year period by 645 plants, from 1,750 in 1995 to 2,395 in 1997.

- There was a corresponding increase in average plant density from 4.4 plants/m^2 in 1995 to 6.0 plants/m^2 in 1997.

- Because of the great variability in plant density (as expressed by the standard deviation), the population increase mentioned above was significant (at the 90% or 95% confidence levels) in only three transects in 1997, transects 7, 8, and 12. Two of these significant differences were between 1995 -1997, while only one was between 1996 - 1997 levels. There was also a significant increase in transect 15 from 1995 - 1996 (Moseley 1997). I infer from this that most of the increase took place between 1995 - 1996 and the population stabilized somewhat from 1996 - 1997.

- The total number of stems in the 20 transects increased by 2,421 from 1995 - 1996 and by 4,356 from 1996 - 1997. Correspondingly, the average stems/plant has increased through the three-year monitoring period. This increase in above-ground productivity was significant in seven transects and was especially apparent between 1995 - 1997, less so between 1996 - 1997.

- Most of the transects that had significant increases in plant density and stem production in 1996 (Moseley 1997) and 1997 were from the snowbed community (three of four transects for density and six of eight for stems). This community type represents habitats that are under late-lying snowbanks and the Christ's paintbrush plants may be responding to differences in snow depth and/or timing of release from year to year.

The 1997 field data forms for each transect are contained in Appendix 1. Data forms from 1995 and 1996 can be found in appendices in Moseley (1996) and Moseley (1997), respectively. These data are also in a Lotus 1-2-3 file at the CDC office in Boise. All original forms, maps, slides, and other information related to this monitoring project are in the *Plant and Community Monitoring File* at the CDC office.

Table 1

Table 2.

ELECTRONIC LINE HABITAT RECOVERY

An old buried electric cable that services several electronic sites on Point 9033, about one mile north of Mount Harrison, traverses a considerable amount of the Christ's paintbrush population. The cable was buried at least 20 years ago (possibly more). There has been a subsequent recovery of the habitat to the point where the location of the cable is hardly discernable on the ground (although it is visible on air photos). Both Christ's paintbrush and the other endemic to the Albion Mountains, Davis' wave-wing (*Cymopterus davisii*), have reestablished on the old line.

This cable out-lived its excepted life span and has been causing problems with delivering power to the sites. In 1995, Raft River Electric proposed replacing the cable. Instead of following the old route and disturbing considerable habitat, they wanted to follow a new route and cut below most of the paintbrush population. In August 1995, Pete Peterson and Howard Hudak, Sawtooth NF, a representative from Raft River Electric, and myself surveyed a new route that minimized the impact to Christ's paintbrush. The route selected traversed only a few meters of occupied habitat. The cable was buried along the new route late in the 1995 season. Burying the cable created a two-meter-wide swath of bare ground.

In 1996 I established a permanent transect that can be used to monitor habitat recovery along the part of the route that traverses occupied and suitable-appearing habitat. The transect starts (O m) at the base of the road fill where the line crosses beneath the road bed and heads west across the slope (see Moseley 1997 for a map of the transect location). I started the transect at a red fiberglass post in 1996, although beginning the transect at the base of the road fill in the middle of the bare-ground swath will suffice if the post is missing. The transect is 325 m long, with a 1 m^2 plot placed every 25 m. Plots were placed directly over the depression where the cable was buried, which generally lies in the center of the two-meter-wide swath of bare ground. The first plot was put in at 25 m. A photograph was taken of each plot in 1996; none were taken in 1997. I estimated the percent cover for every plant species in the plot using the midpoint of 12 cover classes, as follows:

1 = <1%	50 = 45 - 54.9%
3 = 1- 4.9%	60 = 55 - 64.9%
10 = 5 - 14.9%	70 = 65 - 74.9%
20 = 15 - 24.9%	80 = 75 - 84.9%
30 = 25 - 34.9%	90 = 85 - 94.9%
40 = 35 - 44.9%	98 = 95 - 100%

Table 3 contains cover data for the 13 plots along the transect. Plant cover was very low in the first year following disturbance, with bare soil accounting for most of the cover of each plot. Twenty species were recorded along the transect that year and only six species had more than trace cover (Moseley 1997). Twenty-nine species were present in the plots in 1997, with three

Table 3. Cover of species along the Electronic Line Habitat Recovery Transect in 1997. Blanks indicate that the species does not occur at that station.

	Station (Plot) Along Transect												
Species	25	50	75	100	125	150	175	200	225	250	275	300	325
Abies lasiocarpa													1
Achillea millefolium	1	1	1	1	10	1	1	1	1	3	1	1	1
Agoseris glauca			1			1	1		1	1			
Agropyron trachycaulum								1					
Agrostis variabilis											1		
Allium brandegei			1										
Artemisia ludoviciana	1		1		10	1	1	1					
Aster integrifolius			1										
Bromus inermis					30								
Chenopodium fremontii					1				1				
Cymopterus davisii						1		1					
Epilobium alpinum			1										
Erigeron peregrinus				1	3			1			1	1	1
Eriophorum lanatum	1			1		1	1		1	1			
Gayophytum racemosum								1				1	
Lewisia pygmaea											1	1	
Ligusticum tenuifolium			1			1		1				1	1
Lupinus argenteus						1	1	1	1	1	1	1	
Microsteris gracilis				1	1	1	1		1	1			
Poa (?) sp.		1									1		
Penstemon rydbergii						1			1	30			

Table 3 continued.

	Station (Plot) Along Transect												
Species	25	50	75	100	125	150	175	200	225	250	275	300	325
Polygonum douglasii	3	3	1	40	10	20	60	1	1	1	1	1	1
Polygonum kelloggii		1	1										
Rumex paucifolius		1									1		
Solidago multiradiata							3	1	1	10			1
Spergularia rubra	1	1	1	1		1	3		1				1
Spraguea umbellata		1		1		1	1			1	1		1
Stellaria jamesiana				1	1			1	1				1
Trisetum spicatum										1	1		
Bare Ground	90	90	90	80	20	80	70	90	80	50	90	98	98
Litter					20								

of the 1996 species not appearing in 1997. This represents a total immigration of 12 new species into the plots during the two years of monitoring. No Christ's paintbrush was observed in the disturbed area in 1996 or 1997. In 1997, there was substantially more plant cover along the transect than 1996, although bare ground values were still high. Most of the plant cover consisted of species that had seeded into the disturbed swath over the last couple of years, including *Cymopterus davisii* (which set fruit both years!), some *Achillea millefolium*, *Spraguea umbellata*, *Lupinus argenteus*, *Microsteris gracilis*, *Polygonum douglasii*, and possibly *Lewisia pygmaea* and *Agoseris glauca*. Species whose stems, rhizomes, or roots persisted in the swath following the disturbance contributed high cover to certain plots. Examples of persistent species include *Penstemon rydbergii*, *Erigeron peregrinus*, *Solidago multiradiata* and *Bromus inermis*. Of special note are the five seedlings of subalpine fir (*Abies lasiocarpa*) in the last station along the transect (325 m). This plot is within a few meters of a tree island.

Data forms for plots along this transect are contained in Appendix 2.

RECOMMENDATIONS

1. *Population Monitoring* - Remeasure population data annually for at least five years, through the 1999 growing season, as specified in the Conservation Agreement. This will assure that some annual variability in the population is accounted for in any management recommendations generated from this monitoring program. After the fifth year, the program should be evaluated to determine if a less-than-annual sampling frequency is warranted.

2. *Electronic Line Habitat Recovery Monitoring* - The Electronic Line Habitat Recovery Transect should also be sampled annually through 1999. The determination of a sampling frequency beyond 1999 should probably be the same as for the population monitoring.

3. *Habitat Monitoring and Photo Points* - As I recommended after the 1995 season (Moseley 1996), methods employed for vegetation monitoring at the 20 transects will detect habitat change at a lower resolution than those employed for population monitoring. Therefore, the ecological plots should be sampled every five years, in this case 1999. Similarly, the photo points should be retaken every five years instead of annually, as recommended in the Conservation Agreement.

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REFERENCES

Moseley, R.K. 1993. The status and distribution of Christ's Indian paintbrush (*Castilleja christii*) and Davis' wavewing (*Cymopterus davisii*) in the Albion Mountains, Sawtooth National Forest and City of Rocks National Reserve. Unpublished report on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID. 18 p., plus appendices.

Moseley, R.K. 1996. Christ's Indian paintbrush (*Castilleja christii*) monitoring on the Sawtooth National Forest: Transect establishment and baseline data. Unpublished report on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID. 16 p., plus appendices.

Moseley, R.K. 1997. Christ's Indian paintbrush (*Castilleja christii*) monitoring on the Sawtooth National Forest: Second-year results. Unpublished report on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID. 8 p., plus appendices.

U.S. Fish and Wildlife Service. 1995. Conservation Agreement: *Castilleja christii*/Christ's Indian paintbrush. Unpublished document on file at the Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.

Appendix 1

Copies of field sheets with 1997 *Castilleja christii* population data.

Appendix 2

Copies of field sheets with 1997 species cover data for the
Electronic Line Habitat Recovery Transect.

Table 1. Population data for Christ's paintbrush in 20 permanently-marked transects, recorded in 1995, 1996, and 1997. Number in parentheses denotes ± 1 standard deviation. Significance probabilities -- 1995 to 1997 differences: * = significant at P < 0.1; ** = significant at P < 0.05. 1996 to 1997 differences: none significant. Community types are: G = graminoid; S = snowbed; A = sagebrush/Idaho fescue.

Transect	Community Type	Total Plants			Plant Density (sd)		
		1995	1996	1997	1995	1996	1997
1	G	122	129	168	6.1 (5.1)	6.5 (6.0)	8.4 (6.4)
2	A	21	21	23	1.1 (2.2)	1.1 (2.4)	1.2 (2.2)
3	A	26	36	38	1.3 (1.6)	1.8 (2.5)	1.9 (3.0)
4	S	64	90	129	3.2 (4.4)	4.5 (6.6)	6.4 (8.0)
5	S	36	55	69	1.8 (1.5)	2.8 (2.1)	3.5 (2.3)
6	G	174	193	195	8.7 (5.0)	9.7 (5.6)	9.8 (5.3)
7	S	143	165	190	7.2 (3.8)	8.3 (3.9)	9.5 (4.3)*
8	A	12	21	43	0.6 (0.9)	1.1 (1.4)	2.2 (3.4)**
9	A	49	39	55	2.5 (4.4)	2.0 (4.2)	2.8 (4.3)
10	A	10	7	11	0.5 (1.1)	0.4 (0.8)	0.6 (1.2)
11	A	8	11	15	0.4 (0.7)	0.6 (1.1)	0.5 (1.3)
12	S	46	54	108	2.3 (3.1)	2.7(2.4)	5.4 (5.7)**
13	G	178	206	249	9.2 (6.5)	10.3 (7.1)	12.5 (7.0)
14	S	148	178	182	7.4 (6.4)	8.9 (8.3)	9.4 (6.7)
15	S	222	384	317	11.1 (4.7)	19.2 (9.7)	15.1 (7.1)
16	S	38	27	40	1.9 (2.5)	1.4 (2.1)	2.0 (2.4)
17	G	78	88	86	3.9 (3.1)	4.4 (3.6)	4.3 (3.3)
18	G	192	181	218	9.6 (6.9)	9.1 (7.9)	10.9 (10.1)
19	A	12	13	13	0.6 (1.3)	0.7 (0.9)	0.7 (1.3)
20	S	171	219	246	8.6 (8.2)	11.0 (7.3)	12.3 (8.5)
Total		1,750	2,117	2,395	--------	---------	--------
Average		87.9	105.9	119.8	4.4	5.3	6.0
(sd)		(70.9)	(96.4)	(91.8)	(3.6)	(4.8)	(4.5)
Range		8 - 222	7 - 384	11 - 317	0.6 - 11.1	0.4 - 19.2	0.5 - 15.1

Table 2. Stem data for Christ's paintbrush in 20 permanently-marked transects, recorded in 1995, 1996, and 1997. Number in parentheses denotes ± 1 standard deviation. Significance probabilities -- 1995 to 1997 differences: * = significant at P < 0.1; ** = significant at P < 0.05. 1996 to 1997 differences: ^ = significant at P < 0.1; ^^ = significant at P < 0.05.

Transect	Total Stems			Average Stems/Plant (sd)		
	1995	1996	1997	1995	1996	1997
1	629	735	982	5.2 (3.6)	5.7 (4.1)	5.8 (3.9)
2	115	112	152	5.5 (4.2)	5.3 (3.1)	6.6 (4.1)
3	151	221	223	5.8 (3.1)	6.1 (3.3)	5.9 (3.5)
4	261	435	963	4.1 (1.9)	4.8 (2.4)	7.5 (5. 9)**^^
5	145	290	503	4.0 (2.2)	5.3 (4.1)	7.3 (4.6)**
6	935	1,199	1,067	5.3 (3.9)	6.2 (4.3)	5.8 (3.8)
7	922	1,082	1,352	6.4 (5.3)	6.6 (5.2)	7.1 (5.9)
8	54	86	153	4.5 (2.4)	4.1 (2.3)	3.6 (2.8)
9	167	142	144	3.4 (2.2)	3.6 (2.1)	2.6 (2.0)
10	30	30	36	3.0 (1.6)	4.3 (1.7)	3.3 (1.8)
11	52	52	111	6.5 (3.5)	4.7 (1.9)	7.4 (5.8)
12	223	233	623	4.8 (3.1)	4.3 (2.6)	5.8 (4.2)**^
13	1,063	1,073	1,849	6.0 (6.4)	5.2 (3.6)	7.4 (6.5)**^
14	800	944	1,220	5.4 (4.4)	5.3 (3.6)	6.7 (4.4)**^
15	1,046	2,119	2,440	4.7 (3.0)	5.5 (4.3)	7.7 (5.4)
16	262	218	268	6.9 (6.4)	8.1 (6.4)	6.7 (5.0)
17	360	479	464	4.6 (2.7)	5.4 (3.9)	5.4 (3.6)
18	922	862	1,284	4.8 (3.6)	4.8 (3.4)	5.9 (4.1)^^
19	56	91	66	4.7 (4.8)	7.0 (4.1)	5.1 (2.1)
20	773	1,434	1,834	4.5 (3.1)	6.5 (4.8)	7.5 (5.5)**
Total	8,966	11,387	15,734	--------	---------	--------
Average (sd)	448.3 (375)	591.9 (556)	786.7 (686)	5.0 (1.0)	5.4 (1.1)	6.1 (1.4)