INITIATION OF LONG-TERM POPULATION MONITORING OF PACIFIC DOGWOOD,*CORNUS NUTTALLII*, ON THE CLEARWATER AND NEZ PERCE NATIONAL FORESTS

by

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ABSTRACT

Pacific dogwood (Cornus nuttallii) is a small, often shrub-like tree that occurs in only one location in Idaho, at the confluence of the Lochsa and Selway Rivers on the Clearwater and Nez Perce National Forests. This is the only location of the species outside its main range west of the Cascade/Sierra crest. The population has suffered severe decline over the past 20 years to the extent that it may now be subject to local extinction due to disease, low numbers, and lack of reproduction. The cause of the decline has tentatively been identified as one or more fungal root diseases (Bertagnoli and Partridge 1990). Because of its biological significance, limited distribution, and the threat of disease, Pacific dogwood is designated a US Forest Service Region 1 Sensitive Species.

In response to the decline of the Idaho population of Pacific dogwood a comprehensive conservation strategy was initiated in 1990 by the Clearwater and Nez Perce National Forests and the Idaho Conservation Data Center. This report documents one aspect of that strategy: the establishment of permanent plots for long-term demographic monitoring. Twenty-one, tenth-acre plots where established which can be used to gather data on life history traits of the species. Methods used to obtain community and baseline demographic data are documented. Maps show locations of permanent plots.

In the first year of the study all live Pacific dogwood trees in the plots were mapped and numbered, and live stems greater than 1/4-inch basal diameter were measured and tagged so their growth and survival can be followed. Data on reproductive output could not be obtained because trees did not flower in 1991. Plant community composition at monitoring sites was recorded using ECODATA methods (USDA Forest Service 1991). Observations were made on the health and disease symptoms and growth habits of the trees. Baseline demographic data are presented and discussed. Survey of the population indicates it is still in decline, is not reproducing, and exhibits a variety of disease symptoms, although basal sprouting was vigorous and the new sprouts appeared healthy.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

Pacific dogwood, Cornus nuttallii, was at one time the most highly visible example of a host of coastal disjunct species occurring in central Idaho. Pacific dogwood is a small tree that occurs, in Idaho, only along the lower Lochsa and Selway rivers within 20 miles of their confluence, but is widespread west of the Cascade Mountains. Pacific dogwood is a US Forest Service sensitive species in Region 1 due to the small size of the population in a single locality, the serious threat of disease, and the potential value of the isolated gene pool. Most of the Idaho population occurs on Forest Service land administered by the Clearwater and Nez Perce National Forests. Some trees occur on private inholdings at Lowell and along the Selway River.

Severe decline of the population was noted in 1987 and documented shortly thereafter in research conducted by Johnson (1988). Root disease was later implicated as the primary cause of mortality (Bertagnoli and Partridge 1990). In response, a conservation plan was developed to assess trends in the population and to see what could be done to save it (Lorain 1991a). This report documents one aspect of the conservation plan: the establishment of permanent monitoring plots for acquiring demographic data on Pacific dogwood.

Demography is the study of population changes and their causes through time. Population attributes such as birth and death rates, growth, size, density, and distribution are some of the characteristics measured. These characteristics determine local abundance and persistence through time--parameters central to all conservation efforts (Pavlik and Barbour 1988). The demographic approach attempts to understand the natural dynamics of the population and to determine what factors control abundance and distribution of a species. Demographic monitoring studies also generate data that can be used to predict the future size and age structure of a population.

Demographic monitoring of rare plant species has become increasingly important as the efforts of natural resource agencies have evolved from an emphasis on inventory and status determination of rare species to active protection efforts.

To better understand the biology of Pacific dogwood,

long-term community and demographic monitoring of the population was deemed necessary. The primary objective of this study is to acquire data on life history, growth, and population trends over time. After three consecutive years of data has been collected, modeling techniques will be used to determine the probability of extinction of the population and minimum viable population levels.

DESCRIPTION

Pacific dogwood is a lovely, graceful, single to multiple-stemmed native tree growing to over 50 ft in its coastal range, but usually much less than 30 ft in Idaho. It flowers in early spring before leaves emerge. Inconspicuous flowers are arranged in a compact, capitate inflorescence subtended by 4-7 showy white bracts (Appendix I). The flowering display of white bracts on naked branches rivals the beauty of its relative, the eastern flowering dogwood. Clusters of single-seeded, berry-like fruits (drupes) are bright red by fall. Leaf arrangement is strictly opposite; the typical dogwood leaves are prominently veined, pale beneath and bright green above. They turn brilliant red in fall.

On exposed sites, Pacific dogwood tends to be multiple-stemmed and shrubby. One stem may be larger than the rest but there is no single dominant stem as under shaded conditions where the species takes on a more typical tree form (Roper 1970). Stems arise from a root crown very near the surface, or from the base of other stems. Lochsa trees are particularly shrubby in aspect due to vigorous sprouting from the base. Branches that are pressed to the ground can root at the nodes when covered with soil.

The most useful characteristic in recognizing both dead and living Pacific dogwood trees is the unique arrangement of the branches, with two pairs of opposite branches arising from nearly the same point on the trunk in an apparent whorled arrangement.

There are only two species that can be confused with Pacific dogwood in its Idaho range. Red osier dogwood (Cornus stolonifera) is a common riparian shrub overlapping somewhat in habitat with Pacific dogwood. It can take on the habit of a small tree and has leaves very similar to those of Pacific dogwood. Flowering or fruiting

plants are easily distinguished by the loose, globose cymes with no subtending bracts. In non-flowering plants, look for arching branches that arise strictly two per node. Older stems of red osier dogwood are usually deep red and arise many from the base, however, away from streambanks these characters are much less pronounced.

Cascara (Rhamnus purshiana) is another sympatric tree-like shrub that can be mistaken for Pacific dogwood when either alive or dead. Closer examination shows that its branching pattern and leaf arrangement are not strictly opposite.

TAXONOMY

Cornus is the type genus of the dogwood family, Cornaceae, and includes about 30 species worldwide, of which only three are trees, two native to North America. Pacific dogwood's closest relative is the eastern flowering dogwood, Cornus florida, which is best represented in the southeastern US. These two trees, along with the trailing subshrub bunchberry dogwood (C. canadensis) belong to a line of dogwoods distinguished by red fruits and flowers with basal bracts. Although a native species, eastern flowering dogwood is known primarily as a highly prized ornamental and as such has been the subject of much breeding and research. There is presently a great deal of concern over the devastation of eastern flowering dogwood over much of its range by a fungal root disease called dogwood anthracnose. In contrast, there is very little literature on Pacific dogwood.

Pacific dogwood is thought to represent further evolution of the Cornus florida line. Its larger flowers with more numerous bracts and its taller stature are derived characters that may have arisen during its adaptation to climatic changes in the Pacific Northwest during the late Pliocene (Eyde 1988). Pacific dogwood was one of many northwestern forest species that adapted to the dry-summer climate resulting from these climatic changes (Wolfe 1969).

BACKGROUND

This disjunct population of Pacific dogwood is thought to be a remnant of preglacial conditions under which the species enjoyed a much wider distribution, and to persist in the Lochsa/Selway canyons due to the combination of abundant moisture with temperatures moderate for this region (Daubenmire 1956). Much of what we know about Pacific dogwood in its disjunct range is through the work of Roper (1970) who mapped and studied this population prior to its drastic decline. Roper described a stable population very different from that which now exists and his study supplies us with valuable baseline information with which to compare existing conditions. He observed no unusual mortality or blatant disease symptoms in the population.

Pacific dogwood is well adapted for a role in secondary succession following disturbance because the loss of aerial growth through burning, cutting, or defoliation with herbicide stimulates resprouting from the root crown. Several stems develop concurrently in open conditions of early succession, but as crown cover closes, most of these die and a dominant main stem develops, resulting in a much more tree-like habit in late-successional stages (Roper, 1970).

In studying the successional status of Pacific dogwood, Roper found that tree density, coverage, crown diameter, tree height, and number of stems per plant were all related to the seral position of the stand. Tree density was highest in mid-successional stages and tailed off as communities approached climax. Density again increased in near-clmax stands due to seedling establishment which was observed almost exclusively under closed canopy. While flowering and fruit production were most pronounced in open environments, seedling establishment seemed to require heavy shade. Roper concluded that in the Idaho population Pacific dogwood forms the dominant tall shrub layer of a climax western redcedar habitat type in which sword fern dominates the herb layer. He further proposed that Pacific dogwood might accelerate succession by supplying early cover to moderate a site and allow the return of mesic understory species

For several years prior to 1988 reports circulated that an unusually high rate of mortality was occurring in the Pacific dogwood population along the Lochsa River. This

was confirmed by Fred Johnson in 1988 who also observed severe die-back of branches on living plants. This led to a survey by Johnson in the fall of 1988 in which he mapped the extent of the population and used line transects to sample 16 selected stands.

By the time of Johnson's study, Pacific dogwood numbers along the Middle Fork Clearwater River were insufficient to warrant sampling. The most extensive subpopulations still occurred along the Lochsa River. Mortality of trees in the Selway River drainage, while severe, appeared to be lower than in the Lochsa. Only two seedlings were found, in contrast to observations of numerous seedlings in previous years. Of the 460 plants counted in transects, 98% were either dead or appeared to be affected by an unknown ailment. No resistant plants were found.

Among the recommendations resulting from Johnson's study were:

- to collect seed from the Idaho population for preservation at long-term storage facilities,
- to investigate the pathogen(s) responsible for the population decline,
- to search for resistant plants both in Idaho and in the main, west coast range and
- to monitor presently known stands with permanent plots.

Seed were collected by Lorain in fall of 1990 and sent to the the Berry Botanical Garden in Portland, Oregon for tests and long-term storage (Lorain 1990).

Pathogens isolated from the population have been reported by Bertagnolli and Partridge (1990). They found several root diseases affecting the trees, as well as stem canker and symptoms of leaf disease. Root disease appeared to be the most likely cause of observed mortality. Their report suggests that disease in the population may have been exacerbated by drought or by increased competition resulting from natural succession. However they suggested that crown closure might favor growth of the species.

THE STUDY AREA

Physiography and soils: The study encompasses most of range of Pacific dogwood in north-central Idaho, extending

along the lower Lochsa and Selway Rivers for 15 miles upstream of their confluence (Fig. 1). The species occurs sporadically in the river canyons and steep breaklands of their lower tributaries, particularly on south-facing mid to lower slopes in the main canyons. The area is one of steep, dissected mountain slopes cut by narrow river canyons and steeply graded streams. Relief of several thousand feet is common. Elevations at which Pacific dogwood is found range from 1600 ft at river level to 2800 ft. Metamorphic bedrock of gneiss and quartzite outcrops through much of the area.

Soils of canyon slopes are colluvial, weakly developed and vary widely in properties. Andepts and Andic Dystrochrepts occur on northerly aspects with Andic Dystrochrepts, Typic Dystrochrepts, Xerochrepts, and Xerorthents occurring on southerly slopes (Wilson et al. 1983). Pacific dogwood also occurs on benches along the rivers on gravelly, well-drained substrates.

Vegetation: Western redcedar (Thuja plicata) habitat types occur on north-facing slopes and lower slopes and benches near valley bottoms. Moving upslope, forest cover on south aspects changes rather abruptly to grand fir or ponderosa pine. Climax stands are rare due the fire history of the area. Habitat types in which Pacific dogwood occurs include:

- Thuja plicata/Adiantum pedatum (western redcedar/maidenhair fern)
- T. plicata/Asarum caudatum (western redcedar/wild ginger)
- T. plicata/Clintonia uniflora (western redcedar/queencup beadlily)
- Abies grandis/Physocarpus malvaceus (Douglas-fir/ninebark)

Pacific dogwood can be found extending up into the ponderosa pine forest above the Selway River.

Extensive brushfields occupy south aspects above the Lochsa River. Brushfields show only spotty conifer regeneration and generally have a medium to tall shrub layer of oceanspray (Holodiscus discolor), cascara (Rhamnus purshiana), and serviceberry (Amelanchier alnifolia) and sometimes red-stemmed ceanothus (Ceanothus velutinus). The medium shrub layer is consistently dominated by bracken fern (Pteridium aquilinum). These

brushfields are the result of periodic wildfires that swept this area, most recently in 1934. Most of the habitat in which Pacific dogwood occurs has been affected by fire (US Forest Service records at Fenn and Kooskia ranger stations).

Figure 1

Climate: Lack of extreme winter temperatures is indicated by long-term means for December and January of 32 and 30 degrees respectively (Roper 1970). Precipitation averages 34 inches (85 cm) annually, most of this occurring during winter and spring. Hot, dry summers contribute to the frequency with which wildfires occur. A local climate of abundant moisture and relatively moderate temperates, thought to result from a unique combination of elevation, physiography and maritime influences, has been proposed to explain the occurence of Pacific dogwood and other local endemics of the area (Daubenmire 1956).

Management: Most of the Idaho range of Pacific dogwood is restricted to lands owned by the US Forest Service. Land along the Selway River is under jurisdiction of the Nez Perce NF, and along the Lochsa, the Clearwater NF. All sections of the river where Pacific dogwood occurs are classified as wild and scenic and subject to special management considerations primarily related to aesthetic values. In 1977 the Lochsa Research Natural Area was established, in part to encompass a portion of the distribution of Pacific dogwood (Appendix III, Map B). The river canyons are managed primarily for recreation and wildlife. Logging roads, both old and in planning, link main roads along the two rivers, Highway 12 and the Selway River Rd., with nearby timber sales.

METHODS

Methodology used in the study was specified in the Study Plan (Lorain 1991b). Only minor deviations from this plan were necessary and these are mentioned as they arise.

Plot locations: In establishing plots, I attempted to represent the range of habitat types, successional stages, and topographic variation present in the population, beginning with the sites of Johnson's 16 original transects (Appendix II). If the precise transect site (marked with flagging) could not be located I tried to find a suitable location in the vicinity provided Pacific dogwood was still present. Where Johnson's transects could be relocated, plots were numbered the same as the transects. Additional plots were numbered consecutively beginning with #017. In two cases no living Pacific dogwood trees could be found in the vicinity of the transect. A total of 21 plots were eventually established, 10 at original transect locations (Table 1). Although

Johnson's sites were used, our 0.1-acre plots only include a small fraction of the trees sampled in his belt transects.

Community sampling: ECODATA methods (USDA Forest Service 1991) were used to describe plant communities associated with Pacific dogwood. ECODATA is a standard system that is well documented, accessible through the Forest Service database, and provides standardized sampling techniques used throughout Region 1. The basic sampling unit was a 0.1-acre circular plot (37-ft radius). The ECODATA General form (GF) and Location linkage (LL) were used to provide information about plot location, environmental features, and vegetation structure. Form PC, Plant Composition was used to record a complete species list with canopy cover classes and height classes. Forms GF and LL were slightly modified for our use by removing most of the optional fields (Appendix IV).

At each site, plots were subjectively located within a representative and uniform portion of the plant community in which Pacific dogwood was found. Our criteria required only one live Pacific dogwood plant, but in most cases it was easy to include at least three plants in the 0.1-acre plot. Three sites were not suited to circular plots so rectangular plots were used. Sizes and orientations of ECODATA plots used at these sites are shown in Appendix V.

Table 1

Plot center was marked with a steel fence post, painted red and inscribed with the 15-digit ECODATA Key ID number. Plots located in campsites or campgrounds were not marked with a post (Plots 012, 014, 018). The center of these plots can be located from a bearing tree marked with a metal sign.

At three sites Pacific dogwood occurred exclusively at the edge of forest canopy. Because the ECODATA plot could not overlap different communities, I either 1) placed the plot in the mature forest community because dead trees indicated that the species once existed here, and probably not in the adjacent open site (Plots 009 and 022) or 2) used a rectangular plot to sample within a narrow ecotonal zone (Appendix V).

In October a ground fire swept across slopes on the north side of the Selway affecting one of the plots (Slide Ck) and Pacific dogwood trees above the Fenn Boneyard and Rackliff Campground. I visited these sites immediately after the fire, marked some of the burned trees and put in Plot 027 which includes both severely burned and unburned trees.

Demographic sampling: The 0.1-acre ECODATA plot was also used as the sampling unit for gathering demographic data. All Pacific dogwood plants within the plot, both standing dead and living, were mapped by recording their azimuth and distance from plot center. A back-azimuth was taken while standing at the tree to avoid interference by the metal post. For multi-stemmed plants the distance was measured to the center of the cluster of stems.

Circular plots were used for all mapping of Pacific dogwood. Where rectangular ECODATA plots were used, the fence post marking the plot is the center post of the circular plot (see Appendix V). In a few cases where Pacific dogwood trees were sparse and only a couple occurred within the plot, nearby trees outside the perimeter were also mapped and measured.

In most cases it was easy to distinguish between genetic individuals (genets) because Pacific dogwood trees do not spread extensively. New stems originate from a root crown and stems tend to curve inward toward the crown at their bases.

Live genets were numbered and their individual stems (ramets) were tagged and measured. Initial reconnaissance indicated that many plants had an abundance of current year's, non-woody basal sprouts less than 1/4-inch diameter. Therefore a simple tally was taken of basal sprouts under 1/4 inch, distinguishing between woody and non-woody. Seedlings were treated as genets.

Each stem (ramet) greater than or equal to 1/4 inch basal diameter was numbered and tagged near the base with an aluminum tag bearing the plot number, genet number, and stem number. Dead stems were tallied. The following information was recorded on page 2 of the Demographic Data Form (Appendix VI):

For each live genet:
- genet number
- distance and azimuth from plot center
- number of fruiting inflorescences
- number of aborted inflorescences
- number of basal sprouts (green/woody)

For each ramet:
- height (feet)
- basal diameter (inches)
- health class (healthy, dead top, alive top, mixed)
- presence of stem sprouts
- ailments/symptoms
- shoot cankers
- leaf diseases
- insect damage

Explanations of health classes, ailments, codes used and data fields are given in Appendix VI. Notes were taken on the general appearance of the population and individual genets. Data on numbers of flowers, fruits, and seeds could not be collected because flowering was virtually absent in 1990.

Trees were not cored for aging for two reasons. First, since they have the ability to resprout following the death of stems, the plant's actual age cannot be deduced from the ages of stems. Secondly, I did not want to induce further stress on the few remaining trees in the population.

Basal sprouts, stems, and stem sprouts--a Cornus conundrum: It was necessary to make a distinction between "stems" and "branches" because stems were viewed as units of vegetative propagation that could replace dead or ailing stems, or survive them. Branches were viewed as units of the stem more fixed in number and arrangement, and dependent on the stem for survival. However, in the field it became apparent that there was almost a continuum between these two types of growth, with new sprouts arising anywhere along the length of a living stem.

For our purposes, basal sprouts (<1/4 inch) and stems had to be somewhat arbitrarily differentiated from stem sprouts and branches. Where basal sprouting was profuse, there was usually a flush of sprouts from a discrete zone near the base of a large living stem, just above the ground surface. Even sprouts arising from beneath the soil surface could usually be traced to their origin on a larger stem. Sprouts above this apparent "sprouting zone" were considered "stem sprouts". Stem sprouts usually consisted of only 1 or 2 leaf pairs on a short stem. In cases where it became difficult to distinguish stem sprouts from basal sprouts notes were made describing the situation.

Stem sprouts are new (current-year's) sprouts from the main stem as opposed to those coming from the root crown or branches. They can originate anywhere along the length of the stem but were only recorded when they occurred below the lowest pair of live branches. It was thought that production of these sprouts may be a response to death of upper portions of the plant. In some cases a single stem sprout was the only indication that a tree was still alive.

Similarly, a single stem arising from a larger stem above ground level was considered a branch, but if several live and dead stems arose at the same point low on the larger stem I considered these to be basal stems. Some large stems that appeared dead had a single living branch originating near the base, making the basal diameter rather misleading. The point of origin of new "stems" often appeared to be slightly elevated above the ground.

Health classes: Each ramet was given a health class ranking that reflects the proportion of dead branches on that stem. The health class does not consider leaf disease symptoms or stem canker which were noted separately (see Appendix VIII

for explanations of health classes and disease symptoms). Therefore, even though leaves were badly affected a ramet could get an "H2" health rating meaning that most of its branches were alive. No ramet > 0.3 inches was given an H1 rating (no dead branches or twigs).

RESULTS AND DISCUSSION

The population of Pacific dogwood occupying the canyons of Lochsa and Selway Rivers has continued the decline documented in Johnson's 1988 survey, at which time he concluded that over half of the original population had died. Although Roper's maps indicate that Pacific dogwood was continuous for long stretches paralleling the Lochsa, it is much more sporadic now.

Demographic sampling: As observed by Roper (1970), the growth habit of Pacific dogwood is dependent on the type of site on which it grows--primarily whether it is in forest understory or in the open. On exposed sites plants generally have a shrubby habit with multiple stems, some prostrate or decumbent, and vigorous basal sprouting (Fig. 2).

Basal sprouts were generally < 18 inches tall and herbaceous, apparently representing current-year production. They had very healthy stems and leaves compared to older stems and very little evidence of browsing was observed. Relatively few of the stems < 1/4 inch had a woody epidermis (5%, Table 2). These likely represented the previous year's sprouts and were frequently branched low as a result of browsing. Dead basal sprouts were difficult to assess because they broke off easily.

All of the largest stems of brushfield sites are long dead, have lost all their bark, and are in various stages of falling over. Occasionally a large stem is still alive at the base where it might support a sizable branch, which has become the new leader. For this reason some of the larger stems indicated in Figure 2 are actually old bases supporting much younger stems. Often, the old root crown, including several large dead stems, appears to have been abandoned in favor of a sprouting point near the bottom of one of the remaining stems. Even though most of the large old stems have died, the size distribution of stems is fairly even for stems > 0.6 inches basal diameter (Fig. 2). Dead stems are commonly > 4 inches basal diameter, in contrast to the low number of living stems that large.

The number of large dead stems that have already fallen over is so great that younger stems were characteristically found growing flattened to the ground on the downslope side having been pushed down by large

(4-7 inch) falling boles (note numbers of prostrate stems in Table 2). These prostrate and decumbent stems can layer (root at the nodes) when they become covered with soil. This was seldom observed although plenty of opportunity exists. These stems can have vigorous growth of leaves and of vertical branches that appear at first to be basal stems.

Age distribution: Although it is often dangerous to infer age from size, the relationship is probably better among the smaller size classes. The size distribution of stems (ramets) indicates initially high mortality, especially in the first year, and then a relatively low but constant mortality rate (Fig. 2). Again I should note that many of the largest stems are dead for most of their length.

The most troubling observation made of the population was the lack of seedlings and young trees, even though prolific flowering and fruit set took place the previous spring. Seedlings were found at three sites (006, 020, 021). Two of these sites were patchy stands of mixed young conifers where the seedlings were found growing under dense cover of bracken fern or thimbleberry--conditions that make them easy to overlook. The other site was a near-climax conifer stand, and the seedling was growing out of the bottom of an upturned stump. Like the labelled stems, these seedlings can now be followed to determine their fate.

Figure 2

Table 2. Baseline demographic data collected for Pacific dogwood in permanent monitoring plots, 1991[1].

Woody Plot	Live basal genets sprouts	Dead basal genets sprouts	Basal stems > 1/4 inch b.d. Total genets ramets sprouts	Ave. ht. (ft)	Ave. diam. (in)	Prostrate sprouts		Genets w/ Basal stems	
	#	#	#			#	#	#	#
CN003	4	0	19	5.0	0.7	6	31	0	3
CN004	5	1	25	5.5	1.1	4	5	8	3
CN006	12	1	72	5.5	0.7	17	124	2	8
CN009	7	0	30	5.0	0.7	2	13	1	4
CN010	9	4	34	6.8	1.0	9	72	3	7
CN011	5	3	7	9.0	1.3	1	61	0	4
CN012	20	16	35	9.0	1.2	0	300	0	19
CNO13	6	3	9	5.5	0.6	0	70	2	4
CN014	5	1	7	18.0	2.3	0	22	0	3
CN015	3	4	11	7.5	1.8	0	48	0	2
CN017	10	2	48	8.0	1.3	2	343	5	10
CN018	11	1	99	5.5	0.8	17	57	19	8
CN019	4	1	5	18.0	3.1	0	38	0	3
CN020	10	4	40	3.0	0.4	1	42	5	8
CN021	16	7	38	7.0	1.1	3	22	8	6
CN022	4	2	10	10.0	1.3	0	24	1	2
CN023	2	2	1	25.0	2.8	0	71	0	2
CN024	8	0	48	4.5	0.5	17	72	21	0
CN025	6	3	19	5.0	1.1	4	9	7	0
CN026	2	4	6	14.0	2.6	0	1	0	0
CN027	6	3	8	8.2	1.7	0	28	0	2
Totals	155	62	571	185.0	28.1	83	1453	82	97

[1] b.d. = basal diameter; genet = plant or collection of genetically identical stems; ramet = basal stem.

The presence of large dead stems or stumps on almost all of the living plants sampled in brushfields indicates a population with age distribution strongly skewed toward the oldest trees. Few if any of the trees observed appeared young enough to have become established since Johnson's study in 1988. Only 18 genets out of 155 (seedlings excepted) had stems all under 1 inch basal diameter, and there is still the possibility that larger, dead stems had already become buried. Sometimes little evidence remains of dead stems. "Reproduction" occurring in this population may be exclusively through vegetative propagation from these old individuals.

Standing dead Pacific dogwood trees were found at all sites and at all historic locations visited. Twenty-eight per cent of the trees mapped in permanent plots were dead. However, this is an underestimate of mortality in the population because plots were located to include live trees and only standing dead were counted. In some areas no dead stems remain standing. I think its reasonable to assume that less than 10% of the original population remains. Often a tree that appears dead will actually have some sprouting at the base or low on the stem.

Synecology: In the Lochsa canyon, Pacific dogwood commonly occurs on highly exposed sites, sometimes on river terraces (Plots 018 and 003) but most often on steep, south-facing brushfields (Appendix III, Plots 004, 010, 017, 024, 025). On these early-seral sites Pacific dogwood has a shrubby growth habit with numerous stems and vigorous basal sprouting. Another typical site where subpopulations remain is on wide, gentle toe slopes in the canyon bottoms occupied by moderately open, mixed stands of young and mature conifers (Plots 006, 013, 019, 021).

It was sometimes difficult to site plots in near-climax communities because live Pacific dogwood trees tended to occur exclusively at the very edge of forest cover--typically at abrupt edges along highway right-of-ways (Plots 009, 022, 026) or river banks (Plot 003). In light of this, it was interesting to read the following regarding eastern flowering dogwood: "... flowering dogwood grows as an understory in the shade of taller trees. However, it is more often seen at woodland margins where it tends to lean toward the light and develop a one-sidedness" (Lynch 1981). At Plot 022 a wide right-of-way had been allowed to grow up into dense, sapling grand fir and all of the living Pacific dogwood

was lined-up along the margin of the mature conifer forest. At 009 and 022 I placed the plot in mature conifer community because it was the undisturbed habitat and contained evidence of dead Pacific dogwood trees. At these sites, the ECODATA plot inaccurately describes the environment presently occupied by Pacific dogwood because the plot was located under closed, near-climax forest and live Pacific dogwood trees occurred strictly at the edge. These stands are more accurately described as "edge habitat" than climax forest. At sites 003 and 026, I attempted to fit a rectangular plot into a narrow ecotone to provide a more accurate picture of the habitat.

Trees along the Selway show a similar association with open environments. Many of the trees that remain are in and near an old utility corridor (ca 1930s), now vague in many places, that once paralleled the road. Stands sampled at Slide Creek (013), Rackliff (011), and an unsampled stand at Twenty-mile Bar appear to be related to this corridor, although some trees occur in forest cover on either side of the corridor as well. This relationship could simply be due to the fact that the corridor, once a telephone line to Moose Creek Ranger Station, follows Pacific dogwood habitat. However, the relationship is more convincing in view of the plant's disposition in "edge habitats" and exposed sites along the Lochsa.

At only three sites was Pacific dogwood observed in any numbers in the understory of near-climax forest: O'Hara and Rackliff campgrounds and Major Fenn North (Plots 012, 014 and 020). A large population mapped by Johnson in forest understory at Apgar Creek (Appendix III, Map B), appears to have died out completely. Remnants of a once-extensive population near Fenn ranger station are now restricted to openings that were at one time cleared for pasture.

Associated species: Within the various community types occupied by Pacific dogwood, certain species associates are very constant (Appendix VII). Tree associates are grand fir, western redcedar and Douglas-fir, in order of decreasing dominance. Pacific yew occurred in three plots. In brushfield communities the most common associates are tall shrubs of cascara, ocean spray, serviceberry, and Rocky Mountain maple. The middle layer (2-6 ft) is consistently dominated by thimbleberry and bracken fern which also carry over into forested sites. The grass-and-forb layer is often dominated by Geyer's sedge

or the mat-forming mint yerba buena. Early seral stands represented by plots 011, 018, 019 and 021 are extremely variable in over- and understory composition, but thimbleberry, bracken fern, creeping honeysuckle and snowberry are highly constant. These early-seral stands are very patchy with dense growth of sapling and pole conifers interspersed with shrub-dominated openings where Pacific dogwood occurs. Above Fenn picnic area (Plot 020) scattered trees occupy forest understory near the margin of a small brushfield. The plot however--situated to encompass a greater density of Pacific dogwood trees--coincides with a canopy opening that resulted from wind fall of several large conifers. In addition to 10 Pacific dogwood plants, the small opening supports dense growth of sapling grand fir.

Pacific dogwood occasionally reaches into mature ponderosa pine habitat types on upslope positions. It can also be found in right-of-ways and old pasture areas along the Selway where vegetation is dominated by pasture weeds and introduced grasses (Plot 015).

A survey of the population of Pacific dogwood in the Lochsa/Selway River canyons leaves the distinct impression that the species is being displaced by conifers in much of its range as natural succession proceeds. This is a very different picture than that seen by Roper (1970) in which Pacific dogwood was a component of the climax forest or by Johnson (1988) who adopted the more commonly held view that the species is shade tolerant but does not persist under closed conifer overstory (Kagan pers. comm.). It may well be that the ecology of this population has been altered due to its diseased state. However, we must also consider the effect that fire suppression over the last 50 years must have had on vegetation structure along these rivers (Habeck 1972). A seral species such as Pacific dogwood might be adapted to a certain frequency of fire (Kagan pers. comm.). However it should be noted that--in both seral brushfields and near-climax forest--the majority of Pacific dogwood trees have died within the past 20 yrs. The trees remaining tend to occupy brushfields and forest openings and margins. It is interesting to note that, while fire undoubtedly played a large role in the history of this population by initiating secondary succession, many of the remaining individuals seem to be associated with human disturbance.

Disease symptoms: All Pacific dogwood plants observed

during sampling were affected by leaf spot and leaf margin necrosis, some to a greater degree than others. Stem canker was observed at all sites. Disease symptoms are described in Appendix VIII. Insect ovipositor damage was rare. At many sites plants exhibited typical leaf symptoms of dogwood anthracnose in which the leaf tip turns brown and the necrosis proceeds up the mid-vein in a solid "V". However, examination of a leaf sample did not indicate anthracnose (Bertagnolli, pers. comm.).

One of the most common symptoms in addition to leaf spot and necrosis, was the death of terminal twigs and their buds. The symptom was very distinctive because the dead leaves remained attached and hung straight down. Initially I thought this indicated frost damage and used an "F" to indicate the symptom. However, I later learned that this was another characteristic symptom of dogwood anthracnose.

ASSESSMENT AND RECOMMENDATIONS

The coastal disjunct population of Pacific dogwood occupying the canyons of the Lochsa and Selway Rivers has continued its decline documented in Johnson's 1988 survey, at which time he concluded that over half of the original population had died. The species has been reduced in both extent and density within its previous range. At all sites surveyed in 1991 plants showed a variety of symptoms, some of which are indicative of root disease. The population now appears to be dominated by old, decadent individuals and seedling establishment is virtually nonexistent. The outlook for survival of this population is very poor.

The population of Pacific dogwood in Idaho is unique from botanic and genetic aspects. Because the species is largely confined to National Forest lands, its future may depend on Forest Service conservation efforts. Efforts have already resulted in identification of a probable cause of the observed mortality, and the long-term preservation of germ plasm from the population. Ongoing genetic analysis of the population will help clarify its relationship to coastal populations and indicate the amount and pattern of genetic variation present.

While current land uses and management of habitat containing Pacific dogwood in the Lochsa/Selway canyons probably conflicts little with the specie's survival, the small number of remaining individuals makes every tree important. Activities that might threaten individual groups of plants are construction, improvements and/or maintenance of roads or trails. Clearance surveys should be conducted for any projects in Pacific dogwood habitat along the Middle Fork Clearwater, Lochsa, and Selway River drainages. Proposed actions should be carefully assessed with regard to their impact on any Pacific dogwood plants present.

The root disease present in the population poses a severe threat for which no solution is presently available. Disease in the population could be related to environmental factors such as drought or competition from conifer growth. The plant's resiliency to burning means that controlled fires could be used as a treatment without undue harm to the population. To stimulate seedling establishment, such burns should be carried out on sites with some overstory cover.

At many of the monitoring sites Pacific dogwood trees were

restricted to openings in young conifer stands or to the edges of mature forest. In my opinion, thinning of some of these stands could release these trees, stimulating stem production and possibly flowering.

This report documents the initiation of population monitoring which will provide data needed to make predictions about the future of the Pacific dogwood population. Other points that need to be addressed before any extensive on-site conservation strategy can be initiated are:

- Continue to monitor the stands located and documented in the present study for a minimum of three years a which time population models can be implemented to predict the fate of the population and estimate the minimum viable population size.

- Return to burned sites along the Selway to make observations on tress affected to various degrees by the Fall, 1991 fire.

- Investigate the potential role of fire in population dynamics and species distribution. Small-scale experimental burning should be initiated on a trial basis using these plots for baseline data.

- Conduct additional work on isolating the responsible pathogen and possible ways to mitigate its effect.

REFERENCES

Bertagnolli, C.L., University of Idaho Plant Pathologist. Personal communication.

Bertagnolli, C.L. and A.D. Partridge. 1990. Mortality of Pacific dogwood, a coastal disjunct population in northern Idaho. Unpublished report by IFG, CDC, Boise, ID for US Forest Service.

Daubenmire, R. 1956. Climate as a determinate of vegetation distribution. Ecological Monographs 26:231.

Eyde, R.H. 1988. Comprehending Cornus: puzzles and progress in the systematics of the dogwoods. Botanical Review 54(3): 233.

Habeck, J.R. 1972. Fire ecology investigations in Selway-Bitterroot Wilderness: historical considerations and current observations. Dept. of Botany, Univ. of Montana. US Forest Service Pub. No. R1-72-001. 119 pp.

Johnson, F.D. 1988. Damage survey of Cornus nuttallii in northern Idaho. Unpublished report by IFG, CDC, Boise, ID for US Forest Service. 30 pp.

Kagan, J. Ecologist, Oregon Natural Heritage Program. Personal communication. Nov, 1991.

Lorain, C.C. 1990. Seed collection and conservation of Cornus nuttallii (Pacific dogwood), a Region 1 sensitive species. Unpublished report by IFG, CDC, Boise, ID for US Forest Service.

Lorain, C.C. 1991a. Conservation Plan for Cornus nuttallii (Pacific dogwood), in Idaho. Unpublished report by IFG, CDC, Boise, ID for US Forest Service. 15 pp plus appendices.

Lorain, C.C. 1991b. Study plan: long-term demographic and community monitoring of Cornus nuttallii (Pacific dogwood) in Idaho. Unpublished report by IFG, CDC, Boise, ID for US Forest Service.

Lynch, J.A. 1981. Outriders of spring. American Forests 87:22.

Pavlik, B.M. and M.G. Barbour. 1988. Demographic monitoring of endemic sand dune plants, Eureka Valley, California. Biological Conservation 46:217-242.

Roper, L.A. 1970. Some aspects of the synecology of Cornus nuttallii in Northern Idaho. MS Thesis, Univ. of Idaho, Moscow.

USDA Forest Service. 1991. Ecosystem Classification Handbook FSH 6/91 R-1. Regional Office, Northern Region, Missoula, MT.

Wilson, D., J. Coyner and T. Deckert. 1983. Land System Inventory, Clearwater National Forest, First Review Draft. Clearwater National Forest Supervisor's Office, Orofino, ID.

Wolfe, J.A. 1969. Neogene floristic and vegetational

history of the Pacific Northwest. Madrono 20:83 (see page 106).