

SEED COLLECTION AND CONSERVATION OF  
CORNUS NUTTALLII (PACIFIC DOGWOOD),  
A REGION 1 SENSITIVE SPECIES

by

Christine C. Lorain

Natural Heritage Section  
Nongame/Endangered Wildlife Program  
Bureau of Wildlife

November 1990

Idaho Department of Fish and Game  
600 South Walnut, P.O. Box 25  
Boise, Idaho 83707  
Jerry M. Conley, Director

Cooperative Challenge Cost Share Project  
Clearwater and Nez Perce National Forests  
Idaho Department of Fish and Game

Purchase Order No. 43-0276-0-0317 (CNF)  
Purchase Order No. 43-0252-0-0293 (NPNF)

## ABSTRACT

Seed of *Cornus nuttallii* (Pacific dogwood) was collected and preserved from the Clearwater and Nez Perce National Forests during the 1990 field season. This project was conducted by the Idaho Department of Fish and Game's Natural Heritage Program as a cooperative Challenge Cost Share venture between the Department and the Clearwater and Nez Perce National Forests.

Pacific dogwood, a Region 1 Sensitive Plant Species, is a Pacific coastal disjunct to northern Idaho. The principal distribution of this species is west of the Cascade/Sierra crest from southwestern British Columbia to southern California. A single isolated population occurs some 300 miles inland along the confluence of the Lochsa and Selway Rivers on lands administered by the Nez Perce and Clearwater National Forests.

In the late 1980's, a severe population decline caused by a root disease was noted within the disjunct population. Due to this serious threat, a comprehensive conservation strategy for Pacific dogwood in Idaho was initiated. Part of this strategy concentrated on preserving this unique disjunct population and its potentially valuable (including commercial) gene pool through seed collection and long-term storage.

During the early spring of 1990, flowering Pacific dogwood plants from throughout the Idaho population were flagged and revisited that same fall for systematic fruit collections. Detailed seed collection data, in addition to notes on the population health and extent of flowering at various locations throughout the Idaho population were taken. Extracted seeds were sent to the Berry Botanic Garden (Portland, Oregon) for ex situ (off-site) long-term storage.

TABLE OF CONTENTS

ABSTRACT ..... i

TABLE OF CONTENTS ..... ii

LIST OF APPENDICES .....iii

INTRODUCTION ..... 1

CURRENT STATUS ..... 3

TAXONOMY

- Family ..... 3
- Common Name ..... 3
- Citation ..... 3
- Synonymy ..... 3
- Technical Description ..... 3
- Nontechnical Description ..... 3
- Distinguishing Features and Similar Species ..... 3

DISTRIBUTION

- Range ..... 4
- Habitat and Associated Species ..... 5
- Role of Fire ..... 6
- Monitoring Plots ..... 6
- Seed Collections ..... 6

STATUS

- Ownership ..... 7
- Threats ..... 8
  - Natural ..... 8
  - Man-caused ..... 8
- Management Implications ..... 9

ASSESSMENT AND RECOMMENDATIONS

- Summary ..... 9
- Recommendations to the Regional Forester..... 9
- Recommendations to the Clearwater and Nez Perce  
National Forests ..... 10

REFERENCES ..... 12

LIST OF APPENDICES

APPENDIX I .... Line drawing of Cornus nuttallii.

APPENDIX II ... Map of overall distribution of Cornus nuttallii  
and exact extent of Idaho population.

APPENDIX III .. Location and collection data from 1990 Idaho seed  
collection sites.

APPENDIX IV ... Precise locations of 1990 Idaho seed collection  
sites.

Clearwater National Forest

- Map A. Portion of Syringa 7.5' quadrangle
- Map B. Portion of Lowell 7.5' quadrangle
- Map C. Portion of Coolwater Mountain 7.5' quadrangle

Nez Perce National Forest

- Map D. Portion of Lowell 7.5' quadrangle
- Map E. Portion of Goddard Point 15' quadrangle
- Map F. Portion of Stillman Point 7.5' quadrangle

APPENDIX V .... Slides of Cornus nuttallii, its habitat, and  
disease damage.

## INTRODUCTION

The National Forest Management Act of 1976 (16 U.S.C. 1600. Planning Regulations Section 219.19, Fish and Wildlife Resource) and Forest Service policy require that Forest Service land be managed to maintain populations of all existing native animal and plant species at or above the minimum viable population level (USDA Forest Service 1984). A minimum viable population consists of the number of individuals, adequately distributed throughout their range, necessary to perpetuate the existence of the species in natural, genetically stable, self-sustaining populations.

The Forest Service, along with other Federal and State agencies, has recognized the need for special planning considerations in order to protect the flora and fauna on the lands in public ownership. Species recognized by the Forest Service as needing such considerations are those that (1) are designated under the Endangered Species Act as endangered or threatened, (2) are under consideration for such designation, or (3) appear on a regional Forest Service Sensitive Species<sup>1</sup> list.

Cornus nuttallii (Pacific dogwood) is a Region 1 Sensitive Plant Species (USDA Forest Service 1988) and one of Idaho's most prominent Pacific coastal disjuncts. The species is recognized as "Sensitive" due to the small size of the Idaho population, the serious threat of disease, and the potential value of this separate gene pool. The entire disjunct population of Pacific dogwood occurs on Forest Service land administered by the Clearwater and Nez Perce National Forests.

Severe population decline within this disjunct population was noted in 1987 and two recent investigations by University of Idaho scientists have dramatically documented the decline and cause as a root disease (Bertagnolli and Partridge 1990). Damage surveys conducted in 1988 documented 58% mortality and another 40% of the trees appeared to be infected. Moreover, no evidence of resistance was found within any portion of the population (Johnson 1988).

This investigation is part of a comprehensive conservation strategy for Pacific dogwood in Idaho. The specific objectives of this project are as follows:

- 1) Flag all flowering individual Cornus nuttallii plants throughout the species range in Idaho during early spring 1990.
- 2) Return to flagged plants in the fall and make systematic collections of mature fruits.
- 3) Document fruit collections in detail and make observations concerning the population health and extent of flowering at various locations throughout range.
- 4) Extract seeds from fruit and send seeds for *ex situ* conservation in long-term storage facilities at the Berry Botanical Garden in Portland, Oregon.

---

<sup>1</sup> Sensitive Plant Species - a plant species, or recognized subspecies or variety, for which the Regional Forester has determined there is a concern for population viability, within a state, as evidenced by significant current or predicted downward trend in populations or habitat (USDA Forest Service 1984, 1988).

Cornus nuttallii Aud.

CURRENT STATUS USFS Region 1 Sensitive Species

TAXONOMY

Family: Cornaceae (Dogwood)

Common Name: Pacific dogwood, western dogwood

Citation: Audubon, J. 1838. Page 652. In: A Flora of North America, Vol. 1, by J. Torrey and A. Gray. G. & C. Carvill & Co., New York. 711p.

Synonymy: Cynoxylon nuttallii Shafer (N. Am. Trees 746, fig. 684. 1908)

Technical Description: Small, deciduous tree 2-20 meters tall; bark smooth and brownish; leaves ovate-elliptic, opposite, shortly acuminate, 4-10 cm long with arcuate veins; flowers numerous, greenish-white petals, arranged in capitate heads 1.5-2 cm broad, heads develop in the fall and flower early in the spring as leaves expand; flower heads subtended by 4-7 conspicuous white obovate bracts 2-7 dm long; fruit bright red drupes, ca. 10 mm long, and arranged in head (Hitchcock 1961). Frequently, plants will "flower" in the late summer or fall, but actually this is only the development and emergence of the white bracts with no true flowers associated with them.

Nontechnical Description: A lovely small flowering tree that is a highly prized native ornamental. Leaves are deciduous, opposite, and have a vein pattern that arches outward then follows the leaf margins (arcuate pattern). Numerous flowers are produced in early spring and are arranged in a small round clump surrounded by conspicuous white bracts, usually six in number. The fruit are bright red, single-seeded drupes that occur in clumps in the early fall (see Appendix I for line drawings).

Distinguishing Features and Similar Species: A number of features easily distinguish this species from other tree species within its range. In spring and sometimes fall, the most obvious characters are the bright white showy bracts which subtend the flower heads. These bracts are easily identified from a distance, especially when off-set against a green background. Non-flowering plants can be distinguished by the opposite leaves and branches. In addition, the leaves possess arcuate veins, a pattern distinctive to Cornus. In fall, Pacific dogwood can be identified by the bright red fruit clumps and the deep red-colored fall foliage (see Appendix I for line drawings).

Very few, if any, species can be easily confused with Pacific dogwood. Only two other members of the Cornus genus occur in the same vicinity. Red-osier, or creek dogwood, (Cornus stolonifera) is a many-stemmed shrub that is principally found occupying riparian areas. Flowers of red-osier dogwood are arranged in open cymes and have no bracts. Bunchberry, or dwarf dogwood, (Cornus canadensis) produces bracted flowers similar to Pacific dogwood, however, the plant is a low, trailing, subshrub less than 3 dm tall.

The only other taxon that looks similar to Pacific dogwood in the non-flowering stage is cascara or chittam bark (Rhamnus purshiana). Cascara is a small tree with a similar leaf shape and overall appearance to that of Pacific dogwood. Since these two species often grow sympatrically, it will likely be necessary to check for opposite leaves and branches on Pacific dogwood until one is able to differentiate between the overall appearance of these two trees.

DISTRIBUTION

Range: Pacific dogwood was first collected by the explorers Thomas Nuttall and John Kirk Townsend during their 1834 expedition to the Pacific Northwest. A detailed painting and subsequent description of the species was made by James Audubon in his "Birds of America" publication and the accompanying text entitled "Ornithological Biography". Audubon (1838) proceeded to name this beautiful tree

Cornus nuttallii after its discoverer.

In 1900, explorer and botanist James Leiberg noted the occurrence of Cornus nuttallii along the confluence of the Selway and Lochsa Rivers in northern Idaho. "That the species should occur in the basins of the Clearwater drainage is remarkable. Its home in this latitude is in the Cascades and, so far as known, it does not grow at any intermediate station." It appears that Leiberg (1900) was the first person to note the remarkable phenomenon of Pacific coastal disjunction in the northern Rocky Mountains.

A disjunction exists when a population segment is separated by some distance from the main, or principal population (Johnson 1983). This separation is greater than the species' natural dispersal capacity can account for (Polunin 1960). Pacific dogwood, as the common name implies, is principally a Pacific coastal species occurring west of the Cascade/Sierra crest from southwestern British Columbia to southern California (Hitchcock 1961). The only known locality for Pacific dogwood east of the Cascades occurs at the confluence of the Lochsa and Selway Rivers in northern Idaho (see Appendix II). A detailed study of the distribution limits and ecological significance of this population is presented by Roper (1970).

In Idaho, the entire population of Pacific dogwood is restricted to land administered by the Clearwater and Nez Perce National Forests. On the Clearwater National Forest plants have been documented from Three Devils Picnic Area, along the Middle Fork Clearwater River (western limit) and continuing eastward to Black Canyon along the Lochsa River. On the Nez Perce National Forest the population stretches from the mouth of the Selway River and continues upstream to Boyd Campground (Roper 1970)(see Appendix II).

The existence of Pacific dogwood, a Pacific coastal disjunct, within northern Idaho is an unusual phenomenon, but not unique. Presently, some 40 other vascular plants can be classified as Pacific coastal disjuncts, with high numbers and concentrations occurring within the canyons of the Clearwater River drainage. All of these taxa have their major distributions west of the Cascade summits. Due to their limited distribution in the interior Pacific Northwest, many of these species are listed as Sensitive Plant Species for the Northern Region. A more complete explanation of this phenomenon is presented by Lorain (1988).

Habitat and Associated Species: In Idaho, Pacific dogwood is found at lower elevations in the Thuja plicata (western redcedar) zone. In this region it inhabits brushfields, rather dense mature forests, and streamsides (Roper 1970)(see Appendix V for slides of habitat). Slopes vary from flat to >60% and plants can be found growing on all aspects, though southern aspects appear to support the highest concentrations of plants. Pacific dogwood ranges in elevation from 1600 feet to ca. 2800 feet and soils tend to be moderately developed spodosols with good drainage and humus surface. Occasionally it grows in riparian habitats with gravelly, well-drained substrates (Roper 1970).

Cornus nuttallii grows in a variety of habitats ranging from secondary successional stages induced by fire, to near climax. Most communities are mid-successional and dominated by seral trees of Pseudotsuga menziesii (Douglas-fir), Larix occidentalis (western larch), and Abies grandis (grand fir). The corresponding habitat types are (Cooper et al. 1987, Johnson 1988):

- Thuja plicata/Adiantum pedatum h.t.  
(western redcedar/maidenhair fern)
- Thuja plicata/Asarum caudatum h.t.  
(western redcedar/wild ginger)
- Thuja plicata/Clintonia uniflora h.t. - Clun phase  
(western redcedar/queencup beadlily)
  
- Abies grandis/Asarum caudatum h.t.  
(grand fir/wild ginger)
- Abies grandis/Clintonia uniflora h.t. - Clun phase  
(grand fir/queencup beadlily)

Plants commonly found growing with Pacific dogwood varied by habitat, however, a

certain group of species was almost always present, which consisted of Holodiscus discolor (oceanspray), Rubus parviflorus (thimbleberry), Physocarpus malvaceus (ninebark), Rhamnus purshiana (cascara), Acer glabrum (Rocky Mountain maple), Symphoricarpos albus (snowberry), and Pteridium aquilinum (braken fern). In dryer brushfields, occasional associates included Rhus radicans (poison ivy), Ceanothus sanguinius (buckbrush), Amalanchier alnifolia (serviceberry), Philadelphus lewisii (syringa), and Spiraea betulifolia (white spiraea). In more mesic sites additional associates included Polystichum munitum (swordfern), Smilacina stellata (starry Solomon-seal), Cornus stolonifera (red-osier dogwood), and Cornus canadensis (bunchberry).

Role of Fire: The influence of fire in northern Idaho has long played an important role on the vegetation of the area. The Lochsa/Selway region is noted for large, uncontrolled forest fires in the past. Its presence is recorded in the earliest written reports and histories of the area, dating as far back as 1719 (Leiberg 1900). In more recent times major burns have occurred in 1910, 1919, 1924, 1930, and 1934. The result is a complex mosaic of communities in different secondary successional stages to near climax (Roper 1970, Habeck 1972).

Fire also appears to have played a key role in the distribution and density of Pacific dogwood in Idaho (Roper 1970). Although the species is shade tolerant, when growing in such conditions plants tend to be single-stemmed and produce few flowers or fruits. Open or lightly shaded habitats in seral communities induced by fire, support the greatest concentration of plants. Pacific dogwood will flower/fruit more consistently in seral habitats and readily resprouts from established rootstalks following fire, creating dense multi-stemmed shrubs (Roper 1970, Johnson 1988).

Advances in fire suppression and control efforts over the last 50 years, suggests that the extent of fire reduction over a sufficient number of years has had an environmental impact on the forest ecosystem (Habeck 1972). Such suppression may likely have altered the natural cycles, reducing suitable habitat for species adapted to seral communities, such as Pacific dogwood.

Monitoring Plots: In 1988, following the discovery of considerable mortality, an extensive survey of the Lochsa-Selway population of Pacific dogwood was conducted by Johnson (1988). Sixteen stands were sampled throughout the Idaho population using line transects totaling 6055 feet. Details of sampling procedures and results are presented in Johnson (1988).

Seed Collections: Systematic seed collections from throughout the Idaho population of Pacific dogwood were made by the Idaho Natural Heritage Program during the 1990 field season. This project was part of a comprehensive conservation strategy for Pacific dogwood in Idaho. In this manner, the genetic composition of this unique population is preserved as seed even if the population itself is extirpated.

In the early spring of 1990, all flowering Pacific dogwood plants from throughout the species distribution in Idaho were flagged. That fall, systematic fruit collections were made from these same plants, provided fruit was present. Detailed collection data were taken, in addition to notes on the population health and extent of flowering at various locations (see Appendix III and IV). Following collection of fruits, the seeds were extracted with the assistance of Loring Jones (Northplan Seed Producers, P.O. Box 9107, Moscow, Idaho). The cleaned and labelled seed was then forwarded by express mail for storage.

The Berry Botanic Garden (Portland, Oregon) was contracted by the Idaho Natural Heritage Program to provide long-term storage for the collected Pacific dogwood seeds. The following outlines the contract responsibilities agreed to by the Garden:

- 1) Process seed gathered by Heritage Program botanists and store in long-term seed storage facilities;
- 2) Conduct germination trails and attempt to grow the seedlings until they are large enough to plant out;



- 3) Distribute the growing part of the collection (i.e., products of successful germination trails) to other botanical gardens or arboreta in the Pacific Northwest to spread the risk of disease and other site-specific hazards;
- 4) As needed, return all remaining seed to the Heritage Program for reintroduction efforts in Idaho.
- 5) Prepare a summary report by 30 June 1991, explaining results of germination and growth trails and condition of stored seed.

#### STATUS

Ownership: The entire Idaho population of Cornus nuttallii occurs on Forest Service land administered by the Clearwater and Nez Perce National Forests. The population has been extensively surveyed and mapped to cover some 51 river miles in scattered or dense concentrations (see Appendix II). No additional populations are known to occur in Idaho or other interior locations.

#### Threats:

Natural: In 1970 when Roper (1970) conducted his ecological and distributional study, Pacific dogwood was "locally common" at lower elevations of the Thuja plicata zone. Photographs from this time reveal healthy, dense stands of Cornus nuttallii within the Lochsa and Selway River canyons. Extensive mortality within this population was noted in 1987 and investigations were initiated to determine the extent and cause of this malady in 1988 (Johnson 1988, Bertagnolli and Partridge 1990). Results were not optimistic. Damage surveys documented 58% mortality with another 40% of the trees showing signs of infection. Only 2% of the Pacific dogwood plants were healthy and these were all under 4 feet tall. Moreover, no evidence of resistance was found within any portion of the population. Johnson (1988) concludes that "There seems every reason to believe that this population may be extirpated by this unknown malady".

A root disease, caused by a Phytophthora sp., has been isolated as the primary cause of this severe decline. In addition, secondary diseases including tip (shoot) cankers, leaf diseases, and insect damage was evident on most of the remaining plants (Bertagnolli and Partridge 1990).

Some positive signs of recovery were visible in 1989 and 1990 with many plants producing apparently healthy basal sprout growth (Bertagnolli and Partridge 1990). During this investigation stem sprouts and widespread flowering was also noted.

Natural threats to Pacific dogwood may also include the process of natural succession. Although the species is shade-tolerant and can grow in climax communities, it appears to be better adapted to mid-successional seral habitats. As succession proceeds in a disturbed community, species composition and community structure change. Such change could potentially reduce or eliminate suitable habitat for Pacific dogwood, resulting in removal or severe stress to individual plants.

Man-caused: In Idaho, Pacific dogwood occurs in valley bottoms of relatively narrow river corridors. While such areas frequently undergo human habitat-altering activities, the two river drainages occupied by Pacific dogwood are designated as "Wild and Scenic". This affords the population a certain degree of protection since such a designation promotes scenic values and discourages "development" and most management activities.

Along each of these rivers, however, is a well-maintained and traveled road. Development of these roads in the past likely impacted and reduced the population of Pacific dogwood. Numerous trails also exist in habitat supporting Pacific dogwood stands in this region. Construction, improvement and/or maintenance of roads or trails in the general area poses a significant threat to the population.

Management Implications: Most of the current land-use and management of habitat containing Cornus nuttallii on the Clearwater and Nez Perce National Forests does not appear to conflict with the species long-term viability. However, a root disease present in the population has caused a significant decline and poses a severe threat. Future man-caused activities may exacerbate the problem by damaging plants and/or habitat. All management activities in habitat supporting Pacific dogwood, particularly road and trail construction, improvement and/or maintenance, should be carefully assessed with regard to their impact on the conservation status of the species.

#### ASSESSMENT AND RECOMMENDATIONS

Summary: Pacific dogwood is an attractive native species that is disjunct to northern Idaho. The principal distribution of this species is coastal, occurring west of the Cascade/Sierra crest. A single isolated population occurs some 300 miles inland at the confluence of the Lochsa and Selway Rivers. In Idaho, Pacific dogwood is found at lower elevation in the Thuja plicata zone where it occurs in brushfields, rather dense mature stands, and streambanks. Open or lightly shaded habitats in seral communities, often induced by fire, support the greatest concentration of plants.

Severe population decline was noted in 1987 and two recent studies by University of Idaho scientists have dramatically documented the decline and isolated the primary cause as a root disease. In 1990, as part of a comprehensive conservation strategy for Pacific dogwood, systematic seed collections from throughout the Idaho population were made by the Idaho Heritage Program. Seeds were sent to the Berry Botanical Garden (Portland, Oregon) for ex situ conservation in long-term storage facilities.

The entire disjunct population, consisting of some 51 river miles of scattered to dense concentrations, is restricted to lands administered by the Clearwater and Nez Perce National Forest.

While current land-use and management of habitat containing Cornus nuttallii on these Forests does not appear to conflict with the species long-term viability, the root disease present in the population poses a severe threat. Moreover, construction, improvement and/or maintenance of roads or trails in Pacific dogwood habitat could further threaten the remaining population. Any such action should be carefully assessed with regard to their impact on the conservation status of the species in Idaho.

Recommendations to the Regional Forester: The disjunct population of Pacific dogwood in Idaho is unique from botanic and genetic aspects. Because the species is confined to National Forest land, the fate of Pacific dogwood in Idaho may depend on Forest Service conservation efforts. The objectives of this project concentrated on preserving this unique population and genetic pool through seed collection and ex situ long-term preservation.

Proposals for future conservation projects for Pacific dogwood have been submitted to the Clearwater and Nez Perce National Forests for Fiscal Year 1991. Proposed activities include population genetic studies to ascertain genetic variation within the Idaho population and compare this to coastal plants, and long-term monitoring of population and community dynamics.

In recognition of the small size of the Idaho population of Pacific dogwood and the serious threat of disease, it is recommended that Cornus nuttallii be maintained as a Region 1 Sensitive Species. Because of the severity of the threat and uncertainty of the species survival in Idaho, Pacific dogwood should be classified as a high priority species for the Region.

As an additional part of a comprehensive conservation strategy, the Forest Service should develop a Species Management Guide for Pacific dogwood in the Northern Region. Areas that should be addressed in such a plan include a synthesis of known information and proposed activities involving population genetic studies, long-term monitoring, and the role of fire.

Recommendations to the Clearwater and Nez Perce National Forests: At the present

time, the fate of Pacific dogwood in Idaho is far from certain. Severe population decline has been dramatically documented and the exact cause(s) is still under scrutiny. To insure that this unique disjunct population is preserved, a cooperative effort between the Clearwater and Nez Perce National Forest is essential. A number of question still need to be addressed before an extensive in situ (on-site) conservation strategy can be initiated, such as:

- 1) Identify the genetic composition within the Idaho population and compare this to the coastal populations.
- 2) Establish permanent monitoring plots within the Idaho population to quantitatively measure long-term dynamics of the population and the associated community.
- 3) Investigate the potential role of fire in population dynamics and species distribution.
- 3) Conduct additional work on isolating the responsible pathogen and possible ways to mitigate its effect.

In the mean time, the forest should carefully consider the impacts of its future management activities on the conservation status of this species, particularly with regard to road and trail construction, improvement and/or maintenance. Clearance surveys should be conducted for any projects in suitable habitat along within the Middle Fork Clearwater, Lochsa, and Selway River drainages that may support Pacific dogwood.

#### REFERENCES CITED

- Audubon, J. 1838. Page 652. In: A Flora of North America, Vol. 1, by J. Torrey and A. Gray. G. & C. Carvill & Co., New York. 711p.
- Bertagnolli, C.L. and A.D. Partridge. 1990. Mortality of Pacific dogwood, a coastal disjunct population in northern Idaho. Report to the Idaho Natural Heritage Program, Idaho Department of Fish and Game, Boise, ID. 13 p. plus appendices.
- Cooper, S.V., K.E. Neiman, R. Steele, and D.W. Roberts. 1987. Forest habitat types of northern Idaho: a second approximation. USDA Forest Service, Intermountain Research Station General Technical Report INT-236. Ogden, Utah. 135 p.
- Johnson, F.D. 1983. Glossary of ecological terms. College of Forestry, Wildlife and Range Science Experimental Station, Univ. of Idaho, Moscow. 14p.
- Johnson, F.D. 1988. Damage survey of Cornus nuttallii in northern Idaho - Fall, 1988. Report to the Idaho Natural Heritage Program, Idaho Department of Fish and Game, Boise, ID. 19 p.
- Habeck, J.R. 1972. Fire ecology investigations in Selway-Bitterroot Wilderness: historical considerations and current observations. Dept. of Botany, Univ. of Montana. U.S. Forest Service Pub. No. R1-72-001. 119 p.
- Hitchcock, C.L. 1961. Cornus. Pages 586-590. In: Vascular Plants of the Pacific Northwest, Part 3, by C.L. Hitchcock, A. Cronquist, M. Ownbey and J.W. Thompson. University of Washington Press, Seattle. 614 p.
- Leiberg, J.B. 1900. Bitterroot forest reserve. Pages 317-410. In: Twentieth Annual Report of the U.S. Geol. Survey, Part V-Forest Reserves. Wash. Govern. Print. Off. 498 p.
- Lorain, C.C. 1988. Floristic history and distribution of coastal disjunct plants of the northern Rocky Mountains. College Forestry, Wildlife and Range Sciences. M.S. thesis. Univ. of Idaho, Moscow. 221p.
- Polunin, N. 1960. Introduction to plant geography. McGraw-Hill Book Co., Inc., New York. 640 p.
- Roper, L.A. 1970. Synecology of Cornus nuttallii in northern Idaho. College of Forestry, Wildlife and Range Sciences. M.S. thesis. Univ. of Idaho, Moscow. 81p.
- USDA Forest Service. 1984. Threatened, endangered and sensitive plants and animals. Forest Service Manual. Chapter 2670. Washington D.C.
- USDA Forest Service. 1988. Sensitive plant field guide. In house publication, Northern Region, Missoula, MT.

APPENDIX I

Line drawing of Cornus nuttallii.  
(from Hitchcock (1961))

APPENDIX II

Map of overall distribution of Cornus nuttallii  
and exact extent of Idaho population.

APPENDIX III

Location and collection data from 1990  
Idaho seed collection sites.

MIDDLE FORK CLEARWATER RIVER

1. Three Devils Picnic Area

LOCHSA RIVER

1. Glade Creek Campground
2. 1.2 miles NE Glade Creek CG
3. Knife Edge Campground
4. 0.4 miles E of Knife Edge CG
5. Bimerick Creek
6. Split Creek Bridge (N side of River)
7. Split Creek Bridge (S side of River)

SELWAY RIVER

1. 1.0 mile SE of Lowell
2. Fenn Ranger Station (trailers)
3. Cedar Flats - South
4. O'Hara House
5. O'Hara Campground
6. Rackliff Campground
7. 20-mile Bar Campground
8. Slide Creek Campground
9. Boyd Creek Campground

APPENDIX IV

Precise locations of 1990 Idaho  
seed collection sites.

Clearwater National Forest

- Map A. Portion of Syringa 7.5' quadrangle
- Map B. Portion of Lowell 7.5' quadrangle
- Map C. Portion of Coolwater Mountain 7.5' quadrangle

Nez Perce National Forest

- Map D. Portion of Lowell 7.5' quadrangle
- Map E. Portion of Goddard Point 15' quadrangle
- Map F. Portion of Stillman Point 7.5' quadrangle

APPENDIX V

Slides of Cornus nuttallii, its habitat, and  
disease damage.