

FINAL REPORT
Monitoring *Corydalis aquae-gelidae* in a Restoration Zone
2007 ISSSSP Program
Gifford Pinchot National Forest
Mt. Adams Ranger District
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BACKGROUND

Corydalis aquae-gelidae (cold water *Corydalis*) is a Pacific Northwest endemic vascular plant species that grows at the edge of cold water streams in the Cascades of Washington and Oregon. On federal lands, occurrences for this species are found on the Gifford Pinchot and Mt. Hood National Forests, and on Salem District, Bureau of Land Management. NatureServe ranks this species as G3 (considered at moderate risk of extinction due to a restricted range, relatively few populations, recent and widespread declines, or other factors). It is ranked as S2 in Washington and Oregon (considered imperiled and very vulnerable to extirpation). Washington State ranks this species as Threatened, and it is considered a Candidate for listing in Oregon. It is a Region 6 Forest Service Sensitive species, and a U.S. Fish and Wildlife Service Species of Concern.

On the Gifford Pinchot National Forest, cold water *Corydalis* is most often found associated with headwaters and tributaries (stream order 0 to 2) of cold, mountain streams. Of the reported occurrences region-wide, 93 of a total of 159 occurrences are found on the Gifford Pinchot National Forest. Of these 93 sites, 57 are located within the Wind River 5th field watershed; all of these are within the Trout Creek 6th field subwatershed, most concentrated along Compass, Crater, Layout and Trout Creeks. This area has been focus of intensive restoration since 2005; the Upper Trout Aquatic Restoration Project has included thinning dense riparian forests, removal of invasive species from riparian areas adjacent to stream channels, placement of trees that were thinned into the stream or on adjacent floodprone areas along the stream, and in some cases directly modifying the channel with heavy equipment to promote improved channel form and function. Implementation of the Upper Trout Aquatic Restoration Project is anticipated to extend through 2008.

Cold water *Corydalis* presents unique monitoring challenges. Occurrences (defacto populations) are linear, and may be locally abundant, scattered, or absent from stream segments along the length of a channel. Because the species grows in close proximity to stream channels, occurrences and habitat are subject to seasonal inundation, deposition, and scouring. As a result, habitat is dynamic, and it is often difficult to identify/re-locate individual plants, determine the extent of ‘occurrences’, or monitor ‘population’ or ‘occurrence’ trends. As a result, previous monitoring efforts have attempted to quantify plant numbers at a gross scale, consisting (for the most part) of reporting whether the species is still present in the general vicinity of previously reported occurrences, and with an estimate of number of plants within the occurrence. Since occurrence boundaries may change from year to year, this methodology provides an unacceptable level of uncertainty in terms of gauging occurrence status, or measuring population trends. Within this

dynamic zone, and in the midst of an ongoing restoration project, a need to develop a better way to monitor “occurrence” and/or “population trends” was recognized.

This project was designed as an exploratory (pilot) study to determine and test a new monitoring method that allows us to gain greater resolution in our monitoring of individual plant status and demographic trends (using representative plants), as well as a more accurate gross resolution measure of ‘population’ or ‘occurrence’ status (based on plant numbers within discrete stream segments). Our objectives in developing this methodology included: 1) ensuring that it is repeatable, so that trends in the status of occurrences may be seen over time; and 2) developing metrics to gauge the status of the species at multiple scales, including the scale of “occurrences” or “populations,” and at the scale of individual plants. Ideally, monitoring results taken at these different scales should be linked, so as to inform each other. Monitoring data should be useful in informing management decisions and restoration strategies. The following methods were developed to address these objectives.

METHODS

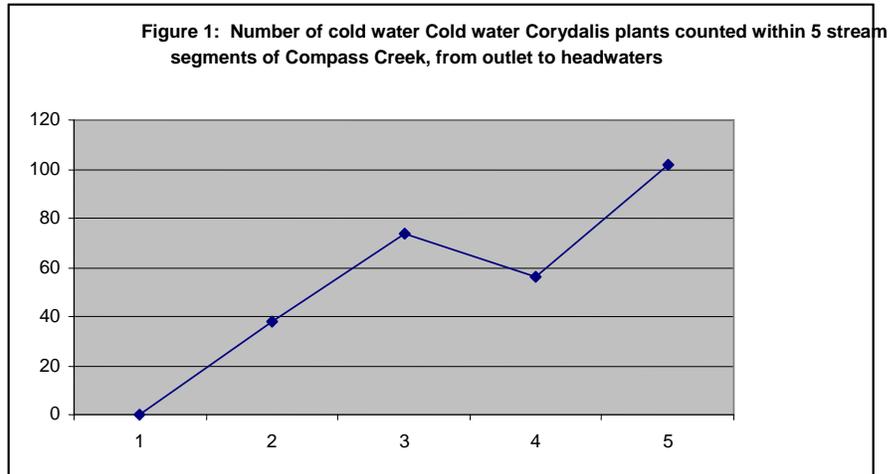
1. Occurrences along Compass Creek were re-visited, and previous/historic occurrence reports with compared with current observations, to give us a first year gross estimate of trends.
2. A complete census of plants was taken along well defined, pre-designated reaches of Compass Creek. Along Compass Creek, from headwaters to the junction with Trout Creek (our chosen focus area), stream reaches were delineated based on topographical and/or stand level differentiation that was either visible on aerial photography, or clearly recognizable in the field. Five segments were designated along Compass Creek. Within each of these segments, complete plant tallies were recorded. In future years, we will also categorize all observed plants as mature (reproductive), juvenile, or seedlings.
3. A methodology was developed to allow for reliable re-location of individual plants, as well groups of plants (“occurrences”, or “populations”), and detailed demographic data was collected for selected plants. Over time, this data, in combination with the census data, will allow us to track changes and observe trends at multiple scales.
 - a) Within each reach, 4-6 plants were chosen to act as representative individuals. Care was taken to select plants from a variety of topographic positions, and in various life stages (selection was not randomized for this pilot study).
 - b) Selected plants were permanently monumented, photo-documented, and detailed demographic data was collected (see *Corydalis aquae-gelidae* 2007 Habitat Study data sheet at the end of this report). Monumentation was carried out by installing labeled plastic placards on 2 separate trees per site, using aluminum nails. Azimuths and distances were then taken from the monumented trees to the individual monitored plants. GPS coordinates were also taken of all selected plant locations and mapped. Detailed notes on identifying site characteristics were also taken to help pinpoint the location of individual plants.

PRODUCTS

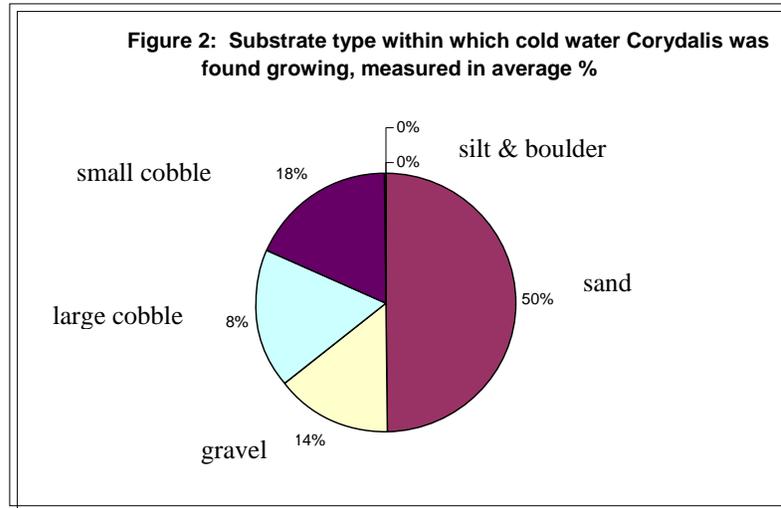
- Census data was collected for all cold water *Corydalis* occurrences located along Compass Creek, and quantified by stream segment.
- Permanent monitoring plots were established to track 18 individual cold water *Corydalis* plants within stream segments 1-4.
- A cold water *Corydalis* monitoring data sheet was developed for the collection of demographic data on individual plants (at end of report).
- Demographic data was collected for selected plants. Demographic data was not collected within the uppermost stream segment (headwaters reach) during 2007, but will be collected during 2008.
- Updated occurrence data was entered into NRIS Rare Plants database.
- Cold water *Corydalis* seed was collected and sent to Berry Botanic Garden for experimental storage (cold water *Corydalis* seeds are recalcitrant).

MONITORING RESULTS

- Sampling of selected plants suggests/confirms the importance of shade to cold water *Corydalis** (confirming information provided in the species management guide from 1983): On average, plants were found under 73% shade (measured with a spherical densiometer); the range was from 56-85%.
- We confirmed the absence of *Phalaris arundinacea* (reed canary grass) in the upper reaches of Compass Creek.
- We discovered the absence of cold water *Corydalis* in the lowest stream segment (1) on Compass Creek; this consists of all the area below the 33 Rd. bridge. This represents a decline since 2003, when 3 plants (comprising 2 separate occurrences) were reported from this area.
- We refined our understanding of the abundance and distribution of plants along Compass Creek by taking a complete census: 270 plants were counted along the entire stream from headwaters to Trout Creek. This included 0 plants from stream segment 1, 38 plants along stream segment 2, and 74 plants along stream segment 3, 56 plants from stream segment 4, and 102 plants from stream segment 5 (Figure 1).

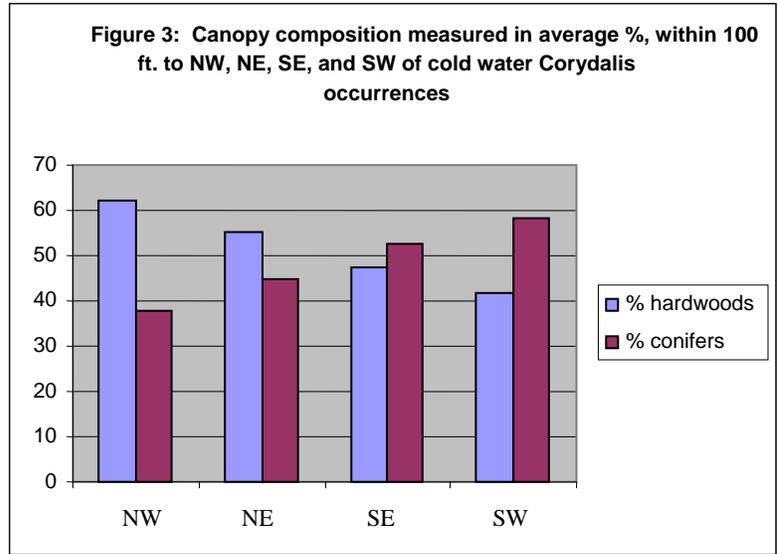


- Comparison of 2007 data to the last recorded visits to the Compass Creek cold water *Corydalis* occurrences in 1997, 2002, and 2003 suggest that there may be an overall decline in numbers, though the data collection methods during those earlier visits preclude definitive conclusions. This trend is particularly clear within stream segment 1, where we observed a definitive change in plant numbers from a total of 3 plants reported from 1997 and 2002 to 0 plants in 2007.
- Anecdotal observations suggested that large woody debris structures were important in establishing/maintaining habitat for the species at 80% of the 15 individual monitored plant sites.
- Herbivory and disease did not appear to substantially impact cold water *Corydalis* plants during 2008 (based on observation of selected plants)*.
- We learned that the majority of monitored cold water *Corydalis* sites were located within substrates dominated by sand* (Figure 2). We feel that this may indicate a trend that would hold true with statistical sampling; this could be tested in future monitoring years by utilizing a statistical sampling design. This result suggests that deposits of fine sediments may be important to creating habitat for cold water *Corydalis*. Sand deposition indicates that the site is in an area of slow water flow, or protected from high force flows (allows deposition of fine sediments).



- Selected plants* were most often found growing above the bank-full level of the creek (47% of the time); plants were also found growing at bank-full (denoted by vegetation line) and below bank-full (27% each). This observation makes intuitive sense; plants growing in the vegetated zone at the creek's edge (above bank-full) are less likely to be uprooted by high water flows, or buried by sediment.
- Average distance of selected plants* from the water's edge at low flow (September) was 9.9 ft., and ranged from 0 ft. (plants growing in the water) to 25.3 ft (plant growing in an abandoned channel).
- An interesting pattern was noted regarding distribution of hardwoods and conifers located within 100 ft. of monitored cold water *Corydalis* plants within the Compass Creek riparian zone: hardwoods (primarily *Alnus rubra*) dominated riparian zones along southern aspects, while conifers (primarily *Pseudotsuga menziesii* and *Tsuga heterophylla*) dominated northern aspects (Figure 3). Compass Creek runs from west to east, and the topography of this area may explain this overstory distribution: the landscape is flat to gently sloping, seepy and wet on the northern side of the Creek (southern aspects), while the southern side of the creek rises more steeply out of the floodplain, and is (as a result) less consistently seepy and wet (northern aspects). The distribution of the taller conifers on the steeper, north bank may be significant to the success of cold water *Corydalis* in this area by blocking the sun from reaching the more flat, southern aspects, particularly during the height of the summer growing season.

* it is important to note that representative plants were not randomly chosen, and for this reason, the data set generated from this project cannot be considered representative, and no statistical inferences may be made. Plants were chosen in order to capture variability in topographic positions and life stages.



Establishing a *Corydalis aquae-gelidae* monitoring plot along Compass Creek, 2007



Plot marker used to delineate area for measurement of substrate type.



Looking up at the canopy over a *Corydalis aquae-gelidae* monitoring plot, Compass Creek, 2007. Canopy cover was measured with a spherical densiometer.

RECOMMENDATIONS / LESSONS LEARNED

1. In 2008, begin implementation of a randomized sampling design; this will allow for statistical analysis of trends.

2. Establish monitoring points for farthest upstream location of *Phalaris arundinacea* along Compass, Crater and Layout Creeks, to allow for monitoring and containment of this species' movement.
3. Collections of *Corydalis aquae-gelidae* seed were made for banking at Berry Botanic Garden. At the time of collection, the collectors were not aware that *Corydalis aquae-gelidae* produces "recalcitrant" seed. Recalcitrant seeds are seeds that do not survive drying and freezing during ex-situ conservation. Moreover, these seeds cannot resist the effects of drying or temperatures less than 10° C thus they cannot be stored for long periods like orthodox seeds because they can lose their viability. As a result, some seeds will be experimentally stored at Berry Botanic Garden; the rest of the seed collected was grown out for planting at Berry Botanic Garden. In future, *Corydalis aquae-gelidae* seed should not be collected except for the purpose of immediate grow-out in preparation for out-planting (such as for a restoration project).
4. In future years, categorize all observed plants as mature (reproductive), juvenile, or seedlings.

FUTURE MONITORING QUESTIONS

- Is it feasible to monitor individual plants within a dynamic riparian environment? Are the permanent markers sufficient to allow re-location of individual plants?
- Do individual plants tend to persist from year to year? (annual or semi-annual monitoring will allow us to better understand plant life spans, and persistence of plants at particular sites).
- Is there annual variation in the types of threats plants face? (i.e. herbivory, disease, invasive species, etc.)?
- Do individual plants seem to shift between life stages (i.e. from reproductive back to unproductive, etc.)?
- Does the percentage of non-reproductive plants vs. adult plants differ from year to year?
- How much do individual plants vary in terms of seed production (measured through surrogate of flowering stalks) on an annual basis?
- Which environmental variables appear to be important to *Corydalis* distribution and status?

Corydalis aquae-gelidae Habitat Study 2007 Data Sheet

Plant NRIS site ID: _____

Monitoring project site ID: _____

Stream segment and plant number: _____

PLANT DESCRIPTION

Phenology: Vegetative
 flower/bud
 Fruit/Dispersed
 Seedlings
 Juvenile

of stems _____

of racemes _____

Av. # flowers/raceme _____

Evidence of : disease
 competition
 predation
 collection
 trampling
 herbivory

Plant Size (ft): width1 _____

 width 2 _____

 height _____

TOPOGRAPHIC POSITION OF PLANT

Spring fed

Side channel: above bank full

at bank full

below bank full

Main channel: above bank full

at bank full

below bank full

distance from edge of water at low flow _____

Ht. above water at edge of water at low flow _____

SITE CHARACTERISTICS

UTM coordinates (NAD 83):

 Northing _____

 Easting _____

Slope

Aspect

Elevation

Potential veg. classification:

% shade

Spherical densiometer _____

Substrate pebble count in quadrat (%)

silt _____ small cobble _____

sand _____ large cobble _____

gravel _____ boulder _____

Nearest PHAR: NA (not in sampling segment)

 _____ ft

In-stream structures affecting site? N

Y

If Yes: species _____

 in channel on bank

 upstream downstream

STAND CHARACTERISTICS

Riparian type _____

Size classes of overstory trees(%)
measured within 100 ft radius:

Hardwoods

> 50 ft. _____ < 50 ft _____

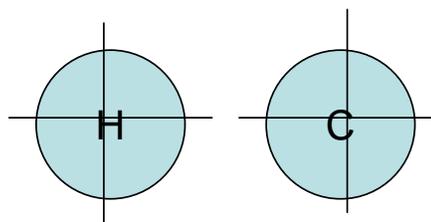
Conifers

> 50 ft. _____ < 50 ft _____

Old growth remnant trees? Y N

Overstory composition

% hardwood/conifers within
100 ft. radius:



Notes

(Include additional hydrological features feeding the plant, and note adjacent restoration opportunities, if any).

COMPLETION CHECKLIST

Form complete? Y N

Pictures: close up with measuring device and quadrat Y N
 picture of plant in relation to channel Y N
 Picture of habitat Y N

Monumentation (2 trees, labelled with azimuth and distance to plant) Y N