

Rough Popcornflower Population Augmentation at Douglas Soil and Water Conservation District (Roger Johnson) Parcel

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Figure 1. Leaves of *Plagiobothrys hirtus* emerge from the water in this seasonally inundated habitat at the Douglas Soil and Water Conservation Site in Sutherlin, Oregon. This picture from November 2006 shows seedlings from seeds produced by plants out-planted in April of 2006.

Background

Conservation Review

Currently restricted to only a few protected sites, *Plagiobothrys hirtus* (hairy or rough popcorn flower) is rapidly declining in its native habitat (Figure 1). Rapid urbanization of the Sutherlin area is threatening, and in some cases destroying, the remaining populations of this unique species; filling and draining of adjacent wetlands has reduced the habitat quality at most remaining localities. In response to this decline, the species was listed as Endangered by the Oregon Department of Agriculture (ODA) in 1989, and by the U.S. Fish and Wildlife Service (USFWS) in 2000. These problems are challenging, but recovery efforts for this species are promising. A Recovery Plan for the species was issued by USFWS in 2003, and successful methods for greenhouse propagation and cultivation have been developed (Amsberry and Meinke 1998).



Figure 2. Close up of *Plagiobothrys hirtus* flowers. Notice the spreading hairs on the stem which are indicative of this species.

Plant Description

Plagiobothrys hirtus is an herbaceous plant which can be 50-60 cm tall and perennial, or considerably smaller and annual, depending on environmental conditions. The upper stems are distinctly hirsute with bright green, simple linear leaves having ciliate margins. Flowering stems are spreading, with paired coiled inflorescences containing many 5-10 mm five-petaled flowers with yellow centers (Figure 2). Each flower can produce four tan-colored to black nutlets. Calyces with fewer than four nutlets are often observed due to fruit abortion or lack of pollination.



Figure 3. *Plagiobothrys hirtus* stem with adventitious roots produced at the nodes. This allows rough popcornflower to reproduce asexually as well as sexually.

Ecology

The preferred habitat for *Plagiobothrys hirtus* is sedge/grass dominated open marsh. These sites are wet and often inundated throughout the winter. Plants are often submerged during this time, emerging when wetlands dry in spring and blooming in mid-summer. Profuse flowering of this plant attracts many generalist insect pollinators. *Plagiobothrys hirtus* plants are also self-fertile. Seed production is generally prolific, and seeds germinate readily when fall rains begin. Plants may reproduce asexually by rooting at the stem nodes (Figure 3), and older plants in optimally hydric habitat produce large clonal vegetation mats before flower initiation begins. In drier sites, plants may reproduce precociously as annuals (Amsberry and Meinke 1997, Amsberry 2001).

Many sites that were good habitat for this plant are currently degraded by infestations of exotic weeds. Associated native species include *Beckmannia syzigachne*, *Limnanthes douglasii*, *Sidalcea cusickii*, *Juncus effusus*, *Juncus patens*, *Deschampsia caespitosa*,

Veronica scutellata, and *Downingia elegans*. Non-native associates include *Mentha puligeum*, *Festuca arundinacea*, and *Dipsacus sylvestris*.

Project Goals

The first goal of this project is to create a recovery level population and establish an on-the-ground management protocol for the endangered rough popcornflower that meets the criteria for a secured reserve, as detailed in the recovery plan for the species. Our objective is to attain a vigorous population of at least 3,000 reproducing plants (from direct out-planting and on-site seed sowing) at an available one-acre publicly administered property. Efforts to achieve this included seed collection in 2005 from appropriate sites, greenhouse-based propagation, on-site noxious weed removal, and hydrologic improvements. The site for the project is the (Roger Johnson) Parcel managed by the Douglas Soil and Water Conservation District (DSWCD) in Sutherlin, Oregon. Collected seed was used to grow plants in flats for augmentation the site in 2006, using techniques shown by ODA to be population-level recovery strategies.

The second goal of our proposed project is to initiate a program aimed at providing a stable popcornflower seed source for distribution (by USFWS) to cooperating land managers for re-vegetation and habitat improvement projects in Douglas County. Made possible through greenhouse cultivation, seeds are stored at Oregon State University. Stored seeds will be made available for future recovery based projects based on criteria established by USFWS.

Partners

The following partners worked on this project: U.S. Fish and Wildlife, Douglas Soil and Water Conservation District, Oregon Department of Agriculture, and Oregon State University.



Figure 4. Seed collection technique showing four mature nutlets produced by a *Plagiobothrys hirtus* fruits. Collected seeds are put into coin envelopes (left), then cleaned and stored for later planting.

Methods

Seed Collection

Seeds for the out-planting were obtained from collections made by the Native Plant Conservation Program staff in 1998, 1999, 2005, and 2006 (Figure 4). The seeds were collected from four sites within the Sutherlin area (Maddux and Meyers 2006). Seeds were collected in the field, plant materials and debris are removed, then the seeds are weighed to estimate number and stored in coin envelopes to keep them from molding. The envelopes were stored in a temperature controlled environment to avoid temperature extreme exposure. Surplus seeds, those collected but not planted, are stored at the ODA Native Plant Conservation Program facilities at OSU. This seed will be used for growing more seed in the greenhouse, or for distribution to other organizations carrying out rough popcornflower projects.



Figure 5. *Plagiobothrys hirtus* plants growing in the greenhouse at OSU.

Propagation

Plagiobothrys hirtus seeds were propagated in an unheated greenhouse at OSU (Figure 5). The seeds were allowed to grow for a few months before being planting in the field. Plants were propagated in January of 2006 for the spring out-planting and in August of 2006 for the fall out-planting. Seeds were planted in plastic trays filled with sterile growing medium and watered frequently to keep the plants wet. High pressure sodium grow lights were used to speed growth in seedlings and to allow proper timing of planting in the field.



Figure 6. Troy Maddux (ODA), Sam Friedman (USFWS) and Eric Riley (DSWCD) plant trays of *Plagiobothrys hirtus*.

Outplanting

The popcornflower augmentation site was initially prepared by a crew from DSWCD and USFWS by removing invasive hawthorns and blackberries. Micro-sites appropriate to rough popcornflower's hydrologic requirements were chosen using indicator plant species of seasonally inundated sites and proximity to an existing water channel.

Vegetation was removed from these sites prior to planting. Plants were put out in the field in April of 2006 and in November of 2006. The spring planting was done by putting out whole trays of *Plagiobothrys hirtus* plants and planting them close together to give them a competitive advantage over invasive weeds that colonize newly disturbed ground (Figure 6). The fall planting was done with a different technique that allowed some space between trays to give the rough popcornflower some room to grow. Weeds were discouraged in this area by planting sloughgrass (*Beckmannia syzigachne*) seeds and plants around the transplants.



Figure 7. Popcornflower planting, taken on the day of the planting in April 2006.



Figure 8. By November 2006, many adult plants had senesced.



Figure 9. By November, many popcornflower seedlings had appeared at the spring outplanting site.

Results

Spring outplanting

Seven hundred greenhouse-grown plants were put out on 4 April 2006 (Figure 7). These plants grew vigorously through the spring and summer, producing copious flowers and seeds, and dying when the site dried out in the summer, having produced over 60 times their number in seedlings (Figure 8). Seedlings were counted in ten randomly selected plots of 1 square decimeter. The number of seedlings in these plots was averaged and then multiplied by 100 to give an estimate for number of seedling per square meter. This produced an estimate of 6090 rough popcornflower plants per square meter. Multiplying this number by the size of the plot, which is about 7 square meters, gives an estimate of 42420 seedlings in the spring out-planting of 700 plants (Figure 9). That is an average of 60.6 seedlings produced per plant, surviving 8 months after outplanting. Five permanent one square-meter plots were established. They are marked with rebar, covered with a one square meter frame, and photographed to allow for long-term monitoring of these plants if interest and future funding make this possible.

Fall Outplanting

Seven hundred additional plants were put out on 8 November 2006. The planting was timed with weather forecasts so that the site was relatively dry at planting, followed shortly by rains that inundated the site, producing ideal growing conditions for the rough popcornflower. These plants were revisited on December 8, 2006 and found to be growing well with some flowers and fruits still intact but not actively growing. As at the spring out-planting site, five permanent one square-meter plots were established at this site, marked with rebar, covered with one square meter frame, and photographed.

Seed Planting

Roughly 5000 seeds were planted at this site in 3 plots of 1 meter square each. The plots were prepared by choosing an area that is close enough to seasonally deep water to get inundated but not too deep to allow for planting of seeds. Vegetation was removed from these areas and the soil was raked smooth. The plot was sprinkled uniformly with *Plagiobothrys hirtus* seeds, marked with rebar, tagged and photographed. Seed numbers were estimated by weighing 200 seeds and extrapolating from that weight to the weight of seed collections. The seeds for the three seed plots are as follows.

Plot #553

- 1500 seeds from DSWCD site
- 200 seeds from William Oerding Popcorn Swale Preserve
- 200 seeds from William Oerding Popcorn Swale Preserve

Plot #554

- 1000 seeds from DSWCD site
- 1000 seeds from William Oerding Popcorn Swale Preserve

Plot #555

- 900 seeds from DSWCD site
- 125 seeds from Sutherlin Park

Revisiting the site next spring will give important information on germination of rough popcornflower at this site (Figure 10). If germination and survival rates are high then much time and effort can be saved by sowing seeds directly. If germination and/or survival rates are low, seed-planting techniques need to be re-examined or site augmentation needs be done with plants grown in the greenhouse, a field technique which has been field-tested and shown to be effective.



Figure 10. Spring out-planting site, a couple of weeks after the fall out-planting. The rain has now inundated the seedlings produced from the spring planting. Notice the large number of seedlings. One seedling has been circled to show which are *Plagiobothrys hirtus*.

Recommendations

The DSWCD site contains good habitat for the long-term growth of hairy popcornflower but it will require some human intervention to continue to support large populations of this plant. Recommended management actions include:

- **Fence the site:** A fence around the site will protect it from cows on nearby private lands. Local land owners have mentioned that cows have been let into this area in the past. A fence will prevent this in the future.
- **Periodically remove competing vegetation:** Periodic mowing or burning will reduce the competition from native grasses and rushes as well as competition from invasive weeds. This will also keep the plant succession of the site from moving into woody vegetation that can shade out and out-compete *Plagiobothrys hirtus*.
- **Exotic plant suppression:** Several exotic plant species occur at this site including, *Rubus armeniacus* (Himalayan blackberry), *Crataegus monogyna* (hawthorn), *Centaurea nigrescens* (tyrol knapweed), *Parentucellia viscosa* (yellow glandweed), *Leucanthemum vulgare* (ox-eye daisy), *Mentha pulegium* (pennyroyal). Eradication of these species is probably not feasible but controlling them is and will give the native species more competitive advantage and a better chance at survival. One of the most worrisome plants in the list above is pennyroyal. This plant colonizes the same, seasonally inundated, microhabitats utilized by hairy popcornflower. For species such as pennyroyal that produce copious seeds, mowing or burning before seed-set could be very helpful. Most of the larger woody species such as the hawthorn and the blackberry have been removed from the site and continued control can be achieved through digging or spot-spraying.

Acknowledgements

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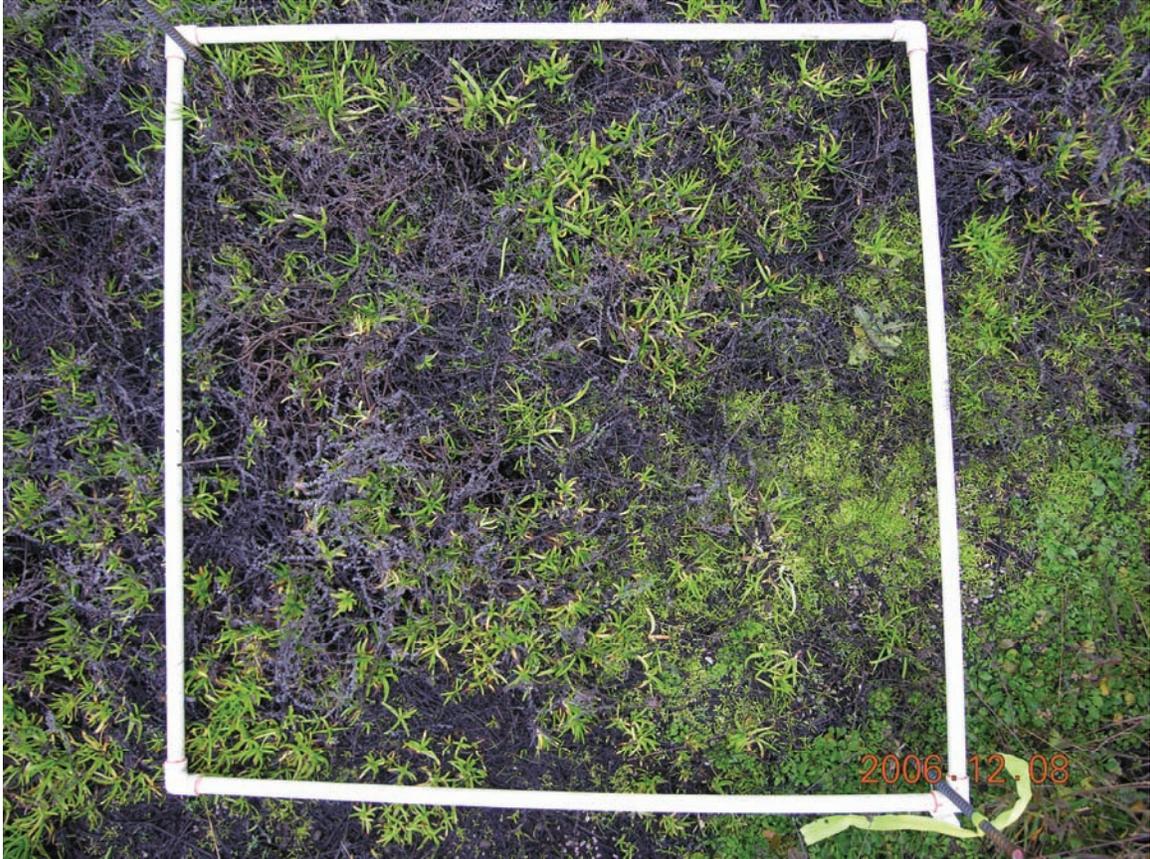
Appendix

Plot photos

The Spring Plots



Plot number 643. This picture was taken on December 8, 2006. The small green plants with linear leaves are *Plagiobothrys hirtus* seedlings that have germinated since April 4, 2006. Those plants put out in the spring are seen here as the dead grayish material over some of the seedlings.



Plot number 644. This picture was taken on December 8, 2006. The small green plants with linear leaves are *Plagiobothrys hirtus* seedlings that have germinated since April 4, 2006. Those plants put out in the spring are seen here as the dead material over some of the seedlings.



Plot number 645. This picture taken on December 8, 2006. The small green plants with linear leaves are *Plagiobothrys hirtus* seedlings that have germinated since April 4, 2006. Notice that the seedlings spread are more numerous than and spread out to a larger area than the original plants which are the dried grayish plants.



Plot number 646. This picture taken on December 8, 2006. The small green plants with linear leaves are *Plagiobothrys hirtus* seedlings that have germinated since April 4, 2006. The grayish plant material in the lower left corner is one of the original out-planted individuals. Notice the seedlings occurs in the inundated regions above and the more upland areas below.



Plot number 647. This picture taken on December 8, 2006. The small green plants with linear leaves are *Plagiobothrys hirtus* seedlings that have germinated since April 4, 2006. Those plants put out in the spring are seen here as the dead material over some of the seedlings.

The Fall Plots



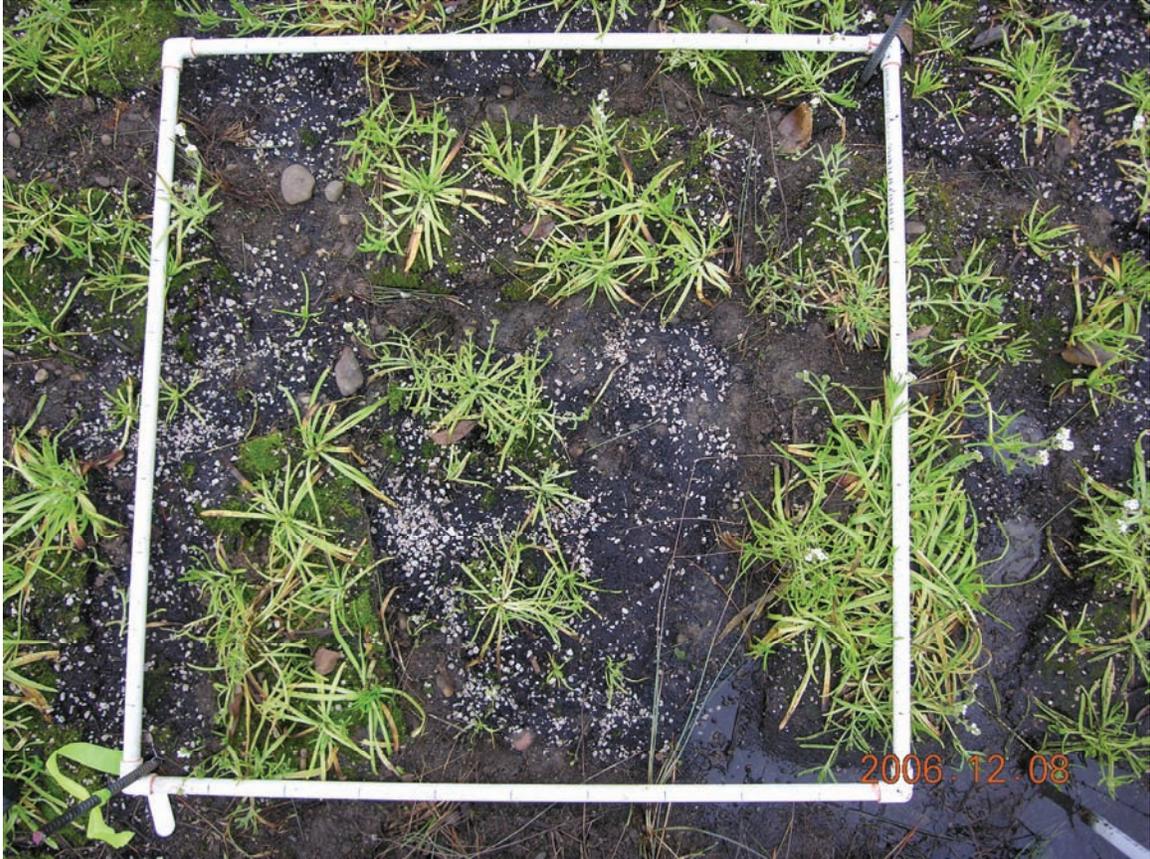
Plot number 648. This plot was planted on November 8, 2006 and this picture was taken one month later on December 8, 2006. Notice the space between the trays to allow the popcornflowers to grow together and form an even larger area of plants. The grass at the bottom of the picture is sloughgrass. It was put out as plants and seeds to help discourage the grow of noxious weeds.



Plot number 649. This plot was planted on November 8, 2006, unlike the spring planting, the plants were put out with space between them to allow the popcornflowers to grow together and form an even larger area of plants.



Plot number 650. This plot was planted on November 8, 2006, and photographed on December 8, 2006. The plants had space between them to allow the popcornflowers to grow together and form an even larger area of plants. The grass at the bottom of the picture is sloughgrass this was put out as plants and seeds to help discourage the grow of noxious weeds.



Plot number 651. This plot was planted on November 8, 2006, and photographed on December 8, 2006. Unlike the spring planting, the plants were put out with space between them to allow the popcornflowers to grow together and form an even larger area of plants. Notice the white flowers on the plants at the right of the frame.



Plot number 652. This plot was planted on November 8, 2006 and photographed one month later. This plot is right on the edge of the channel and is thus inundated for longer than those that are farther from the channel. Unlike the spring planting, the plants were put out with space between them to allow the popcornflowers to grow together and form an even larger area of plants.

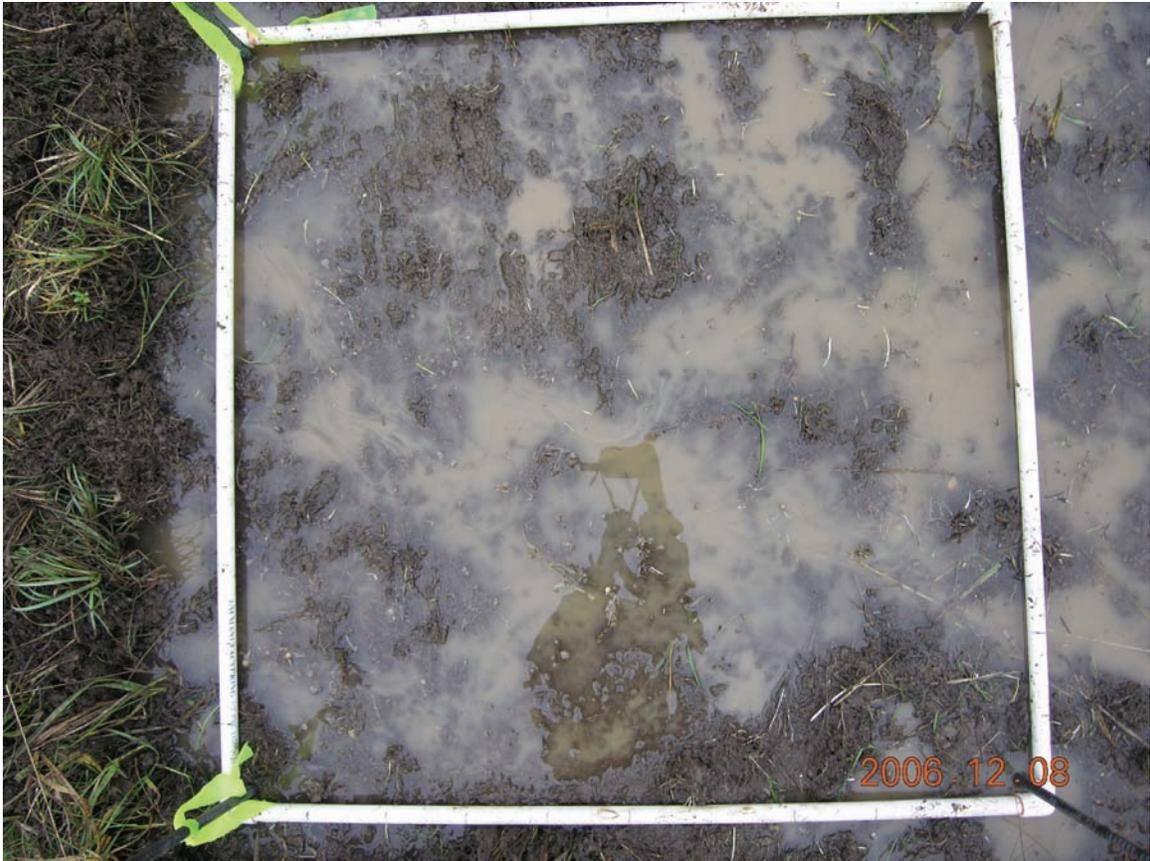
The Seed Plots



Seed plot number 653. This seed plot is a single meter square plot placed in a very wet site, slightly west of the main channel that runs down slope through the property to Sutherlin creek.



Seed plot number 654 is connected to plot number 655. Each of the two plots measures one meter across, they are both just west of seed plot 653 in a very wet site.



Seed plot number 655 is connected to plot number 654 on its western border. Each of the two plots measures one meter across, they are both just west of seed plot 653 in a very wet site.