Ecology and Management of *Ranunculus ficaria* in Rock Creek Park

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ABSTRACT

The invasive non-native plant, *Ranunculus ficaria* (lesser celandine), is a locally abundant, perennial spring ephemeral species found along the forested floodplains of the upper reaches of Rock Creek in Rock Creek Park (ROCR) in Washington, D.C. (Photo 2). The plant grows in dense patches (Photo 1) displacing other vegetation, most importantly native spring vernal species. Part of its aggressiveness and spread-vigor is attributable to the formation of tubers from the roots as well as vegetative bulbils (Photo 4) which can be transported locally or travel extensive distances downstream in floodwaters. Overwintering tubers and bulbils begin sprouting from fall into early spring often forming mats or colonies in mid- to late winter before other species emerge. This early emergence presents a window of opportunity for selective herbicide treatment. There are few literature reports concerning the ecology and control of lesser celandine. This study endeavors to probe further such things as: the conditions that promote its invasiveness, rate and mode of spread, displacement of native species, sensitivity to and timing of herbicide treatments, as well as ability of treated sites to recover with native species. Measures of cover, species displacement, response to herbicide treatments and site recovery post-treatment were accomplished thru the establishment of a statistically valid system of test plots.

Objectives:

1) Test chemical/herbicide treatment efficacies including timing and concentrations, as potential means to manage the extent of and impact from *R. ficaria*

2) Evaluate the ability of local native species to sustain and/or reestablish themselves following treatment; also, similarly evaluate the potential for non-native species to invade

3) Determine the rate of reestablishment of *R. ficaria* following treatments

4) Try to determine the means and rate of spread of *R. ficaria*

5) Evaluate the impact of *R. ficaria* growth on local plant populations.

Two additional objectives evolved during the course of the project:

6) Test the importance of retreatment by respraying half of the plots

7) Bracket the lower herbicide concentration (0.75%) by adding two lower herbicide dosages.

The study hypothesis stated that the herbicide Rodeo formulation of glyphosate could be used to selectively control the invasive non-native species, *Ranunculus ficaria,* when applied at an optimal concentration and time of year; and that treated areas would recover with native spring vernal wildflowers.

The project was a cooperative effort between USGS/PWRC and NPS ROCR.

EXPERIMENTAL DESIGN

Two ~20 acre (8 ha) floodplain areas in upper ROCR were identified for the study. Herbicide study plots were randomly selected in *R. ficaria* colonies using ArcView's random selection function (ESRI, 1998) and located to within 1 m using real-time corrected GPS navigation (Trimble, 1998). The experimental design consisted of a series of ten 1 m^2 plot replications per treatment per area. The treatments (N=10) included two herbicide levels (Rodeo - 1.5% and 0.75%) and two treatment times depending on weather and growth conditions. There were 10 control plots per area containing *R. ficaria* that were left untreated (sprayed with herbicide mix minus the herbicide). The plots were read for total plant cover (herbaceous), per cent cover of lesser celandine, cover of other species, and contributing cover by soil/detritus/leaves. The first treatment time was made in late winter/early spring when *R. ficaria* came into full leaf but before most other herbaceous ephemerals sprouted. Since this may not be the most efficacious time for herbicide activity, as conditions seemed suitable during flowering or shortly thereafter, a later treatment was made. The treatment area covered the plot and a 1 m buffer around each plot to assure that plots were not immediately reinvaded by adjacent plants (Photo 5). There was also a set of 10 1M ^{2} plots established at the advance edge of *R. ficaria* infestation to measure the rate of plant growth/colony expansion. Percent cover of *R. ficaria* in these plots were also documented. All plots were read before treatment and after treatment when spring ephemerals were at their peak. Then the plots were reread in Years 2 and 3 looking for regrowth of the *R. ficaria* and establishment of native herbs. Additional treatments were applied in Year 2 to include retreatment of the 0.75% and 1.5% in early March and treatment at two lower concentrations to bracket the most effective treatment concentration. Based on the primary treatment periods 100 plots will be established (50 for each of the treatment concentrations and controls). Additional plots were established to cover other tests.

MAJOR RESULTS:

1. Effects of Rodeo Treatments on *R. ficaria* over Time

Single Early Spray treatments with 0.75% and 1.5% Rodeo in early March 2000 reduced *R. ficaria* cover significantly to ~5% in April 2000 (Photo 5). In the two years subsequent to treatment, *R. ficaria* showed an initial decrease in cover (March 2001), followed by gradual increases as the *R. ficaria* recovered from the single early treatment (Figure 1). By April (T2) 2002, *R. ficaria* cover in both Early Spray treatments had increased significantly compared to previous years. Significantly greater *R. ficaria* cover in the 0.75% Rodeo plots (52% *R. ficaria*, compared to 29% in the 1.5% Rodeo plots) suggests that *R. ficaria* was able to bounce back more quickly from the 0.75% Rodeo treatment compared to the 1.5% Rodeo treatment (Figure 1). An Early Respray conducted in early March of the second project year (2001) produced lower levels of *R. ficaria* in the respayed plots compared to the corresponding single-treatment plots (Figure 2).

2. Effects of Rodeo Treatments on Native Cover over Time

The only significant effect on the native species from the Rodeo treatments was an increase in June (T3) 2002 for the 1.5% respray treatment, which one would expect to be the most deleterious, but if it removed most of the competitive *R. ficaria* then recovery of native species over time would be in order (Figure 3).

3. Effects of Rodeo Treatments on non-*Ranunculus ficaria*/non-Native Cover

The data reflecting the question as to whether the treatments permitted or encouraged invasion by exotic species other than *R. ficaria* suggests very little occurred during the course of the study(Figure 4).

DISCUSSION:

The cover produced by growth of the vernal *Ranunculus ficaria* was most impressive, almost a monoculture, such that by mid-April it covered nearly 95% of the Rock Creek floodplain in the study areas, although the density was greater in some patches than others (Photo 1). When *R. ficaria* was in bloom in April the floodplain became a sea of yellow flowers (Photo 2). While we were unable to find quantitative historic data for native vernal species in Rock Creek Park, the memories of local naturalists such as Bob Ford and Bill Yeaman recall the floodplain in Rock Creek Park dominated by vernal natives such as spring beauties (*Claytonia virginica*), dogtooth violet (*Erythronium americanum*), and Virginia bluebells (*Mertensia virginica*).

We also visually compared the study areas at Rock Creek with a similar bottomland hardwood forest at Patuxent Wildlife Research Center, which has not been invaded by *R. ficaria* (Photo 3). Note the sea of pink produced by spring beauties and other native vernal species. No relatively undisturbed comparable area free of *R. ficaria* was located in Rock Creek Park. As a result of these observations and others we can surmise that much of the pre-existing native vernal species has been displaced following invasion by *R. ficaria*.

Based on these results we would recommend treating two years in a row with the 1.5% concentration with the point being that there would be considerably less spraying needed the second year. Thereafter, one could use judgment and perhaps skip a year or plan on coming back and applying spot treatments to keep the population suppressed perhaps even to the point of elimination. The difficulty with an elimination goal is not with the treatment efficacy but with the likelihood that new propagules will enter the treatment area, most likely from upstream. The purpose of treating two consecutive years despite treatment response is that there inevitably will be a portion of escapes the first year. These may come from new growth overlapping and protecting plant components underneath, some bulbils or even plants may remain dormant for a year or more, the spray technique is not perfectly even and likely will miss or hit some patches with reduced chemical spray, and by spraying early (the desired treatment time is early March) not all (but most) of the plants will have emerged. A gallon of Rodeo costs roughly $100 and can treat an acre; therefore much of the management costs are attributed to personnel time. This means the management goal will likely be to minimize field time and achieve the greatest treatment effect possible while in the field. Some of this relies on each manager finding out what works best for him/her. This is because there is a point where reduced plant presence starts creating more field time than desirable on a per plant basis although one could also manage on a treatment area basis. Again, one must decide whether the goal is simply suppression such that programmatically it may be necessary to treat periodically indefinitely, or if one feels elimination is possible in a situation, then considerably more effort would need to be expended up front.

Figure 1. Overall Effects of Rodeo Treatments on *Ranunculus ficaria* Cover over Time Showing Significance of Differences within Sampling Events

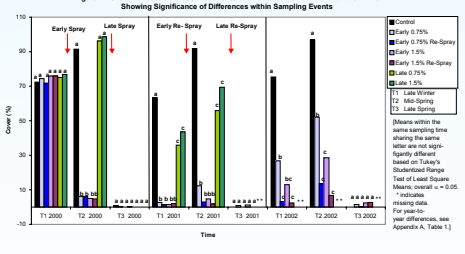

Figure 3. Effects of Early 1.5% Rodeo Treatment with and without Re-Spray on *Ranunculus ficaria* Cover over Time

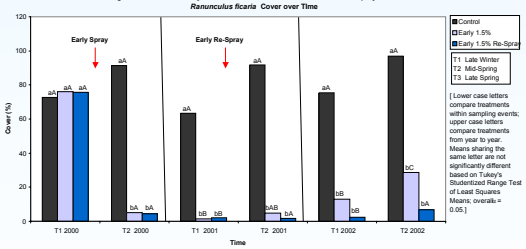

Figure 5. Side Effects on Native Species Cover from *Ranunculus ficaria* Treatments over Time

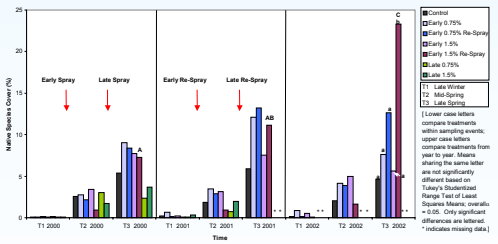

Figure 6. Side Effects on non-*Ranunculus ficaria*/non-Native Cover from *Ranunculus ficaria* Treatments over Time

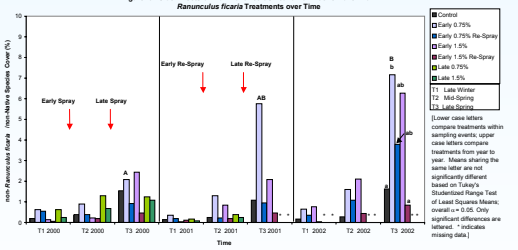

Photo 1. Ranunculus ficaria grows densely often excluding native vegetation.

Photo 2. Display of Ranunculus ficaria in flower covering much of the Rock Creek floodplain.

Photo 3. Floodplain along Patuxent River displaying spring vernal flora as might have occurred along Rock Creek prior to Ranunculus ficaria invasion.

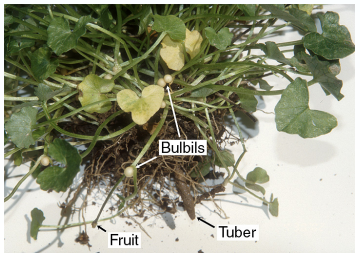

Photo 4. Ranunculus ficaria plant displaying fruit, tuber and bulbils.

Photo 5. An area of Rock Creek floodplain with a portion revealing Glyphosate treatment of Ranunculus ficaria.