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A Status Report on Harperella, *Ptilimnium nodosum* (Rose) Mathias, in Arkansas

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Introduction

A survey of the federally endangered *Ptilimnium nodosum* (Apiaceae) was conducted in Arkansas during August 2000. During the course of the research, 12 populations of the species in the state were visited to estimate population size. *Ptilimnium nodosum* is unique in both morphology and habitat requirements. The unique morphological characteristics that differentiate the plant from all others in this family are its hollow, septate, quill-like leaves (Easterly, 1957). *Ptilimnium nodosum* is distributed across the eastern and southern flanks of the Appalachian Mountains in six southeastern states in the U. S.: Alabama, Georgia, Maryland, North Carolina, South Carolina, and West Virginia (Bartgis, 1997).

After review by the U. S. Fish and Wildlife Service, the plant was listed as a federally endangered species in 1988 (U. S. Fish and Wildlife Service, 1988). Two years later, the plant was discovered in Arkansas (Bates, 1993). Since that time, multiple occurrences have documented extending the range of the species in Arkansas to four counties (Montgomery, Garland, Scott, Yell) in the Ouachita and Fourche LaFave watersheds. This study will establish a highly repeatable and accurate method by which populations of *P. nodosum* may be monitored. Accurate population estimates are essential to the formulation of sound management policies and to address the impact of various forestry or recreational activities in the area.

Methods

Twelve populations of *Ptilimnium nodosum* were surveyed to determine population size. Two procedures were used. On sites comprised of a small number of individuals, i.e., less than about 250 plants, a complete census of the populations was made.

For larger occurrences, a sampling procedure was used to estimate population size. The technique involved two basic steps, an estimate of the area of occurrence and a 10 % sample based on a stratified random design. The area of occurrence was determined by using the off-set method (Christians and Agnew, 2000). This method is appropriate for measuring irregularly shaped but discrete areas.

The first step in utilizing the off-set method is determining the longest axis of the occurrence. A line is established to bisect the occurrence into roughly equal halves. Next, the total length of the occurrence is determined and offset lines are established at right angles to the long axis of the occurrence. Offset lines divide the long axis of the occurrence into equal segments. The long axis and offset lines served as a grid for stratified random sampling of the area.

The area of the occurrence was calculated by adding the measurements of all offset lines and multiplying the sum of these by the interval used to mark offsets along the main axis. This provided an estimate of the occurrence in square meters.

To determine sample size, the total area of the occurrence was multiplied by 10 %. This provides the total area necessary for a 10% sample of the population. The sample plot size was established at 0.5 m^2.

Plots were systematically placed throughout the occurrence so that each subdivision had an equal number of plots. Plots were randomly assigned within each subunit. This resulted in a uniform number of plots per subdivision while maintaining a random plot layout. The number of individual *Ptilimnium nodosum* plants was recorded in each plot. Plot counts were totaled and multiplied by 10 to yield a total population estimate.

Results

The 2000 survey resulted in a total population estimate of 31,517 individuals at 12 locations in the Ouachita Mountains. Table 1 summarizes the results of this survey and also provides population estimates generated from two previous surveys. It is important to note the methods employed to estimate population size in previous years differ from the current survey. Therefore, past estimates are not directly comparable to the current study.

Discussion

The 2000 survey generated population estimates greater than any previous survey. Specifically, the difference between the last survey of 1999 and the survey of 2000 was in excess of 21,000 plants. Since different methods were employed on previous studies, it is impossible to know if these differences represent increases in population size or simply reflect differences due to sampling methodology. It should be noted that the plants' small size and high density make population estimates problematic when non-systemat-

Table 1: Population sizes from previous studies compared to current study.
Note: populations that were not previously surveyed are denoted with an na.

Location	1996	1999	2000
Fiddlers Creek, Site 1	250	500	2832
Fiddlers Creek, Site 2	na	225	632
West Fiddlers Creek, Site 3	na	250	2001
Irons Fork, Site 4	2500	na	5834
Irons Fork, Site 5	2000	500	11691
Irons Fork, Site 6	500	500	2700
Irons Fork, Site 7	na	50	110
Irons Fork, Site 8	500	500	312
Irons Fork, Site 9	10,000	na	3177
Irons Fork, Site 10	75	na	55
Ouachita, North Fork, Site 11	50	na	52
Rainy Creek	na	1000	2476

ic methods are used. We can conclude from these data that past population estimates were low. It seems improbable that the populations would have undergone such a dramatic increase in one season. The problems of comparing past survey data should further underscore the importance of establishing standardized sampling methods. This is essential to provide meaningful data sets for longitudinal studies of this species. Although no sampling technique is perfect, population trends can be effectively and repeatedly estimated by the methods employed in this study.

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