

LONG-TERM POPULATION MONITORING OF
DAVIS' PEPPERGRASS (*LEPIDIUM DAVISII*)
ON THE MOUNTAIN HOME AIR FORCE BASE:
ESTABLISHMENT OF MONITORING PLOTS AND FIRST-YEAR RESULTS

by

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November 1991

Report Submitted to the Mountain Home Air Force Base
as part of the
Department of Defense
Legacy Resource Management Program

ABSTRACT

Lepidium davisii (Davis' peppergrass) is a regional endemic restricted mainly to Ada, Elmore, and Owyhee counties, Idaho, and small parts of Twin Falls County, Idaho, and Malheur County, Oregon. In addition to a narrow distribution, it is also restricted to a very narrow set of habitat conditions: flat, hard floors of dry lake beds known as vernal pools or playas. These small, isolated habitats are subjected to numerous and varied disturbances. For these reasons it is a category 2 candidate for federal listing.

Recent rare plant surveys of the Mountain Home Air Force Base revealed the presence of three populations of Davis's peppergrass on the Small Arms Range. The emphasis of this study is to help meet monitoring requirements for any future pre-listing Conservation Agreement between the Air Force and the U.S. Fish and Wildlife Service. A demographic monitoring program will provide pertinent population data to develop a habitat management plan. During June and July, 1991, six permanent monitoring transects were established in the Davis' peppergrass population on the Small Arms Range. A total of 832 Davis' peppergrass plants were mapped in six transects. Selected density and fecundity data are presented.

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INTRODUCTION

The management of natural communities containing rare plant populations poses several basic questions for land managers? Are current land management practices adequate to maintain the community or the species? What effect will specific management activities have on the survival of a species? What is necessary to ensure the survival of a species? Most of these questions cannot be answered by casual observation and, therefore, some level of monitoring is needed (Sutter 1986).

For this study, monitoring is defined as the quantitative assessment of the status of a population over time using data derived from individual plants. A monitoring census is accomplished by identifying individual plants in a population and repeatedly measuring characteristics of their viability and health.

Demography is the study of population changes and their causes throughout the life cycle (Moseley and Mancuso 1990). Population attributes such as germination and mortality rates, growth, size, density and distribution are some of the characteristics measured. Demographic studies of plants have indicated that each population possesses attributes that determine local abundance and/or persistence through time. A thorough analysis of these attributes is of primary importance in the management of rare and endangered plants, simply because abundance and persistence are at the center of all conservation efforts (Pavlik and Barbour 1988). Demographic monitoring studies can help determine the factors that control the abundance and distribution of a species and can generate data useful in predicting the future size and age structure of a population.

Demographic monitoring of rare plant species has become increasingly important as the efforts of agencies have evolved from an emphasis on the inventory and status determination of rare species to active protection efforts, such as management of rare plant populations. Such is the case with *Lepidium davisii* (Davis' peppergrass). A demographic approach will reveal possible limiting stages in the life cycle, if any, and suggest alternative management (Harvey 1985; Pavlik and Barbour 1988).

Because of a high degree of habitat specificity, narrow range, and numerous threats, Davis' peppergrass is a category 2 candidate for listing under the Endangered Species Act (U.S. Fish and Wildlife Service 1990). A majority of Davis' peppergrass habitat occurs on Bureau of Land Management (BLM) land, where a pre-listing Conservation Agreement was recently signed between the BLM and the U.S. Fish and Wildlife Service (Anonymous 1989). The Conservation Agreement outlines BLM responsibility for conserving and monitoring Davis' peppergrass habitat under its jurisdiction. These small, isolated habitats (vernal pools) are subjected to numerous and varied disturbances, including livestock trampling, construction of water storage reservoirs, recreational and military vehicle use, rangeland fires and related increase in sedimentation rates, herbicide spraying, rangeland rehabilitation, and other disturbances (Debolt and Doremus 1989).

In 1990, a rare plant survey performed on the Mountain Home Air Force Base revealed the presence of three populations of Davis' peppergrass on the Small Arms Range (Thompson 1990). Two of the three vernal pools have had a history of disturbance, while the surrounding landscape has been highly altered and may be contributing to the weed invasion in the vernal pools and possibly to increased rates of sedimentation. In addition, Davis' peppergrass may have been extirpated from a small, highly disturbed vernal pool where no peppergrass was found.

Goals

The emphasis of our study on the Small Arms Range was to help meet monitoring requirements for any future Conservation Agreement between the Air Force and the U.S. Fish and Wildlife Service. The results of this study will provide important data for management plan development.

The study has three major areas of focus:

1. The largest part is to initiate demographic monitoring of populations of Davis' peppergrass on the Small Arms Range;
2. To measure sedimentation rates in the vernal pool habitats;
3. To collect seeds from an appropriate number of plants and to deposit them in the Berry Botanical Gardens, Portland, OR; and,
4. To determine the effect of exotic species invasion on the population viability of Davis' peppergrass.

NATURAL HISTORY AND MORPHOLOGY

Davis' peppergrass is a regional endemic restricted mainly to Ada, Elmore and Owyhee counties, Idaho, and small parts of Twin Falls County, Idaho, and Malheur County, Oregon. In addition to a narrow distribution, it is also restricted to a very narrow set of habitat conditions: flat, hard floors of dry lake beds known as vernal pools or playas.

Davis' peppergrass is a deep-rooted perennial with a low compact growth form commonly referred to as a clump or cushion. The plant is described as follows: stems are many, slender, mostly unbranched, 4-8 cm tall with small, pubescence of white, simple hairs; leaves simple, sessile, narrowly spatulate, greenish but usually gray with adhering clay, sparingly pubescent to glabrous, 1-2.5 cm. long; inflorescence subcorymbose; petals white, spatulate, 2-3 mm long; siliques crowded, ovate to sparingly pubescent, flattened contrary to replum, slightly notched at apex 3-5 mm long, 2-4.5 mm wide; style about 0.5-0.75 mm long (Packard 1979).

METHODS

Sampling

Demographic Data Collection

For recording Davis' peppergrass demographic data we used methods developed by Lesica (1987). The technique employs a contiguous, subdivided belt transect that has been found to be useful for nonrhizomatous perennial plants with low to moderate density.

Six belt transects were established on the largest, most undisturbed and most accessible vernal pool. The first transect was randomly located with the remaining five transects located roughly parallel at randomly determined intervals. However, consideration was given to locate transects far enough apart to avoid stepping in any other transect when collecting data.

A transect consists of adjacent 1 m² quadrats placed along one side of a tape stretched between the start and end points. The quadrat is graduated in 1 cm increments along the x and y axes to be used for establishing a coordinate locator for each target plant encountered. For each quadrat along the transect there is a corresponding box on the data form where the location of each plant is mapped. Coded life history data for each plant are written next to the corresponding mark on the data form (see Appendix 1).

Lesica (1987) found that life history codes have to be developed on a case by case basis. Following is a list of categories and their codes that were used for Davis' peppergrass.

Stage classes

- S Seedlings - very small plants with one rosette of leaves. Attributes recorded: presence/location.
- N Nonreproductive - plants greater than one rosette that are not producing inflorescences. Attributes recorded: presence/location.
- R Reproductive - plants that have one or more inflorescences. Attributes recorded: (1) presence/location; (2) reproductive classes as described below.

Classes for reproductive plants

- I Indicates the number of inflorescences per plant. Branched stems were counted as one inflorescence.
- A Indicates the number inflorescences where all fruits were aborted per plant.
- P Indicates the number of inflorescences removed by predation per plant.

Size

Size of each plant was calculated by measuring the diameter of each plant and averaging of the longest and shortest dimensions of the living portion of the cushion, in centimeters.

Sedimentation Rates

Increased sedimentation of vernal pools resulting from the degradation of the surrounding landscapes is believed to have resulted in the decline in at least four populations of Davis' peppergrass (DeBolt and Doremus 1989). Thompson's (1990) survey indicates that this may be a threat to populations on the Small Arms Range. To measure sedimentation input into the vernal pools, we used methods developed by the Boise District, BLM. The relatively simple method involves driving rebar into selected areas of the vernal pools and measuring the above-ground height of the bar during successive years.

Seed Collection

No analysis of genetic variability of Davis' peppergrass has yet been undertaken. The isolated nature of its habitat and the location of the Small Arms Range populations at the northern edge of the species distribution, however, suggests that the Air Force may be managing important and unique genotypes. Although habitat preservation is the most efficient and prudent method of genotype conservation, the use of long-term seed storage facilities has recently become viable. As recommended in Thompson (1990), seeds will be collected from an appropriate number of plants in each vernal pool and deposited them in facilities at the Berry Botanical Garden. Berry, located in Portland, Oregon, is the Pacific Northwest regional repository for rare plant seed.

Population Modeling

After three years of demographic data have been collected, modeling can be used to predict the extinction probability and minimum viable population level in individual plant populations. We will use transition matrix techniques to project population age structures through time. Refer to Bierzychudek (1982), Menges (1986) and Fiedler (1987) for detailed explanations of the use of transition matrices for studying plant population dynamics.

Matrix projections for Davis' peppergrass will begin with the stage structure (i.e., seed, seedling, nonreproductive, reproductive) of the population in 1990. The stage structure then changes over one year as some individuals remain at that stage, while others grow to another stage or die. Stage-specific survivorships, fecundity, and transfer (growth) rates project the future dynamics of the populations.

Matrix projections will be computed using "RAMAS/Stage: Generalized Stage-based Modeling for Population Dynamics", a transition matrix modeling program by Scott Ferson of Applied Biomathematics, Setauket, NY.

Exotic Species Competition

To determine how competition from exotic species affects the population viability of Davis' peppergrass, every other transect was weeded of all exotics. In nonweeded transects the number of each exotic species was recorded by plot.

RESULTS

During June and July, 1991, we established six transects in Davis' peppergrass populations on the Small Arms Range. The location of the transects appear on a map in Appendix 2. As summarized in Table 1, three transects were weeded of exotic species and three were nonweeded.

Table 1. Demographic monitoring transects for Davis' peppergrass on the Small Arms Range, Mountain Home, Idaho, July 1991.

#	Weeded/Non Weeded	Length (m)
1	Weeded	40
2	Nonweeded	52
3	Weeded	38
4	Nonweeded	37
5	Weeded	29
6	Nonweeded	36

For each transect, the location of each plant and pertinent coded life stage and reproductive data were recorded. A summary of density and selected fecundity data is presented in Table 2.

A total of 832 Davis' peppergrass plants were mapped in six transects. The highest density population was found in transect six and the lowest in transect two. Only 11 seedlings and 79 nonreproductive plants were observed in the six transects, for 1% and 10% of the population respectively. Very few plants showed signs of predation. No seeds were collected because greater than 95% of the inflorescences aborted in 1991.

Rebar (4'6" by 0.5") was used to mark the beginning and end of the transects. A piece was also placed at roughly eleven meters along the transects to facilitate plot locations and to determine sedimentation rates over time. The height of the portion of the rebar extending out of the ground was measured. Table 3 lists rebar location and height by transect.

Table 2. First-year population density and fecundity data for Davis's peppergrass in long-term transects established on the Small Arms Range, 1991.

TRANSECT #	1	2	3	4	5	6	
Total # plots/transect		40	52	38	37	29	36
Total # plants/transect		135	194	181	139	87	196
Density (plants/m ²)		3.4	3.7	2.1	3.8	3.0	5.4
Avg diameter of plants (cm)		10.8	7.1	12.2	10.2	9.6	6.5
Total # seedlings/transect (% population)		4 (3%)	5 (3%)	0 (0%)	0 (0%)	0 (0%)	2 (1%)
Total # nonreprod/transect (% population)		3 (2%)	26 (13%)	3 (4%)	11 (8%)	14 (16%)	22 (11%)
Total # reprod/transect (% population)		127 (95%)	163 (84%)	78 (96%)	128 (92%)	73 (88%)	172 (87%)

Table 3. First-year height of rebar on six transects on the Small Arms Range, 1991.

Transect #	Rebar Location	Height (mm)
1A	0 m	337
1B	11	320
1C	22	310
1D	34	383
1E	40	361
2A	0	329
2B	11	370
2C	22	396
2D	37	386
2E	52.4	495
3A	0	288
3B	11	356
3C	22	527
3D	39	325
4A	0	370
4B	11	412
4C	22	574
4D	32	378
4E	38.8	384
5A	0	370
5B	11	339
5C	22	472
5D	30.6	346
6A	0	286
6B	11	417
6C	22	655
6D	32	538
6E	37.7	429

RECOMMENDATIONS

A minimum of three years of data are needed to make predictions on future population trends using matrix models, although a decade or more of data will appreciably increase the power of the model by including relatively long-term annual variability.

Population modeling and consequent analyses of extinction probabilities and minimum viable population sizes cannot take place until after the third year of data are collected. Funding to collect the second year's data has been requested through the Department of Defense's Legacy Program.

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APPENDIX 1.

1991 demographic data field forms for six Davis' peppergrass monitoring transects
on the Mountain Home Air Force Base Small Arms Range.

APPENDIX 2.

Map showing the location of six demographic monitoring transects established
on the Mountain Home Air Force Base Small Arms Range.