

ANALYSIS OF COMMUNITY COMPOSITION AND HABITAT  
OF PEDIOMELUM PARIENSE (FABACEAE)  
IN BRYCE CANYON NATIONAL PARK

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ABSTRACT - The distribution of Pedimelum pariense in Bryce Canyon National Park, Utah, and the vegetation and soils associated with it are described. Management suggestions are presented.

Information about the habitat of a plant species proposed for threatened or endangered designation is essential. A detailed habitat description provides guidance for the search for other possible locations to improve knowledge of the species' distribution and abundance, which can affect decisions about its status and identify areas where special protection may be warranted. A habitat description also provides information required for planning and executing recovery programs: selection of possible transplant sites; guidelines for vegetation manipulation to increase or improve habitat.

*Paria breadroot*, Pedimelum pariense (Welsh & Atwood) Welsh (= Psoralea pariensis Welsh & Atwood), is under consideration for Federal protection as a threatened species (Welsh and Chatterley 1985). The type specimen was collected in Bryce Canyon National Park, and this Utah endemic is known elsewhere only from two locations in Kane County. This paper describes the habitat of the Bryce Canyon population of *Paria breadroot*.

STUDY AREA

The study area is located in Bryce Canyon National Park on the canyon rim on the east edge of the Paunsaugunt Plateau in southern Utah. Surficial geology consists of Wasatch Formation limestones derived from Tertiary fresh-water sediment depositions (Hintze 1973, Lindquist 1977). The soils are fine-

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textured with varying amounts of coarse fragments, and the surface is often covered with a stony pavement. The terrain is flat to slightly undulating with occasional draws. Elevation is about 8000-83000 feet.

The vegetation is open forest, consisting largely of the Pinus ponderosa/Arctostaphylos patula (PIPO/ARPA) habitat type with pockets of the Abies concolor/Arctostaphylos patula (ABCO/ARPA) habitat type, especially in the draws (Youngblood and Mauk 1985).

#### METHODS

Areas where *Paria breadroot* is known to occur were searched for the plants and mapped (Fig. 1). Other portions of the Park having similar combinations of forest habitat and soils, based on U.S. Soil Conservation Service soils maps, were also searched.

Eight 0.1 acre macroplots were located subjectively to describe areas where the species occurs. Each macroplot had a 100-foot line-intercept transect, randomly oriented, running through its center. Ten 20 X 50 cm quadrats were placed at 10-foot intervals along the right side of the transect, and perpendicular to it, beginning at the 10-foot mark. Understory cover was estimated from the quadrats (Daubenmire 1959), and frequency and density were estimated from the transect. Trees within the macroplot were measured for breast-height diameter (dbh) to determine basal area.

After vegetation sampling, ten samples of the surface 10 cm of mineral soil were taken at 10-foot intervals, beginning at the 10-foot mark of the transect, air dried, pooled by macroplot, and analyzed for pH, percent organic matter, P (sodium carbonate solution), and Ca, Mg, and K (sodium acetate solution).

Taxonomic nomenclature follows Welsh et al. (1987).



## RESULTS

The observed distribution of *Paria breadroot* is shown in Fig. 1. No other populations were found.

Macroplots 2 and 6 were located in the ABCO/ARPA habitat type, the rest were in the PIPO/ARPA habitat type. Average cover, frequency, and density of understory species by macroplot are shown in Table 1. Tree diameter class and basal area estimates by macroplot are given in Table 2.

Arctostaphylos patula was constant throughout and was the dominant shrub, in terms of cover, frequency, and density, in all macroplots except macroplot 6, which was located in the ABCO/ARPA habitat type. There it had the same density as Mahonia repens, but occurred more frequently. Mahonia repens had a greater estimated coverage but this may be an incorrect assumption since it did not occur in any of the quadrats and its cover was estimated from the line-intercept transect.

Carex rossii was the only graminoid to occur in all macroplots and was generally dominant. In macroplot 1, Elymus elymoides had greater density than C. rossii, but accounted for less cover and frequency. Macroplots 3 and 6 were dominated in all respects by Stipa hymenoides.

No single forb species, other than P. pariense, was universally constant among macroplots. The most common forbs were Arenaria fendleri, Hymenoxys acaulis, and Petradoria pumila. Dominance of the three species varied among the five macroplots in which they were found together such that no one species can be considered to be dominant among forbs for the study area.

Shrubs were the dominant understory morphological class, followed closely by forbs. Graminoids were relatively unimportant. In general, the understory vegetation with which P. pariense is associated is dominated by A. patula and a



mixture of forbs and graminoids, especially A. fendleri, H. acaulis, P. pumila, and C. rossii.

In the overstory, the macroplots in the PIPO/ARPA habitat type were dominated by the signature tree except macroplot 4 where the only measurable tree was Juniperus scopulorum. Pinus ponderosa was incidental in the occurrence of young trees too short for dbh measurement. The distribution of diameter classes of P. ponderosa in the six PIPO/ARPA macroplots indicates that vegetation in this habitat type is at or near climax, and approximates the description of this type given by Youngblood and Mauk (1985).

In the two macroplots in the ABCO/ARPA habitat type, A. concolor is associated with other, less shade-tolerant, trees and is not dominant, indicating that these sites are in an early seral stage. Continued development of A. concolor on these sites will probably lead to additional crown closure and loss of some or all of the associated tree species.

When the macroplots are lumped according to the habitat types, P. ponderosa dominates in terms of basal area in both types: about 70% (25 ft<sup>2</sup>/ac) in the PIPO/ARPA type and about 45% (33 ft<sup>2</sup>/ac) in the ABCO/ARPA type (Table 3). Pedimelum pariense was found in measurable quantities in all PIPO/ARPA macroplots except macroplot 7, a harsh site dominated by Pinus longaeva. Of the ABCO/ARPA macroplots, only macroplot 2 had measurable quantities of P. pariense. This species was incidental on macroplot 6 which had the greatest tree basal area of all macroplots.

The results of the soil analysis are presented in Table 4. The most noticeable feature is the wide fluctuation in the Ca:Mg ratio. These fluctuations did not seem to affect the presence of P. pariense, however, as the sites with the highest and lowest ratios were similarly endowed with this species.



## CONCLUSIONS

The results of this study indicate that Pendiomelum pariense is an element of open-growth climax PIPO/ARPA type forests on Wasatch Formation limestone soils, with dominant understory species consisting of Arctostaphylos patula, Arenaria fendleri, Hymenoxys acaulis, Petradoria pumila, and Carex rossii. It may also appear in early seral stages of other forest habitat types on these soils, associated with climax PIPO/ARPA, when the crown canopy is still open. Crown closure would probably eliminate the species from these types.

Until the status of Paria breadroot is determined, the sites where it occurs should be protected from disturbance. One small patch of the species is near the trail between the Paria View overlook and a parking lot. Any development there should be pursued very carefully to avoid damaging or destroying the site. Because the species grows quite close to the rim of the canyon to the south of Paria View, any hiking trail or other tourist facility development there should also be planned with care or avoided.

Other sites in the Park, and elsewhere in southern Utah, with similar vegetation and soils characteristics should be carefully searched for other populations of Paria breadroot.

Vegetation manipulation to improve the habitat of the species is an option to be considered. This could consist of the removal of more shade-tolerant tree species from stands where P. pariense occurs and where P. ponderosa dominates, thus reducing tree basal area and maintaining an open canopy. This is probably a relatively short-term aid to the survival of the species and great care must be exercised to avoid damaging breadroot plants and disturbing the understory unduly.

Seeding or transplanting may be possible to increase the distribution and abundance of Paria breadroot. To be safe, only sites closely approximating



those described here should be used for such exercises. Because of the limited number of plants available seeding should be considered first to avoid loss of existing plants. Transplanting from less-than-optimum seral sites should be the next method to be considered. In any case, attempts to introduce the species on other sites should be preceded by studies of its reproductive biology so that existing populations will not be depleted needlessly.

#### ACKNOWLEDGMENTS

We thank Linda Kerr, Bryce Canyon National Park, for her administrative and field assistance. This work was funded by National Park Service Research Cooperative Project.

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Table 1. Cover, frequency, and density of plant species.

| Macroplot number                 | 1            | 2            | 3            |
|----------------------------------|--------------|--------------|--------------|
| Location:                        |              |              |              |
| Quarter quarter                  | SENW         | SENW         | NWSW         |
| Section                          | 13           | 13           | 13           |
| Township                         | 37S          | 37S          | 37S          |
| Range                            | 4W           | 4W           | 4W           |
| Topographic position:            |              |              |              |
| Slope (percent)                  | 5            | 20           | 5            |
| Aspect (degrees)                 | 65           | 145          | 345          |
| Elevation (feet)                 | 8240         | 8200         | 8280         |
| Bearing (degrees)                | 328          | 122          | 164          |
| Cover/Frequency/Density          |              |              |              |
| Trees                            |              |              |              |
| <i>Abies concolor</i>            | -            | *            | -            |
| <i>Juniperus osteosperma</i>     | *            | -            | -            |
| <i>Juniperus oespulorum</i>      | -            | (1.7)/10/2   | *            |
| <i>Pinus longaeva</i>            | -            | -            | -            |
| <i>Pinus ponderosa</i>           | *            | *            | *            |
| <i>Pseudotsuga menziesii</i>     | -            | *            | -            |
| Shrubs                           |              |              |              |
| <i>Arctostaphylos patula</i>     | 3/30/4.1     | 12.8/100/51  | 7.9/100/33.7 |
| <i>Ceanothus martinii</i>        | -            | 0.4/40/14.3  | (7.4)/20/3.3 |
| <i>Cercocarpus ledifolius</i>    | *            | -            | -            |
| <i>Chrysothamnus depressus</i>   | -            | -            | *            |
| <i>Chrysothamnus parryi</i>      | *            | *            | *            |
| <i>Gutierrezia sarothrae</i>     | -            | *            | 0.5/(20)/-   |
| <i>Juniperus communis</i>        | -            | *            | *            |
| <i>Mahonia repens</i>            | -            | -            | -            |
| <i>Ribes cereum</i>              | -            | -            | -            |
| <i>Symphoricarpos oreophilus</i> | *            | *            | *            |
| <i>Tetradymia canescens</i>      | (0.2)/10/1.4 | *            | (0.7)/10/1.1 |
| Graminoids                       |              |              |              |
| <i>Carex rossii</i>              | 2/30/5.5     | (1.3)/20/6.1 | 0.3/20/5.4   |
| <i>Elymus elymoides</i>          | 0.3/20/6.8   | -            | 0.3/10/1.1   |
| <i>Elymus lanceolatus</i>        | -            | -            | -            |
| <i>Elymus salinus</i>            | -            | -            | -            |
| <i>Muhlenbergia montana</i>      | -            | -            | *            |
| <i>Poa fendleri</i>              | *            | *            | -            |
| <i>Stipa comata</i>              | -            | -            | 0.8/10/1.1   |
| <i>Stipa hymenoides</i>          | -            | *            | (0.9)/60/7.6 |
| Forbs                            |              |              |              |
| <i>Arabis demissa</i>            | 0.5/30/5/5   | *            | -            |
| <i>Arenaria fendleri</i>         | (1.2)/30/4.1 | -            | *            |
| <i>Astragalus</i> sp.            | -            | -            | -            |
| <i>Astragalus convallarius</i>   | 0.3/20/2.7   | *            | 0.3/20/2.2   |
| <i>Astragalus humistratus</i>    | *            | -            | -            |
| <i>Astragalus kentrophyta</i>    | (0.1)/10/1.4 | -            | -            |
| <i>Astragalus megacarpus</i>     | -            | -            | -            |
| <i>Castilleja linariifolia</i>   | (0.1)/10/1.4 | -            | 0.3/(10)/-   |
| <i>Cirsium</i> sp.               | -            | *            | *            |



|                                     |              |             |              |
|-------------------------------------|--------------|-------------|--------------|
| <i>Clematis columbiana</i>          | -            | -           | -            |
| <i>Cryptantha</i> sp.               | *            | -           | *            |
| <i>Draba subalpina</i>              | -            | -           | -            |
| <i>Erigeron canus</i>               | *            | -           | -            |
| <i>Eriogonum alatum</i>             | *            | (0.1)/10/2  | *            |
| <i>Eriogonum racemosum</i>          | (0.8)/10/1.4 | -           | *            |
| <i>Euphorbia brachycera</i>         | -            | (0.4)/10/2  | *            |
| <i>Gilia aggregata</i>              | *            | *           | *            |
| <i>Haplopappus armerioides</i>      | -            | -           | -            |
| <i>Hymenoxys acaulis</i>            | 1/40/20.5    | 0.5/20/8.2  | 0.3/10/1.1   |
| <i>Hymenoxys richardsonii</i>       | 0.3/20/2.7   | -           | 0.5/30/3.3   |
| <i>Linum kingii</i>                 | -            | -           | 2.3/40/5.4   |
| <i>Linum perenne</i>                | -            | -           | (0.2)/10/1.1 |
| <i>Machaeranthera canescens</i>     | -            | *           | -            |
| <i>Machaeranthera grindelioides</i> | 0.3/10/1.4   | -           | 0.5/30/5.4   |
| <i>Oenothera howardii</i>           | -            | -           | 0.5/50/6.5   |
| <i>Pediomelum pariense</i>          | (0.8)/30/4.1 | 0.5/30/12.2 | 0.8/80/17.4  |
| <i>Penstemon</i> sp.                | (2.1)/10/2.7 | -           | -            |
| <i>Penstemon caespitosus</i>        | (0.5)/10/1.4 | -           | -            |
| <i>Petradoria pumila</i>            | 5/80/32.9    | 0.3/10/-    | *            |
| <i>Phlox</i> sp.                    | -            | -           | -            |
| <i>Senecio multilobatus</i>         | *            | *           | (0.5)/10/1.1 |
| <i>Stempanomeria tenuifolia</i>     | *            | -           | -            |
| <i>Streptanthus cordatus</i>        | -            | *           | -            |
| <i>Yucca angustissima</i>           | -            | -           | (1.9)/10/3.3 |
| unknown forb                        | -            | 0.3/10/2    | -            |
| forb 1                              | -            | -           | -            |
| forb 2                              | -            | -           | -            |

Cover was estimated using quadrat frames. Where this figure is presented in parentheses, the species did not occur in a quadrat and cover was estimated from the line-intercept transect.

Frequency and density were estimated using line-intercept transects. Where the frequency figure is presented in parentheses, the species did not occur on the transect and frequency was estimated from quadrats. Where a dash occurs in the density position, the species did not occur on the transect. Density was not recorded in the quadrats so no figure can be given.

\* indicates occurrence within the macroplot but not on the transect or in the quadrats.

Taxonomy follows A Utah Flora.



| 4            | 5            | 6             | 7            | 8            |
|--------------|--------------|---------------|--------------|--------------|
| NWSE         | SWSW         | NESW          | SWSE         | SWSW         |
| 13           | 13           | 13            | 13           | 13           |
| 37S          | 37S          | 37S           | 37S          | 37S          |
| 4W           | 4W           | 4W            | 4W           | 4W           |
| 10           | 10           | 25            | 10           | 15           |
| 255          | 315          | 70            | 305          | 325          |
| 8220         | 8240         | 8160          | 8220         | 8290         |
| 358          | 246          | 62            | 96           | 294          |
| -            | -            | (0.5)/10/3.8  | -            | -            |
| -            | -            | -             | -            | -            |
| *            | 6.3/(10)/-   | -             | *            | -            |
| -            | -            | -             | *            | -            |
| *            | (1.7)/10/1.7 | *             | *            | *            |
| -            | -            | *             | -            | -            |
| 8.5/80/44.1  | 3.5/50/22    | 3/40/23.1     | 5.8/60/4.29  | 6.5/70/44.4  |
| *            | 0.3/10/1.7   | *             | -            | 0.8/20/5.6   |
| -            | *            | -             | -            | -            |
| -            | -            | -             | -            | -            |
| *            | -            | -             | -            | *            |
| -            | -            | -             | -            | -            |
| -            | (10)/10/3.4  | -             | -            | *            |
| -            | -            | (5.4)/30/23.1 | -            | -            |
| *            | -            | -             | -            | -            |
| -            | -            | (0.8)/10/3.8  | -            | -            |
| -            | *            | -             | *            | *            |
| 0.5/70/11.9  | 0.5/30/10.2  | (0.1)/10/3.8  | (2.9)/30/9.5 | 0.5/30/11.1  |
| -            | -            | -             | -            | *            |
| -            | -            | -             | -            | *            |
| -            | -            | -             | *            | (0.1)/10/2.8 |
| -            | -            | -             | -            | -            |
| *            | -            | 0.3/10/3.8    | -            | -            |
| -            | -            | -             | -            | -            |
| 0.3/(10)/-   | -            | (0.4)/30/15.4 | -            | *            |
| -            | -            | -             | -            | -            |
| 0.5/10/1.7   | 0.8/40/10.2  | *             | 0.5/40/16.7  | 0.5/20/5.6   |
| -            | (0.2)/10/1.7 | *             | -            | 0.3/(10)/-   |
| 0.3/10/1.7   | -            | *             | -            | 0.3/10/2.8   |
| -            | -            | -             | -            | -            |
| 0.3/20/8.5   | -            | -             | -            | -            |
| (0.5)/10/5.1 | -            | -             | -            | -            |
| -            | 0.3/(10)/-   | -             | -            | (0.1)/10/2.8 |
| *            | (0.7)/20/3.4 | -             | *            | *            |



|              |              |              |              |              |
|--------------|--------------|--------------|--------------|--------------|
| -            | -            | (1)/10/3.8   | 0.3/(10)/-   | 0.5/30/8.3   |
| *            | 0.3/(10)/-   | -            | 0.3/20/4.8   | 0.5/20/5.6   |
| -            | -            | 0.3/10/3.8   | -            | -            |
| -            | -            | -            | -            | -            |
| *            | *            | -            | -            | -            |
| *            | -            | -            | -            | -            |
| (0.4)/20/3.4 | 0.3/(10)/-   | -            | *            | 0.5/(20)/-   |
| -            | -            | -            | -            | -            |
| *            | -            | -            | *            | -            |
| 0.5/30/8.5   | 0.8/60/11.9  | -            | (0.3)/20/7.1 | 0.5/10/2.8   |
| *            | (0.4)/10/1.7 | -            | (0.2)/10/2.4 | *            |
| *            | 0.8/60/18.6  | -            | *            | *            |
| *            | -            | -            | -            | -            |
| -            | -            | -            | -            | -            |
| *            | 0.5/10/1.7   | -            | *            | 0.3/(10)/-   |
| -            | 0.3/20/3.4   | *            | (0.3)/10/4.8 | 0.3/(10)/-   |
| 0.8/30/8.5   | 0.3/20/3.4   | *            | *            | (0.3)/10/2.8 |
| -            | -            | -            | -            | -            |
| (2.3)/20/3.4 | -            | -            | -            | -            |
| 1.8/20/3.4   | 0.8/10/5.1   | -            | 0.3/20/4.8   | 0.3/20/5.6   |
| -            | -            | -            | *            | -            |
| *            | -            | *            | -            | *            |
| -            | -            | -            | -            | -            |
| -            | -            | -            | -            | -            |
| *            | *            | (3.6)/10/3.8 | *            | *            |
| -            | -            | (1.6)/10/7.7 | -            | -            |
| -            | -            | -            | (0.5)/20/4.8 | -            |
| -            | -            | -            | (0.3)/10/2.4 | -            |



Table 2. Diameter classes and basal areas of trees.

[illegible]



Table 3. Basal area by habitat type.

| Species                      | Habitat Type    |           |            |                 |           |            |
|------------------------------|-----------------|-----------|------------|-----------------|-----------|------------|
|                              | PIPO/ARPA (n=6) |           |            | ABCO/ARPA (n=2) |           |            |
|                              | Total           | $\bar{x}$ | % of Total | Total           | $\bar{x}$ | % of Total |
| <i>Abies concolor</i>        |                 |           |            | 12.97           | 6.49      | 8.99       |
| <i>Juniperus scopulorum</i>  | 22.5            | 3.8       | 10.6       | 10.83           | 5.42      | 7.51       |
| <i>Pinus longaeva</i>        | 38.3            | 6.4       | 18.1       |                 |           |            |
| <i>Pinus ponderosa</i>       | 150.9           | 25.2      | 71.3       | 67.30           | 33.65     | 46.67      |
| <i>Pseudotsuga menziesii</i> |                 |           |            | 53.10           | 26.55     | 36.82      |
| Total                        | 211.7           | 35.4      |            | 144.20          | 72.11     |            |



Table 4. Soil analysis.

| Macroplot | pH  | Organic<br>Matter<br>(%) | P<br>(mg/<br>kg) | K<br>(meq/<br>100g) | Ca<br>(meq/<br>100g) | Mg<br>(meq/<br>100g) | Ca:Mg |
|-----------|-----|--------------------------|------------------|---------------------|----------------------|----------------------|-------|
| 1         | 7.7 | 8.7                      | 5.0              | 1.97                | 101.6                | 14.21                | 7.2   |
| 2         | 7.7 | 13.0                     | 7.8              | 1.93                | 158.7                | 9.88                 | 16.1  |
| 3         | 7.9 | 6.3                      | 3.3              | 1.41                | 75.1                 | 7.01                 | 10.7  |
| 4         | 7.6 | 12.0                     | 7.1              | 1.31                | 125.6                | 7.26                 | 17.3  |
| 5         | 7.8 | 13.5                     | 4.8              | 1.54                | 148.8                | 17.61                | 8.5   |
| 6         | 7.8 | 14.1                     | 6.1              | 1.78                | 126.4                | 9.12                 | 13.9  |
| 7         | 7.9 | 17.6                     | 5.3              | 1.03                | 126.1                | 13.50                | 9.3   |
| 8         | 7.8 | 15.3                     | 5.6              | 1.34                | 135.1                | 18.30                | 7.4   |
| $\bar{x}$ | 7.8 | 12.6                     | 5.6              | 1.54                | 124.7                | 12.11                | 11.3  |
| SE        | 0.1 | 3.6                      | 1.4              | 0.33                | 26.3                 | 4.45                 | 4.0   |



Fig. 1. Study area.



