

Las Vegas Bearpoppy Habitat and Soils Comparison in Lake Mead National Recreation Area

Submitted by E. Powell
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Introduction

One question that has been asked about Las Vegas bearpoppy (*Arctomecon californica*) habitats is what soil type does the bearpoppy prefer. Meyer (1986) considered the Las Vegas bearpoppy a gypsocline, indicating that it occurs primarily on gypsum (calcium sulfate dehydrate), but also can occur on other substrates. Sheldon and Smith (1997) found that the Las Vegas bearpoppy occupied sites with higher levels of sulfur, calcium and soluble salts than comparative sites that did not support bearpoppies. The sites that supported bearpoppy were mostly gypsum outcrops.

At Lake Mead National Recreation Area (LMNRA), we have the unique opportunity to compare bearpoppy habitat for mapping work has been done primarily in 1998 and to a soils map made of the Clark County portion of LMNRA by the US Department of Agriculture Natural Resources Conservation Service (NRCS) (NRCS 2000).

The purpose of this study was to determine if the soil preferences of bearpoppies can be determined from soils and mapping data. The information could be used to protect potential bearpoppy habitat in the absence of live bearpoppies. Further, preferred soil may be useful for the cultivation of bearpoppies in garden or arboretum situations.

Methods

The soils map created by NRCS was overlaid with the bearpoppy mapping data in Clark County using Arcview computer program. For each mapping point for bearpoppy map, the number of bearpoppy plants and the associated vegetation on the site were recorded. Further, the soils map unit on which that point fell was also recorded for each point on the map.

Each soils map unit has a name called an association. Each association is described by the dominant soil series in the map unit, but may contain a number of different soil types (NRCS, 2000). For this reason, it was unclear whether the soils map was detailed enough to determine a specific soil type associated with bearpoppy location as mapped. An attempt was made to determine which soil series a particular bearpoppy location occurred on by looking at the typical or potential vegetation of the series and comparing that to the associated plant species found on the mapped bearpoppy location.

Mapping of the Las Vegas bearpoppy at LMNRA was done in an arbitrary manner. Map locations were based on the presence of a large bearpoppy population on a site, or of a bearpoppy outlier site. Therefore, map locations were taken when there was a large bearpoppy population or where small, but disjunct populations were discovered. Mapped areas were chosen by their large bearpoppy populations and the lack of any mapping information for the site. Binoculars were used to identify populations and then the area was walked and points taken to identify the number of plants and outline of the

population. Map locations tended to be taken on edges and in the center of bearpoppy populations and do not represent the entire population. Therefore, the locations and the number of plants at those locations were not taken to represent poppy habitat soil type on the site. The locations and numbers of plants were intended to create a polygon and indicate an estimate of density within the polygon of bearpoppy habitat, and therefore, were not meant to be used as accurate representations of the entire bearpoppy population in an area, or to give a an accurate number of bearpoppies in the area.

A different kind of survey and mapping of the bearpoppy would be needed to represent soil type preferences without bias. Bearpoppy mapping was done primarily in 1998. It is known that the bearpoppy will have large populations in certain years and small or no live plants on a particular site in other years. It is therefore, possible that the large populations do not represent the range of soil types used by bearpoppies, but only those soil types used by large bearpoppy populations in the areas mapped in 1998. Also, the number of locations (GPS points) taken on a site was not consistent and may not represent how frequently a certain soil type was encountered. Therefore, simple presence or absence of bearpoppies on a site and the soil type of that site may be of most use for determining bearpoppy soil preferences. The existence of even 1 plant on a site indicates use of that site's soil type by bearpoppy. Nevertheless, an attempt was made to analyze data by number of locations and number of plants on each soil association.

Soil associations were then broken down into soil series in each association and the listed inclusions in each association were examined. The typical or potential vegetation for each soil series was compared to associated plants at bearpoppies mapped locations on each soil association.

Typical or potential vegetation as described by NRCS (2000) for each site may or may not be the actual vegetation on the site or on the particular area for various reasons. Therefore, in some instances, the potential or typical vegetation of a site as described by NRCS would not correspond to the actual vegetation on the site as mapped. In these cases, no good match for vegetation would be possible, and therefore, the soil series on which the mapped bearpoppy site occurred would not be accurately identified.

Results

Las Vegas bearpoppy was found to occur on 23 different soils map units within LMNRA. Of the 212 mapped bearpoppy locations, 90% of the locations were on 13 soil map units, 75% were on 8 soil map units, 66% were on 6 soil map units and 43% were on 3 soil map units. Of the total number of plants recorded for all of the locations (9,394 plants), 99% of the plants occurred on 16 soil map units, 89% occurred on 10 soil map units, 74% on 6 soil map units and 46% on 3 soil map units (Table 1).

Each soil association is made up of 2 or 3 component soil series or landforms. Of all the soil associations on which bearpoppies were found, there were 24 soil series or types. Only Rock outcrop and Badlands had no typical or potential vegetation listed. Certain soils series were listed more than once. Table 2 gives the list of soils series. It is possible that only a subset of these soils series is actually used by bearpoppies. It is thought that

those soil series that appear to have vegetation most similar to that found on mapped bearpoppy sites are probably are more likely to be soils on which poppies actually occurred.

For each soil association, only four soil series had Las Vegas bearpoppy listed as part of the typical vegetation: Guardian, Callville, Drygyp, and Bracken. The Bracken soil series did not show up in any of the soil associations on which bearpoppies were mapped. However, Guardian, Callville, and Drygyp did. All three of these soil series were part of the soil types listed as part of the associations with the most mapped locations of bearpoppies and highest number of plants. These soils series were also reflected in more soil associations for mapped bearpoppy locations than other soil series.

The results of looking at both locations and number of plants were similar for the soil map units. The largest number of locations and the largest number of individual plants fell on 3 soils map units: the Baseline-Callville-Badland Association, The Drygyp-Guardian-Baseline Association, and the Drygyp-Bluegyp Association. The majority of the locations on those soil types were taken in three areas: the Bitter Springs Valley (Baseline-Callville-Badland Association), Echo Wash (Drygyp-Guardian-Baseline Association), and Stewarts Point/ Blue Point Springs area (Drygyp-Bluegyp Association). These three soils association with the largest number of mapped locations and the largest number of plants are discussed below.

Baseline-Callville-Badland Association

The Baseline-Callville- Badland association was described as consisting of the 2-15% baseline soil series, 15-30% Callville series, and 30-75% Badland with contrasting inclusions of 0-6% Guardian and similar soils, 0-5% Heleweiser and similar soils, and 0-4% Carrizo and similar soils. A comparison of typical vegetation of each of these soil series was made to the plants found associated with bearpoppies found on this soil association. There were 32 bearpoppy locations mapped to this soil association.

The vegetation association noted for the Baseline component of the Baseline-Callville-Badland Association was 40% white bursage (*Ambrosia dumosa*) and 20% creosotebush (*Larrea tridentata*) with smaller elements of Nevada ephedra (*Ephedra nevadensis*), big galletagrass (*Pleuraphis rigida*) and Pima ratany (*Krameria erecta*). Although 10 bearpoppy mapped locations noted both white bursage and creosotebush together on the site, only 3 noted Pima ratany, and 1 noted big galletagrass.

For the Callville series component of the Baseline-Callville-Badland Association, the vegetation noted was 60% desert holly (*Atriplex hymenelytra*), 10% white bursage, and smaller elements of indigobush (*Psorothamnus fremontii*), creosotebush, and Pima ratany. None of the mapped locations that fell on this association recorded desert holly as an associate of the bearpoppy; however, 30 of the 32 bearpoppy mapped locations noted indigobush as an associate. Twenty of those also had white bursage as an associate.

The Badland component of the soil association does not list any plants as typical vegetation. The Guardian series listed these plants as part of the typical vegetation of the

soil series: 15% sunray (*Enceliopsis argophylla*), 1% Las Vegas bearpoppy, 45% pygmy cedar (*Peucephyllum schottii*), 20% Parrys sandpaper plant (*Petalonyx parryi*), with smaller portions of indigobush and matted tiqulia (*Tiquilia latior*). Once again, the Las Vegas bearpoppy was most highly associated with indigobush than any other plant (30 out of 32 mapped bearpoppy locations), and second most highly correlated with sunray with 24 out of 32 mapped locations. Six bearpoppy locations had matted tiqulia, four had Parrys sandpaper plant, and only 1 was associated with pygmy cedar.

Soil color was recorded during bearpoppy mapping, and was compared to soil color of each soil series in the association. None of the soil colors recorded at bearpoppy mapped locations corresponded to the Baseline series soil color of light brown or to the Heleweiser series of light brown or the Carrizo series of light yellowish brown. Thirteen of the mapped bearpoppy locations indicated a soil color of red or pink, corresponding to the red color of the Callville series and 12 mapped bearpoppy locations had a recorded soil color of light or white corresponding to the soil color of Guardian of very pale brown. Six mapped bearpoppy locations had a soil color noted as being of multiple colors.

Of the features analyzed here, it appears that the bearpoppy occurred primarily either on the Guardian soil series or on the Callville soil series. Both of these soil types contain gypsum. The Callville series is noted as consisting of “moderately deep, well drained soils that form in residuum derived from gypsiferous sandstone and siltstone.” (NRCS, 2000). The Guardian soil series is defined as “shallow, somewhat excessively drained soils that formed in residuum derived from gypsiferous sedimentary rocks.” (NRCS, 2000) (See also Table 3).

The Drygyp-Bluegyp Association

The Drygyp-Bluegyp Association is described as 55% Drygyp soil series, 30% Bluegyp soil series, 8% Guardian series, 5% Typic Torrifolists and 2% Badlands. The Drygyp soil series typical vegetation is noted as 1% Las Vegas bearpoppy, 30% indigobush, 20% Parrys sandpaper plant, 10% Torreys ephedra (*Ephedra torreyana*), 10% white bursage, and 3% desert alyssum (*Lepidium fremontii*). This combination of plants listed for typical vegetation was most closely matched by the mapped bearpoppy locations that fell on this soil association. Twenty-four of the 31 mapped bearpoppy locations had 2 or more of these plants listed as bearpoppy associates.

The typical vegetation for Bluegyp is 45% Shadscale (*Atriplex confertifolia*), 30% alkali seepweed (*Suaeda moquinii*), 5% indigobush, and 5% alkali goldenbush (*Isocoma acradenius*). Twenty-three of the 31 mapped bearpoppy locations were associated with indigobush, but only 4 mapped locations had 2 or more of the plants listed as typical vegetation for this series other than indigobush. However, 21 mapped bearpoppy locations had shadscale noted as a bearpoppy associate.

The typical vegetation of the Guardian soil series is described above. Seventeen of the 31 mapped locations had sunray as an associate. Twenty-three had indigobush as an associate.

Typic Torrifolists are described as streambanks and the typical vegetation for this series is 10% alkali sacaton (*Sporobolus airoides*), 5% big galletagrass, 15% willow (*Salix* spp.), 10% desert willow (*Chilopsis linearis*), 5% arrowweed (*Pluchea sericea*), 5% mesquite (*Prosopis* spp.), and 2% cottonwood (*Populus fremontii*). Of these plants, only arrowweed and mesquite were noted as associated with a mapped bearpoppy location. Only 4 of the 31 mapped bearpoppy locations for this soil association had either mesquite or arrowweed as an associate.

The Drygyp soil series is noted as being reddish yellow, or pink, or pinkish white in color; the Bluegyp soil series is noted as being very pale brown; and the Guardian series is also very pale brown. Twenty-four of the mapped locations had soil color noted as white or light and 5 had soil color of pink or red and 2 were noted as being multicolored.

It appears that bearpoppies may have occurred on any of the soil series in this association, but may have been more common on the Drygyp and Guardian soil series components. It may be possible that the vegetation between Drygyp and Bluegyp series overlap in certain areas.

Drygyp is described as “very shallow to a petrogypsic horizon, somewhat excessively drained soils that formed in alluvium derived from gypsum rock.” (NRCS,2000). Bluegyp is described as “deep, well drained soils that formed in residuum derived from gypsum rock.” (NRCS, 2000). Bluegyp is noted as having a microbiotic crust. Fourteen of the 31 mapped locations for this association had a microbiotic crust noted.

Drygyp-Guardian-Baseline

This soil association is described as 45% Drygyp, 25% Guardian, 15% Baseline, 8% Heleweiser, 4% Teebar, and 3% badlands. Drygyp typical vegetation is described above. Only 3 locations did not have 2 or more of the plants noted as typical vegetation associated with bearpoppies.

The Guardian vegetation was, for this association, 1% Las Vegas bearpoppy, 50% shadscale, 15% indigobush, 15% Parrys sandpaper plant, and 5% sunray. Of the 26 mapped bearpoppy locations, only 2 did not have indigobush associated with bearpoppies. All of the locations had 2 or more of these species of plants associated with bearpoppies.

The Baseline series vegetation is described as 55% desert holly, 15% white bursage, 5% Torrey ephedra, 5% creosotebush, and 5% Pima ratany. None of the 26 mapped bearpoppy locations that occurred in this soil association had desert holly associated with bearpoppies. White bursage only occurred on 1 location and Pima ratany did not occur on any location.

The Heleweiser series typical vegetation is listed as 95% creosotebush. The Teebar series is listed as 2% globemallow (*Sphaeralcea ambigua*), 30% matted tiqulia, 10% creosotebush, 10% white bursage, 10% paperflower (*Psilostrophe cooperi*), 5% ephedra

(*Ephedra* spp.), 5% Pima ratany, 3% spiny menodora (*Menodora spinescens*), and 1% ocotillo (*Fouquieria splendens*). Paperflower, Spiny menodora, and ocotillo were not associated with any mapped bearpoppy location. Matted tiquilia was associated with 6 locations, but only overlapped with globemallow on 2 locations. Although creosotebush and white bursage are common, they only occurred together on 1 location of the 26 mapped bearpoppy locations for this soil association, and not with any of the other plant listed for this soil series.

The soil colors for Drygyp are reddish-yellow or pink. There were 9 locations noted as having pink soil. The color of Guardian soils is very pale brown. However, 16 locations noted soil color as white and 1 noted the soil color as multicolored. For this soil association, it is probable that the bearpoppies occurred on the Guardian and/or the Drygyp soil series.

The Remaining Soil Associations

A similar soil color and associated vegetation comparison was made for the other 20 soil associations on which bearpoppies were found. For each soil association, a particular soil series or several soil series were identified as soil series with the most similar vegetation to that associated with the bearpoppies found on that soil association. Three soil associations did not have any listed component that had vegetation similar to that associated with bearpoppies. For these associations, the bearpoppy may exist on a small inclusion that was not listed as a component of the soil association. Six soil associations had more than one soil series component that had vegetation similar to that associated with bearpoppy or had a soil color noted that was similar to that in the soils series description for surface soil color.

A total of ten soil series were identified in this manner (Table 2), excluding the three associations already discussed above. The Guardian series was identified 8 times; the Callville series was identified 6 times; the Gypwash series was tentatively identified 2 times, the St Thomas series was identified 2 times, the Huevi series was tentatively identified 2 times; the Drygyp series was identified once; the Azsand series was tentatively identified once; the Cheme series was tentatively identified once; the Hiller series was tentatively identified once; and the Teebar series was identified once. The soil series that were tentatively identified did not match with more than 1 or 2 plant species in vegetation or soil color, but were the closest of any of the components, by having one or more plant species of typical vegetation in common with the associated species with bearpoppies.

In order to look at each of the soils series that were identified, Table 3 gives the basic description of each important soils series. The soils series that are most often associated with bearpoppies are those derived from gypsum and from limestone. The other soils series listed may be from mixed rock sources and may have had gypsum or limestone in them.

Conclusions

Soils most often associated with large bearpoppy populations are soils that contain gypsum: Drygyp, Callville, and Guardian. Limestone and dolomite also may be important for bearpoppies (St Thomas, Gypwash, and Teebar soil series). A population of the bearpoppy occurs on limestone cliffs in the Rampart Cave area of lower Grand Canyon, Northern Arizona. Although the bearpoppy population in the lower Grand Canyon may be taxonomically distinct from other Las Vegas bearpoppy populations (A. Phillips, personal communication), they are currently placed in the same taxon.

Although bearpoppies may occur on other soils types than those derived from gypsum or limestone, it was difficult to determine which soil type the mapped bearpoppy locations fell on, because the soils map was not detailed enough for that comparison. Typical or potential vegetation and soil color were used in an attempt to determine which soil types supported bearpoppies. This comparison suggests that bearpoppies were often found on soils that contain gypsum and/or limestone, but may occur on other soil types. This conclusion supports Sheldon and Smith (1997) who suggested that the distribution of *A. californica* may not be based on soil factors alone, and Meyer (1986) who suggests that soil surface texture (presence of rocks or crytogamic crusts) may be an important factor for the establishment of species noted as gypsophiles or gypsoclines. Soil chemistry itself may be a less important factor in determining where certain plants species establish. Meyer (1986) indicates that even gypsophiles may grow well in non-gypsum soils and that mineral content of the soil may be less important than soil factors affecting water relations and seedling establishment.

A more thorough investigation of soils and bearpoppy populations will need to be designed and carried out in a year in which bearpoppies are abundant. Soil samples or soil type designations should be made on the specific sites on which bearpoppies are found.

References

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- Sheldon, Sheila K. and Stanley D. Smith. 1997. Ecology of *Arctomecon californica* and *Merriamii* (Papaveraceae) in the Mojave Desert. *Madrono* 44(2): 151-169.
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Table 1:
Soil associations and number of locations of Las Vegas bearpoppies mapped,
number of plants, rank by number of locations, and rank by number of plants.

Soil Association	Number of Locations	Rank by #Locations	Number of Plants	Rank by # plants
Baseline-Callville-Badlands	33	1	1,365	2
Drygyp-Bluegyp	31	2	1,887	1
Drygyp-Guardian-Baseline	27	3	1,087	3
Iceberg-St Thomas-Rock Outcrop	23	4	1,017	4
Huevi-Badland	15	5	362	9
Heleweiser-Carrizo	12	6	898	5
Huevi-Hiller	10	7	250	10
Sunrock-Callville-Badland	8	8	442	8
Callville-Gypwash-Badland	8	9	16	17
Cheme-Huevi	7	10	550	7
Govwash-Guardian-Badland	7	11	189	11
Callville-Badlands-Guardian	5	12	725	6
Ramshead-St. Thomas-Rock outcrop	5	13	125	14
Mesabase extremely gravelly	5	14	39	16
Heleweiser-Carrizo-Teebar	4	15	89	15
Huevi Association	4	15	85	15
Zeheme-Rock outcrop	3	16	173	12
Mesabase-Azsand	3	17	12	19
Sunrock-Rock outcrop	2	18	15	18
Guardian-Badland	1	19	10	20
Gypwash very gravelly	1	20	1	21
Drygyp	1	21	142	13
Gypwash-Callville-Carrizo	1	22	1	22

Table 2:
Soil Associations and component soil series that had typical
or potential vegetation that was most similar to that found at bearpoppy
locations on those associations. Soil series with ? were tentatively identified.

Soil Association	Components (soils series)
Baseline- Callville-Badlands	Callville; Guardian
Drygyp-Bluegyp	Drygyp; Bluegyp; Guardian
Drygyp- Guardian-Baseline	Drygyp; Guardian
Iceberg-St Thomas-Rock Outcrop	St Thomas; Callville
Huevi-Badland	Callville
Heleweiser-Carrizo	Gypwash?
Huevi-Hiller	Huevi?
Sunrock-Callville-Badland	Callville; Guardian
Callville-Gypwash-Badland	Callville; Guardian
Cheme- Huevi	Cheme? Huevi? Hiller?
Govwash-Guardian-Badland	Guardian
Callville-Badland-Guardian	Callville; Guardian
Ramshead-St Thomas- Rock outcrop	St Thomas; Guardian
Mesabase, extremely gravelly	None
Heleweiser-Carrizo-Teebar	Teebar? Callville
Huevi Association	Huevi?
Zeheme-Rock outcrop	None
Mesabase- Azsand	Azsand?
Sunrock-rock outcrop	None
Guardian-Badland	Guardian
Gypwash	Gypwash?
Drygyp	Drygyp; Guardian
Gypwash-Callville-Carrizo	Guardian

Table 3:
Basic description of soils series that support bearpoppies.
Descriptions are taken from NRCS, 2000.

Soil Series	Basic Description
Guardian	Shallow, somewhat excessively drained soils that formed in residuum derived from gypsiferous sedimentary rocks.
Callville	Moderately deep, well drained soils that formed in residuum derived from gypsiferous sandstone and siltstone.
Drygyp	Very shallow to a petrogypsic horizon, somewhat excessively drained soils that formed in alluvium derived from gypsum rock.
St. Thomas	Very shallow and shallow, well drained soils that formed in residuum of limestone and dolomite.
Gypwash	Very deep, somewhat excessively drained soils formed in alluvium derived predominately from limestone.
Huevi	Very deep, well drained soils that formed in semi-consolidated alluvium from mixed rock sources.
Bluegyp	Deep, well drained soils that formed in residuum derived from gypsum rock.
Azsand	Very deep, somewhat excessively drained soils that formed in eolian sand over alluvium derived dominantly from sandstone.
Teebar	Very shallow to a petrocalcic horizon, somewhat excessively drained soils that formed in alluvium derived from limestone and dolomite.
Cheme	Very shallow and shallow over duripan, well drained soils on fan remnants.
Hiller	Very deep, well drained soils that formed in alluvium derived from mixed rocks.