MASTER

BIOLOGICAL/ENVIRONMENTAL RELATIONSHIPS
IN DESERT ECOSYSTEMS OF THE NEVADA TEST SITE

Progress Report
for Period May 1, 1977 - June 30, 1978

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ABSTRACT - Technical Progress Report, May 1, 1977 - June 30, 1978

Activities covered by the report are (1) preparation of reports on Endangered and Threatened plant species of central-southern Nevada; (2) status of review of Camissonia heterochroma complex in western United States; (3) gift of plant collections to the United States Museum of Natural History; and (4) preparation of shrub data manuscript, and significant conclusions from the data.

Technical Progress Report, May 1, 1977 - June 30, 1978.

Because of the requirement of time to clarify her academic status, the investigator requested, in a letter April 18, 1977, a two-month no-fund extension (through June 30, 1977) of the contract ending April 30, 1977. On June 10, 1977, a revised budget was submitted for the July 1 renewal request, to cover especially the program needs for the months of July and August, 1977. Notice of contract renewal came in late August, at the end of her summer work period. Four of the five years of this contract, delay in contract renewal has resulted in loss of the principal work period scheduled for processing the Test Site data. Without funds or letter of intent, the work cannot proceed as scheduled, and these delays have seriously affected the continuity and flow of manuscript preparations.

All herbarium specimens of the complex to which one of the Endangered Species, Camissonia megalantha, belongs were requested and obtained from the major herbaria of western United States. Most of the sheets are previously distributed duplicates of the Test Site collections, which constitute the bulk of the total collections that have been made of this complex in southwestern United States. These have been under critical review since last summer.

Except for the Camissonia megalantha and C. heterochroma sheets in use, all collections of the other 42 Endangered and Threatened Species of the Nevada Test Site herbarium housed at the University of Cincinnati, the 600 grasses, 85 cacti, and around 1000 Eriogonums, were delivered to the Museum of Natural History of the Smithsonian Institution, Washington, in September, 1977. In total these numbered around 2000 sheets. The specimens were accompanied by printed labels to be affixed to each: "Presented to the National Museum of Natural History by the University of Cincinnati on behalf of the Energy Research and Development Administration, 1977".

Test Site data with the highest publication priority are the nearly 30 miles of line interception (and measured height) data for shrubs. These were collected by the investigator and a technician on all 68 study sites in 1963, and again in 1975 along 1100 feet of permanently-marked lines on each site. Data are recorded on 27,000 IBM cards, and were processed on the computer for the parameters of interest. Beginning in the summer, 1977, and continuing intermittently until the present (March, 1978), investigator has attempted to organize these many data into a form permitting (a) grouping of the site data by plant associations already recognized in the literature (in "Vascular Plants of the Nevada Test Site and Central-Southern Nevada: Ecologic and Geographic Distributions". ERDA. 1976); (b) the species composition in each of the vegetation types; (c) comparisons of the shrubs in 1963 and 1975, using as the bases of comparison for each species the number and percent cover of living and dead plants, and their average height both years. In addition, for Larrea there are 1963 data for the percent cover due to dead plants plus dead branches, in relation to living plants and branches. Organization of these data has been a very formidable task, and if the data are to be meaningful and usable, far more large tables are required for presentation than any journal is likely to accept.

No statistical analyses are anticipated in the final presentation of the shrub data. Obvious from the data is the overall large increase (to 50%) in numbers of shrub plants/site, their height, and their percent cover during this 12-year period. This is true for all shrub species and, although the increases vary with the site, they occurred on essentially all of the Mojave, transition, and Great Basin study sites. The site-increase pattern is not correlatable with total site rainfall of 1963-1972, or with the site rainfall patterns of the three heavy-rain periods (spring and fall of 1965, and winter of 1969) of the 10-year record. Nevertheless these increases are certain in

some way to reflect rainfall during the 12-year period, perhaps primarily the extremely heavy rains of the winter of 1973, which immediately followed the end of the site rainfall records and were prior to the 1975 spring data collections. From the data it is concluded that there are large fluctuations in the number of plants and size of desert shrubs through time, and it is inferred that these occur in relation to climatic fluctuations and should be predictable with refinements in understanding of the growth rates and germination characteristics of desert shrub species in relation to soil moisture. Potentially possible are significant changes in species composition through time, and relative numbers of each kind of shrub, but neither is suggested by these data.

The Spring Quarter will be taken up with full-time teaching, and the preparation necessary for it. In June, investigator will make the trip to the Gray Herbarium and New York Botanical Garden necessary to complete the review of the Camissonia heterochroma complex. This trip was previously scheduled for last summer, and then February after the recent AAAS meetings (cancelled because of the seaboard blizzard). The nine U. S. National Herbarium sheets were reviewed in February.

PUBLICATIONS:

- Beatley, Janice C. February 1977. Endangered plant species of the Nevada Test Site, Ash Meadows, and central-southern Nevada. ERDA COO-2307-11. 77 p.
- Beatley, Janice C. April 1977. Threatened plant species of the Nevada Test Site, Ash Meadows, and central-southern Nevada. ERDA COO-2307-12. 66 p.
- Beatley, Janice C. July 1977. Addendum to COO-2307-11 and COO-2307-12 (Endangered and Threatened plant species of the Nevada Test Site, Ash Meadows, and central-southern Nevada). ERDA COO-2307-13. 10 p.
- Beatley, Janice C. 1978. Ash Meadows: Nevada's unique oasis in the Mojave Desert. Mentzelia (in press).

(Two other manuscripts submitted, unrelated to this contract)

ASH MEADOWS: NEVADA'S UNIQUE OASIS IN THE MOJAVE DESERT

In extreme southern Nye County, Nevada, extending for a short distance into Inyo County, California, is one of the most remarkable and interesting botanical areas of the state. Here, in the Amargosa Valley near the northern end of the Mojave Desert and below the foothills of the large Spring Mountain range, is a sprawling oasis -- covering about 75 square miles and lying between 2100 and 2300 ft. elevation. Over the northern and eastern parts, water from more than 20 springs comes to the surface from the deep underground aquifers of the Death Valley region. ^{There are} Circular lime-encrusted pools, small streams that flow year-round, and ^{many} seepage and swampy areas, ^{There,} together with the salty, clay soils of a once-extensive playa that occupied these lowlands, make this area -- known as Ash Meadows -- a unique oasis not only in Nevada and the Mojave Desert, but in all of southwestern United States. Not surprisingly, the unusual habitats here are the home of a number of strictly endemic and rare plants (and desert fish), all of which are more or less critically endangered today.

The name "Ash Meadows" has been attributed to the ashen color of the heavy alkaline soils (Denney and Prewes, 1965), but it seems more likely to refer to the groves of Velvet Ash trees (Fraxinus velutina var. coriacea) which, with Screwbean (Prosopis pubescens), are scattered throughout the spring areas of the nearly level terrain of the northern and eastern parts. This is the type locality for the Ash variety. Neither of the trees is known to be native elsewhere in Nevada, and both are at their northern limits in Ash Meadows. Nearly always at least the large diecious shrub, Baccharis emoryi, is associated with the Ash-Screwbean communities. In much of western and southern Ash Meadows, there are low sand dunes -- the sands deposited on top of the old playa surface -- with low Mesquite trees (Prosopis glandulosa var. torreyana) covering and stabilizing the undulating surface of the sand deposits.

Away from the sites directly affected by the spring waters, the vegetation is dominated by Shadscale (Atriplex confertifolia), often with one or the other, or both, of the subspecies of Haplopappus acradenius associated with it as codominants. Over large areas of more or less salt-encrusted soils that are at least seasonally wet, sod-forming saltgrass (Distichlis spicata var. stricta) is the vegetation matrix within which many other kinds of native herbaceous plants also live.

The vegetation pattern is unique because of the patterns of the controlling environmental factors. Some of the vascular plants also are unique to the area. Some are known only from here and a few other places in the Death Valley region. Others are more widely distributed in the northern and eastern Mojave Desert, occurring also in other spring and seepage areas in southern Nevada -- especially in Oasis Valley between Beatty and Springdale in southern Nye County, but also at the small local springs of the region. There are species that here reach their northern limits, some their southern limits, and others their western or eastern limits.

In total, around 200 vascular plant species are presently known from Ash Meadows. The first botanical collections from the region appear to be those made in 1891 by Frederick V. Coville -- then Botanist of the Death Valley Expedition, and in 1893 to become the long-time Curator of the U. S. National Herbarium in Washington, D. C. -- assisted in the field by Frederick Funston from Kansas. As recorded by Coville (1893), in late February and March of 1891 Ash Meadows was used as a base-camp from which collecting forays were made to the Charleston (Spring) Mountains, Vegas Wash, Pahrump Valley, and the Death Valley region of California. A number of type collections were made at this time, including Ivesia (Potentilla) eremica from Ash Meadows, a member of the Rose Family; the collecting party's visits there were at a time unfortunately several months before the appearance of the numerous small white-petalled

flowers of this species in late summer and autumn. What is perhaps the most unusual and beautiful of the poppies, Arctomecon merriamii -- named for C. Hart Merriam in charge of the entire Expedition -- also was described by Coville in 1892 from a collection made in Vegas Wash; although ~~this species~~ ^{this species} is identified with limestone mountain ranges, it also occurs on the clay uplands of the spring areas in northern Ash Meadows.

In 1898 Carl Anton Purpus, a native of Germany, collected in southern Nevada, and among his collections were the type collection of Mentzelia leucophylla and fragments of Astragalus phoenix, both strict endemics of northern Ash Meadows. The Mentzelia, a large, yellow-flowered member of the Loasaceae, is distinguished in part by a bright-white, felt-like pubescence of short hairs that cover almost the whole plant; it was described by T. S. Brandegee in 1899. The Astragalus, which grows in broad dense mounds close to the ground, has large but rather pale pink-purple and inconspicuous pea-like flowers, but the pods are conspicuously large and curved in outline; description of this species had to wait until after 1966, when Arthur Cronquist re-collected the Astragalus (and also made the type collection of a new variety of Enceliopsis nudicaulis (E. n. var. corrugata)) in northeastern Ash Meadows. Astragalus phoenix was described in 1970 by Rupert Barneby, 72 years after it had first been found by Purpus.¹

Selected collections from the area have been made by California botanists, especially John and Lucille Roos, including the original and type collections of a small herbaceous chenopod, Nitrophila mohavensis, in the early 1950's. The species was described in 1954, and has never been found outside the small area at the south end of Carson Slough east of Death Valley Junction, in the California part of Ash Meadows but near the Nevada line. It has been intensively looked for, but without success, by James L. Reveal on the Nevada side -- only a few hundred yards from the type locality.

The first collections of a large summer- and autumn-flowering, orange-yellow rayed composite, Grindelia fraxino-pratensis, and a delicate gentian with deep pink flowers, Centaureum namophilum, were made in Ash Meadows by the author in 1965. Both were common in wet soils of the spring areas at that time. The Centaureum, described in 1973, had been collected earlier ^{in the Death} by ~~Roos~~ ^{Valley region of} and ~~Roos near Tecopa~~ in California to the west, but the Grindelia, described in 1971, is unknown beyond Ash Meadows.

Also occurring in Ash Meadows are the Tecopa Bird's-beak, Cordylanthus tecopensis, described in 1950 from a 1949 collection by Philip Munz near Tecopa Springs, and Ephedra funerea, described in 1935 from a Frederick Coville and French Gilman collection in Death Valley, both in Inyo County, California. Cordylanthus, a diminutive and inconspicuous annual in the Scrophulariaceae, is locally associated with salt-encrusted soils near the springs. The Ephedra, like the higher-elevation E. viridis in having three tiny leaves at a node, is sparingly present on the bajadas below the nearby limestone mountains, but it also occurs elsewhere in southern Nevada and the Death Valley region of southern California.

These are the Ash Meadows species included in the Federal Register lists as Endangered or Threatened. There are, in addition, others which because of their rarity, the range extensions they represent, or the taxonomic status of the Ash Meadows populations, make them of extraordinary interest and meriting protection and preservation here. These include especially the hybrids of two subspecies of Chrysothamnus nauseosus -- ssp. mohavensis and ^{The mountain} ssp. hololeucus -- which make up the rabbitbrush population of the spring areas. The linear-leaved paintbrush (Castilleja linariaefolia), a mountain species of the higher elevations in southern Nevada, occurs as local populations in the wet soils of nearly all spring areas, where it is larger, stouter-stemmed, and flowers more profusely and later than the mountain form.

Because of the availability of free-flowing potable water from the springs, and the plains-like nature of the land, Ash Meadows has been tempting to agricultural usage for over a century. The efforts of early homesteaders -- the scattered remains of whose homesteads are still evident -- to farm the land, all ended in failure because the salty, clay soils are not suitable for crops. The land was early abandoned for this purpose, and until around 10 years ago this unique oasis and its springs remained largely intact. About this time, an out-of-state corporation acquired large tracts (around 20 sq. mi.) in the northern and eastern parts, totally removed all vegetation by plowing, installed pumps at the springs, and otherwise obliterated the natural features of the area. A cattle-feeding operation was visualized as possible by way of exploitation of the water resources, but this large, heavily mechanized effort, which like all the preceding small agricultural efforts was necessarily based on the success of plant introductions, also ended this past year. The latest effort, however, took with it forever nearly all of the native plants and animals and their habitats in the northern half of this once remarkable and singular area -- scarcely known biologically at the time of its destruction.

What remains in northern and eastern Ash Meadows are primarily two privately owned tracts of a few hundred acres south and west of Devils Hole of Death Valley National Monument. On both tracts there have been extremely intense, year-round grazing pressures for many years by horses on open range. One, known as the "Collins Ranch", is the type locality for several of the plant species, and at least until recent years all but one (Nitrophila mohavensis) of the Endangered and Threatened species were known yet to occur on this abandoned ranch. If these tracts are not soon acquired and preserved, we can expect that future evidence of the existence of the strictly endemic plants of the spring areas of Ash Meadows will rest solely with herbarium records. Those made by the author and her associates are on file at the U. S. National Herbarium,

Washington, D. C., with duplicates at the University of Nevada, Reno and Las Vegas, California Academy of Sciences, Rancho Santa Ana Botanic Garden, New York Botanical Garden, and other herbaria.

A complete list of all plant species known to occur in Ash Meadows, and more detailed discussions of the physical features and plant communities of the area, appear in Beatley (1971, 1976). The collecting records of the Endangered and Threatened species are recorded in detail in Beatley (1977a, b, c). Numerous publications and other documents have dealt with the Desert Pupfish (Cyprinodon diabolis and C. nevadensis mionectes), critically endangered by the pumping operations at the springs, and their survival has been the subject of continuing litigation for nearly a decade.

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- _____. 1977b. Threatened plant species of the Nevada Test Site, Ash Meadows, and central-southern Nevada. COO-2307-12. Dept. Biol. Sciences, Univ. of Cincinnati, Cincinnati, Ohio. 66 p.
- _____. 1977c. Addendum to COO-2307-11 and COO-2307-12 (Endangered and threatened plant species of the Nevada Test Site, Ash Meadows, and central-southern Nevada). COO-2307-13. Dept. Biol. Sciences, Univ. of Cincinnati, Cincinnati, Ohio. 9 p.

Coville, Frederick V. 1893. Botany of the Death Valley Expedition.

Contr. U. S. Nat. Herb. 4: 1-363 (and map).

Denny, Charles S. and Harald Drewas. 1965. Geology of the Ash Meadows quadrangle Nevada-California. Geol. Surv. Bull. 1181-L. U. S. Govt. Printing Off., Washington. 55 p. (and map).

FOOTNOTES

¹ Barneby's own efforts to obtain material adequate for describing the species are recorded in a 1974 letter to the author: "... You may be amused to hear encapsulated my own experience there [Ash Meadows] about 1945, early May. We drove in on a mule track from the highway and at the first boggy place found an itinerant preacher with wife, children, and a delapidated tin Lizzie bedded deeply in the ooze. The car was painted all over with encouraging slogans of the Time to Repent, Down with Whore of Babylon sort, and one would have hoped that a Higher Power would have helped them in their distress. The Higher Power turned out to be Dwight and Myself, who in the process of towing them out got royally bogged down ourselves. As soon as they were on dry land, delivered by the improbable angels of wickedness, the Holy Family made tracks for the highway, not without leaving us blessed, but without waiting to see how we would get ourselves back in business. This is why, I think, I never saw the phoenix loco, which I was looking for, tipped off by the fragments at POM collected by Purpus."