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CURRENT DISTRIBUTION, HABITAT, AND STATUS OF CATEGORY 2 CANDIDATE PLANT SPECIES ON AND NEAR THE U.S. DEPARTMENT OF ENERGY'S NEVADA TEST SITE

DECEMBER 1995

LAS VEGAS AREA OPERATIONS
Las Vegas, Nevada

DISCLAIMER

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CURRENT DISTRIBUTION, HABITAT, AND STATUS OF CATEGORY 2 CANDIDATE PLANT SPECIES ON AND NEAR THE U.S. DEPARTMENT OF ENERGY'S NEVADA TEST SITE

by
Kevin W. Blomquist, Tim A. Lindemann, Glen E. Lyon,
Dan C. Steen, Cathy A. Wills, Sarah A. Flick, and W. Kent Ostler

DECEMBER 1995

REVIEWED BY

W. Kent Ostler, Director
Environmental Sciences Division

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ABSTRACT

Results of surveys conducted between 1991 and 1995 were used to document the distribution and habitat of 11 Category 2 candidate plant species known to occur on or near the Nevada Test Site (NTS). Approximately 200 areas encompassing about 13,000 ha were surveyed. Distributions of all species except *Frasera pahutensis* and *Phacelia parishii* were increased, and the ranges of *Camissonia megalantha, Galium hilendiae* ssp. *kingstonense, Penstemon albomarginatus,* and *Penstemon pahutensis* were expanded. The status of each species was assessed based on current distribution, population trends, and potential threats. Recommendations were made to reclassify the following five species to Category 3C: *Arctomecon merriamii, F. pahutensis, P. pahutensis, Phacelia beatleyae*, and *Phacelia parishii*. Two species, *C. megalantha* and *Cymopterus ripleyi* var. *saniculoides*, were recommended for reclassification to Category 3B status. No recommendation was made to reclassify *Astragalus funereus, G. hilendiae* ssp. *kingstonense, P. albomarginatus*, or *Penstemon fruticiformis* var. *amargosae* from their current Category 2 status. Populations of these four species are not threatened on NTS, but the NTS populations represent only a small portion of each species' range and the potential threats of mining or grazing activities off NTS on these species was not assessed. Conservation measures recommended included the development of an NTS ecosystem conservation plan, continued conduct of preactivity and plant surveys on NTS, and protection of plant type localities on NTS.

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Taxonomic identifications were provided by: Dr. R. Barneby, New York Botanical Garden, *Cymopterus ripleyi*; Dr. N. Holmgren, New York Botanical Garden, *Penstemon pahutensis*; and Dr. W. Wagner, Smithsonian Institution, *Camissonia megalantha*.

Updated information on candidate plants was provided by: Arizona Game and Fish Department; California Department of Fish and Game; the Las Vegas, Phoenix, and Tonopah District Offices of the Bureau of Land Management; Nevada Natural Heritage Program; Toiyabe National Forest; and the Utah Natural Heritage Program.

Death Valley National Park and Humboldt National Forest allowed plant surveys and plant collections.

Rancho Santa Ana Botanic Garden: University of Nevada, Las Vegas Herbarium; and University of Nevada, Reno Herbarium allowed access to specimens and collection records.

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1.0 INTRODUCTION

The U.S. Department of Energy Nevada Operations Office (DOE/NV) operates the Nevada Test Site (NTS) located 105 km (65 mi) northwest of Las Vegas, Nevada (Figure 1). NTS is located in the transition zone between the Mojave and Great Basin deserts and supports biota typical of both deserts. Among these are plants which have been classified by the U.S. Fish and Wildlife Service (FWS) as candidates for listing as threatened or endangered under the Endangered Species Act of 1973 (ESA).

Candidate species fall into three categories. Category 1 candidates are those for which FWS believes there is sufficient information available to list them as threatened or endangered. Category 2 candidates are those which FWS believes listing is probably deserved but for which there is insufficient information available to support a proposal for listing. The ESA does not provide protection to Category 1 and 2 candidate species; however, federal agencies are encouraged to consider these species during the planning stages of their activities. Category 3 candidates are those which were once considered for listing but are no longer considered because (1) they are extinct (Category 3A), (2) they are not taxonomically distinct enough to meet the ESA definition of a species (Category 3B), or (3) they are more abundant or widespread than previously believed and/or are not subject to any identifiable threat (Category 3C).

Following passage of the ESA, DOE/NV initiated a conservation strategy for candidate species on NTS that included field surveys to determine their distributions and to assess possible threats to their existence, and implementation of preactivity surveys designed to minimize or eliminate potential threats. Results of the earlier field surveys (Beatley, 1977a, 1977b; Rhoads and Williams, 1977; Rhoads et al., 1978; Cochrane, 1979; Rhoads et al., 1979a, 1979b) were used by FWS to reduce the list of candidates that possibly warranted federal protection to 12 (U. S. Department of the Interior, 1993a). They include one Category 1 species, *Astragalus beatleyae*, and 11 Category 2 species: *Arctomecon merriamii*, *Astragalus funereus*, *Camissonia megalantha*, *Cymopterus ripleyi* var. *saniculoides*, *Frasera pahutensis*, *Galium hilendiae* ssp. *kingstonense*, *Penstemon albomarginatus*, *Penstemon fruticiformis* var. *amargosae*, *Penstemon pahutensis*, *Phacelia beatleyae*, and *Phacelia parishii*.

Much of the earlier conservation efforts on NTS were directed towards *Astragalus beatleyae* because of its perceived vulnerability. DOE/NV has entered into two Conservation Agreements with FWS for *A. beatleyae*. A Species Management Plan was developed to establish management protocols. Some protocols, such as prohibiting domestic animal grazing, off-road vehicle travel, and public access, are standard operating procedure on NTS and provide protection to all candidate plants. Information gathered by DOE/NV about *A. beatleyae* was summarized (Blomquist et al., 1992) and provided to FWS.

Between 1991 and 1995, the focus shifted to conducting field surveys for the 11 Category 2 candidates. These surveys were to gather sufficient information which DOE/NV could provide to FWS so that a determination could be made about which species really deserved federal protection and which could be dropped from consideration. FWS evaluates five factors (CFR 50, ch. IV, part

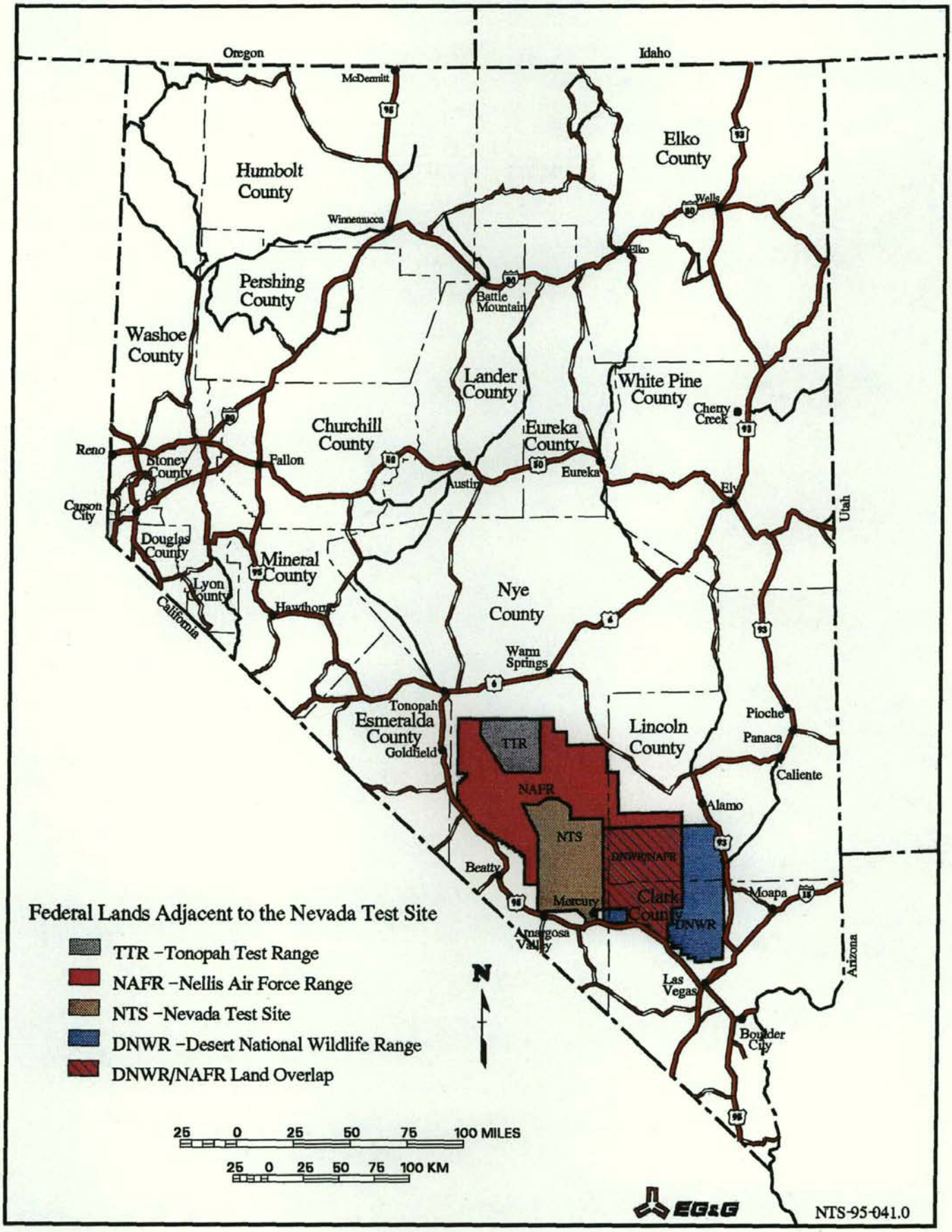

Figure 1. Location of Nevada Test Site, Southern Nevada

424.11) to make such determinations about a species: 1) present or threatened destruction, modification, or curtailment of habitat or range; 2) over-utilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) inadequacy of existing regulatory mechanisms; and 5) other natural or man made factors affecting continued existence. The specific objectives of the Category 2 candidate plant surveys conducted between 1991 and 1995 were to:

1) Determine the distribution and habitat characteristics of the species on NTS.

2) Resolve taxonomic problems, if possible, so that invalid taxa were not given further consideration.

3) Document and evaluate actual, as opposed to perceived, threats to the species based on the history of past DOE/NV activities conducted within their habitats.

4) Determine which species probably warrant federal protection based on criteria for listing species under the ESA.

2.0 METHODS

2.1 CANDIDATE PLANT SURVEYS

Previous reports were consulted to document plant locations, plant descriptions, habitat descriptions, distribution maps, and collection records (Beatley, 1977a, 1977b; Rhoads and Williams, 1977; Rhoads et al., 1978, 1979a, 1979b; Cochrane, 1979; Ackerman, 1981; WESTEC, 1981; Collins and O'Farrell, 1984). Known plant locations, including those found during preactivity surveys, were visited to confirm their existence, document habitat and population characteristics, map location boundaries, and collect voucher specimens. Surveys were then conducted to locate new populations and extend the known ranges. New areas to survey were selected based on similarity of surface geology, elevation, and other habitat characteristics.

Surveys were conducted between March and September and were scheduled to coincide with each species' flowering season. A survey area was defined as an area of land that was searched. Surveys often included searches for more than one species. Meandering transects were walked through each survey area and all distinct habitats were searched. Transects did not cover 100% of the area. The information recorded during each survey is listed in Table 1.

Approximately 200 areas on and off NTS were surveyed from 1991 to 1995. When candidate plant species were found, the area that the plants occupied was identified and the perimeter of the area was marked on a 7.5' U.S. Geological Survey (USGS) quadrangle map. Voucher specimens were also collected and sent for taxonomic verification when necessary. Each separate area occupied by a candidate plant will be called a "location" rather than a "population". Thus, a plant location represents a group of individuals of the same species having a distinct geographic boundary which may or may not be interbreeding with other groups of individuals.

All survey areas and plant locations recorded on the 7.5' USGS quadrangle maps were digitized. Computerized maps were then generated showing survey areas and plant locations as polygons. Spatial statistics (center point, area, elevational range, slope range, and aspect range) were calculated for each polygon.

2.2 INFORMATION SEARCHES

Additional information on each candidate species was gathered from literature searches and discussions with federal and state agencies including: FWS, Ventura, California; Bureau of Land Management (BLM), Barstow, California, Kingman, Arizona, and Las Vegas, Nevada; California Department of Fish and Game Natural Heritage Division Natural Diversity database; Nevada Natural Heritage Program (NNHP) database; Utah Department of Natural Resources database; and the Arizona Game and Fish Department database. Collection records were obtained from the herbaria at the University of Nevada, Reno (UNR), the University of Nevada, Las Vegas (UNLV), and Rancho Santa Ana Botanic Garden (RSA).

Table 1. Information gathered during plant surveys.

Parameter	Description
Species	Genus and species name of the plant searched for (target species)
Date	Month/day/year of the survey
Quadrangle name	Name of the 7.5' USGS quadrangle map used
Specimen collection	Specimen(s) collected (Y/N)
Elevational range	Lowest and highest elevation target species occupies
Vegetation association	Two or three most dominant plants of the survey area
Disease/grazed	Species showed evidence of being diseased or grazed (Y/N)
Location	Universal Transverse Mercator (UTM) coordinate marking approximate center of the plant location
Associated species	Three to five plants found in the plant location in association with the target species
Congeners	Plants in the survey area that are the same genera as the target species
Substrate	General particle size and color of the soils in the area and the geologic formation or member name
Disturbance	Target species found in disturbed area (Y/N)
Number	Number of plants counted; this is not a count of all plants in the area since the survey did not cover 100% of the area
Phenology/age structure	Count of how many plants fit into each phenology/age structure: 1) Seedlings - fleshy cotyledons still present 2) Immature - cotyledons wilted or not present; vegetative; no reproductive part present 3) Budding - flower buds present but less than 50% of them opened 4) Flowering - flower buds present with greater than 50% of them opened 5) Immature fruit - greater than 50% of the flowers wilted and showing formation of a fruit 6) Mature fruit - all flowers wilted with fruits visible and enlarged 7) Seed dispersing - greater than 50% of the fruits opened and dispersing seed 8) Dormant/senescent - live but not actively growing; dying back after a growth or fruiting stage; post reproductive

Table 1. Continued.

Parameter	Description
Abundance	Target species' abundance within the survey area of suitable habitat: 1) Rare - have to search intensively over a large area to find a few plants 2) Widely scattered - plants appear to be randomly scattered and are not hard to find 3) Common - easily observable 4) Locally abundant - high density of plants but appear to be found in clumps 5) Abundant - high density of plants; consistently see next plant(s) while standing by current plant(s)
Aspect	Direction slope faces in the survey area or the plant location: N, S, E, W, NE, NW, SE, SW
Slope	Percent slope category of the survey area or the plant location: Flat, 1-10%,11-35%, 35+%
Topographic position	Portion of the landscape the target species occupies: 1) crest, 2) upper slope, 3) mid slope, 4) lower-slope, or 5) bottom
Light	Light regime the target species was found in: 1) open - direct sunlight 2) partial - direct and indirect sunlight for separate parts of the day 3) filtered - a mosaic of direct and indirect sunlight 4) shade - indirect sunlight

Information was also solicited from the following consulting firms: Ogden Environmental, San Diego, California; Dames & Moore, Las Vegas, Nevada and San Diego, California; LSA Inc. Orange County, California; The Chambers Group, Orange County, California; Jones and Stokes, Sacramento, California; The Keith Companies, Palm Desert, California; and Recon, San Diego, California. In many instances information was obtained by a phone call, and copies of available reports were requested.

3.0 RESULTS AND DISCUSSION

3.1 *Arctomecon merriamii* Coville, white bearpoppy

3.1.1 Description

A. merriamii (Figure 2) is a perennial herb in the Papaveraceae (poppy) family. Its hairy leaves grow in a cluster at the base of the plant forming a compact mat up to 10 cm high. Its white flowers are large, showy, and are borne on naked stems 20-30 cm tall. The flowers are inclined to nod in bud. Flowering occurs during April and May. For a complete taxonomic description, see Coville (1892).

3.1.2 Distribution

A. merriamii is known from Inyo County, California, and Lincoln, Nye, and Clark counties, Nevada. The type locality is a few miles west of Vegas Ranch, Clark County (previously Lincoln County), Nevada. This species was first collected there in 1891 (Coville, 1892). The type locality was most likely extirpated by development of the Las Vegas metropolitan area (Rhoads and Williams, 1977). The current range of *A. merriamii* reaches its northern extent in the Desert Range, Lincoln County, Nevada; its western extent on the western boundary of Death Valley National Park (DVNP), Inyo County, California; its eastern extent in the Kane Spring Valley, Lincoln County, Nevada; and its southern extent in the Clark Mountain Range of San Bernardino County, California (Figure 3; additional information on numbered map points can be found in Appendix A, Table 1).

Prior to 1978, 11 locations were found on or near NTS (Rhoads and Williams, 1977). One location is near the southern edge of Frenchman Lake, six locations are in the Spotted Range (Red Mountain and Mercury Ridge), and four locations are in the Specter Range. The location near the southern edge of Frenchman Lake and one of the locations in the Specter Range were documented in Figure 25 of the Rhoads and Williams (1977) report but were not documented on the accompanying topographic maps. None of the collection records in Appendix C (Cochrane, 1979) correlated with either of the two locations. On that basis, no attempt was made to revisit either location, and they were not included in this report. Cochrane (1979) reported several collection records from Mercury Valley but they lacked detail so no attempts were made to relocate these populations. Although it cannot be verified, some of these locations may have been rediscovered during subsequent preactivity surveys conducted in Mercury Valley. From 1991 to 1993, five of the six known locations in the Spotted Range were visited. The location boundaries observed were consistent with those reported on Rhoads and Williams' (1977) maps. Seven additional plant surveys were conducted in the Specter Range and Striped Hills south of NTS, and on Syncline Ridge in Areas 1 and 16 of NTS to find new locations. Approximately 1,450 ha were surveyed.

Figure 2. *Arctomecon merriamii* in flower on Mercury Ridge, Nevada Test Site.

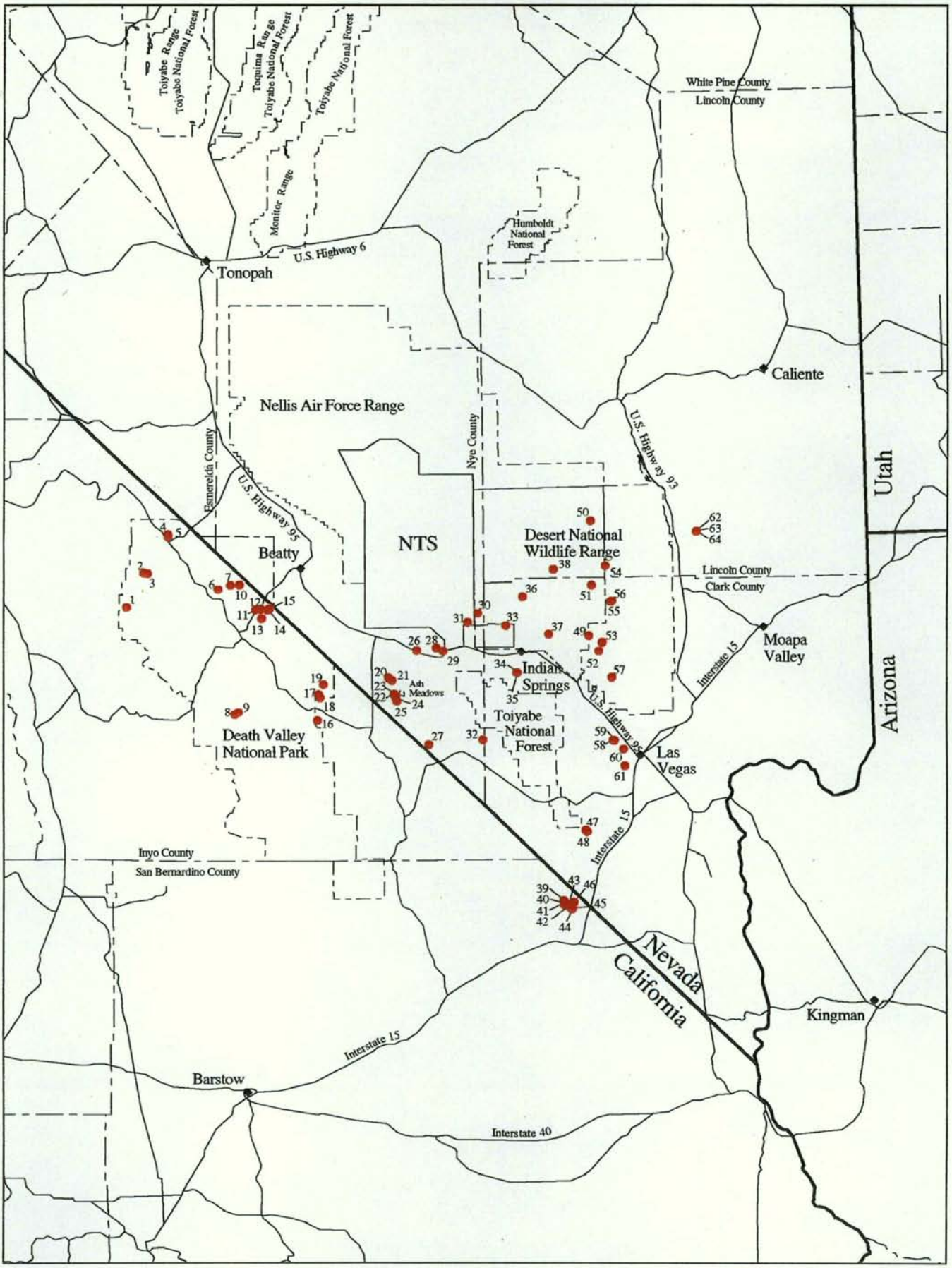

Figure 3.

Known Distribution of

Arctomecon merriamii

0 25 50 MILES

0 25 50 75 100 KM

N

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Eight new locations were found in the Specter Range. Two of these were located on the south side of the Specter Range and coincided with locations reported in the late 1960's (Cochrane, 1979). The remaining six locations were new or extensions of those recorded earlier.

From 1993 to 1995, four locations were discovered in Mercury Valley during preactivity surveys, and one new location was discovered along Burma Road north of Red Mountain during a candidate plant survey. Due to the lack of detail in the collection records (Cochrane, 1979), the four locations in Mercury Valley may not be new. No previous record of the Burma Road location was found.

On NTS, 11 locations of *A. merriamii* are currently known from Red Mountain, Mercury Ridge, and Mercury Valley (Figure 4; these 11 locations are included in the 63 locations represented by Map Point 31 on Figure 3 and Table 1 of Appendix A). Two locations are just off NTS near Mercury Ridge, and eight locations are south of NTS in the Specter Range (Figure 4; Figure 3, Map Points 26, 28 and 29). At some locations *A. merriamii* was locally abundant while at others it was widely scattered or even rare. Estimated numbers of plants ranged between one and approximately 2,000.

A. merriamii was found at 135 locations on the Nellis Air Force Range (NAFR) east of NTS. Ackerman (1981) documented 2,187 plants at 110 locations. Knight and Smith (1994) estimated that 11,600 plants occurred on 39 sites, 11,000 of which were found in 25 locations which were not documented by Ackerman. Knight and Smith (1994) reported population estimates ranging from 1 to >3,000 plants.

The locations of *A. merriamii* on NTS and in the Specter Range off NTS encompassed approximately 278 ha; the largest location covered 58.8 ha. The 39 sites surveyed by Knight and Smith (1994) occupied approximately 9 ha, and the population area size class for each site, as recorded on field data sheets, ranged from "< 1m²" to "> 1 ha".

Across its range *A. merriamii* is known from approximately 355 locations (Figure 3, Appendix A. Table 1) scattered within an area of approximately 25,000 km² (9,650 mi²).

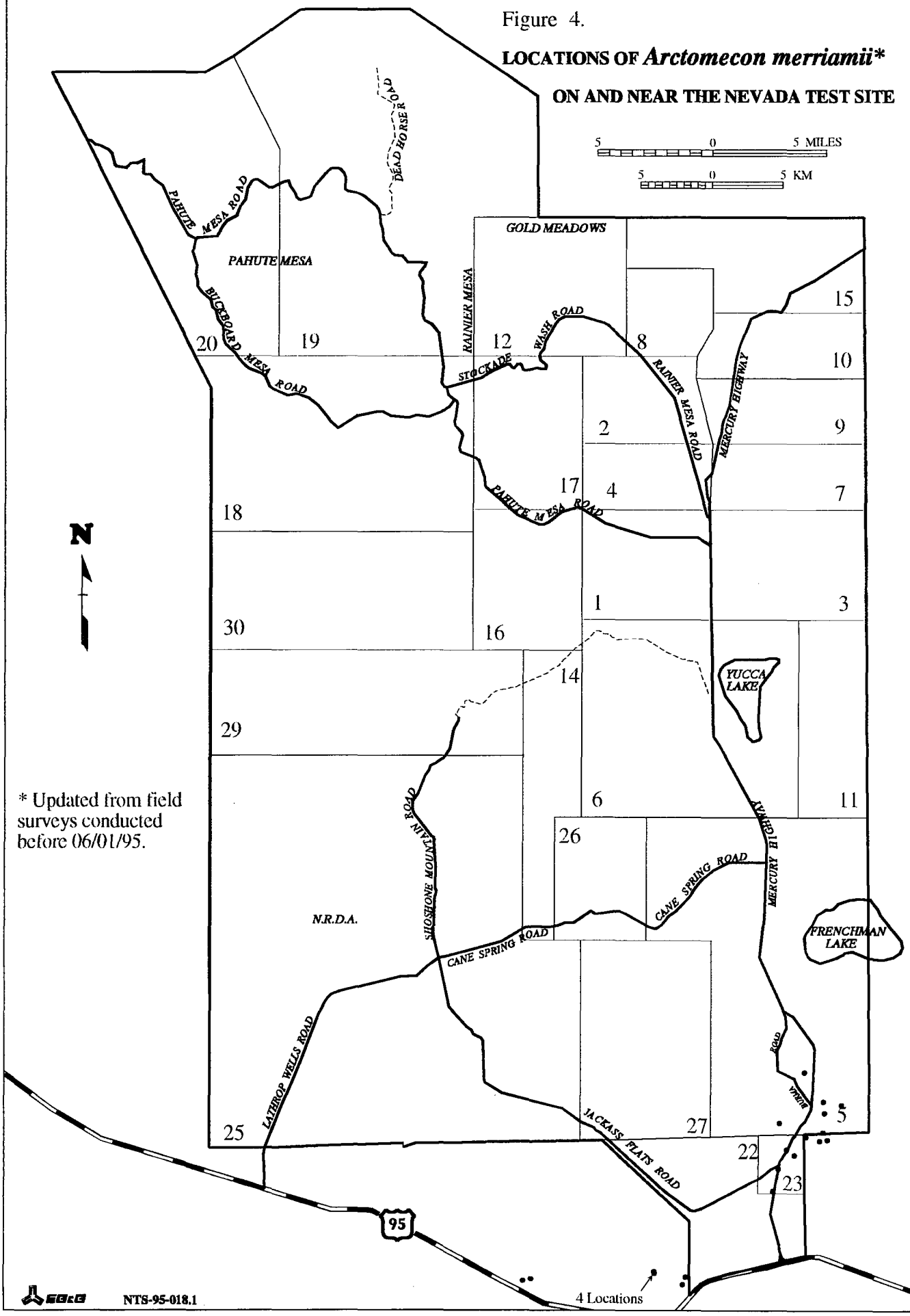
3.1.3 Habitat

A. merriamii occurs on limestone and dolomite ridges, rocky slopes, gravelly canyon washes, and less often on flats and old lake beds derived from carbonate rock sources. The species is commonly associated with *Coleogyne ramosissima*, *Atriplex* spp., *Larrea tridentata*, *Ambrosia dumosa* or *Chrysothamnus* spp. at elevations of 610-1,920 m (2,000-6,300 ft). Other less commonly associated plant species include *Penstemon petiolatus*, *Agave utahensis*, *Cymopterus gilmanii*, *Ephedra viridis*, *Psorothamnus fremontii*, *Yucca schidigera*, *Lycium andersonii*, or *Eriogonum* spp.

A. merriamii occurs on carbonate rock formations that include Devils Gate Limestone, Nevada Formation, Dolomite of the Spotted Range and Ely Springs Dolomite (Barnes et al., 1982). On

Figure 4.

LOCATIONS OF *Arctomecon merriamii
ON AND NEAR THE NEVADA TEST SITE



* Updated from field surveys conducted before 06/01/95.

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NTS, *A. merriamii* occurs primarily on limestone and dolomite outcrops of Red Mountain and Mercury Ridge (Figure 5).

Three of the locations in Mercury Valley are on man-made disturbances below Red Mountain and Mercury Ridge. Two of the disturbed areas are seldom-used staging and/or parking areas that were cleared of vegetation sometime prior to 1990. The third area was found in 1994 along a backfilled trench in which a fiber optic line was buried in 1993. This species had not been observed during preactivity surveys conducted at these three sites prior to construction. The trench, constructed for burial of the fiber optic line, passed through a population of *A. merriamii* approximately 1.6 km (1 mi) north of the site where the *A. merriamii* plants were found in 1994. It is presumed that seeds were dispersed along the trench during construction. At the staging/parking areas, no *A. merriamii* were observed growing in the adjacent undisturbed area, and it is likely that nearby locations on Red Mountain or Mercury Ridge were the seed source. This plant also inhabits roadsides and bladed areas on NAFR (Ackerman, 1981).

Approximately 20% of the area occupied by *A. merriamii* on NTS and in the Specter Range has a 0-3% slope and 62% has a 10-50% slope. *A. merriamii* on NTS and in the Specter Range is found almost exclusively in open sunlight at elevations of 853-1,463 m (2,800-4,800 ft).

3.1.4 Assessment of Status

A. merriamii is widely distributed across southern Nevada and occurs on lands under a variety of ownerships (Ackerman, 1981; Knight and Smith, 1994; Mozingo and Williams, 1980; Morefield and Knight, 1991; NNHP, 1994). Although the known range of *A. merriamii* has not increased much since the early 1980's, the number of locations has increased. On DNWR, Ackerman (1981) documented 110 locations on DNWR, and Knight and Smith (1994) documented 25 additional populations and noted that some potential habitat has still not been surveyed. On NTS and in the Specter Range the number of locations increased from 11 to 21.

Locations discovered on NTS in the late 1970's (Rhoads and Williams, 1977) and NAFR in the early 1980's (Ackerman, 1981) were revisited in the early 1990's by DOE/NV and others (Knight and Smith, 1994), and all were still in existence. Threats to the continued existence of this species are minimal. On NTS, this species was unaffected by past construction or nuclear testing. Some land-disturbing activities in Mercury Valley apparently created suitable habitat and an opportunity for recruitment of seeds into new locations.

Off NTS, threats to this species over most of its known range appear to be minimal. The known *A. merriamii* locations which occur within DNWR, Ash Meadows, and DVNP are protected because of the conservation and management policies employed there. On NAFR, where the largest concentration of plants is found, ordnance impacts or off-road travel may affect some populations, particularly those in valley bottoms or near targets (Knight and Smith, 1994). These Valley-bottom plant locations, however, account for only about 15% of the known locations. Urban development may continue to threaten this plant near Las Vegas (WESTEC, 1980). Threats to this species in Kane Spring Valley and the Clark Mountain Range are unknown.

Figure 5. *Arctomecon merriamii* habitat at Red Mountain, Nevada Test Site. Plants are found on the grey limestone outcrops of the middle and upper slopes and ridge tops.

Disease and/or predation were not observed at locations on NTS. The family Papaveraceae is characterized by large quantities of alkaloids and is, therefore, toxic to most organisms (Lawrence, 1951). No one has successfully grown *A. merriamii* from seed or by transplanting, and no horticultural value has been recognized (Knight and Smith, 1994), therefore, it is unlikely that collection by the nursery trade will ever pose a threat.

A. merriamii was found at several new locations in recent years, and there do not appear to be any significant threats to its continued existence over the majority of its range. FWS recommended that *A. merriamii* be reclassified as a Category 3C candidate (Bair, 1995a), which is a species that is more abundant or widespread than previously believed, and/or do not have an identifiable threat. Data gathered on NTS support that recommendation.

3.2 *Astragalus funereus* M. E. Jones, Funeral milk-vetch

3.2.1 Description

A. funereus (Figure 6) is a perennial herb in the Fabaceae (legume) family. It's stems lie flat on the ground forming a loose mat. The entire plant is covered with white or grayish, dense, stiff and sometimes wavy hairs, giving it a woolly appearance. The flower stalks contain 3 to 10 pink-purple flowers that are large and showy. It forms large (>2.5 cm in length), leathery, hairy seed pods. Flowering generally occurs between March and May although flowers have been seen in July (Rhoads et al, 1978). For a complete taxonomic description, see Jones (1908).

3.2.2 Distribution

A. funereus was first collected at Rhyolite, Nevada and described in 1907 (Jones, 1908). *A. funereus* is known from Nevada and California, along the east-west corridor of the transition desert from DNWR to just west of DVNP (Figure 7; additional information on numbered map points can be found in Appendix A, Table 2). The western boundary of its range is in the Cottonwood Mountains of DVNP, Inyo County, California (Figure 7; Map Point 1). The northeastern limit of its range is in Raysonde Buttes of DNWR, Nye County, Nevada. The southern limit of its range is thought to be at Goodsprings, Nevada (southern Spring Mountain Range) which was documented by Reveal and Ripley in 1941 (RSA herbarium, accession #109681). The validity of this site is questionable due to its isolation from other known locations. This location was not revisited to confirm its existence or Reveal and Ripley's identification of *A. funereus* plants found there. Janice Beatley (1977b) notes from Rupert Barneby's *Contributions Toward a Flora of Nevada* published in 1956, that "*A. funereus* occurrences reported from the Charleston Mountains (Spring Mountains) are based on forms of the strictly acaulescent *A. newberryi*, superficially similar in the black-hairy calyx". *A. funereus* was again documented in the Spring Mountains near Wheeler Pass in 1985 by Duane Atwood (Figure 7; Map Point 17), however, this collection was determined to be *A. newberryi* (Welsh, 1995). Locations in the Panamint Range and Panamint Valley of Inyo County California collected in the 1930's were also questioned as possibly being *A. purshii* or some other *Astragalus* species (Cochrane, 1979), however, *A. funereus* continues to be documented in the Panamint Range (Figure 7; Map Points 1, 2, and 3). Plants from Map Point 3, collected by Wayne Armstrong 3.2 km (2 mi) west of Aguereberry point, DVNP, were identified from both flowers and fruits.

Prior to 1979, there were three known locations on NTS (two at French Peak and one at Shoshone Mountain) (Rhoads et al., 1978). In 1991, portions of the Shoshone Mountain location and the largest French Peak location were visited. Plants were found at both locations. In 1992, more searches were performed at these same sites. The Shoshone Mountain location was found to have expanded by over 100% and three new locations were discovered nearby. This species was common to locally abundant and a total of 789 plants were counted. The French Peak locations were also surveyed in 1992 and the location boundaries were found to have expanded slightly. The total number of plants counted at these sites was 473. Surveys were also conducted in 1992 at Calico Hills, Paintbrush Canyon, and areas near Shoshone Mountain, but no new locations were

Figure 6. *Astragalus funereus* in flower on French Peak of the Halfpint Range, Nevada Test Site.

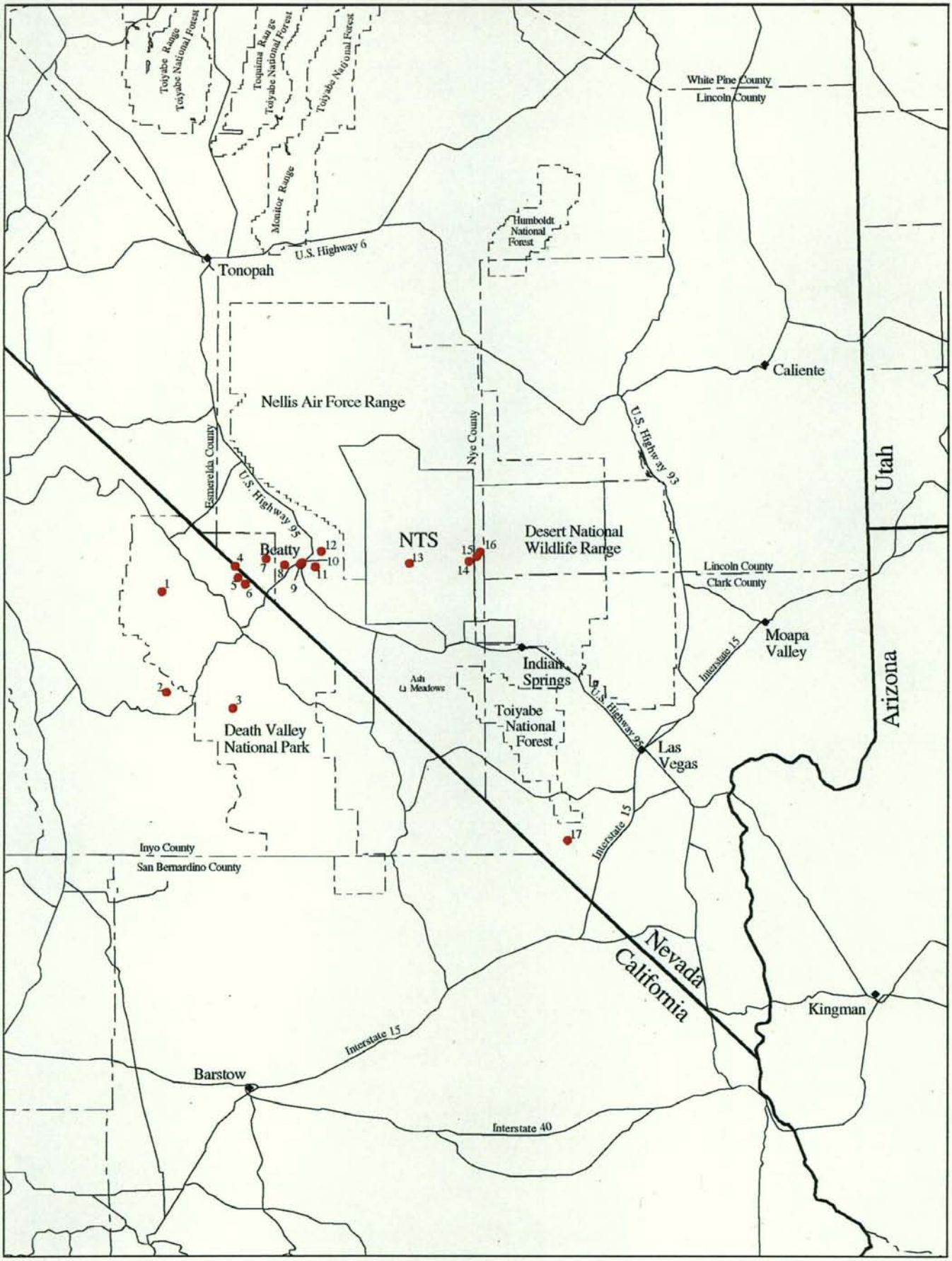

Figure 7.

Known Distribution of

Astragalus funereus

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found. No new locations were discovered as a result of preactivity surveys conducted on NTS since 1976. Currently there are seven known *A. funereus* locations concentrated in two areas on NTS (Figure 7, Map Points 13 and 14; Figure 8). Plants at these locations occupy approximately 228 ha.

In 1992, surveys were conducted to document known locations off NTS. Based on information from Cochrane (1979), four locations surrounding Beatty, Nevada, were visited: Rhyolite, Bullfrog Hills, Beatty Mountain, and Beatty Wash. Ten plants were found at Rhyolite (Figure 7; Map Point 8) and 256 were found at Bullfrog Hills (Figure 7; Map Point 7). No plants were found at Beatty Mountain or Beatty Wash. Two new locations were found approximately 0.4 km (0.2 mi) away from where the historic Beatty Wash location was supposed to be. Approximately 175 plants were counted there (Figure 7; Map Point 12). The Beatty Mountain location may still exist since many locations of potential habitat occur in the area. A new location on the saddle between Fluorspar Canyon and Tates Wash east of Beatty Mountain was found as a result of these surveys. Thirty-one plants were counted at this site (Figure 7; Map Point 11). The total area occupied by *A. funereus* at these five locations was approximately 106 ha.

In 1994, 18 additional areas off NTS were surveyed. Seven areas were surveyed on DVNP to find new locations and relocate poorly documented locations in Titus Canyon, but none were found. The remaining surveys were conducted in the Beatty, Nevada area, west of NTS on Yucca Mountain, the Funeral Mountains east of DVNP, and near Death Valley Junction.

In April, 1995, Wes Niles documented what may be the historic Beatty Wash location. Three or four plants were found on a steep, south-facing talus slope in Beatty Wash (Figure 7; Map Point 12). This location was found in Township 11 south, Range 48 east, Section 19 rather than in Township 11 south, Range 48 east, Section 30 as reported in Cochrane (1979).

Currently there are 29 locations of *A. funereus* distributed over a range of 12,500 km^2 (4,825 mi^2) (Appendix A., Table 2). Within this range, *A. funereus* occupies at least 334 ha (228 ha on NTS and 106 ha at five locations around Beatty).

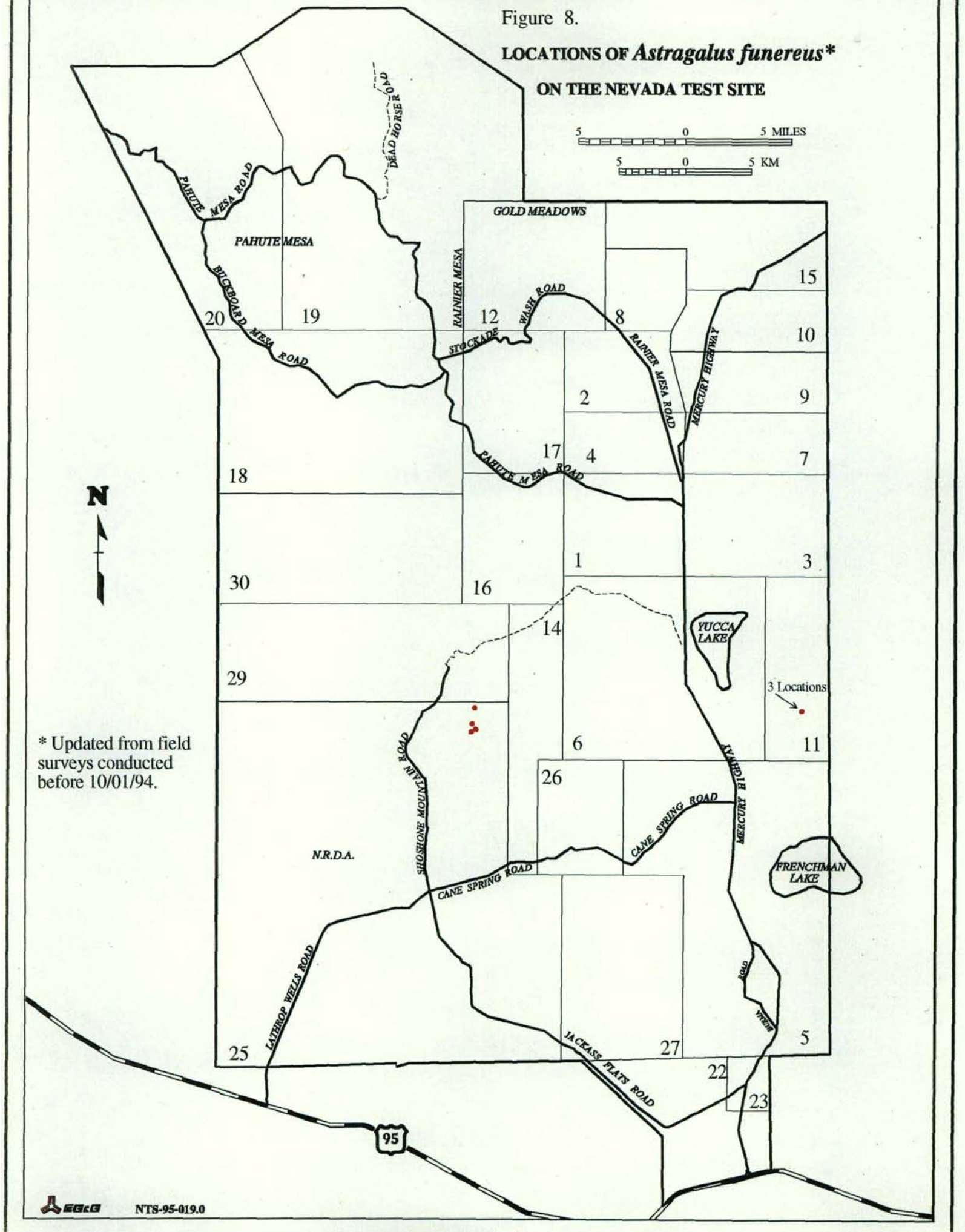
3.2.3 Habitat

A. funereus grows at elevations of 975-2,286 m (3,200-7,500 ft) (Kartesz, 1988). On NTS, it occurs at elevations of 1,310 m (4,300 ft) at French Peak to 1,950 m (6,400 ft) at Shoshone Mountain. Approximately 36% of the area occupied by *A. funereus* on NTS has a 30-50% slope and 16% has a 50-60% slope. Only 11% of the occupied area on NTS occurs on a 0-10% slope. On NTS, *A. funereus* occurs on a variety of aspects, but the largest portion of plants, roughly 35%, have southern, southeastern, or southwestern aspects.

On NTS, *A. funereus* occurs on steep hillsides composed of ash-flow volcanic tuff (mostly Topopah Spring Member or Rainier Mesa Member) (Hinrichs and McKay, 1965) that is typically light gray to reddish-brown (Figure 9). Soils are loosely compacted as gravel or cobble. In the Grapevine, Funeral, and Cottonwood mountains of DVNP, *A. funereus* occurs on sedimentary and

Figure 8.

LOCATIONS OF *Astragalus funereus
ON THE NEVADA TEST SITE



* Updated from field surveys conducted before 10/01/94.

EG&G NTS-95-019.0

Figure 9. *Astragalus funereus* habitat on southwest slopes of French Peak of the Halfpint Range, Nevada Test Site. Plants are found at the base of the cliffs in the light colored substrate near the center of the photograph.

metasedimentary rocks consisting mostly of mixed limestone and sandstone (Hickman, 1993; Kurzius, 1981; Peterson, 1984). The species has been documented in deserted roadbeds consisting of loosely compacted gravel and talus (Rhoads et al., 1978).

Species commonly associated with *A. funereus* include *Grayia spinosa, Atriplex confertifolia, A. canescens, Artemisia tridentata, A. spinescens, Coleogyne ramosissima, Acamptopappus shockleyi, Ephedra viridis,* or *Chrysothamnus teretifolia.* It is sometimes associated with *Astragalus newberryi* or *A. purshii.*

3.2.4 Assessment of Status

A. funereus occurs on DOE/NV, FWS, BLM and National Park Service lands. At least seven additional locations have been found within its range since 1980, and the area occupied by this plant at the Shoshone Mountain location on NTS has increased. Locations in Titus Canyon of DVNP and the southern Spring Mountain Range (Figure 7; Map Points 4,5,6, and 18) have not been visited for more than 35 years, so it is not known if they still exist.

Locations discovered in the 1960's and 1970's (Rhoads and Williams, 1977) on NTS and near Beatty were revisited in the early 1990's and are still in existence. Inferences on population trends cannot be made because there are no data available on plant abundance at these locations through time. This species' continued existence at sites known since the late 1970's however, suggests that the populations on NTS are stable.

Threats to the continued existence of this species on NTS appear to be negligible. Rhoads et al. (1978) stated that populations on NTS occurring on steep talus slopes might be disturbed by landslides caused from underground nuclear testing. The species' survival does not appear to have been affected by landslides or other DOE/NV activities. Additionally, the threat of nuclear testing is less now than it was in 1978. Testing is banned and is unlikely to resume (U.S. Department of Energy, 1994). The steep talus slopes that the species grows on are undesirable for construction and inaccessible to off-road vehicles.

Habitat modification or destruction off NTS also appears to be minimal. Those locations that have been documented (but not relocated) in DVNP are protected from disturbance by the conservation and management policies employed there. No man-made disturbances were observed in 1992 at the locations near Beatty and Rhyolite, however; there are active mines in the vicinity. The impact of these mines on *A. funereus* was not assessed. Because *A. funereus* locations in the Beatty area comprise a signification portion of this species' distribution, an assessment of mining impacts should be performed. If threats from mining are determined to be non-significant, this species should be reclassified as Category 3C. Without such an assessment, its current classification as a Category 2 species may be appropriate.

3.3 *Camissonia megalantha* (Munz) Raven, Cane Spring evening primrose

3.3.1 Description

C. megalantha (Figure 10) is a robust spring-germinating annual herb in the Onagraceae (evening primrose) family. It is 0.1 to 2 m tall with numerous branches. The entire plant is covered with sticky hairs. Its leaves are most numerous and largest near the base of the plant. Its pale to dark lavender flowers are rather large and showy (Figure 10). Flowering occurs primarily during September and October, with some small plants beginning to flower in June.

C. megalantha was first described as a variety of *Oenothera heterochroma* (S. Wats) (Munz, 1941). Dr. Peter Raven elevated it to the species level in 1962 and assigned it to the genus *Camissonia* in 1964. Since the 1970's there has been debate regarding its synonymy with *C. heterochroma* (S. Wats) Raven (Shockly's evening primrose). *C. megalantha* and *C. heterochroma* both have lavender flowers (only one other species of the genus *Camissonia* does: *C. atwoodii* Cronq. [Atwood's evening primrose] which is endemic to Kane County, Utah). *C. megalantha* and *C. heterochroma* both occur in Nye County, Nevada and are distinguished from one another by flower size and the position of their stigma. Flowers of *C. megalantha* have their stigma held above the anthers at maturity, a hypanthium 4.5-8.5 mm long, and petals 9-13.8 mm long. Flowers of *C. heterochroma* have their stigma surrounded by the anthers at maturity, a hypanthium 2-5 mm long, and petals 2-6 mm long (Kartesz, 1988).

Rhodes and Williams (1977) stated that "... *C. megalantha* has been determined to be a synonym for *C. heterochroma* by the taxonomic authority on the genus, Dr. Peter Raven." Raven has stated that he "...was inclined now toward considering all populations as belonging to a single polymorphic species...", and "...has delegated to... [Janice Beatley] ...further studies and taxonomic judgements of the whole complex" (Beatley, 1977a). In 1978, Janice Beatley stated, "There is no question that *C. megalantha* will remain a taxon -- probably a subspecies of *C. heterochroma*." To our knowledge, Janice Beatley never published her findings after Raven delegated authority of the complex to her. *C. heterochroma* and *C. megalantha* are recognized as separate species by Kartesz (1988).

Observations made during surveys on NTS conducted from 1991 to 1994 indicate that there is no clear geographic separation between the two species on NTS. Plants exhibiting *C. megalantha* characteristics have been observed at scattered locations from Slanted Buttes (northeastern NTS), south to Massachusetts Mountain (eastern NTS), and west to Little Skull Mountain (southwestern NTS). Plants exhibiting *C. heterochroma* characteristics have been observed at scattered locations throughout NTS from Jackass Flats (southwestern NTS), east to French Peak and the Halfpint Range (eastern NTS), and north to Pahute Mesa (northern NTS). *C. heterochroma* has also been documented in Elko, Mineral, Churchill, and Esmeralda counties in Nevada, and California. Plants exhibiting characteristics of both species simultaneously have been observed within and adjacent to the range of plants exhibiting *C. megalantha* characteristics on NTS.

Figure 10. *Camissonia megalantha* in flower growing out of the asphalt on Orange Blossom Road, Nevada Test Site.

In 1993, 22 specimens from 15 locations across NTS were collected. These specimens were sent to Peter Raven for identification. Raven subsequently sent the specimens to Warren Wagner of the Smithsonian Institution for identification. Wagner identified specimens from Little Skull Mountain, Cane Spring (type locality), south Slanted Buttes, and Orange Blossom Road as *C. megalantha*. He identified specimens from the Massachusetts Mountains, Camera Station Butte, a second location on Orange Blossom Road, and the hills east of Camera Station Butte as *C. heterochroma*, although specimens previously collected from the Massachusetts Mountains and Camera Station Butte have been identified as *C. megalantha* (Beatley, 1976; Collins and O'Farrell, 1984). Two specimens from Orange Blossom Road were collected from separate sites less than 1 km apart. One was identified as *C. megalantha* and the other was identified as *C. heterochroma*. Wagner's conclusions raise a question regarding the distinction of these species, especially in areas previously thought to contain only *C. megalantha*, such as the Massachusetts Mountains and Camera Station Butte. The authors of this report are inclined to share Raven's decision to consider "all populations as belonging to a single polymorphic species."

The chronology of *C. megalantha* discoveries presented in Section 3.3.2 includes sites later disqualified by the results of Wagner's 1994 identifications (i.e. Massachusetts Mountains and Camera Station Butte). These sites are shown on the fold-out map of Appendix B as *C. heterochroma*, but are noted as being previously identified as *C. megalantha*.

3.3.2 Distribution

C. megalantha is found in Nye and Lincoln counties, Nevada. It is located on NTS in the Halfpint Range, northeast of Skull Mountain at Cane Spring , and Little Skull Mountain, and on DNWR in the Halfpint Range. It was also collected at two locations farther north, one in the eastern footslopes of the Groom Range of Lincoln County and one on NAFR on the west side of the Kawich Range. Previous reports of the species in Utah and Arizona are in error (Hayes, 1981; Welsh et al., 1993). The type locality is located on NTS at Cane Spring where it was described as a variety of *Oenothera heterochroma* (Munz, 1941). *C. megalantha*'s range reaches its northern extent in the Kawich Range, its eastern extent in the Groom Range, and its southwestern extent at Little Skull Mountain on NTS (Figure 11; additional information on numbered map points can be found in Appendix A, Table 3).

Prior to 1978, *C. megalantha* was known from only three locations: the type locality, the Massachusetts Mountains (Rhoads and Williams, 1977), and the west side of the Kawich Range on NAFR (Figure 11; Map Point 1). The Kawich Range site is known from one specimen collected in 1977 by Susan Cochrane. The specimen is missing and its identification could not be verified. No attempt was made to relocate this site. In 1978, locations were discovered on north Slanted Buttes, near drill pad U11c south of the Massachusetts Mountains, and adjacent to Tweezer Road in eastern Yucca Flat (Cochrane 1979; Figure 11; Map Points 4, 5, and 6, respectively). No specimens were collected at the sites north of Slanted Buttes or near the U11c drill pad so a current species determination was not made. These two locations are noted in Figure 11 because they may be *C. megalantha*, but they were omitted in Figure 12 and Appendix B which are based on

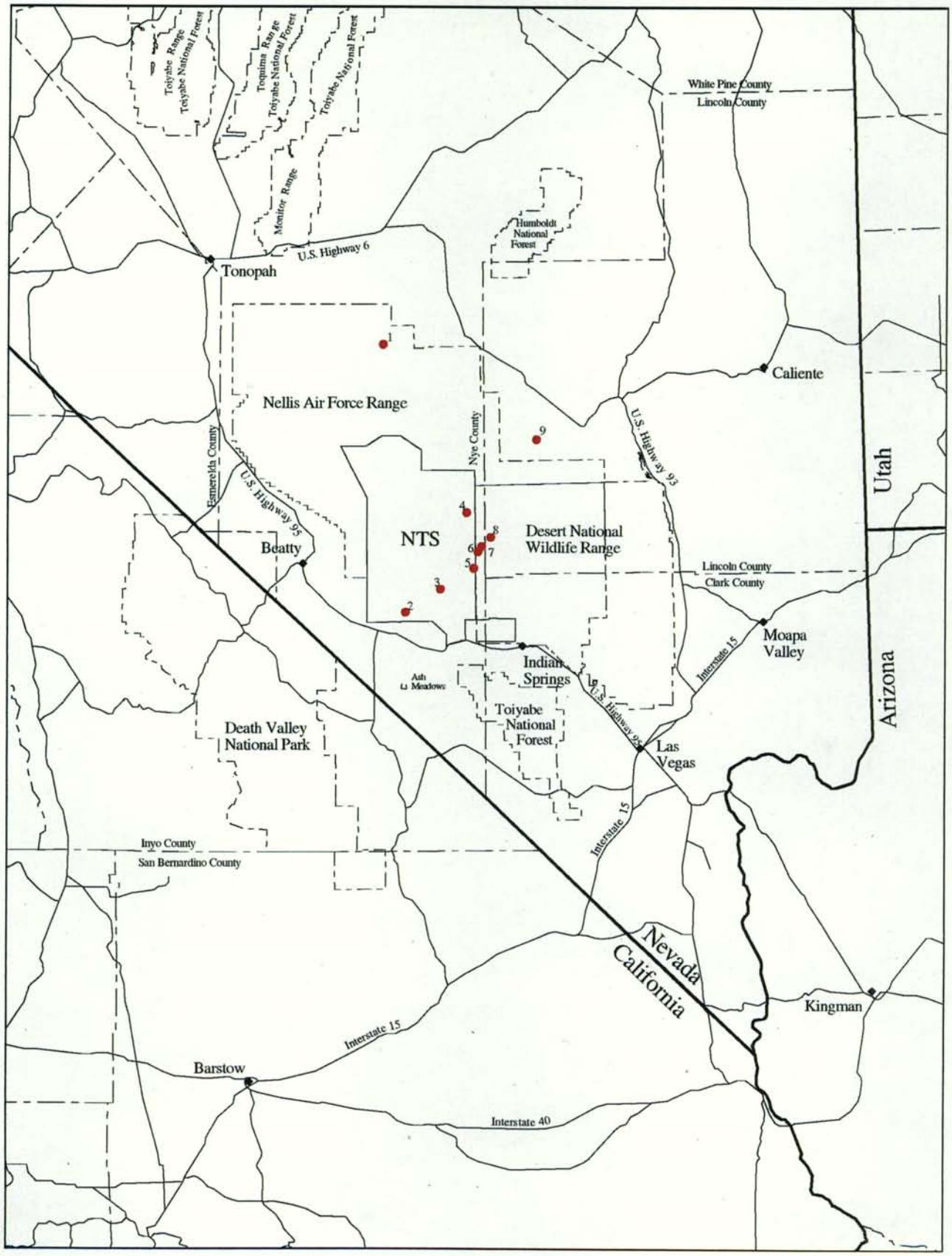


Figure 11.

Known Distribution of

Camissonia megalantha

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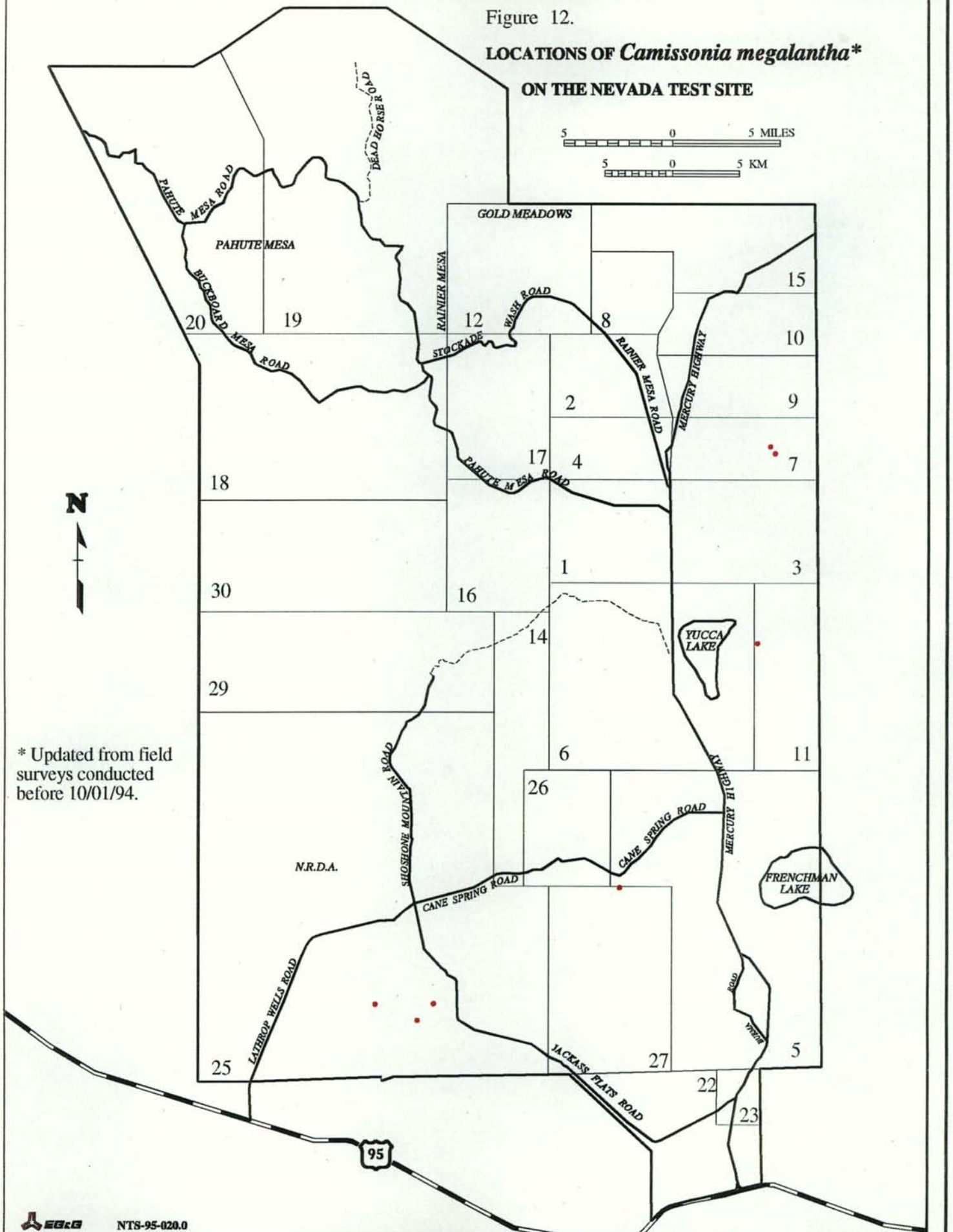
Figure 12.

LOCATIONS OF *Camissonia megalantha** **ON THE NEVADA TEST SITE**



* Updated from field surveys conducted before 10/01/94.

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Wagner's determination. The Tweezer Road sighting is on what is now called Orange Blossom Road. Ackerman (1981) reported four new locations on DNWR (west side of Scarp Canyon, Cockeyed Ridge, Raysonde Buttes and west side of Nye Canyon), and Collins and O'Farrell (1984) discovered a location on NTS at Camera Station Butte in 1984. In 1993, the Groom Range location was discovered (BLM, 1994).

Three known locations on NTS were revisited in 1992 and plants were found in large numbers at all three locations. Several thousand plants were found at the Massachusetts Mountain site, approximately 5,500 plants were counted at Camera Station Butte, and approximately 2,000 were counted at Cane Spring. Wagner's subsequent specimen identifications indicate that the Camera Station Butte and Massachusetts Mountains locations are populated by *C. heterochroma*, not *C. megalantha*.

Other areas were surveyed on NTS in 1992 and 1993 to find new locations of *C. megalantha*. Five new locations were documented. Three of these were found on the southern exposure of Little Skull Mountain (Figure 11; Map Point 2). These locations occupied approximately 115 ha and 900 plants were counted. The other two new locations (Figure 11; Map Point 4) were discovered south of Slanted Buttes, occupied approximately 2 ha, and had roughly 1,000 plants.

Two new locations which were thought to be *C. megalantha* were found on NTS during preactivity surveys. One plant was found in November 1993 in disturbed soil along a dirt road that was to become an access route to a drill pad in Area 5 in western Frenchman Flat. No flowers were present so a positive identification could not be made and the site was not revisited in the fall of 1994. An alternate access route was selected and the plant was not disturbed. This location is approximately 6 km (3.7 mi) southeast of the type locality. A second location was found in September 1993 along an edge of a proposed revegetation study plot approximately 1 km (0.6 mi) east of the known Orange Blossom Road location of *C. megalantha* in southeastern Yucca Flat. This location was an extension of the second Orange Blossom Road location that was later identified by Wagner as *C. heterochroma.*

There are currently 15 locations of *C. megalantha* on NTS, DNWR, and NAFR. These locations are distributed within a range of approximately 4,000 km^2 (1,544 mi^2). On the NTS, the total area occupied by the seven known *C. megalantha* locations (Figure 12), as identified by Wagner, is approximately 134 ha.

3.3.3 Habitat

C. megalantha occurs on light colored volcanic soils of washes and talus slopes especially below cliffs (Figure 13). It is associated with *Atriplex* spp. at elevations of 1,030-1,615 m (3,380-5,300 ft). *C. megalantha* occurs primarily on colluvial gravel and less often on alluvial sand derived from volcanic ash-flow and tuff components of quaternary and tertiary formations (Rhoads and Williams, 1977).

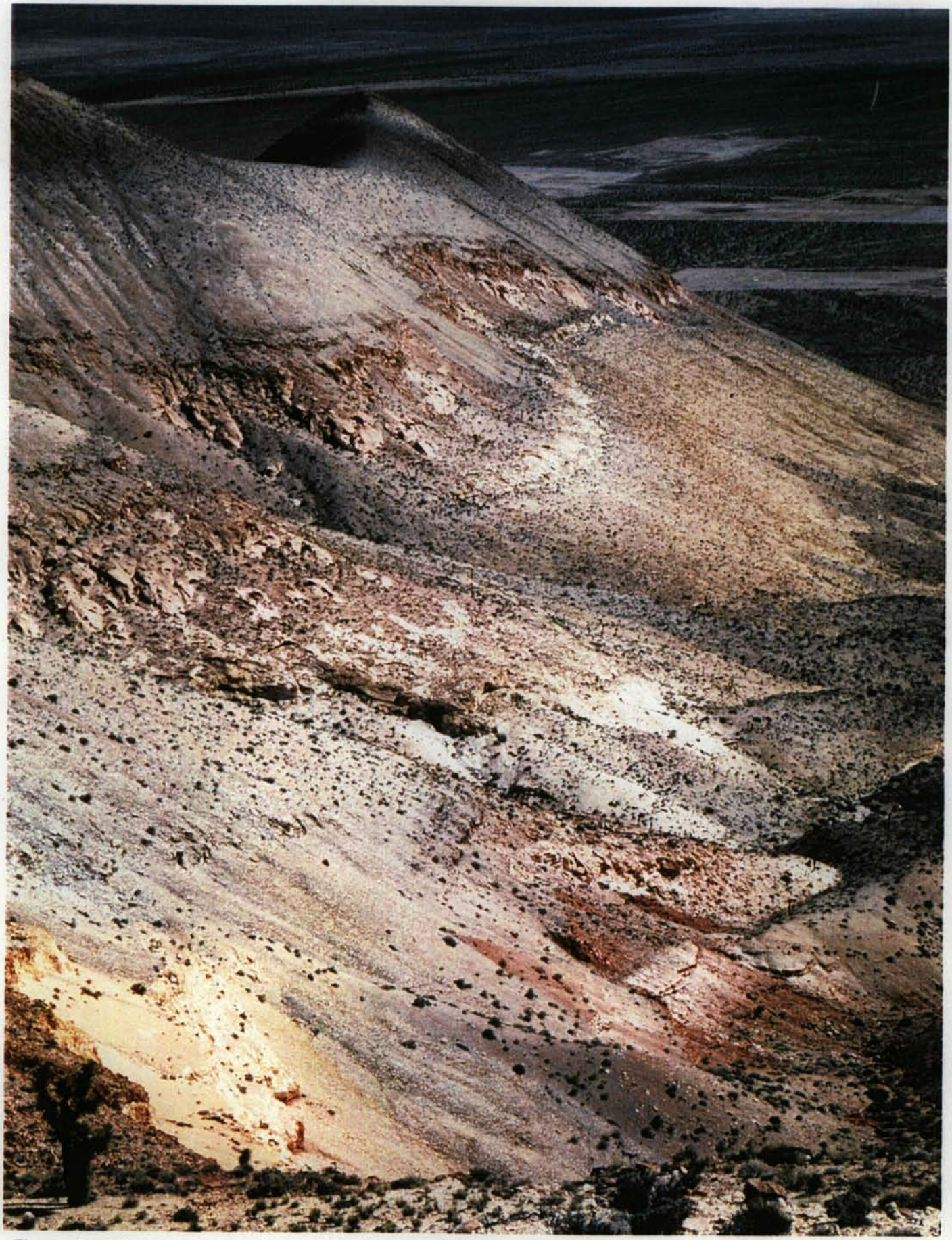

Figure 13. *Camissonia megalantha* habitat on southern extension of French Peak of the Halfpint Range, Nevada Test Site. Plants are found scattered throughout the light colored, loose talus from the ridge crest to the lower slopes.

On NTS, the species occurs on light colored volcanic soils of washes and talus slopes especially below cliffs of Little Skull Mountain and Slanted Buttes. It also occurs on man-made disturbances like the road ditches and cracks in the asphalt along Orange Blossom Road (Figure 10). At Cane Spring it is found on a north-facing gentle slope in open bare areas between shrubs on loose sandy soil. Approximately 13% of the area occupied by *C. megalantha* on NTS has a 0-3% slope and 64% has a 5-20% slope. *C. megalantha* tends to be found on south-facing slopes. Approximately 18% of the area occupied by this species has a southeastern aspect, 44% has a southern aspect, and 19% has a southwestern aspect. The species is found almost exclusively in open sunlight.

3.3.4 Assessment of Status

Since 1978, the range of *C. megalantha* has increased. The eastern extent of its range was on Massachusetts Mountain, but is now Groom Range, an increase of approximately 25 km (15.5 mi). Its known western extent was Cane Spring on NTS and is now Little Skull Mountain, an increase of approximately 18 km (11.2 mi). The number of known locations has increased from three to fifteen and it is now known to DNWR as well as on NTS and NAFR.

The abundance of this spring-germinating annual fluctuates from year to year based on precipitation. During the high-precipitation years of 1992 (198 mm) and 1993 (274 mm), this species was abundant at all locations visited on NTS. During the low precipitation year of 1994 (102 mm), there were few or no individuals at known locations. Inferences on population trends are therefore difficult to make and there is also sparse information on plant abundance from the late 1970's. Rhoads and Williams (1977) reported 4,000 plants at Cane Spring, while a 1992 survey documented 2,000 plants. It is possible that plant numbers are actually decreasing at this location because the site has been protected from disturbance. Rhoads and Williams (1977) stated that the land disturbing activities that were associated with use of the spring "allowed" *C. megalantha* to spread into the area.

Threats to the continued existence of this species are minimal. In the French Peak area on NTS, this species occurs primarily on talus slopes that are unsuitable for most human activities and are impassable to vehicle traffic. Only one DOE/NV activity is known to have disturbed a location of *C. megalantha,* a portion of a fiber optic cable route bisected a population in 1993 along Orange Blossom Road. Nuclear testing was mentioned as a potential threat by Ackerman (1981); however, there is no evidence on NTS that nuclear weapons testing has harmed the species. Biologists observed evidence of grazing primarily by rabbits. Most of the grazed plants were not killed and produced lateral shoots, flowers, and fruits below the point of damage.

Off NTS, there are no documented threats to this plant. On DNWR, it was found primarily on slopes at the base of cliffs in loose volcanic tuff where no bombing was being conducted in 1981 (Ackerman, 1981). The status of the Kawich Range *C. megalantha* location and its susceptibility to threats from NAFR activities is unknown.

Land disturbance from human activities appears to have increased rather than decreased *C. megalantha* habitat. Cane Spring was continually used as a water source by humans and livestock

prior to its designation as an archaeological site in 1976 (Wade, 1976). Since the site was fenced in 1976 to exclude grazing by wild horses, open spaces between *Atriplex canescens* shrubs have decreased and so have the number of *C. megalantha* individuals (Rhoads et al., 1977). *C. megalantha* also occurs in the road ditches along Orange Blossom Road, NTS (Figure 10). The species' occurrence in a variety of man-made disturbances suggests that its requirements for germination and establishment are sufficiently broad that it can become established in areas currently not inhabited.

Based on the presented information of this species' current range, stability, and susceptibility to threats, *C. megalantha* does not appear at risk of becoming threatened with extinction over the majority of its range. It, therefore, should not remain a Category 2 candidate species. There is also a justification to reclassify the species based on its taxonomic similarity with *C. heterochroma.* The specimen identifications by Warren Wagner in 1994 resulted in the renaming of several historical *C. megalantha* sites on NTS to *C. heterochroma* locations (see Appendix B). These taxonomic identifications along with field observations presented in this report support the original conclusion by Peter Raven that *C. megalantha* and *C. heterochroma* should be combined into one species. Therefore, it is recommended that this species be reclassified as a Category 3B species.

3.4 *Cymopterus ripleyi* var. *saniculoides* Barneby, Sanicle biscuitroot

3.4.1 Description

C. ripleyi var. *saniculoides* (Figure 14) is a low growing perennial herb in the Apiaceae (carrot) family. Its leaves and stems arise directly from a single root crown and flowers are generally dark purple. Its leaves generally have three sections and each section has three dentations. The species flowers from April to May, which is typically the time it can be found aboveground. A complete taxonomic description can be found in Barneby (1941).

The validity of this variety of *C. ripleyi* is in question. It was first described by Dr. Rupert Barneby in 1941 when he found a population 610 m (2,000 ft) lower and 80 km (50 mi) farther south than the known habitat of the typical form. This type locality is at the base of the Spotted Range toward Frenchman Flat on NTS (Figure 15, Map Point 20). The distinctive morphologic features of this new variety which Barneby noted were the black-purple coloration of the flowers, usually smaller flower heads and longer flower stems, and the silky-pubescent mericarps (Barneby, 1941).

Both varieties of this species (var. *saniculoides* and var. *ripleyi)* occur on NTS. Beatley (1976) comments that, "Plants of the lower elevations are often referable to var. *saniculoides* Barneby, and higher-elevation plants to var. *ripleyi*, but characters distinguishing the two varieties become ill-defined and somewhat clinal with latitude and elevation when populations as a whole are considered." In a letter to Robert Powell, Lincoln Constance the authority for *Cymopterus*, states that he does not consider var. *saniculoides* to be a valid taxon, "Dr. James Reveal . . . . has assured me that var. *saniculoides* is not a valid taxon. Dr. Mathias and I have arrived at the same conclusion . . . ." (Constance, 1979). Based on this determination, the FWS in California has decided not to recognize this variety as a valid taxon (Rutherford, 1994). During plant surveys conducted on NTS between 1991 and 1995, plants matching the description of both varieties have been found in some of the same locations. Barneby has observed this situation from NTS collections and stated that, ". . . it is hardly worthwhile to continue recognizing the two varieties" (Barneby, 1993). The Jepson Manual also presents both varieties in synonymy (Hickman, 1993).

3.4.2 Distribution

C. ripleyi var. *saniculoides* is found in central and southern Nevada. Although not recognized by FWS as a valid taxon in California, plants matching the description of *C. ripleyi* var. *saniculoides* are found in Owens Valley and Lee Flat of Inyo County, California. The range of this plant reaches its southwestern extent in Owens Valley and its northern extent in the Monitor Range of northern Nye County, Nevada. The eastern boundary of its range is found just north of NAFR in Lincoln County, Nevada (Figure 15; additional information on numbered map points can be found in Appendix A, Table 4).

Known locations of *C. ripleyi* var. *saniculoides* were not well documented prior to 1985 when it became classified as a Category 2 candidate species. Beatley (1976) documents the species as

Figure 14. *Cymopterus ripleyi* var. *saniculoides* in flower on Yucca Flat, Nevada Test Site.

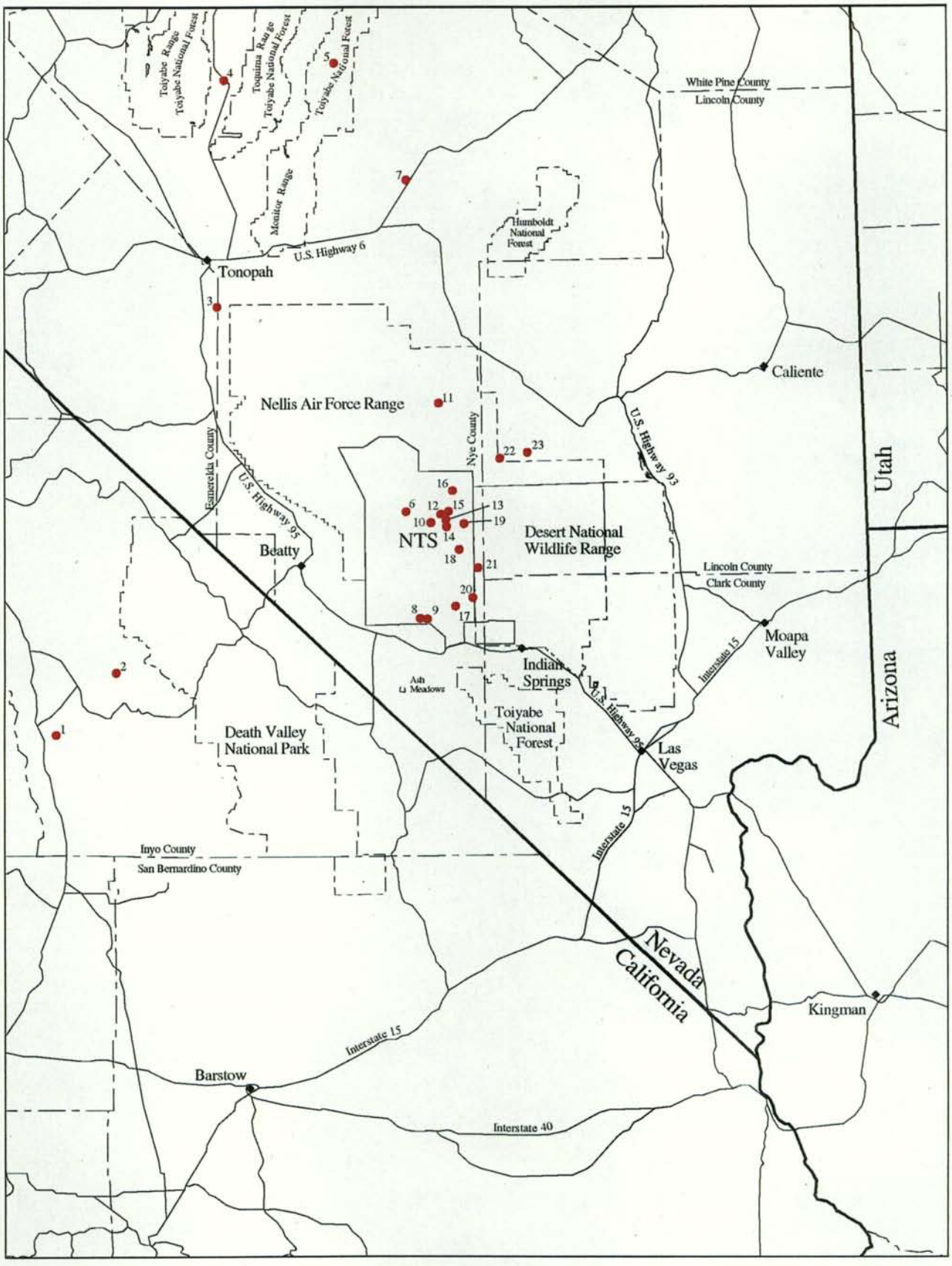

Figure 15.

Known Distribution of

C. ripleyi* var. *saniculoides

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occurring on NTS locally in Rock Valley, abundant in the sands of northeast Frenchman Flat, south and central Frenchman Flat, more or less common in east Forty-Mile Canyon, most areas of Yucca Flat, and the south face of Rainier Mesa. Off NTS, Beatley notes that locations have been found in west Emigrant Valley, the sands of south Groom Lake, south Penoyer Valley, and central Kawich Valley.

In 1991, DOE/NV began surveys on NTS for this variety. Eleven locations have been found during 19 plant surveys (Figure 16). Surveys were conducted mostly in sandy washes and gentle sandy slopes. Plants were found in two types of vegetation associations; creosote bush-bursage and pinyon-juniper. At the locations visited from 1991 to 1994 in the creosote bush-bursage vegetation associations, plant abundance ranged from 5 to 116. In contrast, approximately 1,000 plants were observed at the three locations in the pinyon-juniper association. Two other NTS locations were documented from herbarium collection searches and database searches (Figure 15; Map Point 18 and the type locality, Map Point 20). These two locations were not surveyed. Six additional locations in Areas 1, 4, and 7 of NTS were found during four preactivity surveys conducted from 1991 to 1995 (Figure 16). In summary, approximately 1,285 ha have been searched on NTS, and *C. ripleyi* var. *saniculoides* was found occupying approximately 60 ha. It is likely that more locations would be found if additional surveys were conducted, especially in Frenchman Flat.

Currently, *C. ripleyi* var. *saniculoides* is documented at 34 locations (19 on NTS and 15 off NTS) distributed over a range of approximately 32,500 km^2 (12,545 mi^2). The three locations north of Tonopah, Nevada (Figure 15; Map Points 4 and 5) would probably be considered of the variety *ripleyi* because of the altitude at which they occur.

3.4.3 Habitat

C. ripleyi var. *saniculoides* is usually found in sandy soils, but can also be found in gravelly or rocky substrate. It is found at elevations from 980 to 1,700 m (3,200-5,600 ft). Off NTS this plant has been found in the Monitor Range at elevations of 3,260 m (10,700 ft) (NNHP, 1994). At lower elevations, this variety is associated with desert scrub vegetation such as *Larrea tridentata, Atriplex canescens, Lycium andersonii, Ambrosia dumosa, Coleogyne ramosissima,* and *Grayia spinosa*. In the Monitor Range, it is associated with *Pinus flexilis* (NNHP, 1994).

On NTS, *C. ripleyi* var. *saniculoides* is primarily found in braided sandy, flat wash bottoms (Figure 17). Ninety percent of the area occupied by *C. ripleyi* var. *saniculoides* occurs at a slope of 3% or less. Three locations on NTS have slopes ranging from 10-35%, and are situated on midslopes and hill crests.

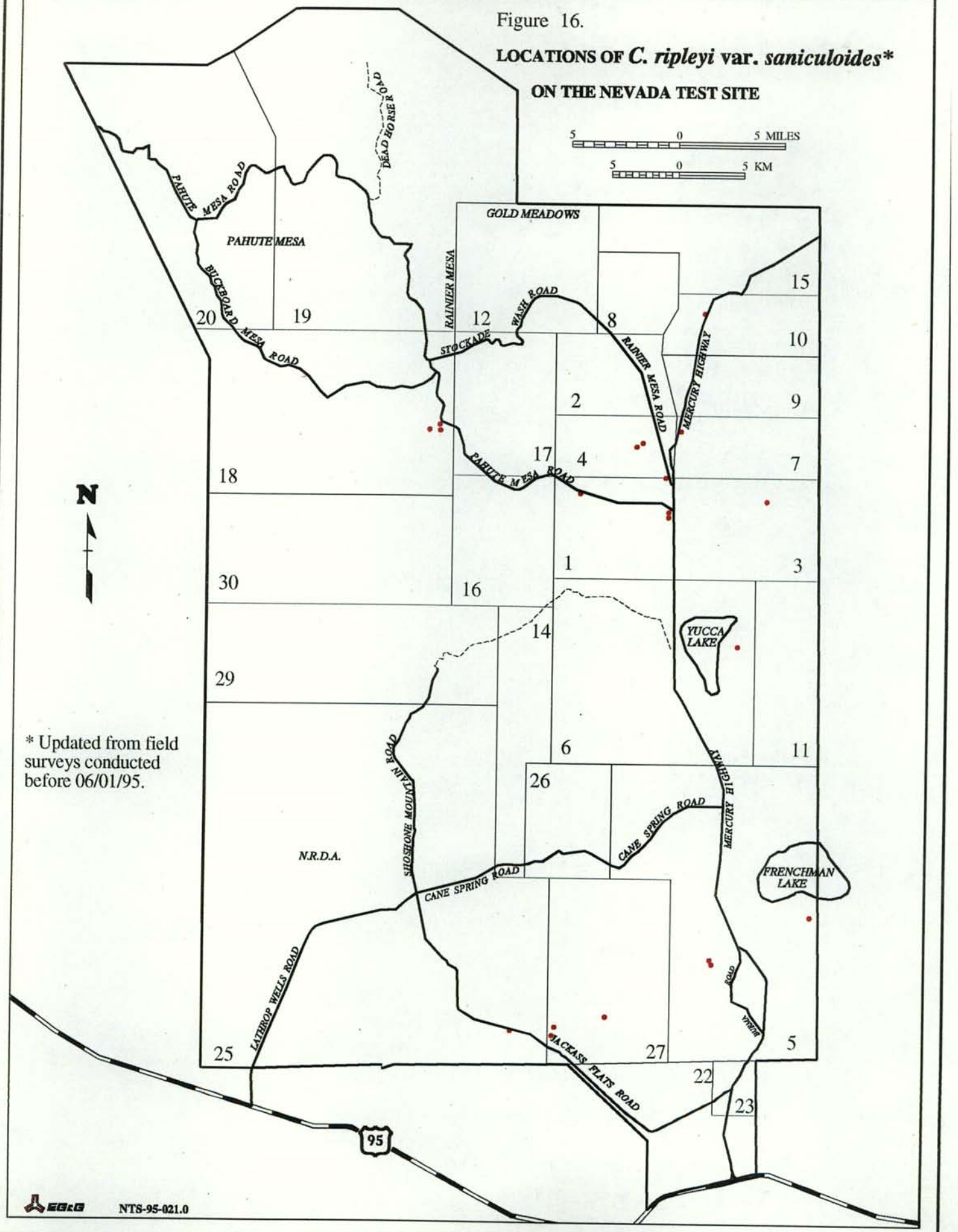
3.4.4 Assessment of Status

There is little historical data on the presence of this species on NTS. According to Beatley (1976) this variety is widely distributed on NTS and recent surveys support this conclusion. The plant's habitat is widespread across southern and central Nevada and southeastern California.

Figure 16.

LOCATIONS OF *C. ripleyi* var. *saniculoides

ON THE NEVADA TEST SITE



* Updated from field surveys conducted before 06/01/95.

EG&G NTS-95-021.0

Figure 17. *Cymopterus ripleyi* var. *saniculoides* habitat in northeastern Yucca Flat, Nevada Test Site. Plants are found in the sandy wash bottom in the center of the photograph.

Conclusions on population trends cannot be made since information for most known locations is based on a single collection record. On NTS, some locations were probably eliminated in Yucca Flat due to construction for nuclear testing activities; however, *C. ripleyi* var. *saniculoides* has continued to exist in Yucca Flat through the height of the nuclear testing era, and to date is still present. Since 1991, two small populations of this plant were found along proposed off-road driving routes, and one plant was found at the edge of a proposed drill pad, all in northern Yucca Flat. Current construction activities on NTS do not appear to threaten this plant's survival given its widespread distribution on NTS. No disease or predation was observed during field surveys.

Although there are no identifiable threats to this plant's continued survival, the problems with its taxonomic identification alone warrants its reclassification from a Category 2 to a Category 3 species. *C. ripleyi* var. *saniculoides* should not be considered as a valid taxon by FWS based on the previous decisions of Lincoln Constance and other taxonomists who hold this variety in synonymy with variety *ripleyi*. *C. ripleyi* var. *saniculoides* should therefore be reclassified as a Category 3B species.

3.5 *Frasera pahutensis* Reveal, Pahute green gentian

3.5.1 Description

F. pahutensis (Figure 18) is a herbaceous perennial in the Gentianaceae family. Five to ten branches arise from a woody taproot. Basal leaves have a 0.2 to 0.3-mm wide white margin. Between May and July the plant produces a greenish-white to cream or very pale blue flower, flecked with dark purple (Morefield, 1992). For a complete taxonomic description of the species refer to Reveal (1971).

3.5.2 Distribution

F. pahutensis is found solely in Nye County, Nevada. It was first collected on NTS by Janice Beatley in 1970 and described by James Reveal as a new species in 1971 (Reveal, 1971). The type locality is on Pahute Mesa on NTS (Figure 19; Map Point 5). It also occurs in the southern Toquima, southern Monitor, and Hot Creek ranges, and in Squaw Hills (Morefield, 1992) (Figure 19; additional information on numbered map points can be found in Appendix A, Table 5). The southern boundary of the species' range is Pahute Mesa on NTS, while the southern Toquima Range and Squaw Hill make up the western and northern boundaries, respectively. The Squaw Hill locations also represent the eastern boundary of its range (Morefield, 1992).

The two known *F. pahutensis* populations on NTS are located on Pahute Mesa less than 2.5 km (1.5 mi) from each other (Figure 20). The second site was found in 1976 northeast of the type locality along 19-01 Road (Rhoads and Williams, 1977). The type locality was revisited in July 1991 and again in May 1992. Approximately 175 plants were found during the 1991 survey, and about 780 plants were observed in 1992. The other known NTS site was visited in June 1992 and approximately 150 plants were found. The two areas over which the plants were found total approximately 100 ha. To search for new plant locations, three surveys were conducted in June and July 1992 in areas of similar substrate geology, vegetation association, and topography located within 5.5 km (3.4 mi) of the type locality. No new populations were found. Surveys specifically designed to locate new populations of this species on NTS were not conducted in 1993 and 1994 because of the large number of new sites that were being discovered off-site in Toiyabe National Forest and the need to focus NTS surveys on those species for which less information about range and abundance was available.

F. pahutensis is currently documented at 59 known sites off NTS, however, new sites are still being discovered in the Toiyabe National Forest (Brack, 1995). The total number of plants across all known locations off NTS is estimated to be 755,000, and the total habitat for *F. pahutensis*, including all populations, is estimated at approximately 2,100 ha.

3.5.3 Habitat

Throughout its range, *F. pahutensis* is found in pinyon-juniper vegetation types. Topographic positions include both drainage bottoms and slopes with elevational ranges from 2,130-2,590 m

Figure 18. *Frasera pahutensis* in flower on Pahute Mesa, Nevada Test Site.

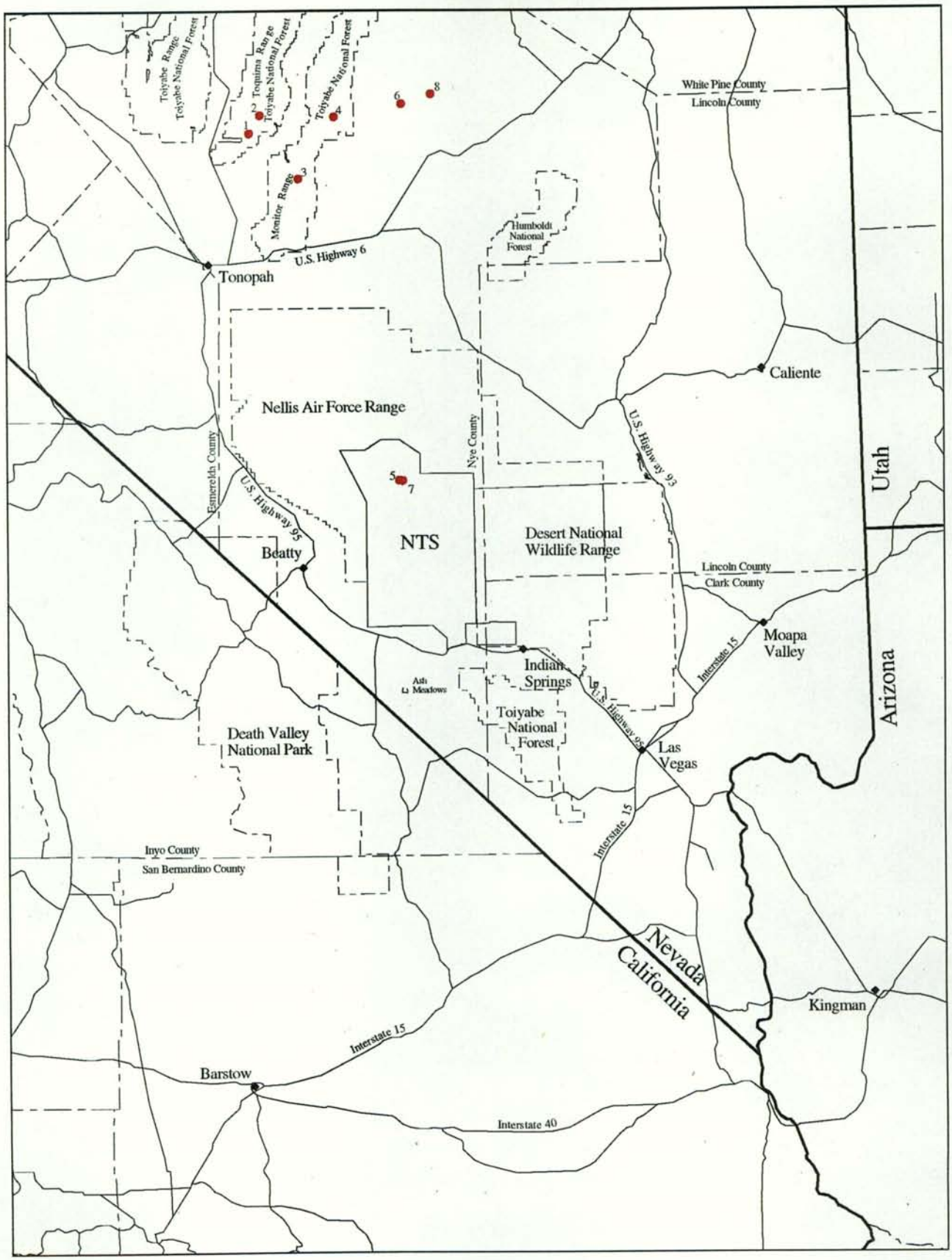


Figure 19.

Known Distribution of

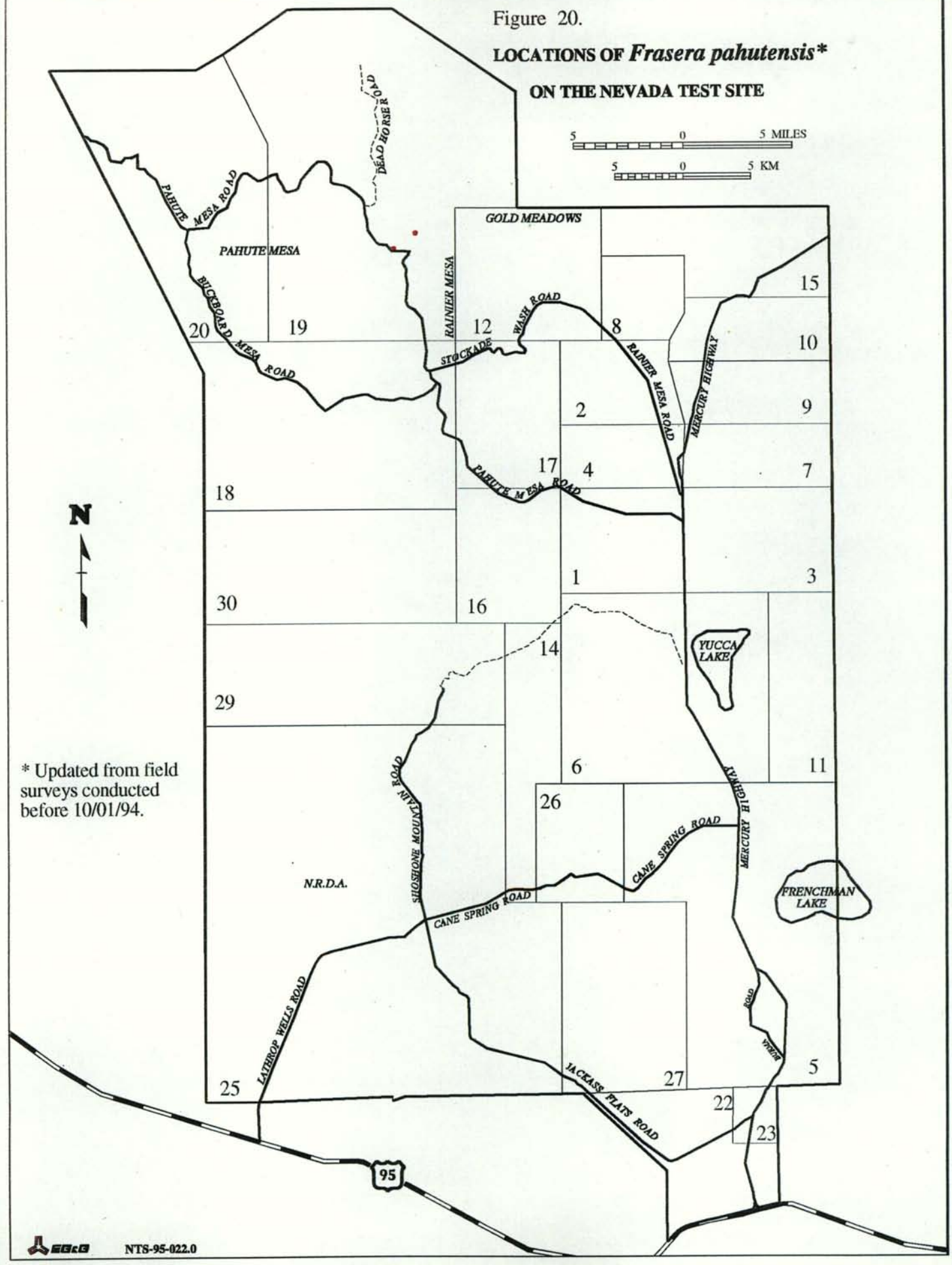
Frasera pahutensis

EG&G

NTS-95-034.0

Figure 20.

LOCATIONS OF *Frasera pahutensis** **ON THE NEVADA TEST SITE**



* Updated from field surveys conducted before 10/01/94.

EG&G NTS-95-022.0

(6,980-8,480 ft) (Morefield, 1992). A common factor among *F. pahutensis* populations is the deep, loose, sandy or sandy-rocky soils on which it is found. Quartzite is the most common geologic substrate on which *F. pahutensis* is found but it can also be found on limestone, basalt, ash flow tuff, felsite, and alluvial materials (Smith, 1990). The species has been found on all exposures but most commonly occurs on or near protected (wooded or north-sloping) exposures (Morefield, 1992). At higher elevations, populations are also found on open, south-facing slopes. This species has colonized disturbed areas such as roadbeds and pads when the areas are next to undisturbed source populations (Morefield, 1992). Brack (1993) also noted that many sites that had been reclaimed after mineral exploration had been colonized by *F. pahutensis* if the plant was found adjacent to the site.

The two populations on NTS are located between 2,190 m (7,200 ft) and 2,310 m (7,570 ft) in elevation. The plants occur in relatively level terrain in open spaces between *Pinus monophylla, Juniperus osteosperma,* and *Artemisia tridentata* (Figure 21). Other associated species include *Cryptantha confertifolia, Eriogonum caespitosum,* and *Ipomopsis congesta. F. pahutensis* on NTS occurs on slopes between 0 and 20% and on all exposures. The substrate at both sites is a shallow soil comprised of fine particles mixed with volcanic gravel derived from rhyolite tuff of the Rainier Mesa Member of the Timber Mountain Tuff (Frizzell and Shulters, 1990).

On NTS and elsewhere, *F. pahutensis* habitat does not appear distinctly different from areas where the plant is not growing. It was expected that many other locations of this species would be found on Pahute Mesa, NTS where areas of similar vegetation, elevation, and surface geology occur. However, during 63 surveys conducted on Pahute Mesa for another candidate species (*Penstemon pahutensis*) between 1991 and 1994, no new *F. pahutensis* were located.

3.5.4 Assessment of Status

The range of this species has increased since it was first discovered on NTS in 1970. The number of plant locations within its range has also steadily increased. In 1990, there were approximately 46 known locations covering approximately 340 ha and totaling at least 74,141 plants (Morefield, 1992). By 1992, 15 new locations had been documented that occupied approximately 146 ha in which 103,940 plants had been counted (Morefield, 1992). Finally in 1993, more surveys resulted in the discovery of eight new locations and the expansion of 14 previously known sites (Brack, 1993). These surveys located 1,558 ha of previously unknown habitat, populated by approximately 577,000 plants. There are now 2,044 ha of *F. pahutensis* habitat occupied by approximately 755,000 plants in central Nye County, Nevada. There is little doubt that as more surveys are conducted more plants will be found. These numbers indicate that the species is much more widespread and abundant than was previously thought.

The Pahute Mesa sites have not been disturbed since 1976 when new roads were cut through the populations (Rhoads and Williams, 1977). One hundred seventy five preactivity surveys of areas proposed for land disturbing activities were conducted on and near Pahute Mesa between 1978 and 1995. These activities included roads, utility corridors, drill pads, staging areas, and borrow pits to support DOE/NV's nuclear weapons testing mission. No *F. pahutensis* plants were ever observed

Figure 21. *Frasera pahutensis* habitat on southern Pahute Mesa, Nevada Test Site. Plants are found in the open spaces on rocky soil between the juniper and sagebrush.

during these preactivity surveys. Since 1976, the closest land disturbance to the known *F. pahutensis* populations on Pahute Mesa occurred in 1983, 2.3 km (1.4 mi) away.

There are no new threats to the species on NTS and previous threats from testing of nuclear weapons is non-existent due to the moratorium on such testing. Off NTS, clearing of habitat, mining, and livestock grazing are reported to be the primary causes of this plant's destruction. Since many locations in the Toiyabe National Forest occur in relatively inaccessible areas and the locations are spread over such a wide area, it is unlikely that these activities would affect the species as a whole. Additionally, approximately 500 ha (25%) of the currently known occupied area and approximately 159,450 plants (21%) are within Wilderness Areas or Wilderness Study Areas designated by the Forest Service and BLM which restricts human disturbance.

The Tonopah Ranger District Office of Toiyabe National Forest is currently petitioning FWS to reclassify *F. pahutensis* to Category 3C. This action has resulted from the large increases of both known locations and area occupied by the species. A review of the plant's status on NTS also supports this recommendation to reclassify the species to Category 3C.

3.6 *Galium hilendiae* Demp. & Ehrend. ssp. *kingstonense* (Demp.) Demp. & Ehrend., Kingston bedstraw

3.6.1 Description

G. hilendiae ssp. *kingstonense* (Figure 22) is a mat-forming, slender, semi-erect perennial, in the Rubiaceae (Madder) family. It has pink, bell-shaped flowers up to 3 mm long. The fruits can be 2 mm long and are covered with long hairs. A complete taxonomic description can be found in Dempster and Ehrendorfer (1965). This subspecies flowers from late May to June.

3.6.2 Distribution

G. hilendiae ssp. *kingstonense* is found in scattered populations on rocky slopes of southwestern Nevada and southeastern California (Figure 23; additional information on numbered map points can be found in Appendix A, Table 6). The type locality is in the Kingston Range (Figure 23; Map Point 5), southwest of Tecopa Pass, San Bernardino County, California, and was discovered in 1941 (Dempster, 1958). In California, *G. hilendiae* ssp. *kingstonense* is known only from the Kingston Range. In Nevada, this subspecies is known from the Eleana Range and southern Belted Range, NTS, Nye County.

G. hilendiae ssp. *kingstonense* is known to occur at four locations on NTS. It was first discovered in 1967 by Vernon Bostick (Cochrane, 1979) on cliffs at the head of Butte Wash, below Oak Spring Butte (Figure 23; Map Point 3). The second location was discovered in 1979 (Cochrane, 1979), 0.32 km (0.2 mi) north of Tub Spring at the southeast base of Oak Spring Butte (Figure 23; Map Point 4). The third and fourth locations (Figure 23; Map Points 1 and 2) were discovered in 1992 on the east and northeast face of Rainier Mesa in the Belted Range approximately 15 km (9.3 mi) southwest of the Oak Spring Butte sites (Figure 24). Since 1991, 11 surveys were conducted on NTS for this subspecies. The two Oak Spring Butte locations known at that time were surveyed as well as new areas on NTS. Most of the surveys were conducted on steep talus slopes of the Indian Trail Formation (Barnes et al., 1963) which were within the pinyon-juniper-oak vegetation association. These areas included the Belted Range (western portion), the east and northeast faces of Rainier Mesa, along Rainier Mesa Road, the northeast face of Burnt Mountain, and as far west as the Shoshone Mountain Range near Tippipah Spring. All of these sites have identical or similar habitat characteristics (i.e., geology, topography) as the known locations near Oak Spring Butte. During the NTS surveys, plants at all four locations were found in small localized patches in numbers ranging from 16 to 350 plants. Since the plant is mat-forming, or clonal, exact numbers are difficult to determine. A total of 649 ha were surveyed for this subspecies on NTS, and the total area occupied by this subspecies on NTS is approximately 13 ha.

One survey was conducted off NTS in June 1994 at the area thought to be the type locality in the Kingston Range. Twenty *Galium* plants were found, but they were not flowering or fruiting so the plants could not be determined to the species level. This subspecies has been identified at six locations, including the type locality, within the Kingston Range (Figure 23; Map Point 5). They are in Amethyst Canyon about 2.4 km (1.5 mi) west southwest of Horsethief Springs, in Silktassel

Figure 22. *Galium hilendiae* ssp. *kingstonense* in flower on Rainier Mesa, Nevada Test Site.

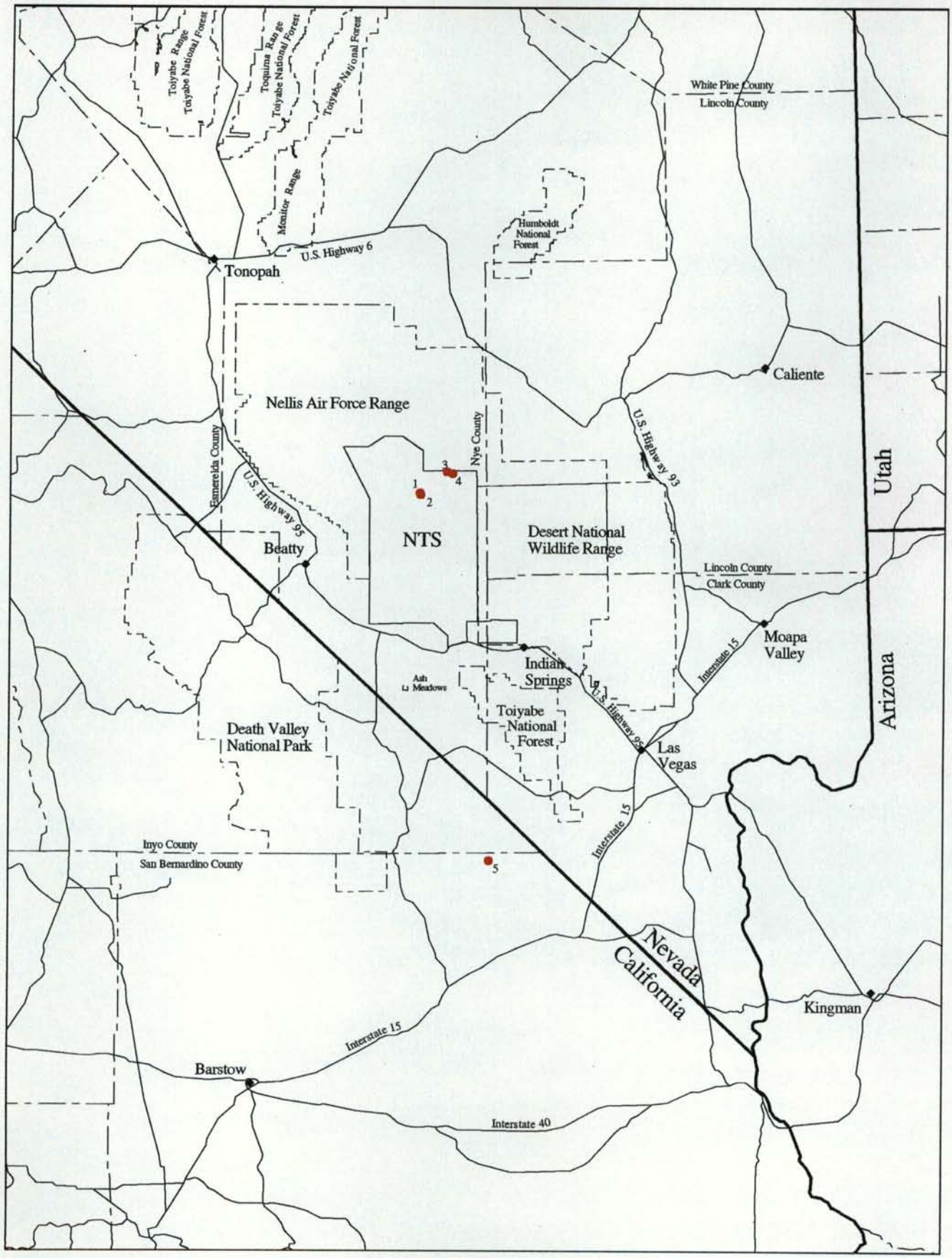


Figure 23.

Known Distribution of

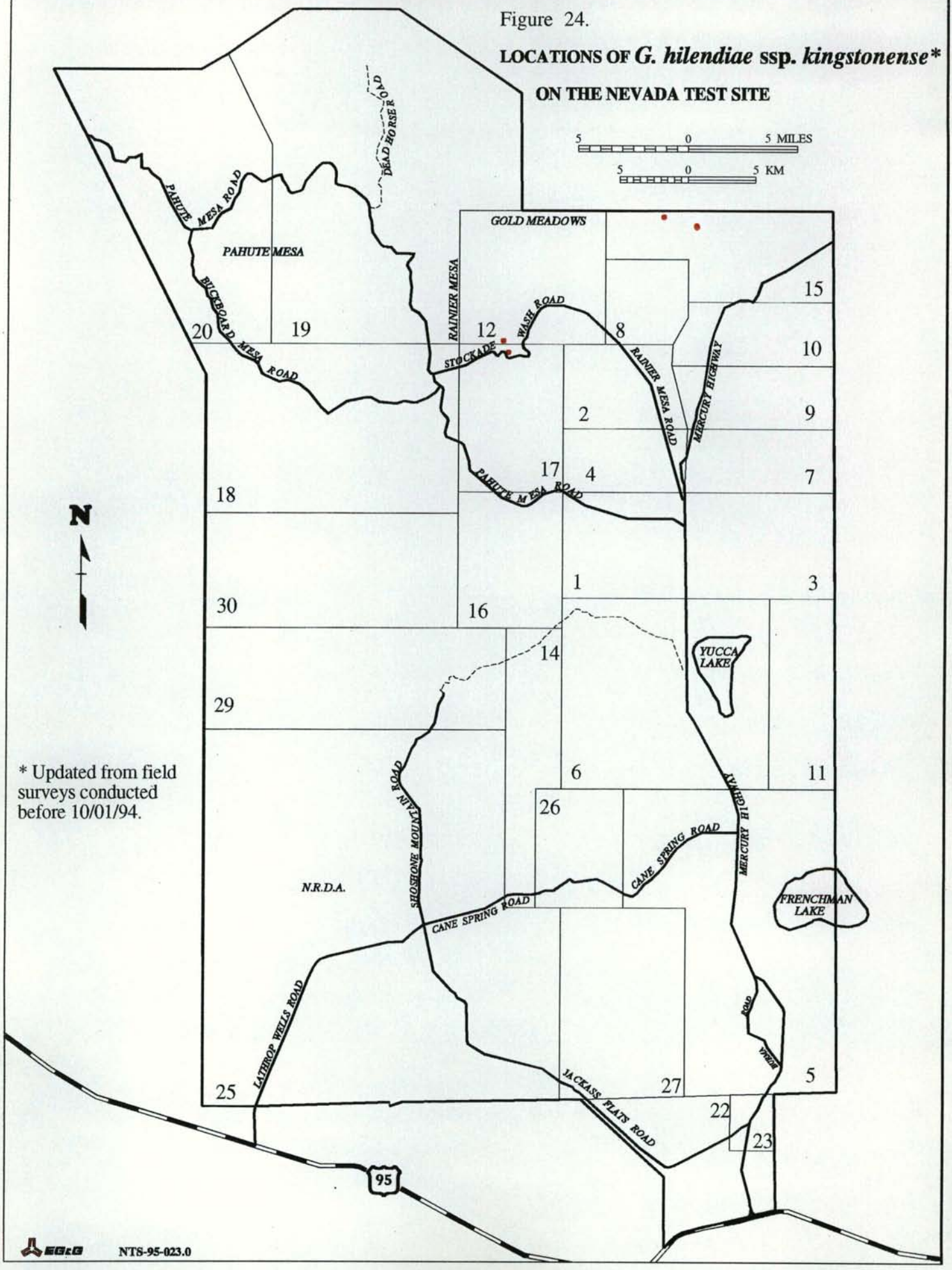
G. hilendiae* ssp. *kingstonense

EG&G

NTS-95-035.0

Figure 24.

LOCATIONS OF *G. hilendiae* ssp. *kingstonense
ON THE NEVADA TEST SITE



* Updated from field surveys conducted before 10/01/94.

EG&G NTS-95-023.0

Canyon in the southeast extension of Horsethief Valley, north of Kingston Peak, north of Kingston Benchmark, 3.3 km (2.7 mi) east southeast of the Kingston Benchmark, and southwest of Tecopa Pass just north of Kingston Peak. Based on data from the California Diversity Database and herbarium collection records from Rancho Santa Ana Botanic Garden, it appears that five of the locations were visited during 1979 and 1980. The last time the type locality was visited seems to be 1941 when the plant was first found, although there is a vague collection record from 1959 (RSA herbarium, accession #202631) for the Kingston Mountains by Ehrendorfer and Dempster, the authors of the species. Information is lacking regarding the size of these Kingston Range locations and the number of plants observed at each location.

3.6.3 Habitat

Across its range, *G. hilendiae* ssp. *kingstonense* is found primarily on steep north and east-facing slopes and among boulders and cobbles. This subspecies can be found at elevations from 1,200 to 2,100 m (3,940-6,980 ft).

On NTS, *G. hilendiae* ssp. *kingstonense* occurs at elevations between 1,550 to 2,070 m (5,090 to 6,790 ft). At the Oak Spring Butte locations, it is found on loose scree and steep talus slopes, and at the Rainier Mesa locations it is found on steep, white sandy gravel areas (Figure 25). Based on data collected during NTS field surveys, over 80% of the area occupied by this species occurs on slopes greater that 20%, and 50% of the area has a southeast aspect. It was found predominately on mid-upper slopes, and occasionally on hill crests. This species appears to prefer soils comprised of ash flow tuffs or zeolitized tuff of the Indian Trail Formation (Barnes et al., 1963).

This subspecies is often found growing beneath the canopies of *Rhus* spp., *Juniperus osteosperma, Quercus gambelii,* and *Pinus monophylla.* Other associated species include *Artemisia tridentata, Ephedra viridis, Chrysothamnus nauseosus, Purshia glandulosa, Cercocarpus* spp., *Symphoricarpos longiflorus,* and *Leptodactylon pungens.*

3.6.4 Assessment of Status

The range of *G. hilendiae* ssp. *kingstonense* before 1977 was restricted to three locations, two near Oak Spring Butte occupying about 12.3 ha, and the type locality in the Kingston Range. Currently there are four locations on NTS and six locations in the Kingston Range. The two new locations on NTS do not represent an increase in the species' range nor a significant increase in the area occupied by this subspecies on NTS since the two areas are so small (< 10 m^2 each). The discovery of these two sites indicates that there is a probability of finding other new locations on the east face of Rainier Mesa. New locations could possibly be found in the Kingston Range as well.

Rhoads and Williams (1977) listed accelerated ground movement from underground nuclear testing and construction activities associated with these events as potential threats to the continued existence of *G. hilendiae* ssp. *kingstonense* on NTS. In 1977, only the two Oak Spring Butte

Figure 25. *Galium hilendiae* ssp. *kingstonense* habitat on east face of Rainier Mesa of the Belted Range, Nevada Test Site. Plants occur on the face of the light-colored volcanic cliff and beneath the canopies of the juniper and pinyon trees at the base of the cliff.

locations were known, and these locations remain undisturbed. At the two new Rainier Mesa sites, an area of approximately 0.1 ha, which had been disturbed by a rock fall, was observed. The rock fall may have been the result of ground movement from underground nuclear testing. A nuclear testing moratorium is in effect for NTS and the possibility of renewed testing is slight (U.S. Department of Energy, 1994). None of the plants observed during the spring surveys on NTS between 1991-1992 showed signs of disease or predation. Plant locations on NTS are situated in steep, unstable substrates that are unsuitable for construction. NTS populations of this subspecies do not appear to be threatened by current DOE/NV activities.

In the Kingston Range, there are mining claims in the general area of the *G. hilendiae* ssp. *kingstonense* locations, and the status of these mining claims is not known (Monroe, 1995). The Kingston Range populations represent a significant portion of the species' distribution. If the mining claims do not threaten these populations, then *G. hilendiae* ssp. *kingstonense* should be reclassified to Category 3C status. Without this assessment of the threat from mining in the Kingston Range, the species' current status of Category 2 may be appropriate.

3.7 *Penstemon albomarginatus* Jones, White-margined beardtongue

3.7.1 Description

P. albomarginatus (Figure 26) is a perennial subshrub in the Scrophulariaceae (figwort) family. It is a pale-grayish, hairless, 5-25 cm high, many stemmed plant. Leaves are 1-3 cm long and narrowly bordered with a cream-colored, somewhat rough margin about 1 mm wide. *P. albomarginatus* flowers from March to May and produces lavender-pink flowers that are whitish on the ventral side. Kartesz (1988) gives a complete taxonomic description.

3.7.2 Distribution

P. albomarginatus was first discovered at Good Spring Station, NV, in 1905 (Kartesz, 1988) and is known from Arizona, Nevada, and California (Figure 27; additional information on numbered map points can be found in Appendix A, Table 7). The southwestern extent of its range occurs near the Twenty-Nine Palms Marine Corps Training Center (MCTC) approximately 60 km (37.3 mi) east of Barstow in San Bernardino County, California. The southeastern extent is east of Yucca, Arizona in Mojave County (BLM, 1993). This species occurs in and adjacent to Hidden Valley, south of Las Vegas, Nevada, and reaches the northern extent of its range in the Amargosa Valley in southern Nevada (Sheldon, 1994; Beatley, 1976).

P. albomarginatus does not occur on NTS, however, there are five locations between 1 to 11 km (0.6-6.8 mi) from the southern boundary of NTS (Figure 28). All five locations were found in 1992 and 1994 in and near the Specter Range and the Striped Hills and are within a 14-km radius of each other. The Striped Hills location is closest to NTS, approximately 1 km (0.6 mi) from the NTS boundary. Plants counted at each location ranged from 600 to approximately 1,900. The total number of plants counted across all five locations was approximately 6,200 plants, and the known area occupied near NTS by this species is approximately 54 ha. Seven additional surveys for *P. albomarginatus* were conducted near the southern boundary of NTS in 1992 and 1994 covering approximately 1,000 ha. No additional locations were found.

Two locations (Figure 27; Map Point 7) documented from 1976 herbarium collections could not be relocated. These locations were reported as being 13 km and 23 km, respectively (8.3 and 14.1 mi) south of Amargosa Valley along U.S. Highway 95. It is suspected that they may have been extirpated by highway maintenance and improvement activities sometime over the past 20 years.

This species is locally abundant at the Hidden Valley, Nevada and the Yucca, Arizona locations. In Hidden Valley, *P. albomarginatus* is documented from eight locations (Figure 27; Map Points 10, 11, 13, and 15). Sheldon (1994) reports that seven of these locations cover approximately 324 ha and that the number of plants at these locations total 8,775. Sheldon (1994) reports another location as occurring "against the eastern hills and ridges of the Lucy Gray Mountains" (Figure 27; Map Point 12), and the number of plants at this location were reported as few.

Figure 26. *Penstemon albomarginatus* in flower in the Specter Range south of the Nevada Test Site.

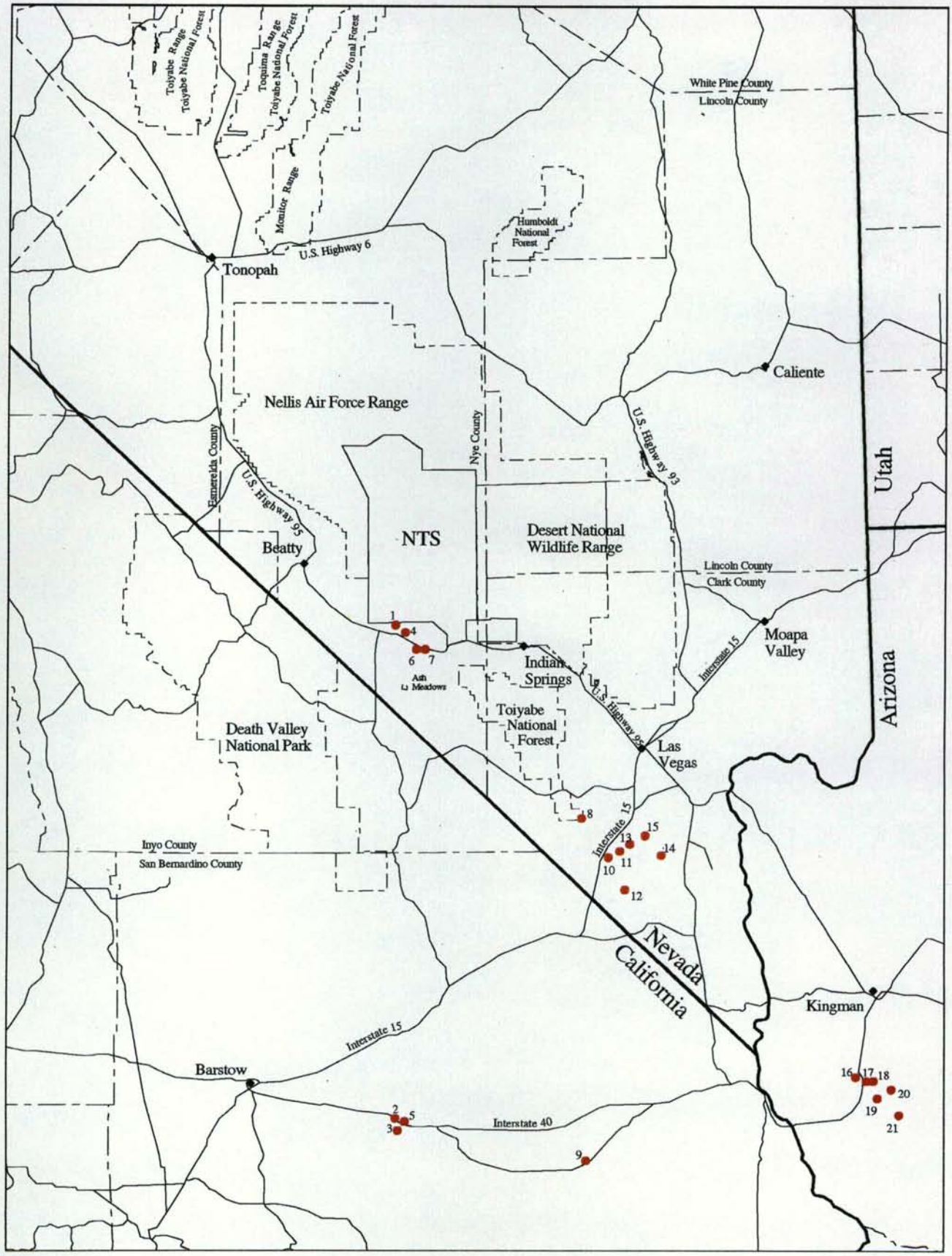


Figure 27.

Known Distribution of

Penstemon albomarginatus

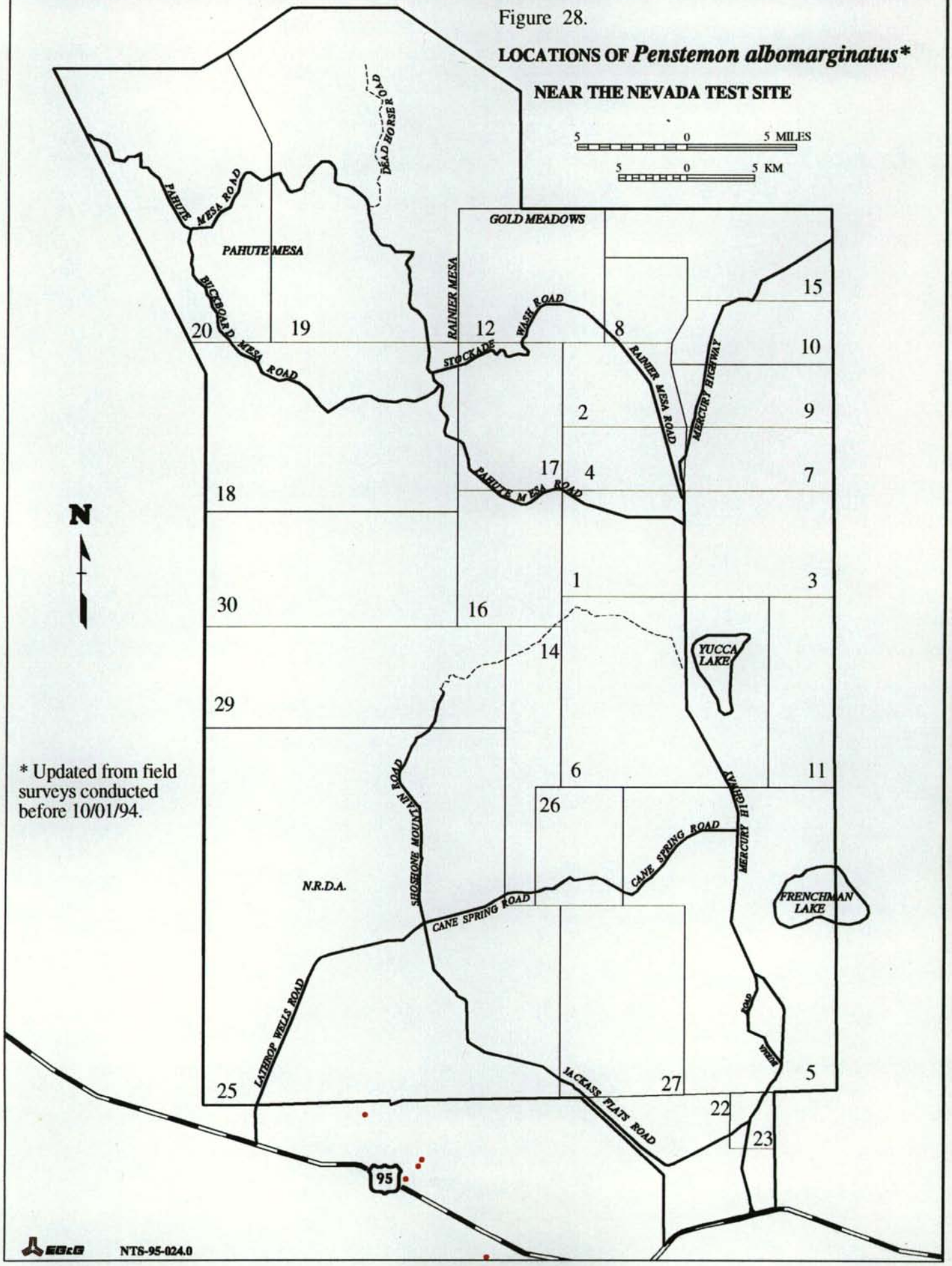
EG&G

NTS-95-036.0

Figure 28.

LOCATIONS OF *Penstemon albomarginatus

NEAR THE NEVADA TEST SITE



* Updated from field surveys conducted before 10/01/94.

EG&G NTS-95-024.0

In 1965 this species was collected in or near the edge of the dry lake east of Jean (Figure 27; Map Point 14). In 1969 another location was found east of the McCullough Mountains (Figure 27; Map Point 14). In Arizona there are approximately 28 locations near Yucca (BLM, 1993) (Figure 27; Map Points 16-21). The total number of plants over all these locations is in the low thousands (Sheldon, 1994).

Four *P. albomarginatus* locations have been documented in San Bernardino County, California (California Department of Fish and Game, 1994) (Figure 27; Map Points 2, 3, 5, and 9). Eight plants were seen at Map Point 5 (Figure 27) near the MCTC in 1989. This location, however, may be the same as Map Point 2 near the MCTC (Figure 27). According to Scogin (1989) and Sanders (1994), the location near the MCTC is the only one that still exists in California. Approximately 4,420 plants occur at this location along the margins of a 9.7 km (6 mi)-long sandy wash in deep stabilized desert sand (Sheldon, 1994).

Currently, *P. albomarginatus* occupies 50 locations distributed across a range of 22,000 km^2 (8,492 mi^2).

3.7.3 Habitat

P. albomarginatus occurs in the Mojave Desert on sandy desert soil (Hickman, 1993; Kartesz, 1988; Munz, 1974) (Figure 29). The soils in which *P. albomarginatus* is found across its entire range have little or no profile development. The plant typically occurs in flat wash bottoms of outwash canyons (Scogin, 1989), and occasionally on the slopes above them (Sheldon, 1994). The plant can also be found on stabilized sand dunes deposited on the lee sides of mountains. The elevational range over the species' entire range is from 460 m to 1,094 m (1,520 ft to 3,590 ft). The elevational range for *P. albomarginatus* at the locations near NTS is from 790 m (2,620 ft) at the southern base of the Specter Range to 1,094 m (3,590 ft) in the Striped Hills.

This species' habitat is usually dominated by *Larrea tridentata* and *Ambrosia dumosa*. In the sandiest regions of the Hidden Valley site south of Las Vegas there is also *Hilaria rigida*, with scattered *Oryzopsis hymenoides*. At some Hidden Valley locations, *P. albomarginatus* occurs with non-native plant species that typically dominate disturbed habitats, such as *Salsola australis* and *Schismus arabicus* (Sheldon, 1994).

Near NTS this species occurs on all aspects and on slopes between 5% and 35%. The associated species and soil at these sites are similar to that found across its entire range.

3.7.4 Assessment of Status

In Nevada the range of this species has remained fairly constant. The five new locations found near the southern border of NTS in Specter Range and Striped Hills have increased the range to the north and west approximately 20 km (12.4 mi). New locations, although not range extensions, have also been discovered in Hidden Valley near the Southern Nevada Correctional Center (Sheldon, 1994).

Figure 29. *Penstemon albomarginatus* habitat in the western Specter Range, south of the Nevada Test Site. Plants are found on the valley floor in foreground of the photograph.

Cattle grazing and human disturbance are routinely cited as the factors responsible for the current threat on the continued existence of this plant. Cattle grazing is not allowed on NTS, and there are no grazing allotments along its southern border. Road maintenance/improvement activities along U.S. Highway 95 may have extirpated two locations which were found in the 1970's, however, there appears to be no threat to the five existing locations south of NTS. They are not easily accessible to the public by vehicle since they are protected against public access from the north by the NTS and on the south by a fence with locked gates. During plant surveys of these locations, no identifiable threats were noted.

Cattle grazing is allowed in the Hidden Valley area and destruction of plants has been observed (Sheldon, 1994). Sheldon states that the largest populations of *P. albomarginatus* in the Hidden Valley area were found in areas with a high level of disturbance from both grazing and human development. Although grazing has been cited as a threat to the species in Hidden Valley (Sheldon, 1994), this conclusion cannot be supported since the original distribution of the species in the area is unknown. More information on the effect of grazing on the survival of this species is needed.

In Arizona, urban development and off-road vehicle use are reported to be the greatest threat to *P. albomarginatus* (BLM, 1993). The BLM has designated an Area of Critical Environmental Concern near Kingman, Arizona which will preserve various sensitive desert resources, including approximately two thirds of the *P. albomarginatus* habitat in Arizona (BLM, 1993).

P. albomarginatus has been observed since the 1920's in California, but recent reports indicate that the number and size of populations are dwindling (Sanders, 1994; Sheldon, 1994; Scogin, 1989). In 1990-91, U. S. Marine Corps activity damaged the site at the MCTC in San Bernardino County, California. It is not known whether the population will completely recover (Sanders, 1994; Sheldon, 1994). At this time, *P. albomarginatus* is thought to occur at only one of the four documented locations in San Bernardino County.

Based on information gathered for this report, *P. albomarginatus* populations nearest NTS do not warrant Category 2 status due to the lack of identifiable threats at these locations. However, the Hidden Valley locations represent a significant portion of this species' range, and the effect of grazing on these populations is unclear. The current Category 2 status of P. albomarginatus may therefore be appropriate. If it is determined that grazing is not a viable threat, this species should be reclassified to Category 3C.

3.8 *Penstemon fruticiformis* Cov. var. *amargosae* Keck, Amargosa bush penstemon

3.8.1 Description

P. fruticiformis var. *amargosae* is a shrubby perennial in the Scropulariaceae (figwort) family. It can reach 60 cm in height. It's flowers are whitish to pale pink and reach 27 mm in length. The upper portion of the corollas are colored lavender-blue and have purple lines extending into the interior (Figure 30). The distinguishing characteristics which separate it from var. *fruticiformis* are the presence of "hairs" on the exterior of the corolla, and the pointed-oval sepals. A complete taxonomic description can be found in Keck (1937). This subspecies flowers from April to June.

3.8.2 Distribution

P. fruticiformis var. *amargosae* is found in sandy or gravelly washes, and on steep limestone slopes of southwestern Nevada and southeastern California (Figure 31; additional information on numbered map points can be found in Appendix A, Table 8). It was first collected and described from the Amargosa Desert, Nye County, Nevada, in 1907 (Keck, 1937) (Figure 31; Map Point 3). The southeastern boundary of its range is in the Kingston Mountains in San Bernardino County, California; the western boundary is in Grapevine Canyon at the southeastern end of Saline Valley, Inyo County, California; and the northern boundary is in the southern Grapevine Mountains in DVNP, Inyo County.

In 1978 the only known *P. fruticiformis* var. *amargosae* location near NTS was in the Specter Range, approximately 5.5 km (3.4 mi) from the southern NTS boundary (Rhoads et al., 1978). In 1981, a location along U.S. Highway 95, 32 km (20 mi) southwest of NTS was reported (Pinzl, 1984). From 1991 to 1994, 11 field surveys were conducted for this subspecies. Surveys were conducted at the two known locations near NTS and nine surveys were conducted to search for new locations. No attempt was made to relocate the type locality in Amargosa Valley found in 1907 because the site description was too vague. A collection record from the Specter Range documented plants in the wash at the mouth of a canyon (UNR herbarium, accession #24974). In 1991, plants were found on all slope positions at this site from the wash bottom to the crest of the mountain. A total of 155 plants were counted in six isolated pockets. Most of the plants were positioned at mid-slope growing in coarse talus. In 1992 another area was surveyed to the north of these six locations. A total of six plants were found on the crest and upper mid-slope at two sites near the previous six locations (Figure 31; Map Point 5).

The location along U.S. Highway 95 recorded by Pinzl was not found during an April 1994 survey. This location was adjacent to the highway along the shoulder of the road and may have been extirpated as a result of road maintenance activities.

Additional surveys to find new locations were restricted to limestone canyons and sandy to gravelly washes. During 1992, these search areas included the extreme southeast portion of Specter Range, the south portion of the Striped Hills, and the western foothills of Specter Range.

Figure 30. *Penstemon fruticiformis* var. *amargosae* in flower in Specter Range south of the Nevada Test Site.

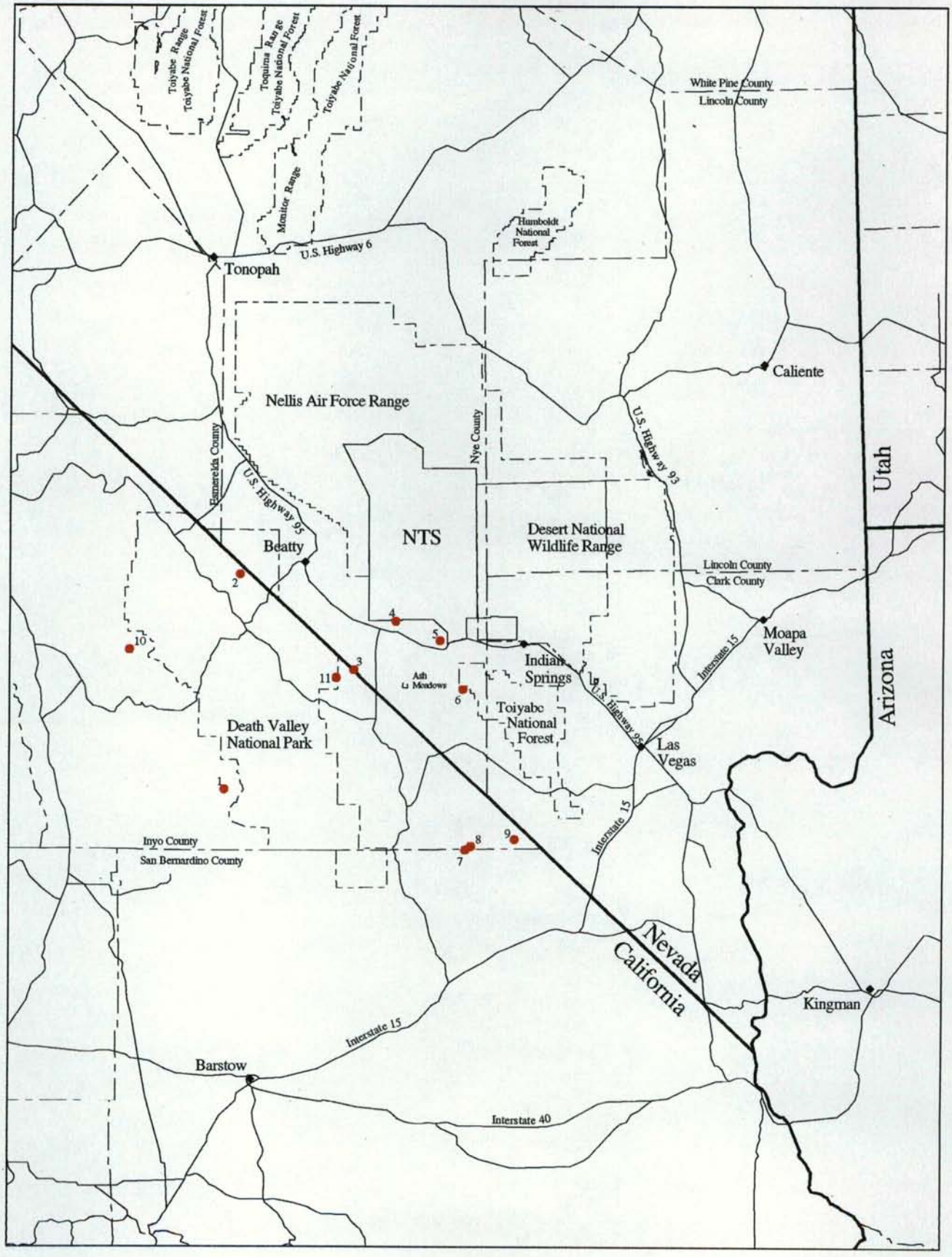


Figure 31.

Known Distribution of

P. fruticiformis* var. *amargosae

0 25 50 MILES

0 25 50 75 100 KM

N

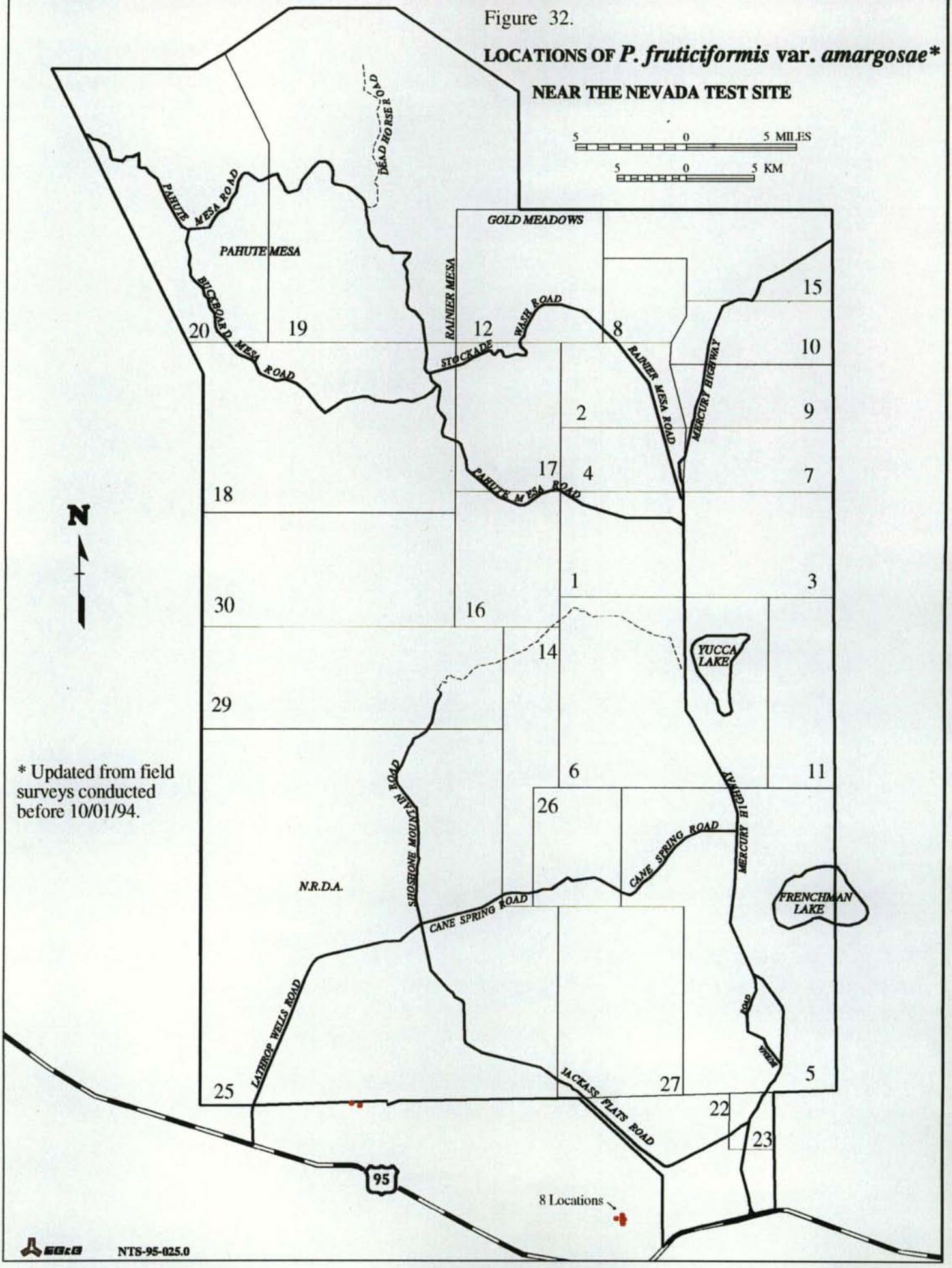
EG&G

NTS-95-037.0

Figure 32.

LOCATIONS OF *P. fruticiformis* var. *amargosae

NEAR THE NEVADA TEST SITE



* Updated from field surveys conducted before 10/01/94.

Two new locations (Figure 31, Map Point 4) were found on the north face of the Striped Hills on the NTS boundary about 21 km (13 mi) west of the Specter Range locations. Twenty-five plants were counted across both locations and the area of occupied habitat was small (< 0.001 ha). In 1994, search areas included the east part of the Striped Hills, the extreme southern portion of Specter Range, an area near Panama Mine in eastern Bare Mountain, and the southeast end of the Funeral Mountains, Inyo County, California. No new locations were found during these 1994 surveys.

Since 1991, a total of 1,141 ha were surveyed for *P. fruticiformis* var. *amargosae*. The total area within the Specter Range and Striped Hills occupied by *P. fruticiformis* var. *amargosae* is approximately 3 ha.

Off NTS at the Spring Mountain location (Figure 31; Map Point 6), the plant is found along the wash and lower banks near Crystal Spring, southeast of Mount Sterling at an elevation of 1,430 m (4,700 ft). It was collected from this site in 1970 and the plant abundance was reported as "occasional" along the wash (UNLV herbarium, accession #4566). The plant was observed again at this site in 1993 and 1994 (Knight, 1995). In 1993, Teri Knight documented 50 to 100 plants, many of them seedlings. In 1994, however, she observed much less reproduction at this location.

In California, seven locations have been documented, three in the Kingston Range (Figure 31; Map Points 7, 8, and 9), one in the Funeral Mountains on the east side of Schwaub Peak (Figure 31; Map Point 11), one in Titus Canyon of the southern Grapevine Mountains in DVNP (Figure 31; Map Point 2), one in Pleasant Canyon of the Panamint Range (Figure 31; Map Point 1), and a questionable location in Grapevine Canyon east of DVNP (Figure 31; Map Point 10). In the Kingston Range, *P. fruticiformis* var. *amargosae* is located in the lower Silver Rule Canyon between 980 to 1,400 m (3,200-4,500 ft) and in the large canyon southeast of Crystal Spring. More than 20 individuals occur at both Map Point 7 and 8 (Figure 31) (Clark, 1994). These two locations may have been discovered in 1940 (Unpublished data from the Barstow, California BLM resource area) and they were last visited in May, 1991. The eastern-most Kingston Range location (Figure 31; Map Point 9) is found 14.4 km (9 mi) east-northeast of Horse Thief Springs at 975 m (3,200 ft) elevation.

A specimen from the Schwaub Peak location was found in 1983 on the east side of the Funeral Mountains at 990 m (3,250 ft) elevation southeast of Schwaub Peak (RSA herbarium, accession #351965). In Titus Canyon *P. fruticiformis* var. *amargosae* occurs about 0.8 km (0.5 mi) below Leadfield at an elevation of 1,140 m (3,750 ft) (Figure 31; Map Point 2). A specimen was collected in Pleasant Canyon of the Panamint Range in 1906 (UNR herbarium, accession #10459). A specimen from Grapevine Canyon was collected in 1982 along Saline Valley Road in the canyon at the south end of Saline Valley at an elevation of 1,280 m (4,200 ft). This specimen was originally identified as var. *fruticiformis* by Steven Junak, but was annotated in 1983 by Karen Rich as having "some corollas more or less glandular puberulent externally, approaching var. *amargosae*" (RSA herbarium, accession #354859).

In summary, there are 19 *P. fruticiformis* var. *amargosae* locations distributed over a range of approximately 10,500 km² (4,053 mi²).

3.8.3 Habitat

P. fruticiformis var. *amargosae* grows at elevations of 1,000 to 1,580 m (3,280-5,185 ft) throughout its range. This species occurs mostly in sandy or gravelly washes of desert canyons (Rhoads, et al., 1978; Mozingo and Williams, 1980) and on gravel and cobble-sized rubble of canyon slopes. The soils on which this variety is found is derived from a parent material combination of light- to dark-gray limestone mixed with dolomite and occasional nodular chert. The collection southeast of Crystal Spring in the Kingston Range occurs anomalously on granitic substrate (Clark, 1994).

At the Specter Range locations, the plants grow in gravelly wash bottoms at the mouth of side canyons and on mid-upper limestone talus slopes and mountain crests (Figure 33). Plants are found in eight localized pockets throughout a 20 ha area. At the Striped Hills locations, the plants occur on steep canyon walls of limestone.

P. fruticiformis var. *amargosae* grows on variable slopes. Twenty-eight percent of the area occupied by *P. fruticiformis* var. *amargosae* near NTS has a 20-40% slope, 16% has a slope of 50-60%, and 23% of the area is flat. The steeper slopes are often comprised of large talus and the plants are sometimes one of the only species growing in the area. Approximately 35% of this occupied area has a northeastern aspect, an additional 30% faces north to northwest. These *P. fruticiformis* var. *amargosae* locations near NTS are situated on limestone that are a part of either the Bonanza King or the Nopah Formation. Near NTS dominant associated species include *Atriplex confertifolia, Ambrosia dumosa, Hymenoclea salsola, Stipa speciosa, Encelia virginensis, Ephedra nevadensis, and Sphaeralcea ambigua.* Associated plants reported on collection records from near Crystal Spring in the Kingston Range include *Mortonia* spp., *Buddleja* spp., *Salvia* spp., *Agave* spp., and *Nolina* spp.. Reported associated species at the site near Horse Thief Springs include *Brickellia desertorum, Larrea tridentata, Salvia mohavensis, Gutierrezia microcephala, Stipa speciosa, Buddleja utahensis, Lycium pallidum* var. *oligospermum,* and *Sitanion longifolium.*

3.8.4 Assessment of Status

Prior to 1978 five locations made up the entire range of *P. fruticiformis* var. *amargosae*. Surveys conducted since 1978 have documented additional sites in the Striped Hills and in the Kingston Range. Although the range of *P. fruticiformis* var. *amargosae* has not increased, 12 more locations have been found within its range.

There is little quantitative information about the abundance of these plants at each location and the stability of the populations through time. Field observations indicate that plants are sometimes locally common, but are usually widely scattered and never in high densities. It appears, based on the persistence of plants at the Specter Range and Spring Mountain locations over the past 20 years, that these populations are stable.

Figure 33. *Penstemon fruticiformis* var. *amargosae* habitat in eastern Specter Range south of the Nevada Test Site. Plants occur in the limestone crevices of the cliff and on the gravelly washes and slopes.

Threats which are reported to be present in the Spring Mountains include trampling by wild burros, herbivory by wildlife, and off-road driving (Knight, 1995a). Both the Schwaub Peak and Titus Canyon sites are in DVNP and are presumed to be protected from livestock grazing and off-road vehicle use. Threats are unknown at the Kingston and Panamint ranges and the Grapevine Canyon locations. The wash bottoms and steep canyon walls this variety usually occupies are generally inaccessible to off-road vehicles and undesirable for construction.

There are no documented threats to this species at the sites near NTS, and a Category 2 status does not seem warranted for these populations. However, the California and Spring Mountain, Nevada locations of *P. fruticiformis* represent a significant portion of this species' range. Information from these sites about this plant's susceptibility to threats from human activities were not evaluated for this report and appear lacking from some sites. The current Category 2 status may therefore be appropriate. If it is determined that there are no identifiable threats to populations at the California and the Spring Mountain, Nevada sites, then *P. fruticiformis* should be reclassified to Category 3C.

3.9 *Penstemon pahutensis* N. Holmgren, Pahute beardtongue

3.9.1 Description

P. pahutensis (Figure 34) is a perennial herb in the Scrophulariaceae (figwort) family. It grows 15 to 75 cm tall from a compact woody base which produces one to several leafy stems. Its pink-lavender to bluish-lavender tubular flowers are large and showy. Flowering occurs between June and July. For a complete taxonomic description, see Holmgren (1971).

3.9.2 Distribution

P. pahutensis reaches the northwestern extent of its range in the Montezuma Range, Esmeralda County, Nevada; its eastern extent in the Belted Range, Nye County, Nevada; and its southern extent in the Grapevine Mountains, Nye County (Figure 35; additional information on numbered map points can be found in Appendix A, Table 9). The type locality is on Rainier Mesa, NTS where it was collected by James Reveal in 1968 and described by Noel Holmgren in 1971 (Holmgren, 1971).

Prior to 1991, *P. pahutensis* was only known from Nye County where it occupied 25 locations on NTS and two locations on Stonewall Mountain along the western boundary of NAFR (Figure 35, Map Point 6) (Rhoads and Williams, 1977; Beatley, 1977a; EG&G/EM, 1988).

In 1991, 24 of the 25 known locations on NTS were surveyed. Plants were found at 21 of the locations surveyed. Most of the location boundaries remained consistent with those reported in the map attachments of Rhoads and Williams (1977). Eight locations were found to have larger boundaries and one location was found to have a smaller boundary than previously recorded. The location recorded by Beatley (1977a) on North Pahute Mesa (Figure 35; Map Point 7) was not visited because the recorded location was too vague.

From 1991 to 1995, 17 new locations were discovered on NTS during preactivity surveys. During that same period, 17 other new *P. pahutensis* locations were discovered on NTS as a result of 27 plant surveys. To date, there are 56 locations on NTS (Figure 36) ranging in size from 0.05 ha to 250 ha. *P. pahutensis* occupies approximately 1,340 ha on NTS.

P. pahutensis does not appear in high densities but is usually widely scattered within each location. The number of plants observed commonly ranged from 25 to 300, with the higher counts coming from the larger areas. The largest count, 552 plants, came from a 250 ha location. A density estimated for *P. pahutensis* was calculated in 1987 during a preactivity survey of a 260 ha (1 square mile) area on Rainier Mesa. For this preactivity survey, 18, 4-m wide parallel belt transects were surveyed. The transects averaged 1,469 m (4,818 ft) in length and were spaced at 100 m (328 ft) intervals. Plant density was calculated along each transect. The mean density was 56.7 plants/ha, and the 95% confidence interval for this mean was 27.3 to 86.1 plants/ha. Plants were found in all but one of the transects.

Figure 34. *Penstemon pahutensis* in flower on southern Pahute Mesa, Nevada Test Site.

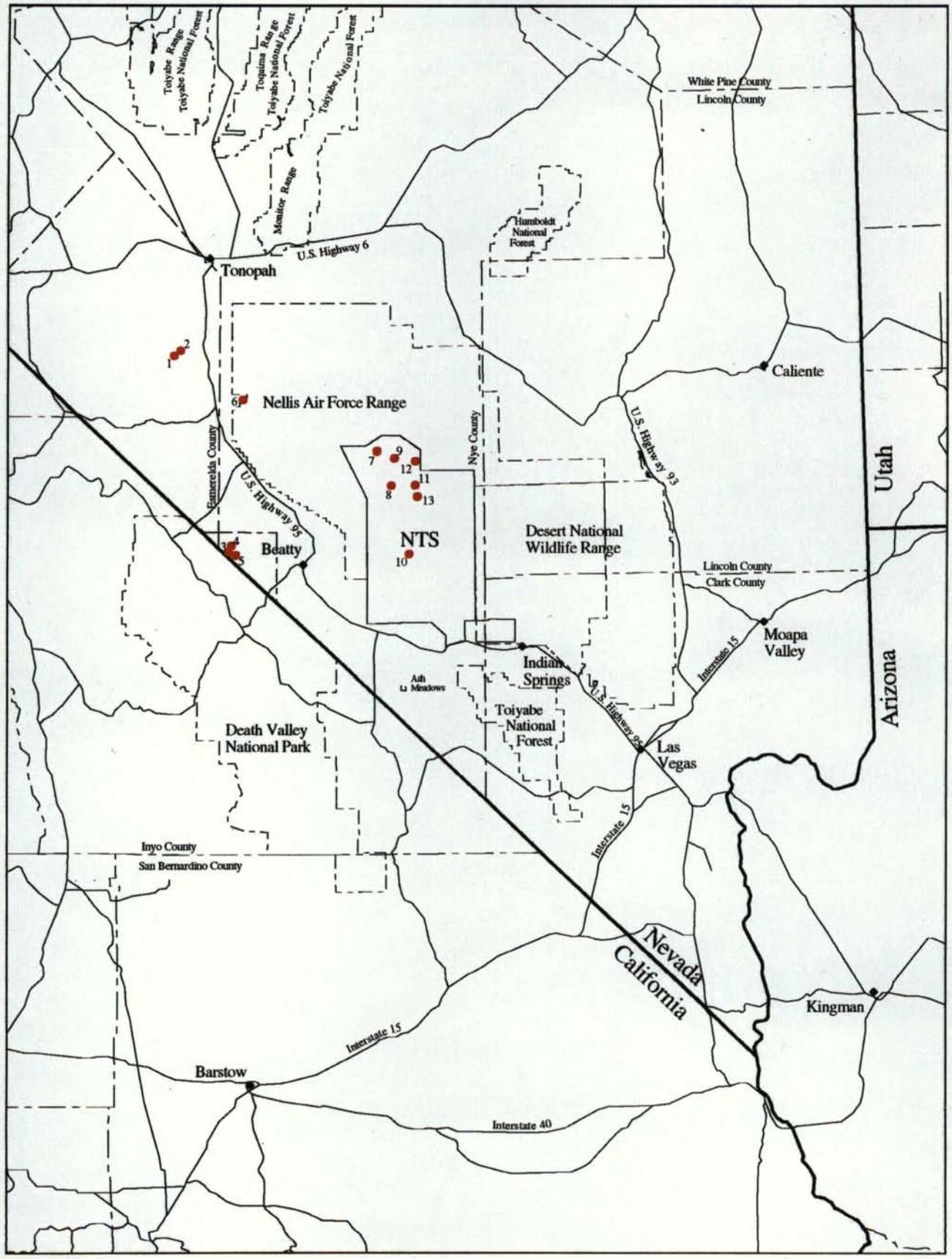


Figure 35.

Known Distribution of

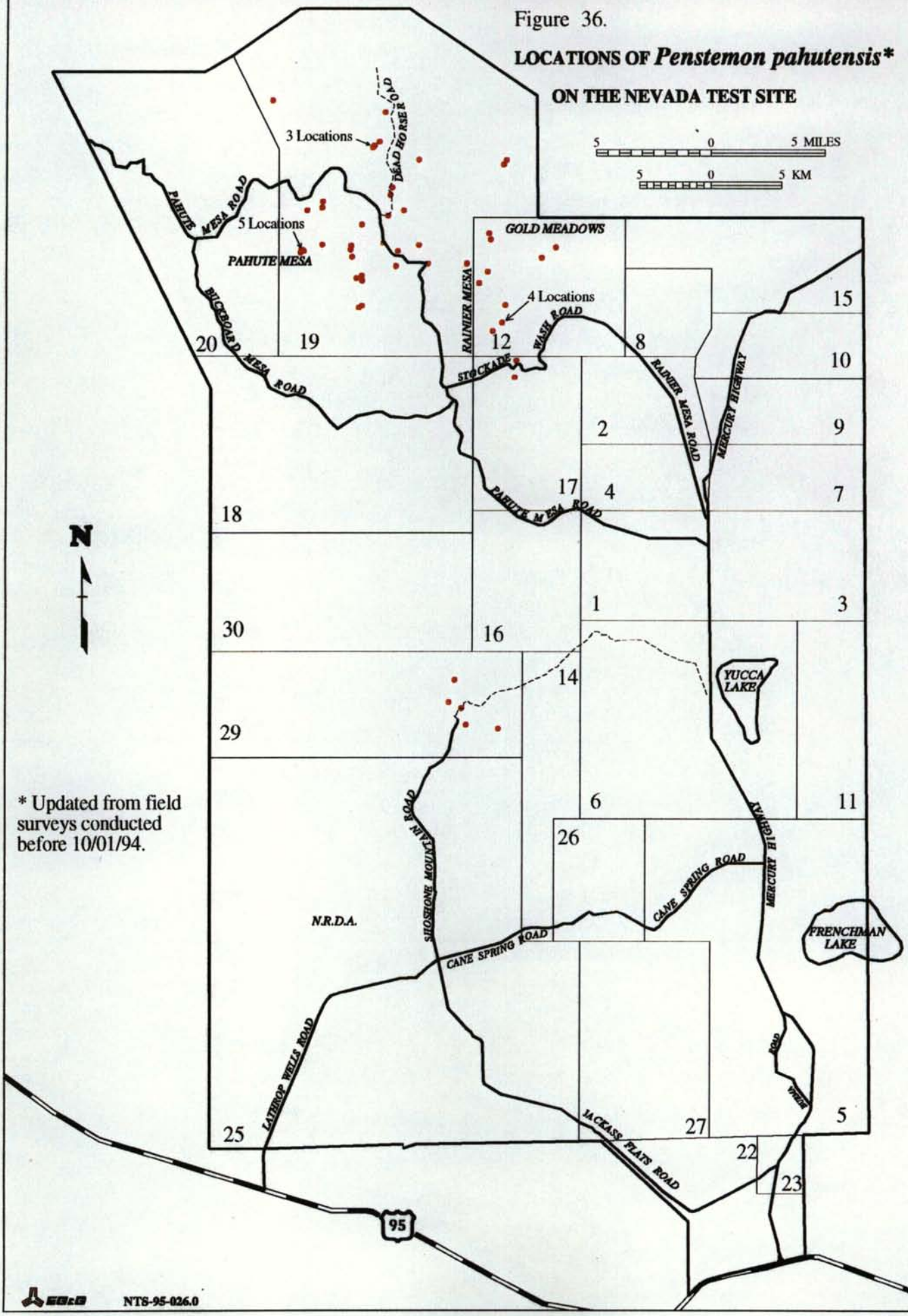
Penstemon pahutensis

EG&G

NTS-95-038.0

Figure 36.

LOCATIONS OF *Penstemon pahutensis
ON THE NEVADA TEST SITE



* Updated from field surveys conducted before 10/01/94.

NTS-95-026.0

In 1993, 18 surveys were conducted in five general areas off NTS to better define the range of *P. pahutensis*. These included the Grapevine Mountains where the plant had recently been reported (Hickman, 1993), northwest of Tonopah in the Pilot and Cedar mountains, west of Goldfield in the Montezuma and Silver Peak ranges, north of Tonopah in the Toiyabe Range, and northeast of NTS in the Grant, Quinn Canyon, Timpahute and Mount Irish ranges. No *P. pahutensis* plants were found in the Pilot or Cedar mountains, or the Silver Peak, Toiyabe, Grant, Quinn Canyon, Timpahute or Mount Irish ranges. In the Grapevine Mountains of DVNP 16 locations were found in the Phinney Canyon and Strozzi Ranch areas (Figure 35; Map Points 3, 4, and 5). The total area occupied by *P. pahutensis* at these two sites was approximately 130 ha, and the total number of plants counted was approximately 1,000. Two other new locations occupying 31 ha were found on Montezuma Peak west of Goldfield (Figure 35; Map Points 1 and 2), where it was in mixed populations with *P. speciosus*. Approximately 240 plants were counted at these two sites.

At the time of the original species description (Holmgren, 1971), *P. pahutensis* and *P. speciosus* (Lindley) (royal beardtongue) were believed to be geographically isolated. With the Montezuma Peak discovery, this is no longer true. Of the approximately 80 plants examined, approximately half had bearded palates and had staminodes which were bearded for greater than half their length (features distinctive of *P. pahutensis*). The majority of the other plants had glabrous palates and had staminodes which were bearded for less than half their length (features distinctive of *P. speciosus*). All other morphological characteristics used to distinguish between the two species (including sepal length, corolla throat width, and anther sac length) were similar. A few plants possessed intermediate characteristics (bearded palates and staminodes bearded for half their length).

In summary, there are 76 locations of *P. pahutensis*. These locations cover an estimated 1,500 ha within a range 5,300 km^2 (2,045 mi^2).

3.9.3 Habitat

P. pahutensis does not appear to be restricted to a specific habitat type. *P. pahutensis* is found in open areas on loose soil, in very rocky areas among boulders, and growing from crevices. It is also found along wash banks and less commonly in wash bottoms. This species is found primarily in the pinyon-juniper vegetation association with *Artemisia* spp. at elevations of 1,280-2,680 m (4,200-8,790 ft). *P. pahutensis* occurs primarily on colluvial gravel and cobble derived from quaternary and tertiary volcanic rock or less often from carbonate rocks (Grapevine Mountains). The species does not appear to be associated with any particular volcanic or carbonate rock formations or any chemically or physically unique components within a formation. *P. pahutensis* is found mostly on the Ammonia Tanks and Rainier Mesa members of the Timber Mountain Tuff Unit (Frizzell and Shulters, 1990). Populations also occur on man-made disturbances such as cut- and fill-slopes and berms of roads on Rainier and Pahute mesas (Figure 37). *P. pahutensis* was found occupying disturbed sites on 14 occasions. Approximately 46% of the known locations on NTS are in or adjacent to disturbed sites such as road berms, cut slopes, and old road beds.

Figure 37. *Penstemon pahutensis* habitat on the slope of the road cut along Stockade Wash Road, Nevada Test Site.

Approximately 41% of the area occupied by *P. pahutensis* on NTS has a 0-3% slope, 32% has a 10-30% slope, 36% has a northern aspect, 11% has a northeastern aspect, and 14% has a northwestern aspect. *P. pahutensis* can be found in open sunlight, filtered sunlight and partial shade, but rarely in full shade.

3.9.4 Assessment of Status

In 1990, *P. pahutensis* was known from only 25 locations on NTS and one location on Stonewall Mountain approximately 45 km (28 mi) northwest of NTS. There are now 56 locations on NTS and 20 off NTS. The range of the species has increased approximately 33 km (20.5 mi) to the northwest with the Montezuma Peak discovery and 70 km (43.5 mi) to the southwest with the Grapevine Mountains discovery.

Population trends for *P. pahutensis* cannot be evaluated because there are no data available on plant counts from the late 1970's. However, *P. pahutensis* populations appear stable due to this species' continued existence at sites on and off NTS for the past 20 years even during the height of nuclear weapons testing on NTS.

Threats to the continued existence of this species are negligible. Pahute and Rainier Mesas (where the largest number of locations occur) have been disturbed by underground nuclear testing and construction activities in the past. However, these activities have not affected the existence of this species since it has been found growing and flowering in areas disturbed by construction. Additionally, nuclear testing activities on NTS have been halted and are unlikely to resume (U.S. Department of Energy, 1994). Rhoads and Williams stated in 1977, before the species was known from the Grapevine Mountains or the Montezuma Range, "It seems likely that only unforeseen engineering and construction on an unprecedented scale on these mesas could endanger the species to the point of extinction."

P. pahutensis is not grown commercially and it is unlikely that the species will ever be threatened by over collection. Disease has not been observed within populations on NTS. Some grazing of the lower leaves was noted by Rhoads and Williams (1977). Occasionally the flowering culm is grazed by deer, which results in no flowers or fruits during the growing season. The basal rosette will persist into the next growing season and the plant will attempt to flower and fruit again. Domestic livestock are restricted from NTS. No grazing allotments occur on DVNP (Threloff, 1995), however, it was estimated in 1981 that about 100 domestic cattle and five to ten horses still roam the Grapevine Mountains of DVNP as remnants of herds from the 1940's (Kurzius, 1981). It was noted during plant surveys that the vegetation, including *P. pahutensis* plants, growing around Brier Spring at the Strozzi Ranch location on DVNP (Figure 35, Map Point 5) had been heavily grazed and cattle droppings were found in the same area.

The current information for this species indicates that it is more widely distributed than previously thought and that there are no significant threats to the continued existence of this species over the majority of its range. Therefore, *P. pahutensis* should be reclassified as a Category 3C species.

3.10 *Phacelia beatleyae* Reveal and Constance, Beatley's Scorpion Weed

3.10.1 Description

P. beatleyae (Figure 38) is an erect annual in the Hydrophyllaceae (waterleaf) family with one to a few stems. The plant is 5-10 cm tall and has no basal rosettes of leaves typical of other species in this genera. The flowers are white to purple with a yellow tube and small ovules and seeds. *P. beatleyae* is distinguished from *P. mustelina*, another species occurring in the same area, by its 5-6 mm long corolla and stems that have short, glandular, fine hair. *P. mustelina* has a corolla 6-10 mm long and glandular villous stems (Ackerman, 1981). A complete taxonomic description of this species is given by Reveal and Constance (1972).

3.10.2 Distribution

P. beatleyae was first collected in 1968 and described as a new species in 1972 (Reveal and Constance, 1972). It is only known to occur on NTS and on DNWR in Nye and Lincoln counties, Nevada (Figure 39; additional information on numbered map points can be found in Appendix A, Table 10). The type locality is on the southern exposure of French Peak on NTS, and is the largest location (Figure 39; Map Point 9). There are currently 35 locations of *P. beatleyae*: 27 occur on NTS (Figure 40) and eight occur on DNWR (Figure 39; Map Points 10, 12, and 13). Thirty-three of the 35 locations occur in the Halfpint Range of eastern Yucca Flat and two occur on the southwest end of Skull Mountain in the southern portion of NTS.

In 1977, only seven locations of *P. beatleyae* were known, five on NTS and two on DNWR (Rhoads and Williams, 1977). These seven sites included one location on the southwest end of Skull Mountain (Figure 39; Map Point 1) and six in the Halfpint Range (Figure 39; Map Points 6, 7, and 11). In 1981 six new locations on DNWR (Figure 39; Map Points 12 and 13) were reported (Ackerman, 1981).

From 1991 to 1994, 39 surveys for *P. beatleyae* covering 700 ha on NTS were conducted in the Halfpint Range, on Skull Mountain, Little Skull Mountain, and in the Calico Hills, resulting in the discovery of 16 new locations. Fifteen of these are in the Halfpint Range and one is on Skull Mountain approximately 0.2 km (0.1 mi) from the previously known Skull Mountain site. No *P. beatleyae* plants were found on Little Skull Mountain or in the Calico Hills. In the Halfpint Range, 13 of the new locations are concentrated near Reitman Seep and French Peak in NTS Areas 7 and 11, respectively (Figure 39; Map Points 4, 6, 8, and 9).

From 1976 to 1994, 37 preactivity surveys were conducted in areas where *P. beatleyae* was known or suspected to occur, resulting in the discovery of six locations. Three of these locations are along a rocky hillside adjacent to a jeep trail proposed for widening on the east side of Paiute Ridge northeast of Camera Station Butte in the Halfpint Range (Figure 39; Map Point 8). The other three new locations are on the southern bajadas of French Peak in the southern Halfpint Range (Figure 39; Map Point 2). These plants were all found in buffer zones around the perimeter of construction projects and no plants were affected during construction activities.

Figure 38. *Phacelia beatleyae* in flower near Reitman Seep, Slanted Buttes, Nevada Test Site.

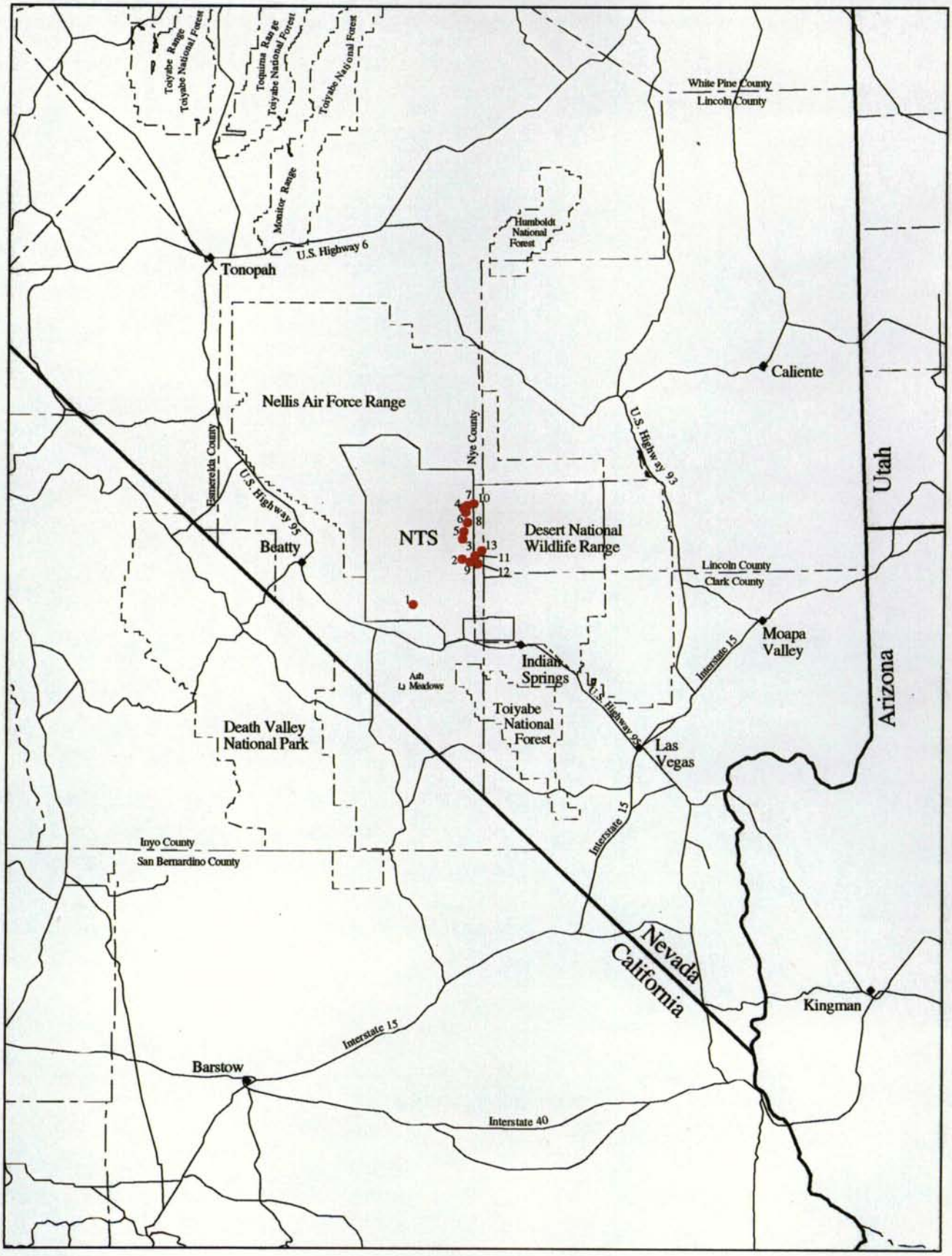


Figure 39.

Known Distribution of

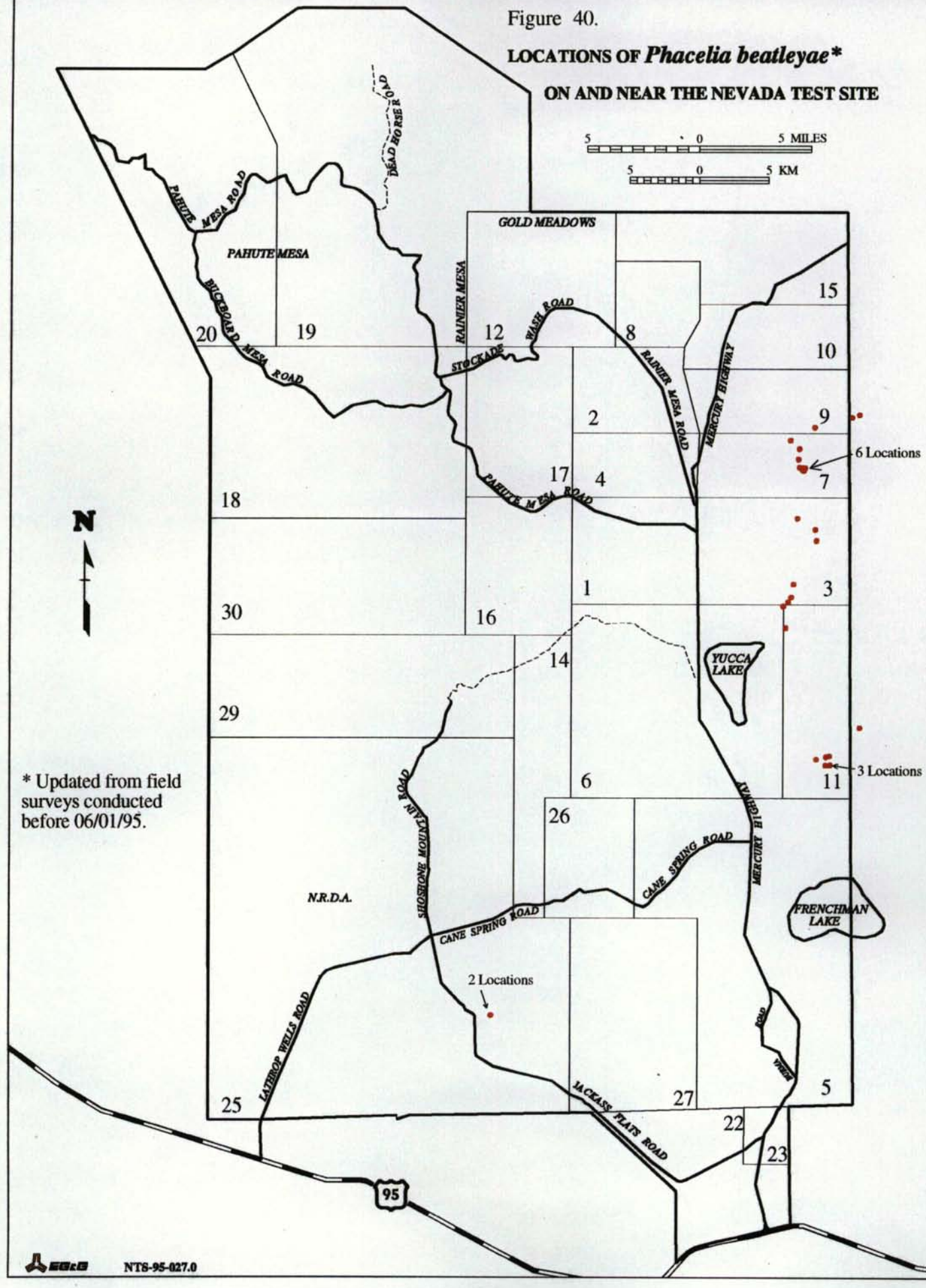
Phacelia beatleyae

EG&G

NTS-95-039.0

Figure 40.

LOCATIONS OF *Phacelia beatleyae
ON AND NEAR THE NEVADA TEST SITE



* Updated from field surveys conducted before 06/01/95.

On NTS, *P. beatleyae* occupies approximately 417 ha. Many of these locations are small isolated pockets of plants growing on exposed outcrops in ravines and washes. During surveys between 1991 and 1994, the number of plants at each location ranged from 4 to approximately 23,000, with most of the locations having between 500 and 12,000 plants. At the type locality on French Peak, *P. beatleyae* were noted as "abundant" in 1976 while only three plants were observed there in 1977 (Rhoads and Williams, 1977). An estimated 10,000 plants were observed at the type locality in 1992. This fluctuation in plant abundance through time is related to annual precipitation. During wet years the plants are abundant within its habitat while in drought years they are rare to nonexistent. For example, in March 1991, only 24 plants were found at a location on French Peak in north Frenchman Flat. In June 1992, the population was estimated at 7,600 individuals at this same location. Total annual rainfall for the Frenchman Flat area in 1991 was 79.3 mm and 141.0 mm in 1992 (Unpublished data for Frenchman Flat, NTS from the National Oceanic and Atmospheric Association, 1994)

3.10.3 Habitat

P. beatleyae is found primarily on hillsides, however, it also has been found in wash bottoms and on hillcrests. On NTS, approximately 70% of the locations occur on slopes between 10% and 50%. *P. beatleyae* occupies southern, southeastern, southwestern, and western aspects more than 80% of the time. Throughout its distribution, *P. beatleyae* occurs at elevations ranging from 1,160 m to 1,770 m (3,800-5,800 ft).

The species is most common on loose soils consisting of white to light-tan volcanic tuff or talus (Figure 41). Plants at the French Peak and Reitman Seep locations are widely distributed on the Rainier Mesa and Ammonia Tanks members of the Timber Mountain Tuff Unit (Frizzell and Shulters, 1990). On NTS the plant occurs mostly on steep, volcanic slopes consisting of gravelly soil that are for the most part void of other shrubs. *P. beatleyae* is also found in washes where the vegetation association is dominated by *Atriplex* species. The type locality is dominated by *A. hymenelytra* and the Skull Mountain locations occur in an *Atriplex-Larrea-Ambrosia* association (Rhoads and Williams, 1977). Other associated species include *Ephedra nevadensis*, *Yucca brevifolia,* and *Stipa speciosa.* Beatley (1976b) and Cochrane (1979) reported that the species also occurred with *Coleogyne ramosissima* and *Juniperus osteosperma* in some areas of the Halfpint Range.

3.10.4 Assessment of Status

P. beatleyae is a Nevada endemic that is distributed in scattered locations over 357 km^2 (138 mi^2). Although the range of *P. beatleyae* has not increased since it was discovered, the number of new locations has increased approximately 500%, from seven sites in the late 1970's to 35 sites in 1995. Ackerman (1981) states that more locations would probably be found if additional searches were conducted on DNWR, especially in the Raysonde Buttes. Additional surveys on NTS would most likely locate more locations as well.

Figure 41. *Phacelia beatleyae* habitat on Slanted Buttes, north of Reitman Seep, Nevada Test Site. Plants are found scattered on the light-colored lower and middle slopes.

After 25 years no location of *P. beatleyae* on NTS has been disturbed by DOE/NV activities. To threaten this species' existence, large scale construction in specific areas would need to occur. Such construction activity is highly unlikely for two reasons. First, the testing moratorium in effect for NTS has stopped all underground nuclear testing since 1992, and future testing is unlikely (U.S. Department of Energy, 1994). Secondly, *P. beatleyae* locations are typically in areas unsuitable for construction activities; i.e., unstable slopes of volcanic tuff. The species' continued existence at NTS sites since 1968 suggests that populations are stable even though plant numbers fluctuate from year to year.

Because *P. beatleyae*'s distribution has increased significantly, no identifiable threats are present that endanger the species, and populations appear stable over the past 27 years, *P. beatleyae* should be reclassified to Category 3C.

3.11 *Phacelia parishii* A. Gray, Parish's phacelia

3.11.1 Description

P. parishii (Figure 42) is an annual herb in the Hydrophyllaceae (waterleaf) family. It has stems that branch from the base, purple flowers up to 6 mm long with the base of the corolla tube yellowish in color, and seeds that are finely pitted and up to 1.3 mm long. A complete taxonomic description can be found in Reveal and Constance (1972). This species flowers between April and June.

3.11.2 Distribution

P. parishii is found in low lying valleys, dry alkaline lake beds, and alluvial slopes and flats. The northern extent of its range is in the Steptoe Valley of White Pine County, Nevada, the southwestern extent is in the Santa Rosa Mountains, Riverside County, California, and the eastern extent is in Mojave County, Arizona (Figure 43; additional information on numbered map points can be found in Appendix A, Table 11). The type locality is near Rabbit Springs, Lucerne Valley, San Bernardino County, California. It was discovered in 1882 by S. P. Parish and W. F. Parish (Gray, 1883) and is thought to be extirpated (Rutherford, 1994).

P. parishii was discovered on what is now NTS in 1941 on the foothills of the Spotted Range. In 1977 there were 16 known locations of *P. parishii* on NTS. The Spotted Range site was destroyed by the construction of a borrow pit sometime before 1977 (Rhoads and Williams, 1977). The 16 locations occurred from southern Frenchman Flat to south of Little Skull Mountain in Rock Valley. During the spring of 1995, all 16 historic locations were visited and 31 locations were defined (Figure 44). Many of these were isolated clusters within larger areas that were originally defined as *P. parishii* habitat by Rhoads and Williams (1977). Three of the areas where the plant was previously found had no plants. No surveys to locate new populations were conducted. The total area occupied by this species on NTS is approximately 235 ha. The number of plants observed ranged from 12 to 25,000 per location. The total number of plants counted across all locations on NTS was approximately 175,000.

Off NTS, this species is widely distributed in Nevada. The plant has been documented at four locations in Nye County: one near Pahrump, one in Hot Creek Valley, and two near the Wayne E. Kirch Wildlife Management Area at Sunnyside (Figure 43; Map Points 6, 10, 16 and 17, respectively). It has been found at five separate locations over three areas in Clark County: west of Las Vegas, near the dry lake bed and the foothills of the Pintwater Range, and in Indian Springs Valley (Figure 43; Map Points 15 and 12). In Lincoln County, it is found at six locations in four areas: west of Hiko and Caliente, in Desert Valley, and in Lake Valley (Figure 43; Map Points 13, 20, 19, 14 and 20, respectively). In White Pine County *P. parishii* has been found in two locations, one in Steptoe Valley and one in Baking Powder Flat (Figure 43; Map Points 18 and 21, respectively). Surveys were conducted by Frank Smith of NNHP to relocate these areas in 1995. All sites were relocated, except for the sites west of Hiko and Caliente, which were not surveyed. The Las Vegas site was surveyed but the plant was not found. New locations in the areas around

Figure 42. *Phacelia parishii* in flower in Rock Valley on the Nevada Test Site.

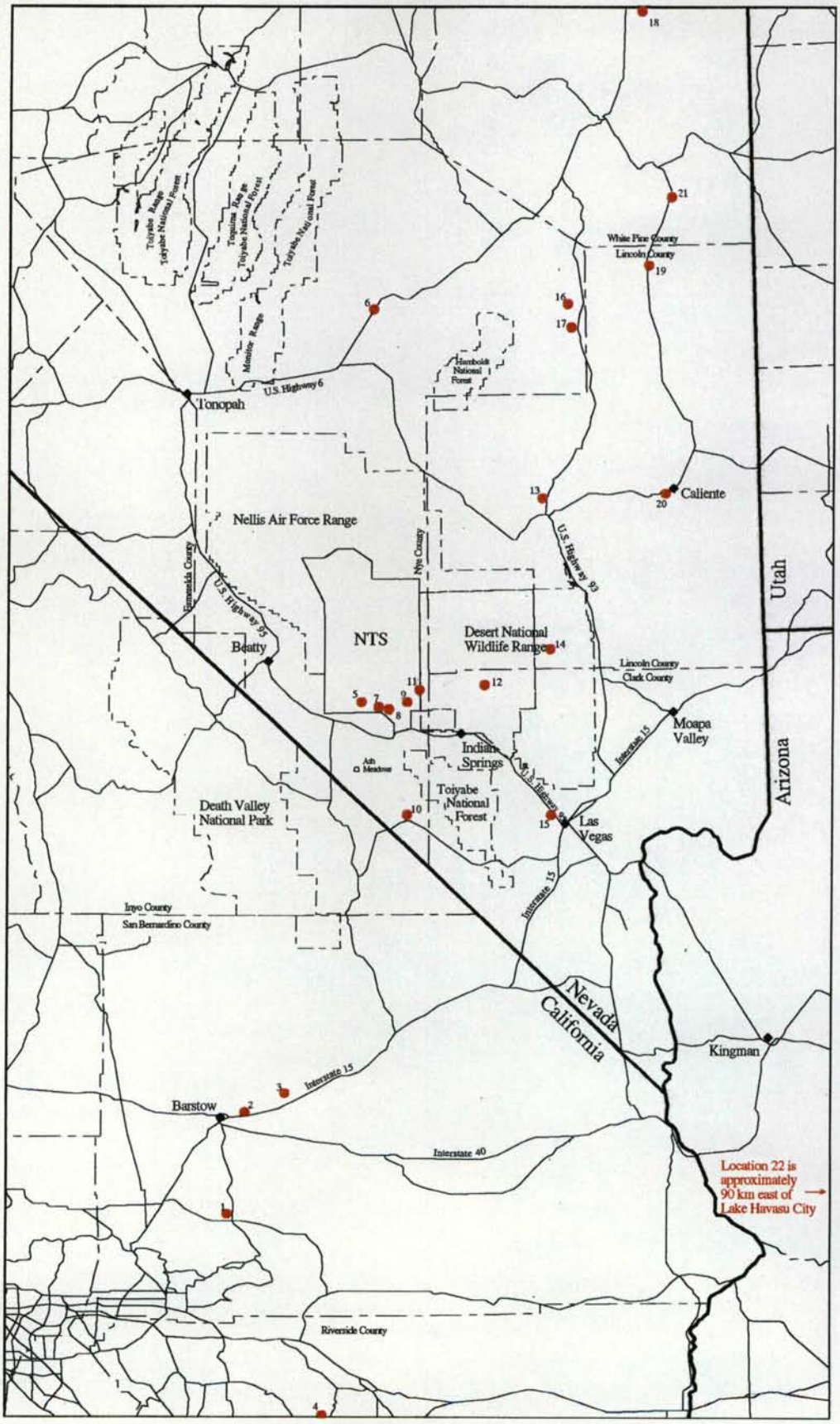


Figure 43.

Known Distribution of

Phacelia parishii

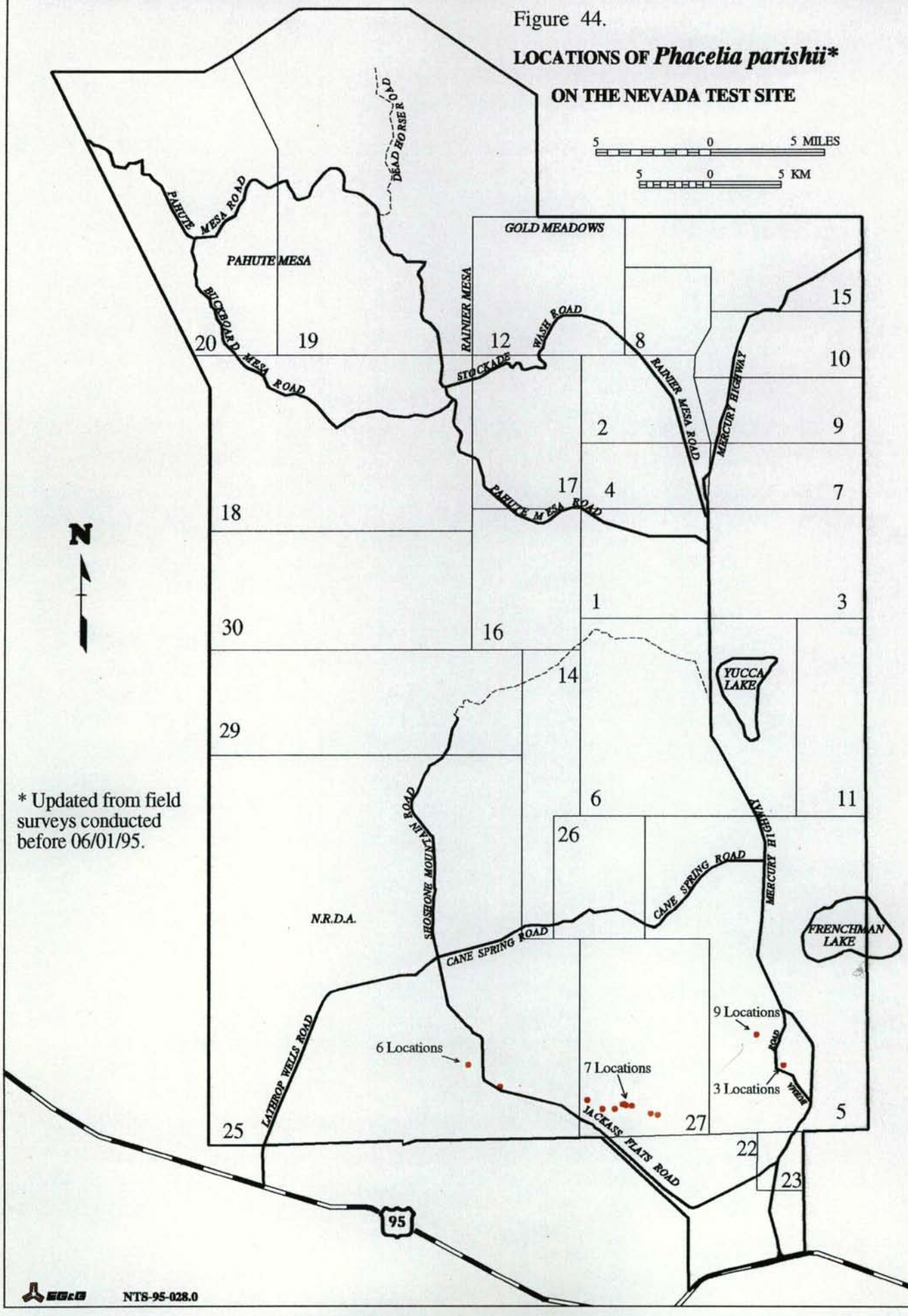
EG&G

NTS-95-040.1

Figure 44.

LOCATIONS OF *Phacelia parishii

ON THE NEVADA TEST SITE



* Updated from field surveys conducted before 06/01/95.

the historic locations were discovered in some instances (Smith, 1995). Plant numbers in the millions were found, however, the size of each location was not recorded (Smith, 1995).

P. parishii has been documented at five sites in California; in the Santa Rosa Mountains of Riverside County (Figure 43; Map Point 4) and in the following four sites in San Bernardino County: Rabbit Springs in Lucerne Valley, Waterman's near Calico, near Yermo, and south of Fort Irwin near Coyote Dry Lake, (Figure 43; Map Points 1, 2 and 3, respectively). The species was considered to be extirpated from California until it was discovered in 1989 south of Fort Irwin near Coyote Dry Lake (Bagley, 1989). At this 2 ha location several thousand plants occurred in dense patches scattered over the playa. FWS conducted a survey at and around this location in 1991. FWS surveyed a series of small dry lakes just north of the junction of the Los Angeles Department of Water and Power powerlines and the Manix Tank Trail, north-northwest to Coyote Dry Lake and subsequently expanded Bagley's location. FWS estimated the population size to be 200 million and the occupied area to be 100 ha (Rutherford and Bransfield, 1991). A second location was found in 1993 on the "Powerline road near Surprise Canyon road off-ramp, Yermo, California" (RSA herbarium, accession #562325). This location is close to the historic Waterman's near Calico site. No sightings have been documented in the past 40 years for plants at the Santa Rosa Mountains and the Rabbit Springs locations.

In 1994 a new *P. parishii* location was found by John Anderson of the BLM in Arizona (Anderson, 1995). This location was found approximately 230 km (143 mi) southwest of Las Vegas and 90 km (56 mi) due east of Lake Havasu City, Arizona (Figure 43; Map Point 22). This location expanded the known range of this species approximately 48 km (30 mi) to the east.

Currently there are 60 locations of *P. parishii* scattered throughout a range of approximately 110,000 km^2 (42,460 mi^2).

3.11.3 Habitat

Throughout its range, *P. parishii* is found primarily along lower portions of dry lake beds. This species has an elevational range of 670 to 1,980 m (2,200-6,500 ft) (Kartesz, 1988).

On NTS, the *P. parishii* locations occur at elevations of 975 to 1,160 m (3,200-3,820 ft) in relatively flat areas or on low knolls. These areas tend to appear as light colored, sparsely vegetated areas on the landscape (Figure 45). This plant grows in calcareous sandstone or siltstone soils and tuffaceous claystone and limestone soils of the Pavits Spring and Horse Spring Formation (Hinrichs, 1968). Approximately 65% of the *P. parishii* locations on NTS have slopes of less than 6% and 50% of the locations have a northern aspect. Associated perennial species include *Atriplex confertifolia, Lycium pallidum, Larrea tridentata, Ambrosia dumosa,* and *Ephedra nevadensis.* Associated annual species are *Syntrichopappus fremontii, Eriophyllum pringleii, Chaenactis stevioides,* and *Psathyrotes annua.* At the locations near Sunnyside, Nevada in the Wayne E. Kirch Wildlife Management Area in northeastern Nye County, *P. parishii* is found growing along the edge of a playa in small hummocks rising above salt encrusted, sandy clay soil (Figure 43; Map Points 16 and 17). Plants are also found growing in a white-mineralized

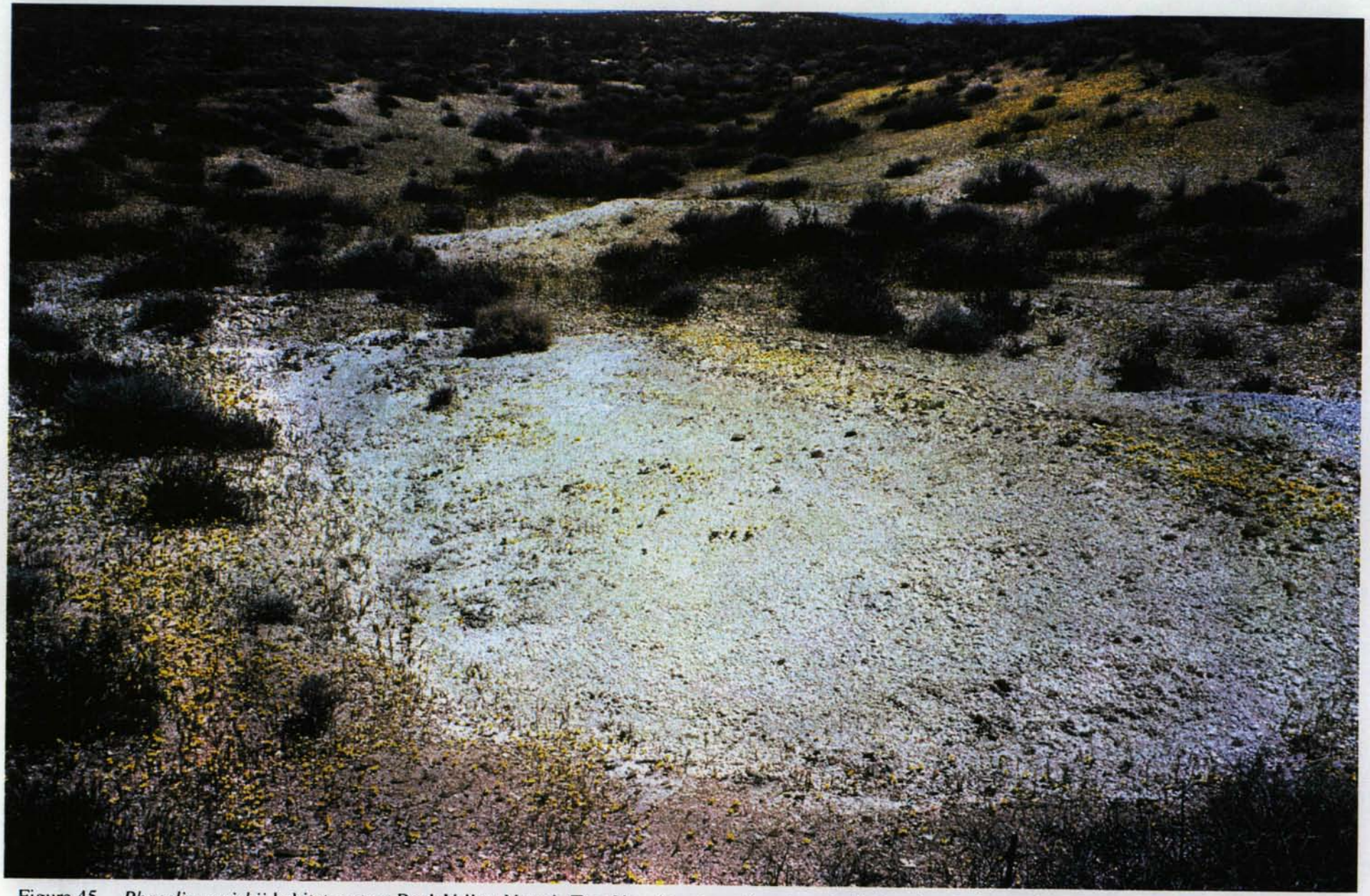


Figure 45. *Phacelia parishii* habitat eastern Rock Valley, Nevada Test Site. Plants are found on the light-colored clay and silt outcrops in the center of the photograph. Plants are associated with the small yellow-flowered annual *Syntrichopappus fremontii*.

crust to the east of the Management Area (Figure 43; Map Point 19). The top 2.5 cm (1 in) of this substrate is dry with wide cracks, but the soil underneath is moist (Harrison, 1980). The elevation at this site is 1,580 m (5,200 ft), and the surrounding vegetation is a saltbush-greasewood community. In general, the soils of the Sunnyside area are wet, have a high clay content, and a high concentration of salts. The dominant plants present at this site include *Sarcobatus vermiculatis, Atriplex* spp., and *Salicornia* spp. (Harrison, 1980). In the White River Valley, plants were found growing in white calcareous exposed slopes with sandy soil, in a desert shrub-sage community.

In California this species is described as occurring on desert alkaline flats and slopes at an elevational range of 540 to 880 m (1,770-2,900 ft). Near Fort Irwin, the plant was found distributed near the edge of a small open playa growing among *Atriplex polycarpa, A. argentea, Larrea* spp., *Phacelia pachyphylla, Plantago insularis* var. *fastigata,* and *Monolepis nuttalliana.*

3.11.4 Assessment of Status

The range of *P. parishii* in California is currently changing. Prior to 1989, this species was considered to be extinct in California (Bagley, 1989). Then in 1989 *P. parishii* was discovered south of Fort Irwin. This new location was subsequently expanded from approximately 2 ha to 100 ha in 1991. Then in 1993 a second location was discovered near Yermo, California.

This species' range on both NTS and throughout Nevada appears to be stable. Surveys conducted by Frank Smith for NNHP have confirmed this species' continued existence at most of the historic sites and documented location boundary extensions in some instances (Smith, 1995). This species' known range increased significantly when it was discovered in Arizona in 1994 east of Lake Havasu City.

Population trends for *P. parishii* across its known range are difficult to determine for two reasons. First, no historical information exists documenting the number of plants at most sites. Secondly, the plant is an annual and thus highly dependent on precipitation (Rhoads et al., 1979; Rutherford and Bransfield, 1991) and in dry years may not emerge at all.

The habitats *P. parishii* occupies are potentially susceptible to construction activities and off-road driving. One location was destroyed on NTS due to construction activities and the location south of Fort Irwin in San Bernardino County, California may become threatened by military maneuvers. The majority of known locations, however, remain undisturbed and plant populations of *P. parishii* appear stable based on the large numbers of plants counted at the different sites. Also, more locations probably exist than are currently known. The habitat in which *P. parishii* has been found on NTS is common throughout the Mojave Desert. Bagley (1989) notes that the basic habitat type for the species is widespread within the California Desert Conservation Area and much of this potential habitat has not been surveyed.

Updated information on *P. parishii* in Nevada indicates that it is still present at almost all of the previously known sites. This species is widespread across Nevada and is in no apparent danger of

becoming threatened over the majority of its known range. For these reasons *P. parishii* should be reclassified as a Category 3C species.

4.0 RECOMMENDATIONS

This section summarizes the recommendations presented in Section 3.0 regarding the future federal status of the eleven Category 2 candidate plants. Category 2 species, by definition, are those for which FWS does not have sufficient information to justify a petition for their classification as threatened or endangered. For this report, the current data on each of the eleven species were examined, including range, population stability, and the presence of threats. It was determined that these data, obtained after successive years of plant surveys conducted by DOE/NV, other federal and state departments, and independent botanists, were adequate to assess the susceptibility of most species to extinction from human perturbation. A recommendation to reclassify to Category 3 was made when the data indicated that a species was not currently susceptible to extirpation over the majority of its range. A recommendation to retain a Category 2 classification for a species was made if data were still lacking regarding the presence of threats over a major portion of its range. The recommendations presented below reflect current assessments of plant status. They may change in the future if unforeseen threats to a species develop, current threats are eliminated, or suspected threats are found to be absent.

The following species' attributes by themselves were not considered valid conditions to justify a recommendation to retain a plant on the list of Category 2 species or to petition for its classification as threatened or endangered. These attributes include: 1) a very small range, 2) rarity within known habitats, and 3) sole management or ownership of lands on which a species is found by one federal, state, or private entity. These attributes alone simply identify those species which are less widespread and abundant than others. It may or may not mean that such a species is more susceptible to harm from human activity and therefore warrants legal protection under the ESA. If available data indicates that such a species is isolated from human activities which may harm it, then the species was recommended for reclassification as Category 3C.

Recommendations are also presented (Section 4.2) for conservation measures which DOE/NV should begin or continue to implement. These measures are part of new and existing DOE/NV conservation policies which affect all native species on NTS regardless of state or federal status.

4.1 Federal Classifications

4.1.1 Recommendations for Category 3C Status

Information in this report supports a recommendation to reclassify the following five species as Category 3C. Category 3C species are more widespread than previously believed and/or they are not subject to any identifiable threat.

Arctomecon merriamii
Frasera pahutensis
Penstemon pahutensis
Phacelia beatleyae
Phacelia parishii

The distributions of *A. merriamii, F. pahutensis,* and *P. pahutensis* and *P. beatleyae* have all increased since they were first classified as Category 2 candidates. *A. merriamii* has been found at approximately 355 locations across much of southern Nevada and a large portion of California. *F. pahutensis* has been found in approximately 71 locations most of which are in the Toiyabe National Forest of northern Nye County. *P. pahutensis* occurs in 76 locations in southern Nye and eastern Esmeralda counties, Nevada. The number of locations of *P. beatleyae* has increased from 7 to 35 over the past 20 years. Although the range of *P. parishii* in California appears to have decreased, new locations have been found in California and Nevada, and the first Arizona location was found in 1994. New locations for all five of these species have been found in the last two years, and there is little doubt that additional locations would be found if survey efforts continue.

None of these five species appear to be subject to significant threats to their continued existence. Historic sites of these species on or near NTS still exist, with the exception of one location of *P. parishii*. They all occur in areas where either disturbance from human activities is low, where human activities affect only a small portion of their range, and/or where such activities are prohibited or restricted by land management policies. *A. merriamii, F. pahutensis,* and *P. pahutensis* are also known to recolonize disturbed areas and in the case of both *A. merriamii* and *P. pahutensis*, can move into disturbed areas not formerly occupied.

4.1.2 Recommendations for Category 3B Status

A Category 3B classification is appropriate for the following two species.

Camissonia megalantha
Cymopterus ripleyi var. *saniculoides*

Category 3B species are those whose names do not represent distinct taxa which meet the ESA's definition of a species. Field observations indicate that *C. megalantha* and *C. heterochroma* should be considered as a single species. Plants of both species can be found in the same location as well as intermediates that have morphological characteristics of both species. Based on this information and previous considerations by Dr. Peter Raven, *C. megalantha* and *C. heterochroma* should be considered as a single polymorphic species.

No published work to our knowledge currently supports the conclusion that *C. ripleyi* var. *saniculoides* is a separate variety from *C. ripleyi* var. *ripleyi.* Dr. Rupert Barneby, the author of the species, has indicated that since both color forms have been found together, it is not worthwhile recognizing the two varieties as separate.

4.1.3 Recommendations for Category 2 Status

A Category 2 classification may still be appropriate for the following four species:

Astragalus funereus	*Penstemon albomarginatus*
Galium hilendiae ssp. *kingstonense*	*Penstemon fruticiformis* var. *amargosae*

Populations of all four of these species on and near NTS appear stable and no identifiable threats to their existence were observed. These on- and near-NTS populations however, represent a small portion of each species' distribution or range, and threats absent on or near NTS may be present elsewhere. In the case of *A. funereus*, plant locations near Rhyolite and Beatty, Nevada appear stable based on recent surveys, but current threats from mining expansion or other developments in these areas are not known. The status of *A. funereus* in DVNP and the Spring Mountain Range is unknown, and the most recent sightings in these two areas date back to the early 1940's. Additionally, some of the collections of *A. funereus* in the western portion of DVNP and the Spring Mountain Range have been questioned as being *A. purshii* or *A. newberryi*; one location in the Spring Mountains has been recently verified as *A. newberryi.*

G. hilendiae ssp. *kingstonense* and *P. fruticiformis* var. *amargosae* both occur in the Kingston Range in San Bernardino County, California where there are mining claims. It is not known if mining activities threaten populations of these species. In the case of *G. hilendiae* ssp. *kingstonense*, the Kingston Range populations represent 60% of the plant's distribution and are the only populations known off NTS. Only three of the 19 known locations of *P. fruticiformis* var. *amargosae* are documented from the Kingston Range, however there are reported threats to this species in the Spring Mountain Range and the identity of specimens from the Panamint Range and the Saline Valley are questionable.

P. albomarginatus may be threatened by grazing in Hidden Valley, south of Las Vegas where eight of its 50 known locations occur. Also, the number of populations of this species in California apparently have dwindled from four to one.

Based on information gathered solely on NTS for these four species, a classification of Category 3C would seem appropriate. No identifiable threats were observed during plant surveys and some of these populations on and near NTS have persisted over 20 years. However, more information about populations which are not near NTS is needed to adequately assess the susceptibility of these four species to threats and to assess their stability over their entire range. The impact of specific activities such as mining and grazing on these species are needed to determine if they warrant further protection under the ESA.

4.2 NTS Conservation Measures

4.2.1 Development of an Ecosystem Conservation Plan for NTS

DOE/NV has recently developed a comprehensive policy to guide facilities, including the NTS, in their land use decisions. This policy, presented below, directs DOE/NV to use ecosystem management principles and to integrate ecologic factors into their decisions.

Department of Energy
Land and Facility Use Management Policy
December 21, 1994

> It is the Department of Energy policy to manage all of its land and facilities as valuable national resources. Our stewardship will be based on the principles of ecosystem management and sustainable development. We will integrate mission, economic, ecologic, social and cultural factors in a comprehensive plan for each site that will guide land and facility decisions. Each comprehensive plan will consider the site's larger regional context and be developed with stakeholder participation. This policy will result in land and facility uses which support the Department's critical missions, stimulate the economy, and protect the environment.

One principle of ecosystem management is the preservation of biodiversity and ecosystem function. To conserve biodiversity on NTS, DOE/NV should identify the native species on NTS and develop management goals and actions to ensure that land and facility use decisions will not threaten viable populations of these plants and animals. These species will include all state and federal endangered, threatened, and candidate species. DOE/NV began to develop a plan to identify such goals and actions for NTS in January 1995. This plan, if completed and implemented, will ensure that all NTS species, even Category 3C and those which have never been categorized as federal candidates, will not be extirpated by DOE/NV activities.

4.2.2 Preactivity Surveys

All proposed land disturbing activities on NTS are reviewed to ensure compliance with the ESA and DOE/NV environmental policies. As part of this review, preactivity surveys are conducted at proposed activity sites to determine the presence of threatened or endangered species and other important biological resources. These other important resources include Category 1 and 2 candidate species, state protected species (e.g. furbearers, game species), individuals of a species that are locally rare (e.g. an isolated stand of Joshua trees on a bajada), and resources on which these species may depend (e.g. free-standing water, burrows, nests).

It is recommended that DOE/NV continue to document the presence of all Category 2 plant species when they are found during preactivity surveys. DOE/NV will modify the design or location of a project when it will significantly impact the survival of the species on NTS. The only current Category 2 species for which project modification or relocation is likely to be considered are *A. funereus*, *P. fruticiformis* var. *amargosae*, and *G. hilendiae* ssp. *kingstonense* because of their limited number of populations on NTS. Mitigation actions would also be considered for all newly-classified Category 1 or 2 plant species for which distribution and abundance data on NTS is lacking.

4.2.3 Plant Surveys

DOE/NV should conduct surveys on NTS to identify the distribution and abundance of all new state- and federally-protected plants, including candidate species. All areas on NTS which have been searched for the presence of specific candidate plants are documented on a Geographic Information System (GIS) map. This map should continue to be updated routinely when needed to identify new areas where species are known to occur and are known to be absent. New information should continue to be submitted to the Nevada Natural Heritage Program database.

4.2.4 Protection of Type Localities

It is recommended that the type localities for *F. pahutensis, P. pahutensis,* and *P. beatleyae* be set aside as lands unavailable for future development on NTS. These sites should be fenced, if possible, and posted to identify their protected status in the field. They should also be identified on a biological resource map of NTS as areas off-limits to disturbance.

4.2.5 Standard DOE/NV Land Use Restrictions

Off-road driving, public access, and domestic livestock grazing are prohibited on NTS. These restrictions provide protection to all native plants on NTS and effectively minimize disturbance to or loss of their habitat.

LITERATURE CITED

Ackerman, T. L. 1981. *A survey of possible threatened and endangered plant species on the Desert National Wildlife Range*. U. S. Fish and Wildlife Service, Desert National Wildlife Range, Nevada.

Anderson, J. 1995. Phoenix District, Bureau of Land Management, Arizona, Personal communication with K. W. Blomquist, EG&G Energy Measurements Inc., Las Vegas, Nevada, April 6.

Arizona Game and Fish Department, Natural Heritage Program. 1994. Database search for Category II plant species.

Bair, J. 1995. U.S. Fish and Wildlife Office, Reno, Nevada. Personal communication with T. A. Lindemann, EG&G Energy Measurements Inc., Las Vegas, Nevada, August 15.

Bair, J. 1995a. U.S. Fish and Wildlife Office, Reno, Nevada. Personal communication with K. W. Blomquist, EG&G Energy Measurements Inc., Las Vegas, Nevada, August 29.

Bagley, M. 1989. *Sensitive plant species survey on a portion of the proposed Fort Irwin NTC expansion area, San Bernardino County, California*. Michael Brandman and Associates, Inc., Santa Ana, California. Submitted to U.S. Army Corps of Engineers, Los Angeles District.

Barneby, R. C. 1941. "A new species of *Cymopterus* from Nevada." *Leaflets of Western Botany*, 3:81-83.

Barneby, R. C. 1993. New York Botanical Garden, Bronx, New York, letter to W. K. Ostler, EG&G Energy Measurements, Inc., Las Vegas, Nevada, regarding the taxonomy of *Cymopterus ripleyi*, November 22.

Barnes, Harley, F. N. Houser, and F. G. Poole. 1963. Geologic map of the Oak Spring quadrangle, Nye County, Nevada: U. S. Geological Survey Quadrangle Map GQ-214, Scale 1:24,000.

Barnes, Harley, E. B. Ekren, L. R. Cleaves, and D. C. Hedlund. 1982. Geologic and tectonic map of the Mercury quadrangle, Nye and Clark Counties, Nevada: U. S. Geological Survey Miscellaneous Investigations Series Map I-1197, Scale 1:24,000.

Beatley, J. C. 1976. *Vascular plants of the Nevada Test Site and central-southern Nevada; ecologic and geographical distribution*. U. S. Energy Research and Development Administration Report TID-26881, U. S. National Technical Information Service, Springfield, Virginia.

Beatley, J. C. 1977a. *Endangered plant species of the Nevada Test Site, Ash Meadows, and central-southern Nevada.* COO-2307-11, U. S. Energy Research and Development Administration, Nevada Test Site, Nevada.

Beatley, J. C. 1977b. *Threatened plant species of the Nevada Test Site, Ash Meadows, and central-southern Nevada.* COO-2307-12, U. S. Energy Research and Development Administration, Nevada Test Site, Nevada.

Beatley, J. C. 1978. Department of Biological Sciences, University of Cincinnati, Cincinnati, Ohio, letter to Bryce MacBryde, U. S. Fish and Wildlife Service, Office of Endangered Species, regarding status of endangered plant species of southern Nevada, March 9.

BLM (U. S. Bureau of Land Management). 1993. *Kingman Resource Area proposed resource management plan and final environmental impact statement.* U.S. Department of the Interior, Bureau of Land Management, Kingman, Arizona.

BLM. 1994. *Caliente management framework plan and Nellis Air Force Range resource plan: proposed White Sides land withdrawal amendment and environmental assessment.* U. S. Department of Interior, Bureau of Land Management, Caliente, Nevada.

Blomquist, K. W., C. A. Wills, W. K. Ostler, K. R. Rautenstrauch, and T. P. O'Farrell. 1992. *Distribution, life history, management, and current status of Astragalus beatleyae on the U.S. Department of Energy's Nevada Test Site.* EG&G/EM Santa Barbara Report No. 10617-2187.

Brack, J. W. 1993. *The pahute green-gentian (Frasera pahutensis) survey and status summary.* U. S. Department of Agriculture, Forest Service, Toiyabe National Forest, Tonopah Ranger District.

Brack, J. W. 1995. Tonopah Ranger District, Toiyabe National Forest, personal communication with D. C. Steen, EG&G Energy Measurements, Inc., Las Vegas, Nevada, January 11.

California Department of Fish and Game. 1994. Natural diversity database search for Category II plant species.

Clark, D. 1994. Bureau of Land Management, Barstow, California, personal communication with S. A. Flick, EG&G Energy Measurements, Inc., Las Vegas, Nevada, November 1.

Cochrane, S. 1979. *Status of endangered and threatened plant species on Nevada Test Site - a survey. Parts 1 and 2. Appendix C: Collection records for the taxa considered.* EG&G/EM Santa Barbara Report No. 1183-2356.

Collins, E. and T. P. O'Farrell. 1984. *Surveys for plant species of concern on northern and eastern Yucca Flat, Nevada Test Site, Nye County, Nevada.* EG&G/EM Santa Barbara Report No. 10282-2039.

Constance, L. 1979. University of California, Department of Botany, Berkeley, California, letter to W. Robert Powell, University of California, Department of Agronomy and Range Science, Davis, California, regarding "The taxonomic classification of *C. ripleyi*," March 1.

Coville, F.V. 1892. "New plants from southern California." *Proceedings of the Biological Society of Washington,* 7:66.

Dempster, L. T. 1958. "New names and combinations in the genus *Galium.*" *Brittonia* 10:181-192.

Dempster, L. T., and F. Ehrendorfer. 1965. "Evolution of the *Galium multiflorum* complex in western North America. II. critical taxonomic revision." *Brittonia* 17:289-334.

EG&G Energy Measurements. 1988. Nevada Test Site Area Map: Distribution of known populations of *Astragalus beatleyae* and *Penstemon pahutensis* on the Nevada Test Site and Nellis Bombing Range, prepared for the U.S. Department of Energy, Nevada Operations Office, Las Vegas, NV.

Frizzell, V. A. and J. Shulters. 1990. *Geologic map of the Nevada Test Site, southern Nevada.* United States Geological Survey, Map I-2046.

Gray, A. 1883. "Contributions to North American botany." *Proceedings of the American Academy of Arts and Sciences,* 19:88.

Harrison, B. 1980. *Botanical survey, T/E plants, Schell Resource Area.* Department of Interior, Bureau of Land Management, Ely, Nevada.

Hayes, J. A. 1981. Missouri Botanical Garden, St. Louis, Missouri, letter to Dr. Thomas R. Van Devender, Arizona Natural Heritage Program, Phoenix, Arizona, regarding "*Camissonia megalantha* in Arizona," February 24.

Hickman, J. C. 1993. *The Jepson manual; higher plants of California.* University of California Press, Berkeley, California.

Hinrichs, E. N. and E. J. McKay. 1965. Geologic map of the Plutonium Valley quadrangle, Nye and Lincoln Counties, Nevada: U. S. Geological Survey Geologic Survey Map GQ-384, Scale 1:24,000.

Hinrichs, E. N. 1968. Geologic map of the Camp Desert Rock quadrangle, Nye County, Nevada: U. S. Geological Survey Quadrangle Map GQ-726, Scale 1:24,000.

Holmgren, N. H. 1971. "A new species of *Penstemon* from Nye County, Nevada." *Aliso,* 7:351-356.

Jones, M. E. 1908. "Notes on *Astragalus.*" *Contributions to Western Botany,* 12:11-12.

Kartesz, J. T. 1988. *A flora of Nevada.* Ph.D. thesis, University of Nevada, Reno, Nevada.

Keck, D. D. 1937. "Studies in Penstemon V. The section Peltanthera." *American Midland Naturalist,* 18:790-829.

Knight, T. and F. Smith. 1994. *An inventory for rare, threatened, endangered, and endemic plants and unique communities on Nellis Air Force Bombing and Gunnery Range, Clark, Lincoln, and Nye counties, Nevada.* U.S. Department of Defense, Department of the Air Force, Nellis Air Force Bombing and Gunnery Range, Contract Number M67004-91-D-0010-S401.

Knight, T. and F. Smith. 1995. *An inventory for rare, threatened, endangered, and endemic plants and unique communities on Nellis Air Force Bombing and Gunnery Range, Clark, Lincoln, and Nye counties, Nevada.* Volume II. U.S. Department of Defense, Department of the Air Force, Nellis Air Force Bombing and Gunnery Range, Support Agreement FB4852-94200-0741.

Knight, T. 1995. The Nature Conservancy, Las Vegas, Nevada, personal communication with T. A. Lindemann, EG&G Energy Measurements, Inc., Las Vegas, Nevada, August 3.

Knight, T. 1995a. The Nature Conservancy, Las Vegas, Nevada, personal communication with T. A. Lindemann, EG&G Energy Measurements, Inc., Las Vegas, Nevada, August 28.

Kurzius, M. A. 1981. *Vegetation and flora of the Grapevine Mountains, Death Valley National Monument, California-Nevada.* National Park Service and University of Nevada, Las Vegas, Nevada.

Lawrence, G. H. 1951. *Taxonomy of vascular plants.* MacMillan Company, New York, New York.

Morefield, J. D. and T. A. Knight. 1991. *Endangered, threatened, and sensitive vascular plants of Nevada.* Department of Interior, Bureau of Land Management, Reno, Nevada.

Morefield, J. D. 1992. *Frasera pahutensis Reveal, interim status report.* Prepared for Department of Interior, Forest Service, Toiyabe National Forest, Sparks, Nevada by Nevada Natural Heritage Program, Carson City, Nevada.

Mozingo, H. and M. J. Williams. 1980. *Threatened and endangered plants of Nevada: an illustrated manual.* Department of Interior, U.S. Fish and Wildlife Service and Bureau of Land Management, Reno, Nevada.

Munz, P. A. 1941. "*Oenothera heterochroma* var. *megalantha.*" *Leaflets of Western Botany,* 3:52.

Munz, P. A. 1974. *A flora of Southern California.* University of California Press, Berkeley, California.

NNHP (Nevada Natural Heritage Program). 1994. "Database search and report generated November 1994," Department of Conservation and Natural Resources, Carson City, Nevada.

O'Farrell, T. P and E. Collins. 1984. *Surveys for Astragalus beatleyae on Nellis Bombing Range, Nye County, Nevada.* EG&G/EM Santa Barbara Report No. 10282-2032.

Peterson, P. M. 1984. *Flora and physiognomy of the Cottonwood Mountains, Death Valley National Monument, California.* National Park Service and University of Nevada, Las Vegas, Nevada.

Pinzl, A. 1984. *Nevada's threatened and endangered plant map book.* Nevada State Museum, Carson City, Nevada.

Raven, P. H. 1962. "The systematics of *Oenothera* subgenus *Chylismia.*" *University of California Publications in Botany,* 34:111.

Raven, P. H. 1964. "The generic subdivision of Onagraceae, tribe Onagreae." *Brittonia,* 16:276-288.

Reveal, J. L. 1971. "A new *Frasera* from southern Nevada (Gentianaceae)." *Bulletin of the Torrey Pines Botanical Club,* 98:107-108.

Reveal, J. L. and L. Constance. 1972. "A new *Phacelia* (Hydrophyllaceae) from southern Nevada." *Brittonia,* 24:199-201.

Rhoads, W. A. and M. P. Williams. 1977. *Status of endangered and threatened plant species on Nevada Test Site - a survey. Part 1: endangered species.* EG&G/EM Santa Barbara Report No. 1183-2356.

Rhoads, W. A., S. Cochrane, and M. P. Williams. 1978. *Status of endangered and threatened plant species on Nevada Test Site - a survey. Part 2: threatened species.* EG&G/EM Santa Barbara Report No. 1183-2356.

Rhoads, W. A., S. Cochrane, and M. P. Williams. 1979a. *Addendum to status of endangered and threatened plant species on Nevada Test Site - a survey. Parts 1 and 2.* EG&G/EM Santa Barbara Report No. 1183-2356.

Rhoads, W. A., S. Cochrane, and M. P. Williams. 1979b. *Status of endangered and threatened plant species on Tonopah Test Range - a survey.* EG&G/EM Santa Barbara Operations Report No. 1183-2387.

Ripley, S. D. 1975. *Report on endangered and threatened plant species of the United States.* U. S. Government Printing Office, House Document No. 94-51, Washington D. C.

Rutherford, C. and R. Bransfield. 1991. *Survey for four annual plants, Parish's phacelia (Phacelia parishii), Mohave monkeyflower (Mimulus mohavensis), Barstow woolly sunflower (Eriophyllum mohavense), Lane Mtn. Milkvetch (Astragalus jaegerianus), in the Fort Irwin / BLM proposed land acquisition.* Prepared for the U.S. Army Corps of Engineers, Los Angeles District, Contract No. DACA09-90-D0024, by the U.S. Fish and Wildlife Service, Ventura Field Office, Ventura, California.

Rutherford, C. 1994. U. S. Fish and Wildlife Service, Ventura, California, personal communication with S. A. Flick, EG&G Energy Measurements, Inc., Las Vegas, Nevada, November 3.

Sanders, A. 1994. Curator of University of California, Riverside Herbarium, Riverside, California, personal communication with S. A. Flick, EG&G Energy Measurements, Inc., Las Vegas, Nevada, November 21.

Sauls, M. L., T. P. O'Farrell, and W. A. Rhoads. 1980. *The plant species Astragalus beatleyae on the Nevada Test Site.* Unpublished U.S. Department of Energy Topical Report, EG&G Santa Barbara Operations Report No. 1183-2412.

Scogin, R. 1989. *Studies of Penstemon albomarginatus in California.* Rancho Santa Ana Botanic Garden, Claremont, California.

Schram, D. R. 1982. *Floristics and vegetation of the Black Mountains, Death Valley National Monument, California.* National Park Service and University of Nevada, Las Vegas, Nevada.

Sheldon, S. K. 1994. *Sensitive plant survey of Hidden Valley, Nevada.* Department of Interior, Bureau of Land Management, Las Vegas, Nevada.

Smith, F. J. 1990. *Rare plant survey, Nevada Goldfields, Inc. project.* Nye County, Nevada. Prepared for Nevada Goldfields, Inc., Manhattan, Nevada.

Smith, F. J. 1995. Nevada Natural Heritage Program, Carson City, Nevada, personal communication with K. W. Blomquist, EG&G Energy Measurements, Inc., Las Vegas, Nevada, July 5.

Threloff, D. 1995. Death Valley National Park, Death Valley, California, personal communication with K. W. Blomquist, EG&G Energy Measurements, Inc., Las Vegas, Nevada, August 28.

U.S. Department of Energy. 1994. *FY 1994 Nevada Test Site technical site information. Volume 1 of 2.* U. S. Department of Energy, Nevada Test Site, Nevada.

U.S. Department of the Interior. 1993a. "Plant taxa for listing as endangered or threatened species; notice of review." Federal Register, 58:51144-51190.

Wade, T. E. 1976. *Announcement no. 127: preservation of antiquities and historic sites.* U. S. Energy Research and Development Administration, Nevada Operations Office, Las Vegas.

Wagner, W. 1994. Smithsonian Institution, Washington, D. C., letter to Kevin Blomquist, EG&G Energy Measurements, Inc. ,Las Vegas, Nevada, regarding species determination of *Camissonia* specimens collected on the NTS, March 31.

Welsh, S. L, N. D. Atwood, S. Goodrich, and L. C. Higgins. 1993. *A Utah flora; Great Basin naturalist memoir*, No. 9, Second Edition. Brigham Young University, Provo, Utah.

Welsh, S.L. 1995. Brigham Young University herbarium curator, Provo, Utah, personal communication with W.K. Ostler, EG&G Energy Measurements, Inc., Las Vegas, Nevada, September 11.

WESTEC Services Inc. 1980. *Field research of rare plants in Las Vegas ES Area, Clark County, Nevada.* Prepared for Bureau of Land Management, Las Vegas District Office, Las Vegas, Nevada. Contract No. YA-512-C79-127.

WESTEC Services, Inc. 1981. *Sensitive plant survey Nellis Air Force Range, Nevada.* Prepared for U.S. Fish and Wildlife Service, Sacramento, California. Contract No. 11310-0237-80.

APPENDIX A.

Table 1. Known locations of *Arctomecon merriamii*. The map point corresponds with the numbered points on the regional distribution map (Figure 3). Information includes: the county and state in which it was observed, the date(s) they were last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Inyo, CA	1986	1	California Department of Fish and Game, 1994
2	Inyo, CA	1982	1	California Department of Fish and Game, 1994
3	Inyo, CA	1982	1	UNLV herbarium (accession #18441)
4	Inyo, CA	1973	1	California Department of Fish and Game, 1994
5	Inyo, CA	1973, 1979	2	UNLV herbarium (accession #'s 15691, 9594)
6	Inyo, CA	1979	1	California Department of Fish and Game, 1994
7	Inyo, CA	1940	1	California Department of Fish and Game, 1994
8	Inyo, CA	1977	1	RSA herbarium (accession #552106)
9	Inyo, CA	1931	1	California Department of Fish and Game, 1994
10	Inyo, CA	1954	1	California Department of Fish and Game, 1994
11	Inyo, CA	1935	1	California Department of Fish and Game, 1994
12	Inyo, CA	1932	1	California Department of Fish and Game, 1994
13	Inyo, CA	1957	1	California Department of Fish and Game, 1994
14	Inyo, CA	1973	1	California Department of Fish and Game, 1994
15	Inyo, CA	1932	1	California Department of Fish and Game, 1994
16	Inyo, CA	Unknown	1	Schram, 1982
17	Inyo, CA	1983	1	UNLV herbarium (accession #19243)
18	Inyo, CA	1983	1	California Department of Fish and Game, 1994
19	Inyo, CA	1980	1	California Department of Fish and Game, 1994

Table 1. Continued.

Map point	County & State	Year last observed	Locations represented	Most recent information source
20	Nye, NV	1970	1	Nevada Natural Heritage Program, 1994
21	Nye, NV	1986	1	Nevada Natural Heritage Program, 1994
22	Nye, NV	1971	1	Nevada Natural Heritage Program, 1994
23	Nye, NV	1968, 1979	2	Nevada Natural Heritage Program, 1994; UNLV herbarium (accession #3117)
24	Nye, NV	1986	1	Nevada Natural Heritage Program, 1994
25	Nye, NV	1970	1	Nevada Natural Heritage Program, 1994
26	Nye, NV	1992	2	EG&G plant survey, 1992
27	Nye, NV	1971	1	Nevada Natural Heritage Program, 1994
28	Nye, NV	1991, 1992	4	EG&G plant surveys, 1991 & 1992
29	Nye, NV	1992	2	EG&G plant survey, 1992
30	Nye, NV	1967	1	Nevada Natural Heritage Program, 1994
31	Nye & Lincoln, NV	1977, 1979, 1981, 1992, 1993, 1994	63	Rhoads and Williams, 1977; Ackerman, 1981; EG&G plant surveys, 1992, 1993, 1994; Knight and Smith, 1994
32	Nye, NV	1970	1	Nevada Natural Heritage Program, 1994
33	Clark, NV	1971	1	Nevada Natural Heritage Program, 1994
34	Clark, NV	1939	1	Nevada Natural Heritage Program, 1994
35	Clark, NV	1981	1	Ackerman, 1981
36	Clark, NV	1981, 1994	34	Ackerman, 1981; Knight and Smith, 1994
37	Clark, NV	1981, 1994	27	Ackerman, 1981; Knight and Smith, 1994
38	Lincoln, NV	1981, 1994	44	Ackerman, 1981; Knight and Smith, 1994
39	San Bernardino, CA	1979	1	California Department of Fish and Game, 1994

Table 1. Continued.

Map point	County & State	Year last observed	Locations represented	Most recent information source
40	San Bernardino, CA	1979	1	California Department of Fish and Game, 1994
41	San Bernardino, CA	Before 1975	1	California Department of Fish and Game, 1994
42	San Bernardino, CA	1974	1	California Department of Fish and Game, 1994
43	San Bernardino, CA	1979	1	California Department of Fish and Game, 1994
44	San Bernardino, CA	1973, 1977	2	RSA herbarium (accession #'s 275878, 269625)
45	San Bernardino, CA	1979	1	California Department of Fish and Game, 1994
46	San Bernardino, CA	1973	1	California Department of Fish and Game, 1994
47	Clark, NV	1970, 1980	2	UNLV herbarium (accession #'s 6649, 14572)
48	Clark, NV	1980	1	Nevada Natural Heritage Program, 1994
49	Clark, NV	1981, 1994	57	Ackerman, 1981; Knight and Smith, 1994
50	Lincoln, NV	1994	1	Knight and Smith, 1994
51	Clark, NV	1981, 1994	22	Ackerman, 1981; Knight and Smith, 1994
52	Clark, NV	1953	1	Nevada Natural Heritage Program, 1994
53	Clark, NV	1981	12	Ackerman, 1981
54	Lincoln, NV	1964, 1973, 1976	4	Nevada Natural Heritage Program, 1994; UNLV herbarium (accession #'s 26285, 10138, 8819)
55	Clark, NV	1983	1	Nevada Natural Heritage Program, 1994
56	Clark, NV	1981	14	Ackerman, 1981
57	Clark, NV	1981	12	Ackerman, 1981
58	Clark, NV	1980	1	Nevada Natural Heritage Program, 1994
59	Clark, NV	1980	1	WESTEC, 1980

Table 1. Continued.

Map point	County & State	Year last observed	Locations represented	Most recent information source
60	Clark, NV	1993	1	Nevada Natural Heritage Program, 1994
61	Clark, NV	1937, 1938, 1939, 1978	4	Nevada Natural Heritage Program, 1994; *UNR 9124, UC 854904, CAS 272510, DS696685, UC 854907, UC 854903
62	Lincoln, NV	1981	1	Nevada Natural Heritage Program, 1994
63	Lincoln, NV	1980	1	Nevada Natural Heritage Program, 1994
64	Lincoln, NV	1981	1	RSA herbarium (accession #300796)

* UNR=University Nevada, Reno herbarium; UC=University of California at Berkeley; CAS=California Academy of Sciences; DS=Dudley Herbarium Stanford University

Table 2. Known locations of *Astragalus funereus*. The map point corresponds to the numbered points on the regional distribution map (Figure 7). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Inyo, CA	1981	1	California Department of Fish and Game, 1994
2?	Inyo, CA	1977	1	California Department of Fish and Game, 1994
3	Inyo, CA	1983	1	RSA herbarium (accession #305686)
4	Inyo, CA	1957	1	California Department of Fish and Game, 1994
5	Inyo, CA	1932	1	California Department of Fish and Game, 1994
6	Inyo, CA	1941	1	California Department of Fish and Game, 1994
7	Nye, NV	1992	1	EG&G plant survey, 1992
8**	Nye, NV	1992	1	EG&G plant survey, 1992
9	Nye, NV	1978	1	Nevada Natural Heritage Program, 1994
10	Nye, NV	1988	1	Nevada Natural Heritage Program, 1994
11	Nye, NV	1992	1	EG&G plant survey, 1992
12	Nye, NV	1992	3	EG&G plant survey, 1992; UNLV herbarium (Wes Niles collection in Beatty Wash, April 28, 1995)
13	Nye, NV	1992	4	EG&G plant survey, 1992
14	Nye, NV	1992	3	EG&G plant survey, 1992
15	Nye, NV	1981	5	Ackerman, 1981
16	Nye, NV	1979	1	Ackerman, 1981
17?	Clark, NV	1941	1	RSA herbarium (accession #109681)

**Type Locality
?-questionable identification

Table 3. Known locations of *Camissonia megalantha*. The map points correspond to the numbered points on the regional distribution map (Figure 11). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Nye, NV	1977	1	UNLV herbarium (accession #21482)
2	Nye, NV	1992	3	EG&G plant survey, 1992
3**	Nye, NV	1992	1	EG&G plant survey, 1992
4	Nye, NV	1978, 1979, 1992	4	EG&G plant survey, 1992; Cochrane, 1979; Ackerman, 1981
5	Nye, NV	1978	1	Cochrane, 1979
6	Nye, NV	1992	1	EG&G plant survey, 1992
7	Nye, NV	1979	2	Ackerman, 1981
8	Lincoln, NV	1979	1	Ackerman, 1981
9	Lincoln, NV	1994	1+	U.S. Department of Interior, Bureau of Land Management, 1994

**Type Locality

Table 4. Known locations of *Cymopterus ripleyi* var. *saniculoides*. The map points correspond to the numbered points on the regional distribution map (Figure 15). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Inyo, CA	1974,1978, 1980, 1982	5	California Department of Fish and Game, 1994
2	Inyo, CA	1988	1	California Department of Fish and Game, 1994
3	Nye, NV	Unknown	1	Pinzl, 1984
4	Nye, NV	1979	1	Nevada Natural Heritage Program, 1994
5?	Nye, NV	1979	2	Nevada Natural Heritage Program, 1994
6	Nye, NV	1992	3	EG&G plant survey, 1992
7	Nye, NV	1978	1	Nevada Natural Heritage Program, 1994
8	Nye, NV	1992	1	EG&G plant survey, 1992
9	Nye, NV	1994	2	EG&G plant survey, 1994
10	Nye, NV	1992	1	EG&G plant survey, 1992
11	Nye, NV	1971	1	Nevada Natural Heritage Program, 1994
12	Nye, NV	1991	2	EG&G plant survey, 1991
13	Nye, NV	1993	1	EG&G plant survey, 1993
14	Nye, NV	1992	2	EG&G plant survey, 1992
15	Nye, NV	1993	1	EG&G plant survey, 1993
16	Nye, NV	1992	1	EG&G plant survey, 1992
17	Nye, NV	1994	2	EG&G plant survey, 1994
18	Nye, NV	1966	1	UNR herbarium (accession #22936)
19	Nye, NV	1993	1	EG&G plant survey, 1993

Table 4. Continued.

Map point	County & State	Year last observed	Locations represented	Most recent information source
20**	Nye, NV	1941,1965	2	Nevada Natural Heritage Program, 1994; UNLV herbarium (accession #01451)
21	Lincoln, NV	1979	1	UNLV herbarium (accession #28380)
22	Lincoln, NV	1985	1	UNLV herbarium (accession #19574)
23	Lincoln, NV	1985	1	UNLV herbarium (accession #19577)

**Type Locality
? - questionable identification

Table 5. Known locations of *Frasera pahutensis*. The map points correspond to the numbered points on the regional distribution map (Figure 19). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Nye, NV	1993	28	Brack, 1993; Morefield, 1992; Reveal, 1971; Smith, 1990
2	Nye, NV	1990	3	Smith, 1990
3	Nye, NV	1991	4	Morefield, 1991; Smith, 1990
4	Nye, NV	1993	15	Brack, 1993; Morefield, 1992; Smith, 1990
5**	Nye, NV	1992	1	EG&G plant survey, 1992
6	Nye, NV	1993	6	Brack, 1993; Morefield, 1992; Smith, 1990
7	Nye, NV	1992	1	EG&G plant survey, 1992
8	Nye, NV	1991	1	Morefield, 1992

**Type Locality

Table 6. Known locations of *Galium hilendiae* var. *kingstonense*. The map points correspond to the numbered points on the regional distribution map (Figure 23). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Nye, NV	1992	1	EG&G plant survey, 1992
2	Nye, NV	1992	1	EG&G plant survey, 1992
3	Nye, NV	1992	1	Cochrane, 1979; EG&G plant survey, 1992
4	Nye, NV	1992	1	Cochrane, 1979; EG&G plant survey, 1992
5**	San Bernardino, CA	1941,1980	6	California Department of Fish and Game, 1994; RSA herbarium (accession #'s 334471, 305354, 296673)

**Type Locality

Table 7. Known locations of *Penstemon albomarginatus*. The map points correspond to the numbered points on the regional distribution map (Figure 27). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Nye, NV	1994	1	EG&G plant survey, 1994
2	San Bernardino, CA	1989	1	California Department of Fish and Game, 1994
(3)	San Bernardino, CA	1935	1	California Department of Fish and Game, 1994
4	Nye, NV	1994	3	EG&G plant survey, 1994
5	San Bernardino, CA	1989	1	California Department of Fish and Game, 1994
6	Nye, NV	1992	1	EG&G plant survey, 1992
(7)	Nye, NV	1976	2	UNR herbarium (accession #'s 37329, 56152)
8**	Clark, NV	Unknown	1	Kartesz, 1988
(9)	San Bernardino, CA	1941	1	California Department of Fish and Game, 1994
10	Clark, NV	1994	2	Sheldon, 1994
11	Clark, NV	1965	1	UNLV herbarium (accession #1912)
12	Clark, NV	1994	1	Sheldon, 1994
13	Clark, NV	1994	2	Sheldon, 1994
14	Clark, NV	1969	1	UNLV herbarium (accession #2739)
15	Clark, NV	1994	3	Sheldon, 1994
16	Mojave, AZ	1994	2	Arizona Game and Fish Department, 1994
17	Mojave, AZ	1994	2	Arizona Game and Fish Department, 1994
18	Mojave, AZ	1994	8	Arizona Game and Fish Department, 1994
19	Mojave, AZ	1994	7	Arizona Game and Fish Department, 1994
20	Mojave, AZ	1994	5	Arizona Game and Fish Department, 1994
21	Mojave, AZ	1994	4	Arizona Game and Fish Department, 1994

**Type Locality
( ) thought to be extirpated

Table 8. Known locations of *Penstemon fruticiformis* var. *amargosae*. The map points correspond to the numbered points on the regional distribution map (Figure 31). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Inyo, CA	1906	1	UNR herbarium (accession #10459)
2	Inyo, CA	1968	1	UNR herbarium (accession #24205)
3**	Nye, NV	1907	1	Nevada Natural Heritage Program, 1994
4	Nye, NV	1992	2	EG&G plant survey, 1992
5	Nye, NV	1991	8	Rhoads et al. 1978; EG&G plant survey, 1991
6	Nye, NV	1993	1	Knight, 1995
7	San Bernardino, CA	1991	1	Unpublished data, BLM Barstow resource area
8	Inyo, CA	1991	1	Unpublished data, BLM Barstow resource area
9	Inyo, CA	1980	1	RSA herbarium (accession #296661)
10?	Inyo, CA	1982	1	RSA herbarium (accession #354859)
11	Inyo, CA	1983	1	RSA herbarium (accession #351965)

**Type Locality
? questionable identification

Table 9. Known locations of *Penstemon pahutensis*. The map points correspond to the numbered points on the regional distribution map (Figure 35). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Esmeralda, NV	1994	1	EG&G plant survey, 1993; UNLV herbarium (G.E. Lyon Collection #233)
2	Esmeralda, NV	1994	1	EG&G plant survey, 1993; UNLV herbarium (G.E. Lyon Collection #'s 221, 222, 225)
3	Nye, NV	1994	5	EG&G plant survey, 1993; DVNP herbarium (G.E. Lyon Collection #'s 234, 235, 236, 237)
4	Nye, NV	1993	4	EG&G plant survey, 1993
5	Nye, NV	1994	7	EG&G plant survey, 1993; DVNP herbarium (G.E. Lyon Collection #'s 217, 218)
6	Nye, NV	1971, 1977	2	Nevada Natural Heritage Program, 1994; Knight and Smith, 1995; Beatley, 1977a
7	Nye, NV	1964	1	Nevada Natural Heritage Program, 1994
8	Nye, NV	1991	1	EG&G plant survey, 1991
9**	Nye, NV	1991, 1992	32	EG&G plant surveys, 1991 & 1992
10	Nye, NV	1991, 1992, 1993	5	EG&G plant surveys, 1991, 1992 & 1993
11	Nye, NV	1991, 1992	13	EG&G plant surveys, 1991 & 1992
12	Nye, NV	1992	2	EG&G plant survey, 1992
13	Nye, NV	1991, 1992	2	EG&G plant surveys, 1991 & 1992

**Type Locality

Table 10. Known locations of *Phacelia beatleyae*. The map points correspond to the numbered points on the regional distribution map (Figure 39). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year last observed	Locations represented	Most recent information source
1	Nye, NV	1992	2	EG&G plant survey, 1992
2	Nye, NV	1992	3	EG&G plant survey, 1992
3	Nye, NV	1993	1	EG&G plant survey, 1993
4	Nye, NV	1992, 1993	3	EG&G plant surveys, 1992 & 1993
5	Nye, NV	1993	4	EG&G plant survey, 1993
6	Nye, NV	1992	6	EG&G plant survey, 1992
7	Nye, NV	1979	1	Rhoads, et al., 1977
8	Nye, NV	1992, 1993	3	EG&G plant surveys, 1992 & 1993
9**	Nye, NV	1992	3	EG&G plant survey, 1992
10	Nye, NV	1979, 1992	2	Rhoads, et al., 1977; EG&G plant survey, 1992
11	Nye, NV	1979	1	Rhoads et al., 1977
12	Nye, NV	1978	1	Ackerman, 1981
13	Nye, NV	1978	5	Ackerman, 1981

**Type Locality

Table 11. Known locations of *Phacelia parishii*. The map points correspond to the numbered points on the regional distribution map (Figure 43). Information includes: the county and state in which it was observed, the date it was last observed, the number of individual locations the point represents, and the information source(s).

Map point	County & State	Year Last Observed	Locations represented	Most recent information source
(1)**	San Bernardino, CA	1941	1	California Department of Fish and Game, 1994
(2)	San Bernardino, CA	1884, 1993	2	California Department of Fish and Game, 1994; RSA herbarium search (accession #562325)
3	San Bernardino, CA	1991	1	Bagley, 1989; Rutherford and Bransfield, 1991
4	Riverside, CA	1937	1	WESTEC, 1980 (Located at Dudley herbarium Stanford University, Munz Collection #15101)
5	Nye, NV	1995	7	EG&G plant surveys, 1995
6?	Nye, NV	1969	1	UNR herbarium (accession #56466)
7	Nye, NV	1995	3	EG&G plant surveys, 1995
8	Nye, NV	1995	9	EG&G plant surveys, 1995
9	Nye, NV	1995	12	EG&G plant surveys, 1995
10	Nye, NV	1983	1	UNLV herbarium (accession #16734)
(11)	Nye, NV	1941	1	Cochrane, 1979; EG&G plant surveys, 1995
12	Clark, NV	1940, 1993	3	WESTEC, 1980 (Located at RSA herbarium Barneby Collection #'s 2912, 2917); UNLV herbarium (Smith & Watkins Collection #3670)
13	Lincoln, NV	1941	1	WESTEC, 1980 (Located at RSA herbarium Ripley and Barneby Collection # 3475
14	Lincoln, NV	1983, 1987	2	UNLV herbarium (accession #28501); Nevada Natural Heritage Program, 1994
15	Clark, NV	1941, 1979	2	Cochrane, 1979; UNLV herbarium (accession #17045)
16	Nye, NV	1978, 1979	3	UNLV herbarium (accession #14706); Harrison, 1980
17	Nye, NV	1979	2	UNR herbarium (accession #'s 46923, 46924)
18	White Pine, NV	1980	1	Harrison, 1980
19	Lincoln, NV	1980	1	Harrison, 1980

20?	Lincoln, NV	1904, 1941	2	WESTEC, 1980 (Located at RSA herbarium Ripley & Barneby collection #3496; Located at Pomona College Jones collection #4/29/04)
21	White Pine, NV	1982	1	UNR herbarium (accession #63419)
22	Mojave, AZ	1994	1	Anderson, 1995

**Type Locality
( ) thought to be extirpated
? - questionable identification

APPENDIX B.

MAP:

DISTRIBUTION OF CANDIDATE PLANT SPECIES ON AND NEAR THE NEVADA TEST SITE

EG&G MAP NUMBER: NTS-94-034.5

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Arizona Game and Fish Department, Natural Heritage Program
Phoenix, Arizona
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California Department of Fish and Game, Natural Heritage Division
Sacramento, California
K. Hashegan

Utah Natural Heritage Program
Salt Lake City, Utah
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Las Vegas, Nevada
W. Niles

The Nature Conservancy
Las Vegas, Nevada
T. Knight
F. Smith

Nellis Air Force Base
Las Vegas, Nevada
E. Watkins

Las Vegas Valley Water District
Las Vegas, Nevada
J. Monico

U.S. Fish and Wildlife Service, Reno Field Office
Reno, Nevada
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Ventura, California
C. Rutherford

Nevada Department of Wildlife, Region III
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Bureau of Land Management
Kingman, Arizona
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Bureau of Land Management
Phoenix, Arizona
J. Anderson

Bureau of Land Management
Barstow, California
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Tonopah, Nevada
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Toiyabe National Forest
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N. H. Holmgren

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Environmental Sciences Division
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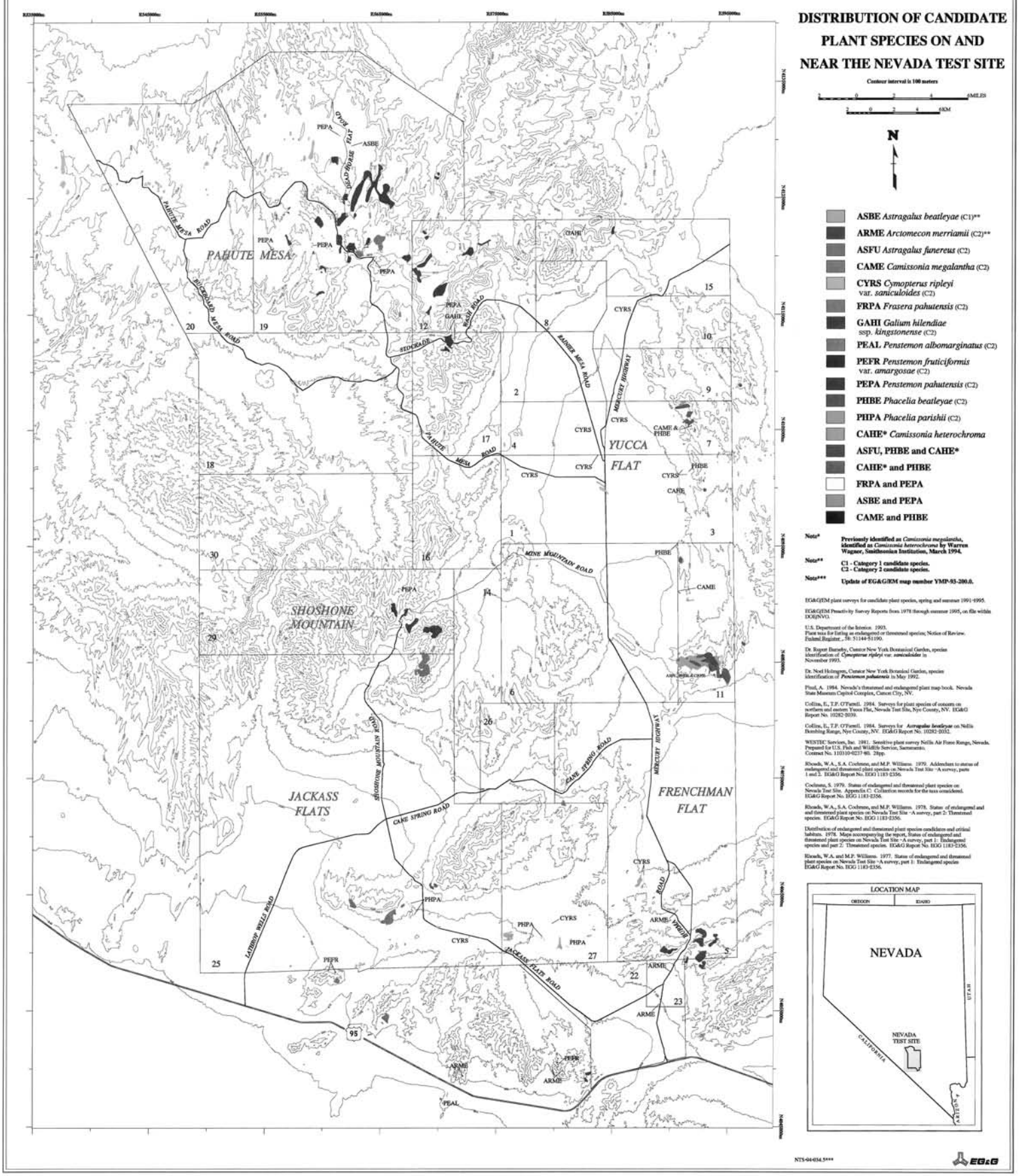

DISTRIBUTION OF CANDIDATE PLANT SPECIES ON AND NEAR THE NEVADA TEST SITE

Contour interval is 100 meters

3 0 2 4 6MILES

2 0 2 4 6KM

N

- **ASBE** *Astragalus beatleyae* (C1)**
- **ARME** *Arctomecon merriamii* (C2)**
- **ASFU** *Astragalus funereus* (C2)
- **CAME** *Camissonia megalantha* (C2)
- **CYRS** *Cymopterus ripleyi* var. *saniculoides* (C2)
- **FRPA** *Frasera pahutensis* (C2)
- **GAHI** *Galium hilendiae* ssp. *kingstonense* (C2)
- **PEAL** *Penstemon albomarginatus* (C2)
- **PEFR** *Penstemon fruticiformis* var. *amargosae* (C2)
- **PEPA** *Penstemon pahutensis* (C2)
- **PHBE** *Phacelia beatleyae* (C2)
- **PHPA** *Phacelia parishii* (C2)
- **CAHE*** *Camissonia heterochroma*
- **ASFU, PHBE and CAHE***
- **CAHE* and PHBE**
- **FRPA and PEPA**
- **ASBE and PEPA**
- **CAME and PHBE**

Note* **Previously identified as *Camissonia megalantha*, identified as *Camissonia heterochroma* by Warren Wagner, Smithsonian Institution, March 1994.**

Note** **C1 - Category 1 candidate species.**
C2 - Category 2 candidate species.

Note*** **Update of EG&G/EM map number YMP-93-200.0.**

EG&G/EM plant surveys for candidate plant species, spring and summer 1991-1995.

EG&G/EM Proactivity Survey Reports from 1978 through summer 1995, on file within DOE/NVO.

U.S. Department of the Interior. 1993. Plant taxa for listing as endangered or threatened species; Notice of Review. Federal Register , 58: 51144-51190.

Dr. Rupert Barneby, Curator New York Botanical Garden, species identification of *Cymopterus ripleyi* var. *saniculoides* in November 1993.

Dr. Noel Holmgren, Curator New York Botanical Garden, species identification of *Penstemon pahutensis* in May 1992.

Pinel, A. 1984. Nevada's threatened and endangered plant map book. Nevada State Museum Capitol Complex, Carson City, NV.

Collins, E., T.P. O'Farrell. 1984. Surveys for plant species of concern on northern and eastern Yucca Flat, Nevada Test Site, Nye County, NV. EG&G Report No. 10282-2039.

Collins, E., T.P. O'Farrell. 1984. Surveys for *Astragalus beatleyae* on Nellis Bombing Range, Nye County, NV. EG&G Report No. 10282-2032.

WESTEC Services, Inc. 1981. Sensitive plant survey Nellis Air Force Range, Nevada. Prepared for U.S. Fish and Wildlife Service, Sacramento. Contract No. 110310-0237-80. 28pp.

Rhoads, W.A., S.A. Cochrane, and M.P. Williams. 1979. Addendum to status of endangered and threatened plant species on Nevada Test Site –A survey, parts 1 and 2. EG&G Report No. EGG 1183-2356.

Cochrane, S. 1979. Status of endangered and threatened plant species on Nevada Test Site. Appendix C: Collection records for the taxa considered. EG&G Report No. EGG 1183-2356.

Rhoads, W.A., S.A. Cochrane, and M.P. Williams. 1978. Status of endangered and and threatened plant species on Nevada Test Site –A survey, part 2: Threatened species. EG&G Report No. EGG 1183-2356.

Distribution of endangered and threatened plant species candidates and critical habitats. 1978. Maps accompanying the report, Status of endangered and threatened plant species on Nevada Test Site –A survey, part 1: Endangered species and part 2: Threatened species. EG&G Report No. EGG 1183-2356.

Rhoads, W.A. and M.P. Williams. 1977. Status of endangered and threatened plant species on Nevada Test Site –A survey, part 1: Endangered species EG&G Report No. EGG 1183-2356.

LOCATION MAP

NTS-94-034.5***

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