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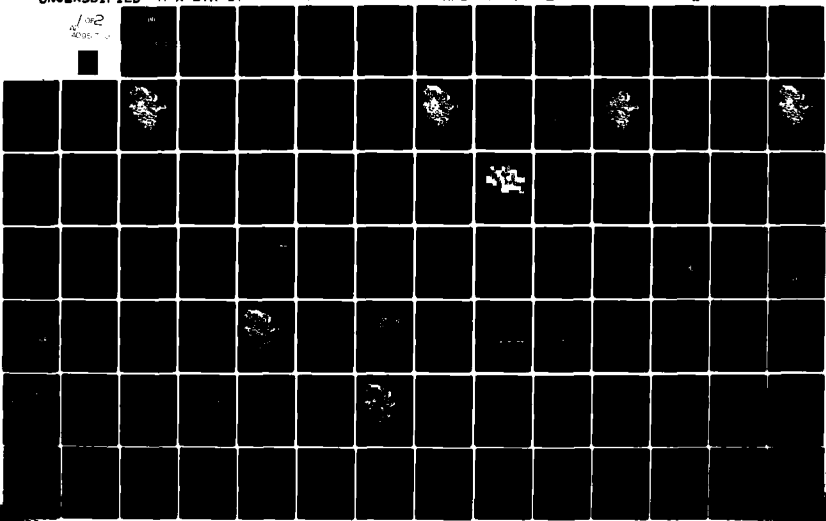

AFSC-TR-81-32

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M-X ENVIRONMENTAL TECHNICAL REPORT

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PROTECTED SPECIES

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Protected species in Utah, Nevada, Texas and New Mexico can be divided into six functional categories of protection or other regulation under state and federal laws. These categories are (1) federally listed threatened and endangered (protected under the Endangered Species Act of 1973 and amendments), (2) state-listed threatened and endangered (protected by state laws), (3) federally protected (under other federal laws, (4) state-protected (under other state laws), (5) game and furbearing, and (6) unprotected but rare.

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M-X ETR-17

ENVIRONMENTAL CHARACTERISTICS OF ALTERNATIVE DESIGNATED DEPLOYMENT AREAS: PROTECTED SPECIES

Prepared for

United States Air Force
Ballistic Missile Office
Norton Air Force Base
California

By

Henningson, Durham & Richardson
Santa Barbara, California

22 December 1980

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PROTECTED SPECIES

1.0 INTRODUCTION

The American public let their desire for conservation be known in the passage of the Endangered Species Act in 1973. They have become aware of the necessity to preserve biological species to prevent biotic impoverishment, which "represents a reduction of the planet's capacity to support man." (Lovejoy, 1979)

Many species of rare, endangered, and threatened plants grow in severe or unusual habitats and often possess unique qualities that make them particularly valuable to man: they contribute to ecological diversity which may provide greater ecological stability; they commonly stock unstable and unusual habitats with "preadapted" ground cover; some provide sources of medicines and other chemicals; they may serve as bioindicators of minerals and metal ores; some may possess potential value for food crops and horticultural use; and some provide man with sources of aesthetic value. "Loss of any species of plant represents an irretrievable loss of unique genetic material or germ plasm that cannot be duplicated and narrows man's future for his own use of the environment. . ." (Ayensu and DeFillips 1978)

Species are becoming extinct. The growth of San Francisco caused the extinction of the adobe samicle (*Sanicula maritima*) and threatened the San Francisco manzanita (*Arctostaphylos franciscana*), now represented by a single wild shrub. Populations of yellow bear-poppies (*Arctomecon californica*) have been lost as a result of the growth in population of Las Vegas, Nevada (Janish, 1977). To paraphrase Lovejoy, while it is not always easy to deduce the complete meaning for society of any particular endangered species, it will always be true that the loss of such species will reflect a deterioration of a biological system.

Protected species can be divided into six functional categories of protection or other regulation under state and federal laws. These categories are (1) federally listed threatened and endangered (protected under of the Endangered Species Act of 1973 and amendments), (2) state-listed threatened and endangered (protected by state laws), (3) federally protected (under other federal laws), (4) state-protected (under other state laws), (5) game and furbearing, and (6) unprotected but rare.

As defined by the Endangered Species Act of 1973, federally listed endangered species are those in danger of extinction throughout all or a significant portion of their world range; federally listed threatened species are those likely to become endangered in the foreseeable future.

The state of Nevada has an analogous definition for species in danger of extinction within the state, but not necessarily throughout their entire range. These are the state-listed endangered and threatened species. For Nevada, state-listed plant species are those declared by the state forester fire warden to be threatened with extinction under NRS 527.270. Utah has no state-protected plant species. Federally protected animals are those protected by federal law, such as wild horses and burros. State-protected animal species are those that cannot be hunted, captured, or possessed at any time. State-protected plant species include: "any tree, shrub, plant, fern, wildflower, cacti, desert or montane flora, or any seeds, roots, or bulbs or either or any of the foregoing; all cacti, yucca, and evergreen trees; and of any flora declared endangered by the state forester fire-warden." These cannot be removed or destroyed without permission from any private, state, or federal lands (Nevada Revised Statutes, 1973, Sections 527.050 and 527.070).

Game animals and furbearers may be hunted or captured during specified seasons in specified ways, or only in certain regions. All other animal species have no protection under state laws. The term "species of special concern" was coined (NNNPS, 1980) to include rare plant species that cannot be regarded as either endangered or threatened but which, because of their rarity, limited range, or uncertain future, must be considered in planning. Species that are recommended to be delisted consist of species that were erroneously listed in the first place and are not known to occur in Nevada or Utah; species that are no longer considered to be valid; or species that have been found to be more abundant and widespread since their original listing and are now considered not to warrant sensitive status (NNNPS, 1980; Welsh and Thorne, 1979).

Numerous protected aquatic species occur in the Nevada/Utah study area. These are primarily fish that had once been more widespread in the vast freshwater lakes (e.g., Lake Bonneville, Lake Lahontan) but that are now confined to isolated spring-fed habitats in the valleys. In the thousands of years since the lakes began drying, populations of these fish have evolved in isolation and have adapted to the peculiar set of conditions of the habitat in which they became isolated. As a result, from valley to valley, fish from the same ancestral stock possess unique characteristics of appearance and sets of physiological adaptations. Similarly, numerous rare plant species, candidates for state and federal protection, occur in the Nevada/Utah study area. Many of these are restricted to the high mountaintops which form evolutionary islands in much the same way as the springs in the valleys. The candidate protected plant species occurring in the valleys commonly are found only in limited, discrete habitat types, such as a patch of unusual soil, where they may be abundant. Most large game animals and furbearers in or near the project are protected, with controlled hunting and trapping allowed. Some birds, small mammals, and reptiles are also protected.

The analogous classifications for Texas are endangered and protected non-game, and for New Mexico, Group I and Group II. Many species not federally listed fall into these categories because of their local abundances, regardless of their commonness outside the state in question. The New Mexico list contains about 105 species, the Texas list about 130; Texas has more rare species than New Mexico because of its size and habitat diversity, but New Mexico's legal interpretation of endangerment is broader. Consequently, the number of species in the High Plains, protected by New Mexico, is greater than the Texas counterpart.

In the Texas/New Mexico study area, the landscape is a relatively homogeneous portion of a large, more-or-less continuous area, the Great Plains. As a result of the lack of isolation and the relative uniformity of the habitat, there is less intrinsic rarity of species than in Nevada and Utah. There are no protected plant species in the study area and the only protected fish occur in rivers or other habitats that are peripheral to the study area. The federally protected black-footed ferret may still reside in or near the project area, and three federally protected birds casually visit the area. All other nearby protected fauna, except for the federally protected Pecos gambusia, are state protected, mostly by New Mexico.

2.0 PROTECTED SPECIES - NEVADA/UTAH

2.1 PLANTS

Numerous species of rare plants have been considered for protection under federal and state endangered species legislation in Nevada and western Utah. Several species in Utah have already been federally listed for protection under the Endangered Species Act of 1973. Three of these endangered species--the purple-spined hedgehog cactus (Echinocereus engelmanii var. purpureus), the Siler pincushion cactus (Pediocactus sileri), and the dwarf bear poppy (Arctomecon humilis), occur in southwestern Utah near the study area. No plant species has yet been federally listed in Nevada. There are nine rare plant species in the Nevada/Utah study area for which the U.S. Fish and Wildlife Service is preparing a rulemaking package. These species have a high probability of being listed for protection (USFWS, 1980). Eighteen rare plant species in Nevada have been listed for protection by the Nevada Forestry Division under NRS 527.270, and most of these are likely to be directly or indirectly affected by the project. In addition, all species of the family Cactaceae and the genus Yucca and all evergreen trees are protected under NRS 527.050 and NRS 527.070. Utah has no state laws which afford protection to rare plants.

Under the Endangered Species Act of 1973, preliminary lists of endangered and threatened plant species were published in the Federal Register (FR:40:127: July 1, 1975, and FR:41:117: June 16, 1976). The 1975 list was a notice of review and species included on it and not subsequently proposed or listed have been generally referred to as "candidate" threatened or endangered species. Species included on the 1976 list of 1,700 proposed endangered species have been generally referred to as "proposed" species. Both lists were screened to determine those species which are known to occur in or near the study areas in Nevada and Utah, and more than 200 such species were identified. Recent changes in the Endangered Species Act (the amendments of 1978) have resulted in withdrawal of the 1976 proposals as of 10 November, 1979. A new notice of review is scheduled to be published in the Federal Register in September/October of this year (1980) which substantially reduces, for various reasons, the number of species under consideration. This notice of review will list rare species for which proposals are anticipated. Currently, rare plants are being reviewed on a case-by-case basis by federal and state authorities, and many species are likely to be elevated to formal protection under state or federal laws prior to commencement of M-X construction. Rare plant lists for Nevada and Utah have recently been reviewed by local authorities (NNNPS, 1980; Welsh and Thorne, 1979), and several species on their list of recommendations have either been added, delisted, or their status changed to more accurately reflect existing population trends.

The geographical area covered in this inventory has been made larger than the potential project area to include areas that might be indirectly affected. The list of species under consideration in this area will be updated periodically as the legal status of species changes and/or more species are determined to require protection.

Knowledge of the distributions and ecological status of rare plants is limited, and information from a wide variety of sources had to be located and synthesized. Appendix I lists all rare plants for Nevada and western Utah, their status, and a summary of the distribution and habitat information available at the present time. Figure 2.1-1 shows locations where collections of these plants have been made and

RARE PLANTS LEGEND

NUMBER	SPECIES
1	*Agave utabensis* var. *eborispina*
3	*Angelica scabrida*
4	*Antennaria arcuata*
5	*A. soliceps*
6	*Arabis dispar*
8	*Arctomecon californica*
9	*A. bumilis*
10	*A. merriamii*
11	*Arenaria kingii* var. *rosea*
12	*A. stenomeres*
14	*Asclepias eastwoodiana*
15	*Astragalus aequalis*
16	*A. alvordensis*
17	*A. ampullarius*
18	*A. beatleyae*
19	*A. callitbrix*
20	*A. calycosus* var. *monopbyllidius*
21	*A. convallarius* var. *finitimus*
22	*A. funerus*
23	*A. geyeri* var. *triquetrus*
24	*A. lancearius*
25	*A. lentiginosus* var. *latus*
26	*A. l.* var. *micans*
27	*A. l.* var. *sesquimetralis*
28	*A. l.* var. *ursinus*
29	*A. limnocharis*
30	*A. mohavensis* var. *hemigyrus*
31	*A. musimonum*
32	*A. nyensis*
33	*A. perianus*
34	*A. oophorus* var. *clokeyanus*
35	*A. o.* var. *lonchocalyx*
36	*A. phoenix*
37	*A. porrectus*
38	*A. pseudiodanthus*
39	*A. pterocarpus*
39a	*A. robbinsii* var. *occidentalis*
40	*A. serenoi* var. *sordescens*
41	*A. solitarius*
42	*A. striatiflorus*
43	*A. tephrodes* var. *eurylobus*
44	*A. toquimanus*
45	*A. uncialis*
48	*Calochortus striatus*
49	*C. sp. (Ash Meadows)*
50	*Camissonia megalantha*
51	*C. nevadensis*
53	*Castilleja parvula*
54	*C. salsuginosa*
55	*Centaurium namophilum*
56	*Cirsium clokeyi*
57	*Cordylanthus tecopensis*
58	*Coryphantha vivpara* var. *rosea*
59	*Cryptantha compacta*
60	*C. hoffmanni*
61	*C. insolita*
62	*C. interrupta*
63	*C. tumulosa*
64	*Cuscuta warneri*
65	*C. basalticus*
67	*Cymopterus coulteri*
68	*C. minimus*
69	*C. nivalis*
71	*C. goodrichii*
72	*Dalea kingii*
73	*Draba arida*
74	*D. asperella* var. *zionis*
75	*D. asterophora* var. *asterophora*
76	*D. crassifolia* var. *nevadensis*
78	*D. jaegeri*
79	*D. paucifructa*
79a	*D. sobolifera*
80	*D. sphaeroides* var. *cusickii*
81	*D. stenoloba* var. *ramosa*
82	*D. subalpina*
83	*Echinocereus engelmannii* var. *purpureus*
84	*Elodea nevadensis*
85	*Enceliopsis nudicaulis* var. *corrugata*
87	*Epilobium nevadense*
88	*Erigeron latus*
89	*E. ovinus*
90	*E. proselyticus*
91	*E. religiosus*
92	*E. uncialis* var. *conjugans*
93	*Eriogonum ammophilum*
94	*E. anemophilum*
95	*E. argophyllum*
95a	*E. beatleyae*
96	*E. bifurcatum*
98	*E. corymbosum* var. *matthewsiae*
99	*E. darrovii*
100	*E. eremicum*
101	*E. holmgrenii*
102	*E. jamesii* var. *rupicola*
103	*E. lemmonii*
104	*E. lobbii* var. *robustius*
105	*E. natum*
105a	*E. nummulare*
106	*E. ostlundii*
109	*E. panguicense* var. *alpestre*
110	*E. rubricaule*
111	*E. thompsonae* var. *albiflorum*
112	*E. viscidulum*
113	*E. zion* var. *zionis*
115	*Forsellesia pungens*
116	*Frasera gypsicola*
117	*F. pahutensis*
118	*Fraxinus cuspidata* var. *macropetala*
119	*Galium hilendiae* ssp. *kingstonense*
120	*Geranium toquimense*
121	*Gilia nyensis*
122	*G. ripleyi*
123	*Grindelia fraxino-pratensis*
124	*Hackelia ophiobia*
125	*H. alpinus*
128	*H. watsoni*
129	*Helianthus deserticolus*
130	*Heuchera duranii*
132	*Hymenopappus filifolius* var. *tomentosus*
133	*Ivesia cryptocaulis*
134	*I. eremica*
135	*Lathyrus hitchcockianus*
136	*Lepidium nanum*
136a	*L. ostleri*
137	*Lesquerella hitchcockii*
138	*Lewisia maguirei*
140	*Lomatium ravenii*
142	*Lupinus ionesii*
143	*L. malacophyllus*
144	*L. montigenus*
145	*Machaeranthera grindelioides* var. *depressa*
146	*M. leucanthemifolia*
147	*Mentzelia leucophylla*
148	*Mertensia toiyabensis*
149	*Mimulus washoensis*
150	*Mirabilis pudica*
151	*Opuntia pulcbella*
152	*O. whipplei* var. *multigeniculata*
153	*Oryctes nevadensis*
154	*Oxytheca watsonii*
155	*Pediocactus sileri*
156	*Penstemon arenarius*
157	*P. bicolor* spp. *bicolor*
158	*P.b.* spp. *roseus*
159	*P. concinnus*
160	*P. francisci-pennellii*
161	*P. fruticiformis* spp. *amargosae*
162	*P. bumilis* var. *obtusifolius*
163	*P. keckii*
165	*P. nanus*
166	*P. pabutensis*
167	*P. procerus* var. *modestus*
168	*P. pudicus*
169	*P. rubicundus*
170	*P. tbompsoniae* spp *jaegeri*
171	*P. tburberi* var. *anestius*
172	*P. tidestromii*
173	*P. wardii*
173a	*P. sp. (Deep Creek Mtns.)*
174	*Perityle megalocepbala* var. *intricata*
175	*Peteria thompsonae*
176	*Pbacelia anelsonii*
176a	*P. argillaceae*
177	*P. beatleyae*
178	*P. cepbalotes*
179	*P. glaberrima*
180	*P. inconspicua*
183	*P. parisbii*
184	*Pblox gladiformis*
186	*Polygala subspinosa* var. *beterorbyncba*
187	*Primula capillaris*
188	*P. nevadensis*
189	*Rorippa subumbellata*
190	*Salvia funerea*
191	*Sclerocactus polyancistrus*
192	*S. pubispinus*
193	*Selaginella utabensis*
195	*Silene clokeyi*
196	*S. petersonii* var. *minor*
197	*S. scaposa* var. *lobata*
198	*Smelowskia bolmgrenii*
199	*Spbaeralcea caespitosa*
200	*Spbaeromeria compacta*
201	*S. rutbiae*
202	*Streptantbus oligantbus*
203	*Syntbyris ranunculina*
204	*Tbelypodium laxiflorum*
205	*T. sagittatum* var. *ovalifolium*
206	*Townsendia jonesii* var. *tumulosa*
207	*Trifolium andersonii* spp *beatleyae*
207a	*T. a.* var. *friscanum*
208	*T. lemmonii*
209	*Viola purpurea* var. *cbarlestonensis*
214	*Cymopterus newberryi*
216	*Ditaxis diversiflora*
219a	*Haplopappus abberans*
230	*Polemonium nevadensae*

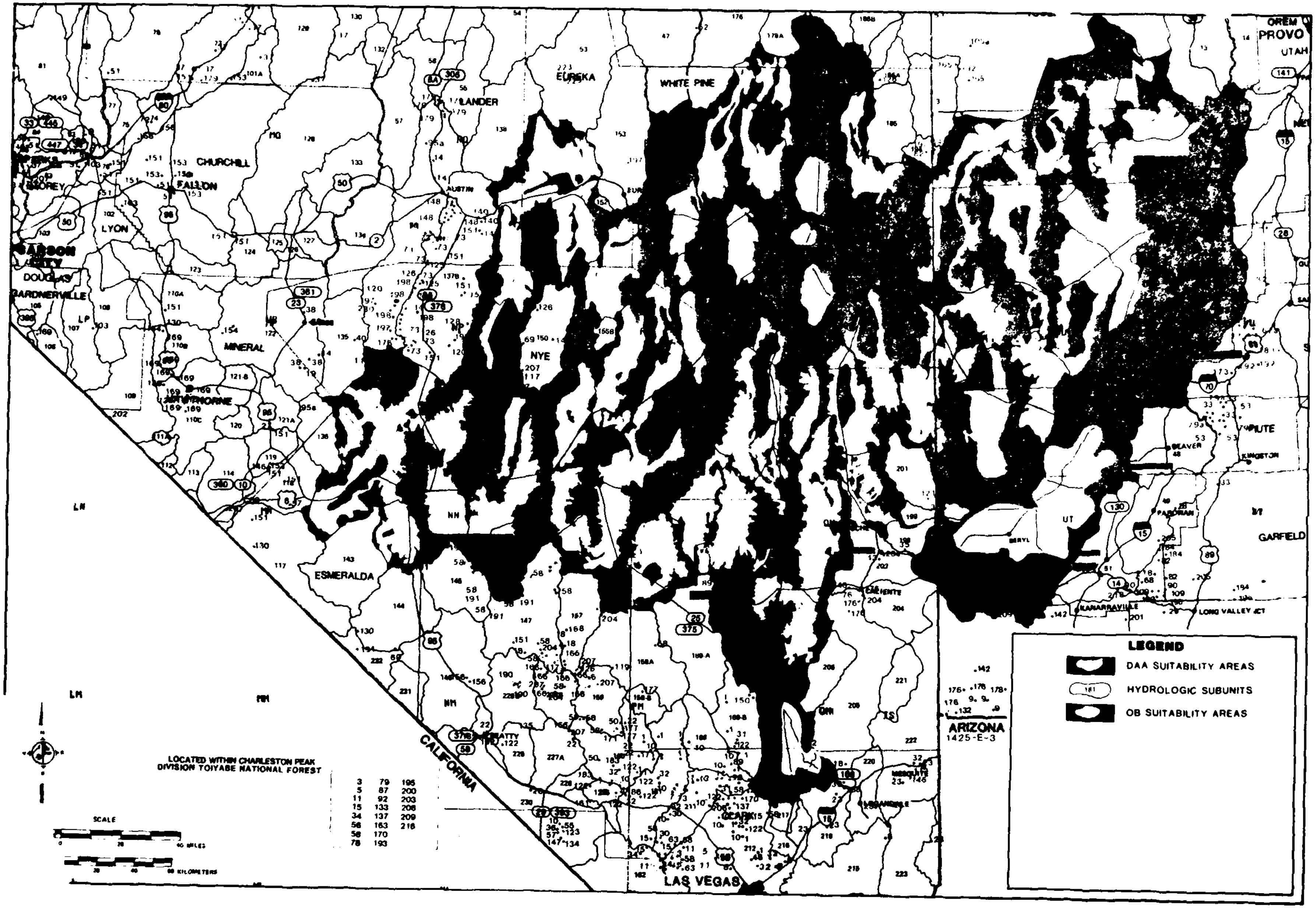

Figure 2.1-1. Location of rare plants in Nevada/Utah.

outlines the general project area and hydrologic subunit (HSU) boundaries. The hydrologic subunit will be used as the unit for impact analysis. Appendix II lists the rare plant species found in each hydrologic subunit in the project area. The information is based on existing literature, herbarium searches, and limited field inventories contracted out by the Bureau of Land Management, U.S. Forest Service, and other agencies. In addition, local authorities such as the Northern Nevada Native Plant Society, the Nevada State Museum, and experts from local universities such as Dr. Stanley Welsh of BYU were also contacted.

Many rare plants in Nevada and Utah are geographic endemics. That is, they are restricted in their occurrence to small geographic areas. Surrounding Charleston Peak in the Spring Mountains, and within the Toiyabe National Forest, for instance, is a region where many species not found anywhere else in the world grow. Examples of such species are: Charleston angelica (Angelica scabrida), Charleston pussytoes (Antennaria soliceps), Clokey milkvetch (Astragalus aequalis), Lee Canyon milkvetch (Astragalus oophorus var. clokeyanus), Charleston and Jaeger drabas (Draba paucifructa and D. jaegeri), Charleston ivesia (Ivesia cryptocaulis), and Charleston tansy (Sphaeromeria compacta). In the Ash Meadows area, endemic plants include: Ash Meadows blazing star (Mentzelia leucophylla), Ash Meadows ivesia (Ivesiay eremica), Ash Meadows gumweed (Grindeliay fraxino-pratensis), Ash Meadows sunray (Enceliopsis nudicaulis var. corrugata), and Ash Meadows milkvetch (Astragalus phoenix). Endemic to the Nevada Test Site and vicinity are Beatley milkvetch (Astragalus beatleyae), Beatley five-leaf clover (Trifolium andersonii var. beatleyae), Pahute green gentian (Frasera pahutensis), and Beatley scorpionweed (Phacelia beatleyae).

These particular areas are out of the DDA as shown in Figure 2.1-1 and will not be directly affected. One narrow endemic occurs within geotechnically suitable area this species is the Sunnyside green gentian (Frasera gypsicola), known only from the Sunnyside Wildlife Management Area in White River Valley (HSU #207). Other endemics include the steno sandwort (Arenaria stenomeres), known from only a few locations in Coyote Springs Valley, the squalid milkvetch (Astragalus serenoi var. sordescens), Toquima milkvetch (A. toquimanus), Toquima geranium (Geranium toquimense), and Holmgren smelowskia (Smelowskia holmgrenii), all known only from the Toquima Range. The newly discovered Goodrich cymopterus (Cymopterus goodrichii), and the Toiyabe Mountain bluebell (Mertensia toiyabensis), known only from the Toiyabe Mountains, and the only known population of the Monte Neva paintbrush (Castilleja salsuginosa), from Monte Neva Hot Springs in Steptoe Valley (HSU #179) are also endemics. Other areas with endemic plant species include Zion National Park and Cedar Breaks National Monument in Utah, and the Snake Range and Ruby Mountains in Nevada.

In general, rare plants in Nevada and Utah are adapted to narrow edaphic (soil) situations, habitat, and elevational ranges. As a result, they may be divided into two general categories--those that are likely to be directly affected by widespread surface disruption during project construction of roads, protective structures, and other facilities; and those that may be indirectly affected by activities of project-related M-X personnel. Approximately 80 species fall in the first category. These usually occur on valley floors and the alluvial fans or bajadas on a wide variety of substrate types. Table 2.1-1 lists these types and some species found on them.

Species that occur in the mountains adjacent to potential deployment valleys or in popular recreation areas nearby, such as Zion National Park and Cedar Breaks National Monument, could be indirectly affected.

Table 2.1-1. Substrate types and rare plants which often occur on them. (Page 1 of 2)

Species which occur near thermal springs, seeps
Castilleja salsuginosa *Centaurium namophilum* *Cymopterus basalticus* *Eriogonum argophyllum*
Species which occur in sandy washes and on flats—Mojave Desert Region
Astragalus geyeri var. *triquetrus* *A. nyensis* *Penstemon fructiciformis* var. *amargosae* *Phacelia anelsonii*
Species which occur on sand dunes and deep sandy soils
Astragalus callithrix *A. lentiginosus* var. *micans* *A. pseudiodanthus* *Cymopterus ripleyi* *Eriogonum ammophilum* *E. concinnum* *Helianthus deserticolus* *Penstemon arenarius* *Thelypodium laxiflorum*
Species which occur on limestone, Sevy dolomite or gypsum (valley floors)
Arabis shockleyi *Asclepias eastwoodiana* *Astragalus pterocarpus* *A. uncialis* *Coryphantha vivipara* *Cryptantha compacta* *Eriogonum eremicum* *E. nummulare* *E. rubricaule* *Frasera gypsicola* *Lepidium nanum* *Phacelia parishii* *Polygala subspinosa* var. *heterorhyncha* *Sclerocactus polyancistrus* *S. pubispinus*

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Table 2.1-1. Substrate types and rare plants which often occur on them. (Page 2 of 2)

Species which occur on outcrops, ridges and cliffs *Agave utahensis* var. *eborispina* *Arctomecon merriamii* *Arenaria stenomeres* *Gilia ripleyi*
Species known from bajadas of limestone mountains, with sagebrush, pinyon pines or junipers *Astragalus calycosus* var. *monophyllidius* *A. convallarius* var. *finitimus* *A. oophorus* var. *lonchocalyx* *Coryphantha vivipara* var. *rosea* *Cryptantha hoffmanii* *C. interrupta* *Eriogonum darrovii* *E. nummulare* *Hulsea vestita* var. *inyoensis* *Lupinus holmgrenanus*
Species known from Sevy dolomite in pinyon-juniper woodland (Pine, Hamlin, Wah Wah Valleys) *Cryptantha compacta* *Eriogonum eremicum* *E. natum* *Penstemon concinnus* *P. nanus* *Sphaeralcea caespitosa*
Species which occur in mountainous areas *Astragalus lentiginosus* var. *latus* *Eriogonum natum* *Frasera pahutensis* *Gilia nyensis* *Lewisia maguirei* *Lomatium ravenii*

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There is a dearth of information on the ecological status and distributions of many rare plants in Nevada and Utah. Fairly complete literature and herbarium searches have been conducted; emphasis is now being placed on comprehensive field inventories as rather detailed knowledge of these species is necessary to predict potential impacts and design mitigation strategies. Therefore, accelerated area-wide field searches for rare plants were conducted during the growing season of 1980. The five areas selected for study are shown in Figure 2.1-2. The criteria for selecting these areas were (1) the area had known localities of rare plants, (2) it was a potential site for M-X facilities, or (3) no comprehensive botanical study had been conducted in the area. It is likely that some species once thought to be rare will be found to be common and abundant. This technical report will be updated as the results from these studies become available.

2.2 Wildlife

Terrestrial animal species protected by law include threatened and endangered species and feral horses and burros.

The threatened and endangered species occurring in the study area are listed in Table 2.2-1 and their distributions are shown in Figure 2.2-1. Threatened and endangered species receive special treatment because they have shown recent, steep declines in abundance and their present rarity is in all cases due mostly to human activities.

Three federally listed terrestrial species in the study area are classified as endangered and include the bald eagle (Haliaeetus leucocephalus), peregrine falcon (Falco peregrinus anatum), and Utah prairie dog (Cynomys parvidens). The desert tortoise (Gopherus agassizi) population on the Beaver Dam Slope in southwestern Utah is federally listed as threatened and those in Nevada are protected by the state. The gila monster (Heloderma suspectum) and the spotted bat (Euderma maculatum) are also protected by the state of Nevada. The state-listed species are all given a status analogous to the federal classification of threatened.

The bald eagle winters in desert valleys in western Utah and eastern Nevada and along major waterways in both states. The study area supports about 250-350 birds in Utah and perhaps 20-30 (the actual number is unknown) in Nevada (Wagner, 1979; Herron, 1979). Rush Valley, Utah, in the northeast corner of the study area, contains up to 200 birds each winter and is thus a major wintering area (Wagner, 1979). The bald eagle feeds on jackrabbits in desert shrubland and also on fish and waterfowl along rivers and lakes. Eagles roost, often in groups, in tall trees in canyons and in planted groves in open valleys (Edwards, 1969). The species is endangered with extinction principally because of habitat loss due to development, pesticide poisoning, and shooting.

The peregrine falcon is a spring and fall migrant through the study area, occurring in very small numbers. A few pairs have bred in the mountains of western Utah, principally in the Wasatch Front, within the past 20 years (Porter and White, 1973). Intensive searches may turn up other pairs in their preferred nesting habitat of cliffs near permanent water courses. The species feeds in open country on smaller birds, especially waterfowl and shorebirds. Its decline in numbers is attributed largely to pesticide contamination of the food chain, illegal capture by falconers, and general human disturbance.

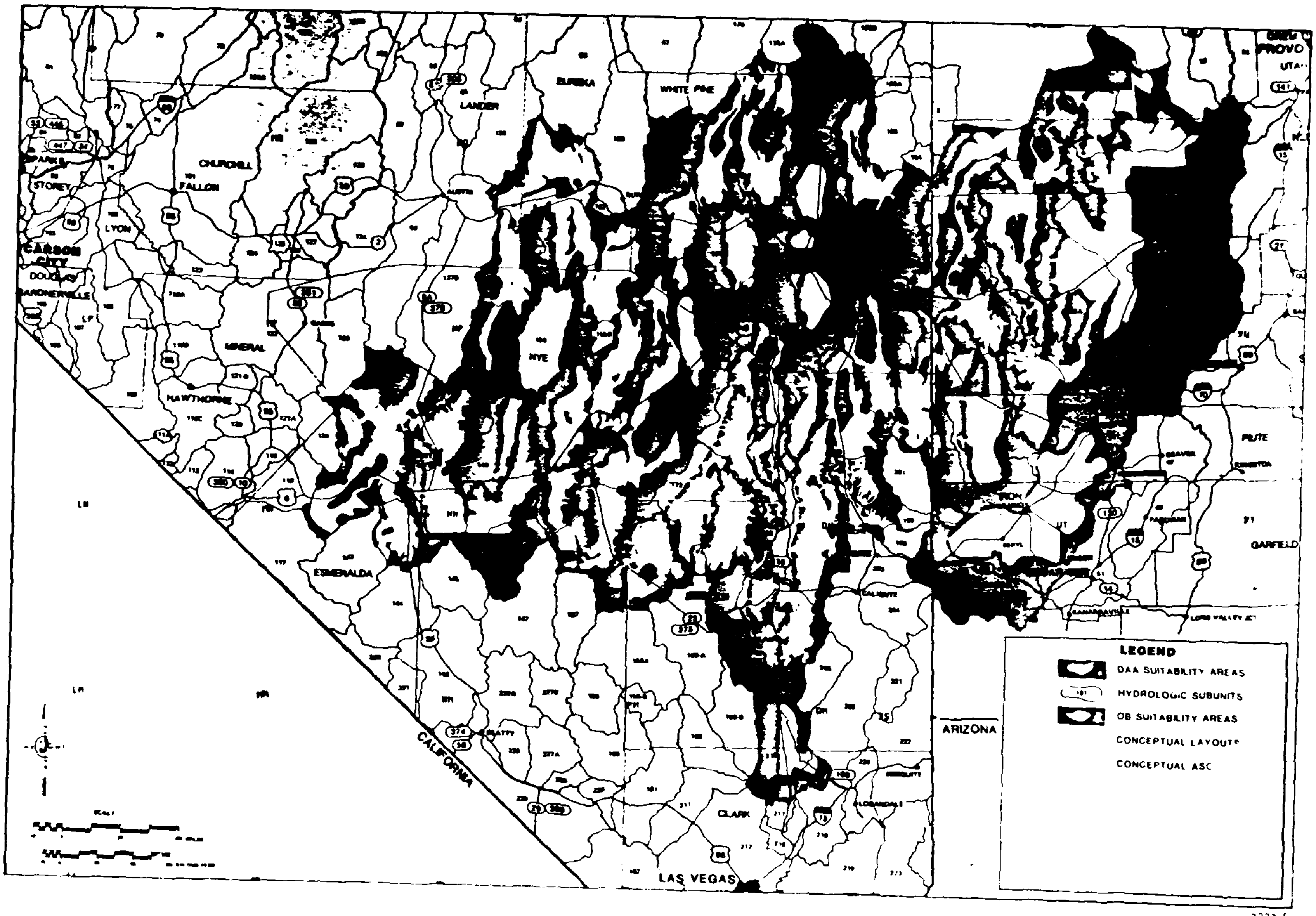

Figure 2.1-2. Hydrologic subunits within the study area chosen for further rare plant research.

Table 2.2-1. Threatened and endangered terrestrial wildlife species of the Nevada/Utah study area.

SPECIES		STATUS[1]	
COMMON NAME	SCIENTIFIC NAME	FEDERAL	STATE
Bald eagle	*Haliaeetus leucocephalus*	E	E
Peregrine falcon	*Falco peregrinus anatum*	E	E
Utah prairie dog	*Cynomys parvidens*	E	E (UT)
Desert tortoise	*Gopherus agasizzi*	T*	T (NV, UT)
Gila monster	*Heloderma suspectum*		T (NV, UT)
Spotted bat	*Euderma maculatum*		T (NV)

073-1

[1]E = endangered; T = threatened.

* = population on the Beaver Dam slope in southwestern Utah.

THREATENED AND ENDANGERED WILDLIFE SPECIES

LEGEND

- BALD EAGLE WINTERING AREA (ESTIMATED)
- BALD EAGLE KNOWN ROOST SITE
- DESERT TORTOISE RANGE
- DESERT TORTOISE CRITICAL HABITAT
- GILA MONSTER RANGE
- PEREGRINE FALCON: REGION CONTAINING ACTIVE NESTS SINCE 1960
- GUILIANI'S DUNE SCARAB BEETLE RANGE
- SPOTTED BAT SIGHTING
- UTAH PRARIE DOG RANGE

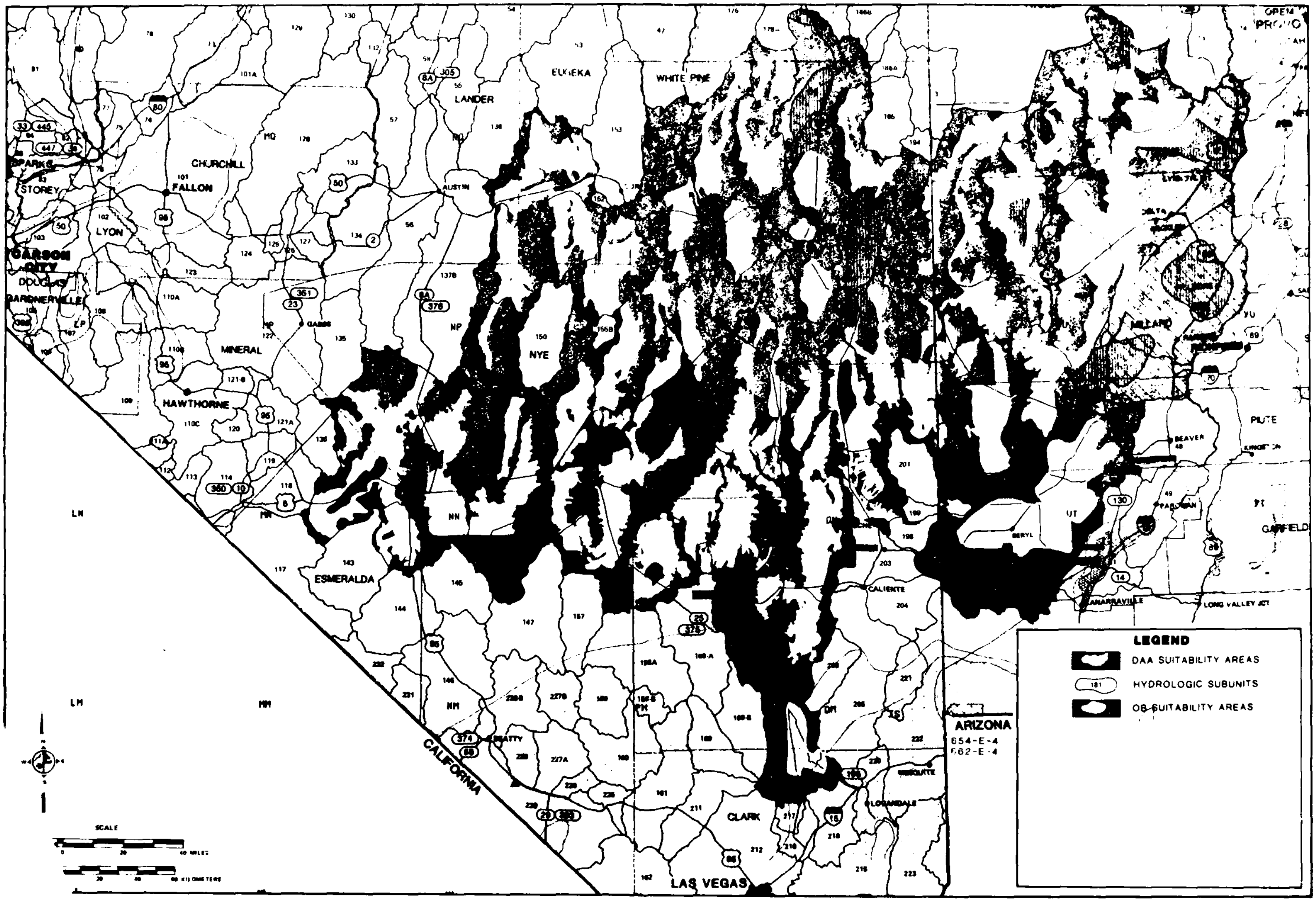

Figure 2.2-1. Threatened and endangered wildlife species.

The Utah prairie dog occurs in the study area in prairie grasslands in Beaver and Iron counties, at the western edge of its range (Hasenyager, 1979). It prefers wet meadows and hay fields which provide green forage and, thus, needed moisture throughout the active season. The species is endangered because of intensive trapping and poisoning by ranchers (Pizzimenti and Collier, 1975).

The desert tortoise reaches its northern range limit at the southern edge of the study area in Lincoln and Nye counties, Nevada, and on the Beaver Dam slope in extreme southwestern Utah (Herron and Lucas, 1979). It is at home in creosote-bush scrub at elevations below 4,000 ft (1,220 m). The tortoise is a slow moving herbivore, and its threatened status has come about partly from competition with and habitat degradation from cattle and sheep, and partly from being hit by cars, captured by people for pets, or shot.

The gila monster, like the tortoise, reaches its northern range limit at the southern border of the study area, living in arroyos in the creosote bush zone (Bradley and Deacon, 1966). It is a slow moving, partially nocturnal predator, eating birds' eggs and small animals. Its rarity has resulted largely from its collection as a pet and from shooting.

The abundance and distribution of the spotted bat is poorly known. It is nocturnal, eats insects, and roosts among cliffs, rock outcrops, and sometimes in buildings. Since it is known from only a few locations in Nevada and Utah, it is impossible to determine population trends or the reasons for its rarity.

Horses were native to this continent but became extinct during Pleistocene glaciation about 15,000 years ago. Those present in the West today result from introductions by European man, the earliest introduction being from the Spaniards in the early 1500s (Brandon, 1972). Burros, on the other hand, were never native to North America. Feral burros in the West resulted from mining activities in the 1800s. When mining began to decline in the late 19th century, many of these animals were abandoned (O'Farrell, 1978).

Wild horses and burros are now protected under Public Law 92-195, the Wild Free-Roaming Horse and Burro Act of 1971. Under this act, the Bureau of Land Management (BLM) and Forest Service (USFS) are charged with managing and protecting these animals. With protection, wild horse and burro populations began increasing at a rapid rate. BLM estimated 17,000 horses and burros on public lands in 1971 when the Act was passed. By 1974, the numbers estimated by BLM and the Forest Service had increased to 44,000 horses and 14,000 burros. The estimate for wild horses in 1976 was 50,000 animals. Most of the wild horses are found in Nevada while feral burros are concentrated in California and Arizona (Godfrey, 1979). In Nevada, the rapidly increasing population of wild horses is becoming a problem, and Attorney General Richard Bryan has filed a federal court suit to force the BLM and USFS to better manage these animals (Las Vegas Sun, 28 August, 1979). Burros are also considered a problem in many areas by land and wildlife management agencies. These animals are very adaptive and can out-compete all native species. In some areas of Nevada, they are in direct competition with bighorn sheep and tend to drive the sheep out of their natural habitat (Zarn et al., 1977). The present distribution of wild horses and burros in Nevada and western Utah is shown in Figure 2.2-2 and herd size estimates and dates of surveys are also shown.

2.3 Aquatic Species

The fish and invertebrates of the western freshwater habitats are characterized by a large variety of unique forms (Minckley and Deacon, 1968; Hubbs, Miller, and Hubbs, 1974). This resulted from the series of climatic and geological events leading to increased isolation of aquatic habitats occurring within the Great Basin. A great shallow sea once existed between two north-south oriented mountain ranges near what is now the California coast and the Appalachians. Then, a broad plain arose and separated the western mountains from the receding seas of what is now Utah and Colorado. The formation of the Rockies shifted the Continental Divide from western Nevada to about its present location. The low mountains of the West did not inhibit moist Pacific air from creating a tropical climate in what is now a desert. During the Oligocene, the now westward flowing rivers formed and eroded the land. A cooling trend accompanied by minor mountain building in the Miocene, produced boreal evergreen forests throughout the Great Basin. Volcanic activity along the western mountains diverted rivers into what are now the Colorado and Columbia drainages. Renewed mountain building in the early Pleistocene raised the Rocky, Sierra, and Basin ranges to their present elevations. Later, four Pleistocene glacial periods scoured valleys and provided water for enclosed basins. During the long interglacial periods, lakes were formed and often overflowed as did the pluvial Lake Bonneville into the Snake drainage. The last glacial period, which ended about 10,000 to 12,000 years ago, produced two major pluvial (rainy) periods in the Lahontan and Bonneville basins. One of these pluvial periods occurred about 22,000 years ago and the other some 10,000 years ago. Since the last glacial period, desiccation of the great pluvial lakes has created islands of endemism, which facilitated speciation of aquatic biota. Some present-day aquatic habitats, thus, have been separated by as little as 10,000 years whereas others have been separated by 20,000 or more years (Deevy, in Berwick, 1966; Hubbs and Miller, 1948). This apparently allowed enough time for natural selection, isolation, and environmental pressures to create a wide variety of unique aquatic taxa from common ancestors. Nowhere else have the processes of genetic drift and resulting reproductive isolation been so evident. The unique aquatic biota occurring therein are remnants of the once vast fishery and aquatic food web (Pister, 1974; Deacon and Minckley, 1974). Their diversity, occurrence, or even uniqueness have yet to be fully studied in most locations, and they warrant protection as unique biota (Williams and Finnley, 1977).

In central Nevada and western Utah a number of native aquatic species are protected by federal or state laws and have been recommended for protection (Table 2.3-1). Although eight federally protected fish occur in the two-state area, only four of these are found in or near the potential deployment area. These sensitive fish are the Pahranagat roundtail chub which inhabits the Ash Spring outflow in Pahranagat Valley, the Pahrump killifish in the Shoshone Ponds Refugium in Spring Valley, the Moapa dace in the Moapa Fish Sanctuary (near the southern boundary of the potential deployment area), the Lahontan cutthroat trout which inhabits the upper Reese River near Austin. Hybrids of Lahontan and Humboldt cutthroat trout occur in various montane drainages along the Humboldt River (Figure 2.3-1). The Lahontan cutthroat trout is classified as a game fish in Nevada and, therefore, is subject to sportsfishing. Twenty-three fish are protected by either the state of Nevada or Utah including all those on the federal list except for the Lahontan cutthroat trout. Twelve of these, that are not federally protected occur in or near project boundaries. Five of the state-protected fish in Nevada are subspecies of the White River springfish. Recent taxonomic studies indicate that at least five distinct subspecies of this fish occur throughout the White River, Pahranagat, and Moapa valleys.

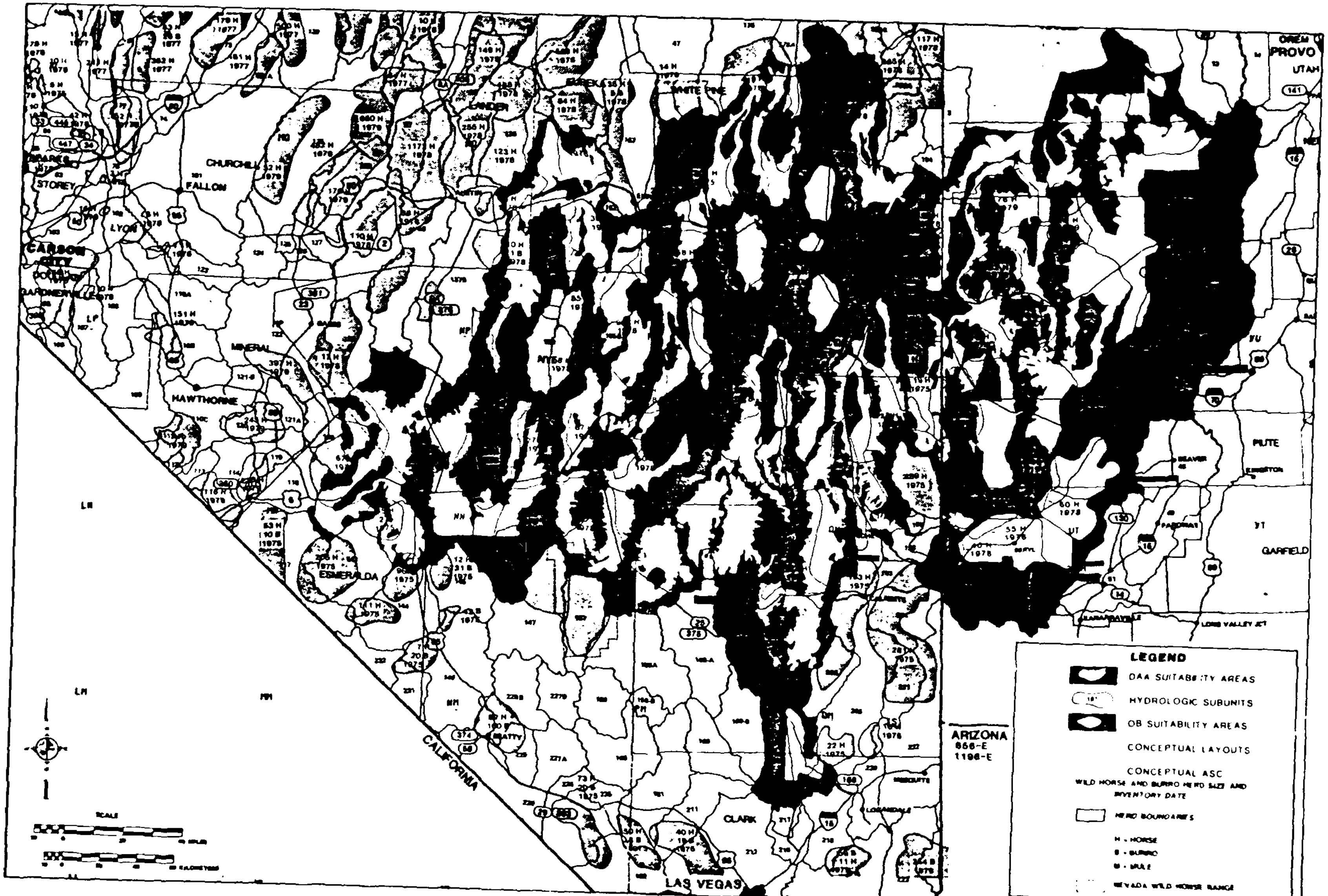

Figure 2.2-2. Wild horse and burro herd size and inventory date.

As can be seen in Table 2.3-1, the legal status of several species differs between federal and the state classification. For instance, both the Pahrump killifish and the Moapa dace are classified as endangered by the federal government but as threatened by the state of Nevada. The federal and state classifications are in agreement, however, for the Devil's Hole pupfish, Pahranagat roundtail chub, and cui-ui. As pointed out previously, the Lahontan cutthroat trout, although protected as threatened by the federal government, is afforded no legal protection by the state of Nevada except as a game fish.

Many other fish and invertebrates that currently are not protected by either federal or state law are recommended for protection by at least one authoritative source (Table 2.3-1). Any or all of these species could receive legal protection in the future. These include 11 fish recommended for protection, at least at the threatened level, and 22 invertebrates considered either threatened or endangered. There is little agreement between the recommended classifications for many fish and that already afforded by either state or federal law. Fish already legally protected, the recommended classification is more stringent than the legal one, as is the case with the Virgin River roundtail chub and the White River springfish. In other instances, the recommended status is downgraded from the official classification as a result of recent findings: this is the case for the relict dace, June sucker, and Utah or Snake Valley cutthroat trout.

For several of the fish, no consensus has been reached on the level of protection that is recommended by two different authorities. This is partly the result of more recent data upon which to base these recommendations. Fish whose recommended status has recently been upgraded include the White River springfish, Independence Valley tui chub, Newark Valley tui chub, Lahontan tui chub, White River spinedace, and possibly the relict dace. Those fish whose recommended classification has recently been downgraded as result of new findings include most of the White River springfish subspecies, the Moapa speckled dace, the Fish Creek Spring tui chub, the Virgin River roundtail chub, and the White River desert sucker. Besides the subspecies of the White River springfish that have been recently described and assigned recommended status, the only other fish recommended for protection (that has not been previously recommended) is the White River speckled dace, which is recommended as either threatened or endangered.

Among the invertebrates, those species whose populations are considered to be most sensitive include the Ash Meadows turban, Hot Creek turban (located in the lower White River Valley), Overton assiminea, White River Valley fontelicella, White River Valley hydrobiid, Ash Meadows tryonia, and Zion Canyon physa. All these invertebrates (snails) are recommended for protection as endangered. The remaining invertebrates recommended for protection need to be studied in more detail, not only with respect to their distribution but also to their taxonomy. Many of these invertebrates are new species and some are even new genera. Most are considered to be highly endemic and should be considered, at least, threatened. Although these invertebrates are not as well known as fish inhabiting some of the same habitats, many are unique and as worthy of conservation as protected fish.

Little is known about the feeding or spawning habitats of protected species (fish or invertebrates) in either Nevada or Utah. Recent studies, however, have increased the knowledge of habitat requirements and behavior for some species. This information is necessary for assessing the effects of livestock use, agricultural development, mining operations, recreational use, and, potentially, the construction and operation of the M-X project. It is also useful for developing mitigation

Table 2.3-1. Summary of the legal status of protected and recommended protected fish and invertebrates in the Nevada/Utah study area. (Page 1 of 2)

COMMON NAME	SCIENTIFIC NAME	PRESENT CLASSIFICATION		RECOMMENDED CLASSIFICATION			MAP SYMBOL
		FEDERAL	STATE	DEACON et al. (1979)	HARDY (1980a)	HARDY (1980b)	
Killifishes (Cyprinodontidae)							
Ash Meadows Amargosa Pupfish	*Cyprinodon nevadensis mionectes*		T	T			A
Devil's Hole Pupfish	*C. diabolis*	E	E	E			H
Warm Springs Amargosa Pupfish	*C. nevadensis pectoralis*	E	T	E			G
Pahrump Killifish	*Empetrichthys latos latos*	E	T	E			N
Railroad Valley Springfish	*Crenichthys nevadae*		T	SC			E
Preston White River Springfish	*C. baileyi albivallis*		T	T	SC/T		L, 1
Mormon White River Springfish	*C. b. thermophilus*		T	T	SC/T		L, 2
Hiko White River Springfish	*C. b. grandis*		T	T	SC/T		L, 3a
White River Springfish	*C. b. baileya*		T	T	E		L, 3
Moapa White River Springfish	*C. b. moapae*		T	T	SC		L, 3b
Minnows (Cyprinidae)							
Ash Meadows Speckled Dace	*Rhinichthys osculus nevadensis*			E	T/E		4
Independence Valley Speckled Dace	*R. o. lethoporus*			E			5
Clover Valley Speckled Dace	*R. o. oligoporus*			E			
Moapa Speckled Dace	*R. o. moapae*			T	T/SC		6
White River Speckled Dace	*R. o. velifer*				T/E		18
Moapa Dace	*Moapa coriacea*	E	T	E			0
Fish Creek Spring Tui Chub	*Gila bicolor euchila*			E	E/T		13
Independence Valley Tui Chub	*G. b. isolata*			T	T/E		11
Newark Valley Tui Chub	*G. b. newarkensis*			SC	SC/T		8
Lahontan Tui Chub	*G. b. obesa*			SC	T/E		9
Pahranagat Roundtail Chub	*G. robusta jordani*	E	E	E			L
Virgin River Roundtail Chub	*G. r. seminuda*		SC[1]	E	T		S
Least Chub	*Iotichthys phlegethonis*		T[1]	T			Q
White River Spinedace	*Lepidomeda albivalis*		T	T	T/E	E	J
Virgin Spinedace	*L. mollispinis mollispinis*		T[1]	T			R
Big Spring Spinedace	*L. m. pratensis*			E			I
Woundfin	*Plagopterus argentissimus*	E	T, E[1]	E	E		T
Relict Dace	*Relictus solitarius*		T	SC	T/SC		C
Suckers (Catostomidae)							
White River Desert Sucker	*Catostomus clarki intermedius*		T	T	SC/T	E	K
June Sucker	*C. liorus*		E[1]	SC			14
Cui-ui	*C. cujus*	E	E	E			B
Trout (Salmonidae)							
Lahontan Cutthroat Trout	*Salmo clarki henshawi*	T		T			P
Utah/Snake Valley Cutthroat Trout	*S. c. utah*		E	T			F
Humboldt/Lahontan Cutthroat Trout	*S. c. ssp.*			SC			17
Sculpin (Cottidae)							
Utah Lake Sculpin	*Cottus echinatus*			E			16

[1]Utah state protected.

720-1

SC = Special Concern

T = Threatened

E = Endangered

Table 2.3-1. Summary of the legal status of protected and recommended protected fish and invertebrates in the Nevada/Utah study area. (Pate 2 of 2).

COMMON NAME	SCIENTIFIC NAME	LANDYE (1980)	HDR (1980)	MAP SYMBOL
Mollusca-Gastropods				
Bulimidae				
Moapa Valley Turban	*"Fluminicola" avernalis*	T		20
Ash Meadows Turban	*"F." erythropoma*	E		21
Pahranagat Valley Turban	*"F." merriami*	T		22
Hot Creek Turban	*"F." n. sp.*	E		23
Steptoe Turban	*"F." nevadensis*	T/E		24
Assimeidae				
Overton assiminea	*Assiminea n. sp.*	E		19
Hydrobiidae				
White River Valley Fontelicella	*Fontelicella n. sp.*	E		25
Ruby Valley Fontelicella	*F. n. sp.*	T/E		26
Current Fontelicella	*F. n. sp.*	T/E		27
Duckwater Fontelicella	*F. n. sp.*	T/E		28
Red Rock Fontelicella	*F. n. sp.*	T/E		29
White River Valley Hydrobiid	*N. gen., n. sp.*	E		30
Duckwater Snail	*N. gen., n. sp.*	T/E		31
Corn Creek Snail	*N. gen., n. sp.*	T/E		32
Ash Meadows Tryonia	*Tryonia n. sp.*	E		33
Moapa Tryonia	*T. clathrata*	T/E		34
Physidae				
Zion Canyon Physa	*Physa zioni*	E		35
Lymnaeidae				
Russell's Snail	*Lymnaea pilsbryi*	T/E		36
Insects				
Dipterans (Blepharoceridae				
Virgin River Net-winged Midge	*Blephariceral zioni*		T/E	37
Hemipterans (Naucoridae)				
Ash Springs Creeping Water Bug	*Pelocoris shoshone*		T/E	38
Moapa Creeping Water Bug	*Usingerina moapensis*		T/E	39
Plecopterans (?)				
Giant Stonefly Nymph	*N. gen., n. sp.*		T/E	40

3518

N = Novum or new

Sp. = Species

gen. = Genus

LEGEND

PROTECTED FISH SPECIES FOR NEVADA AND UTAH

A ASH MEADOWS AMARGOSA PUPFISH
B CUI-UI*
C RELICT DACE
E RAILROAD VALLEY SPRINGFISH
F UTAH OR SNAKE VALLEY CUTTHROAT TROUT
G WARM SPRINGS AMARGOSA PUPFISH*
H DEVIL'S HOLE PUPFISH*
I BIG SPRING SPINEDACE
J WHITE RIVER SPINEDACE
K WHITE RIVER DESERT SUCKER
L WHITE RIVER SPRINGFISH
M PAHRANAGAT ROUNDTAIL CHUB*
N PAHRUMP KILLIFISH*
O MOAPA DACE*
P LAHONTAN CUTTHROAT TROUT*
R VIRGIN SPINEDACE
S VIRGIN RIVER ROUNDTAIL CHUB
T WOUNDFIN*
Q LEAST CHUB

* Federally protected

RECOMMENDED PROTECTED FISH SPECIES FOR NEVADA AND UTAH

1 PRESTON WHITE RIVER SPRINGFISH
2 MORMON WHITE RIVER SPRINGFISH
3 WHITE RIVER SPRINGFISH
3a HIKO WHITE RIVER SPRINGFISH
3b MOAPA WHITE RIVER SPRINGFISH
4 ASH MEADOWS SPECKLED DACE
5 INDEPENDENCE VALLEY SPECKLED DACE
6 CLOVER VALLEY SPECKLED DACE
7 MOAPA SPECKLED DACE
8 NEWARK VALLEY TUI CHUB
9 LAHONTAN TUI CHUB
10 ALVORD CHUB
11 INDEPENDENCE VALLEY CHUB
12 SHELDON TUI CHUB
13 FISH CREEK SPRINGS TUI CHUB
14 JUNE SUCKER
16 UTAH LAKE SCULPIN
17 HUMBOLDT LAHONTAN CUTTHROAT TROUT
18 WHITE RIVER SPECKLED DACE
(F) UTAH OR SNAKE VALLEY CUTTHROAT TROUT
(R) VIRGIN SPINEDACE

RECOMMENDED PROTECTED INVERTEBRATES

MOLLUSCS

19 OVERTON ASSIMINEA
20 MOAPA VALLEY TURBAN
21 ASH MEADOWS TURBAN
22 PAHRANAGAT VALLEY TURBAN
23 HOT CREEK TURBAN
24 STEPTOE TURBAN
25 WHITE RIVER VALLEY FONTELICELLA
26 RUBY VALLEY FONTELICELLA
27 CURRENT FONTELICELLA
28 DUCKWATER FONTELICELLA
29 RED ROCK FONTELICELLA
30 WHITE RIVER VALLEY HYDROBID
31 DUCKWATER SNAIL
32 CORN CREEK SNAIL
33 ASH MEADOWS TRYONIA
34 MOAPA TRYONIA
35 ZION CANYON PHYSA
36 RUSSELL'S SNAIL

INSECTS

DIPTERANS:
37 VIRGIN RIVER NET WINGED MIDGE
HEMIPTERANS:
38 ASH SPRINGS CREEPING WATER BUG
39 MOAPA CREEPING WATER BUG
PLECOPTERANS:
40 GIANT STONEFLY NYMPH

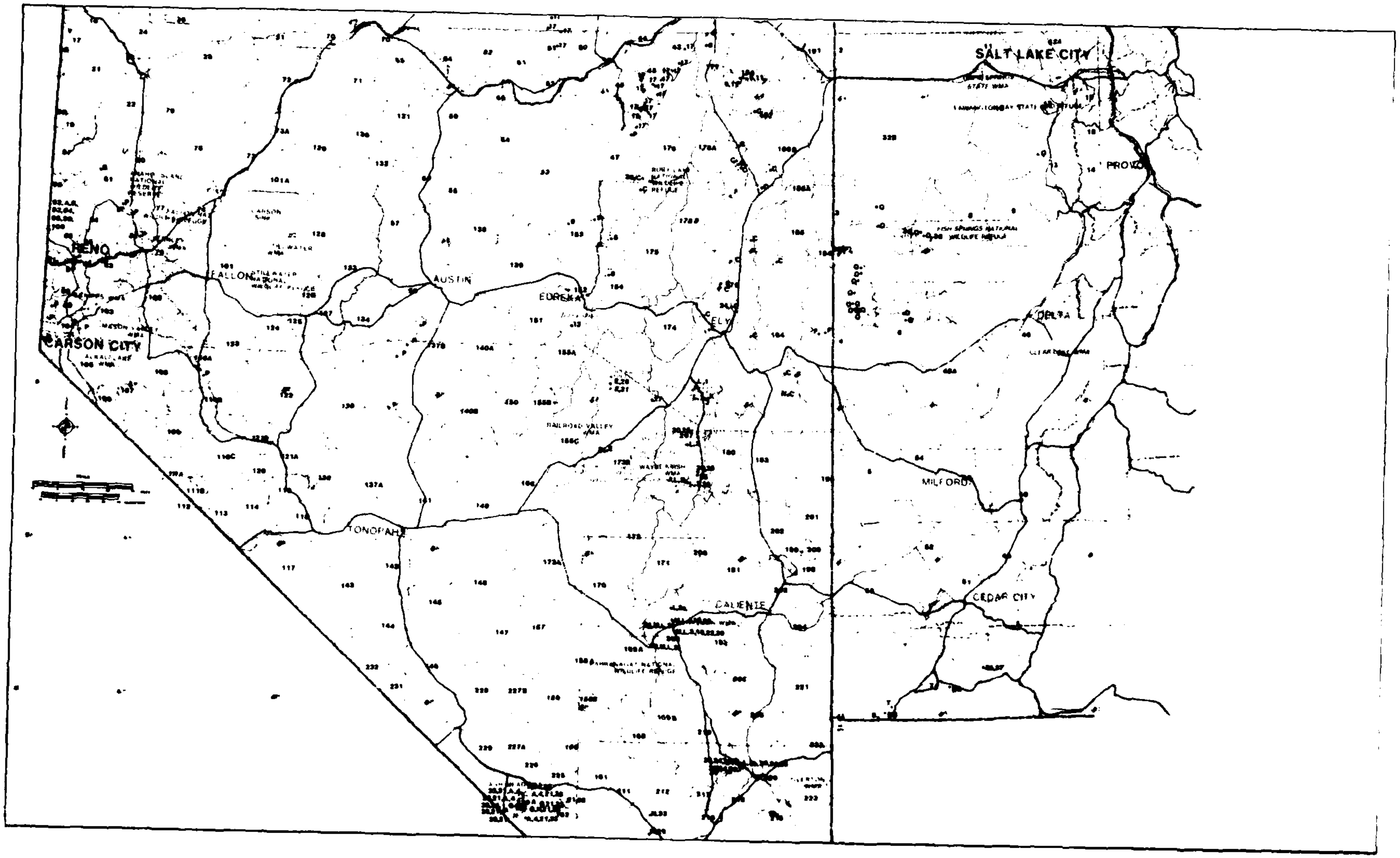

Figure 2.3-1. Protected and recommended protected aquatic species in the Nevada/Utah study area.

measures. The data are summarized below for studies prior to 1980. The results of intensive studies at five springs in Nevada and Utah will be presented in the FEIS.

The least chub, which is protected as threatened by Utah and found in only a very few locations in western Utah, spawns intermittently with females depositing only a portion of their eggs at any one time (Lamarra and Miller, 1979; Baugh, 1980). Spawning peaks in May and is completed by August. Least chub are broadcast spawners, and their eggs adhere to vegetation (chiefly emergent macrophytes). Filamentous green algae is utilized most for egg deposition in the field, and bottom substrate type is not important in spawning. Larvae are poorly developed at hatching, and the young use shallow areas with vegetation. They become adults within one year at 28 to 30 mm in total length. Essentially nothing is known about their feeding habits, although it is expected that they utilize periphyton and aufwuchs occurring on substrates such as mud, rocks, and vegetation. The White River springfish, which is similar to the Railroad Valley springfish, has been studied enough to show that each female produces 20 to 40 eggs per spawning period and that it usually spawns twice per year (Deacon et al., 1979b). It is small and probably feeds upon attached algae and small invertebrates. Little is known about the breeding activities of tui chubs although their breeding rate in the wild is expected to be quite adequate to maintain population levels in undisturbed habitats. In disturbed areas, or where exotic species are introduced, its survival may be uncertain. The Lahontan cutthroat trout ascends rivers and creeks to spawn. In refuges or hatcheries, fish average about 2,500 eggs per individual or about 1,200 per pound of female (Deacon et al., 1979b). The spawning run lasts from the middle of April to late May. This trout feeds upon larger macroinvertebrates and prefers the active type of insect larvae (stoneflies, mayflies, etc.) characteristic of clean, rapidly flowing streams.

3.0 PROTECTED SPECIES - TEXAS/NEW MEXICO

3.1 PLANTS

There are no federally listed protected plant species in the study area. The state of Texas is preparing a proposed list of endangered species, but this is not yet complete. The state of New Mexico, on the other hand, keeps an extensive list of state-protected species.

The state-protected species and proposed protected species are presented in Table 3.1-1 and their distributions shown on Figure 3.1-1. In Texas, locations are identified at the county level only. Each state contains one endemic in or near the study area: Correll's buckwheat (Eriogonum correllii) in Texas and Kuenzler's barrel cactus (Echinocereus kuenzleri) in New Mexico. All the other species listed are also found outside the study area, some being quite abundant elsewhere. Two state-listed species, Rocky Mountain juniper (Juniperus scopulorum) and Limonium limbatum, are more widespread than formerly known and have been proposed to be declassified. Yellow lady's slipper (Cypripedium calceolus var. pubescens), annual skeleton plant (Lygodesmia rostrata), and little-seed ricegrass (Oryzopsis micrantha) have probably been extirpated in Texas. Their status in New Mexico is unknown. The likelihood of many more rare species being found in the area is not great due to intensive agricultural use throughout the study area with concomitant habitat destruction or degradation.

3.2 WILDLIFE

The five federally listed terrestrial species in the study area, bald eagle (Haliaeetus leucocephalus), American peregrine falcon (Falco peregrinus anatum), Eskimo curlew (Numenius borealis), whooping crane (Grus americana), and black-footed ferret (Mustela nigripes), are all endangered. The bald eagle does not nest in the study area, but is seen with fair frequency during migration and winter. Its primary food is fish and it remains close to reservoirs and large rivers. The peregrine falcon is recognized as casual in the study area, although there may be a few nests in the mountains of New Mexico to the west of the study area. The Eskimo curlew may be seen as a migrant, but may be close to extinction as sightings are very rare. Randall County, Texas, provides a stopover point for the whooping crane along its migratory route from Canada to the Aransas National Wildlife Refuge on the Texas Gulf Coast. An experimental transplant population, introduced in 1975 in association with a flock of sandhill cranes, winters in the Rio Grande Valley in New Mexico, outside the study area. The black-footed ferret has been sighted only 3 times in the last decade in Texas, and New Mexico has had no verifiable records in three decades, although there have been recent reports from reliable sources (Hubbard et al., 1978). This species is restricted to prairie dog towns, which have been in decline. The ferret is nocturnal making sighting difficult. It may be extinct in the area.

The remaining species are all state-listed, most of them as threatened. The black hawk (Buteogallus anthracinus anthracinus), which may nest in the area, is considered endangered in New Mexico. The interior least tern (Sterna albifrons athalassos), which nests in sandy areas along rivers and lakes, is endangered in Texas. Only one form, the sanddune sagebrush lizard (Sceloporus graciosus

Table 3.1-1. Rare and protected plants, Texas/New Mexico high plains.

SPECIES	COMMON NAME	FAMILY	STATUS *	KNOWN DISTRIBUTION	HABITAT	FLOWERING TIME	REMARKS AND REFERENCES
Asclepias involucrata Torr.	Bracted milkweed	Asclepiadaceae	RE(TX)	Daliam, Hart.ey Counties, Tx; NM	Dry gravelly hills, prairie flats, arroyos in high places	Apr-May	Rare in TX, reported STOM NM
Carex aurea Nutt	Golden sedge	Cyperaceae	RE(TX)	Ceta Cyn. Randall Co., TX	Seeps on shaded hillsides	June	Rare in Tx; reported from NM, widespread in U.S.
Cypripedum calceolus var. *pubescens* (Willd.) Correll	Yellow lady's sliper	Orchidaceae	RE(TX)	Bailey Co., TX;NM	Playa lake edges	Apr-June	Probably extirpated; not seen since 1957; widespread in eastern U.S. to Rockies.[1]
Echinocereus Kuenzleri Benson	Kuenzler's barrel cactus	Cactaceae	SE(NM) (ECF)	Rio Elk Cyn., NM[2]	Limestone outcrops	May	Apparent local endemic
Eriogonum Correllii Reveal	Correll's buckwheat	Polygonaceae	RE(TX)	Hartley, Briscoe, Armstrong Counties Texas	Clay mounds, caprock, rocky ledges	July-Oct	TX high plains endemic
Juniperus Pinchotii Sndw.	Redberry juniper	Cupressaceae	RT(NM)	Texas Panhandle, West Texas, adjacent NM	Dry hillsides and canyons	Spring	Widespread in Texas, rare in NM; one stand near Roswell on Mescalero Ridge
Juniperus scopulorum Sarg.	Rocky Mt. juniper	Cupressaceae	RD(TX)	High plains + Trans-Pecos, TX;NM	Cedar breaks, rocky canyon areas	Spring	Widespread in Rockies, western U.S. north of TX; status in NM undocumented, but probably common
Limonium limbatum Small	none	Plumbaginaceae	RD(NM)	Panhandle, Trans-Pecos, TX; wide-spread in NM	Saline flats	June-Aug	Widespread in TX, NM in appropriate habitat
Lygodesmia rostrata (Gray) Gray	Annual skeleton plant	Asteraceae	RE(TX)	High plains, TX; NM	Loose sandy soils	June-Oct	Probably extinct in TX; TX; not known from NM
Muhlenbergia pungens Thurb.	Sandhill muhly	Poaceae	RE(TX)	Hartley Co. TX; NM	Loose sandy soils, dunes, sandy clay hills	late summer	Rare in TX; reported from NM; high plains in adjacent states
Oryzopsis micrantha (Trin. & Rupt.) Thurb.	Littleseed ricegrass	Poaceae	RE(TX)	Deaf Smith, Culberson Cos. TX;NM	Canyons in high plains	Summer	Probably extirpated in TX; reported from NM
Pellaea glabella	Smooth cliff brake	Polypodiaceae	RE(TX)	John Rey Ck., Potter Co., TX	Crevices in limestone, calcareous soils		Widely distributed in eastern United States

RE = recommended endangered; SE = state endangered; RD = recommended delisted; E(F) = endangered, federally listed

[1] Rowell, C. M., Jr. 1971. "Vascular plants of the playa lakes of the Texas Panhandle and South Plains", Southwestern Naturalist 15(4): 4 [illegible] 41

[2] found southwest of study area proper - not mapped

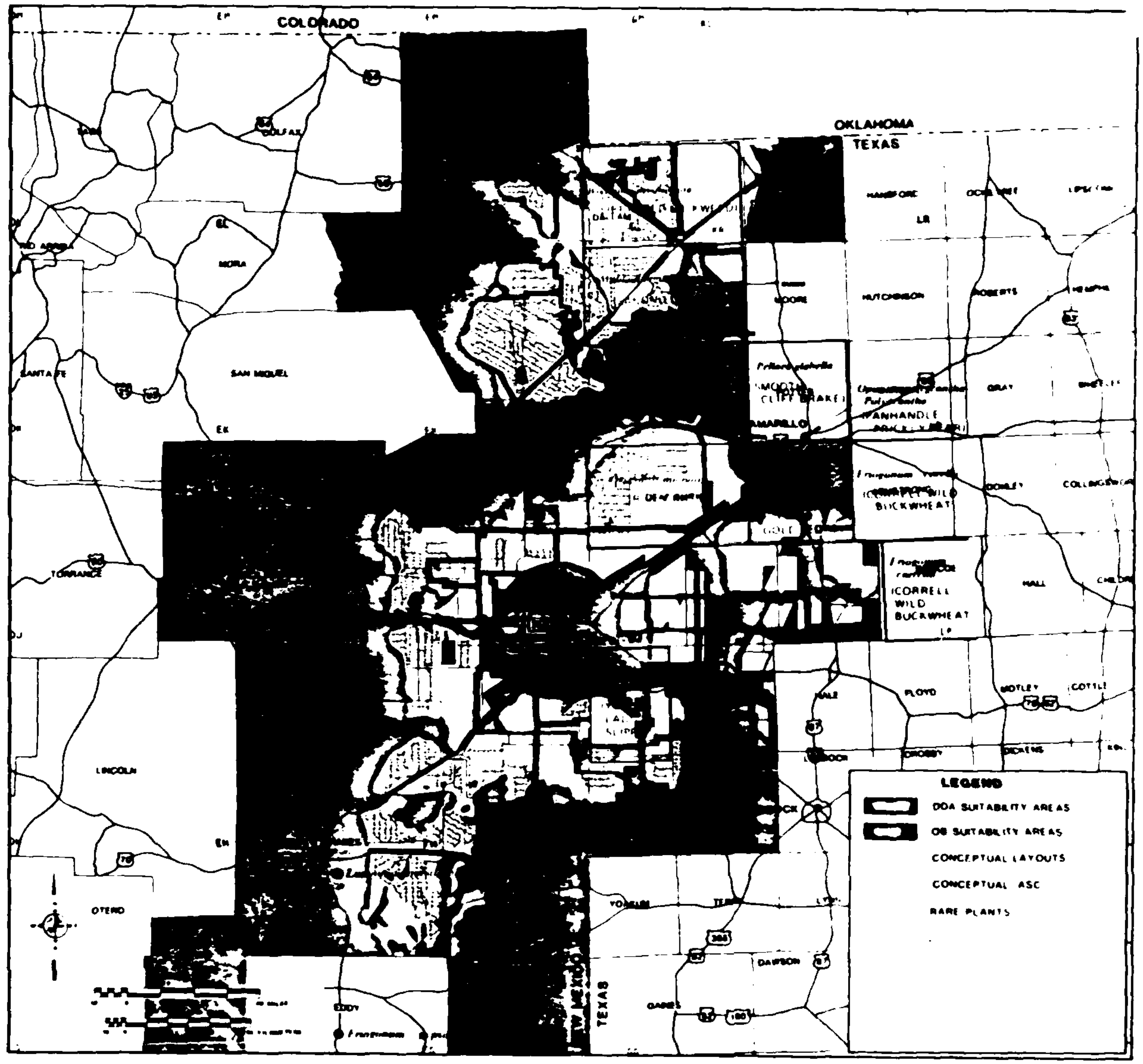

Figure 3.1-1. Protected plant species of the Texas/New Mexico study area.

arenicolus), is endemic, being restricted to active dunes in the Mescalero Sands area of New Mexico. The others are found elsewhere, but are either rare throughout their ranges (e.g., Texas horned lizard) or at the edges of their geographic distributions. As can be seen in Table 3.2-1 most of the species are found in or along water courses, so their success is limited by lack of proper habitat. The rare upland species, such as Bairds' sparrow and the two milk snake subspecies, are rare due to the reduction of their preferred habitat, shortgrass prairie. Locations of protected animal species in the Texas/New Mexico study area are shown in Figure 3.2-1.

3.3 AQUATIC SPECIES

The protected aquatic species in the study area are all fishes. Their status and habitats are presented in Table 3.3-1 (Hubbard et al., 1978; USFWS, 1980). Their distribution is shown in Figure 3.3-1.

The Pecos gambusia (Gambusia nobilis) is the only federally listed species in the study area. Although formerly occurring throughout the lower Pecos River drainage, it is now restricted to seven locations in Bitter Lake National Wildlife Refuge and one location at Blue Springs, New Mexico (Bednarz, 1979).

Of the other species listed, only three have restricted geographic distributions. The Pecos pupfish (Cyprinodon sp.) is found in mineralized springs, sinkholes, and ponds in the Bitter Lake National Wildlife Refuge, Salt Lakes, and the mouth of the Delaware River in New Mexico (Hubbard et al., 1978). The bigscale logperch (Percina macrolepida) is found in the central Pecos River drainage, where it is rare, and the Edwards Plateau area of Texas, where it is common (Hubbard et al., 1978). The Pecos River population of the greenthroat darter (Etheostoma lepidum) is found in the lower Pecos River and its tributaries, Blue Springs in New Mexico and the Bitter Lake National Wildlife Refuge. Although the species is widely distributed, the Pecos River form seems to be at least subspecifically distinct (Hubbard et al., 1978).

The remaining ten species are at the edges of their geographic ranges and are common to abundant outside the state in which they are protected.

Table 3.2-1. Threatened and endangered animal species in the Texas/New Mexico High Plains area (page 1 of 2).

SPECIES	FEDERAL	TEXAS	NEW MEXICO	STATUS	HABITAT
MAMMALS					
Black-footed Ferret (*Mustela nigripes*)	E	E	E	Resident	Prairie Dog Towns
* **BIRDS**					
Olivaceous Cormorant (*Phalacrocorax olivaceus*)			T	Occasional[1]	Lakes, Reservoirs
Little Blue Heron (*Florida caerulea*)			T	Occasional Breeder	River Marshes
Mississippi Kite (*Ictinia mississippiensis*)			T	Occasional Breeder	Riparian Woods
Black Hawk (*Buteogallus anthracinus anthracinus*)			E	Casual	Riparian Woods
Zone-tailed Hawk (*Buteo albonotatus*)		T	T	Occasional Breeder	Canyons
Bald Eagle (*Haliaeetus leucocephalus*)	E	E	E	Casual	River Valleys
Osprey (*Pandion haliaetus carolinensis*)		T	T	Occasional Breeder	River Valleys
American Peregrine Falcon (*Falco peregrinus anatum*	E	E	E	Casual	All habitats
Whooping Crane (*Grus americana*)	E	E	T	Casual[2]	River Valleys and Marshes
Interior Least Tern (*Sterna albifrons athalassos*)		E	T	Occasional Breeder	River Valleys
Red-headed Woodpecker (*Melanerpes erythrocephalus caurinus*)			T	Occasional Breeder	Riparian Woods
White-faced Ibis (*Plegadis chihi*)		T		Casual	River Valleys
Bell's Vireo (*Vireo belli*)			T	Occasional Breeder	Riparian Shrubs, Woods
Baird's Sparrow (*Ammodramus bairdi*)			T	Winter Resident	Grasslands
McCown's Longspur (*Calcarius mccowni*)			T	Casual	Shortgrass
REPTILES					
Central Plains Milk Snake (*Lampropeltis triangulum gentilis*)		T		Resident	Grassland
Pecos Western Ribbon Snake (*Thamnophis proximus diabolicus*)			T	Resident	Edges of Ponds, Streams
Texas Horned Lizard (*Phrynosoma cornutum*)			T	Resident	In Open Terrain
Sanddune Sagebrush Lizard (*Sceloporus graciosus arenicolus*)			T	Resident	Active Sand Dunes
Texas Slider (*Chrysemys concinna texana*)			T	Resident	Rivers, Ponds
Spiny Softshell Turtle (*Trionyx spiniferus hartwegi*)			T	Resident	Rivers, Reservoirs
Smooth Softshell Turtle (*Trionyx muticus*)			T	Resident	Rivers, Reservoirs
* Numenius Borealis	E	E	E	Migrant[3]	Grassland and playas

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Table 3.2-1. Threatened and endangered animal species in the Texas/ New Mexico High Plains area (page 2 of 2).

SPECIES	FEDERAL	TEXAS	NEW MEXICO	STATUS	HABITAT
AMPHIBIANS					
Eastern Barking Frog *(Hylactophryne augusti latrans)*			T	Resident	Limestone Regions
Blanchard's Cricket Frog *(Acris crepitans blanchardi)*			T	Resident	Pond, Stream Edges
FISHES					
American Eel *(Anguilla rostrata)*			E	Resident[3]	Rivers, Streams
Blue Sucker *(Cycleptus elongatus)*		T	E	Resident	Large Rivers
Gray Redhorse *(Moxostoma congestum)*			E	Resident	Rivers, Large Streams
Mexican Tetra *(Astyanax mexicanus)*			T	Resident	All Water Bodies
Roundnose Minnow *(Dionda episcopa)*			T	Resident	Creeks, Springs
Canadian Speckled Dace *((Hybopsis aestivalis tetranemus)*			T	Resident	Rivers (Below Ute Dam)
Arkansas River Shiner *(Notropis girardi)*			E	Resident	Rivers, Streams
Silverband Shiner *(Notropis shumardi)*			E	Resident	Large Rivers
Suckermouth Minnow *(Phenacobius mirabilis)*			T	Resident	Streams with Gravel Bottoms
Pecos Pupfish *(Cyprinodon sp)*			T	Resident	Springs, Sinks, Ponds
Rainwater Killifish *(Lucania parva)*			T	Resident	Swamps
Greenthroat Darter *(Etheostoma lepidum)*			T	Resident	Vegetated Springs
Bigscale Logperch *(Percina macrolepida)*			T	Resident	Small Lakes, Rocky Silt Bottoms
Pecos Gambusia *(Gambusia nobilis)*	E		E	Resident	Sinkholes, Springs (Known from 8 localities)

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E = Endangered

T = Threatened

[1]Breeds west of study area.

[2]Winters outside of area.

[3]Possibly extirpated.

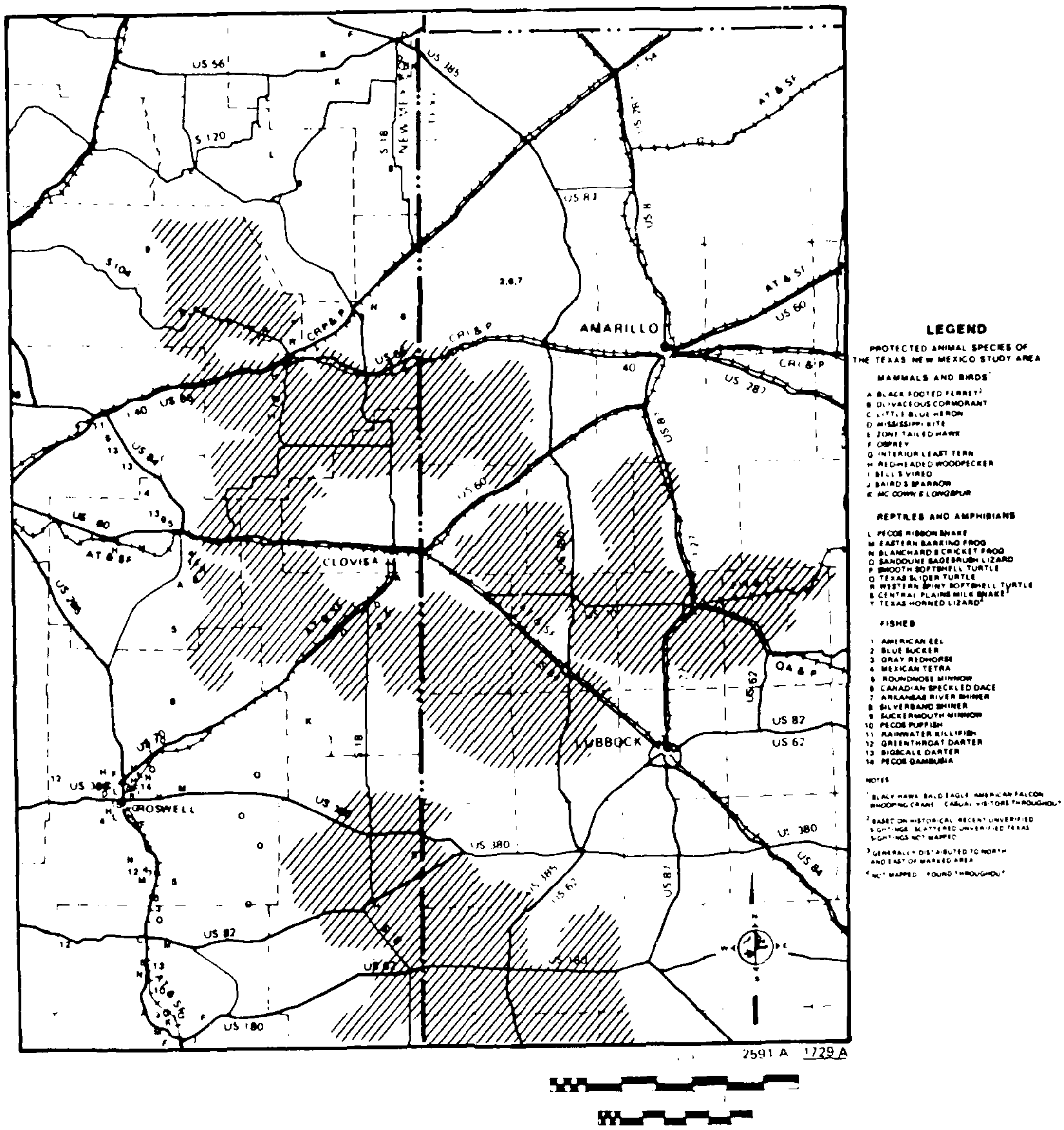


Figure 3.2-1. Protected animal species of the Texas/New Mexico study area.

4.0 PROJECT IMPACTS

4.1 METHOD OF IMPACT ANALYSIS

PLANTS (4.1.1)

This section briefly discusses the method used to determine the impacts of the project and those rare plant species which are affected by the project. Impact analysis was performed in these steps: (1) a description of the project and an analysis, based on scientific literature, of the effects on rare plants, (2) an assessment of the impact (all effects combined) to the species of concern, and (3) a determination of the significance of the impact (see Section 4.2, Significant Impacts). Effects were determined by combining baseline information with project information. Locations of rare plants (see Appendix I for comprehensive list) were received from available literature, various institutions, and field work performed for this purpose. Each species was given a number and its locations were plotted on a clear mylar overlay to a 1:500,000 scale base map. Since vegetation clearing for construction purposes poses the greatest threat to rare plant species (because of the large areas involved), this was considered to be the primary project action that would affect rare plant species. The effect would be realized by a narrowing of the distribution of the rare species or a decrease in the abundance of the species. A clear mylar overlay of the Proposed Action layout (Drawing 1843 E) was placed over the clear mylar rare plant overlay (drawing 1425-B-2). Both of these were then overlain to the base map of Nevada/Utah. Whenever project features such as clusters or DTN appeared to occur over a plotted rare plant location, the occurrence was counted and entered in Table 4.2.1-3 (see also significant impact section, 4.2). The results were organized by hydrologic subunit, see Appendix II.

Due to the uncertainty involved in plotting exact rare plant locations, rare plants with map plots occurring within 1 mile of project features were considered to have the potential for being directly impacted. Figure 4.2.1-3, which appears in the significant impact section, provides an example of the type of maps and overlays used in this analysis.

WILDLIFE (4.1.2)

Intersections of conceptual project layouts and distribution and key habitats of protected wildlife were determined using 1:500,000 scale map overlays. The intersection of the project with wildlife habitat was assumed to be permanent habitat loss. Two kinds of effects can occur to protected wildlife, direct and indirect. Direct effects consist of permanent loss of habitat or required resources due to construction activities, or loss of habitat due to behavioral avoidance of areas adjacent to construction or other human activities. Direct effects have both short and long-term aspects. Short-term effects are those that occur during construction or the peak of human activity. For most protected wildlife species this is likely to be the period when negative impacts are greatest. Long-term effects include effects that persist from the construction phase through the operations phase, and those that are a function of system operation and occur throughout all or most of the operational life of the M-X system. During operations construction would have been completed, and the human population present in the DDA would be reduced or absent. During operations human population would be associated mainly with the OBs. Under these conditions some disturbed habitat may recover, and behaviorally avoided habitats may again be utilized. Long-term negative effects are expected to be less than short-term effects for all protected wildlife species.

Direct effects were calculated by summing range or key habitat area intersected by project features in each hydrologic subunit. The total acreage of range and key habitat per hydrologic subunit was measured, and the total area disturbed compared to total present and converted to a percentage form. Insufficient data precluded the quantification of acreage of habitat behaviorally avoided because of construction activities. For a more detailed discussion of the calculation of direct effects see Appendix III (Quantification of Direct Effects of M-X Deployment on Biological Resources in Nevada/Utah).

Indirect effects are primarily people-related effects resulting from an increase in human population, with attendant traffic, noise, and recreation activities. Since long-term people-related effects would be closely associated with the OB sites, indirect effects analysis concentrated there. The basic tenet of the analysis is that the number of people that recreate in a particular area decreases with distance from the OB site. A model was developed to mathematically predict the relative intensity of human use with distance from the OB site. The population of the OB and recreational attractants (e.g., parks, lakes) in the vicinity were factored into the calculations. Only long-term effects were considered in this analysis. Short-term indirect effects do not differ in kind from long-term effects, but only in intensity. For a detailed discussion of the indirect effects model see ETR 30 (Indirect Effects Index for Impact Analysis).

AQUATIC SPECIES (4.1.3)

Direct impacts to protected aquatic species were estimated by considering information about the species (e.g., habitat requirements, legal status, and abundance) and the project (e.g., water use). To quantify these general impacts in each hydrologic subunit, the conceptual project configuration was overlain on a map (1:500,000 scale) showing known locations of the resource. A radius of potential impact of 1-5 mi (2-8 km) was assumed for effects of construction, such as habitat disturbance and runoff of sediments or pollutants. Potential habitat loss resulting from groundwater drawdown was estimated as the percentage of perennial yield required by the project. Direct (short and long-term) impacts were then calculated by averaging abundance, legal status, and habitat loss. Numerical values were assigned to each category for this average.

Abundance: low = 1, moderate = 3, high = 5

Legal Status: ST or RT = 2, SE or RE = 3, FT = 4, FE = 5

Habitat loss: 0-10% = 1, 11-20% = 2, 21-30% = 3, 31-40% = 4

Average: 1-2.5 = low, 2.6-3.7 = moderate, 3.8-5 = high

Indirect impacts resulting from recreational activities of people attracted to the area because of the project were assessed for the OB vicinities using a mathematical model to predict dispersion of people from these population centers (see ETR 30 for model description). The indirect effect index produced by this model was assigned ranks of low (1) for values less than 1,000, moderate (3) for values of 1,000 to 10,000, and high (5) for values greater than 10,000. Impact level was calculated by averaging the abundance, legal status, and indirect effect index ranks. No indirect impact analysis was performed for the DDA. Indirect impacts would be short-term and were assumed to be less than the direct impacts.

4.2 PRINCIPAL IMPACTS TO PROTECTED SPECIES: EVALUATION OF PROJECT ALTERNATIVES

PLANTS (4.2.1)

Rare plants were considered to be significantly affected by MX in Nevada/Utah because of the large number of them under consideration by various authorities, and because some species have a high potential for being directly affected by the conceptual layout. An analysis of these impacts was performed. Impact analysis methodology is outlined in Section 4.1.1.

Impacts to rare plant species in the Texas/New Mexico study area were not considered in this analysis because none are known from the DDA and because definite locations are not available for those species which might occur there.

There are no federally listed threatened or endangered species in either study region, but several species are rare and are either listed by state agencies or are being considered for federal listing. A rare plant treated here is a species known or thought to have a small population in its range. A rare plant may be common where it occurs but very restricted in distribution, or may be widespread but sparse in occurrence. Over 200 species of rare plants in the study area are being considered for protection under federal and state endangered species legislation in Nevada and Western Utah. Twenty-eight are considered in this analysis because of the potential for direct impacts to them.

Impact analysis was performed in three steps: (1) a description of project effects on rare plants, (2) an assessment of the impact (all effects combined) to the species of concern, and (3) a determination of the significance of the impact. Effects were determined by combining baseline information presented in DEIS ___ with project information. Whenever project features such as clusters or DTN appeared to occur over a plotted rare plant location (using a 1:500,000 scale map), that occurrence was counted and summed on a hydrologic subunit basis. The total number of known locations of rare plants in a hydrologic subunit was determined and compared with the number of disturbed locations. Each species was considered individually.

Due to locational uncertainty, rare plants within 1 mile of project features were considered to have the potential for being directly impacted. They may also receive impacts as a result of ORV activity. Potential recreational ORV use is likely to occur, but on the basis of available data, the extent of the effects of this activity cannot be predicted. The significance of the impact was arrived at by considering the impact of the project on the distribution and abundance of the individual species (See Table 4.2.1-1) within the project area.

The following points should be considered when analyzing the following discussion of impacts:

1) Undetected locations of rare species may be present and may be significantly affected by the project. However, hydrologic subunits with no known locations were given a no impact rating, on the basis of available data.

Table 4.2.1-1. Rare plant species directly intersected by the proposed action layout. Numbers in parentheses are reference numbers for Figure 2.1-1 (above) and Appendix table (Page 1 of 2)

NEVADA	
(12)	Arenaria stenomeres (SE)[1]
(14)	Asclepias eastwoodiana (RT)
(19)	Astragalus callithrix (RT)*, **
(20)	A. calycosus var. monophyllidius (RT)
(38)	A. pseudiodanthus (RT)
(40)	A. serenoi var. sordescens (RT)
(45)	A. uncialis (RE)**
(54)	Castilleja salsuginosa (SE)**
(58)	Corypantha vivipara var. rosea (RT)
(95a)	Eriogonum beatleyae (?)[1]
(99)	E. darrovii (RC)
(116)	Frasera gypsicola (SE)[1]
(117)	F. pahutensis (RT)
(120)	Geranium toquimense (RC)
(128)	Haplopappus watsonii (RC)
(136)	Lepidium nanum (RC)[1]
(140)	Lomatium ravenii (RC)
(145)	Machaeranthera grindelioides var. depressa (RC)*
(146)	M. leucanthemifolia (RC)
(150)	Mirabilis pudica (RC)
(151)	Opuntia pulchella (RC)*
(154)	Oxytheca watsonii (RT)
(156)	Penstemon arenarius (RT)
(168)	P. pudicus (RT)[1]
(183)	Phacelia parishii (RC)
(191)	Sclerocactus polyancistrus (RT)
(192)	S. pubispinus (RT)*[1]
(199)	Sphaeralcea caespitosa (RT)*
(207)	Trifolium andersonii var. beatleyae (RC)

818-3

Table 4.2.1-1. Rare plant species directly intersected by the proposed action layout. Numbers in parentheses are reference numbers for Figure 2.1-1 (above) and Appendix table (Page 2 of 2)

UTAH
(19) Astragalus callithrix (RE)***
(59) Cryptantha compacta (RT)[1]
(70) Cymopterus newberryi
(93) Eriogonum ammophilum (RE)**
(100) E. eremicum (RT)
(105) E. natum (RT)
(105a) E. nummulare (?)
(136a) Lepidium ostleri (?)[1]
(145) Machaeranthera grindelioides var. depressa (RD)***
(151) Opuntia pulchella (RC)***
(159) Penstemon concinnus (RT)**
(165) P. nanus (RT)
(192) Sclerocactus pubispinus (RE)***[1]
(199) Sphaeralcea caespitosa (RT)***

818-3

[1]These species occur within five miles of project features.

*Also occurs in Utah.

**High priority for federal listing.

***Also occurs in Nevada.

SE = State listed as endangered.

RE = Recommended endangered.

RT = Recommended threatened.

RC = Species of special concern.

RD = Recommended to be delisted.

Table 4.2.1-2. Potential impact to rare plants in Nevada/Utah and Texas/New Mexico[1] which could occur as a result of DDA and OB[2] construction for the Proposed Action and Alternatives 1-8.[3]

HYDROLOGIC SUBUNIT NO.	HYDROLOGIC SUBUNIT NAME	TOTAL NUMBER OF KNOWN RARE PLANT LOCATIONS	NUMBER OF PLACES WHERE DAA AND OB FEATURES COULD DIRECTLY AFFECT RARE PLANT LOCATIONS	NUMBER OF RARE PLANT SPECIES WHICH COULD BE AFFECTED	SHORT AND LONG-TERM POTENTIAL IMPACT[3] FOR PROPOSED ACTION & ALTS. 1-6	SHORT AND LONG-TERM POTENTIAL IMPACT[3] FOR ALT. 8
	Subunits with M-X Clusters and DTN					
4	Snake	37	6	4	Moderate	Moderate
5	Pine	36	6	4	High	High
6	White	6	2	2	High	High
7	Fish Springs	1	0	0	No	No
8	Dugway	0	0	0	No	
9	Government Creek	0	0	0	No	
46	Sevier Desert	3	1	2	Low	Low
46A	Sevier Desert & Dry Lake[4,5]	4	4	1	Moderate	Moderate
54	Wah Wah	11	3	3	High	High
137A	Big Smoky-Tonopah Flat	19	3	3	Moderate	
139	Kobeh	3	2	2	Low	
140A	Monitor—Northern	3	3	2	Moderate	
140B	Monitor—Southern	6	0	0	No	
141	Ralston	32	11	8	Moderate	
142	Alkali Spring	2	0	0	No	
148	Cactus Flat	42	0	0	No	
149	Stone Cabin[4]	21	7	3	Moderate	
151	Antelope	2	0	0	No	
154	Newark[4]	1	0	0	No	
155A	Little Smoky—Northern	2	0	0	No	
155C	Little Smoky—Southern	0	0	0	No	No
156	Hot Creek	17	9	1	High	High
170	Penoyer	0	0	0	No	No
171	Coal[5]	2	0	0	No	No
172	Garden	6	2	2	Low	Low
173A	Railroad—Southern	0	0	0	No	No
173B	Railroad—Northern	28	13	7	High	High
174	Jakes	1	0	0	No	
175	Long	0	0	0	No	
178B	Butte—South	0	0	0	No	
179	Steptoe	24	0	0	No	
180	Cave	0	0	0	No	No
181	Dry Lake[4,5]	0	0	0	No	No
182	Delamar	0	0	0	No	No
183	Lake	0	0	0	No	No
184	Spring	25	1	1	Low	Low
196	Hamlin	15	6	4	High	High
202	Patterson	0	0	0	No	No
207	White River[4]	27	8	5	Moderate	Moderate
208	Pahroc	1	0	0	No	
209	Pahranagat	13	1	1	Low	
	Overall DDA, P.A. & Alts. 1-6	484	90	—	High	
	Overall DDA, Alt. 8	218	61	—		High

3900-2

[1]No rare plant species are anticipated to be significantly affected as a result of M-X deployment in Texas/New Mexico.

[2]No direct impact to rare plant species is anticipated at operating bases. See text for discussion of potential impact to species occurring within suitability zones.

[3]

- (empty box) No impact. (No known locations of rare plant species would be affected by the conceptual layout.)
- (box divided into squares) Low impact. (Potential loss of 15 percent or less of known locations of any rare plant species.)
- (box with vertical hatching) Moderate impact. (Potential loss of more than 15 percent of known locations of any rare plant species or where four or more different species could be affected.)
- (solid black box) High impact. (Affected species include those which have high priority for federal listing.)

[4]Conceptual location of Area Support Centers (ASCs) for Proposed Action and Alternatives 1-6.

(2) The number of rare plant locations per hydrologic subunit is difficult to quantify accurately. Locations can be made up of individual plants, or they can be large populations. Collections may have been made in the same location by more than one scientist, leading to duplication. Inherent in this is the problem of defining the limits of the population. "In the field of population genetics a population is often regarded as a naturally occurring group of individuals which share a common gene pool. Such a concept is difficult to apply upon superficial examination of an assemblage of individuals observed in nature." (Welsh & Neese, 1980). Often in mapping rare plant locations, one finds the available information difficult to translate into a point location.

(3) The number of known locations in a hydrologic subunit may not be an accurate reflection of rare species diversity for that area. For example, nine known rare plant locations in Hot Creek Valley are within one mile of project elements, as shown in Table 4.2 1-2. In this case, the nine locations are all of the same rare species, the Callaway milkvetch (Astragalus callithrix). By contrast, in Hamblin Valley six localities of four different species occur within 1 mile of project elements.

Figure 2.1-1 shows locations of rare plants affected by the Proposed Action. Project effects involve either the complete removal of the rare plant (vegetation clearing) and/or alteration of its habitat. Habitat is usually a specific substrate type; a region where substantial moisture is found; a region where the correct biological "link" is found; or a combination of the above factors. Rare plants are usually tied, in some way, to a specific habitat. Destruction or alteration of this habitat decreases the viability of the rare species. Reinvasion of altered habitats by many rare species is extremely slow. Thus, the overall abundance and distribution is decreased by alteration of the habitat.

In addition to vegetation clearing, habitat disruption could damage, remove or inhibit expansion of rare plant populations. Such habitat disruption could be caused by erosion, compaction, sedimentation, and off-road vehicle use.

Project actions which potentially affect rare plants are: (1) construction of permanent roads (e.g., DTN and cluster), protective shelters, buildings, parking areas, and airfields; (2) excavation of quarries and borrow pits; (3) construction and operation of cement and aggregate plants; and (4) increased personnel access, including security patrols and off-road recreational activities. These actions generally involve removal of plants by clearing and grubbing and deposition of excavated material, and increased use of off-road areas by vehicles. Rare plants are potentially affected by these actions primarily because they may be damaged or removed or their habitat may be modified, as stated above.

Twenty-eight rare plant species are within 1 mile of the project layout and have a potential for being directly affected by the proposed action. Four of these are species for which rulemaking packages are being developed, and they are likely to become federally listed in the near future (USFWS, June 6, 1980).

Indirectly affected species are defined as those occurring some distance away from project features, but may be affected by ORV use. They include those species which occur more than 1 mile away from project features and especially those species which occur in areas identified as high potential ORV use areas. These species are discussed under the general impact section of this report. Habitat degradation, crushing of foliage, breakage of stems, and uprooting of small plants, all potential impacts resulting from ORV use (Bury et al., 1977; Wilshire, 1978), can cause a decrease in viability, can result in a decrease in the abundance of the plants, and can decrease their distributional range.

As the project proceeds during construction and more land is disturbed, direct effects on rare plants will increase. Other effects of the proposed action which may change over time are those on indirectly affected rare plants that involve (1) increased erosion resulting from road building and (2) increased loss of viability resulting from crushing of plants. Crushing of foliage, breakage of stems, and uprooting of plants result from ORV activity. This activity is expected to increase as a result of recreational activities of an increased population.

Long-term productivity would be affected by permanent removal of rare species as a result of construction of project facilities. Recovery rates for most rare species are not known. Some may be remnants of ancient species and others may be newly evolved. In regions where a portion of a population remains after scarification, some recovery may occur but the population would not be likely to regain its present productivity. Halogeton, a toxic annual weed, may invade suitable habitat. This extends the time required for recovery of the native vegetation beyond the life of the project and therefore affects long-term productivity.

Scarification, a direct effect which involves clearing of land for the purposes of building roads or other project features, will result in an irretrievable resource commitment if it involves the loss of rare plants. Species lost in this manner cannot be replaced.

Approximately 20 percent of the known locations of rare plants in the hydrologic subunits where the DDA is located are within one mile of projected elements. Many of these rare plants are found in localized habitat and there is a high probability that certain species may become locally extirpated as a result of M-X. Exact distributions for rare plant species in the Great Basin are not known. Available data suggest that for some species, the Proposed Action has the potential to alter a high percentage of all known habitat or cause the loss of many known locations. For example, the Callaway milkvetch (Astragalus callithrix) is found in five valleys in the Great Basin. In four valleys it is potentially affected by the project as proposed. It is highly restricted in distribution and does not occur outside a very limited area of deep yellow sand (Barneby, 1942).

Construction and operation could result in the permanent loss of individual rare plants. Table 4.2.1-2 summarizes effects on rare plants on a valley-by-valley basis. It includes the number of locations potentially affected, the total number of locations, the number of species affected, and the significance of the impact (see Section 4.1 for the method of impact analysis).

The four significance levels were arrived at in the following manner: (1) a questionnaire was filled out to initiate analysis (See Appendix III), (2) the potential for a decrease in abundance of any particular species was taken into account (Table 4.2.1-1) along with the current legal status of each species, and (3) this potential was considered on a hydrologic subunit basis, along with the number of species involved.

First, the species affected by the project and the total number of locations of them in the area were determined. Secondly, the number of times the individual species were intersected by project elements in a hydrologic subunit was determined. Then, based on the above information, a "species per hydrolog subunit" (SP/HSU) index number was arrived at which was weighted more heavily for species greatly affected (i.e. species having a larger proportion of known locations intersected by project elements). The SP/HSU index numbers were summed for each hydrologic subunit and a total for that subunit, the "hydrologic subunit" (HSU) index number was determined. This number, then, is an indication of impact on rare plant species in a particular hydrologic subunit.

Determining the cut-off point between the different significance levels required a somewhat subjective decision. Level 1 applies to HSUs for which no impact is anticipated, based on available data. Level 2 (low to moderate impact) applies to HSUs containing any rare species which potentially loses 15 percent or less of its known locations in the project area. For example, HSU 139, Kobeh Valley, in Table 4.2.1-2 has a low to moderate impact. Locating Kobeh Valley on Table 4.2.1-3, one finds that the highest SP/HSU index number is .01, or 1 percent of known locations affected for species #128, the Watson Goldenweed (Haplopappus watsonii). Likewise, Level 3 (moderate to high impact) applies to HSUs containing any rare species which potentially lose more than 15 percent of its known locations in the project area, or to HSUs which contain more than four species potentially affected. The fourth and highest level of impact includes HSUs which contain species which are likely to be federally listed in the near future.

Even though it can be argued that loss of any individual rare plant location would be highly significant, 15 percent of the known locations was chosen to mark the limits of levels 2 and 3. This is based on scientific knowledge of the reproductive characteristics of vegetation in general and assumes that reproductive biology of rare plants would be similar.

This may not be the case, however, since understanding of the life cycles, longevity, and reproductive habits of rare species is only now being touched upon. It must be understood that each rare species is unique and loss of 15 percent of the known locations of one species may not be as significant as an identical loss involving another species.

The above detailed process resulted in the compilation of Table 4.2.1-3 The equation for calculation of the hydrologic index is as follows:

X_{ij} = number of times the i species is potentially impacted by placing the project in the jth valley.

m = Number of species

n = Number of valleys

W_k = Subunit index for the jth hydrologic subunit

$$W_k = \sum_{i=1}^{m} X_{ik} \sum_{j=1}^{n} X_{ij}$$

Table 4.2.1-3. Potential impact index numbers and occurrences of rare plants for Proposed Action and alternative subunits. (Page 1 of 2)

HYDROLOGIC SUBUNIT	NUMBER OF SPECIES WHICH COULD BE AFFECTED	NUMBER CODE[1] OF SPECIES WHICH ARE INTERSECTED BY PROJECT FEATURES																	
		14	*19	20	38	40	*45	58	*93	99	100	105	105a	117	120	128	140	145	146
Snake	4										.24		.11					.02	
Pine	4																	.02	
White	2		.05						.19										
Fish Springs	0																		
Dugway	0																		
Government Creek	0																		
Sevier D.-DryLake	1											.64							
Sevier Desert	2																		
Wah Wah	3		.05						.19										
Big Smokey-Tonopah F.	3				.05														
Kobeh	2							.005									.01		
Monitor-North	2															.01			
Monitor-South	0																		
Ralston	8	.03				.04		.005						.03	.01				
Alkali Spring	0																		
Cactus Flat	0																		
Stone Cabin	3		.25																
Antelope	0																		
Newark	0																		
Little Smokey-North	0																		
Little Smokey-South	0																		
Hot Creek	1		.46																
Penoyer	0																		
Coal	0																		
Garden	2																		.04
Railroad-South	0																		
Railroad-North	7		.10	.05			.11	.01											.04
Jakes	0																		
Long	0																		
Butte-South	0																		
Steptoe	0																		
Cave	0																		
DryLake	0																		
Delamar	0																		
Lake	0																		
Spring	1							.005											
Hamlin	4								.19		.08								
Patterson	0																		
White River	5			.05				.005		.03								.02	
Pahroc	0																		
Pahranagat	1																		
Index of Cumulative Effect on Species		.18	.81	.31	.55	.20	.33	.18	.75	.17	.57	.83	.33	.17	.11	.08	.11	.21	.29

3815-1

*High priority for federal listing.

[1]Number codes correspond to those in the Rare and Protected Species Table of Appendix I.

Table 4.2.1-3. Potential impact index numbers and occurrences of rare plants for Proposed Action and alternative subunits. (Page 2 of 2)

HYDROLOGIC SUBUNIT	NUMBER CODE[1] OF SPECIES WHICH ARE INTERSECTED BY PROJECT FEATURES										POTENTIAL IMPACT
	150	151	154	156	159*	165	183	191	199	207	
Snake		.02									.39
Pine					.04	.03			.01		*.10
White											*.24
Fish Springs											.00
Dugway											.00
Government Creek											.00
Sevier D.-DryLake											.64
Sevier Desert						.02			.01		.03
Wah Wah				.22		.02				.24	*.26
Big Smokey-Tonopah F.								.0009			.27
Kobeh											.02
Monitor-North			.45								.46
Monitor-South											.00
Ralston		.02		.22							.60
Alkali Spring											.00
Cactus Flat											.00
Stone Cabin	.03	.02									.30
Antelope											.00
Newark											.00
Little Smokey-North											.00
Little Smokey-South											.00
Hot Creek											*.46
Penoyer											.00
Coal											.00
Garden										.12	.16
Railroad-South											.00
Railroad-North		.03							.03		*.37
Jakes											.00
Long											.00
Butte-South											.00
Steptoe											.00
Cave											.00
DryLake											.00
Delamar											.00
Lake											.00
Spring											.005
Hamlin					.06				.01		*.34
Patterson											.00
White River							.36				.47
Pahroc											.00
Pahranagat	.03										.03
Index of Cumulative Effect on Species	.25	.28	.67	.67	.35	.25	.60	.03	.26	.60	

3815-1

*High priority for federal listing.

[1]Number codes correspond to those in the Rare and Protected Species Table of Appendix I.

This analysis shows that M-X has the potential to cause a substantial decrease in the abundance of three rare species: the Calloway milkvetch (Astragalus callithrix), sand-loving buckwheat (Eriogonum ammophilum), and terrace buckwheat (E. natum). Except for one location of Astragalus callithrix, these species are not known from outside the project area and they are intersected by project elements at each known location.

The impact of rare plant species can be greatly reduced by relocating project facilities to avoid these species. Although no plant species in the project area are currently federally listed, nine species are under review by the U.S. Fish and Wildlife Service (USFWS) and have a high potential for listing. Four of these occur in the DDA. In addition to the nine species currently under consideration by the USFWS, a significant number of other rare plants are of concern to the USFWS and could be emergency listed (using fast-track procedures) as a result of planned M-X development. The avoidance of listed and non-listed species would reduce the impact to rare plants. Section 1.7.2 of the DEIS, presents a generic discussion of the sequence of environmental studies and decision points associated with detailed siting subsequent to this report.

Indirect impacts to rare species, in the vicinity of the project, such as from sedimentation, flooding, and dust, could be reduced by implementation of an erosion control and revegetation plan. Limiting off-road vehicle use by construction and operation personnel and provision of aid to land management agencies in the control of public off-road vehicle use would reduce the potential indirect impacts to rare plants anticipated from these activities.

One rare plant species, the steno sandwort (Arenaria stenomeres), occurs just outside the suitability zone of the Coyote Spring operating base (Figure 4.2.1-1) and within 2 mi of the conceptual operating base. Within the boundary of the Desert National Wildlife Range, two other localities for this species have been mapped (Nevada State Museum, 1980). These are the only known locations of the plant. Indirect impacts resulting from ORV use and recreational use could alter habitat for this species resulting in a possible decrease in its abundance or a narrowing of its distribution. Quarry sites used for highway construction or improvement may involve habitat removal. Relocation of the operating base within the suitability zone could directly impact the steno sandwort which is protected by the state of Nevada.

There are no direct impacts to rare plants anticipated from vegetation clearing for construction of the Milford operating base. However, indirect impacts as a result of recreational activity may occur.

ALTERNATIVE 1

The DDA for Alternative 1 is identical to that discussed in the Proposed Action section, therefore predicted impacts are the same. (see Figure 2.1-1).

Impacts of an first operating base at Coyote Spring would be the same as for the Proposed Action. There are no direct impacts to rare plants anticipated as a result of actions involved in construction and operation of the second operating base at Beryl (see Figure 4.2.1-2). As for all base sites, previously undetected populations may be located during site-specific studies.

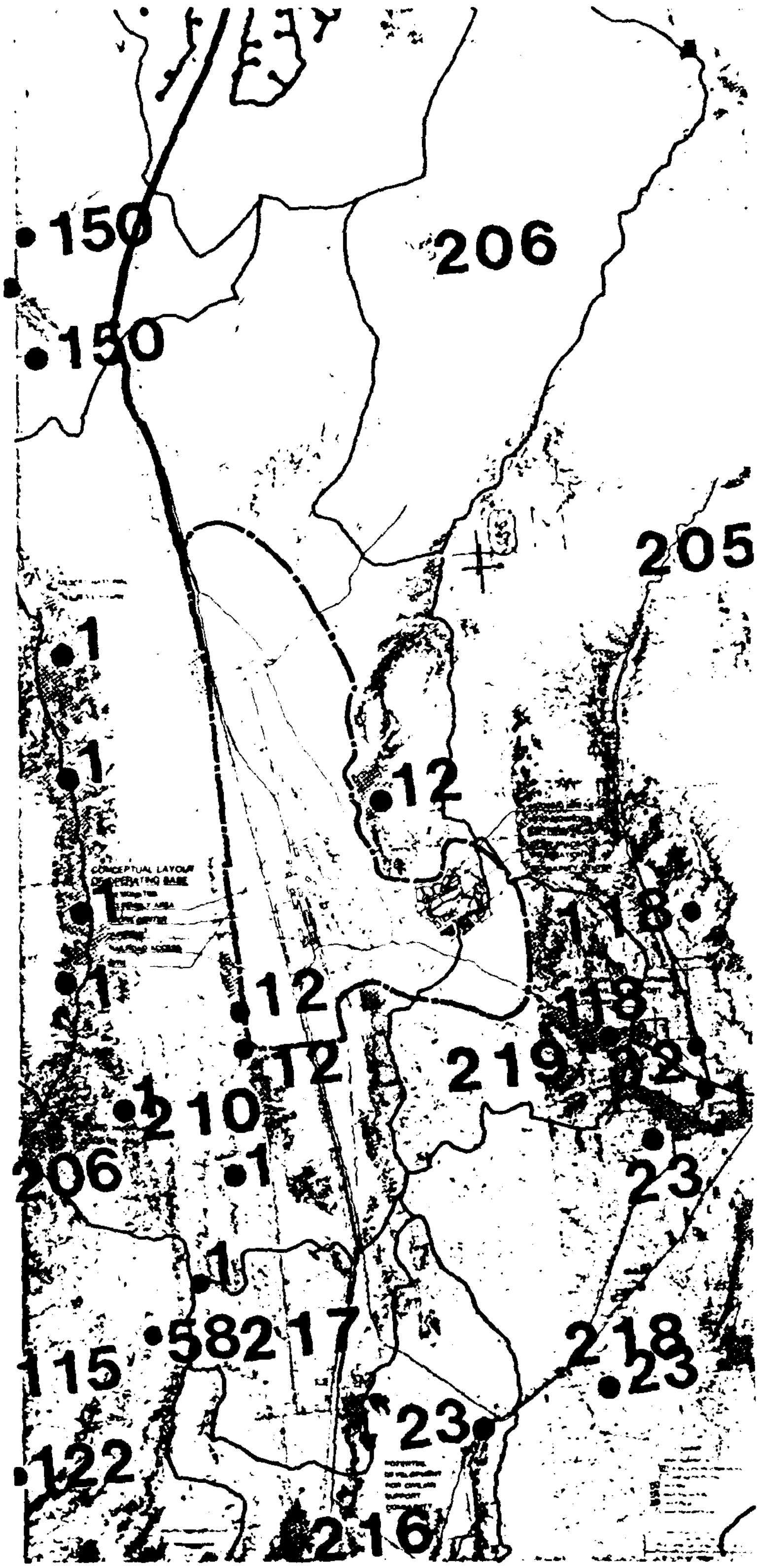


Figure 4.2.1-1. Rare plants in the Coyote Spring OB vicinity. (See figure 2.1-1 for rare plant reference number)

ALTERNATIVE 2

Impacts in the DDA and at Coyote Spring would be the same as for the Proposed Action.

One known location of the terrace buckwheat (Eriogonum natum) occurs within the suitability zone of the Delta operating base (Figure 4.2.1-3). This endemic species, discovered in 1975 (Reveal), has been recommended for threatened status (Welsh and Thorne, 1979). Only 5 locations are currently documented, all in Millard County, Utah. The plant has been found on "low white alkaline clay outcrops" in the Sevier Lake area (Welsh et al., 1975). Most of these locations are near the 5,000 ft elevational level and it is likely that more locations could be found in the surrounding area. In addition to the locality within the suitability zone, two of the five locations are intersected by clusters in the conceptual layout. Construction of the operating base facilities or ORV activity in this area would be likely to affect the habitat of this rare species.

ALTERNATIVE 3

The DDA for Alternative 3 is identical to that discussed in the Proposed Action section; therefore impacts are the same.

The Beryl site for the operating base is identical to that which is discussed for Alternative 1 except that in this case it includes a DAA and an OBTS. More extensive indirect effects may result from a higher population level.

Three rare plant species occur at Monte Neva Hot Springs, within the boundaries of the suitability zone. They are the Monte Neva Indian paintbrush (Castilleja salsuginosa), the spring-loving centaury (Centarium namophilum), and the sheathed death camus (Zigadenus vaginatus). Figure 4.2.1-4 shows the locations of these species. The paintbrush is one species to which the USFWS is considering a rulemaking package, since this is the only known location. It may become a listed species within the next two or three years (USFWS, June 6, 1980). The centaury, an annual, and the death camus, a lily-family member, are recommended endangered and recommended threatened, respectively. Available information indicates that all three species occur on private land, but they may be affected by a change in surface or groundwater levels (Heckard, 1980).

The effects of recreational activity in the area, while not quantifiable may pose a substantial risk to the species, as the hot springs site was once used as a resort. Population growth in the area could again make the site viable as a resort, and thereby impact the species.

ALTERNATIVE 4

The DDA for Alternative 4 is identical to that discussed in the Proposed Action section, therefore impacts are the same. The impacts of the base at Beryl are identical to those of Alternative 3. For the operating base at Coyote Spring impacts would be identical to those of the Proposed Action except that there would be no DAA or OBTS. The presence or absence of these features does not change the impacts.

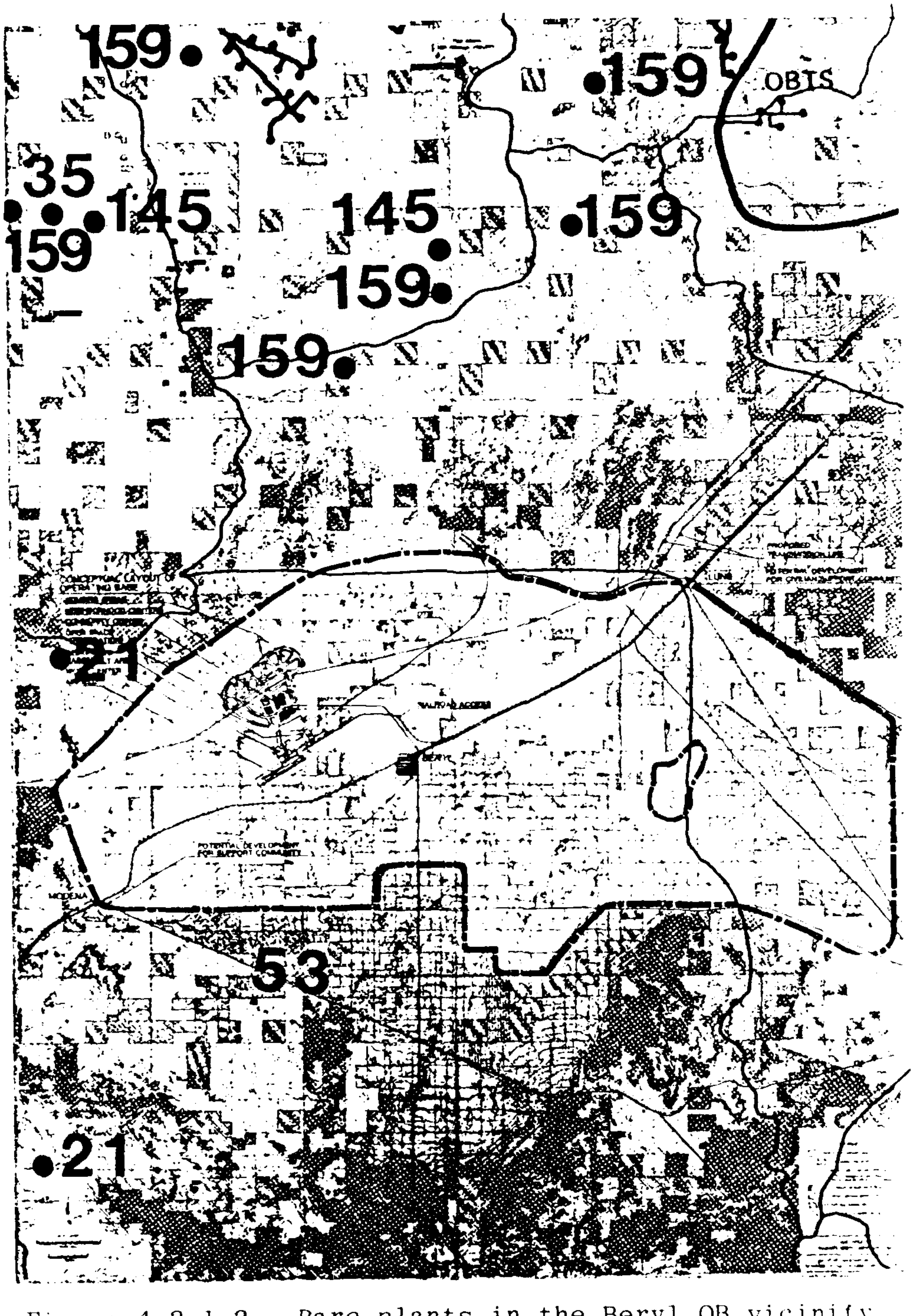


Figure 4.2.1-2. Rare plants in the Beryl OB vicinity. (See figure 2.1-1 for rare plant reference number)

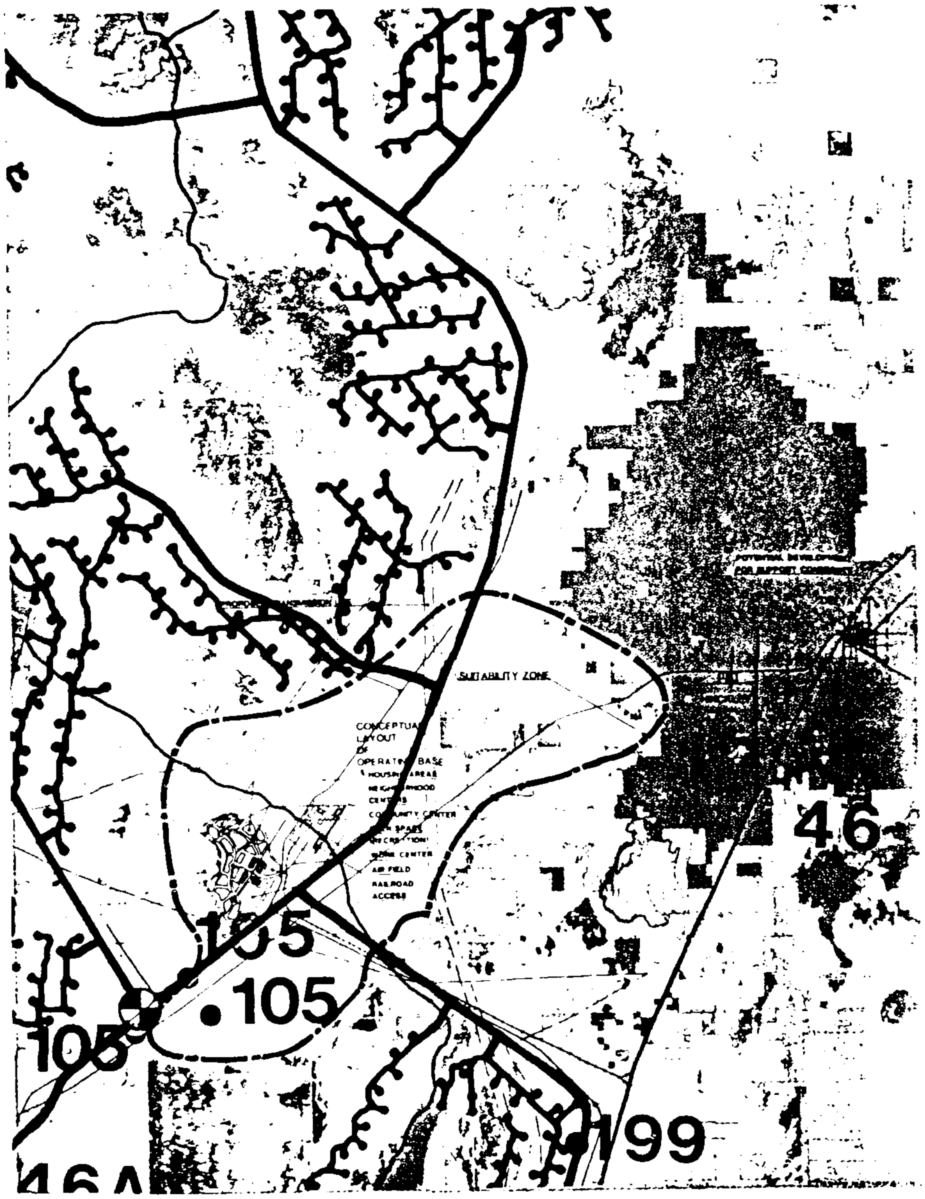


Figure 4.2.1-3. Rare plants in theDelta OB vicinity. (See figure 2.1-1 for rare plant reierence number).

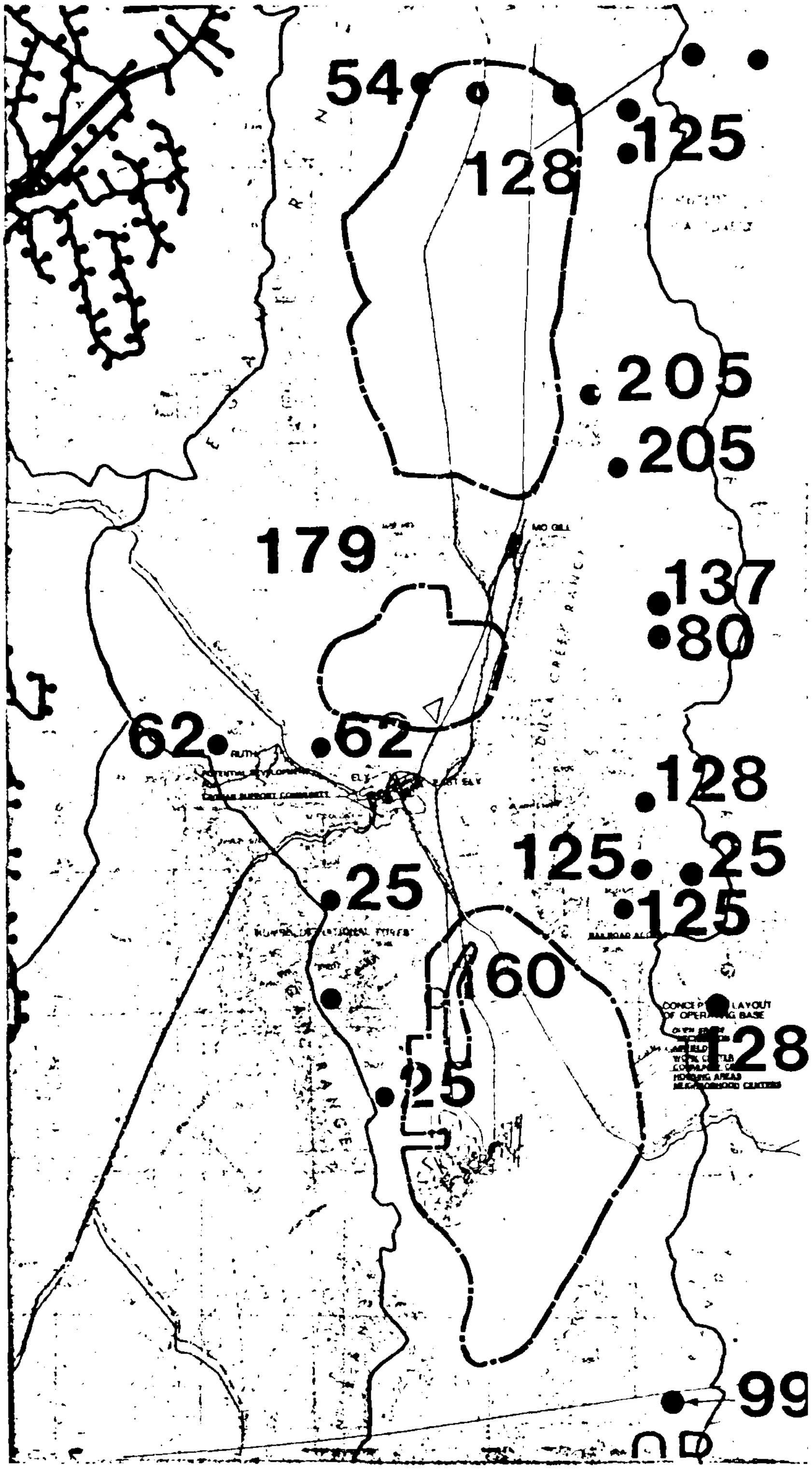


Figure 4.2.1-4. Rare plants in the Ely OB vicinity. (See figure 2.1-1 for rare plant reference number)

ALTERNATIVE 5

The DDA for Alternative 5 is identical to that discussed in the Proposed Action section, therefore impacts are the same. There are no direct impacts to rare plants anticipated as a result of actions involved in construction and operation of the Milford base. There are no known locations in the vicinity of the DAA, OBTS, or OB. Indirect impacts as a result of recreational activity cannot be quantified. Impacts at the Ely base would be identical to those discussed for Alternative 3.

ALTERNATIVE 6

The DDA for Alternative 6 is identical to that discussed in the Proposed Action section, therefore impacts are the same. Impacts at Milford would be identical to those for Alternative 5 and impacts at Coyote Spring would be identical to those for Alternative 4.

ALTERNATIVE 7

No significant impacts to rare plants in the Texas/New Mexico area can be predicted on the basis of available data. The few specific locations known are outside the DDA.

Suitable habitat for rare plant species apparently does not exist in the immediate vicinity of the Clovis or Dalhart sites, due to intensive agricultural activity in the area.

ALTERNATIVE 8

The impacts discussed for the Proposed Action would be the same for this Alternative, except that only half the number of valleys are involved in Nevada and Utah. Clearly, the decrease in the number of valleys involved reduces the number of potentially directly affected rare species locations. The number of known rare plant locations found to be directly affected by (i.e., within one mile of) the split-basing Alternative DDA is 61 (See Table 4.2.1-2). This is compared to 90 locations directly affected by the Proposed Action DDA.

In Texas and New Mexico, no significant impacts to rare plants can be predicted on the basis of available data. Specific locations are known for only a few species, and these are out of the DDA.

Impacts at the operating bases would be comparable to those for the Proposed Action and Alternative 7.

Of all of the protected wildlife species in the Nevada/Utah and Texas/New Mexico deployment areas only the Utah prairie dog (cynomys parvidens) and the desert tortoise (Gopherus agassizii) were considered to be significantly impacted by one or more of the M-X basing alternatives. The legal status of these two species, and direct loss of important habitat and/or nearness to potential OB sites under certain M-X alternatives, makes the potential impacts significant. Significant species such as the bald eagle and peregrine falcon would not lose any roosting or nesting sites (key habitat) to M-X construction, and are sufficiently removed from the OB sites that indirect effects upon these species are anticipated to be minor.

M-X would permanently remove foraging habitat for these two species, but the percentage of total foraging habitat lost would be small (less than 1-2 percent of any hydrologic subunit) and is not considered to be significant. Impact analysis methodology is discussed in Section 4.1.

Impacts upon the Utah prairie dog were judged significant if any habitat was directly removed by project features, or if prairie dogs were located within 15 to 20 road mi of an OB site. Using the output from the indirect effects model (see Section 4.2 and ETR-30) in combination with knowledge of the prairie dog's sensitivity to various indirect effects, gathered from literature, 15 to 20 mi was judged to be a reasonable cut-off point for significant impacts. Knowledge of the exact location of prairie dog colonies also was important in determining impact significance. If colonies were located on private lands with restricted public access than indirect effects were considered moderate within the 15 to 20 mi distance from the OB.

Impacts upon the desert tortoise would only occur when Coyote Spring Valley is used as an OB site. Projected impacts were judged significant at this site because: (1) of the large amount of tortoise habitat directly removed by the OB site and (2) the high indirect effects expected to occur in hydrologic subunits surrounding the OB site. The significance of impacts from indirect effects were estimated for each hydrologic subunit by comparing the abundance index, indirect effect index (from the indirect effects model), and road access from the OB site. The nearness of a hydrologic subunit to Las Vegas was also considered, because recreational activities from Las Vegas may already be heavily impacting the desert tortoise. The presence of an OB at Coyote Spring Valley would not significantly add to the impacts from Las Vegas in certain subunits. The overall impact from indirect effects was judged significant for the Coyote Spring Valley OB because approximately 45 percent of the affected surrounding subunits would be significantly impacted.

WILDLIFE (4.2.2)

Utah Prairie Dog (4.2.2.1)

The Utah prairie dog (Cynomys parvidens) is a medium-sized colonial rodent that lives in large burrow complexes called towns. This species inhabits low, generally level, grassy areas and is dependent upon succulent forbs and grasses for food. The range of this species is the most restricted of all prairie dogs in the United States; it is currently found only in southern Utah an area about half the size of its former range (Collier and Spillett, 1975). This range reduction results from a change in climate, causing a drying trend, loss of habitat to agriculture and urbanization, and poisoning of prairie dogs by ranchers and farmers (Collier and Spillett, 1975). Because of its highly constricted range the Utah prairie dog was federally listed (June 1973) as an endangered species.

DDA:

Figure 4.2.2-1 overlays the M-X DDA in Nevada/Utah and the Utah prairie dog distribution. The Utah prairie dog would not be directly affected by the Proposed Action. No habitat would be lost because of construction activities. The only effects anticipated from DDA construction and operation are indirect effects

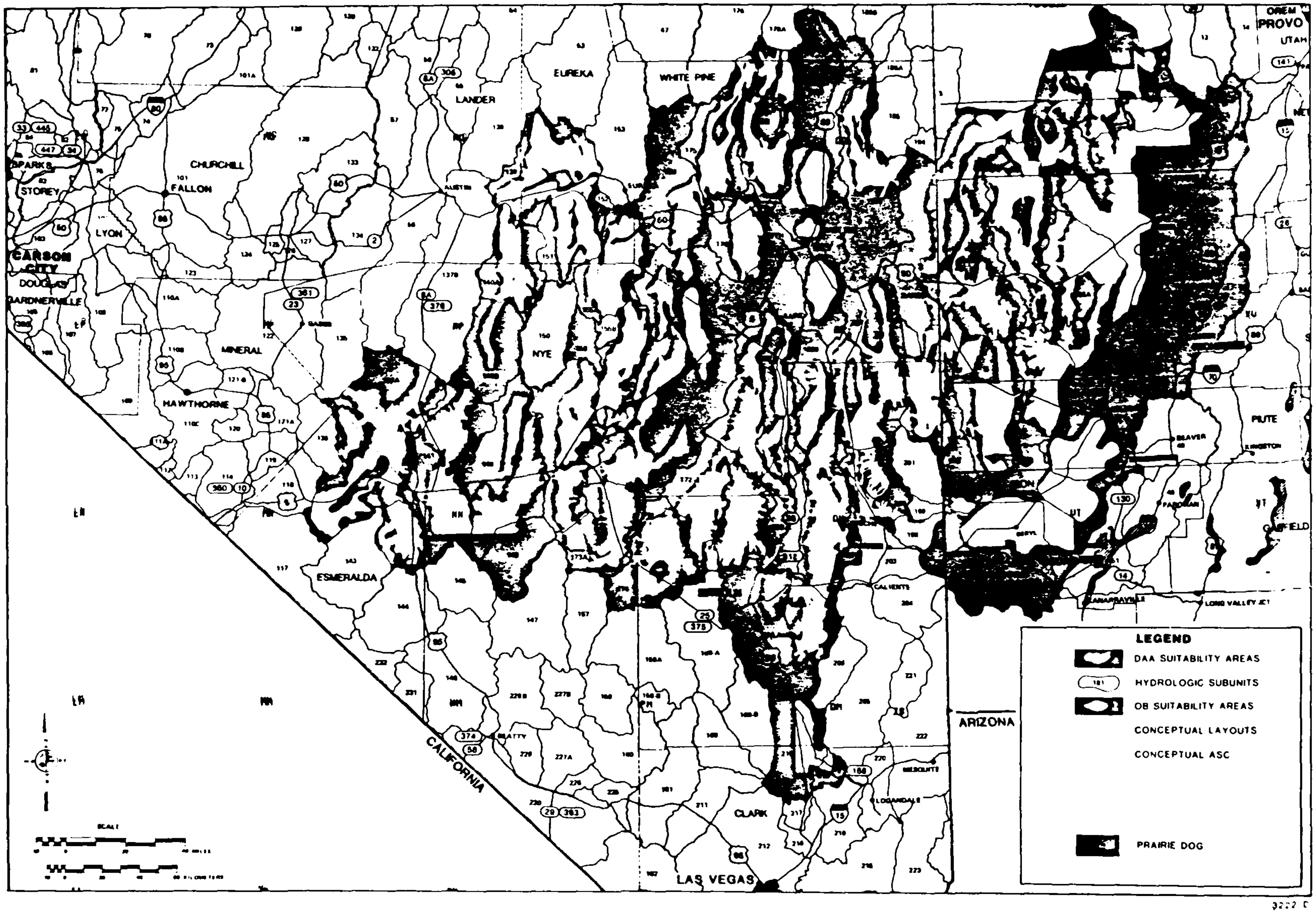


Figure 4.2.2-1. Utah prairie dog distribution and Proposed Action conceptual project layout.

from human activity in Pine Valley, Utah, the only valley within the deployment area supporting this species. These are discussed in greater detail under Alternative 2. Human activity would be greatest during the construction phase of M-X with an estimated population increase of 2,200. Most of these people will be located in a construction camp in central Pine Valley, 15 to 20 mi north of the prairie dog colonies. A dirt road currently exists down the middle of Pine Valley and would provide access to the prairie dog towns.

Indirect effects from human activity, such as shooting, camping, and ORV use, would have some impact upon Utah prairie dogs. Shooting could eliminate small concentrations of prairie dogs but does not greatly influence large populations. Most shooting would likely occur close to the dirt road, perhaps up to one mile away. Camping is not likely to influence prairie dogs in that their habitat holds no attractants to draw campers. ORV activity has the highest potential to significantly impact Utah prairie dog habitat through loss of vegetation, soil disturbance, and noise. ORV activity is expected to be moderate to low in southern Pine Valley because of the distance from the construction camp (15 to 20 mi). Most ORV activity is expected within 5 to 10 mi of camp. Indirect effects upon the Utah prairie dog would cause a slight reduction in their population, perhaps 1 percent or less, and most effects would likely occur within one mile of the central dirt road.

Short-term productivity would decrease slightly, if at all, and long-term productivity should recover to current levels once the construction camp is removed assuming present climatic conditions prevail.

The Proposed Action should not produce any irretrievable commitment of resources. Although indirect effects are not expected to jeopardize populations, the Utah prairie dog is a federally listed endangered species, and because of this any negative impacts must be considered significant. The indirect effects are avoidable by restricting human activities around the construction camp.

Most of the indirect effects can be mitigated by controlling human activity around the construction camp. Prohibition of firearms in camp and restriction of camping and ORV activity to areas not containing Utah prairie dogs could reduce the effects to insignificance.

No direct impacts and no significant indirect impacts upon Utah prairie dogs from an OB at Coyote Spring Valley are anticipated.

Milford OB

A second OB at Milford (see Figure 4.2.2-2) could have a peak of 17,700 people during construction, and a long-term population of 13,100. No direct impacts are anticipated from construction of the OB, however, indirect effects could result from human activity in Parowan Valley. Campgrounds in the mountains to the east of this valley, and other recreation areas east of Milford, would draw people through Parowan Valley and this traffic could possibly disrupt prairie dog habitat. Camping and ORV activity is not expected to be significant in this valley because most of the prairie dog habitat is on private lands and access is likely restricted. Short-term and long-term effects would likely not be significantly different. Indirect effects upon the Utah prairie dog may cause a slight reduction in their population, probably less than one percent, in Parowan Valley and most reductions would likely occur in towns within one mile from a major roadway.

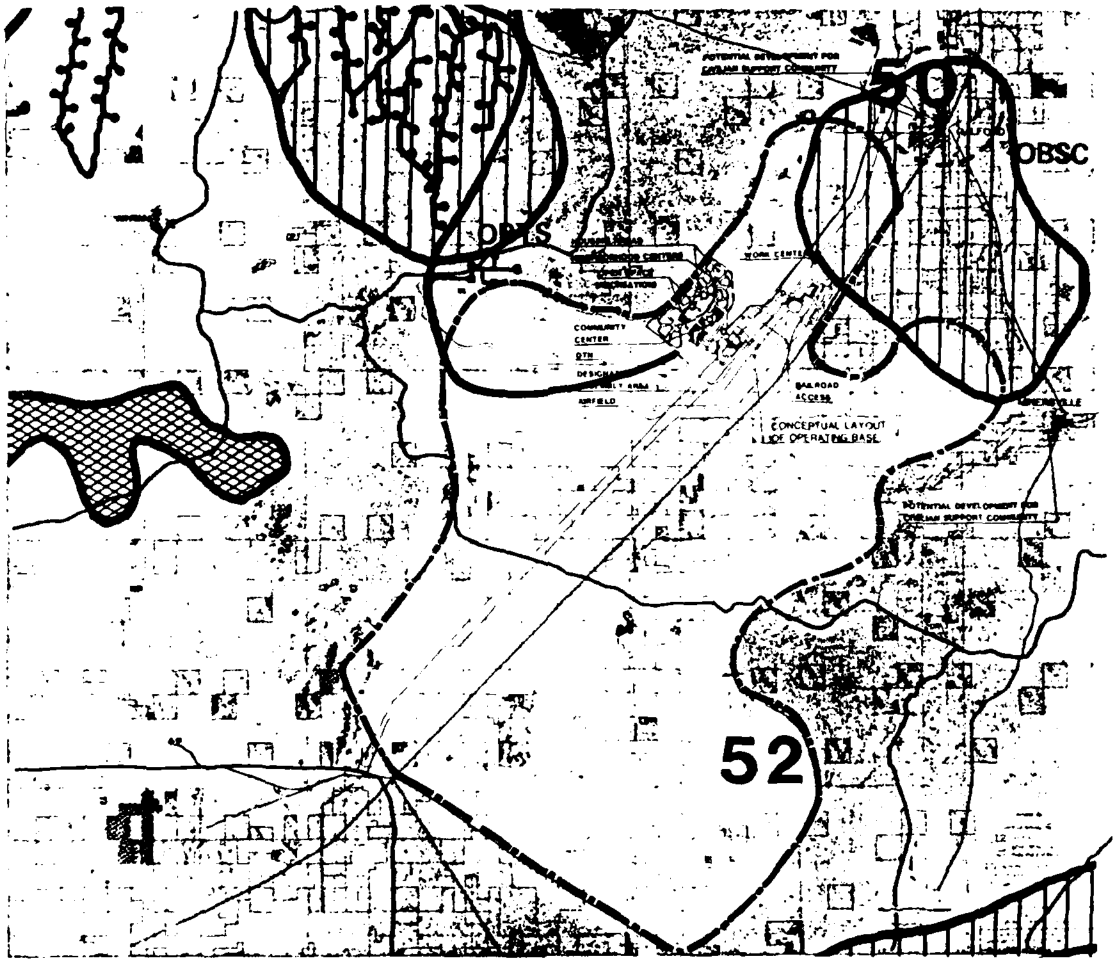


Figure 4.2.2-2. Distribution of Utah prairie dog in the vicinity of the Milford OB. (Hatched area is prairie dog distribution)

Short- and long-term productivity would decrease only slightly, if at all, and the base should not produce any irretrievable commitment of resources. An OB site at Milford has the potential to reduce prairie dog productivity slightly in Parowan Valley through indirect human-related effects. However, the impact potential is considered moderate because the Utah prairie dog is a federally listed endangered species and as such, any negative effects would be considered significant.

Table 4.2.2-1 indicates occurrence and significant impacts upon the Utah prairie dog. The predicted affect is small perhaps unmeasureable and would not be likely to jeopardize the species' existence. Even this effect could probably be mitigated through a variety of means.

Mitigations may be difficult in Parowan Valley because much of the land is privately owned. Fencing and posting of no shooting signs may help restrict human harassment. Utah prairie dog areas can also be labeled as such with signs, and the significance of this species explained. Given the nuisance value of prairie dogs to farmers and ranchers, such attempts on private land may be resisted or may even attract more hunters. Transplantation of prairie dogs from sites of likely human impact, that are privately owned, to areas of good habitat within their historic range under state or federal jurisdiction may partially mitigate the effects of human activity. Transplantation has already been implemented from private lands into Pine Valley, Utah.

ALTERNATIVE 1

Impacts from the Coyote Spring OB are identical to those under the Proposed Action. Impacts from the second base at Beryl (See Figure 4.2.2-3) would consist solely of indirect effects from people-related activities. The second OB site at Beryl would have a peak human population of 17,400 and a long-term population of 12,800. No direct loss of prairie dog habitat would occur as a result of OB construction. This OB site is the only one close enough to Utah prairie dog range in southern Pine Valley (18 to 20 mi) to potentially significantly impact this species. Currently a dirt road provides access from the Beryl OB site into southern Pine Valley. ORV activity in Pine Valley could disrupt prairie dog habitat through loss of vegetation, collapsing of burrows, and noise. Unlike Parowan Valley, where human recreational activities are restricted because of the high proportion of private lands, Pine Valley is readily accessible and use is virtually unrestricted. Although most recreation would be confined to areas closer to the Beryl OB, some effects from ORVs would be likely in Pine Valley, and prairie dog habitat could be impacted. Also unlike Parowan, Pine is near an OB site where long-term human activity would be concentrated. Although the magnitude of the indirect effects may not be great, the fact that this species is federally listed as endangered makes any but the most trivial impacts significant.

Table 4.2.2-1 indicates the occurrence and significant impact upon Utah prairie dog under Alternative 1.

BLM restriction of ORV use through fencing, posting of signs prohibiting ORVs, and law enforcement patrols would partially mitigate indirect effects. However, restrictions on ORV use are very difficult to enforce and fencing the western range is generally not encouraged. Transplantation of prairie dogs into new habitat, plus habitat enhancement through control of livestock grazing would also help mitigate both direct and indirect effects.

Table 4.2.2-1. Potential impact to the Utah prairie dog around operating bases (OBs) for the Proposed Action and Alternatives 1-8. (Page 1 of 2)

HYDROLOGIC SUBUNIT OR COUNTY		ABUNDANCE INDEX[1]	SHORT- AND LONG-TERM IMPACT[1]				
			PROPOSED ACTION	ALT. 1	ALT. 2	ALT. 3	ALT. 4
NO.	NAME		COYOTE SPRING/ MILFORD	COYOTE SPRING/ BERYL	COYOTE SPRING/ DELTA	BERYL/ ELY	BERYL/ COYOTE SPRING
	Subunits or Counties within OB Suitability Area						
46	Sevier Desert	No impact			No impact		
46A	Sevier Desert & Dry Lake[2]	No impact			No impact		
50	Milford[2]	No impact	No impact				
52	Lund District	No impact	No impact	No impact		No impact	No impact
53	Beryl-Enterprise	No impact		No impact		No impact	No impact
179	Steptoe	No impact				No impact	
210	Coyote Spring	No impact	No impact	No impact	No impact		No impact
219	Muddy River Springs	No impact	No impact	No impact	No impact		No impact
	Curry, NM						
	Hartley, TX[2]						
	Other Affected Subunits or Counties						
5	Pine	High	Moderate	High	No impact	High	High
49	Parowan	High	Moderate	High	No impact	High	High
51	Cedar City	High	Moderate	Moderate	No impact	Moderate	Moderate
	Overall Alternative Impact		Moderate	High	No impact	High	High

3921-3

[1]
- No impact. (Prairie dogs are not present for Abundance Index.)
- Low impact.
- Moderate impact.
- High impact. (Prairie dogs are present for Abundance Index.)

[2]Conceptual location of Area Support Centers (ASCs).

Table 4.2.2-1. Potential impact to the Utah prairie dog around operating bases (OBs) for the Proposed Action and Alternatives 1-8. (Page 2 of 2)

HYDROLOGIC SUBUNIT OR COUNTY		ABUNDANCE INDEX[1]	SHORT- AND LONG-TERM IMPACT[1]			
			ALT. 5	ALT. 6	ALT. 7	ALT. 8
NO.	NAME		MILFORD/ ELY	MILFORD/ COYOTE SPRING	CLOVIS/ DALHART	COYOTE SPRING/ CLOVIS
	Subunits or Counties within OB Suitability Area					
46	Sevier Desert	No impact	No impact	No impact	No impact	No impact
46A	Sevier Desert & Dry Lake[2]	No impact	No impact	No impact	No impact	No impact
50	Milford[2]	No impact	No impact	No impact	No impact	No impact
52	Lund District	No impact	No impact	No impact	No impact	No impact
53	Beryl-Enterprise	No impact	No impact	No impact	No impact	No impact
179	Steptoe	No impact	No impact	No impact	No impact	No impact
210	Coyote Spring	No impact	No impact	No impact	No impact	No impact
219	Muddy River Springs	No impact	No impact	No impact	No impact	No impact
	Curry, NM					
	Hartley, TX[2]					
	Other Affected Subunits or Counties					
5	Pine	High impact	Moderate impact	Moderate impact	No impact	No impact
49	Parowan	High impact	Moderate impact	Moderate impact	No impact	Low impact
51	Cedar City	High impact	Moderate impact	Moderate impact	No impact	No impact
	Overall Alternative Impact	No impact	Moderate impact	Moderate impact	No impact	No impact

3921-3

[1]
- No impact. (Prairie dogs are not present for Abundance Index.)
- Low impact.
- Moderate impact.
- High impact. (Prairie dogs are present for Abundance Index.)

[2]Conceptual location of Area Support Centers (ASCs).

ALTERNATIVE 2

DDA effects and Coyote Spring OB effects are the same as for the Proposed Action. Utah prairie dog would not be significantly affected by the OB site at Delta.

ALTERNATIVE 3

Effects upon the Utah prairie dog from M-X deployment would fall into two categories: direct loss of habitat and effects from human presence. Figure 4.2.2-3 overlays the Beryl site onto a distribution map of Utah prairie dog. Utah prairie dogs are currently found only in southern Pine Valley Utah, within the M-X deployment area. Under Alternative 3 the first OB would be located at Beryl, Utah and a portion of DTN would be extended from Beryl through Pine Valley to connect with clusters in that hydrological subunit. This stretch of DTN would bisect prairie dog range. The DTN is estimated to remove 100 ft of habitat along its length, resulting in a direct loss of only 18 to 20 acres of Utah prairie dog habitat. Total habitat in Pine Valley is estimated at 26,300 acres, which means 0.07 percent of total range is removed.

Indirect effects from human activity would be greatest under Alternative 3 since Beryl is the first OB site with a projected peak population of approximately 17,400, and a long-term population of approximately 12,800, and the DTN from Beryl into Pine Valley would provide a convenient corridor for the flow of recreationists into this valley. The major attractant of Pine Valley could be for ORV activity. Increased traffic would likely increase prairie dog road kills in dog towns immediately adjacent to the road, but prairie dogs in other towns are unlikely to be affected. No information currently exists on the significance of road kills on prairie dog populations. Other effects would be comparable to those discussed for the Proposed Action.

There are no cumulative effects expected to occur to Utah prairie dogs because of other projects and the M-X OB sites.

The loss of 18 to 20 acres of prairie dog habitat would result in a drop in prairie dog population approximately in direct proportion to this loss (i.e., less than 0.1 percent). This situation occurs because prairie dogs are closely tied to their burrow complexes and retreat into them to escape danger or disturbance. Scarification would likely eliminate all prairie dogs within that 18 to 20 acre area. Since this loss of habitat would be permanent, no recovery to the current population level would occur.

Indirect effects upon prairie dogs such as discussed above are difficult to quantify. The amount of road kill increase would depend upon the exact alignment of the DTN. If the road bisects a prairie dog town road kills are likely to be higher than if the road is aligned between two dog towns. Prairie dogs other than dispersing juveniles do not normally travel from town to town and so would not cross the road. ORV activity has the highest potential to significantly impact Utah prairie dog habitat. However, because Beryl would be 20 to 25 mi from Utah prairie dog habitat little effect from ORV use is likely (Rajala, 1980). Indirect effects upon the Utah prairie dog would cause a slight reduction in the overall prairie dog population (1-2 percent) in the short term. Most indirect effects would likely be confined to one mile on either side of the roadway.

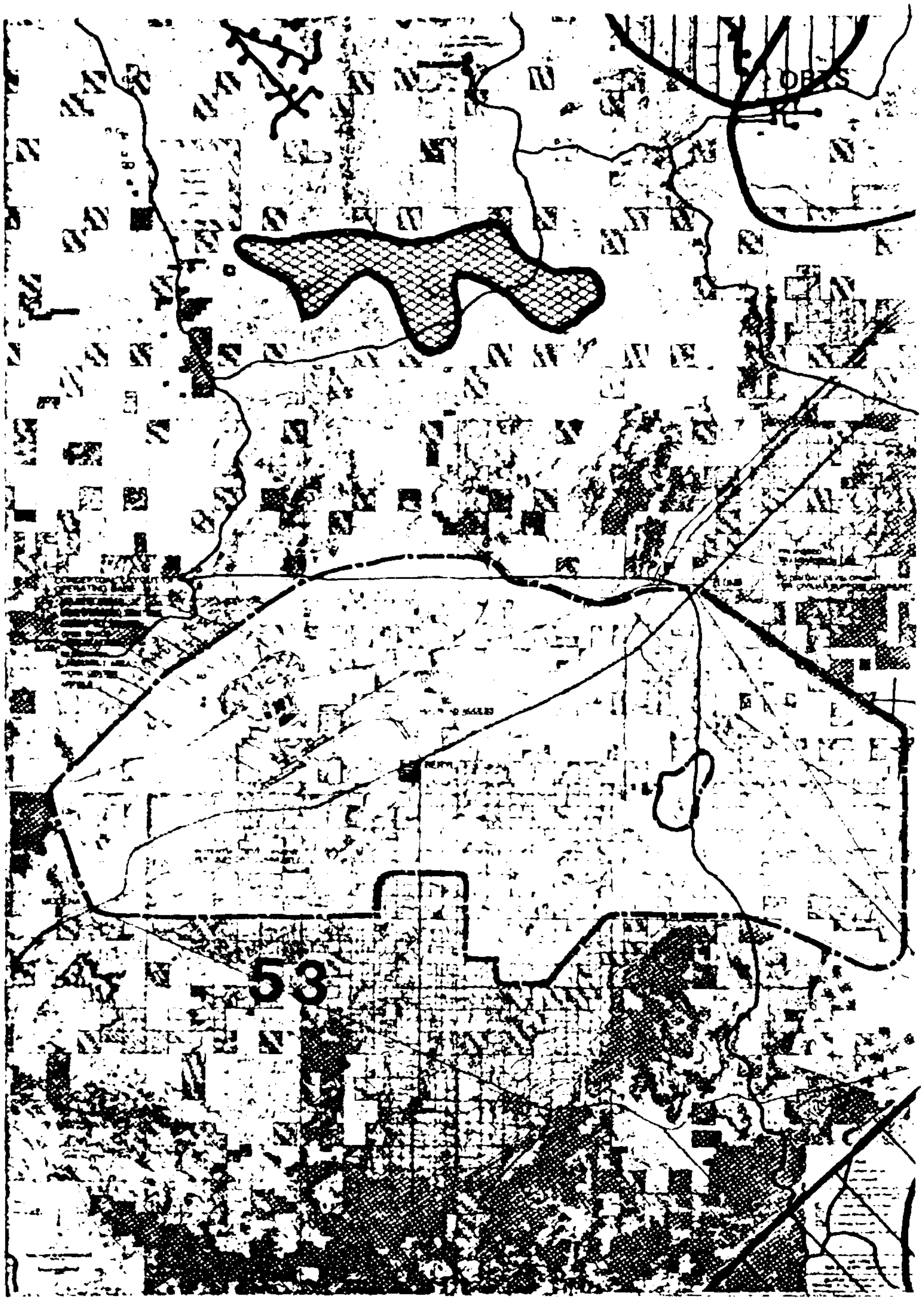


Figure 4.2.2-3. Distribution of the Utah prairie dog in the vicinity of the Beryl OB. (Hatched area is prairie dog distribution)

Productivity should decrease less than one percent in the short term, as it directly relates to loss of habitat. Indirect effects may boost this loss of productivity to perhaps 2 percent. Long-term reduction in productivity would probably remain about the same as or perhaps slightly less (1 percent), than the short-term reduction in productivity. This potential drop in productivity would not be expected to jeopardize the survival of prairie dog populations.

Loss of 18 to 20 acres of Utah prairie dog habitat would be irretrievable commitment of resources but no additional irretrievable commitment of resources is expected from indirect effects. Loss of habitat would be considered a significant impact upon this endangered species.

Table 4.2.2-1 indicates the occurrence and significance of Utah prairie dog in Pine Valley, Utah.

The direct loss of habitat from the DTN could be mitigated by shifting the road alignment to the west to avoid the distribution of Utah prairie dogs in Pine Valley. Another mitigation measure would be to route the DTN through the prairie dog distribution, but align the roadway to avoid the dog towns during detailed surveying. Other mitigations have been discussed previously.

ALTERNATIVE 4

Impacts from the Beryl OB site are identical to those discussed under Alternative 3 and Coyote Spring OB site impacts are comparable to those discussed under the Proposed Action.

ALTERNATIVE 5

The Ely OB site would not significantly impact the Utah prairie dog. With a first OB at Milford the peak human population is projected to be 24,200, with a long-term population of 17,200. Effects upon prairie dogs are expected to be slightly higher than were estimated under the Proposed Action because of this greater human population, but the indirect impacts are expected to be moderate.

Table 4.2.2-1 indicates the occurrence and significance of impact upon Utah prairie dogs under Alternative 5.

ALTERNATIVE 6

Utah prairie dogs would not be significantly impacted by placing a second OB at Coyote Spring Valley and impacts from the first OB at Milford are identical to those for Alternative 5.

ALTERNATIVE 7

Utah prairie dogs do not occur in Texas or New Mexico.

ALTERNATIVE 8

Utah prairie dog would not be significantly affected by an OB site at Coyote Spring Valley. Utah prairie dogs do not occur in Texas or New Mexico.

Desert Tortoise (4.2.2.2)

The desert tortoise is a large, herbivorous reptile that inhabits the Mojave and Sonoran desert habitats in southern Nevada, southwestern Utah, southeastern California, western Arizona, and south into Mexico. There are indications that the desert tortoise is declining throughout its range and that most of this decline can be attributed to human disturbances. These declines have led to the protection of the desert tortoise in the four states in which it occurs and to the federal designation of threatened status for the desert tortoise in the Beaver Dam Slope of southwestern Utah. In addition, throughout its range the desert tortoise is now under review for federal protection (FR 45 (163)). That human activity constitutes the major threat to the desert tortoise many be seen in the following quotation.

> The chief threats to the tortoise include habitat destruction through development for residential and agricultural use, overgrazing (Berry, 1978), geothermal development, taking as pets (now largely controlled by individual states), malicious killing, from being run over on roads, and for competition with grazing or feral animals. Natural predation may or may not be a significant factor in the decline of this species, depending on age class involved (FR 45(163)).

Proposed Action

Figure 4.2.2-4 overlays the M-X DDA in Nevada and Utah and the desert tortoise distribution. No adverse impacts are expected to occur to desert tortoises from the construction of clusters and DTN in the valleys of Nevada and Utah because these structures are not located in desert tortoise habitat.

Figure 4.2.2-5 overlays the conceptual Coyote Spring operating base and suitability envelope and desert tortoise distribution. A base in Coyote Spring Wash will negatively impact desert tortoises by direct habitat destruction and by indirect human actions. This base will directly eliminate approximately 7,000 to 7,500 acres of desert tortoise habitat which has been estimated to have a density of 117 tortoises per sq mi (Enriquez, 1977). More recent work by the Bureau of Land Management estimates 90 percent of this valley to have medium to high tortoise densities. The operating base suitability envelope covers a large portion of medium density tortoise habitat from north to south and a large area of high tortoise density in the eastern part of this envelope. The base community is presently located in a high tortoise density area and the air field and base structures are in a high to medium tortoise density area. The railroad spur running from the Union Pacific Railroad to the east up Coyote Spring from the south would run through high and very high tortoise density areas. Given that the disturbed roadbed is approximately 30 ft wide and the spur will be about 25 mi long, approximately 40 more acres would be permanently lost to tortoises; more than that will be disturbed to build the line; and an additional barrier to tortoise movements could be established. Potential expansion of Route 93 could remove an additional 300 acres.

In addition to direct habitat destruction due to the construction of base facilities and the rail line, approximately 16,000 people will inhabit this area. Collection of tortoises for pets has depleted tortoise populations near cities and collection can significantly change age class ratios which leads to lower reproduction in a population (Berry, 1976). An increase in use of presently little used secondary roads is also expected due to this population influx, which would also

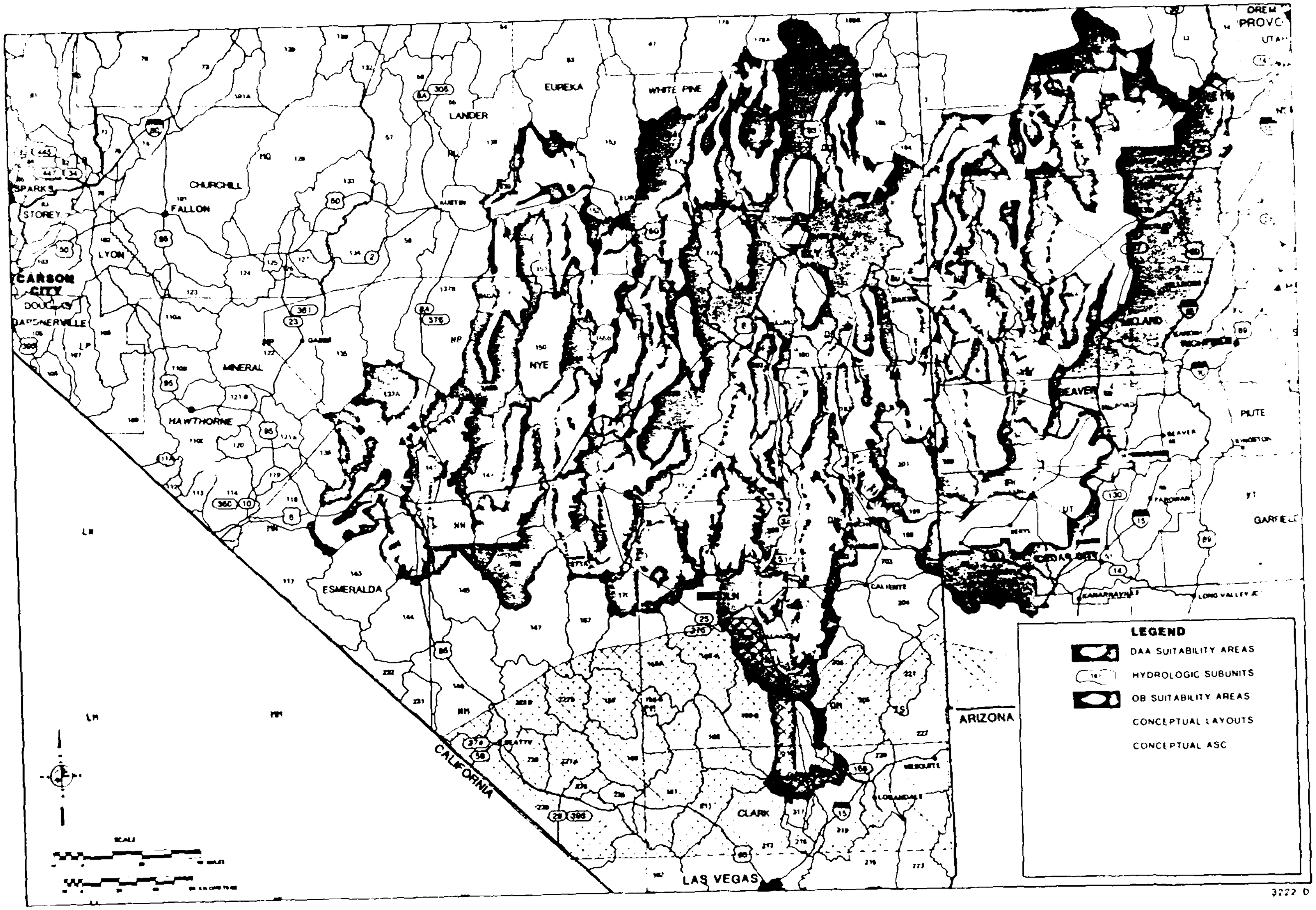
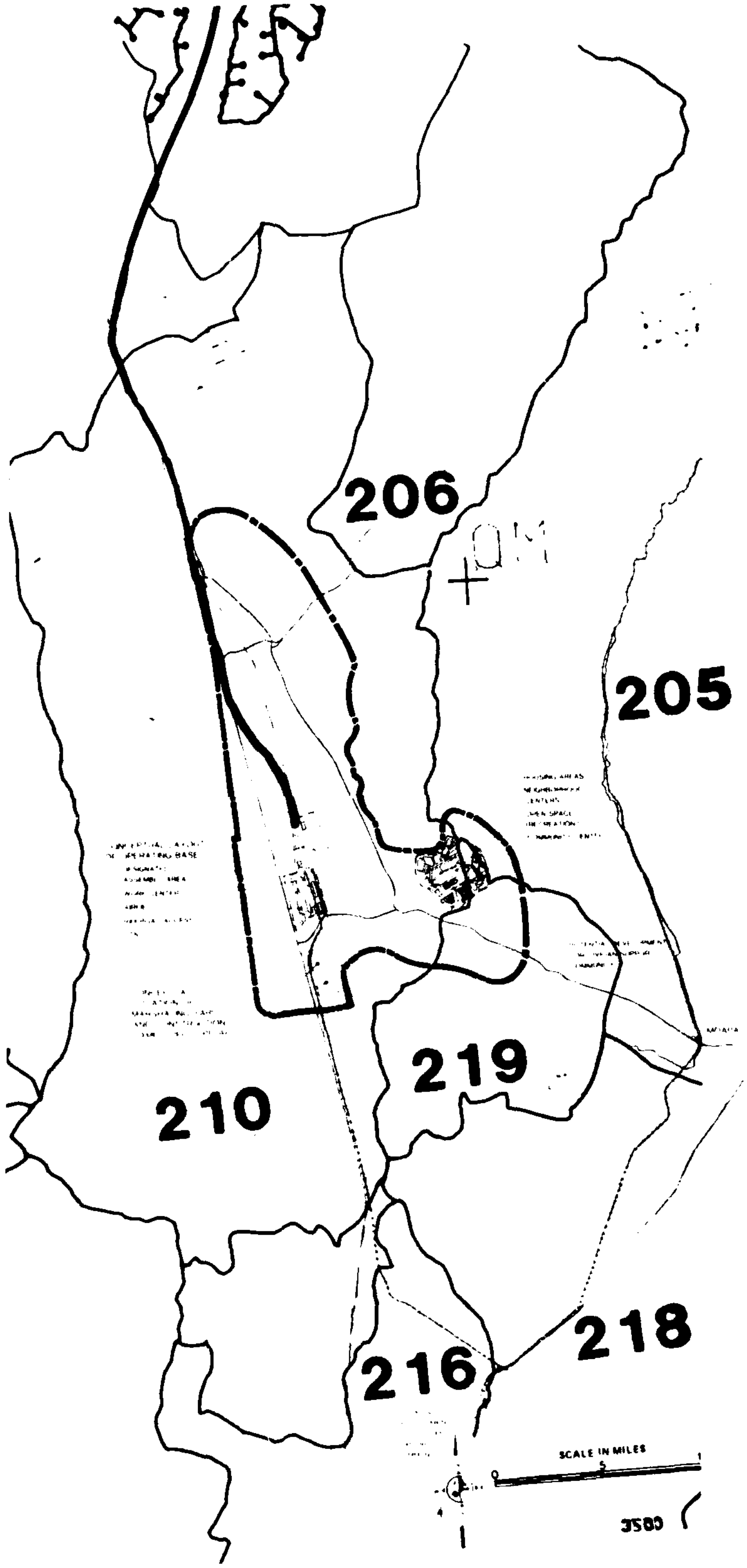


Figure 4.2.2-4. Distribution of desert tortoise.

Figure 4.2.2-5. Intersection of desert tortoise distribution at Coyote Spring OB and vicinity.



result in increased tortoise collecting (Luckenbach, 1975 cited in Steven, 1976). Besides the detrimental effect of people collecting tortoises, new roads, and increased traffic on existing roads (particularly to and from Las Vegas) will result in additional tortoise deaths. Nicholson (1978) found that roads have a measurable detrimental effect on tortoise populations up to one kilometer from a road.

Besides the actual habitat lost due to the construction of facilities, habitat destruction due to off-road vehicle (ORV) activity can be severe. Near Barstow, California, estimated tortoise biomass was 3.4 kg/ha in non ORV-use areas versus 0.5 kg/ha. in the ORV-use area (Bury, 1978). Bury (1978) found that ORVs collapse burrows, destroys vegetation, and cause indirect mortality of tortoises besides killing tortoises by direct collisions. Heavy use around the base at Coyote Spring would probably be concentrated within a 3 mi radius (Rajala, 1980) and diminish with increasing distance. These impacts will be long-term for at least the life of the project. Long-term productivity would continue to decline and given the large number of people introduced to the area, the possibility exists that densities of tortoises in this hydrologic subunit could drop below the point where they can sustain their viability.

Due to its rare and protected status, any negative impacts to the desert tortoise are significant. If an operating base is located in Coyote Spring, most of these impact are unavoidable. The habitat lost to base construction and a new rail line would not be recovered. It may be possible to relocate some portion of the tortoise population, but without almost total cessation of cattle and sheep grazing and ORV activity in nearby areas the remaining habitat may not be able to support these displaced tortoises. Indirect impacts may be reduced if off-road vehicle activity could be strictly prohibited anywhere in the hydrologic subunit. Also, collecting of tortoises, which is prohibited by state law, should be strictly monitored as should any harassment by people. Table 4.2.2-2 compares the effects to desert tortoises by the Coyote Spring and Milford Operating Base. Only the Coyote Spring Operating Base will cause significant negative impacts to desert tortoises. This would be true for any alternative which includes the Coyote Spring operating bases. No tortoises occur near Milford and no adverse impacts are expected.

Desert tortoises do not occur within the area of any other Operating Base. In Alternatives 4 and 6 the Coyote Spring Valley OB is a second base. The impacts to desert tortoises would be similar to those alternatives where Coyote Spring OB is a first base but to a slightly smaller amount. Instead of 7,500 acres of habitat disturbed approximately 4,500 would be used for a second base. Also instead of a long-term population of about 16,000 people, a second base at Coyote Spring Wash would have about 12,000. These reductions are not expected to change the overall effects to tortoises appreciably and use of the Coyote Spring Wash OB as a second OB would still cause significant impacts.

AQUATIC SPECIES (4.2.3)

The significance the predicted impacts was estimated by consideration of the following questions regarding the magnitude of the impact: What is the effect of the disturbance on the viability of the resource. To what extent will the effect be masked by normal variation expressed by the resource. How rapidly will the resource recover from temporary disturbance. What is the scientific or intrinsic value of the resource. To what extent is the resource limited by the impacts threatening its carrying capacity, by a process which has already been set in motion for some historic period of time. Are the consequences such that the ecosystem will

Table 4.2.2-2. Potential impact to desert tortoises in Nevada and Utah within 70 mi of the proposed operating base at Coyote Spring.[1]

HYDROLOGIC SUBUNIT NO.	HYDROLOGIC SUBUNIT NAME	ABUNDANCE INDEX[2]	POTENTIAL INDIRECT IMPACT[3]
	Subunits Containing Base Suitability Area		
210	Coyote Spring		
219	Muddy River		
	Other Affected Subunits		
161	Indian Spring	High	Low
169B	Tikaboo—South	High	Low
205	Meadow Valley Wash	High	High
206	Kane Spring	High	High
209	Pahranagat Valley	High	High
211	Three Lake	High	Low
212	Las Vegas	High	Low
215	Black Mountains	High	Low
216	Garnet	High	High
217	Hidden Valley—North	High	High
218	California Wash	High	Moderate
219	Muddy River	High	High
220	Lower Moapa	High	Moderate
221	Tule Desert	High	Low
222	Virgin River	High	Moderate
223	Gold Butte	High	Low
	Overall Impact[4]	High	High

3852-2

[1]NOTE: Desert tortoises would not be impacted in any other OB location. Also, construction of a DDA in Nevada/Utah or Texas/New Mexico would not impact the desert tortoise.

[2,3]

- No impact. (No abundance.)
- Low impact. (Low abundance.)
- Moderate impact. (Moderate abundance.)
- High impact. (High abundance.)

[3]Significance of impact was estimated for each hydrologic subunit by comparing the abundance index, indirect effect index (see ETR-30), and road access from the OB site. The nearness of a hydrologic subunit to Las Vegas was also considered, because recreational activities from Las Vegas may already be heavily impacting the desert tortoise. The presence of an OB at Coyote Spring Valley would not significantly add to the impacts from Las Vegas in certain subunits.

[4]The overall impact was judged significant because approximately 45 percent of the affected hydrologic subunits would be significantly impacted, and the desert tortoise is protected by Nevada and Utah state law as a threatened species and is under review for Federal protection under the Endangered Species Act.

not recover at all. Are the consequences such that the impact may be large but the recovery process will overcome the damage in a reasonable period of time. Are the deleterious effects measurable? To what extent will funding be required to mitigate the effects on the resource? More detailed and site-specific analysis will be performed after a siting region has been selected. This is consistent with the tiering concept discussed in Section 1.7.2 of the DEIS.

Proposed Action

The distribution of federally and state protected aquatic species and the Proposed Action are shown on Figure 4.2.3-1. Construction and operation of the M-X project in the Great Basin desert may impact protected aquatic species directly through: (1) habitat disturbance, (2) altered runoff patterns, (3) addition of pollutants, and (4) groundwater withdrawal. The last is most difficult to assess, yet most likely to cause adverse impacts. Indirect impacts would largely result from recreation activities of people drawn to the area by the project. Recreational activities of concern include fishing, camping, swimming, and use of off-road vehicles. The introduction of exotic aquatic species may also occur. The most important area of potential impact occurs in the White River Valley system. This system includes White River, Pahranagat, Coyote Spring, and Moapa valleys in addition to feeder hydrologic subunits such as Dry Lake, Delamar, Pahroc, Coal, Garden, Long, and Jakes valleys. Railroad, Hot Creek, Spring, Steptoe, and Snake valleys also contain numerous localized habitats with protected aquatic species which may be subject to either direct or indirect impacts of the Proposed Action.

Potential impact that appears to be most pervasive is that of groundwater withdrawal upon certain aquatic habitats that are hydrologically linked to aquifers that would be used for M-X. Although there is substantial uncertainty associated with these impact predictions, the prospects for impact can be estimated based on known hydrological conditions and expected project requirements (Table 4.2.3-1). Federally and state protected fish occurring in Moapa and Pahranagat valleys (the most important being the Moapa dace and the Pahranagat roundtail chub) stand the greatest chance of being affected by groundwater withdrawal either as a result of water use in the valley of concern or in feeder valleys. See Technical Report on Groundwater Resources.

Since the greatest percentage of groundwater withdrawal will occur in valleys removed from White River, Moapa, and Pahranagat valleys, the impacts may occur much later that when the water withdrawal takes place. This depends upon various hydrological features, such as substrate transmissivity, slope, and fault structure. Water withdrawal impacts on springs in Moapa, Pahranagat, and White River valleys will probably occur on the order of months or years after the initiation of the action. More detailed project requirement data are required before impacts can accurately be measured, but the potential for significant loss of downslope aquatic habitat is especially likely in Moapa, Pahranagat, and White River valleys. Although the magnitude of this effect may be large, its duration is not expected to exceed the duration of the action causing the depletion of groundwater. Since the habitat requirements for the species of concern are also incompletely known the magnitude of the biological impact cannot be predicted.

Current endangerment of federally protected species appears to have resulted, in some instances, from stresses such as water diversion for irrigation purposes or use of the water source by livestock. For instance, in the Ash Spring outflow in Pahranagat Valley, the federally protected Pahranagat roundtail chub has dwindled

PROTECTED FISH SPECIES

LEGEND

PROTECTED FISH SPECIES FOR NEVADA AND UTAH

A ASH MEADOWS AMARGOSA PUPFISH
B CUI UI*
C RELICT DACE
E RAILROAD VALLEY SPRINGFISH
F UTAH OR SNAKE VALLEY CUTTHROAT TROUT
G WARM SPRINGS AMARGOSA PUPFISH*
H DEVIL'S HOLE PUPFISH*
I BIG SPRING SPINEDACE
J WHITE RIVER SPINEDACE
K WHITE RIVER DESERT SUCKER
L WHITE RIVER SPRINGFISH
M PAHRANAGAT ROUNDTAIL CHUB*
N PAHRUMP KILLIFISH*
O MOAPA DACE*
P LAHONTAN CUTTHROAT TROUT*
R VIRGIN SPINEDACE
S VIRGIN RIVER ROUNDTAIL CHUB
T WOUNDFIN*
Q LEAST CHUB

* Federally protected

RECOMMENDED PROTECTED FISH SPECIES FOR NEVADA AND UTAH

1 PRESTON WHITE RIVER SPRINGFISH
2 MORMON WHITE RIVER SPRINGFISH
3 WHITE RIVER SPRINGFISH
3a HIKO WHITE RIVER SPRINGFISH
3b MOAPA WHITE RIVER SPRINGFISH
4 ASH MEADOWS SPECKLED DACE
5 INDEPENDENCE VALLEY SPECKLED DACE
6 CLOVER VALLEY SPECKLED DACE
7 MOAPA SPECKLED DACE
8 NEWARK VALLEY TUI CHUB
9 LAHONTAN TUI CHUB
10 ALVORD CHUB
11 INDEPENDENCE VALLEY CHUB
12 SHELDON TUI CHUB
13 FISH CREEK SPRINGS TUI CHUB
14 JUNE SUCKER
16 UTAH LAKE SCULPIN
17 HUMBOLDT LAHONTAN CUTTHROAT TROUT
18 WHITE RIVER SPECKLED DACE
(F) UTAH OR SNAKE VALLEY CUTTHROAT TROUT
(R) VIRGIN SPINEDACE

RECOMMENDED PROTECTED INVERTEBRATES

MOLLUSCS

19 OVERTON ASSIMINEA
20 MOAPA VALLEY TURBAN
21 ASH MEADOWS TURBAN
22 PAHRANAGAT VALLEY TURBAN
23 HOT CREEK TURBAN
24 STEPTOE TURBAN
25 WHITE RIVER VALLEY FONTELICELLA
26 RUBY VALLEY FONTELICELLA
27 CURRENT FONTELICELLA
28 DUCKWATER FONTELICELLA
29 RED ROCK FONTELICELLA
30 WHITE RIVER VALLEY HYDROBID
31 DUCKWATER SNAIL
32 CORN CREEK SNAIL
33 ASH MEADOWS TRYONIA
34 MOAPA TRYONIA
35 ZION CANYON PHYSA
36 RUSSELL'S SNAIL

INSECTS

DIPTERANS
37 VIRGIN RIVER NET WINGED MIDGE
HEMIPTERANS
38 ASH SPRINGS CREEPING WATER BUG
39 MOAPA CREEPING WATER BUG
PLECOPTERANS
40 GIANT STONEFLY NYMPH

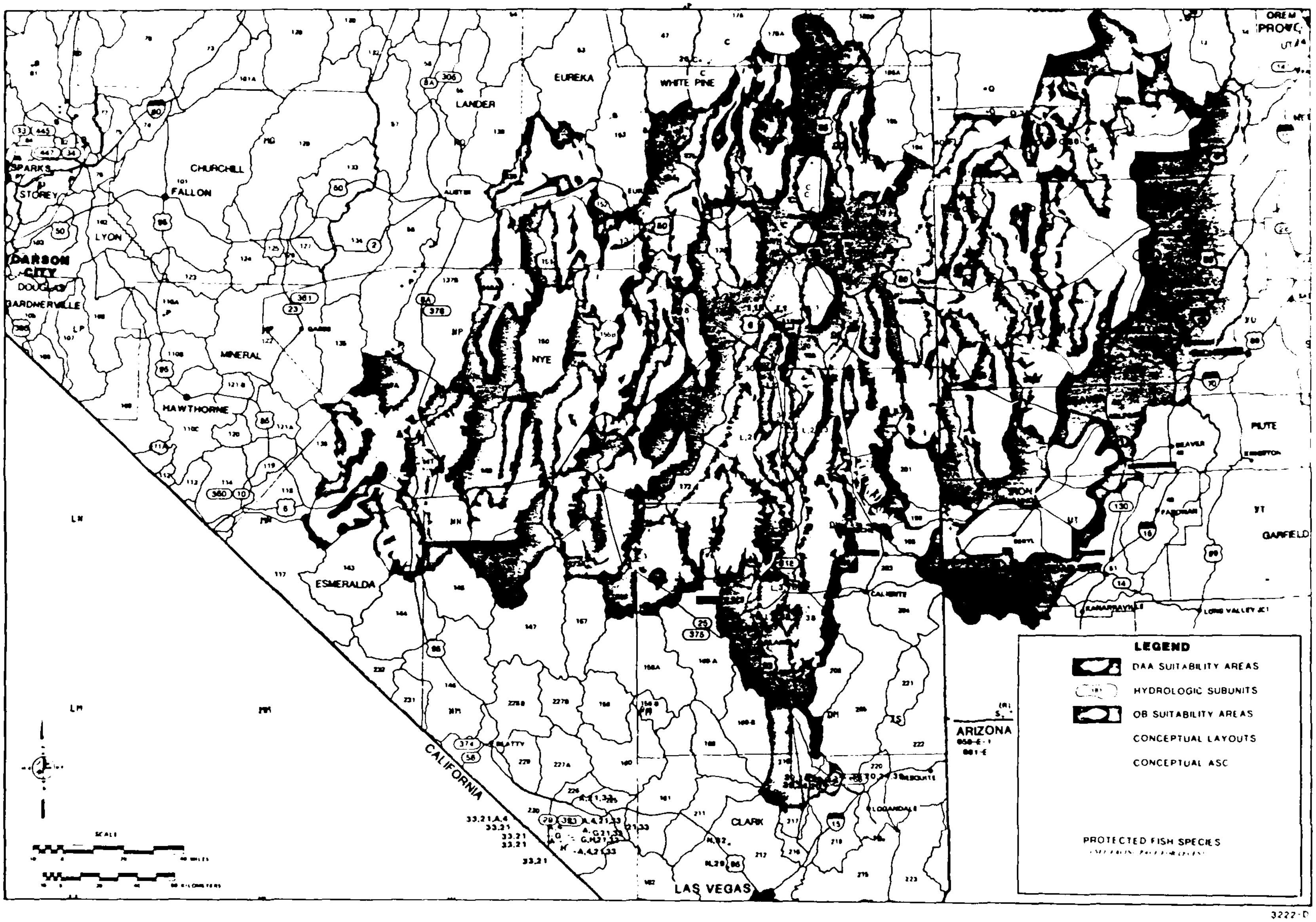


Figure 4.2.3-1. Federal and state protected aquatic species and Proposed Action concept project layout.

to less than 45 individuals. This has probably resulted primarily from loss of spawning and feeding habitat related to periodic reductions in water level by 50 percent for irrigation purposes. Irrigation diversion may have also caused the extirpation of the White River spinedace from Preston Big Spring in White River Valley and the virtual loss of the White River desert sucker from the same habitat. Neither the normal variation in population size of individual species nor baseline conditions, including seasonal fluctuations, are presently known. Present knowledge indicates that population numbers remain fairly constant in some habitats, but fluctuate widely in others; a case-by-case evaluation of baseline conditions and potential project impacts would be required to answer these questions.

Reduction in population does not necessarily spell extirpation or extinction if a nucleus of the population is retained and density dependent compensation is allowed to proceed along its course of rebuilding the population to optimum density for the carrying capacity of each unique habitat. Most aquatic species of concern produce at least one new generation per year and thus recovery would be fairly rapid if the impact were sufficiently mitigated and temporary, and if subsequent conditions permitted recovery. However, once a species population is reduced to such a low size that it can no longer rebuild, it will be extirpated from that particular habitat.

With respect to groundwater withdrawal, avoidance of sensitive aquatic habitats is not possible since the vagaries of groundwater movement are not presently well understood. The most promising mitigation is to change well pumping rates and locations as soon as effects are noted on aquatic habitats of concern. However, since the natural groundwater flow recovery may be slow, additional mitigations may be required. This may involve supplemental augmentation of water supply in affected aquatic habitat by piping in additional supplies from distant wells. Such pumping, however, may complicate the groundwater drawdown picture in the area and actually increase negative impacts on the habitat of concern. In this case, the only remaining mitigation would be transplantation of the affected population to another aquatic habitat unaffected by project impacts. This procedure would be difficult because of the variable water quality and habitat conditions between isolated aquatic habitats near and distant from the affected aquatic habitat. The USFWS discourages such transplantation.

The impacts of direct intersection of project structures with sensitive aquatic habitats is not expected to cause significant impacts on protected aquatic species (Table 4.2.3-2). Only in Railroad and/or Snake valleys do proposed project structures approach within one mile of aquatic habitats containing protected aquatic species -- the state protected Railroad Valley springfish and least chub, respectively. Habitats of the Morman White River springfish, Pahranagat roundtail chub, and White River springfish occur within 5 mi of the proposed DDA. As mentioned previously, habitat disturbance, altered rainfall runoff patterns and addition of pollutants may result from project construction in the immediate vicinity of sensitive aquatic habitats. These impacts could be readily mitigated by avoidance or site-specific customized engineering design, thus reducing the potential for significant impacts. Of particular concern are some of the last known habitats of a pure strain of the federally protected Lahontan cutthroat trout. Located in the Reese River headwaters, and adjacent to some of the westernmost cluster construction areas (Big Smoky Valley, etc.). Fishing pressure, enhanced by project-related personnel (e.g., from nearby construction camps) could produce significant losses unless mitigated. Populations of the state-protected Utah cutthroat trout occurring in the mountains bordering Spring and Snake valleys also would be subjected to increased fishing pressure. Special fishing restrictions may be required for these areas to protect this

Table 4.2.3-1. Protected or recommended protected aquatic biota for which available data indicate close monitoring for water withdrawal-related impacts during construction or operation of the project in Nevada/Utah.

POTENTIALLY IMPACTED PROTECTED OR RECOMMENDED PROTECTED BIOTA[1]	LEGAL STATUS[2]	SPECIES LOCATION[3]	ESTIMATED WATER USE (PERCENT OF PERENNIAL YIELD)[4]	INTERBASIN EXCHANGE - INPUT[5]			
				ADJACENT BASIN	ESTIMATED WATER USE PROJECT (PERCENT OF PERENNIAL YIELD)[4]	NEARBY BASIN	ESTIMATED WATER USE PROJECT (PERCENT OF PERENNIAL YIELD)[4]
Moapa dace	FE	Moapa	N/A	Coyote/Kane	27-163[6]/ 20-120[7]	Dry Lake	>73
Moapa White River springfish	ST	Moapa				Delamar	>20
Moapa speckled dace	RT	Moapa				Coal	>1,000
Moapa Valley turban	RT	Moapa				Garden	23-70
Moapa tryonia	RT/RE	Moapa				Cave	>50
Moapa creeping waterbug	RT/RE	Moapa				Jakes	>5.8
						Long	27-80
Pahranagat roundtail chub	RE	Pahranagat	1.6	Coal	>1,000	Garden	23-70
White River springfish	ST/RE	Pahranagat		Dry Lake	>73	Cave	>50
Hiko White River springfish	ST	Pahranagat		Delamar	>20	Jakes	>5.8
White River speckled dace	RT/RE	Pahranagat				Long	27-80
Pahranagat Valley turban	RT	Pahranagat					
Mormon White River springfish	ST	White River	5.9	Jakes	>5.8	Long	27-80
Preston White River springfish	ST						
White River desert sucker	ST/RE	White River					
White River spinedace	ST/RE	White River					
Hot Creek turban	RE	White River					
White River Valley fontelicella	RE	White River					
White River Valley hybrobiid	RE	White River					
Railroad Valley springfish	ST	Hot Creek	43	No Known Interbasin Exchange			

1449-6

[1]Scientific names are listed in ETR-16.

[2]F = federal, E = endangered, S = state, T = threatened, R = recommended.

[3]Valley, watershed, or hydrologic unit.

[4]MPQ/PY = Estimated water use as determined by most probable quantity (MPQ) divided by perennial yield (PY) as expressed in percent, per information derived from Table 3.2.2.1-1 in Chapter 3.

[5]Information derived from Figure 6 in Eakins (1966).

[6]Assuming location of first OB in valley during operation.

[7]Assuming location of second OB in valley during operation.

N/A = Not Available.

species. For other locations, most of the impacts upon the resource can be mitigated first by avoidance, then by various site-specific mitigations initiated to protect the uniqueness and integrity of sensitive habitats. At this stage, however, neither these impacts nor mitigating measures can be accurately quantified.

Table 4.2.3-3 summarized potential long and short-term impacts for each hydrologic subunit. The highest potential would be in Muddy Springs Valley with a moderate potential in Pahranagat, Spring, and Railroad valleys.

Operating Base Impacts

Coyote Spring

Locating an OB in Coyote Spring Valley (Figure 4.2.3-2) increases the potential for DDA layout impacts resulting from groundwater withdrawals. The boundary of the Operating Base suitability envelope approaches as close as 1-2 mi from the Moapa Fish Sanctuary. Locating an OB at Coyote Spring (Table 4.2.3-1) may reduce the perennial yield for this hydrologic subunit such that, when added to effects of groundwater withdrawal in connecting feeder valleys upslope from the Moapa Fish Sanctuary, the chance for irretrievable losses of the protected aquatic species in the Moapa Fish Sanctuary is high. Pumping of water allotted to Las Vegas from Lake Mead would effectivelly mitigate concern of water withdrawal impacts of the Operating Base upon the Moapa Fish Sanctuary, however.

Federally and state protected fish will also be impacted by DTN construction and support community growth in the portion of the Pahranagat Valley near Alamo. The impacts of road construction and project-related personnel recreation on the habitats in Pahranagat Valley are not expected to be significant in and of themselves, but if added to pre-existing stresses such as irrigation diversion, livestock watering, proliferation of exotic species and swimming, a significant reduction of the resource could result. This would be in addition to impacts resulting from project-related reductions in spring flow.

Federally and state protected species occur both in the Virgin River 30 mi to the east of the proposed OB location in Coyote Spring Valley and in certain habitats located approximately at an equal distance to the west. Impacts may be expected in the Virgin River but not in habitats west of Las Vegas. Water withdrawal and recreation will not directly impinge upon these latter habitats for the following reasons: the groundwater hydrology is such that project-related well water withdrawals would not affect them, and the recreational pressures would most likely be diverted to locations adjacent to the Coyote Spring site such as Lake Mead, the Virgin River, and Las Vegas.

Milford

Since no federally or state protected fish occur within at least a 40-mi radius of the proposed Milford OB, it is postulated that no significant direct or indirect effects of construction or operation of this facility will impact protected aquatic species.

A summary of the impacts for the Proposed Action is presented in Table 4.2.3-4. Moapa (Muddy River) and Pahranagat, Spring, White River valleys and the Virgin River are subject to the most significant losses, although they are mitigatible. Groundwater withdrawal and indirect effects (recreation) cause most concern. Long-term impacts are moderate in two valleys only, and virtually non-existent in all others.

Table 4.2.3-2. Valleys containing both sensitive aquatic habitat and proposed structures (inhabited by either letally or recommended protected aquatic species).

HYDROLOGIC SUBUNITS		SENSITIVE AQUATIC HABITATS		
		TOTAL	I*	PERCENT OF TOTAL
4	Snake	13	2[+]	15.4
5	Pine			
6	White	2	0[+]	0
7	Fish Springs	3	0	0
8	Dugway			
9	Government Creek			
46A	Sevier Desert - Dry Lake (UT)			
46				
52	Lund District (UT)			
54	Wah Wah (UT)			
137A	Big Smoky - Tonopah Flat	1	0	0
139	Kobeh			
140A	Monitor - Northern	2	0	0
141	Ralston			
142	Alkali Spring			
149	Stone Cabin			
150	Little Fish Lake			
151	Antelope			
154	Newark	11	0	0
155A	Little Smoky - Northern	1	1	100
155B	Little Smoky - Central			
155C	Little Smoky - Southern			
156	Hot Creek			
170	Penoyer			
171	Coal			
172	Garden			
173A	Railroad - Southern			
173B	Railroad - Northern	4	1	25
174	Jakes			
175	Long			
178B	Butte - South			
180	Cave			
181	Dry Lake			
182	Delamar			
183	Lake			
184	Spring	4	0	0
196	Hamlin			
202	Patterson			
207	White River	9	0[+]	0
208	Pahroc			
209	Pahranagat	5	0[+]	0
210	Coyote Springs			
53	Beryl			
148	Cactus flat			
179	Steptoe	14	0	0

3688-1

*I = intersection with aquatic habitats (within 1 mi)

[+]Some additonal habitats approached by project in structure within 5 mi.

Table 4.2.3-3. Potential direct impact to protected aquatic species in Nevada/Utah DDA for the Proposed Action and Alternatives 1-6.

Hydrologic Unit or County: No.	Hydrologic Unit or County: Name	Abundance Index[2]	Highest Legal Status[3]	Short-Term Effect: % Habitat Loss: Ground-water Withdrawal	Short-Term Effect: % Habitat Loss: Other Direct[4]	Short-Term Effect: Direct Impact[1]	Long-Term Effect: % Habitat Loss: Ground-water Withdrawal	Long-Term Effect: % Habitat Loss: Other Direct[4]	Long-Term Effect: Direct Impact[1]
Subunits with M-X Clusters and DTN									
4	Snake	Moderate	SE	5	30	Low	5	20	No
5	Pine	No	—	0	0	No	0	0	No
6	White	Moderate	ST	5	30	No	5	20	No
7	Fish Springs	Moderate	ST	5	10	No	5	10	No
8	Dugway	No	—	0	0	No	[illegible]	[illegible]	No
[illegible]	Government Creek	No	—	0	0	No	[illegible]	[illegible]	No
46	Sevier Desert	No	—	0	0	No	[illegible]	[illegible]	No
46A	Sevier Desert & Dry Lake[2]	No	—	0	0	No	[illegible]	[illegible]	No
54	Wah Wah	No	—	0	0	No	0	[illegible]	No
137A	Big Smoky-Tonopah Flat	No	—	0	0	No	0	[illegible]	No
139	Kobeh	No	—	0	0	No	0	0	No
140A	Monitor—Northern	No	—	0	0	No	[illegible]	[illegible]	No
140B	Monitor—Southern	No	—	0	0	No	[illegible]	[illegible]	No
141	Ralston	No	—	0	0	No	0	0	No
142	Alkali Spring	No	—	0	0	No	[illegible]	0	No
148	Cactus Flat	No	—	0	0	No	[illegible]	0	No
149	Stone Cabin[2]	No	—	0	0	No	[illegible]	0	No
151	Antelope	No	—	0	0	No	0	[illegible]	No
154	Newark[2]	Low	RT	10	10	Low	10	5	No
155A	Little Smoky—Northern	No	—	0	0	No	0	0	No
155C	Little Smoky—Southern	No	—	0	0	No	0	[illegible]	No
156	Hot Creek	Low	ST	30	5	Low	5	[illegible]	No
170	Penoyer	No	—	0	0	No	0	[illegible]	No
171	Coal	No	—	0	0	No	0	[illegible]	No
172	Garden	No	—	0	0	No	0	0	No
173A	Railroad—Southern	Moderate	RE	10	40	Moderate	10	15	No
173B	Railroad—Northern	Moderate	RE	10	40	Moderate	10	15	No
174	Jakes	No	—	0	0	No	0	[illegible]	No
175	Long	No	—	0	0	No	0	[illegible]	No
178B	Butte—South	Low	ST	5	0	Low	5	[illegible]	No
179	Steptoe	Moderate	SE	5	0	Low	5	5	No
180	Cave	No	—	0	0	No	0	[illegible]	No
181	Dry Lake[2]	No	—	0	0	No	0	0	No
182	Delamar	No	—	0	0	No	0	[illegible]	No
183	Lake	No	—	0	0	No	[illegible]	[illegible]	No
184	Spring	High	FE	5	5	Moderate	0	0	No
196	Hamlin	No	—	0	0	No	0	[illegible]	No
202	Patterson	No	—	0	0	No	0	0	No
207	White River	High	RE	5	30	Low	5	5	No
208	Pahroc	No	—	0	0	No	0	0	No
209	Pahranagat	High	FE	30	10	Moderate	10	5	Moderate
Other Affected Subunits									
56	Upper Reese River	Moderate	FT	0	0	Low	0	0	No
176	Ruby	Moderate	ST	0	0	Low	0	0	No
187	Goshute	Moderate	ST	0	0	Low	0	0	No
215	Meadow Wash	Low	RE	0	5	Low	0	5	No
219	Muddy River Springs	High	FE	40	20	High	20	0	Moderate
222	Virgin River	High	FE	0	0	Low	0	0	No
	Overall DDA Impact			7	10	Low	4	4	Low

3931-[illegible]

Legend:
- No impact. (No protected aquatic species for abundance index.)
- Low impact. (Low resource for abundance index.)
- Moderate impact. (Moderate resource for abundance index.)
- High impact. (High resource for abundance index.)

[1]Conceptual location of Area Support Center (ASC).

[3]Protection Status FE = Federal Endangered, FT = Federal Threatened, SE = State Endangered, ST = State Threatened, RE = Recommended Endangered, RT = Recommended Threatened.

[4]Construction activity, altered rainwater runoff patterns, addition of pollutants

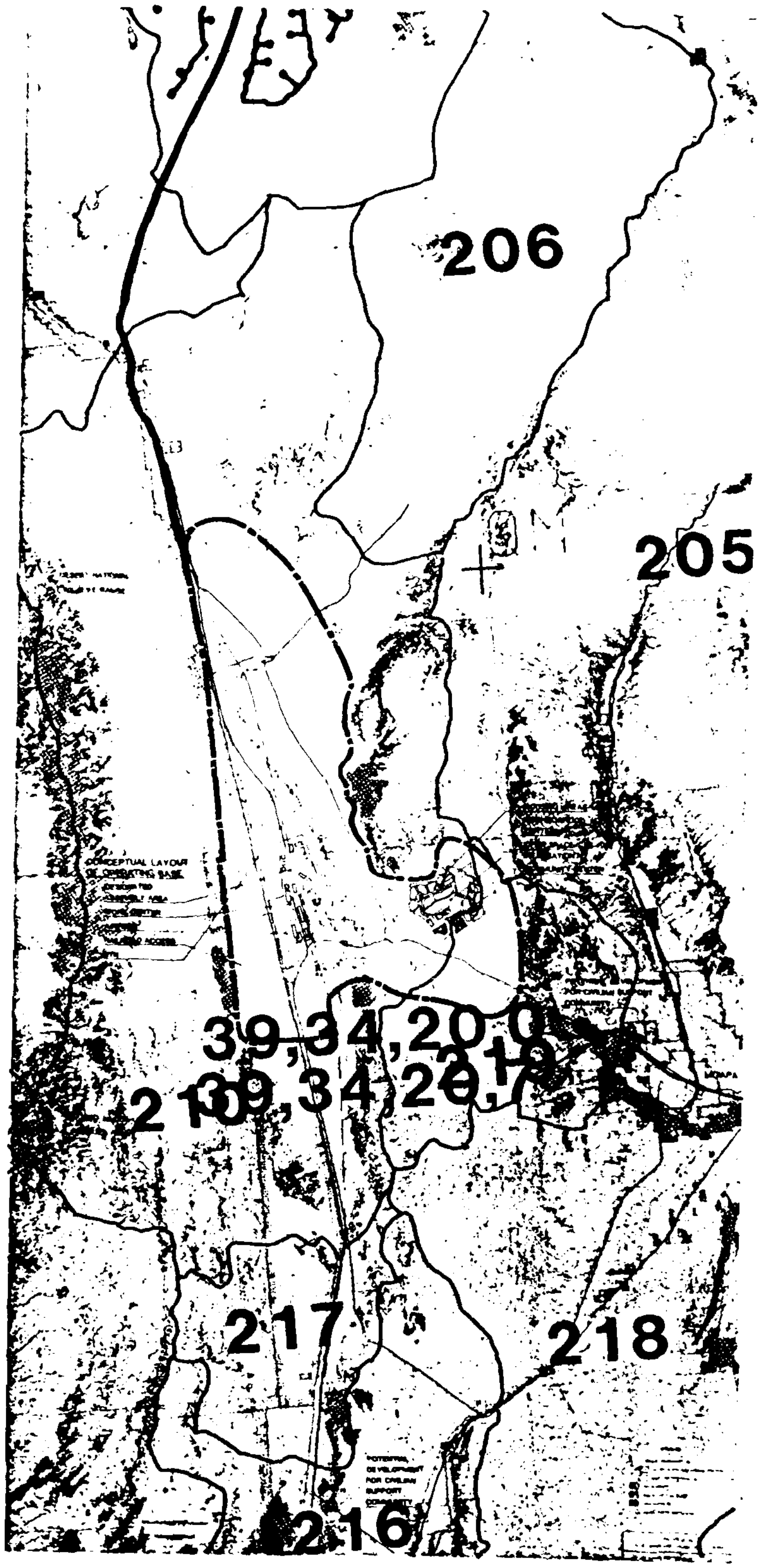


Figure 4.2.3-2. Federally and state protected fish in the Coyote Spring OB vicinity. (See figure 2.3-1 for protected fish species reference numbers.

ALTERNATIVE 1

Operating Base Impacts

Coyote Spring

Potential impacts are the same as for the Proposed Action (Table 4.2.3-4).

Beryl

No federally or state protected aquatic species are known to occur at less than a 40-mi radius from the proposed Beryl Operating Base and thus no additional significant impacts are expected.

ALTERNATIVE 2

The impacts of the DDA would be identical to those for the Proposed Action.

Operating Base Impacts

Coyote Spring

Potential impacts are the same as for the Proposed Action.

Delta

The nearest relevant aquatic biological resource is the historical occurrence of the state protected least chub in Coyote and Tule springs, located about 35 mi to the west. No direct effects of water withdrawal from construction at this site would be expected on these least chub habitats since they occur one valley distant and perpendicular to the direction of groundwater flow. The greatest potential impact resulting from a base at Delta is expected to be related to recreation by persons either directly or indirectly associated with the project (Table 4.2.3-4). Peak recreational activities would occur during the end of the construction period (short-term) and into the operational (long-term) period. Recreational impacts, however, are expected to be moderate, but not significant, since swimming, picnicking, and/or fishing in these areas would be most likely low priority in preference for more desirable and scenic mountainous areas to the west and east, primarily the Snake and Wasatch ranges, respectively.

ALTERNATIVE 3

Operating Base Impacts

Beryl, Utah Area

Impacts to protected aquatic species in the vicinity of the Beryl OB are the same as discussed for Alternative 1.

Ely, Nevada Area

The Ely Operating Base would be situated in a valley containing state protected aquatic species and subject to cumulative effects from other existing and proposed projects unrelated to M-X (Kennecott Copper Mine and White Pine Power

Table 4.2.3-4. Potential impact to protected aquatic species which could result from construction and operation of M-X operating bases for the Proposed Action and Alternatives 1-8. (Page 1 of 3)

HYDROLOGIC SUBUNIT OR COUNTY		ABUNDANCE INDEX[1]	HIGHEST LEGAL STATUS[3]	ESTIMATED INDIRECT IMPACT[4]		
NO.	NAME			PROPOSED ACTION COYOTE SPRING/ MILFORD	ALT. 1 COYOTE SPRING/ BERYL	ALT. 2 COYOTE SPRING/ DELTA
	Subunits or Counties within OB Suitability Area					
46	Sevier Desert	No	—			No
46A	Sevier Desert & Dry Lake[2]	No	—			No
50	Milford[2]	No	—	No		No
52	Lund District	No	—	No	No	
53	Beryl-Enterprise	No	—	No	No	
179	Steptoe	Moderate	SE	Moderate	Moderate	Moderate
210	Coyote Spring	No	—	No	No	No
219	Muddy River Springs	High	FE	High	High	High
	Curry County, NM	—				
	Hartley County, TX[5]	—				
	Other Affected Subunits or Counties					
4	Snake	Moderate	SE	Moderate	Moderate	Moderate
6	White	Moderate	ST	Moderate	Moderate	Moderate
7	Fish Springs	Moderate	ST	Moderate	Low	Moderate
56	Upper Reese River	Moderate	FT	Moderate	Moderate	Moderate
154	Newark	Low	RT	Low	Low	Low
156	Hot Creek	Low	ST	Low	Low	Low
173	Railroad	Moderate	RE	Moderate	Moderate	Moderate
176	Ruby	Moderate	ST	Moderate	Moderate	Moderate
178B	Butte—South	Low	ST	Low	Low	Low
184	Spring	High	FE	High	High	High
187	Goshute	Moderate	ST	Low	Low	Low
205	Meadow Wash	Low	RE	Moderate	Moderate	Moderate
207	White River[2]	High	RE	High	High	High
209	Pahranagat	High	FE	High	High	High
222	Virgin River	High	FE	High	High	High
	Overall Alternative Impact			Moderate	Moderate	Moderate

3932-3

[1,4]
- No impact. (No protected aquatic species for Abundance Index.)
- Low impact. (Low resource for Abundance Index.)
- Moderate impact. (Moderate resource for Abundance Index.)
- High impact. (High resource for Abundance Index.)

[2]Conceptual location of Area Support Center (ASC) for Proposed Action and Alternatives 1-6.

[3]Protection Status: FE = federal endangered; FT = federal threatened; SE = state endangered; ST - state threatened; RE = recommended endangered; RT = recommended threatened.

[5]Conceptual location of Area Support Center (ASC) for Alternative 7.

Table 4.2.3-4. Potential impact to protected aquatic species which could result from construction and operation of M-X operating bases for the Proposed Action and Alternatives 1-8. (Page 2 of 3)

HYDROLOGIC SUBUNIT OR COUNTY NO.	HYDROLOGIC SUBUNIT OR COUNTY NAME	ABUNDANCE INDEX[1]	HIGHEST LEGAL STATUS[3]	ESTIMATED INDIRECT IMPACT[4] ALT. 3 BERYL/ELY	ALT. 4 BERYL/COYOTE SPRING	ALT. 5 MILFORD/ELY
	Subunits or Counties within OB Suitability Area					
46	Sevier Desert	No	—			
46A	Sevier Desert & Dry Lake[2]	No	—			
50	Milford[2]	No	—			No
52	Lund District	No	—	No	No	No
53	Beryl-Enterprise	No	—	No	No	No
179	Steptoe	Moderate	SE	Moderate		Moderate
210	Coyote Spring	No	—			
219	Muddy River Springs	High	FE	High	High	Moderate
	Curry County, NM[5]	—				
	Hartley County, TX[5]	—				
	Other Affected Subunits or Counties					
4	Snake	Moderate	SE	Moderate	Moderate	Moderate
6	White	Moderate	ST	Moderate	Moderate	Moderate
7	Fish Springs	Moderate	ST	Moderate	Moderate	Moderate
56	Upper Reese River	Moderate	FT	High	Moderate	High
154	Newark[2]	Low	RT	Low	Low	Low
156	Hot Creek	Low	ST	Low	Low	
173	Railroad	Moderate	RE	Moderate	Moderate	Moderate
176	Ruby	Moderate	ST	Moderate	Moderate	Moderate
178B	Butte—South	Low	ST	Low	Low	Low
184	Spring	High	FE	High	High	Low
187	Goshute	Moderate	ST	Moderate	Low	Moderate
205	Meadow Wash	Low	RE	Moderate	Moderate	Moderate
207	White River[2]	High	RE	High	High	High
209	Pahranagat	High	FE	High	High	High
222	Virgin River	High	FE	High	High	High
	Overall Alternative Impact			Moderate	Moderate	Moderate

3932-3

[1,4] No impact. (No protected aquatic species for Abundance Index.)

Low impact. (Low resource for Abundance Index.)

Moderate impact. (Moderate resource for Abundance Index.)

High impact. (High resource for Abundance Index.)

[2]Conceptual location of Area Support Center (ASC) for Proposed Action and Alternatives 1-6.

[3]Protection Status: FE = federal endangered; FT = federal threatened; SE = state endangered, ST - state threatened; RE = recommended endangered; RT = recommended threatened.

[5]Conceptual location of Area Support Center (ASC) for Alternative 7.

Table 4.2.3-4. Potential impact to protected aquatic species which could result from construction and operation of M-X operating bases for the Proposed Action and Alternatives 1-8. (Page 3 of 3)

HYDROLOGIC SUBUNIT OR COUNTY		ABUNDANCE INDEX[1]	HIGHEST LEGAL STATUS[3]	ESTIMATED INDIRECT IMPACT[1]		
NO.	NAME			ALT. 6 MILFORD/ COYOTE SPRING	ALT. 7 CLOVIS/ DALHART	ALT. 8 COYOTE SPRING/ CLOVIS
	Subunits or Counties within OB Suitability Area					
46	Sevier Desert	No	—			
46A	Sevier Desert & Dry Lake[2]	No	—			
50	Milford[2]	No	—	No		
52	Lund District	No	—	No		
53	Beryl-Enterprise	No	—			
179	Steptoe	Moderate	SE	Low		Moderate
210	Coyote Spring	No	—	No		
219	Muddy River Springs	High	FE	High		High
	Curry County, NM[5]	—			No	
	Hartley County, TX[5]	—			No	
	Other Affected Subunits or Counties					
4	Snake	Moderate	SE	Moderate		Moderate
6	White	Moderate	ST	Moderate		Moderate
7	Fish Springs	Moderate	ST	Moderate		Low
56	Upper Reese River	Moderate	FT	Moderate		Moderate
154	Newark[2]	Low	RT	Low		Low
156	Hot Creek	Low	ST	Low		Low
173	Railroad	Moderate	RE	Moderate		Moderate
176	Ruby	Moderate	ST	Low		Moderate
178B	Butte—South	Low	ST	Low		Low
184	Spring	High	FE	High		High
187	Goshute	Moderate	ST	Low		Low
205	Meadow Wash	Low	RE	Moderate		Moderate
207	White River[2]	High	RE	High		High
209	Pahranagat	High	FE	High		High
222	Virgin River	High	FE	High		High
	Overall Alternative Impact			Moderate	No	Moderate

3932-3

[1] No impact. (No protected aquatic species for Abundance Index.)
Low impact. (Low resource for Abundance Index.)
Moderate impact. (Moderate resource for Abundance Index.)
High impact. (High resource for Abundance Index.)

[2] Conceptual location of Area Support Center (ASC) for Proposed Action and Alternatives 1-6.

[3] Protection Status FE = federal endangered; FT = federal threatened; SE = state endangered, ST = state threatened; RE = recommended endangered; RT = recommended threatened.

[5] Conceptual location of Area Support Center (ASC) for Alternative 7.

Project). In Steptoe Valley (Figure 4.2.3-3) occur the state protected relict dace and Utah cutthroat trout. A transplanted population of the federally protected Pahrump killifish resides in Spring Valley approximately 40 mi southeast of Ely while several state protected species occur in White River Valley 24 mi or farther to the southwest. Water withdrawal impacts as a result of the Ely Operating Base are likely to be localized, affecting only small portions of Steptoe Valley, since the ratio of water available to that which is needed by the project is large (4 to 1). Only one population of the relict dace occurs near enough to the proposed OB location to be considered subject to a threat of habitat loss from groundwater withdrawal. However, if the M-X OB were in Ely and the proposed White Pine Power Project were constructed in Steptoe or White River valleys, the potential for major cumulative effects of groundwater withdrawal are possible on at the least the southern portions of the Steptoe Valley relict dace populations (e.g., at Grass, Spring, Steptoe Ranch Spring, and Steptoe Creek).

Of more importance is the single population of pure strain Utah cutthroat trout located in the northern portion of the valley in Goshute Creek, approximately 60 mi north of the proposed OB location. It is expected that increased fishing pressure, as a result of not only the M-X project, but also the White Pine Power Project could significantly impact the occurrence of this cutthroat trout. One mitigating measure could be setting aside Goshute Creek as a preserve for the Utah cutthroat trout and not allowing or greatly limiting fishing. Potential recreational effects on adjoining valleys such as Spring and White River are expected to be moderate. Measures to protect critically sensitive habitats, such as those at Shoshone Ponds and Preston or Lund Town Springs could involve fencing of the aquatic habitats in order to limit swimming or habitat disturbance that tend to reduce the viability of the resident populations. One Shoshone Pond containing the Pahrump killifish is already fenced and this should be sufficient to continue protecting the existing populations. Another pond adjacent to this habitat which also contains the Pahrump killifish may need to be fenced. Peak recreational pressure should occur toward the end of the construction period, and for the duration of the operational period of the OB. Recreational impacts to the other protected species are not likely to be significant either because of the unattractiveness of their habitats for recreational pursuits or because they are too remote or already protected from existing recreational pressure. A summary of the Ely OB Alternative 3 related impacts are summarized in Table 4.2.3-4.

ALTERNATIVE 4

Operating Base Impacts

Coyote Spring

Impacts of the OB at Coyote Spring would be similar to those described for the Proposed Action. The DTN would not be in Pahranagat Valley, however, and the OBTS would be at the Beryl OB. Thus, impacts to protected aquatic species in Pahranagat Valley will be alleviated with respect to DTN construction. Impacts of groundwater withdrawal upon the downslope Moapa Fish Sanctuary are expected to slightly decrease because of the reduced water needs at Coyote Spring for this Alternative. However, impacts to the protected fish at Moapa are still expected to be significant and possibly irretrievable, unless water is piped in from Las Vegas.

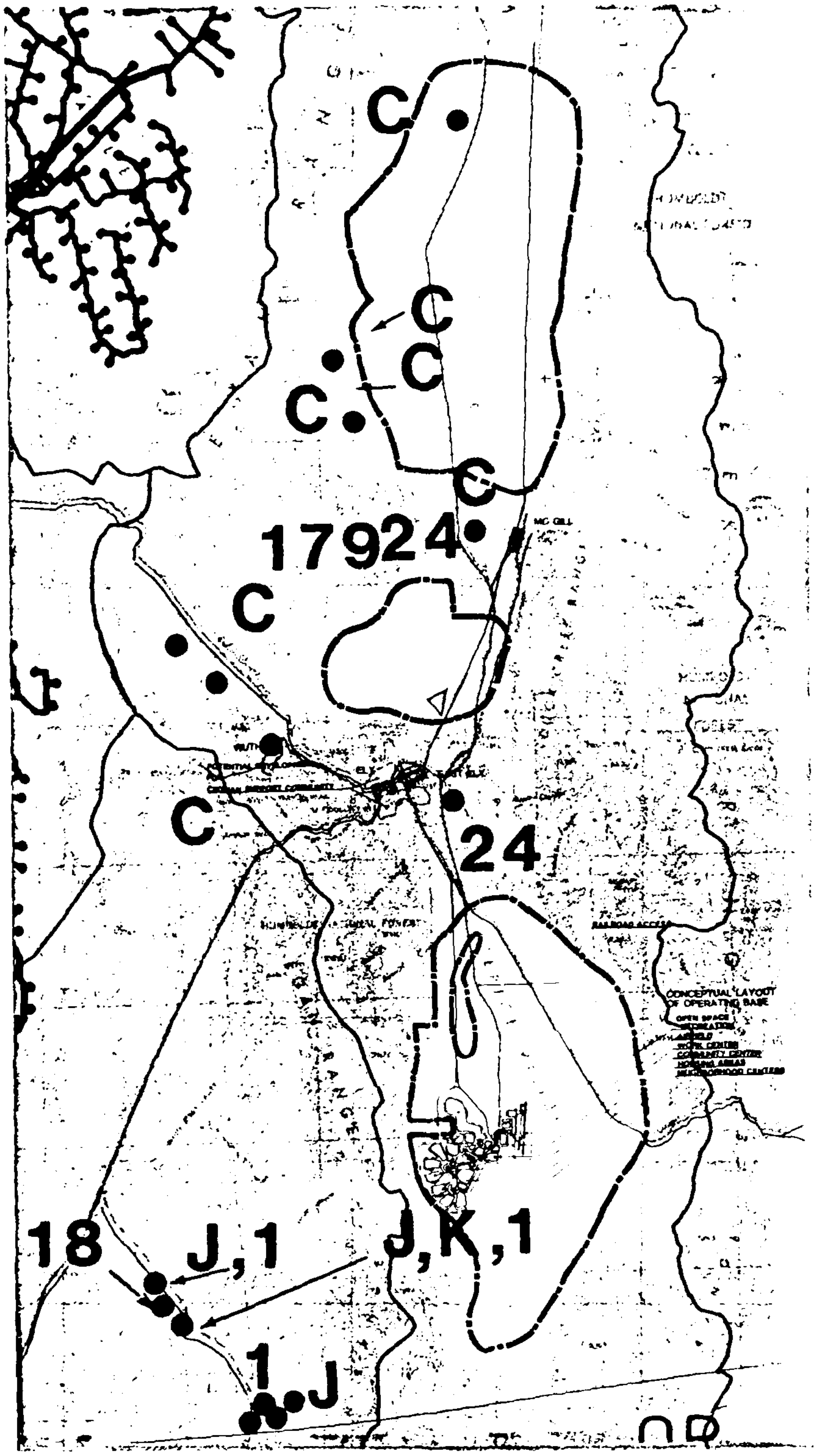


Figure 4.2.3-3. Protected aquatic species in the Ely OB vicinity. (See figure 2.3-1 for protected fish species reference numbers)

ALTERNATIVE 5

Operating Base Impacts

Milford

Impacts would be the same as discussed for the Proposed Action.

Ely

Impacts would be the same as described for Alternative 3.

ALTERNATIVE 6

Operating Base Impacts

Milford

Impacts would be the same as discussed for the Proposed Action.

Coyote Spring

Impacts would be the same as described for Alternative 4.

ALTERNATIVE 7

No significant impacts are expected for this Texas/New Mexico alternative since water depletion and other direct project impacts are not expected to occur at sensitive aquatic habitats. Recreational impacts are more difficult to predict, but are not estimated to be significant because of the lure of more aesthetically attractive locations, instead of those containing protected species, such as the federally listed Pecos gambusia.

ALTERNATIVE 8

DDA Impacts

In Nevada/Utah, impacts resulting from this split basing alternative will be decreased from those predicted for full deployment in the Nevada/Utah study area as discussed in the Proposed Action section. Direct impacts of cluster construction will occur in White River Valley upon the habitats of one or two state protected fish, but they are not expected to be significant since these fish occur elsewhere and impacts will be mitigatable. Groundwater withdrawal effects are not expected to be as large as predicted for previous alternatives since feeder valleys of the White River system will not be so heavily utilized for their water yield as with full deployment in the same area. Recreational effects of the project will occur but in fewer hydrologic subunits than for full development. Effects of recreation upon the federally protected Lahontan cutthroat trout are expected to be alleviated as a result of elimination of cluster construction in valleys adjoining the nearest location of this fish (e.g., Big Smoky Valley and vicinity). Direct impacts in Nevada/Utah are summarized in Table 4.2.3-5.

No significant impacts are expected for the Texas/New Mexico portion of this alternative for reasons discussed under Alternative 7.

Table 4.2.3-5. Potential direct impact to protected aquatic species in Nevada/Utah and Texas/New Mexico DDA for Alternative 8.[1]

Hydrologic Unit or County: No.	Hydrologic Unit or County: Name	Abundance Index[2]	Highest Legal Status[3]	Short-Term Effect: % Habitat Loss: Ground-Water Withdrawal	Short-Term Effect: % Habitat Loss: Other Direct[4]	Short-Term Effect: Direct Impact[5]	Long-Term Effect: % Habitat Loss: Ground-Water Withdrawal	Long-Term Effect: % Habitat Loss: Other Direct[4]	Long-Term Effect: Direct Impact[5]
	Subunits or Counties with M-X Clusters and DTN								
4	Snake	Moderate	SE	5	20	Low	5	10	Low
5	Pine	No	—	0	0	No	0	0	No
6	White	Moderate	ST	0	0	Low	0	0	Low
7	Fish Springs	Moderate	ST	5	5	Low	0	0	Low
46	Sevier Desert	No	—	0	0	No	0	0	No
46A	Sevier Desert & Dry Lake[6]	No	—	0	0	No	0	0	No
54	Wah Wah	No	—	0	0	No	0	0	No
155C	Little Smoky—Southern	No	—	0	0	No	0	0	No
156	Hot Creek	Low	ST	30	5	Low	5	0	Low
170	Penover	No	—	0	0	No	0	0	No
171	Coal	No	—	0	0	No	0	0	No
172	Garden	No	—	0	0	No	0	0	No
173A	Railroad—Southern	Moderate	RE	0	0	Low	0	0	Low
173B	Railroad—Northern	Moderate	RE	0	0	Low	0	0	Low
180	Cave	No	—	0	0	No	0	0	No
181	Dry Lake[6]	No	—	0	0	No	0	0	No
182	Delamar	No	—	0	0	No	0	0	No
183	Lake	No	—	0	0	No	0	0	No
184	Spring	High	FE	5	5	Moderate	0	0	Low
196	Hamlin	No	—	0	0	No	0	0	No
202	Patterson	No	—	0	0	No	0	0	No
207	White River	High	RE	5	30	Moderate	5	5	Low
	Other Affected Subunits								
56	Upper Reese River	Moderate	FT	0	0	Low	0	0	Low
154	Newark	Low	RT	0	0	Low	0	0	Low
176	Ruby	Moderate	ST	0	0	Low	0	0	Low
178B	Butte—South	Low	ST	0	0	Low	0	0	Low
179	Steptoe	Moderate	SE	0	0	Low	0	0	Low
187	Goshute	Moderate	ST	0	0	Low	0	0	Low
205	Meadow Wash	Low	RE	0	5	Low	0	5	Low
209	Pahranagat	High	FE	2	0	Moderate	10	5	Low
222	Virgin River	High	FE	0	0	Low	0	0	Low
	Overall DDA Impact			5	5	Low	2	1	Low

3933-2

[1]There are no known protected aquatic species that would be affected as a result of M-X deployment in Texas/New Mexico.

[2,5]
- No impact. (No protected aquatic species for abundance index.)
- Low impact. (Low resource for abundance index.)
- Moderate impact. (Moderate resource for abundance index.)
- High impact. (High resource for abundance index.)

[3]Protection status. FE = Federal Endangered; FT = Federal Threatened, SE = State Endangered; ST = State Threatened, RE = Recommended Endangered; RT = Recommended Threatened.

[4]Construction activity, altered rainwater runoff patterns, addition of pollutants.

[6]Conceptual location of Area Support Center (ASC).

Operating Base Impacts

Coyote Spring, Nevada Area

Impacts to protected aquatic species would be the same as discussed for the Proposed Action.

Clovis, New Mexico Area

Impacts would be the same as discussed in Alternative 7.

4.3 GENERAL PROJECT EFFECTS

NEVADA/UTAH (4.3.1)

This discussion applies to potential plant species and to species that have been designated rare species and suggested for protection on the basis of nationwide, regional, or statewide reviews. These species are considered to be candidates for legal protection and are considered in this section. Table 4.3.1.1-1 summarizes project actions, effects, and the resultant impacts to rare species.

M-X deployment is expected to have a potential for adversely impacting rare plant species. Over 200 rare plant taxa (species, subspecies, and varieties) are known from Nevada and western Utah. Over 60 percent of these are found in the mountains within and surrounding the deployment area. Of the 200 total, approximately 80 species are known to occur or are likely to occur on valley floors and bajadas of the adjacent mountains within the project deployment area. These are the species that are most likely to be subject to direct impact from M-X system construction (Table 4.3.1.1-2). A detailed analysis was performed to determine which of the 80 valley bottom and bajada species are intersected by the project layout and would therefore be susceptable to surface disruption. Results of this analysis follow this general discussion. There are no federally protected plant species in the study area, although, a few federally protected plant species occur immediately outside the area. Seven of the eighteen species listed by the state of Nevada as critically endangered under NRS 527.270 occur in or near geotechnically suitable areas. In addition, all members of the family Cactaceae, all members of the genus Yucca (including Joshua trees and the Mojave yucca that occur in the southern parts of the project area) and all evergreen trees are protected under Nevada state law from destruction or removal.

Existing information is sparse on the range, degree of endangerment, and population trends of many of these rare plants. As data on these species become available, a number of these species occurring in the project area may be elevated to formal protection under state and federal laws prior to commencement of M-X construction. For other species, additional studies may reveal previously unknown populations, thereby reducing or eliminating the need for legal protection of the species.

The greatest potential for impact on rare plant species is widespread surface disruption during project construction. Human activity associated with M-X deployment (such as use of ORVs during security systems operation) could also adversely impact rare plants, although to a lesser extent. Surface disruption was considered the primary project activity which would result in significant effects on rare plants, and is analyzed following this general discussion.

Table 4.3.1.1-1. Summary of general project effects and impacts for rare plants in the NEvada/Utah study area.

PROJECT ACTION	EFFECT	IMPACT
Construction of permanent roads, buildings, (e.g., operating base, support community and construction camp buildings), parking areas, airfields, drainage diversions.	Removal of plants by clearing and grubbing.	Possible permanent loss of individual plants or entire populations. Impacts minimized by avoidance of rare plant[1] locations found through site-specific survey.
	Deposition of excavated material.	Probably a permanent loss of affected populations. Deposited material may, however, provide habitat for species such as bashful four o'clock (*Mirabilis pudica*) which thrives on disturbed sites.
	Generation of fugitive dust.	Changes in productivity. Annual species such as centaury (*Centaurium namophilum*) may be affected through interference with pollination. (Harper, 1979)
Excavation of quarries and borrow pits.	Removal of plants from clearing or excavation.	May affect many species which are dependent on sandy soil types and other valley bottom and bajada substrates.
	Deposition of excavated material.	As stated above.
	Generation of fugitive dust.	As stated above.
Construction and operation of cement and aggregate plants.	Removal of plants by clearing and grubbing.	Possible permanent loss of individual plants or populations.
	Generation of cement or aggregate dust by plant operation.	Reduced photosynthetic rates of plants coated by dust (Beatley, 1965) with possible resultant decline in vigor of plant.
Withdrawal of groundwater.	Decreased groundwater supply to aquatic habitats.	Possible loss of species which rely on underground water supply or specific substrates associated with groundwater flow.
Increased personnel access, including off-road security patrols and recreational activities.	Increased use of off-road areas by vehicles.	Physical breakage of stems and roots (Bury, et. al., 1977). Crushing of foliage, uprooting of small plants and cacti (Wilshire, et al., 1978). Undercutting root systems (Wilshire, et al., 1978). Such impacts are capable of destroying populations of rare plants.
	Increased use of off-road areas by hikers, campers, hunters.	Trampling and crushing of sensitive plants (Aitchison, et al., 1977). Illegal collection of rare species of cacti or Agave.

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[1]Rare plants may be affected in the same manner as native vegetation. See ETR-14, Native Vegetation.

Table 4.3.1.1-2. Valley or low bajada rare plant species which occur within or near geotechnically suitable areas and near existing roads in the mountains. (page 1 of 2)

NEVADA
Agave utahensis var. *eborispina* (RC)
Arabis shockleyi (RC)*
Arctomecon californica (SE)
A. merriamii (RC)
Asclepias eastwoodiana (RT)
Astragalus callithrix (RT)*,**
A. calycosus var. *monophyllidius* (RT)
A. convallarius var. *finitimus* (RC)*
A. funereus (RT)
A. geyeri var. *triquetrus* (SE)
A. lentiginosus var. *latus* (RC)
A. l. var. *micans* (RT)
A. mohavensis var. *hemigyrus* (RT)
A. nyensis (SE)
A. oophorus var. *lonchocalyx* (RC)*
A. pseudiodanthus (RT)
A. pterocarpus (RC)
A. serenoi var. *sordescens* (RT)
A. tephrodes var. *eurylobus* (RE)
A. uncialis (RE)**
Castilleja salsuginosa (SE)**
Coryphantha vivipara var. *rosea* (RT)
Cryptantha hoffmannii (RT)
Cryptantha interrupta (RC)
Cymopterus corrugatus (RC)
C. ripleyi var. *saniculoides* (RC)
Ephedra funerea (RC)
Eriogonum argophyllum (SE)**
E. beatleyae (?)
E. concinnum (RC)
E. darrovii (RC)
E. rubricaule (RC)
Ferocactus acanthodes (RC)
Frasera gypsicola (SE)
F. pahutensis (RT)
Fraxinus cuspidata var. *macropetala* (RT)
Gilia nyensis (RC)
G. ripleyi (RC)
Haplopappus brickellioides (RC)
Hulsea vestita var. *inyoensis* (RC)
Lathyrus hitchcockianus (SE)
Lepidium nanum (RC)
Lewisia maguirei (RE)
Linanthus arenicola (RC)
Lomatium ravenii (RC)
Lupinus holmgrenanus (RC)

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Table 4.3.1.1-2. Valley or low bajada rare plant species which occur within or near geotechnically suitable areas and near existing roads in the mountains. (page 2 of 2)

NEVADA (Cont.)
Machaeranthera grindelioides var. *depressa* (RC)*
M. leucanthemifolia (RC)
Mirabilis pudica (RC)
Opuntia pulchella (RC)*
Oryctes nevadensis (RC)
Oxytheca watsonii (RT)
Penstemon arenarius (RT)
P. fruticiformis var. *amargosae* (RT)
P. pudicus (RT)
P. thurberi var. *anestius* (SE)
Perityle megalocephala var. *intricata* (RC)
Peteria thompsonae (RC)*
Phacelia anelsonii (RT)*
P. glaberrima (RT)
P. mustelina (RC)
P. parishii (RC)
Pilostyles thurberi (RC)
Polygala subspinosa var. *heterorhynca* (RC)
Sclerocactus polyancistrus (RT)
S. pubispinus (RT)*
Silene scaposa var. *lobata* (RC)
Sphaeralcea caespitosa (RT)*
Thelypodium laxiflorum (RC)
T. sagittatum var. *ovalifolium* (RT)*
Trifolium andersonii var. *beatleyae* (RC)
UTAH
Astragalus callithrix (RE)***
A. oophorus var. *lonchocalyx* (RD)***
Cryptantha compacta (RT)
Cymopterus basalticus (RD)
C. coulteri (RT)
Eriogonum ammophilum (RE)**
E. eremicum (RT)
E. natum (RT)
E. nummulare (?)
Lepidium ostleri (?)
Machaeranthera grindelioides var. *depressa* (RD)***
Opuntia pulchella (RC)***
Penstemon concinnus (RT)**
P. nanus (RT)
Phlox gladiformis (RT)***
Sclerocactus pubispinus (RE)***
Sphaeralcea caespitosa (RT)***
Trifolium andersonii var. *friscanum* (?)

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*Also occurs in Utah.

**High priority for federal listing.

***Also occurs in Nevada/

SE = State listed as endangered.
RE = Recommended endangered.
RT = Recommended threatened.
RC = Species of special concern.
RD = Recommended to be delisted.

Note: Those species which are directly intersected by the conceptual project layout are listed in Table 4.4.3-1.

Rare plant species that occur in valleys and on bajadas are most likely to be impacted by project construction activities. Project suitable areas in Nevada and western Utah have several species that occur in such habitats, including Callaway milkvetch (Astragalus callithrix), Tonopah milkvetch (A. pseudiodanthus), dune beard tongue (Penstemon arenarius), limestone buckwheat (Eriogonum eremicum), and Clokey pincushion cactus (Coryphantha vivipara var. rosea).

Several species have comparatively broad distributions and would therfore have a higher probability of being intersected by the project than species which have highly restricted distributions. Plant species that are most likely to be affected because of their widespread distributions are sand cholla (Opuntia pulchella), low beardtongue (Penstemon nanus), and bashful four o'clock (Mirabilis pudica). Species that are known only from single localized populations such as Frasera gypsicola, Arenaria stenomeres and Astragalus uncialis could be seriously affected by habitat disturbance at or near their locality, but offer the best possibilities for avoidance.

Certain rare plant species such as Mirabilis pudica, Eriogonum natum, and Penstemon pahutensis have been found to thrive on disturbed areas (Rhoads et al., 1977, 1978; Welsh and Thorne, 1979). Construction of roads may provide additional habitat for these species.

Construction-related activities such as mining for sand or aggregate could also affect rare plants. Many rare plant species in the Great Basin are restricted to sandy or gravelly soils and the sites chosen for obtaining these resources would greatly influence the potential for adverse impacts to these species. Fugitive dust which would result from construction activities (such as mining activities, road building, travelling on unpaved roads, and clearing for protective shelters) may not pose a major threat to the vegetation as a whole, yet may affect some of the rare plants present (Harper, 1979). Some rare species may be self-pollinated or agamospermous (producing seed without fertilization); others may require cross-pollination. At this time it is not known what percentage employ which strategy. Activities that interfere with pollination have the potential to cause a decrease in population numbers if they persist for a long time relative to the generation time of the species in question. Dust can foul stigmatic surfaces and essentially eliminate pollination of those plants that require cross pollination (Harper, 1979). Annual species with this type of reproduction would be most severely impacted. Perennial species would be less severely impacted unless the fugitive dust perturbation occurred during one of the periodic optimum years of reproduction. Such an episode would result in the reduction in size of a common age-group or cohort. Such even-aged stands are found in many xeric adapted communities.

Secondary construction effects such as induced population growth and the resultant increase in recreational activities (camping, hiking, ORV use, etc.) could impact rare plants. This would occur through habitat alteration resulting from increased erosion from such activities.

Rare species found on sand dunes, clay hills, springs, and similar habitats would be likely to suffer increased impacts from off-road vehicle use, camping, and hiking. This would result from improved access to rare plant locations in such areas. Data in Welsh (1979) indicate that 45 percent of the threatened or endangered plants occurring in Utah portions of the Great Basin phytogeographic unit occur on such substrate types. Such impacts would be difficult to avoid if DTN and cluster roads are open to civilian use. Stutz (1979) described effects of increased recreation on a rare form of Atriplex in Utah. The plant is sometimes used as fuel for fires and its branches are used as wind shelters. Fruiting stalks are gathered for home decoration. Rare plant species occurring at high elevations and in areas that are likely to receive an increase in recreational use may be indirectly affected. Nationwide, at least 10 rare species have recently been proposed to be federally listed as threatened or endangered because of their decline as a result of recreational activities near their locations. These activities are predicted to increase in certain "attractant" zones in the project area, as a result of the population increase in the area. A model was developed to identify these likely attractant regions and predict how much impact they would be likely to receive as a result of M-X. ETR-30, "Indirect Effect Index for Impact Analysis" discusses this in detail. Rare plant species in these zones would be subject to an increased risk occurring of habitat alteration.

In addition, increased human activity, particularly recreation, would increase plant collection which could affect protected species, particularly cacti. Desert species, especially cacti which are conspicuously attractive when in flower, are in great demand for landscaping purposes. Professional poaching of many species is common in the Southwest (Ayensu and DeFillips, 1978; Gordon, 1980). In addition, collection of many species of cacti for personal use (such as for landscaping or for potted plants) makes significant inroads on plant populations in areas accessible by road or near settlements (Benson, 1977). The rare Clokey pincushion cactus (Coryphantha vivipara var. rosea) is reported to be in demand for gardening purposes, although it may not be as heavily collected as other more conspicuous cacti (Rhoads et al., 1979). In fact, the variety reported to be rare is difficult to distinguish from the species, since the characters differentiating it are subtle and intergrading (Welsh and Neese, 1980). Some specimens upon which locations have been based have been sent to cactus specialist Dr. Lyman Benson for his consideration. The cactus is small and has attractive flowers. With the influx of more people, it is likely to face increased collection pressure. Population influx and increased recreational pressure will be likely to have significant and difficult-to-mitigate effects on rare/protected plant species.

Moreover, construction of operating bases and housing for in-migrating families in areas where cacti and yuccas thrive (e.g., Coyote Spring) will increase the demand for such plants in landscaping, although success rates for such transplantings are commonly low. See Appendix II for other hydrologic subunits that may contain these plants. There may also be introduction of exotic vegetation and pests. Weed species can compete with and take over certain rare plant habitats (Ayensu and DeFillips, 1978).

Groundwater withdrawal would affect any rare species dependent upon groundwater flow or some component of groundwater seepage areas (e.g., substrate at Monte Neva Hot Springs upon which the Indian paintbrush (Castilleja salsuginosa) appears to be dependent).

Table 4.3.1.1-3 lists all the hydrologic subunits within the study area, with an index of rare plant abundance and senstivity to impact.

Criteria for estimation of abundance and sensitivity to impact for rare plants were:

Abundance: High abundance was assigned to hydrologic subunits with greater than ten known localities of rare plant species. Hydrologic subunits with one to ten localities were assigned intermediate abundance and those with no known rare plant

Table 4.3.1.1-3. Abundance and sensitivity of rare plants to impact and quality of data for hydrologic subunits in Nevada/Utah.

NUMBER	LOCATION	A	S	Q
3	Deep Creek	I	I	I
4	Snake	H	H	I
5 (U)	Pine	H	H	H
6	White	I	I	I
7	Fish Springs	I	L	I
8	Dugway	L	L	L
9	Government Creek	L	L	L
13	Rush	L	L	L
32b	Great Salt Lake Desert-Western Desert	I	H	I
46	Sevier Desert	I	H	I
46a	Sevier Desert-Dry Lake	I	H	I
47	Huntington	I	L	I
50	Milford	I	I	I
52	Lund District	I	H	I
53 (N)	Pine	I	H	I
53 (U)	Beryl-Enterprise District	I	L	I
54 (U)	Wah Wah	H	H	H
54 (N)	Crescent	L	L	L
55	Carico Lake	L	L	L
56	Upper Reese River	H	H	I
57	Antelope	L	L	L
58	Middle Reese River	L	L	L
122	Gabbs	I	H	I
124	Fairview	L	L	L
125	Stingaree	L	L	L
126	Cowkick	L	L	L
127	Eastgate	L	L	L
133	Edwards Creek	L	L	L
134	Smith Creek	L	L	L
135	Ione	I	I	I
136	Monte Cristo	I	L	I
137a	Big Smokey-Tonopah Flat	H	H	H
137b	Big Smokey-North	H	H	I
138	Grass	L	L	L
139	Kobeh	I	H	I
140	Monitor	I	H	I
141	Ralston	H	H	H
142	Alkali Spring	I	H	H
143	Clayton	L	L	L
144	Lida	I	I	I
149	Stone Cabin	H	H	I
150	Little Fish Lake	I	I	I

NUMBER	LOCATION	A	S	Q
151	Antelope	L	L	L
152	Stevens	L	L	L
153	Diamond	I	H	I
154	Newark	I	L	I
155	Little Smokey	I	I	I
156	Hot Creek	H	H	H
169a	Tikaboo-Northern	I	L	I
170	Penoyer	L	L	L
171	Coal	I	I	I
172	Garden	I	H	I
173a	Railroad-Southern	L	L	L
173b	Railroad-Northern	H	H	H
174	Jakes	I	L	I
175	Long	L	L	L
176	Ruby	I	H	I
178	Butte	L	L	L
179	Steptoe	H	H	I
180	Cave	L	L	L
181	Dry Lake	L	L	I
182	Delamar	L	L	I
183	Lake	L	L	L
184	Spring	H	H	I
185	Tippett	L	L	L
186	Antelope	I	L	I
187	Goshute	L	L	L
194	Pleasant	I	I	I
196	Hamlin	I	H	H
198	Dry	L	L	L
199	Rose	L	L	L
200	Eagle	L	L	L
201	Spring	I	I	L
202	Patterson	L	L	I
203	Panaca	I	I	I
204	Clover	I	L	I
205	Meadow Valley Wash	I	H	I
206	Kane Springs	L	L	I
207	White River	H	H	H
208	Pahroc	I	I	I
209	Pahranagat	H	H	H
210	Coyote Springs	I	H	I
219	Muddy River Springs	L	L	I
120*	Dixie	L	L	L
129*	Buena Vista	I	L	I
132*	Jersey	L	L	L

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A = Abundance

S = Sensitivity to impact

Q = Quality of data

H = High, I = Intermediate; L = Low

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DEC 80 F04704-78-C-0029
UNCLASSIFIED M-X-ETR-17 AFSC-TR-81-32 NL

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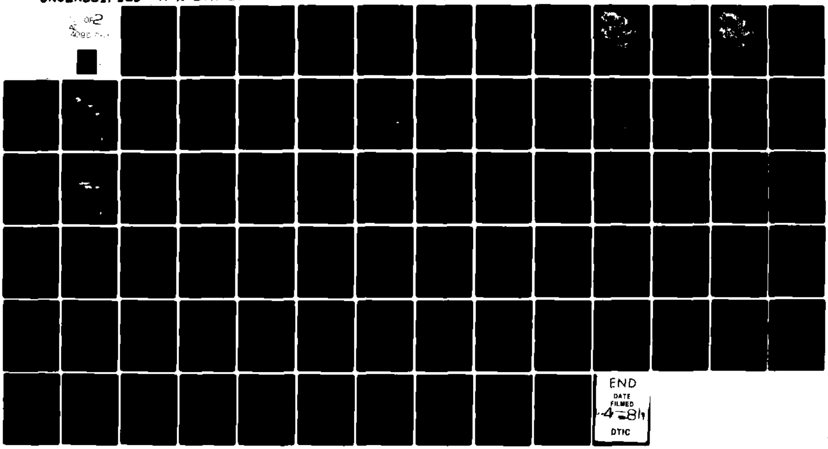

localities were assigned low abundance. The fundamental unit is the known location of a species. It should be realized that a single plant species which has greater than ten known locations in a particular hydrologic subunit can cause that hydrologic subunit to have a high abundance rating while nine solitary locations of different species in one hydrologic subunit would cause that one to have an intermediate abundance rating. In order to maintain objectivity, all rare plant locations were given equal consideration in this analysis since disruption of any locality would potentially affect the species. This is a reflection of the available limited data base. Species, though, are considered individually in the significant impact analysis.

Sensitivity to Impact: Criteria for determining high sensitivity to impact included at least one of the following: (a) one or more populations of rare plants were known from within or in close proximity (within a distance of 5 mi) to suitable area, potential operating base site, or proposed DTN; (b) greater than five rare plant species are known from the hydrologic subunit; (c) at least one species in the hydrologic subunit could be affected by groundwater withdrawal; and (d) at least one species of a rare cactus or agave species was known from the hydrologic subunit. In other words, those subunits containing species with high likelihood of impact were considered to have a high sensitivity. Not enough information is available concerning the biology of each species to determine the specific sensitivity to impact of each particular plant.

Sensitivity to impact was considered intermediate if at least one of the following were true: (a) only one to five species of rare plants were known from the hydrologic subunit; (b) there were valley or bajada species known that were not in suitable areas; (c) there were rare plant species in existing recreation areas within the hydrologic subunit or in adjacent hydrologic subunit which were known to be susceptible to offroad vehicle traffic.

Sensitivity to impact was considered low if: (a) there were no valley or bajada species and species were only found at very high elevations in the adjacent mountains or (b) no rare plant species were known from the hydrologic subunit.

Quality of Data: Hydrologic subunits where comprehensive botanical studies and rare plant searches have been conducted were given a high rating for quality of data. This includes selected hydrologic subunits which were studied by subcontractors during the growing season of 1980. Some hydrologic subunits have been partially studied (e.g., the Deep Creek Mountains have been studied while the adjacent valleys have not). These hydrologic subunits or hydrologic subunits with known localities of rare plants and no comprehensive botanical study were given an intermediate rating for quality of data. Hydrologic subunits with no known rare plant locations were rated low, except for the ones which are known to have been botanically studied. Valleys given a high data quality rating must still be regarded as being relatively poorly known as population sizes and limits are generally undetermined and additional locations are likely to be discovered. Little is known ablout the ecology of the individual species. No federally listed species have been located in the project area. The species under consideration here are recommended by scientific authorities and enthusiasts, or are state protected, and are considered because of their potential to be federally listed in the near future. As additional locational information becomes available, authorities may reconsider certain species and recommend that they be dropped from consideration as rare, threatened, or endangered. However, some may be found to be truly rare.

Fourteen hydrologic subunits were identified for rare plants as having high abundance and sensitivity to impact. These are:

Snake	Stone Cabin
Pine	Hot Creek
Wah Wah	Railroad-North
Upper Reese River	Steptoe
Big Smoky-Tonopah Flat	Spring
Big Smoky-North	White River
Ralston	Pahranagat

The best mitigation strategy for rare plants would be avoidance of all critical habitats (Benson, 1977; Holmgren, 1979). However, to avoid irreparable damage to rare plants and to comply with endangered species legislation, it is necessary to bring information on the status and sensitivities of rare plants to a level appropriate for making informed management decisions. This is being achieved by conducting accelerated area-wide inventories in potential deployment areas prior to site selection and continuing inventories through the preconstruction phases and monitoring during construction activities. Other mitigation methods would include fencing entire rare plant critical habitats to keep out ORV and pedestrian traffic, and continued monitoring of populations and habitats. Cultivation or artificial propagation is not an acceptable alternative to avoidance of species (Ayensu & Defillips, 1978). Stranger enforcement of laws against commercial collecting and exploitation is also recommended.

Wildlife (4.3.1.2)

The final choice of alternative basing areas and layouts will determine the level of impacts that are expected to occur to federal and state listed protected species. Potential impacts of construction and operation on the bald eagle, peregrine falcon, and Utah prairie dog (federally listed), spotted bat (Nevada state listed), desert tortoise (Nevada state listed and population in Utah federally listed), and gila monster (Nevada and Utah state listed) are summarized in Table 4.3.1.2-1. Habitat will be lost or disturbed through construction of roads, rail lines, and operating bases, as well as through urbanization due to development of non-military support facilities. Preferred habitat for protected species is shown in Table 4.3.1.2-2. The large influx of people to the deployment area would lead to increased recreational uses of the land, and attendant poaching, disturbance from noise and human presence, and habitat loss through camping, ORV use, and other activities. Dogs and cats maim and kill native animals close to human population centers (Christian, 1974; McNight, 1964). This could affect such protected species as the desert tortoise, Utah prairie dog, and gila monster which are relatively sedentary land animals.

Two different groups of bald eagles are found in the Great Basin. One group winters in the Carson Sink area, along the Humboldt River, and in the White River and Pahranagat valleys, and since they are found near water, as bald eagles traditionally are (Bent, 1937; Broley, 1958; USFWS, 1975), they are presumed to feed on fish and ducks. But many other bald eagles in this area are found wintering in valleys with no permanent water and feeding on jackrabbits (Edwards, 1969). There are no recent breeding records for this area but approximately 100 eagles winter in Nevada (Nevada Department of Wildlife, 1980) and about 600 birds winter in Utah (Day, 1978). Two major problems may occur for bald eagles in this area. Construction in valleys in which these eagles hunt jackrabbits could drive

Table 4.3.1.2-1. Summary of potential impacts to protected terrestrial and aquatic animal species. (page 1 of 4)

PROJECT PARAMETER	SECONDARY EFFECTS	POTENTIAL IMPACTS			
		PROTECTED TERRESTRIAL ANIMALS	REFERENCES	PROTECTED AQUATIC SPECIES	REFERENCES
Area disturbed	Construction				
Total = 33,120 ac Protective structure = 7.5 acres/structure	Fugitive dust	No effects predicted.		Minimal effects predicted.	
	Erosion and siltation	No impacts directly to desert tortoise, gila monster, spotted bat, and Utah prairie dog. Bald eagle which feeds over water may be affected if prey items are limited by resulting siltation. Peregrine falcons may be affected if prey items are limited.		Chemicals in rainfall runoff from new asphalt roads, cement production, dust suppression activities, and accidental petrochemical spills could temporarily impact some protected organisms. Siltation in aquatic habitats could be locally important. Lahontan, Utah, and Snake Valley cutthroat trout population could be reduced. Phyto and periphyton productivity decreased, gill breathing and filter-feeding organisms smothered or starved.	Deacon, et al, 1979b; Hynes, 1976; Cummins & King, 1979.
	Loss of vegetation	Loss of habitat equal to disturbed area for desert tortoise and Utah prairie dog because forage will be lost. Gila monster prey items may decrease. Spotted bat and peregrine falcon may be minimally affected. Bald eagle may benefit from increase of jackrabbits in disturbed area.	Stebbins, 1954; Pizzimenti & Collier, 1975; Vorhies & Taylor, 1933; Edwards, 1969.	Destruction of aquatic habitat and its associated vegetation could destroy endemic fish populations.	Pister, 1974;
	Presence of machinery and people	Disturbance to desert tortoise, gila monster, and Utah prairie dog may be small. Where human activity occurs at or near a roost site, spotted bat may be severely impacted and may leave the area. Bald eagle and peregrine falcon both may be affected moderately. Possibility they will not return to area until activity ends.	Pizzimenti & Collier, 1975; O'Farrell, pers.comm. 1980; Stalmaster, 1976; Porter & White, 1973.	Minimal impact predicted other than those discussed in recreation.	

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Table 4.3.1.2-1. Summary of potential impacts to protected terrestrial and aquatic animal species. (page 2 of 4)

PROJECT PARAMETERS	SECONDARY EFFECTS	POTENTIAL IMPACTS			
		PROTECTED TERRESTRIAL ANIMALS	REFERENCES	PROTECTED AQUATIC SPECIES	REFERENCES
	Operations				
	Fugitive dust	No effect predicted.		Minimal impacts predicted.	
	Erosion	Some impact, similar to construction but at a lower level.		Some impact similar to construction but at a lower level.	
	Revegetation of disturbed areas	If revegetation favors native plants, immediate benefits may occur for desert tortoise. Gila monster will benefit when prey items return. Utah prairie dog should be minimally affected. Bald eagles could benefit from increased abundance of prey items.	Stebbins, 1954; Pizzimenti & Collier, 1975; Vorhies & Taylor, 1933.	Beneficial impact would result by decreasing erosion/sedimentation and re-establishing condition similar to those of the pre-project.	
	Transmission lines	May impact eagles by electrocution, however, they can be, and are, sometimes constructed to eliminate the chance of electrocution. Can also serve as a roost or hunting perch.	Murphy, per. comm., 1980.	No impact predicted.	
People Construction: direct labor = 13,253 - 13.5 percent/yr peak induced growth = 34,000/yr peak	Sewage	May affect some bald eagle and peregrine falcons by affecting prey.		In habitats near areas of rapid population growth, some reduction in water quality is expected: Ely, Alamo, and Moapa.	
	Solid waste	Landfill may attract exotics with chance of spreading diseases.		None predicted.	
	Introduction of exotic species	Dogs and cats may kill or harass native species which could particularly impact desert tortoises, gila monsters, and prairie dogs, particularly, within several miles of population centers.	Denny, 1974; Christian, 1974.	Goldfish and other aquarium type exotics may outcompete endemics. Game fish may be introduced and eliminate endemics through habitat competition and/or diseases. Pest control species, e.g., mosquito fish, may eliminate endemics.	Deacon et al, 1979; Walstrom, 1973; Hickman & Duff, 1978; Mickley et al, 1977.
Operations: direct labor and induced growth = ~ 103,000/yr peak 59,000 permanent residents During construction, people will be dispersed throughout deployment area. During operations, people and effects will be concentrated in the vicinity of OBs.	Recreation ORV use	Desert tortoise, gila monster, and Utah prairie dog could be seriously impacted, particularly at heavy use areas. Bald eagles may benefit from light activity if jackrabbit numbers increase, but could be seriously impacted by greater activity as prey species decrease. Peregrine falcons may suffer if activity occurs near marshes, degrading these areas for their prey.	Bury, 1978; Nagy & Medica, 1977; Berry, 1978; Keefe & Berry, 1973; Byrne, 1973; Luckenbach, 1978; Porter & White, 1973.	Increased access to pristine habitats damages benthic sediments. Locally increased turbidity and degraded water quality due to waste disposal.	Walstrom, 1973.

Table 4.3.1.2-1. Summary of potential impacts to protected terrestrial and aquatic animal species. (page 3 of 4)

PROJECT PARAMETER	SECONDARY EFFECTS	POTENTIAL IMPACTS			
		PROTECTED TERRESTRIAL ANIMALS	REFERENCES	PROTECTED AQUATIC SPECIES	REFERENCES
	Recreation (Cont.)				
	Camping and hiking	Hiking up canyons has the potential to disturb roosting bald eagles and/or nesting peregrine falcons. Camping and hiking at roosting sites would cause spotted bats to leave the area.	Edwards, 1979; Stalmaster, 1976; Porter & White, 1973; O'Farrell, pers.comm. 1980.	Trampling of pristine areas, waste disposal and littering can result in local erosion/sedimentation and water pollution problems.	Walstrom, 1973.
	Hunting and fishing	Hunting of prey items may affect bald eagles and peregrine falcons. Presence of hunters and fishermen at feeding areas may inhibit eagles and falcons. Impacts expected to be minimal.		Possible depletion of Lahontan, Utah and Snake Valley cutthroat trout.	Dierniger, May 1980; Walstrom, 1973.
	Poaching	May affect all species. Desert tortoise, gila monster, and Utah prairie dogs are often targets of shooting or collecting. Bald eagles are also targets of poachers. Falcon eggs/chicks are illegally collected for falconry.	Stevens, 1976; Pizzimenti & Collier, 1975; Murphy, pers.comm. 1980.	Similar to normal fishing pressure but less intense.	
	Swimming	No impacts predicted.		Disturbance of protected species behavior, increased turbidity, habitat deterioration.	Walstrom, 1973.
Water Use 81,865-99,296 ac. ft total. (Direct use for concrete, compaction, dust suppression, and workers only).	Lowering of water table	No direct impact to desert tortoise, gila monster, spotted bat, or Utah prairie dog. Bald eagles which feed over water and all peregrine falcons could be affected by decrease in prey item availability.		Habitat reduction or loss and extinction or extirpation of isolated populations. Mitigation by transplanting or alteration of well water pumping rates and/or locations. Feeding and spawning habitat reduced. Groundwater overdrafts should impact the following valleys containing protected aquatic biota; Moapa, Pahranagat, White River and Hot Creek.	Deacon et al., 1979; Minckley & Deacon, 1978; Hardy, 1980; Williams, 1977; Piero & Maxey, 1970; Bateman et al., 1974; Dudley & Larsen, 1976; Pister, 1974.

2399-1

Table 4.3.1.2-1. Summary of potential impacts to protected terrestrial and aquatic animal species. (page 4 of 4)

PROJECT PARAMETER	SECONDARY EFFECTS	POTENTIAL IMPACTS			
		PROTECTED TERRESTRIAL ANIMALS	REFERENCES	PROTECTED AQUATIC SPECIES	REFERENCES
Vehicle traffic	Fugitive dust	No effects predicted.		Minimal impact predicted.	
Construction	Road kills	May impact desert tortoise and gila monster heavily at least within one km on either side of a road. Utah prairie dog may be impacted but effect on population expected to be small.	Nicholson, 1978; Funk, 1966.	No impacts.	
Operation: ASC to cluster = ∿ 50,000 trips/year OB/DAA to ASC = ∿ 4,000 trips/year	Noise and visual	May affect bald eagle roosting or peregrine falcon nesting if these occur nearby traffic activity.	Stalmaster, 1976; Porter & White, 1973.	No impacts.	
Security	Radar and microwave emissions	Data insufficient to predict effects.		Data insufficient to predict impacts.	

2399-1

Table 4.3.1.2-2. Habitat preferences of protected terristrial animals in the Nevada/Utah study area.

SPECIES	HABITAT PREFERENCES	SOURCE(S)
Gila Monster	Desert flats, lower slopes of mountains and nearby outwash plains, frequents canyon bottoms and arroyos with permanent or intermittent streams, vegetation of creosote (Larrea tridentata), salt-cedar (Tamarix sp.), mesquite (Prosopis juliflora), four-winged saltbush (Atriplex canescens), and arrowweed (Pulchea sericea), seeks shelter in woodrat nests, dense thickets, and under rocks; often found near irrigated land or rocky areas grown to scattered bushes. Occurs in southern Nevada, perhaps as far north as Coyote Springs Wash, Nevada.	Stebbins, 1954, 1966; Funk, 1966; Bradley and Deacon, 1966.
Desert Tortoise	In the study area found often in dense vegetation of creosote bush with Joshua tree (Yucca brevifolia) or Mojave yucca (Y. schidigera) with a ground cover of six-week fescue (Festuca octoflora). Found on bajadas or gentle slopes at elevations of 1,320 to 4,600 ft. Occurs in southern Nevada north at least to the Coyote Springs area and in southwestern Utah south of the study area.	Stebbins, 1954; Karl, 1980.
Spotted Bat	Caves, cave-like situations; rough, dry, desert terrain. Occurs in low numbers throughout Nevada and Utah.	Watkins, 1977
Utah Prairie Dog	Found only in scattered grassy valleys of south-western Utah.	Pizzimenti and Collier, 1975; Hassenyeager, 1979.
Wild Horses	Low mountains, bajadas, valley bottoms, canyons; especially where human population is sparse. Throughout Nevada and the western desert of Utah.	Zarn et al., 1977; USDI, Bureau of Land Management, 1979.
Bald Eagle	Winter resident only. Roosts in canyons and valley floors; in canyons, roosts are usually on Douglas fir; canyons often 1,200 ft above valley floor, location near top of a ridge with easy access to valleys, freedom from human disturbance. In valleys roosts are most often in trees. Throughout parts of Nevada and Utah.	Edwards, 1969.
Peregrine Falcon	Nest sites on cliffs of limestone, sandstone, quartzite, or volcanic rock; average height of cliffs being 178 ft, typically situated near a marsh. Perhaps found in the western desert of Utah.	Porter and White, 1973.

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the eagles away from impacted valleys into valleys with no activity. Of even greater importance are the roost sites of bald eagles, often found in trees in mountain canyons (Edwards, 1969). Mountain canyons may be heavily used by workers and their families for recreation and could force eagles from their perches (Stalmaster, 1976). Eagles could be driven from the area if suitable roost sites are not available nearby. Bald eagles could benefit, though, from construction activity in their foraging area. After the construction phase is over, the disturbed area could support higher population of lagomorphs (Vorhies and Taylor, 1933) which would mean more food for the eagles.

Endangerment of peregrine falcons has resulted primarily from accumulation in the food chain of persistent pesticides, especially DDT and metabolites (Herman, 1971; Enderson and Wrege, 1973; Porter and White, 1973; Chamberlain, 1974; Reichel et al., 1974). Nest-robbing by falconers, climatic change, and habitat disruption by humans have also contributed to the decline of this species (Porter and White, 1973). No recent nesting has been recorded in Nevada but there is some suggestion that nesting may occur in the mountains near the western desert of Utah (Porter and White, 1973). Figure 2.2-1 shows the areas known to have contained nesting peregrines in the last 20 years. Preferred nesting habitat is cliffs near marshes, where the peregrine feeds (Porter and White, 1973).

Although the peregrine may tolerate activity in the vicinity (Porter and White, 1973), recreation, such as rock climbing, which brings people directly to nest sites, would likely cause peregrines to abandon their nests. Also, recreation could be concentrated in water areas which could interfere with peregrine hunting.

As part of pest control efforts, the Utah prairie dog has been poisoned and shot (Pizzimenti and Collier, 1975), resulting in its eventual decline and subsequent listing as an endangered species. Occurring only in the southwestern portion of Utah, this species is found in agricultural areas and near cities (Figure 2.2-1). In the 1970s, the Utah Division of Wildlife Resources, the U.S. Fish and Wildlife Service, and the Bureau of Land Mangement began transplanting this species to public land to ensure its safety. Presently, a transplant population exists in the southern end of Pine Valley, Utah (Hasenyager, personal communication, 1979). Because the Utah prairie dog lives near ranches and towns, they appear somewhat tolerant of human activity (barring direct shooting and poisoning). A single road going through their range would destroy some of their forage and lead to some animals being run over but the overall impact on the population should be roughly proportional to the amount of habitat lost. Thus, a single road going through the population would be expected to have small direct effects on the population and would not be expected, by itself, to jeopardize its existence. A larger amount of surface disturbance, such as associated with cluster deployment, would have greater impacts by disturbing a larger proportion of the surface area and possibly fragmenting the population into semi-isolated demes having a lower probability of long-term survival than the original contiguous population. Extensive off-road vehicle activity in the area would have similar or greater deleterious effects. Intensive ORV use destroys much vegetation (Keefe and Berry, 1973) and could also lead to destruction of many of their burrow systems.

Little is known about the spotted bat. Although rarely seen, this bat is thought to occur throughout Nevada and Utah (Burt and Grossenheider, 1976). Like many bats, the spotted bat eats insects and evidently prefers caves in desert areas (Watkins, 1977). This animal could be subjected to inadvertant harassment by recreationists exploring caves. Michael O'Farrel (personal communication, 1980)

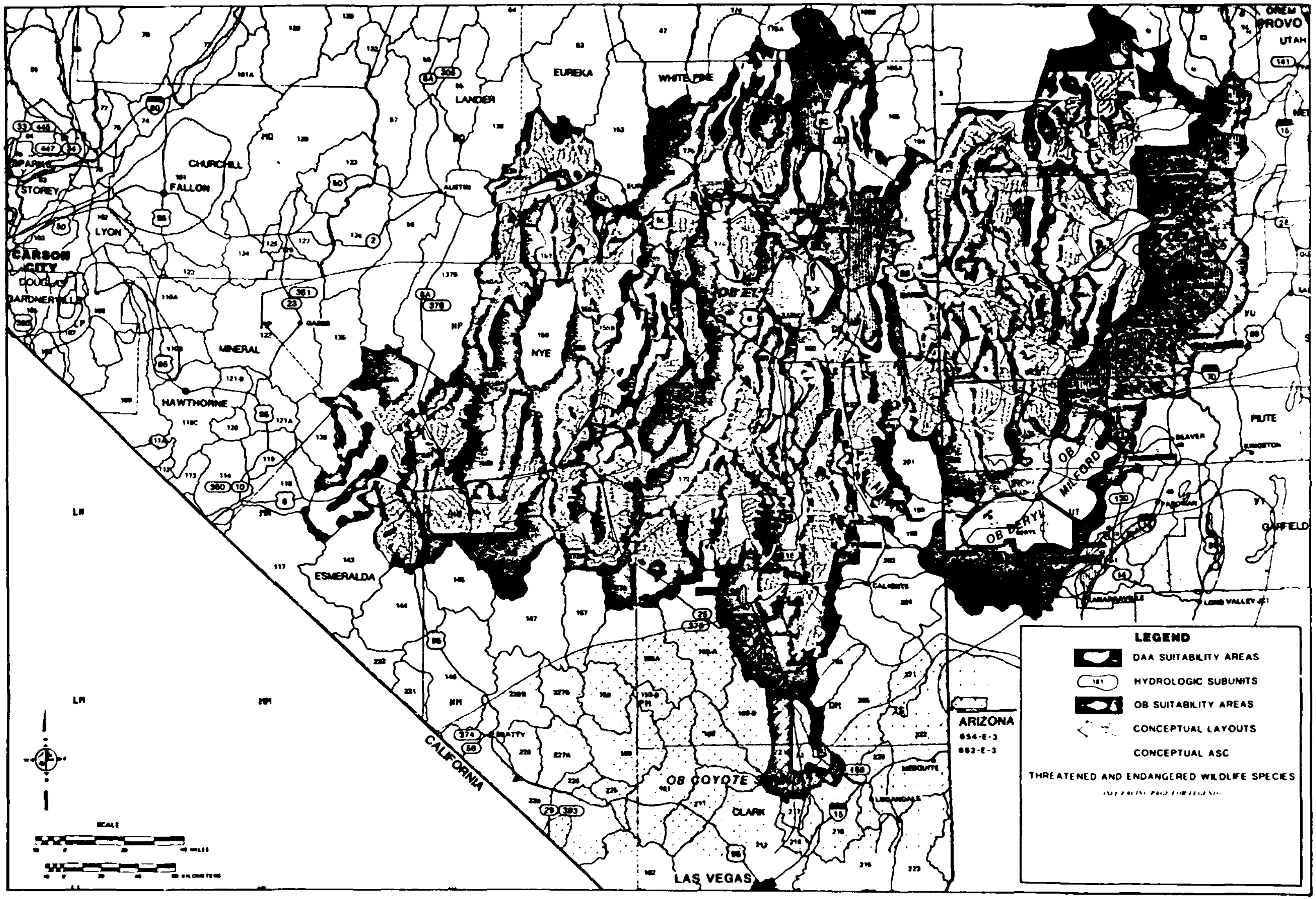

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Figure 4.3.1.2-1. Threatened and endangered wildlife species.

believes these bats are very intolerant of human disturbance and once disturbed at a roost site would leave and not return for many years.

Both the desert tortoise and gila monster are large, slow-moving reptiles occurring at the periphery of the study area in southern Nevada and the very edge of southwestern Utah (Figure 2.2-1). The gila monster, though, has a limited range in southern Nevada; few records show the gila monster occurring very far north of Las Vegas (Bradley and Deacon, 1966). The fact that both animals are slow moving has contributed, in part, to both often being captured by people. The gila monster is often captured for sale to collectors, even though they are venomous. The desert tortoise is often captured to be kept as a pet. Roads constructed through their habitat will undoubtedly lead to increased road mortality for both species and increase the chance of their collection. Nicholson (1978) has shown that tortoise numbers decrease up to one kilometer from roads and attributes this to highway mortality and increased collection pressure. Dogs and cats harass and kill other animals (Christian, 1974; McNight, 1964) and could affect both tortoise young and gila monsters within a mile or two of human populations. ORVs may also affect these species. Bury (1978) has demonstrated that tortoises are less abundant in habitat where ORV use is permitted. Desert tortoises are also quite sensitive to habitat alterations that affect the quality or quantity of the food resource (Nagy and Medica, 1977; Berry, 1978).

Wild horses and burros (see Figure 2.2-2) are protected under Public Law 92-195, which specifies that wild horses and burros on public lands be managed so as to "protect the natural ecological balance of all wildlife species which inhabit such lands" (Wild-Free Roaming Horse and Burro Act as amended, 1971). Management of their populations is a very controversial and emotional subject (Zarn et al., 1977). Preservationists want no control on population numbers while land managers and ranchers wish to see their numbers reduced by varying degrees to conform to the multiple-use concept. Thus, any effects on wild horse or burro populations resulting from M-X deployment would be acceptable to some people and unacceptable to others.

Construction activities during M-X deployment would be more likely to affect wild horses than feral burros for two reasons: horses are much more abundant in the potential deployment areas of Nevada and Utah than are burros, and wild horses utilize valleys more than burros do. Potential impacts of construction and operations activities on these species are summarized in Table 4.3.1.2-1. Areas utilized for equipment parking and maintenance, concrete mixing, materials storage, construction camps, etc., will also be excluded from use by wild horses and burros. Total habitat area disturbed is less than one to two percent in any hydrologic subunit. Additional area would probably be avoided by the animals during construction, but adjacent to the habitat area behaviorally excluded from use cannot be estimated at this time. These animals, decendants of domestic stock, are generally highly adaptable to human activities. The areas avoided are therefore expected to be quite small in comparison to native ungulates (e.g., pronghorn).

Habitat loss or exclusion during construction is expected to cause wild horses to move to adjacent suitable habitat or to concentrate in the portions of their range which are not disturbed. This movement would increase grazing pressure in the areas utilized. Range conditions are currently fair to poor in most areas as a result of past and present livestock grazing practices, and grazing pressure is generally at

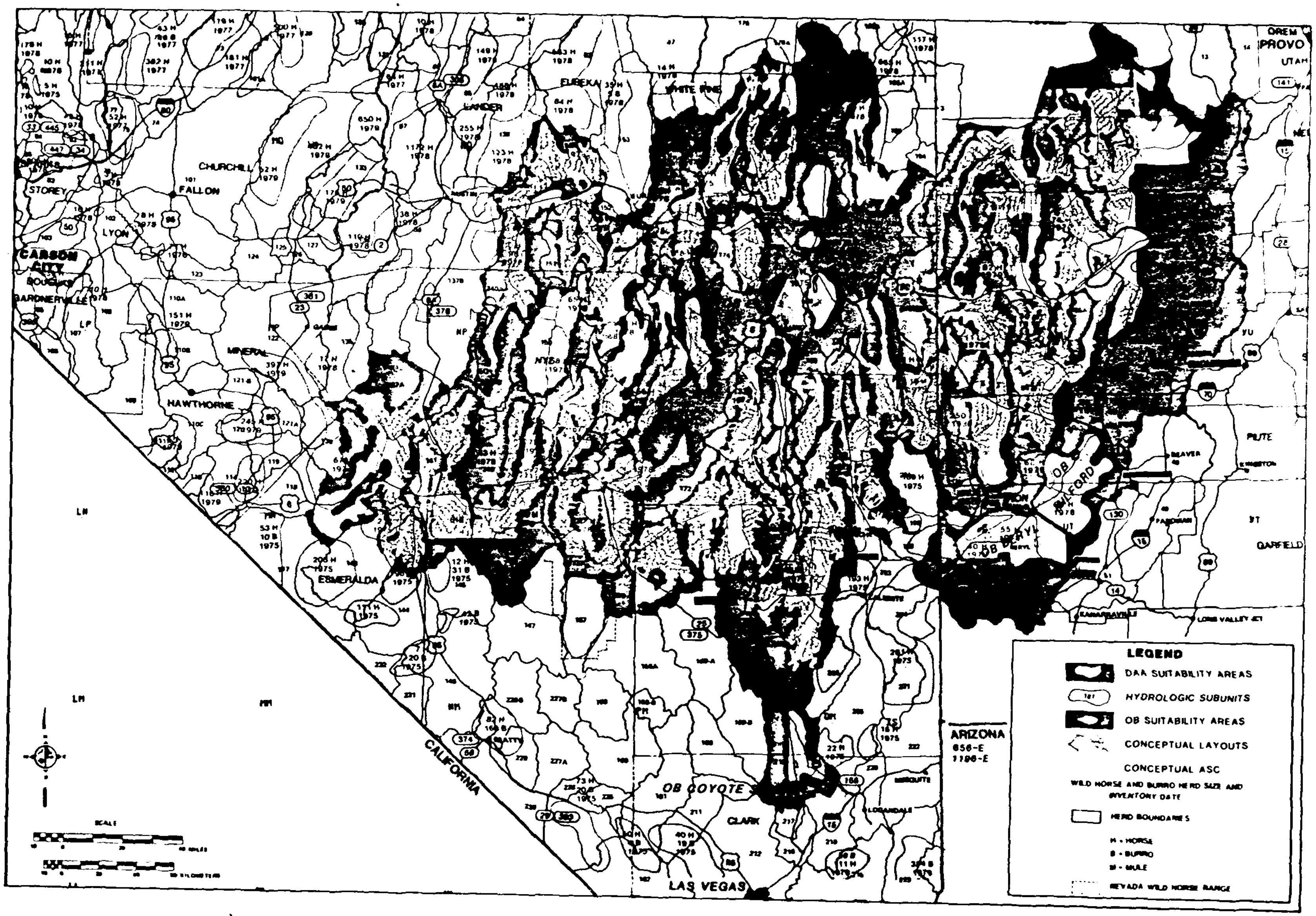

Figure 4.3.1.2-2. Wild horse and burro herd size.

a maximum (USDI, 1980). Thus, the range would not be able to accommodate increased grazing pressure without causing increased competition with livestock and wildlife. Wild horse populations are generally increasing rapidly throughout the Great Basin. Habitat loss, increased competition with livestock, and further deterioration of range quality are expected to slow this increase.

Once construction activities have been completed and the temporary facilities such as construction camps have been removed, wild horses and burros should be able to utilize the space among the shelters with few effects on their behavior. The presence of roads, security and surveillance facilities, and fenced shelters dispersed throughout the valleys is expected to decrease the carrying capacity of the range for these animals approximately by the amount of habitat actually lost. This amounts to 1-2 percent or less in any hydrologic subunit. Near the OBs, indirect effects resulting from population growth are estimated to be similar to those predicted for the construction phase.

Comparison among hydrologic subunits: Information about the abundance and sensitivity to impact of threatened and endangered terrestrial animals, by hydrologic subunit, appears in Table 4.3.1.2-3 in the form of ranked values.

Abundance in each hydrologic subunit was rated high if the hydrologic subunit contained (a) a bald eagle roost site or traditional wintering area, as mapped by Nevada DOW or Utah DWR, (b) Utah prairie dog range, or (c) occurrence records of two or more threatened or endangered species. Intermediate abundance refers to hydrologic subunits which do not meet the above criteria and contain (a) bald eagle feeding areas, or (b) desert tortoise range. Low abundance ratings were given to hydrologic subunits without records of threatened or endangered species.

Sensitivity to impact was considered high if the hydrologic subunit contained: (a) bald eagle roost site, (b) Utah prairie dog range, or (c) desert tortoise range. Hydrologic subunits were regarded as intermediate in sensitivity if they contained only bald eagle foraging areas. Low-sensitivity hydrologic subunits were those with a low abundance rating.

Data quality was considered high in the Utah portion of the table, since hydrologic subunit-specific distribution maps exist for all species. Data quality was considered intermediate in Nevada, based on imprecisely mapped distribution for desert tortoise and lack of information about bald eagle roost sites.

The following hydrologic subunits were rated high in resource abundance and high in sensitivity to impact: Pine (Utah), Government Creek, Rush, and Pahranagat. (see Figure 4.3.1.2-1). The siting of M-X project features in these hydrologic subunits would have the potential for the most damage to the protected wildlife resource.

Protected Aquatic Species (4.3.1.3)

Protected aquatic species in the Nevada/Utah project area occur mostly in isolated springs and small streams. When Pleistocene lakes disappeared 10,000 years ago, the small isolated springs, marshes, and intermittent streams in valleys and on desert mountains became refuges for ancestors of the endemic fish found there today. Many have evolved from the same parent fish, with trout inhabiting cold wafer mountain streams as last refuges and warmwater fish remaining in lowland

Table 4.3.1.2-3. Abundance, sensitivity to impact: protected terrestrial animals.

NUMBER	LOCATION	A	S	NUMBER	LOCATION	A	S
3	Deep Creek	L	L	151	Antelope	H	I
4	Snake	I	I	152	Stevens	L	L
5 (U)	Pine	H	H	153	Diamond	L	L
6	White	L	L	154	Newark	L	L
7	Fish Springs	H	I	155	Little Smoky	L	L
8	Dugway	L	L	156	Hot Creek	L	L
9	Government Creek	H	H	169a	Tikaboo-Northern	I	H
13	Rush	H	H	170	Penoyar	L	L
32b	Great Salt Lake Desert	L	L	171	Coal	L	L
	Western Desert			172	Garden	L	L
46	Sevier Desert	I	I	173a	Railroad-Southern	L	L
46a	Sevier Desert-Dry Lake	L	L	173b	Railroad-Northern	L	L
47	Huntington	L	L	174	Jakes	L	L
50	Milford	I	I	175	Long	L	L
52	Lund District	L	L	176	Ruby	H	I
53 (N)	Pine	L	L	178	Butte	I	I
53 (U)	Beryl-Enterprise District	L	L	179	Steptoe	H	I
54 (U)	Wah Wah	I	H	180	Cave	L	L
54 (N)	Crescent	H	I	181	Dry Lake	L	L
55	Carico Lake	L	L	182	Delamar	L	L
56	Upper Reese River	L	L	183	Lake	L	L
57	Antelope	L	L	184	Spring	H	I
58	Middle Reese River	L	L	185	Tippett	L	L
122	Gabbs	L	L	186	Antelope	H	I
124	Fairview	L	L	187	Goshute	H	I
125	Stingaree	L	L	194	Pleasant	L	L
126	Cowkick	L	L	196	Hamlin	L	L
127	Eastgate	L	L	198	Dry	L	L
133	Edwards Creek	L	L	199	Rose	L	L
134	Smith Creek	L	L	200	Eagle	L	L
135	Ione	L	L	201	Spring	L	L
136	Monte Cristo	L	L	202	Patterson	L	L
137a	Big Smoky-Tonopah Flat	L	L	203	Panaca	L	L
137b	Big Smoky-North	L	L	204	Clover	L	L
138	Grass	L	L	205	Meadow Valley Wash	I	H
139	Kobeh	L	L	206	Kane Springs	I	H
140	Monitor	L	L	207	White River	I	H
141	Ralston	L	L	208	Pahroc	H	H
142	Alkali Spring	L	L	209	Pahranagat	H	H
143	Clayton	L	L	210	Coyote Springs	I	H
144	Lida	L	L	219	Muddy River Springs	I	H
149	Stone Cabin	L	L	128	Dixie	L	L
150	Kuttke Fish Lake	L	L	129	Buena Vista	L	L
				132	Jersey	L	L

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H = high
U = Utah
I or M = intermediate/medium
N = Nevada
L = low
A = abundance, denoting frequency of resource occurrence.
S = sensitivity, relating to a combination of factors including (a) location and/or potential exposure of the resource to project effects, and (b) resource abundance. The criteria used for defining sensitivity levels are contained in the base reference document.

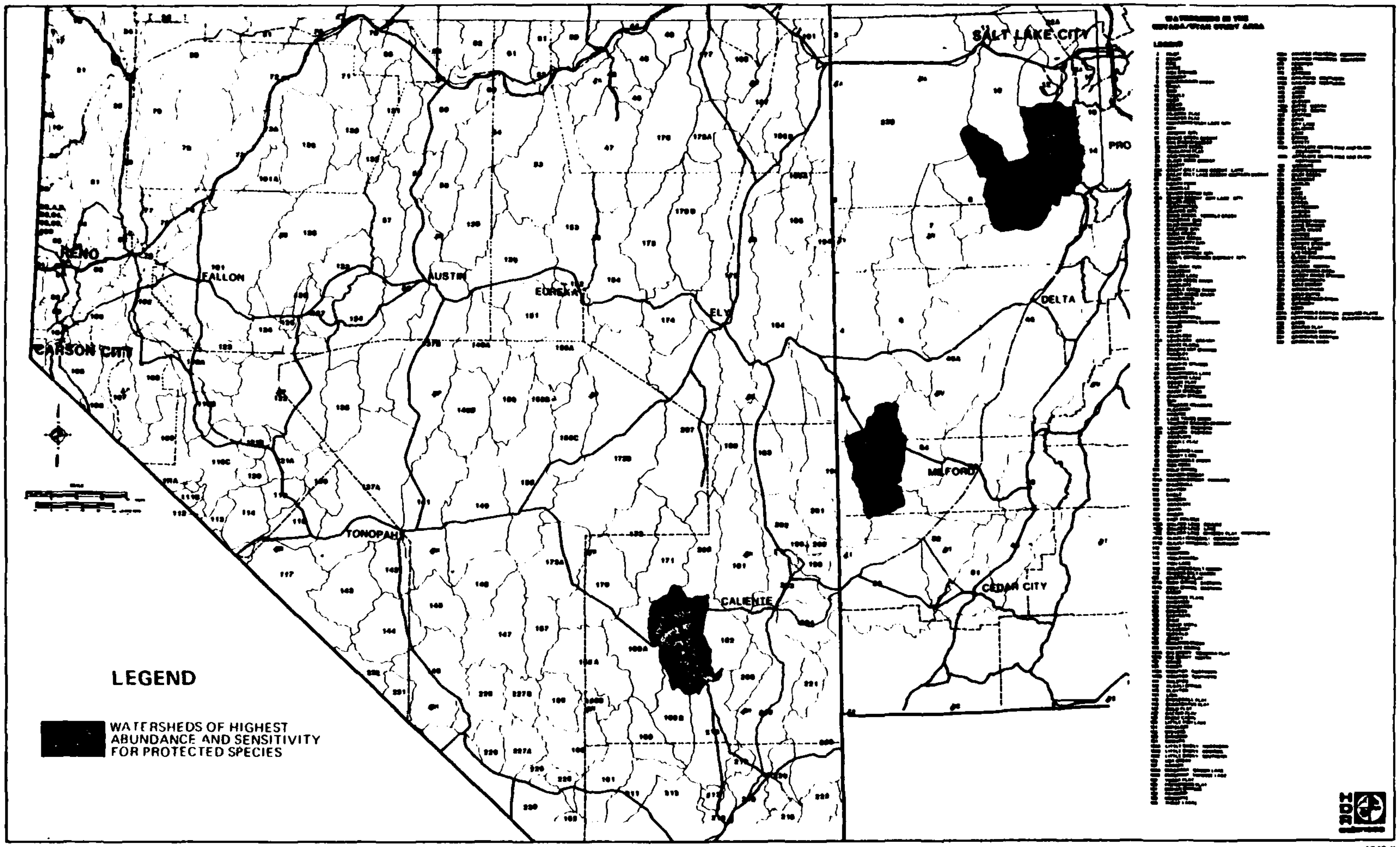

Figure 4.3.1.2-3. Hydrologic subunits of highest abundance and sensitivity for protected species.

springs of variable temperature and water quality. Construction and operation of the M-X project in the Great Basin desert may impact these endemic protected species directly through: (1) habitat disturbance, (2) altered rainfall patterns, (3) addition of pollutants, and (4) groundwater drawdown (Table 4.3.1.2-1). The last of these is most difficult to assess, yet most likely to cause adverse impacts. Indirect impacts relate to recreation of people drawn to the area as a result of project construction and operation. Recreational activities of concern include fishing, camping, swimming, and use of off-road vehicles. Introduction of exotic aquatic species also relates to increased population. The indirect effects are potentially as great or greater than the direct effects. Construction and operation of M-X would exert many of the same kinds of impacts upon protected aquatic species as those predicted for other aquatic species.

It is the sensitive nature of many of the protected aquatic species, however, that makes their susceptibility to potential project impacts of great concern. What may be damaging to a certain population of non-unique aquatic organisms may be catastrophic to an isolated population of a unique and rare taxonomic form. According to Deacon et al. (1979b), "Of Nevada's 40 native fish species, more are considered rare and endangered than in any other state. Seven known extinctions of fish species have resulted from man's activities in Nevada ... No extinctions need ever have occurred ... (they result from) ... our disregard for fish as we develop water supplies."

Lack of information regarding species-specific habitat requirements disallows analysis of the cause of these species extirpations. A detailed discussion of possible M-X related pressures that, without mitigation, could result in similar disturbances follows.

Direct physical destruction of aquatic habitat can result from cutting, filling, or blocking a stream or spring and diversion of water flow so as to desiccate downstream habitat. For example, removal of riparian vegetation as a result of agricultural development destroyed endemic fish habitat in Point of Rock Spring, Ash Meadow, Nye County, Nevada (Pister, 1974). Construction of protective shelters and construction camps could peripherally alter aquatic habitats in a similar manner, although such habitat disturbance is unlikely for most surface waters, except possibly for lowland or bajada springs or streams crossed by road networks.

Altered runoff effects may result from the construction of numerous roads transecting arroyos and other drainages. The greatest potential for altering surface water runoff would occur in lowland habitats where most construction activities would occur; but, since most perennial waters in valley bottoms are spring fed, their primary water sources will not be directly influenced by altered surface drainage patterns or gradients. Changes in surface drainage, however, could cause increased sediment runoff to these habitats. Phytoplankton and periphyton productivity, which forms the base of the aquatic food web, could be reduced by the resulting turbidity (Hynes, 1976 p. 107,). Some gill-breathing or filter-feeding invertebrates could be smothered or starved by increased sedimentation (Cummins and Klug, 1979). Fish could also be adversely affected by the sediment influx. Deacon et al. (1979), reported that population reductions in Lahontan cutthroat trout resulted, at least in part, from erosion that caused siltation.

Pollutants resulting from sanitary waste discharges may increase in receiving waters when OB support communities overload treatment facilities or simply when increased discharge of adequately treated effluents is released. The most harmful constituents in sanitary wastes include nutrients and oxygen demanding substances (Fair, Geyer, and Okun, 1968). These tend to stimulate algae productivity in daylight while depleting surface oxygen at night time. The resulting low dissolved oxygen concentration may change the species composition and abundance of receiving waters to more tolerant forms. Toxicants in sanitary wastes are not expected to be important as most effluents will originate from domestic sources. In the dry desert climate, most sanitary discharges will be disposed of through evaporation (lagooning) and land filling (of residual solid waste), but without careful planning and treatment system development some could be expected to reach surface waters near towns experiencing rapid project-related growth. Increased septic tank use could eventually pollute groundwater aquifers feeding adjacent springs or wells. Protected aquatic biota near Ely, Alamo, and Moapa are most likely to experience water quality degradations from such nearby point and non-point source sanitary discharges. Leaching of pollutants from solid waste landfills will be improbable because of low average rainfall in the desert. Suitable landfill locations (away from sensitive water sources) and maintenance will obviate concern for these potential pollution sources.

Chemicals associated with general construction and operation activities may enter surface waters. Petrochemicals washed from newly constructed asphalt roads (DTN) and from dust suppressants (e.g., $MgCl_2$) used on dirt and gravel roads could become toxic in certain areas. Runoff from cement mixing operations and occasional oil, diesel, or gasoline spills are unlikely (but possible) non-point source contaminants of surface water containing protected aquatic organisms. Areas near DTNs, construction camps, and OBs are most likely to receive runoff and groundwater contaminated by the above-mentioned chemicals. These include Snake, Railroad, and Tule valleys in addition to those containing operating bases. The only additional protected aquatic organism that may be impacted by the above activities, in addition to those discussed in the DEIS regarding OBs, is the Railroad Valley springfish.

Groundwater withdrawal rates necessary for construction of the project and operation of the bases presents the greatest potential for adverse impacts to protected aquatic species of any of the possible direct project effects. In addition, these impacts are the most difficult to assess at this time since they are very site-specific and depend upon specific project configuration and aquifer properties within each hydrologic subunit. The project is expected to require large amounts of water, which would be taken from subterranean aquifers that may supply important aquatic habitats in the vicinity or distant from the source of well water withdrawal. Lowering of the water table could affect an aquatic habitat by reducing its areal extent, its temperature, and the occurrence of protective vegetation such as emergent macrophytes. A reduction of the areal extent of habitat could cause crowding and subsequent physiological stress to populations residing therein. Reproductive success could be reduced or eliminated if spawning habitat were diminished. Water quality could also be affected by changes in the extent of the aquatic habitat because of dewatering protocols.

In Pahrump Valley, the last of three large springs dried up in 1975 (Deacon et al., 1979b). This followed a long history of spring water level declines resulting from nearby groundwater pumping for irrigation (Table 4.3.1.3-1). The Pahrump killifish was native to Manse Spring and nowhere else. It was transplanted to

Table 4.3.1.3-1. Water discharge and utilization in Pahrump Valley, Nye and Clark Counties, Nevada, in the period 1875-1967.

YEAR OR PERIOD	MANSE SPRING (FT^2/SEC, AV.)	PAHRUMP SPRING (FT^2/SEC, AV.)	RAYCRAFT SPRING (FT^2/SEC, AV.)	THOUSANDS OF ACRES IRRIGATED	PUMPAGE (THOUSANDS OF ACRE-FT)	NUMBER OF WELLS OPERATING	DEPTH OF WATER TABLE (FT)
1876	6.0	7.9					
1916	3.2	4.7	0.002	0.5	4.3	15	
1917-37					3.3-4.6		
1937-40	3.1				2.2-3.5		
1940-46	3.1	5.5			2.2-16.3		
1951	2.6				16.1	39	37
1952						39	30-60
1959	2.5	0.0	0.0	5.8	25.6	45	
1960	2.4			6.2	27.4	39	
1961	2.0			6.5	30.1	55	
1962	1.9			6.5	29.2	54	
1963	1.8			7.8	31.9	59	
1964	1.9			7.7	37.5	62	
1965	1.2			8.2	36.5	64	
1966	1.5			7.6	37.9	71	70-85
1967							75-84

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*Data for 1875 are from Malmberg (32); for 1916, from Waring (41); for the years 1917-46, from Maxey and Robinson (42); and for the years 1951-67, from Minckley and Deacon, 1968.

several other locations in a final effort to save it from extinction. This effort has proven to be moderately successful (Hardy, 1980). Two of the three original subspecies in the Pahrump Valley - the Pahrump Ranch Killifish and Raycraft Ranch Killifish - are now extinct as a result of this groundwater pumping.

Another example of where groundwater pumping in the Great Basin area has imperilled an endemic fish habitat was that of the Devil's Hole pupfish (Fiero and Maxey, 1970; Bateman et al., 1974; Dudley and Larsen, 1976). Devil's Hole has no surface outlet and its water level (elevation) is determined by flow from a large underground aquifer. The Devil's Hole pupfish is completely dependent upon water covering a sufficiently large portion of a rocky shelf for spawning and feeding habitat (Pister, 1974). A gradual lowering of the water level reduced the amount of water surface exposed to light and increased the amount of ledge exposed to air (see Figure 4.3.1.3-1). This threatened the survival of what is recognized as one of the most unique and highly evolved species of fish within the Death Valley system. A Supreme Court ruling in 1976 assured the protection of this fish through limitations on groundwater pumping in the vicinity of Ash Meadows (Cappaert vs. U.S., 1976). Some of the Devil's Hole pupfish have also been successfully transplanted to the Hoover Dam Refugium for further protection (Williams, 1977). Descendents of this transplant population however, now differ considerably from the original stock presumably a response to the differing conditions in source and transplant habitats.

Groundwater withdrawal is more likely to seriously affect small point source habitats supplied from the aquifer being tapped rather than linear habitats such as streams or larger habitats such as reservoirs and lakes which are less susceptible to similarly caused desiccation. Also, it is less likely that habitats upslope instead of downslope from water supply wells will be impacted by groundwater withdrawal, although this is inversely proportional to the distance from the well to the habitat of concern. Mathematical modeling of the hydrological conditions in the vicinity of habitats of concern and actual onsite pump testing may answer important questions regarding the degree of effect upon adjacent sensitive aquatic habitats.

Locations where water withdrawal impacts on protected and recommended protected aquatic biota are likely to be greatest occur in the White River Valley system (Table 4.3.1.3-2). These valleys include Moapa, Pahranagat, and White River. Projected water use in these valleys is estimated to consume only a small fraction of the perennial yield. However, since these sensitive valleys are all supplied by groundwater originating from interbasin exchange, the reductions projected to occur in "feeder" valleys (both nearby and distant) could possibly affect spring flow eventually in critical habitats. The Moapa Valley appears to be subject to the greatest overdraft and, therefore, the federally protected Moapa dace, two state protected fish, and three recommended protected invertebrates may suffer adverse consequences.

The Pahranagat Valley, whose springs are fed from the north by the White River Valley, to the east by Coal Valley, and to the west by Dry Lake and Delamar valleys, appears next most likely to incur reduced spring flows. The fish that could be affected are the federally protected Pahranagat roundtail chub, the state protected White River springfish, and at least three recommended protected invertebrates. White River Valley, which is supplied partially by groundwater from Jakes and Long valleys to the north, contains four state protected fish and three recommended protected invertebrates. Hot Creek Valley, which may be slightly overdrafted during peak demand years, may contain a transplanted population of the state protected Railroad Valley springfish. Water depletion in Moapa, Pahranagat,

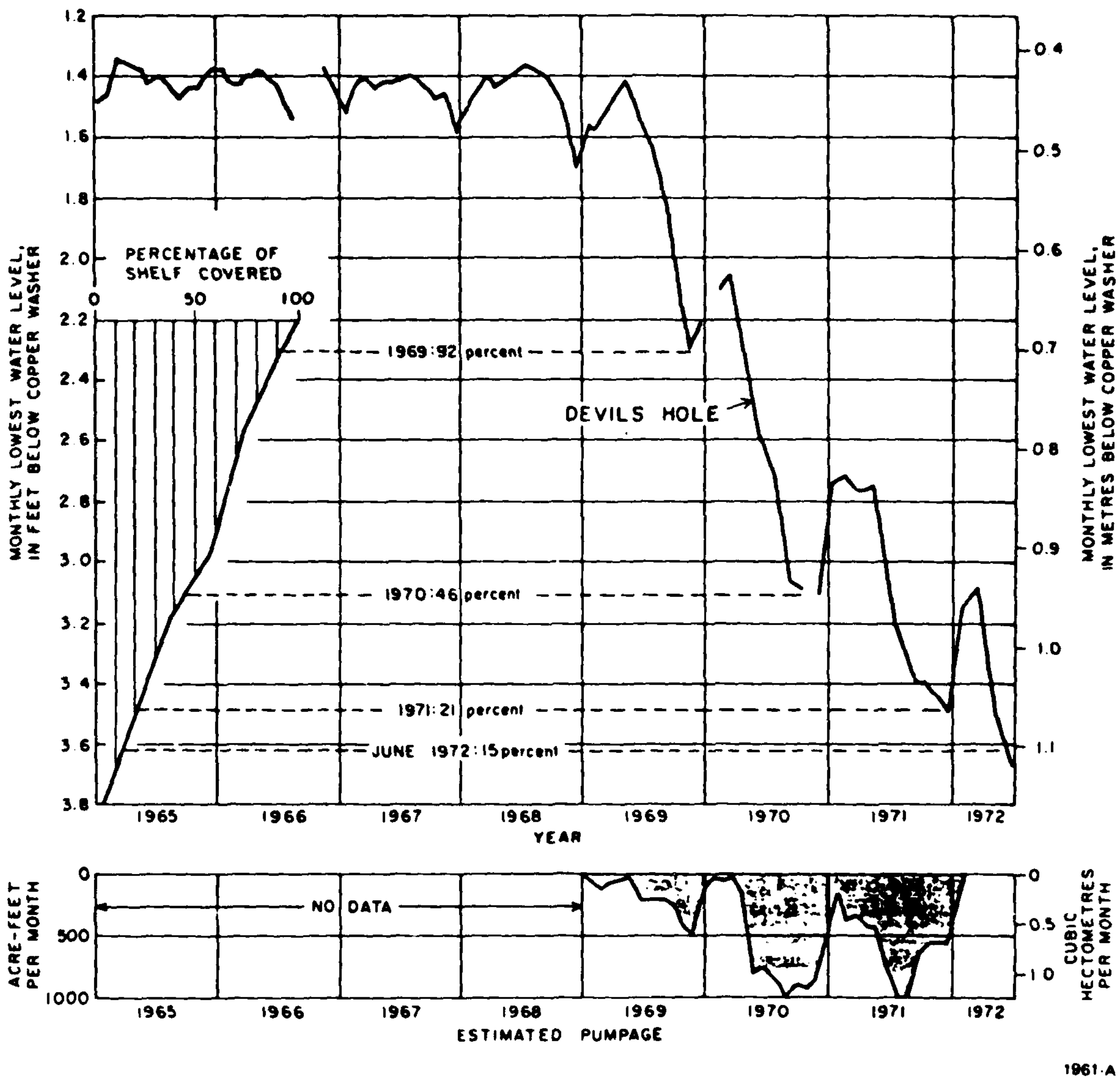

Figure 4.3.1.3-1. Monthly lowest water levels in Devil's Hole, percentage of natural rock ledge submerged, and estimated pumpage from wells in Ash Meadows, 1965 to mid-1972 (from Dudley and Larsen, 1976).

Table 4.3.1.3-2. Protected or recommended protected aquatic biota for which available data indicate close monitoring for water withdrawal-related impacts during construction or operation of the project in Nevada/Utah.

POTENTIALLY IMPACTED PROTECTED OR RECOMMENDED PROTECTED BIOTA[1]	LEGAL STATUS[2]	SPECIES LOCATION[3]	ESTIMATED WATER USE, (PERCENT OF PERENNIAL YIELD)[4]	INTERBASIN EXCHANGE - INPUT[5]			
				ADJACENT BASIN	ESTIMATED WATER USE PROJECT, (PERCENT OF PERENNIAL YIELD)[4]	NEARBY BASIN	ESTIMATED WATER USE PROJECT, (PERCENT OF PERENNIAL YIELD)[4]
Moapa dace	FE	Moapa	N/A	Coyote/Kane	27-163[6]/ 20-120[7]	Dry Lake	>73
Moapa White River springfish	ST	Moapa				Delamar	>20
Moapa speckled dace	RT	Moapa				Coal	>1,000
Moapa Valley turban	RT	Moapa				Garden	23-70
Moapa tryonia	RT/RE	Moapa				Cave	>50
Moapa creeping waterbug	RT/RE	Moapa				Jakes	>5.8
						Long	27-80
Pahranagat roundtail chub	RE	Pahranagat	1.6	Coal	>1,000	Garden	23-70
White River springfish	ST/RE	Pahranagat		Dry Lake	>73	Cave	>50
Hiko White River springfish	ST	Pahranagat		Delamar	>20	Jakes	>5.8
White River speckled dace	RT/RE	Pahranagat				Long	27-80
Pahranagat Valley turban	RT	Pahranagat					
Mormon White River springfish	ST	White River	5.9	Jakes	>5.8	Long	27-80
Preston White River springfish	ST						
White River desert sucker	ST/RE	White River					
White River spinedace	ST/RE	White River					
Hot Creek turban	RE	White River					
White River Valley fontelicella	RE	White River					
White River Valley hybrobiid	RE	White River					
Railroad Valley springfish	ST	Hot Creek	43	No Known Interbasin Exchange			

1449-6

[1]Scientific names are listed in ETR-16.

[2]F = federal, E = endangered, S = state, T = threatened, R = recommended.

[3]Valley, watershed, or hydrologic unit.

[4]MPQ/PY = Estimated water use as determined by most probable quantity (MPQ) divided by perennial yield (PY) as expressed in percent, per information derived from Table 3.2.2.1-1 in Chapter 3.

[5]Information derived from Figure 6 in Eakins (1966).

[6]Assuming location of first OB in valley during operation.

[7]Assuming location of second OB in valley during operation.

N/A = Not Available.

and other valleys may require mitigations meeting requirements determined thrcugh Section 7 consultation with the U.S. Fish and Wildlife Service. The exact degree of spring flow reduction resulting from project water use cannot be calculated at this time, although adverse impacts will be avoided, minimized, or mitigated by alteration of well water pumping rates and/or locations, by supplementing water supply to affected habitats, or by transplanting sensitive populations to sanctuaries until project water demand decreases. The other two valleys will likely require similar consideration.

One of the most dispersed and difficult to control impacts resulting from the project would be that caused by recreational activities of construction and operations related persons in areas previously considered pristine. Recreational activities can be extremely damaging to certain sensitive habitats since it is difficult to protect areas from such pressures and since the extent of such activities is widespread. Off-road vehicles can irreparably damage the benthic sediments of a small stream or spring habitat while swimming and picnicking can cause disturbance of aquatic organisms and gradual deterioration of the habitat through trampling of parks (and vegetation) and littering; some individuals may pan for gold and other precious minerals or stones in certain streams which could render downstream habitats unsuitable for some protected biota through increased turbidity and siltation. Increased fishing pressure may result in depletion of populations of attractive but rare sports fish, the Lahontan or Utah cutthroat trout. Since the exact distribution and abundance of these rare fish are presently poorly known (Deiringer, May 1980), it is difficult to assess how increased fishing pressures may deplete their populations. Projections for fishing pressure even without the M-X project indicate sharp upward trends (Figure 4.3.1.3-2). Access to fishing resources will be facilitated as a result of new roads into formerly pristine areas. Without increased protection of rare endemic game fish, reduced numbers are expected until catch per unit effort decreases to the point of user acceptance (about 3 strikes/angler hour for trout; Walstrom, 1973), and fishermen expend their efforts elsewhere. Density-dependent compensation would be expected to facilitate the repopulation of a stream containing severely overfished stock, although mating success will be initially reduced as a result of fewer spawning encounters (Ricker, 1977; Everhart et al., 1975, pp. 165-178).

Another effect related to recreation would be the introduction of exotic species which may tend to out-compete the local endemic forms. The successful introduction of goldfish into some habitats, for instance, has been quite detrimental to endemic fish species. Moreover, certain tropical aquarium fish do quite well in warm-water springs, sometimes feeding not only upon the food of the resident forms but also upon the resident forms, themselves, some of which may be protected (Deacon et al., 1979). Some exotic fish have been introduced in an effort to reduce nuisance insects such as mosquitos; however, it has been shown recently that the exotic mosquitofish is more effective in eliminating endemic fish than in reducing mosquito populations (Figure 4.3.1.3-3). In fact, endemic fish seem to be more capable of feeding upon mosquito larvae than are the mosquitofish introduced to solve the problem.

The general reduction and los of native fish in the Salt River, Maricopa County, Arizona, is shown in Table 4.3.1.3-3. The correspondence between disappearance of the native taxa and introduction of non-native (exotic) taxa is striking and is indicative of the sensitivity of the native fish fauna of Nevada/Utah to introduction of non-native species.

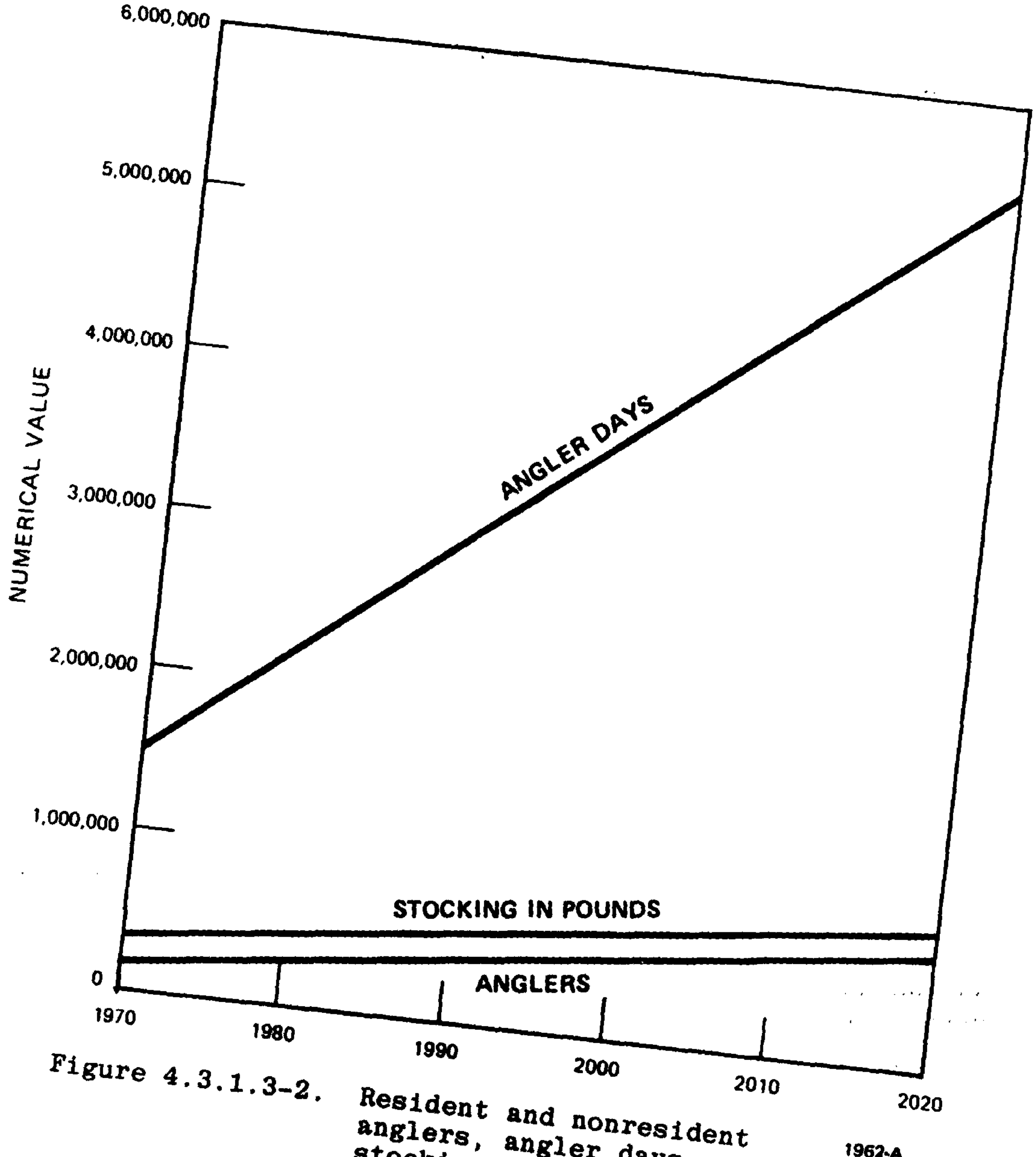

Figure 4.3.1.3-2. Resident and nonresident anglers, angler days, and stocking statewide, 1970-2020 (from Walstrom, 1973).

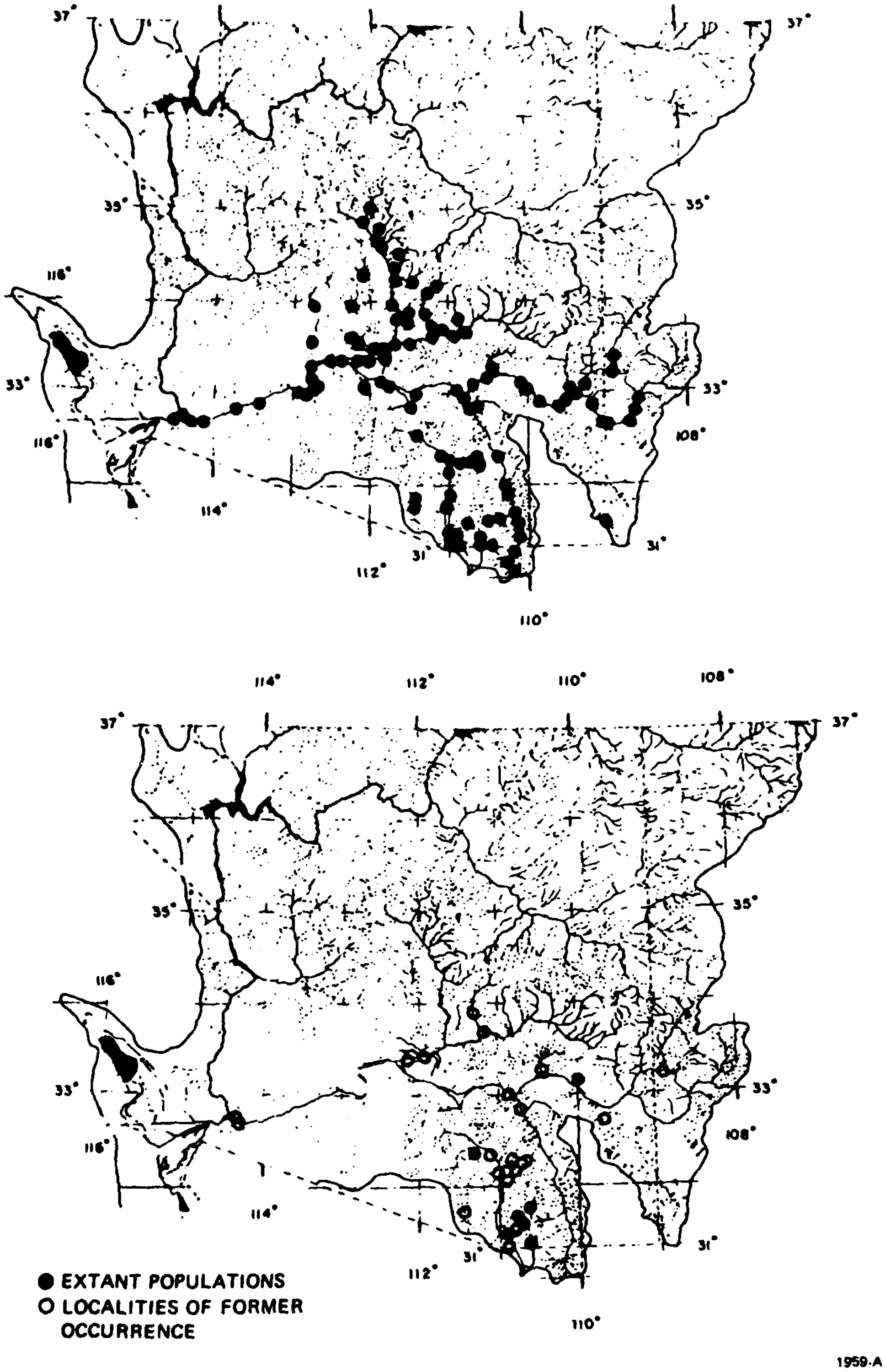

Figure 4.3.1.3-3. Distribution ofmosquitofish (top) based on collections housed at Arizona State University and gila topminnow (bottom) in the Gila River basin (excluding transplant sites) (minckley et al, 1977).

Table 4.3.1.3-3. Fishes recorded from the Salt River, Maricopa Couty, in the city of Tempe, in the period 1890-1967, showing the replacement over time of native fishes by introduced species.

SPECIES	YEAR OF COLLECTION OR PROBABLE OCCURRENCE (1900 — 1920 — 1940 — 1960)
	Native species
Gila elegans	O----
Meda fulgida	O----
Plagopterus argenfissimus	O----
Ptychocheilus lucius	X----
Rhinichthys osculus	O----
Castostomus latipinnis	O----
Xyrauchen texanus	O----
Agosia chrysogaster	X----------------------O----
Gila intermedia	X----------------------O----
Gila robusta	X----------------------O----
Poeciliopsis occidentalis	O----------------------O----
Cyprinodon macularius	O----------------------O-------------X-------------O----
Castostomus insignis	O----------------------X-------------X-------------O--------O--
Pantosteus clarki	O----------------------X-------------X-------------O--------O--
	Introduced species
Gambusia affinis	----O-------------O-------------O--------O--
Lepomis cyanellus	----O-------------X-------------O--------O--
Cyprinus carpio	----O-------------X--------O--
Ictalurus melas	----O-------------O--------O--
Lepomis macrochirus	----O-------------X--------O--
Pomoxis nigromaculatus	----O-------------X--------X--
Poecilia latipinna	----O--------O--
Micropterus salmoides	----O--------O--
Dorosoma petenensis	----O--
Carassius auratus	----O--
*Notemigonus crysoleucus**	----O--
Notropis lutrensis	----O--
*Pimephales promelas**	----O--
Potalurus natalis	----O--
Ictalurus punctatus	----O--
*Lebistes reticulatus**	----O--
*Roecilia mexicana**	----O--
*Xiphophorus variatus**	----O--
Lepomis microlophus	----O--
*Tilapia mossambica**	----O--

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*These species were taken prior to severe flooding in the Salt River channel at Tempe in the winter of 1965-66, but not subsequently.

Dashed lines span the period during which a species probably inhabited this segment of the stream.

O = Occurrences documented by specimens in museums or recorded in the literature; X = Probable occurrence of a species at a given time, on the basis of collections made before that time or in other parts of the drainage, both upstream and downstream from Tempe.

Source: Minckley and Deacon, 1968.

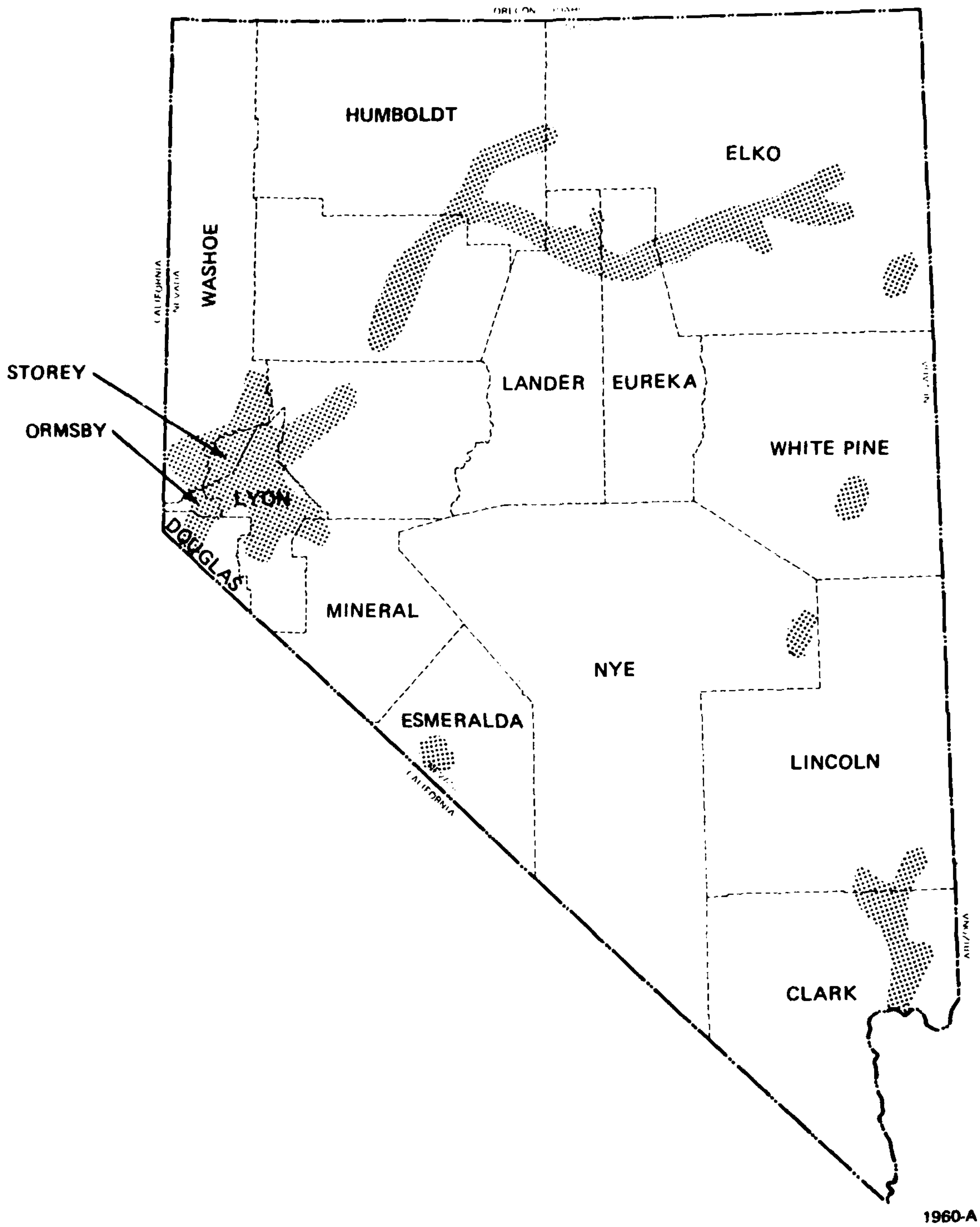

Figure 4.3.1.3-4. Bullfrog distribution in Nevada (from Walstrom, 1973).

In order to maximize the sportfishing yields of both cold and warm water aquatic habitats, some attempts have been and will be made to stock areas that were previously pristine, with popular sportfish. Even though some of these introduced game fish may not be able to survive from year to year and/or reproduce, they may nevertheless exert heavy competitive pressure upon resident forms in their search for limited food resources. Bullfrogs have been introduced in a number of locations in Utah and Nevada (Figure 4.3.1.3-4) for food value, and these voracious feeders have been shown to be highly effective in eliminating not only endemic resident invertebrates but also fish. Introduction of exotic species may also introduce exotic diseases.

Information summarizing the abundance and sensitivity to impact of protected and recommended protected aquatic species, by hydrologic subunit, appears in Table 4.3.1.3-4 in the form of ranked values. Abundance is ranked high if at least two legally listed protected species or three recommended protected species populations occurs within a subunit; intermediate abundance refers to subunits which have one listed protected species or two recommended protected species populations occurring within a subunit; and low abundance ratings are given to subunits with no listed protected or no more than one recommended protected aquatic species population occurring therein. Sensitivity to impact is considered high if the hydrologic subunit contained at least two listed protected species habitats or three recommended protected aquatic species habitats occurring at low elevation or in geotechnically suitable areas; sensitivity is considered intermediate if one protected aquatic species population or two recommended protected aquatic species populations occur in geotechnical suitable areas; and sensitivity is considered low if no protected aquatic species or one or less recommended aquatic species populations occur in geotechnically suitable areas. Data quality is considered high in hydrologic subunits where protected or recommended protected aquatic species populations have been studied with respect to densities or spawning and feeding requirements, intermediate in hydrologic subunits where only species occurrence was studied, and low where no systematic studies have been undertaken. The following hydrologic subunits rate high in resource abundance and high in sensitivity to impact: Spring, White River, Pahranagat, and Muddy River (Figure 4.3.1.3-5).

TEXAS/NEW MEXICO (4.3.2)

The occurrence of protected species in project areas can present important constraints to deployment. Depending upon the level of protection afforded to a particular species, legal or public sanctions may be imposed to assure protection. Federally protected species require a Section 7 consultation with the U.S. Fish and Wildlife Service to assure that protection of the species is taken into account. Such consultation requires the agency to conduct detailed inventories and make detailed analyses concerning potential impact to listed or proposed species. State protected species require similar but less stringent procedures to be followed for maintaining the integrity of the potentially impacted species. Species recommended for protection are also considered a potential constraint, since they may be proposed and listed as either federal or state protected species or both at some point during project deployment. Depending on the importance of a protected species to a national or local special interest group, impacts that could harm the species may face litigation in local, state, or federal courts. Such litigation procedures could be serious enough to delay or even prevent certain aspects of the project from being completed without alteration and/or mitigation. In some cases, only an act of Congress could waive environmental laws and potential litigation regarding suspected adverse impacts to protected species.

Table 4.3.1.3-4. Abundance, sensitivity to impact, and quality of data: protected aquatic species, Nevada/Utah.

NUMBER	LOCATION	A	S	Q
3	Deep Creek	L	L	L
4	Snake	I	I	H
5 (U)	Pine	L	L	L
6	White	I	I	I
7	Fish Springs	I	I	I
8	Dugway	L	L	L
9	Government Creek	L	L	L
13	Rush	L	L	L
32b	Great Salt Lake Desert-Western Desert	L	L	L
46	Sevier Desert	L	L	L
46a	Sevier Desert-Dry Lake	L	L	L
47	Huntington	L	L	L
50	Milford	L	L	L
52	Lund District	L	L	L
53 (N)	Pine	L	L	L
53 (U)	Beryl-Enterprise District	L	L	L
54 (U)	Wah Wah	L	L	L
54 (N)	Crescent	L	L	L
55	Carico Lake	L	L	L
56	Upper Reese River	I	L	I
57	Antelope	L	L	L
58	Middle Reese River	L	L	L
122	Gabbs	L	L	L
124	Fairview	L	L	L
125	Stingaree	L	L	L
126	Cowkick	L	L	L
127	Eastgate	L	L	L
133	Edwards Creek	I	L	I
134	Smith Creek	L	L	L
135	Ione	L	L	L
136	Monte Cristo	L	L	L
137a	Big Smokey-Tonopah Flat	I	L	I
137b	Big Smokey-North	I	L	I
138	Grass	L	L	L
139	Kobeh	L	L	L
140	Monitor	L	L	L
141	Ralston	L	L	L
142	Alkali Spring	L	L	L
143	Clayton	L	L	L
144	Lida	L	L	L
149	Stone Cabin	L	L	L
150	Little Fish Lake	L	L	L

NUMBER	LOCATION	A	S	Q
151	Antelope	L	L	L
152	Stevens	L	L	L
153	Diamond	L	L	I
154	Newark	L	L	I
155	Little Smokey	L	L	I
156	Hot Creek	L	L	I
169a	Tikaboo-Northern	L	L	L
170	Penoyer	L	L	L
171	Coal	L	L	L
172	Garden	L	L	L
173a	Railroad-Southern	L	L	L
173b	Railroad-Northern	I	I	H
174	Jakes	L	L	L
175	Long	L	L	L
176	Ruby	I	I	I
178	Butte	L	L	I
179	Steptoe	I	I	I
180	Cave	L	L	L
181	Dry Lake	L	L	L
182	Delamar	L	L	L
183	Lake	L	L	L
184	Spring	H	H	I
185	Tippett	L	L	L
186	Antelope	L	L	L
187	Goshute	I	I	I
194	Pleasant	L	L	L
196	Hamlin	I	I	I
198	Dry	L	L	L
199	Rose	L	L	L
200	Eagle	L	L	L
201	Spring	L	L	L
202	Patterson	L	L	L
203	Panaca	L	L	I
204	Clover	L	L	L
205	Meadow Valley Wash	L	L	L
206	Kane Springs	L	L	L
207	White River	H	H	H
208	Pahroc	L	L	L
209	Pahranagat	H	H	H
210	Coyote Springs	L	L	L
219	Muddy River Springs (Moapa)	H	H	H
128	Dixie	L	L	L
129	Buena Vista	L	L	L
132	Jersey	L	L	L

2300-3

A = Abundance
S = Sensitivity to impact
Q = Quality of data
H = High; I = Intermediate; L = Low

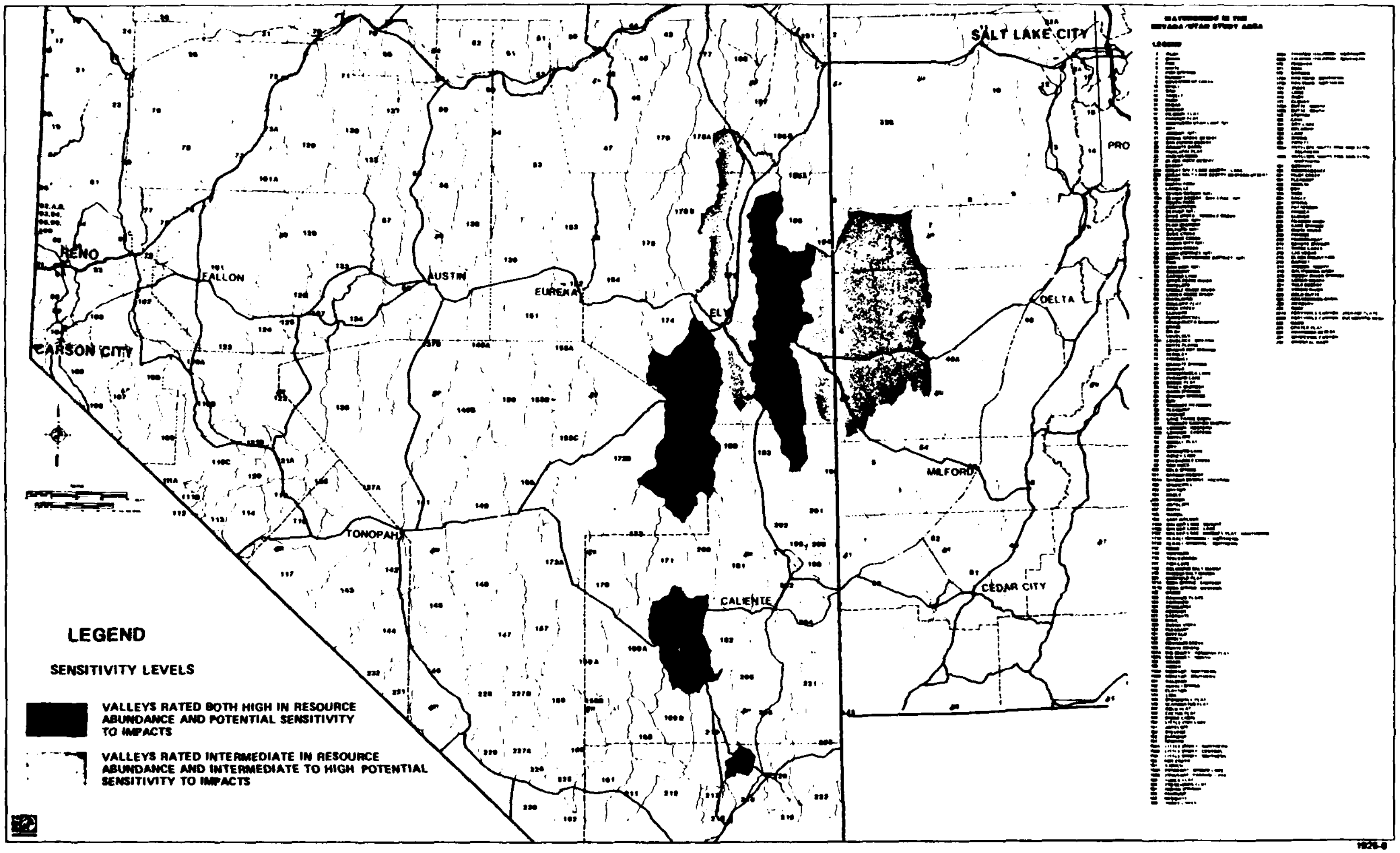

Figure 4.3.1.3-5. Highest abundance and highest potential sensitivity to project-impacts for project-impacts for protected and recommended protected aquatic species.

Plants (4.3.2.1)

Protected plant species most likely to be affected by M-X deployment are those found in what was historically shortgrass prairie. Of the species proposed to be listed for the state of Texas, only bracted milkweed (Asclepias involucrata), Correll's buckwheat (Eriogonum correllii), annual skeleton plant (Lygodesmia rostrata), sandhill muhly (Muhlenbergia pungens) and littleseed ricegrass (Oryzopsis micrantha) are likely to be in such habitats. Littleseed ricegrass and annual skeleton plant are thought to be extirpated in Texas, but may persist in rangeland such as the Rita Blanca National Grassland and in suitable areas in the Canadian and Red River valleys. As presently proposed, deployment would use suitable areas for all of these upland shortgrass prairie species. It is likely that the current rarity of these species is partially due to conversion of prairie to intensive agriculture and heavily used rangeland. Incidental destruction of small shortgrass prairie remnants scattered in agricultural areas now planned for deployment could destroy undetected populations. Thus, should the Texas/New Mexico area be selected for deployment, Tier 2 environmental analysis would be conducted to evaluate potential impacts and to design appropriate stategies for avoidance and mitigation. The tiering process is discussed in Section 1.7 of the DEIS.

The dissected river valleys also provide potential habitat for rare upland plant species, and are locations for other rare species, such as smooth cliff brake (Pellaea glabella), golden sedge (Carex aurea), redberry juniper (Juniperus pinchotti), and Kuenzler's barrel cactus (Echinocereus kuenzleri). River valleys are also prime recreational land, especially for ORV use. Additional recreational stress from construction and operational personnel might destroy habitats supporting protected plant species. Kuenzler's barrel cactus is a federally listed species (FR, May 1980).

Abundance and sensitivity to impact were analyzed and evaluated for protected plant species on a county-by-county basis. See Table 4.3.2.1-1. These categories were rated high, intermediate, or low, using the following criteria. High abundance was assigned to counties where two or more rare species were reported. Counties with one species were assigned intermediate abundance, and counties with no known rare plant species were assigned low abundance.

Sensitivity to impact was considered high if two or more species of rare plants were known from within a county. Sensitivity to impact was considered intermediate if one species of rare plant was known for the county, and sensitivity to impact was considered low if no rare plant species were known for the county.

Only Hartley County has a high abundance rating because of the presence of three proposed protected shortgrass prairie plants, littleseed ricegrass, bracted milkweed, and Correll's buckwheat. These have high impact sensitivity because they are likely to be in the deployment area; however, specific locations are not available at this time.

Wildlife (4.3.2.2)

Of the 25 protected species, only four, the black-footed ferret, American peregrine falcon, bald eagle, and whooping crane, are federally listed. The three birds are seasonal or casual visitors, and the ferret is probably extirpated in the area. Protected terrestrial animal species may be subjected to habitat deterioration and destruction, illegal shooting and capture, and competition with or predation by

Table 4.3.2.1-1. Abundance and sensitivity to impact and data quality for rare and protected plants, Texas/New Mexico High Plains.

STATE/COUNTY	RARE AND PROTECTED PLANTS		
	A	S	Q
Texas			
Bailey	L	L	I
Castro	L	L	I
Cochran	L	L	I
Dallam	I	H	I
Deaf Smith	I	H	I
Hartley	H	H	I
Hockley	L	L	I
Lamb	L	L	I
Moore	L	L	I
Oldham	L	L	I
Parmer	L	L	I
Randall	I	H	I
Sherman	L	L	I
New Mexico			
Chaves	I	L	H
Curry	L	L	H
De Baca	L	L	H
Guadalupe	L	L	H
Harding	L	L	H
Lea	L	L	H
Quay	L	L	H
Roosevelt	L	L	H
Union	L	L	H

2328-2

A = Abundance

S = Sensitivity to impact

Q = Quality of data

H = High; I = Intermediate; L = Low

These are described in detail in the reference documents.

introduced exotic species. Habitat will be lost or disturbed through construction of roads, rail lines, and operating bases, as well as through urbanization due to development of non-military support facilities, although to a lesser degree. The large influx of people to the deployment area will lead to increased recreational uses of the land, and attendant poaching, disturbance from noise and human presence, and habitat loss through camping, ORV use, and other activities. Harm to threatened and endangered species caused by induced population growth will be greatest during construction, because project-related manpower requirements will be greatest then. These effects would, in addition, be spread over the entire project area as construction progresses from place to place. During operations such impacts would become more localized, occurring principally in the vicinity of the operating bases. Free running dogs and cats could pose a threat to small reptiles such as the Texas horned lizard and the Central Plains milk snake, and small birds, such as Baird's sparrow and McCown's longspur (Boggess et al., 1978). Because the New Mexico area is mostly rangeland, populations of these species are larger than in the agricultural areas of Texas. Extensive habitat disturbance could cause changes in the prey populations, mostly small mammals, of the various protected birds of prey, especially black hawk and zone-tailed hawk. These potential impacts are summarized in Table 4.3.2.2-1.

Excessive noise from ORVs and other recreation activities in river valleys and adjacent canyons might disrupt behavior of water-associated birds, such as the little blue heron, Mississippi kite, and osprey, as well as reptiles, such as softshell turtles and amphibians.

Abundance, sensitivity to impact, and data quality were analyzed and evaluated for protected terrestrial animals on a county-by-county basis. These three categories were rated high, intermediate, or low according to the following criteria.

Abundance in each county was called high if the county contained (a) a bald eagle roost site or traditional wintering area, or (b) occurrence records of two or more federally listed threatened or endangered species. Intermediate abundance refers to counties that do not meet the above criteria and contain: (a) bald eagle feeding areas; (b) one other federally listed species; or (c) two or more state listed endangered species. Low abundance ratings were given to counties without records of theatened or endangered species.

Sensitivity to impact was considered high if the county contained: (a) bald eagle roost site, or (b) black-footed ferret sighting. Counties were regarded as intermediate in sensitivity if they contained only state or other federally listed threatened or endangered species. Low sensitivity counties were those with no known threatened or endangered species.

Data quality was considered high in counties for which reliable reports for threatened or endangered species exist. Data quality was considered low for Texas, due to lack of exact sighting records.

Four counties, all in New Mexico, have high abundance ratings (Table 4.3.2.2-2). Chaves County is rated high because of known bald eagle roosting areas along the Pecos River. Sensitivity is low, however, because the valley is not in the direct deployment area. Curry County historically has had black-footed ferret sightings in the deployment area, and without further investigation potential impact is considered high. Tier 2 environmental analyses, and studies conducted in support of Section 7 consultation with U.S. Fish and Wildlife Service under the endangered

Table 4.3.2.2-1. Summary of potential impacts to protected wildlife species in the Texas/New Mexico study area.

SECONDARY EFFECTS	POTENTIAL IMPACTS ON PROTECTED SPECIES
Construction	
Fugitive dust	No effects.
Erosion and filtration	Fish population reduction could affect fish-eating birds, such as bald eagle, osprey, little blue heron. Erosion may cause reduction of prey items for predators such as peregrine falcon and hawks, habitat loss for protected snakes and lizards.
Loss of vegetation	Habitat loss for upland species such as McCown's longspur, Texas horned lizard. Reduction of prey species for raptorial birds, especially peregrine falcon, black hawk.
Presence of machinery and people	Disturbance may drive away reptiles, upland birds, birds of prey for duration of activity.
Operations	
Fugitive dust	No effects.
Erosion	Similar to above, but at lower levels.
Revegetation	Return of animals displaced during construction, including prey items.
Transmission lines	Provide perches for bald eagle, black hawk, etc., but may threaten electrocution. Transmission lines could be designed to prevent this.
Road kills	May impact Texas horned lizard, protected snakes, but projected traffic increases not large.
Noise and visual	No significant effects, as human presence already large.
People	
Sewage	May affect prey items of fish-eating birds, such as bald eagle, osprey.
Introduction of exotic species	Dogs and cats may kill or harass native upland species such as Texas horned lizard, Central Plains milk snake.
Recreation ORV use	Heavy use could impact upland species by habitat destruction and noise, and prey items for raptors could decrease locally.
Camping and hiking	Little significant effect.
Hunting and fishing	Possible reduction of prey species for protected raptors.
Poaching	Possible killing of protected raptorial birds.

3007-1

Table 4.3.2.2-2. Abundance, sensitivity to impact, and data quality for threatened/endangered terrestrial animals, Texas/New Mexico High Plains.

STATE/COUNTY	THREATENED/ENDANGERED TERRESTRIAL ANIMALS		
	A	S	Q
Texas			
Bailey	I	I	L
Castro	I	I	L
Cochran	I	I	L
Dallam	I	I	L
Deaf Smith	I	I	L
Hartley	I	I	L
Hockley	I	I	L
Lamb	I	I	L
Moore	I	I	L
Oldham	I	I	L
Parmer	I	I	L
Randall	I	I	L
Sherman	I	I	L
New Mexico			
Chaves	H	L	H
Curry	H	H	H
De Baca	H	L	H
Guadalupe	L	L	H
Harding	I	I	H
Lea	I	L	H
Quay	I	H	H
Roosevelt	L	H	H
Union	H	L	H

2326-2

A = Abundance
S = Sensitivity to impact
Q = Quality of data
H = High; I = Intermediate; L = Low

species act, would be conducted to determine potential for impacts and appropriate avoidance and/on mitigation stratagies. DeBaca County has known bald eagle roosting areas, but sensitivity is low because these roosts are well outside the deployment area. Union County has had black-footed ferret sightings, but these were located outside the deployment area in unsuitable terrain.

Aquatic Species (4.3.2.3)

Effects on protected aquatic species could occur due to habitat deterioration from any construction or operational activities, and indiscriminate recreational use of the river valleys (Table 4.3.2.3-1). Siltation, habitat destruction by ORVs, and inadvertant introduction of exotic species could adversely affect local protected fish populations. Rare endemic fishes presently found in protected habitats outside the deployment area should not be disturbed unduly. However, other species in unprotected habitats could experience population reduction. If gravel is mined from the river valleys, significant habitat deterioration could occur.

Abundance, sensitivity to impact, and data quality were analyzed and evaluated for protected aquatic species on a county-by-county basis. These categories were rated high, intermediate, or low, using the following criteria. Abundance is called high if at least two listed protected aquatic species or three recommended protected species populations occur within a county. Intermediate abundance refers to counties which have one listed protected species or two recommended protected species populations. Low abundance ratings are given to counties with no listed protected aquatic species or no more than one recommended protected aquatic species population occurring therein. Sensitivity to impact is considered high for the county if habitat for listed protected aquatic species occurs in a geotechnically suitable area; intermediate if habitat occurs near geotechnically suitable areas liable to indirect impact; and low if no aquatic habitat occurs in geotechnically suitable areas. Data quality is considered high in areas where protected or recommended protected aquatic species populations have been studied for habitat requirements, intermediate in areas where only species occurrence was studied, and low where species are not reported.

Only Chaves County, New Mexico, was rated high in abundance, due to the presence of 14 species of protected fishes in the Pecos River (Table 4.3.2.3-2). Impact sensitivity was considered intermediate because of potential damage to the river habitats from increased siltation due to construction activities and recreational impact.

No protected aquatic species live in or near deployment areas or operating bases, thus, habitat degradation due to recreation would be the only impact. Cluster deployment in Chaves County, New Mexico, is fairly close to the springs and ponds of the Pecos River Valley which are habitats for several protected species. No direct effects are expected from cluster, DTN, or OB operation, although construction could cause siltation and some pollution. Indirect impacts from recreational use could threaten these unique habitats and cause decline or loss of population of the Pecos gambusia and the Pecos pupfish.

Table 4.3.2.3-1. Summary of potential impacts to protected aquatic species, Texas/New Mexico study area.

SECONDARY EFFECTS	PROTECTED AQUATIC SPECIES
Construction	
Fugitive dust	Minimal effects predicted.
Erosion and siltation	Chemicals in rainfall runoff from new asphalt roads, cement production, dust suppression activities, and accidental petrochemical spills could temporarily impact some protected organisms. Siltation in aquatic habitats could be locally important. Phyto and periphyton productivity decreased, gill-breathing and filter-feeding organisms smothered or starved.
Loss of vegetation	Habitat deterioration from erosion and siltation.
Presence of machinery and people	Minimal impacts predicted other than those discussed in recreation.
Operations	
Fugitive dust	Minimal impacts predicted.
Erosion	Some impact similar to construction but at a lower level.
Revegetation of disturbed areas	Beneficial impact would result by decreasing erosion/sedimentation and re-establishing conditions similar to those pre-project.
Transmission lines	No impact predicted.
Fugitive dust	Minimal impact predicted.
Sewage	In habitats near areas of rapid population growth, some reduction in water quality may occur, depending on wastewater treatment.
Solid waste	None predicted.
Introduction of exotic species	Already occurs in most streams. Gamefish are introduced and eliminate endamics through habitat competition and/or diseases.
Recreation	
ORV use	Increased turbidity and degraded water quality.
Camping and hiking	Trampling, waste disposal and littering can result in local erosion/sedimentation and water pollution problems.
Hunting and Fishing	No effects.
Poaching	Similar to normal fishing pressure but less intense, and of low significance.
Swimming	No significant effects.

2663-1

Table 4.3.2.3-2. Abundance, sensitivity to impact, and data quality for protected aquatic species, Texas/New Mexico High Plains.

STATE/COUNTY	PROTECTED OR RECOMMENDED PROTECTED AQUATIC SPECIES		
	A	S	Q
Texas			
Bailey	L	L	L
Castro	L	L	L
Cochran	L	L	L
Dallam	L	L	L
Deaf Smith	L	L	L
Hartley	L	L	L
Hockley	L	L	L
Lamb	L	L	L
Moore	L	L	L
Oldham	I	I	L
Parmer	L	L	L
Randall	L	L	L
Sherman	L	L	L
New Mexico			
Chaves	H	I	H
Curry	L	L	H
De Baca	I	L	H
Guadalupe	I	L	H
Harding	I	L	H
Lea	L	L	H
Quay	I	I	H
Roosevelt	L	L	H
Union	L	L	H

2327-1

A = Abundance

S = Sensitivity to impact

Q = Quality of data

H = High; I = Intermediate; L = Low

5.0 FUTURE TRENDS WITHOUT M-X

5.1 RARE PLANTS

More than 200 plant taxa are known from Nevada and western Utah. A large number of these are afforded some degree of protection as they occur within the boundaries of areas with restricted public access. Over the next 20 years, populations of these species are likely to remain stable or even show improvement with proper habitat management or protection.

A majority of rare plants in the Nevada/Utah study area are likely to face increased threats from activities such as energy, industrial, and urban development. Therefore, rare plant species that occur on public lands are likely to face population declines, especially if they are not listed for protection under federal or state laws. The Allen-Warner Valley power plant and the Alunite mine, for example, both in southwestern Utah, have the potential to affect habitat for threatened and endangered plants. The Tunnel Springs beardtongue (Penstemon concinnus), only known from Beaver and Millard counties, Utah, may be proposed for listing as endangered in the near future. The ORV threat is also great in this vast desert as it is difficult to enforce prohibitions on sensitive public lands. Rare plants growing close to urban areas, recreational areas, and on sand dunes are most susceptible to ORV impact.

Commercial collecting of cacti and succulents is another potential threat; some protected species have been overcollected throughout their range.

In many areas of Nevada and Utah, accurate information on the abundance and distribution of rare plant species is lacking, and irreparable damage could be unknowingly done to these plants in the future. However, it is likely that as more information on their status becomes available more species will be listed for protection under federal and state laws.

In Texas/New Mexico, few rare plant species are known from the study area for two reasons. First, the area is a part of the floristically homogeneous southern Great Plains, with low habitat diversity. Second, most of the area has been modified as heavily utilized rangeland, or intensively cultivated cropland, so little undisturbed shortgrass prairie is still present. The species listed in the Texas and New Mexico portions of the study area represent about 1 percent of the species proposed for listing in Texas or listed in New Mexico. Of these, only Texas has shortgrass prairie species identified, and at least two may have been extirpated. Because of the low human population growth of 1.5 percent per year and the probable continuation of present land use practices, it is unlikely that the status of these rare species will change. A search for isolated healthy prairie remnants not already inventoried may reveal other populations of presumably extirpated rare plants, at which point legal protection could be extended. Re-introduction of rare or extirpated species into suitable habitats also is possible.

5.2 WILDLIFE

In the Nevada/Utah study area, all threatened and endangered terrestrial wildlife species are so classified because they have shown recent, steep declines in abundance. Their present rarity is in most cases due to human activities, mostly in the form of habitat destruction, illegal shooting or capture, and poisoning. The legal protection afforded these species is recent, and is designed to reverse this trend toward extinction. If management plans for population recovery succeed, most or all of these species may be expected to increase in numbers over the next 20 years.

Although livestock and agricultural interests will continue to exert some pressure on existing habitat, a larger threat to protected species could come from population growth and increasing industrial, residential, agricultural, and recreational uses of the land. However, without the M-X program this growth should occur slowly in the potential deployment area. Current management by state and federal governments of the habitats of these threatened and endangered species, plus educational and law enforcement activities to reduce shooting and capture, should at least stabilize the populations.

In the Texas/New Mexico study area, threatened and endangered wildlife are given this status because of their present rarity and potential for extinction. Legal protection is designed to ensure their survival and possible increase. Because of a lack of other major projects, a slow population growth, and the likelihood of present land-use patterns remaining for the near future, it is unlikely that the status of any of the protected animal species will change appreciably. Of the three federally listed avian species, only the bald eagle has any potential for increase. Most of the state-protected species are rare because they are at the edges of their geographic ranges. Other species, which are rare because of the destruction of shortgrass prairie, could increase if farmland acreage is converted to well-managed rangeland. This may occur as groundwater drawdown renders irrigation prohibitively expensive.

5.3 AQUATIC SPECIES

Although the status of protected aquatic species in the Nevada/Utah study area will be refined over the next 20 years, the basic condition of protected species is not expected to change greatly during this time. Management of these aquatic resources by the state and federal government will probably continue at about the same level as that over the last 10 to 15 years. Pressure will continue by livestock and agricultural concerns to overutilize existing aquatic resources. Since population growth without the M-X project is expected to be small in non-urban portion of the potential deployment area, deterioration of aquatic habitats by recreational abuse or overutilization is not expected at levels greater than presently occurring. Industrial development throughout both states in the proposed project area is not expected to increase greatly without the M-X project. Mining and energy development, however; may have localized effects on protected aquatic species. The proposed Allen-Warner Valley power plant and the White Pine Power Project have the potential to adversly affect the habitats of some state and federally listed fish species. In general, however, water use, recreational pressure, and fisheries management are not expected to change significantly within the proposed project deployment area.

As with the terrestrial protected species in the Texas/New Mexico study area, many of the protected aquatic species are at the edges of their geographic ranges. Of those that are simply rare, several have experienced population reductions because of habitat deterioration. This situation is likely to remain as water and land-use patterns in New Mexico are not likely to change in the near future.

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Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 1 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
1	*Agave utahensis* Engelm. var. *eborispina* (Hester) Breitung	Ivory-spined Utah agave or pygmy agave	Agavaceae	T RC(NV)	Southern Nye, Clark & Lincoln cos. (mostly in Desert Game Range).	Typically on exposed outcrops or ridges of limestone mtn ranges on S or W exposure slopes or in rock or cliff crevices with *Gutierrezia microcephala, Eriogonum heermannii* var. *sulcatum Atriplex canescens, Perityle megalocephala* var. *intricata* (a threatened sp.) and several spp. of cacti. Also in deep sand in a wash.	3900-5485' (1189-1672 m)	May-June	Perennial So. NV endemic-only in limestone ranges**[4]
2	*A. u.* Engelm. var. *nevadensis* Engelm. ex. Greenm. & Roush	Utah agave	Agavaceae	T RC(NV)	Mojave Desert, San Barnardino Co., CA: Clark, NV; Washington Co., UT.	Dry, stony limestone slopes; shadscale scrub; Joshua Tree Wald.	3000-5000' (914-1524 m)	May-July	Acaulescent perennial commercially exploited
3	*Angelica scabrida* Clokey and Mathias ex. Clokey	Charleston Angelica	Apiaceae	T RT(NV)	Endemic to east slope of Charleston Mtns., Clark Co.	Gravelly soils in yellow pine belt; with *Cercocarpus ledifolius* and *Pinus ponderosa*.	7210-7872' (2200-2400 m)	July-August	Perennial heavy use recreation area [27]
4	*Antennaria arcuata*	Arching pussytoes	Asteraceae	E RT(NV)	N. Nevada and Idaho. Four disjunct locations in Blaine Co., ID and Elko and Humboldt Cos., NV.	Dry meadows	5250-7800'	July	Perennial [33]
5	*A. soliceps* Blake	Charleston pussytoes	Asteraceae	T RT(NV)	Endemic to Charleston Mtns., Clark Co. (Toiyabe NF).	Locally abundant on a ridge to Charleston Pk; on gravelly open slope with *Pinus aristata*.	7544-11,480' (2300-3500 m)	July-August	Perennial [27]
6	*Arabis dispar* M.E. Jones	No common name	Brassicaceae	T RC(NV)	Endemic to S. NV-Eleana Range in NTS.	Red-brown volcanic talus with Pinyon-juniper and *Artemisia nova*.	5800-6200' (1768-1890 m)	April-June	Perennial from caespitose base.
7	*A. shockleyi* Munz	Shockley rockcress	Brassicaceae	T RC(NV) RD(UT)	Tooele Co., UT; Nye Co. NV & San Bern. Mtns., CA.	Dry desert ranges with blacksage *Cowania*, green ephedra and blackbush on limestone soils in ecologically stable areas with well established vegetation.	5250-6500' (1600-2000 m)	May-June	Perennial, unusually disjunct locations.**
8	*Arctomecon californica* Torr. and Frem.	California or Golden bear-poppy	Papavaraceae	E RT(NV) SE(NV)	Clark Co. S.NV & adj. Mohave Co., AZ.	On gypsum-rich soils derived from Muddy Ck. geologic formation with *Larrea-Ambrosia* and shadscale.	1300-1900' (400-600 m)	April-May	An obligate gypsophile ORVs are a threat.**
9	*A. humilis* Coville	Coville bearpoppy	Papavaraceae	E RT(NV) RE(UT) PE	Washington Co., UT close to NV border; Mohave Co., AZ.	Moenkopi formation, on alluvium & sandy clay soil, rolling low hills, bluffs, warm desert shrub community, open desert.	2300-3000' (702-915 m)	April-May	Endemic to Dixie corridor & Moenkopi soils. Sp. should be searched from similar habitats
10	*A. merriamii* Coville	Merriam bear-poppy	Papavaraceae	E RC(NV)	Southwestern Clark & Nye Cos. NV & adj. CA.	Dolomitic limestone outcrops of steep mtn ranges or flat patches of gravelly soil with shadscale, blackbush, & creosote bush. *Agave utahensis* var. *eborispina* also occurs with this species.	4200-4700' (1280-1430 m)	Late April-June	
11	*Arenaria kingii* (Wats.) Jones var. *rosea* Mag.	Rosy King sandwort	Caryophyllaceae	T PT(NV)	Known only from the Charleston Mtns.	On rocky limestone soils with ponderosa and lumber pine and in yellow pine belt.	[illegible] (1800-2600 m)	June-August	[27]
12	*A. stenomeres* Eastw.	Steno sandwort	Caryophyllaceae	T PT(NV) FD(UT) SE(NV)	Lincoln Co. (known only from type location).	On limestone cliffs in a canyon at the south end of Meadow Valley Range.		May-June	[[illegible]]

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Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 2 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
13	*Artemisia papposa* Blake & Cronq	Fuzzy sandwort	Asteraceae	T (ID) RT(NV)	Owyhee Co. & Blaine Co, ID. Endemic to Owyhee Desert Region, Elko Co, northern NV.	On alkaline flats, edge of mtn meadows, & sage-brush-juniper slopes		June-July	Recently found in NV [27, 32]
14	*Asclepias eastwoodiana* Barneby	Eastwood milk-weed	Asclepiadaceae	E RT(NV)	Nye, Esmeralda, and Lander Cos.	Restricted to low alka-line & barren clay hills in the valleys of this region with *Hilaria jamesii*, shad-scale, *Sarcobatus*, *Tetradymia glabrata*, *Ceratoides lanata* & *Artemisia spinescens*	5800-7000' (1770-2140 m)	May-June	Known from 9 locations. ORVs are a threat.** [25, 5]
15	*Astragalus aequalis* Clokey	Clokey milk-vetch	Fabaceae	T RT(NV)	Endemic to the Charleston Mtns, Clark Co., NV	Calcareous gravel flats & open ridges often sheltering under low sagebrush with Pinyon-juniper, up to lower edge of Yellow Pine belt	6000-8200' (1830-2500 m)	May June	In recreation area [12]
16	*A. alvordensis* M.E. Jones	Alvord milk-vetch	Fabaceae	T RC(NV)	Humboldt Co, NV; Harney & Malheur cos, Oregon	Barren knolls, bluffs, hillsides, in loose sandy soils of volcanic origin	4000-5000' (1220-1524 m)	May-June	[12]
17	*A. ampullarius* Wats.	Gumbo milk-vetch	Fabaceae	T RT(UT)	Kane & Washington cos. UT; Coconino & Mohave cos., AZ	Chinle & Tropic shale formations, clay soils, mixed desert shrub & scattered juniper community	3200-5400' (970-1650 m)	Early May	Mineral exploration is a threat [20]
18	*A. beatleyae* Barneby	Beatley milkvetch	Fabaceae	E RE(NV) SE(NV)	Central Nye Co. (endemic to NTS)	On open flat areas with shallow volcanic soil; volcanic outcrops with black sage and pinyon-juniper	5600-6200 (1707-1890 m)	May-August	[3,4,5,25]
19	*A. callithrix* Barneby	Calloway milkvetch	Fabaceae	T RT(NV) RE(UT) High priority for fed. listing	NE Nye Co., NV, W. Millard Co., UT	Bare open places on semi stabilized sand dunes, deep sandy soil on valley floors; desert shrub community	5100-5500' (1500 m - 1700 m)	Late May-June	*, [25, 20, 5]
20	*A. calycosus* Torr. var. *monophyllidius* (Rydb.) Barneby	One-leaflet Torrey milk-vetch	Fabaceae	E RT(NV)	NE Nye Co. to Eureka Co & central NV	Open gravelly hill-sides, in scattered pinyon-juniper, on limestone soils	5600-6500' (1710-2000 m)	May-June	*, [12, 7]
21	*A. convallarius* Greene, var. *finitimus* Barneby	Timber poison-vetch	Fabaceae	T RC(NV) RD(UT)	Lincoln Co.(Highland Range) to Washington Co. UT.	Gravelly & sandy clay hillsides with sage-brush & pinyon-juniper on limestone	6000-6500' (1830-2000 m)	May-June	* [23]
21a	*A. desereticus* Barneby	Deseret milkvetch	Fabaceae	Not listed	Sanpete Co., UT.	Dry hillsides, sage-brush & scattered pinyon-juniper community.	6000-6500' (1830-2000 m)	May	Possibly extirpated as a result of over-grazing [33]
22	*A. funereus* Jones	Funeral milk-vetch or black wooly pod	Fabaceae	T RT(NV)	Nye Co., NV (in/near NTS)	Steep gravelly slopes on gravelly clay ridges among sage-brush and shadscale, cliff ledges or talus under cliffs, some-times on limestone.	4300-7500' (1320-2290 m)	March-May	**, [12, 4]
23	*A. geyeri* Gray var. *triquetrus* (Gray) Jones	Three-cornered pod or Triangle Geyer milk-vetch	Fabaceae	T RT(NV) SE(NV)	Along confluence of Virgin, Muddy and Colorado rivers; Lake Mead Rec. Area, Clark Co., NV; also Esmeralda Co., NV and in AZ.	Sandy wash, disturbed soil with *Larrea Ambrosia* & *Krameria*.	1100-1400' (335-427 m)	May-June	**, [27]
24	*A. lancearius* A. Gray	Lancer milk-vetch	Fabaceae	T RT(UT)	Kane and Washington cos., UT.	Moenkopi Formation, sandy clay barriers, gravelly hillsides, and knolls, pinyon-juniper and mixed desert shrub community.	2000-5500' (610-1678 m)	May-early June	[20]
25	*A. lentiginosus* Doug. var. *latus* (Jones) Jones	Broad pod freckled milkvetch	Fabaceae	T RC(NV)	White Pine Co., NV; known from Schell and Egan Ranges and thought to be in Snake Range and Troy Peak.	Limestone gravel slopes in timber belt, forming colonies.	7500-9500' (2286-2896 m)	May-July	One collection from Spring Valley near Hwy. 6 and 50 Palatable** [27]

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Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 3 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
26	*A. l.* Doug. var. *micans* Barneby	Shiny freckled milkvetch	Fabaceae	T RT(NV)	Found only in southern Eureka V. northern Panamint V. Inyo Co., CA, and central Amargosa drainage basin, NV	Restricted to areas of deep sand & usually found on sand dunes; more study needed.	3500-3100' (1070-945 m)	April-June	ORV activity threat** [27, 23, 4]
27	*A. l.* Doug. var. *sesquimetralis* (Rydb.) Barneby	Sodaville freckled milk-vetch	Fabaceae	E RE(NV) SE(NV) High priority for federal listing	Soda Springs at Sodaville, S of Mina in S. Mineral Co.	Moist alkaline soil with grass (probably salt grass).	4650' (1417 m)	late April-mid May	Known only from type collection. Geothermal development threat. [5,12]
28	*A. l.* Doug. var. *ursinus* (A. Gray) Barneby	Bear Valley milkvetch	Fabaceae	E RE(UT)	Iron Co., UT	Presumably sagebrush or pinyon-juniper community.	7200' (2196 m)	Late April-May	Land has been chained [20]
29	*A. limnocharis* Barneby	Navajo Lake milkvetch	Fabaceae	T RT(UT)	Iron & Kane Co. (Navajo Lake)	Wasatch Formation, lakeshore gravels & limestone breaks.	8800-11,200' (2670-3400 m)		Recreation threat [20]
30	*A. mohavensis* Wats. var. *hemigyrus* (Clokey) Barneby	Half-ring pod milkvetch	Fabaceae	T RT(NV)	Indian Springs, and in Charleston Mtns, Clark Co. and in CA	Rocky slopes in canyons or on cliff ledges.	3000-5200' (914-1590 m)	April-June	**, [22, 26]
31	*A. musimonum*	Sheep Range milkvetch	Fabaceae	T RC(NV)	Known only from Desert Game Range	Desert foothills in mixed shrub type on limestone gravels.	5300-5600'	Late April-early June	[26, 33]
32	*A. nyensis* Barneby	Nye milkvetch	Fabaceae	E RC(NV) SE(NV)	Clark & S. Nye Cos. NV, NTS; Indian Springs, Moapa & Lee Cyn. in Charleston Mtns.	Compacted calcareous alluvial desert pavement with large arroyos with *Larrea* & *Ambrosia*, *Lycium andersonii* & *Polygala subspinosa* var. *heterorhyncha*.	2000-4500' (610-1372 m)	April-May	**, [3, 4a, 23]
33	*A. perianus* Barneby	Rydberg milk-vetch	Fabaceae	E RT (UT) PT	Garfield & Piute Cos., UT	Tertiary igneous gravels, rocky clay soil, mtn woodlands or barrens, alpine meadows.	10,000-11,500' (3050-3508 m)	July-August	On USFS land (not in project area) [20]
34	A. oophorus Wats. var. *clokeyanus* Barneby	Lee Canyon milkvetch	Fabaceae	T RT(NV) RD(UT)	Known only from Charleston Mtns. Clark Co., NV	Slopes & benches in open yellow pine forest in gravelly soil derived from limestone.	8100-9100' (2470-2780 m)	May-July	Narrowly endemic [27, 1a]
35	*A. o.* Wats. var. *lonchocalyx* Barneby	Spearcalyx egg milkvetch	Fabaceae	T RC(NV) RD(UT)	Lincoln Co., NV, Iron & Beaver Cos., UT	Limestone mtns, sheltered by sage-brush on dry gravelly hillsides and stony flats.	6000-6800' (1830-2073 m)	May-July	Locally common; non-toxic to cattle** [6]
36	*A. phoenix* Barneby	Ash Meadows milkvetch	Fabaceae	E RE(NV) SE(NV) High priority for federal listing	Endemic to eastern portion of central Ash Meadows, Nye Co., NV	Restricted to flats & knolls of calcareous, alkaline soil in Ash Meadows with shadscale, *Enceliopsis nudicaulis* var. *corrugata* (threatened sp) and saltgrass.		April-May	ORV activity threat. [12]
37	*A. porrectus* S. Wats.	Lahontan milk-vetch	Fabaceae	E RT(NV)	Known only from lower Humboldt & Truckee valleys of Churchill, Pershing & S. Washoe Cos., NV	Gravelly washes & outwash fans in foothills of desert mtns, volcanic sand or rock debris.	4300-5000' (1311-1524 m)	May-June	Perennial; avoided by cattle [12, 7]
38	*A. pseudiodanthus* Barneby	Tonopah milk-vetch	Fabaceae	T RT(NV)	Nye Co., Mono Co., CA	Deep sandy soils, drifting sands & alluvial soils with *Sarcobatus baileyi*, *Atriplex* spp. *Hilaria jamesii*, *Tetradymia glabrata*, *Chrysothamnus* spp.	5000-6800' (1524 m - 2073 m)	Early June	Known only from four localities. Prostrate perennial herb ** [25, 5]
39	*A. pterocarpus* M. E. Jones	Winged milk-vetch	Fabaceae	T RC(NV)	South central & SE Humboldt Co to Lander Co., NV	Lowhills and akaline sandy flats, saltgrass meadows and openings among halophytic shrubs	4450-4500' (1356-1372 m)	May-June	** [12]

Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 4 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
39a	*A. robbinsii* var. *occidentalis* Wats.	Lamoille Canyon milkvetch	Fabaceae	E RT(NV)	Lamoille Cyn., Ruby Mtns., Elko Co., NV	On stream banks in moist loam soil under aspen in mtn.brush type		July-August	[33]
40	*A. serenoi* (Kuntze) Sheld. var. *sordescens* Barneby	Squalid milk-vetch	Fabaceae	E RT(NV)	Nye Co. only. (Toiyabe N.F.-Toquima Range)	Foothills; in alkaline soil among low sage-brush and pinyon-& juniper scrambles through sagebrush on gentle slopes & flats in Ralston Valley.	6800' (2073 m)	May-July	Known only from type locality. [25,11,5]
41	*A. solitarius*	Solitary milkvetch	Fabaceae	T(OR) RE(NV)	N. Humboldt Co., NV	On sandy clay soil along the Owyhee River.	3800-4600'	June	[34]
42	*A. striatiflorus* M.E. Jones	Escarpment milkvetch	Fabaceae	E RT(UT)	Kane and Washington Cos., UT (Coral Pink Dunes Rec. Area) Coconino Co., AZ	Entrada & Navajo sandstone formations blow sand, interdune valleys, sandy depressions on ledges, bars & terraces in stream channels	5000-6250 (1530-1900 m)		Rec. & ORV threat in Coral Pink Dunes [20]
43	*A. tephrodes* var. *eurylobus*	Peck Station or Needle Mtn. milkvetch	Fabaceae	RE(NV)	NE of Caliente, Lincoln Co., NV	In Needle Mtns. on pink sandstone or sandy soil derived from it.			Not seen since 1945 in Needle Mountains **,[23]
44	*A. toquimanus* Barneby	Toquima milkvetch	Fabaceae	T RT(NV)	Nye Co., Toquima Range; known from Saulsbury Wash	On gravelly slopes in canyons, on lime-stone derived soils growing with *Artemisia arbuscula* and pinyon-juniper	7000' (2134 m)	April-July	[11,5]
45	*A. uncialis* Barneby	Currant milkvetch	Fabaceae	E RE(NV) High priority for fed. listing	Nye Co. foothills of White Pine & Pancake ranges	Bare knoll of stiff, alkaline clay derived from limestone	5300-6500' (1615-1981 m)	Early May	**, [5]
46	*A.* sp.	Osgood Mtns. milkvetch	Fabaceae		E. Humboldt Co. Restricted to the Osgood Mountains	No information available.			Found by M. Yoder-Williams, BLM, Winne-mucca [32, 33, 34]
47	*Brickellia knappiana* E. Drew	Knapp brickellia	Asteraceae	T(CA) RT(NV)	Mojave R. & Panamint Mtns, CA; recently found in Clark Co.,NV in the Desert NWR	Joshua Tree woodland	2500-3500' (762-1067 m)		[32, 22]
48	*Calochortus striatus* Parish.	Streaked mariposa lily	Liliaceae	T RT(NV)	Mohave Desert from Rabbit Springs, CA to Las Vegas, NV	In low alkaline seeps & meadows about springs or in washes. Creosote bush scrub.	2500-4300' (762 - 1311 m)	April-June	[22, 26]
49	*C.* sp.	Unnamed mariposa lily	Liliaceae	RE(NV)	Ash Meadows only.				
50	*Camissonia megalantha* (Munz) Raven = *C. heterochroma*	Cane Springs evening primrose	Onagraceae	E RC(NV) RD(UT)	Nye Co. known from NTS and Utah	Volcanic alkali soil, washes & talus slopes in *Atriplex* & *A. hymenelytra*.	4050' (1235 m)	August-October	[3]
51	*C. nevadensis* Kell.	Nevada evening primrose	Onagraceae	E RC(NV)	West central NV, Washoe & Storey, N. Lyon, W. Churchill cos., NV & CA.	On sandy soils, with slight slope.	4500-5200'	Late April-June	[33, 21]
53	*Castilleja parvula* Rydb.	Tushar paintbrush	Scrophularia-ceae	T RT(UT)	Piute and Beaver cos., UT.	Alpine vegetation in Tertiary igneous gravels.	10,000-11,800' (3050-3599 m)	Late July-August	[20]

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Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 5 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
54	*C. salsuginosa* N. Holmgren	Monte Neva paintbrush	Scrophulariaceae	E RE(NV) SE(NV) High priority for federal listing	White Pine Co., NV; known only from Monte Neva hot springs in Steptoe Valley	On wet saline soil where seepage water is cool growing singly with *Dodecathmon pauciflorum*, *Ivesia kingii* & *Phlox kelseyi* var *salina*	6000' (1830 m)	June-July	Disturbance of seepage flow is a threat. ** [27]
55	*Centaurium namophilum* Reveal, Broome & Beatley	Spring loving centaury	Gentianaceae	E RE(NV)	Nye Co. (Ash Meadows) also known from Tecopa Springs, CA		2200-2300' (671-701 m)	July-Sept	Annual [1a]
56	*Cirsium clokeyi* Blake	Clokey thistle	Asteraceae	E RC(NV)	Known only from Charleston Mtns. Clark Co., NV	On gravelly slopes & moist creek bottoms	-10,000' (2400-3300 m)		[26]
57	*Cordylanthus tecopensis* Munz & Roos.	Tecopa birdbeak	Scrophulariaceae	T RT(NV)	S. Nye Co., NV, Ash Meadows and Inyo Co., CA	On large alkaline flats in Ash Meadows; fairly common locally	2200-2300' (671-701 m)	July-Oct	Annual [1a]
58	*Coryphantha vivipara* (Nutt.) Britt. & Rose var. *rosea* (Clokey) L. Benson	Clokey pin-cushion cactus	Cactaceae	T RT(NV)	Clark, Nye, Lincoln Cos., NV, San Bern. Co., CA, Mohave Co., AZ (most locations in NTS	Dry ridges in pinyon-juniper and mtn mahogany, or with black-sage on shallow, well drained soils & rocky areas in vly bottoms, on mesas or on mtn tops. In Gold Meadows (NTS) it occurs with *Trifolium andersonii* var. *beatleyae* (a rare sp.) Assoc. spp. include *Artemisia* & *Atriplex*; *Sclerocactus polyancistrus* (T) also occurs in same habitat.	5000-9000' (1500-2744 m)	June-July	Threatened by collectors. Difficult to separate from *C. deserti*. ** [4, 5]
59	*Cryptantha compacta* Higgins	Compact catseye	Boraginaceae	T RD(NV) RT(UT)	Millard Co., UT (On Desert Research Experimental Station).	Sevy Dolomite Formation, gravelly loam, open slopes & ridges, outcrops covered with shallow soil layer, desert shrub & grassland community with *Eriogonum eremicum*, *Sphaeralcea caespitosa*, *Penstemon nanus* & other restricted species	5000-6500' (1525-1983 m)	May-Early June	** [20]
60	*C. hoffmanii* Johnst.	Hoffman cats-eye	Boraginaceae	T RT(NV)	Mineral Co., NV & Inyo Co., CA; endemic to White Mtns & Inyo Mtns.	Open slopes of rock & gravel in pinyon-juniper & bristle-cone pine; wide elevational range	6000-9000' (1830-2743 m)		** [27, 5]
61	*C. insolita* (MacBr.) Payson	Las Vegas cryptantha	Boraginaceae	E RE(NV) SE(NV)	Only from north of Las Vegas, S. NV (Clark & Lincoln cos.)	Gravel fans & alkaline clay hills in Charleston range	3936-6560' (1200-2000 m)		Possibly extinct [26, 33]
62	*C. interrupta* (Greene) Payson	Interrupted cryptantha	Boraginaceae	T RC(NV)	Elko, Eureka and NE Nye cos., NV.	Alkaline calcareous foothill & rocky clay with sagebrush.	4400-8000'	June-July	**, [32, 33]
63	*C. tumulosa* (Payson) Payson	Mohave cryptantha	Boraginaceae	T RT(NV)	Charleston Mtns, Clark Co., NV & Providence Mtns., San Bern. Co., CA	Dry rocky places on limestone, on hills & washes associated with Mtn. mahogany & juniper	4500-6000' (1600-2000 m)		[27]
64	*Cuscuta warneri* Yuncker	Warner dodder	Cuscutaceae	E RE(UT)	Millard Co., UT in vicinity of Flowell	Alluvium, sandy soil, desert shrub community	4630' (1403 m)	August	Possibly extinct
65	*Cymopterus basalticus* M. E. Jones	Basalt spring parsley	Apiaceae	T RC(NV) RD(UT)	Millard Co., UT	Restricted to basaltic soils, on exposed slopes; basalt flows are often associated with thermal springs; may be present in adjacent NV		April-early June	Common to abundant in UT ** [18, 19]

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Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 6 of 20).

NO.¹	SPECIES²	COMMON NAME	FAMILY	STATUS³	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES⁴
66	*C. corrugatus* (M. E. Jones) Mats	Corrugate-winged cymopterus	Apiaceae	T RC(NV)	Widely distributed from N. NV to SE OR.	Rocky ridges, sand dune areas		April-May	** [21, 32, 34]
67	*C. coulteri* (M.E. Jones) Mathias	Coulter biscuitroot	Apiaceae	T RT(UT)	Sanpete, Sevier & Juab cos., UT	Arapien Shale Formation, barren foothills, gravelly to clay soil; black sage & shadscale community	2000-5800 (610-1769 m)	March-April	Gypsum exploitation threat [20]
68	*C. minimus* (Mathias) Mathias	Cedar Breaks biscuitroot	Apiaceae	T RE(UT)	Iron & Garfield cos. Cedar Breaks, Bryce Canyon area	Wasatch Formation; mixed conifer woodland, ponderosa community	10,000-10,500' (3050-3203 m)	Late May-June	Limestone exploitation threat
69	*C. nivalis* Wats.	Snowy spring parsley	Apiaceae	E RT(NV)	Mtns. of central ID & NE NV (Nye & Elko Co)	Rocky places at high elevations		July-August	[28]
70	*C. ripleyi* Barneby var *saniculoides*		Apiaceae	Not listed in FR RC(NV)	Nye, Lincoln & Esmeralda cos.	Sand dunes & sandy soils with *Rumex venosus, Oenothera pallida, Chrysothamnus visidiflorus, Grayia* sp.	5000-6700 (1524-2042 m		** [6, 15]
71	*C. goodrichii* Welsh, Neese		Apiaceae	Not listed in FR RT(NV)	Lander Co. NV, Toiyabe Range	On gravelly limestone slopes with *Draba arida* near alpine zone	7300-10,900' (2225-3322 m)	June-July	[27, 35]
72	*Dalea kingii* (S. Wats.) Barneby	King indigo bush	Fabaceae	T RC(NV)	Churchill & Humboldt cos., NV	Drifting sand in high canyons, sand dunes & interdune spaces with *Ambrosia* sp. *Rumex, Oryzopsis & Chrysothamnus* spp.	4300-7000 (1311-2134 m)	June-July	Existing ORV threat **, [12, 8]
73	*Draba arida* C.L. Hitchc.	Desert draba	Brassicaceae	E RC(NV)	Nye & Lander Co.; Toquima & Toiyabe Mtns.	Loamy soil in moist meadows nearing alpine zone with limber pine & aspen	10,000-11,000 (3048-3353 m)	June-July	[11,12,8]
74	*D. asperella* Greene var. *zionensis* (C.L. Hitchc.) Welsh & Reveal	Zion whitlow-grass	Brassicaceae	T RT(UT)	Washington Co., UT Zion NP & BLM land	Decomposed sandstone and talus in mtn brush & pine communities; gravelly soil	6000-8500' (1830-2593 m)		[20]
75	*D. asterophora* Pays var. *asterophora*	Star draba	Brassicaceae	T RT(NV)	Toiyabe Range in Landers & Nye Co., NV, Eldorado & Alpine cos., CA.	Rock crevices & talus Alpine basin meadows with *Pinus flexilis*.	8000-10,200' (2440-3110 m)	July-August	[22, 33]
76	*D. crassifolia* (Graham) var. *nevadensis* C.L. Hitchc.	Rocky Mountain draba	Brassicaceae	T RT(NV)	SW NV & Mono Co., CA Endemic to Toiyabe Range, Lander & Nye cos., NV	Moist meadows and disturbed soils with aspen and species of open meadows	9000-11,700' (2743-3566 m)	June-July	[8]
77	*D. douglasii* A. Gray	Douglas draba	Brassicaceae	T RC(NV)	Central Washington, east OR, south ID, northern NV	Mid to high elevation on exposed slopes; reported in association with serpentine soils in sagebrush community with sage and Engelmann spruce	4600-8500' (1403-2600 m)	June	[7]
78	*D. jaegeri* Munz. & Johnst.	Jaeger draba	Brassicaceae	T RT(NV)	Known only from Charleston Mtns. Clark Co., NV	Occurs occasionally in rock crevices, gravelly slopes, above timber line with *Pinus aristata*	9840-11,500' (3000-3500 m)	Late April-July	[27]
79	*D. paucifructa* Clokey & C.L. Hitchc.	Charleston draba	Brassicaceae	E RT(NV)	Known only from Charleston Mtns. Clark Co., NV	Grows on damp soils where snow drifts persist into summer; associated with limber pine and bristlecone pine	8,700-11,300' (2650-3450 m)	June-early July	[27]
79a	*D. sobolifera* Rydb.	Stolon whitlowgrass	Brassicaceae	T RT(UT)	Piute and Garfield cos., UT	Modified tertiary igneous gravel; timberline, ponderosa pine, mountain shrub communities; gravelly soil.	7500-12,000' (2290-3660 m)		[20]

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NO[a]	SPECIES[a]	COMMON NAME	FAMILY	STATUS[b]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[c]
80	*D. sphaeroides* Payson var. *cusickii* (Robbins.) Hitchc.		Brassicaceae	T(OR) RC(NV)	SE Oregon & adjacent NV (Nye and White Pine cos.?)	Boreal zones		June-August	[31, 34]
81	*D. stenoloba* Ledeb. var *ramosa* C.L. Hitchc.	Carson Range draba	Brassicaceae	T RT(NV)	Region of Lake Tahoe	Damp, shady places.	7000-12,000' (2134-3660 m)	May-August	[22]
82	*D. subalpina* Goodman & Hitchc.	Subalpine whitlow grass	Brassicaceae	T RT(UT)	Iron, Garfield, Kane, & Millard cos. (NPS USFS & BLM land)	Pink limestone Member of the Wasatch Formation, gravel or clay loam, spruce, fir, Douglas fir or bristle cone pine woodlands	8000-11,315' (2140-3447 m)	May-July	Restricted to limestone [20]
83	*Echinocereus engelmannii* (Parry) Lemaire var. *purpureus* L. Benson	Purple hedgehog cactus	Cactaceae	E RE(UT) FE(UT)	Washington Co., UT	Navajo sandstone formation, sandy clay soil, desert shrub community	2900' (835 m)	July	Commercially exploited [20]
84	*Elodea nevadensis*	Nevada water-weed	Hydrocharitaceae	E RE(NV)	Washoe Co., NV	In ponds near Wadsworth		July	Possibly extinct [33]
85	*Enceliopsis nudicaulis* (A. Gray) A. Nels. var. *corrugata* Cronq.	Ash Meadows sunray	Asteraceae	T RT(NV)	Nye Co. (Ash Meadows)	Several locations of Ash Meadows, in *Atriplex*.	2200-2300' (671-710 m)	April-May	[1a]
86	*Ephedra funerea* Cov. and Morton	Death Valley ephedra	Ephedraceae	T(CA) RC(NV)	Endemic to northern Mojave Desert; Death Valley N.M. & SW NV	On bajadas, gentle slopes & hills among & below limestone ranges with *Larrea Atriplex*, *Ambrosia*, or *Coleogyne*	2000-5000' (610-1524 m)	March-May	**, [4]
87	*Epilobium nevadense* Munz.	Nevada willowherb	Onagraceae	E RT(NV)	Beaver Dam Mtns. Washington Co. UT & Charleston Mtns. Clark Co., NV	Talus slopes, rocky outcrops, ponderosa pine & aspen community in pine duff	7500-9200' (2288-2806 m)	July	Perennial. Mineral exploit [27, 4]
88	*Erigeron latus* (Nels.& Macbr.) Cronquist		Asteraceae	E(ID) RT(NV)	Owyhee Co.,ID, Elko Co.,NV (recently located)	On lava sands and rocky outcrops in mtn brush; occurs w/*Antennaria arcuata*	5250-< 7800'	July	[27, 33]
89	*E. ovinus* Cronq.	Sheep fleabane	Asteraceae	T RC(NV)	Known only from Desert Game Range, Clark & Lincoln Cos., NV	Rocky places in the mountains.			[30, 34]
90	*E. proselyticus* Nelson	Cliff daisy	Asteraceae	E RE(UT)	Iron Co., UT (USFS land)	Wasatch Formation, talus slopes, loose sandy soil on canyon walls, or calcareous rocks; spruce-fir community	9000' (2745 m)	July	Endemic to type locality; limestone mining; hwy realignment; timber harvest [20]
91	*E. religiosus* Cronq.	Clear Creek fleabane	Asteraceae	E RE(UT)	Kane & Washington Co. BLM, state & NPS land	Quaternary sand dunes, interdune valleys & sand terraces	5000-6000' (1525-1830 m)	June-August	Main habitat Coral Pink Dunes; ORV use [20]
92	*E. uncialis* Blake var. *conjugens* (Blake) Cronq.	Inch-high fleabane	Asteraceae	T RC(NV)	Toiyabe N.F., Clark & Nye cos., NV	Crevices of limestone rocks with *Abies concolor*, *Pinus monophylla*, *P. ponderosa*	< 7800' (2377 m)	June	[27,5]
93	*Eriogonum ammophilum* Reveal	Sand-loving buckwheat	Polygonaceae	E RE(UT) High priority for fed. listing	Millard Co., UT	Quaternary alluvium, sandy soil, desert shrub community	5270' (1595 m)	June-July	**, [20]
94	*E. anemophilum* Greene	Wind-loving buckwheat	Polygonaceae	E RC(NV)	Humboldt Co., NV & CA	Dry granitic and volcanic soils, Yellow Pine F., Red Pine F., Alpine fell-fields.	9000-12,000' (2743-3660 m)	July-August	[22]

Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 8 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
95	*E. argophyllum* Reveal	Silver-leaf buckwheat	Polygonaceae	E RE(NV) SE(NV) High priority for fed. listing	Elko Co., NV	On crusty mineralized sand or sandy washes below Sulphur Hot Springs, Ruby Valley	6050' (1844 m)	July	**[27]
95a	*E. beatleyae* Reveal	Beatley buckwheat	Polygonaceae	Not listed ?	Nye, Churchill, Lander, & Mineral Co., NV; Mono Co., CA	Dry volcanic outcrops, dark red clay in pinyon-juniper and blacksage; found primarily on mine tailings around abandoned mines	6400-7600' (1951-2316 m)	May-August	**,[25, 5]
96	*E. bifurcatum* Reveal	Stewart or Pahrump Valley buckwheat	Polygonaceae	T RT(NV)	S. Nye Co. only from W. Pahrump Vly & S. Stewart Vly & Inyo Co., CA	On lower portion of valley floodplain	2500' (762 m)	June	[1a]
97	*E. concinnum* Reveal	Elegant buckwheat	Polygonaceae	T RC(NV)	Nye Co. (found in NBGR & NTS)	Restricted to sandy soils of volcanic origin with *Atriplex canescens* & *Artemisia* or pinyon-juniper; also on recent road-cuts in this soil type with *Salsola* & other *Eriogonum* sp.	4500-6700' (1370-2050 m)	May-Sept.	Regional endemic with limited range ** [4, 5]
98	*E. corymbosum* Benth. var. *matthewsiae* Reveal	Matthews buckwheat	Polygonaceae	RE(UT)	Washington Co., UT near Zion Nat'l Pk on private land	Chinle Formation, purplish siltstone & sandy loam soil	3800-4000' (1159-1220 m)	August-September	[20]
99	*E. darrovii* Kearney	Darrow buckwheat	Polygonaceae	E RC(NV)	White Pine Co., NV & Coconino Co., AZ	On sandy soil with *Cowania* & sagebrush in Pinyon-Juniper woodlands	6000-6500' (1830-1981 m)	August-Sept.	**, [12]
100	*E. eremicum* Reveal	Limestone buckwheat	Polygonaceae	T RD(NV) RT(UT)	Millard Co., UT	Sevy dolomite gravel, clay & limestone, rolling hills & flats; semi-desert shrub community	5400-6200' (1647-1891 m)		An obligate calciphile **, [20]
101	*E. holmgrenii* Reveal	Holmgren buckwheat	Polygonaceae	T RT(NV)	Snake Range, White Pine Co., NV within Humboldt N.F.	In quartzite rock crevices and limestone soils	10,000-12,000'	July-August	[22, 33]
102	*E. jamesii* Benth. var. *rupicola* Reveal	Sandstone buckwheat	Polygonaceae	T RT(UT)	Kane & Washington cos., UT (N.P.)	Navajo Sandstone Formation or sandstone ledges & adjacent reddish sand blow-out areas	5200' (1586 m)	July-August	ORV use
103	*E. lemmonii* S. Wats.	Lemmon buckwheat	Polygonaceae	E RT(NV) SE(NV)	Truckee R. Cyn. Washoe Co., NV	Dry gypseous gravelly clay	4200' (1280 m	June	[27]
104	*E. lobbii* T&G var. *robustius* (Greene) Jones	Andesite buckwheat	Polygonaceae	T RT(NV)	Washoe, Storey cos., NV			June	
105	*E. natum* Reveal	Terrace buckwheat	Polygonaceae	Not listed in FR RT(UT)	Millard Co., UT	Quaternary lacustrine deposits, saline marly playa remnant	5000-5800 (1525-1769 m)	August-Sept.	Roadways gravel pits** [20]
105a	*E. nummulare*	No common name	Polygonaceae	Not listed in FR	S. Tooele, Juab and Millard cos., UT	With shadscale and juniper	5000-6000'	July-Sept.	From 2 disjunct locations** [33]
106	*E. ostlundii* M.E. Jones	Ostlund buckwheat	Polygonaceae	T RT(UT)	Piute & Sevier cos., UT	Clay hills & slopes, cool desert shrub & pinyon-juniper community along the Sevier River	4300-6500 (1312-1983 m)	August-Sept.	[20]
107	*E. ovalifolium* Nutt. var. *caelestinum* Reveal	Cushion buckwheat	Polygonaceae	T RC(NV)	Nye Co. (Toquima & Toiyabe Mtns)	Alpine; sandy & gravelly areas	10,900-11,800' (3322-3600 m	June-July	[11]
108	*E.* o		Polygonaceae	Not on FR list RE(NV)	Washoe Co. (Steamboat Springs)	No information available		July-Sept.	Geothermal development threat [32]
109	*E. panguicense* (M.E. Jones) Reveal var. *alpestre* S. Stokes Reveal	Panguitch buckwheat	Polygonaceae	T RT(UT)	Iron Co., UT	Volcanic gravel & limestone, whitish clay outcrops of rim rocks; spruce fir meadow community	9500-11,000' (2898-3355 m)		Endemic to upper rim of Cedar Breaks ORV [illegible]

Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 9 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
110	*E. rubricaule* Tidestrom	Red-stem buckwheat	Polygonaceae	T RC(NV)	Pershing, Lander, Churchill, Mineral & Nye cos., NV	A variety of soil conditions from lava outcrops to heavy clay soils & dry desert foothill slopes, often with shadscale & other spp. of *Eriogonum*	6000' (1830 m)		**, [5]
111	*E. thompsonae* S. Wats. var. *albiflorum* Reveal	Thompson buckwheat	Polygonaceae	T RT(UT)	Washington Co., UT & Mohave Co, AZ	Moenkopi Formation, red gypsiferous clay silt to sandy soil; desert shrub community	3600-4600' (1098-1403 m)		[20]
	E. t. S. Wats. var. *thompsonae*	Thompson Buckwheat	Polygonaceae	T RT(UT)	Kane & Washington cos., UT; Mohave Co., AZ	Carmel & Chinle formations, sandstone talus, clay loam; desert shrub community	5000-6000' (1525-830 m)		[20]
112	*E. viscidulum* J.T. Howell	Sticky buckwheat	Polygonaceae	E RE(NV) SE(NV)	Known only from near Riverside, Clark Co., NV	In sandy soil on north bank of Virgin River	1550' (472 m)	April-August	[27,12]
113	*E. zion* J.T. Howell var. *zionis*	Zion buckwheat	Polygonaceae	E RT(UT)	Kane & Washington cos.	Navajo Sandstone Formation, sandy alluvium; cool desert & montane shrub community	5000' (1525 m)		[20]
114	*Ferocactus acanthodes* Lemaire) Britt & Rose	Miner's compass	Cactaceae	RC(NV)	Deserts of SE CA, south NV, and AZ	Dry rocky desert slopes and hillsides		April - June	**, [2, 23]
115	*Forsellesia pungens* (Bdg.) Heller	Low grease-bush	Celastraceae	Not listed RC(NV)	Endemic to Mojave Desert in NV & CA. Typical variety is found in the Sheep Mtns,Clark Co.,NV	Rocky slopes	4000-5000' (1219 - 1524 m)	May-June	[2, 33, 22]
116	*Frasera gypsicola* (Barneby) D.M. Post	Sunnyside green gentian	Gentianaceae	E RE(NV) RD(UT) SE(NV)	Nye Co., Sunnyside Known only from type locality	Gypsum flats along the lower waters of the White River in sandy alluvial soils; sometimes arising from mounds of *Lepidium nanum*	4950-5000' (1509 - 1524 m)		Locally abundant ** [2,5]
117	*F. pahutensis* Reveal	Pahute green gentian	Gentianaceae	E RT(NV)	Nye Co., south Toquima Range & Pahute Mesa	Loose volcanic soil in pinyon-juniper, & sagebrush, *Purshia* & *Chrysothamnus* spp.	7200-7500' (2200-2275 m)	May-June	**, [3, 11, 5, 25]
118	*Fraxinus cuspidata* var. *macropetala*	Fragrant ash	Oleaceae	T RT(NV)	N. AZ & S. NV (Clark Co.)	About small swamps 8 mi. N. of Glendale			Known only from 1 location in 1934 [22,34]
119	*Galium hilendiae* (Dempster & Ehrendorfer) var. *kingstonense* (Dempster) Dempster & Ehrendorfer	Kingston bedstraw	Rubiaceae	E RE(NV)	Nye Co (NTS only) & San Bern., Inyo cos., CA	Steep talus slopes derived from cliffs of zeolitized tuff of the Indian Trail Formation with pinyon pine, big sage, & Gambel's oak	5600' (1707 m)	June	[3]
120	*Geranium toquimense* Holmgren & Holmgren	Toquima geranium	Geraniaceae	E RC(NV)	Nye Co., Pine Creek in Toquima Range	In boulders on south-facing slope, endemic to talus slopes with *Ribes montigenum*, *Aquilegia scopulorum*, *Pestemon procerus* (alpine & sub-alpine vegetation)	9500-10,700' (2896 - 3262 m)	August	[11,5]
121	*Gilia nyensis* Reveal	Nye gilia	Polemoniaceae	T RC(NV)	Endemic to central & southern Nye Co., NV (mostly on NTS)	Restricted to areas of deep sand derived from light volcanic tuff in open spaces among shrubs, pinyon-juniper, big sage, black sage & four wing saltbush; on flats or moderate slopes; sometimes found along roadsides	2600-7900' (200 m - 2400 m)	May & June to Nov	Annual** [4, 5, 25]

Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 10 of 20).

NO.	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
122	*G. ripleyi* Barneby	Ripley gilia	Polemoniaceae	T RC(NV)	Endemic in Panamint Range, Inyo Co., CA to mountains of SW Nye Co.	In crevices of steep south-facing limestone cliffs	3000-4800' (915-1463 m)	May-Oct (June/July)	Herbaceous perennial ** [4]
123	*Grindelia fraxino-pratensis* Reveal & Beatley	Ash Meadows gumweed	Asteraceae	T	Nye Co. Ash Meadows	Common on wet, clay, alkaline soils in salt grass meadows	2180-2300' (664-701m)	June-Oct.	Perennial or long-lived biennial [27]
124	*Hackelia ophiobia*	Owyhee River stickseed	Boraginaceae	T RE(NV)	Humboldt Co. in the Sheldon NWR.			June	
125	*Haplopappus alpinus* Anderson	Goldenweed alpine	Asteraceae	Not listed RT(NV)	Toiyabe Range, Lander & Nye cos.	Steep granite slopes with scattered *Pinus flexilis* (limber pine)	9000-10,800' (2743-3292m)	July	[27]
126	*H. brickellioides* Blake	Brickell goldenweed	Asteraceae	T RC(NV)	Regional endemic in limestone mtns. of Death Vly & SW NV (Nye Co)	Steep north or east exposure slopes, rock outcrops & cliff faces or in crevices of mtn ranges of limestone or dolomite co-dominant with *Perityle megalocephala* var. *intricata*, *Gilia ripleyi* & *Agave utahensis* var. *eborispina* (all rare species associated shrubs include shadscale, *Brickellia atractyloides*, *Ephedra*, *Lepidium fremontii* & *Gutierrezia microcephala*	2000-6500' (610 m - 1982 m)	April-Oct	**, [4]
127	*H. eximius* Hall		Asteraceae	T RC(NV)	S. Washoe Co. NV to Eldorado Co. CA	Granitic soils near tree line Subalpine Forest	8600-9600' (2621-2926 m)	July-August	[22]
128	*H. watsonii* A. Gray	Watson goldenweed	Asteraceae	Not listed RC(NV)	Nye Co (NTS)	Restricted to crevices in volcanic cliffs in *Artemisia*-Pinyon-juniper	6400-6600 (1951-2012 m)	Sept.-Oct	[la]
129	*Helianthus deserticolus* Heiser	Desert sunflower	Asteraceae	Not listed RE(UT)	Washington Co., UT; Mohave Co., AZ & Clark Co., NV (BLM land)	Dry sandy soil, open areas in desert shrub community	2100-4500' (641-1373 m)	June-Sept.	Annual, urban sprawl threat [20]
130	*Heuchera duranii*		Saxifragraceae	Not listed RC(NV)	Nye Co., NV Toquima Mtns	Rock crevices on morainal slope	9600-10,800' (2926-3292m)		[27]
131	*Hulsea vestita* A. Gray var. *inyoensis* (Keck) Wilken	Inyo hulsea	Asteraceae	T RC(NV)	Nye & Esmeralda Co., NV, NTS & Inyo Co., CA	On undisturbed sites on steep slopes of coarse volcanic tuff gravel; plants utilize unstable habitats characterized by erosion & landslides with pinyon-juniper, big sage or four wing salt bush	4600-7200' (1402-2195 m)	May-July or Sept-Oct in some areas	**, [4]
132	*Hymenopappus filifolius* Hook var. *tomentosus* (Rydb.)	Cobweb hymenopappus	Asteraceae	T RT(UT)	Washington & Kane Cos.	Sandy soils over a broad range		June-July	ORV use threat [20]
133	*Ivesia cryptocaulis* (Clokey) Keck	Charleston ivesia	Rosaceae	E RT(NV)	Known only from a small area on Charleston Peak, Toiyabe N.F. Clark Co., NV	Occurs at or above timberline in limestone, rocky or gravelly slopes	11,500' (3500m)	July-August	[12]
134	*I. eremica* (Cov.) Rydb.	Ash Meadows ivesia		E RE(NV)	Nye Co.(Ash Meadows endemic)	On light colored clay uplands with other endemics near spring areas	2200-2300' (670-710m)	Sept.-Oct.	Perennial [29]

Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 11 of 20).

NO.	SPECIES	COMMON NAME	FAMILY	STATUS	KNOWN DESCRIPTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES
135	*Lathyrus hitchcockianus* Barneby & Reveal	Mojave sweet pea	Fabaceae	E RE(NV) SE(NV)	2 locations in Nye Co. NV (NTS) & one in Inyo Co., CA	In protected positions, often under shrubs, through which their longish green stems with tendrils climb; in pinyon-juniper associations, washes & canyon bottoms in gravelly to sandy loam	4600' (1380 m)	April-May	[27,2]**
136	*Lepidium nanum* S. Wats.	Dwarf pepper-grass	Brassicaceae	T RC(NV)	Nye & Elko, White Pine, Eureka cos., NV	Well drained soils, in sand or gravel with black sage in calcareous mtns.	6000-7200' (1830-2195 m)	June-July	[27]**
136a	*L. ostleri* Welsh	Ostler peppergrass	Brassicaceae	Not Listed F.R.	Information not available			July	**, [33]
137	*Lesquerella hitchcockii* Munz	Hitchcock bladderpod	Brassicaceae	T RC(NV)	White Pine (Schell Creek Range), Nye Co. (Grant & Quinn Cyn. Range) Clark Co. (Charleston Mtns.)	Limestone outcrops & gravelly soils with scattered bristle-cone pine	10,000-10,900' (3048-3322 m)	June-July	[27]
138	*Lewisia maguirei* Holmgren	Maguire lewisia	Portulacaceae	T RE(NV) RD(UT)	Nye Co. Endemic to Cherry Creek Summit in Quinn Canyon Range.	Loose denuded soil derived from limestone in pinyon-juniper & sagebrush	7500-7800' (2286-2377 m)		**, [15, 5]
139	*Linanthus arenicola* (Jones) Jeps.& Bail.	Sand flax flower	Polemoniaceae	T RC(NV)	Throughout Mojave Desert region; NE Nye Co., Clark, Esmeralda cos, NV & Inyo Co., CA	In gypsum-rich, sandy soils in flat areas in Joshua tree wood-land vegetation or *Larrea-Ambrosia* vegetation	2500-4500' (762-1219 m)	March-May	Annual [4]**
140	*Lomatium ravenii* Math. & Const.		Apiaceae	E(CA) RC(NV)	Lander & Nye cos (Toiyabe Range) and Millard Co., UT (Confusion Range); also OR, ID & CA	On rocky talus slopes in pinyon-juniper & sagebrush or mtn mahogany communities	6000-10,600' (1830-3231 m)	May-July	Widespread and abundant throughout its range** [27]
141	*Lupinus holmgrenanus* C.P. Smith	Holmgren lupine	Fabaceae	T RC(NV)	Esmeralda & Nye Co., NV & Inyo Co., CA; mostly in Sarcobatus Flat drainage S Nye Co., NV	Gravelly soil in pinyon & sagebrush; abundant in sandy washes near Tolicha Peak & Grapevine Mtns.	4850-7500' (1478-2286 m)	May	[1a]**
142	*L. jonesii* Rydb.	Jones lupine	Fabaceae	RT(UT)	Washington Co.	Alluvium, sandy or limestone soil; pinyon-juniper & mtn brush communities	5800-7000' (1769-2135 m)		[20]
143	*L. malacophyllus* Greene	Jawleaf lupine	Fabaceae	T RC(NV)	W. NV-Washoe Co., Douglas Co. and in CA.	Dry hillsides in pinyon-juniper.	4750-5000'	Late May-early July	[33]
144	*L. montigenus* Heller.	Mountain lupine	Fabaceae	T RC(NV)	Washoe Co., Desert Game Range, Clark Co. and eastern CA.	Loose gravel on high ridges, dry fell fields (barren alpine areas) and granitic outcrops.	9000-10,000' (3048 m)	July-August	[22, 33]
145	*Machaeranthera grindelioides* var. *depressa*	Dwarf gum-weed machaeranthera	Asteraceae	T RC(NV) RD(UT)	Western Millard, Tooele & Beaver cos., UT	On knolls and ridges		May-June	Widespread in UT [19]**
146	*M. leucanthemi-folia* (Greene) Greene	White-leaf machaeranthera	Asteraceae	E RC(NV)	Washington to Montana & Idaho, south to Colorado & NV	A weedy species of disturbed sites with shadscale, sagebrush, pinyon-juniper, mtn. mahogany & ponderosa pine		June-Sept.	Taxonomic problem; considered by some to be a minor variant within widespread *M. canescens*. [5]**
147	*Mentzelia leucophylla* Bdg.	Ash Meadows blazing star	Loasaceae	E RE(NV) SE(NV) High priority for F.R. listing	Endemic to Ash Meadows SW Nye Co. NV	Restricted to flats & knolls of calcareous alkaline soil with shadscale & *Enceliopsis nudicaulis* var. *corrugata*	2240-2300' (680-700 m)	May-Sept	[12]
148	*Mertensia toiyabensis* MacBride	Toiyabe Mtn bluebell	Boraginaceae	E RC(NV)	Toiyabe Range, Lander & Nye cos., NV	Near aspen stands & in drainages with aspen, sagebrush, snowberry, choke-cherry & Great Basin wildrye	7000-8200' (2134-2500 m)	June	[8]

Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 12 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DESCRIPTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
149	*Mimulus washoensis* Edwin	Washoe monkey flower	Scrophulariaceae	RC(NV)	Washoe Co. Pyramid Lake area.	Granite fans and mountain slopes	4000-4500'	May	[33]
150	*Mirabilis pudica* Barneby	Bashful four o'clock	Nyctaginaceae	T RC(NV)	Endemic to SE Nye, SW Lincoln, NW Clark cos., NV, Pahranagat, Groom, Penoyer & several other valleys & NTS	Confined to basin floors & alkaline areas near lake beds from calcareous gravel foothills to sandy vlys & playas in saline soils with chenopodiaceous shrubs; prompt & weedy coloniser in disturbed areas (roadsides or denuded areas) where highest density populations are found	3000-5000' (915 - 1679 m)	May-June	Geophytic perennial shrub [4]**
151	*Opuntia pulchella* Engelm.	Sand cholla	Cactaceae	Not listed in FR RC(NV) RC(UT)	Nevada from east central Washoe Co., Lyon Co., Esmeralda to Lander & S. White Pine cos.; western UT, NW AZ (Mohave Co)	Sand of dunes, dry lake borders, river bottoms, washes, valleys, & sagebrush desert	4000-7000' (1219-2134 m)	May-July	Important food source [12,8]**
152	*O. whipplei* Engelm. & Bigel. var. *multigeniculata* (Clokey) L. Benson	Many-jointed whipple cholla	Cactaceae	T RT(NV) RD(UT)	Mojave Desert from CA to AZ. Charleston Mtns., Clark Co., NV.	Rocky or sandy ridges.	4700'	June-August	[34]
153	*Oryctes nevadensis* Wats.	Nevada oryctes	Solanaceae	RC(NV)	Western NV, CA & ID.	Sandy places near Alkali Sink.	4000-5000' (1220-1524 m)	May	[22]**
154	*Oxytheca watsonii* T&G	Watson oxytheca	Polygonaceae	RT(NV)	Lake Mead NRA, Clark Co., Nye Co., Mineral Co.		5500' (1680 m)	July	[27]**
155	*Pediocactus sileri* (Engelm.) L. Benson	Siler pincushion cactus	Cactaceae	E RE(UT) FE	Washington Co., UT; Mohave Co., AZ near St. George UT	Moenkopi Formation, sandy, gypsiferous, calciferous soils high in soluble salts; desert shrub, *Atriplex-Tetradymia* communities	3000-5000' (915-1525 m)	June	[20]
156	*Penstemon arenarius* Greene	Dune penstemon	Scrophulariaceae	T RT(NV)	Nye & Esmeralda; endemic to Tonopah area	Sandy soils with four-wing salt bush & *Tetradymia glabrata*	4000' (1220 m)	May-June	[5]**
157	*P. bicolor* (Brandegee) Clokey & Keck var. *bicolor*	Bicolor penstemon	Scrophulariaceae	T RT(NV)	Known only from Clark Co. (Charlestons) and adjacent AZ	Gravelly soils in washes along road shoulder in *Larrea Ambrosia* & Joshua tree	2900-4700' (884-1433 m)	May	[26,27]
158	*P. b.* (Brandegee) Clokey & Keck var. *roseus* Clokey & Keck	Rosy bicolored penstemon	Scrophulariaceae	T RT(NV)	E. Charleston Mtns., Clark Co., NV & W. Mohave Co., AZ	Gravelly washes with *Larrea* & *Yucca*		May	[27]
159	*P. concinnus* Keck	Tunnel Springs beardtongue	Scrophulariaceae	E RT(UT) High priority for federal listing	Beaver & Millard cos., UT	Sevy Dolomite Formation, gravelly soil, pinyon-juniper woodland	5500-7500' (1678-2288)	May-June	Occurs with several other endemics on Sevy Dolomite Form.** [20]
160	*P. francisci-pennellii* Crosswhite	Pennell penstemon	Scrophulariaceae	RT(NV)	White Pine Co., NV. Restricted to Wheeler Peak area.	On open stony spruce slopes, talus slopes below cliffs.	9500-11,500'	August	[33]

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Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 13 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DESCRIPTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
161	*P. fruticiformis* Cov. var. *amargosae* Keck	Amargosa penstemon	Scrophularia-ceae	RT(NV)	Collected only rarely in SW NV and adjacent areas in CA	In certain sandy or gravelly washes; from Specter Range (NTS), Spring Mtns. & Kingston Mtns. More study needed	1200-5200′ (375-1585 m)	Late May to	[4, 1a]**
162	*P. humilis* Nutt. var. *obtusifolius* (Pennell)	Springdale beardtongue	Scrophularia-ceae	RT(UT)	Washington Co., UT (only near Zion NP)	Navajo Sandstone Formation, ponderosa pine, oak, service berry & juniper community	5000-7300′ (1525-2227 m)		[illegible]
163	*P. keckii* Clokey		Scrophularia-ceae	E RC(NV)	Charleston Mtns, Clark Co & Snake Range, White Pine Co	On slopes of cyns from ponderosa pine & aspen type to near timberline	2650-3150 m	June-July	[27]
164	*P. moriahensis* Holmgren.	Mt. Moriah penstemon	Scrophularia-ceae		White Pine Co.-N. Snake Range (USFS)	Sagebrush in mtn mahogany woodlands and ponderosa pine.	9000′ (2500-280[illegible] m)		[34]
165	*P. nanus* Keck	Dwarf beard-tongue	Scrophularia-ceae	E RT(NV) RD(UT)	Beaver, Millard cos., UT: in Desert Range Experimental Station and vicinity	Sevy Dolomite Formation, calcareous gravel, dry exposure in sage-brush, pinyon, & mixed desert shrub community on alluvial fans, talus slopes & rocky outcrops in arid sites where other plants are few	5500-6400′ (1676-1952 m)	Late May-early June	** [20, 33] Was con-fused with *P. dolius* until recently.
166	*P. pahutensis* N. Holmgren	Pahute penstemon	Scrophularia-ceae	E RT(NV)	Southcentral Nye Co (in & around NTS & Stonewall Mtn.)	Open areas in loose soil, or rocky areas or growing from crevices, in pinyon juniper or big sage-brush; not restricted to one specific habitat, common on disturbed areas	6700-7150′ (2042-2180 m)	June-mid-July	[3,5]
167	*P. procerus* Keck var. *modestus* Greene	Ruby Mtns beardtongue	Scrophularia-ceae	T RT(NV)	E. Ruby Mtns., Elko Co., NV	In alpine dry meadows usually on rocky soils with mtn mahogany and *Juniperus scopulorum*.	8600-9000′	July-August	[33]
168	*P. pudicus* Reveal & Beatley	Bashful penstemon	Scrophularia-ceae	T RT(NV)	Nye Co. known only from Kawich Peak areas of Kawich Range	Washes & barren slopes in pinyon-juniper with big sage & mtn mahogany	7600-9000′ (2317-2743 m)	June	[25, 1a]**
169	*P. rubicundus* Keck		Scrophularia-ceae	E RC(NV)	Mineral Co.-W. of Walker Lake	Dry places		June	[2[illegible], 34]
170	*P. thompsoniae* (Gray) Rydb. var *jaegeri* Keck	Jaeger penstemon	Scrophularia-ceae	T RT(NV)	Clark Co., NV	Flats and gentle slopes	2600-2900′ (792-884 m)	May-June	[27]
171	*P. thurberi* Torr. var *anestius* Reveal & Beatley	Buried Hills penstemon	Scrophularia-ceae	E RE(NV) SE(NV)	Known only from type locality in NW Clark Co., near boundary of NTS and Desert Game Range, Nye Co.	The type population covers several hectares in deep volcanic sands on the upper bajada below the SW end of the Buried Hills association with *Larrea-Ambrosia-Krameria* & *Larrea-Dalea femontii*.	3800-4100′ (1159-1250 m)	June	
172	*P. tidestromii* Pennell	Tidestrom beardtongue	Scrophularia-ceae	RT(UT)	Sanpete & east Juab cos., UT	Desert shrub, sage-brush, snowberry & juniper communities on a variety of substrates.	5600-8200′ (1708-2501 m)	May-early June	Has been impacted by grazing [20]

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NO.[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
173	*P. wardii* A. Gray	Ward beard-tongue	Scrophulariaceae	T RT(UT)	Sanpete & Sevier cos. UT	Arapien Shale, Bald Knoll & Colton formations, clay shale hills, pinyon-juniper and grease-wood communities	5250-6400' (1600-1952 m)	Late April-June	Gypsum & salt mining [illegible]
173a	*P.* sp. Holmgren	Deep Creek Mtns. beardtongue	Scrophulariaceae	Not listed	Deep Creek Mtns., Juab Co., UT	Information not available.			Recently discovered [33]
174	*Perityle megalocephala* (Wats.) Macbr. var. *intricata* (Brandeg.) Powell	Large headed rock daisy	Asteraceae	T RC(NV)	S. Nye & Lincoln cos., Clark Co & may be Inyo Co., CA	Edaphically restricted to sedimentary carbonate substrates (limestone or dolomite) in most of the mtn ranges of southern NV in habitats ranging from lower slopes & washes to steep cliffs & ridge tops at higher elevations with other rare calciphiles, e.g., *Haplopappus brickellioides*, & *Gilia ripleyi*; other associations are *Ephedra*, *Gutierrezia*, *Lepidium fremontii*, *Coleogyne* & shad-scale	2600-5100' (793-1555 m)	June-August	**, [4]
175	*Peteria thompsonae* S. Wats.	Thompson peteria	Fabaceae	T(UT & AZ) RC(NV) RD(UT)	Localized populations in Emery, Grand, Kane, San Juan, & Washington cos., UT, north AZ, & 2 populations in NTS in southern NV	On dry rocky cliffs in various vegetation types such as *Coloegyne* in AZ; *Sarcobatus*, *Lycium-Grayia* or shad-scale-green molly on NTS.	3200-5800' (975-1768 m)	May-June	Herbaceous perennial ** [4]
176	*Phacelia anelsonii* J.F. Macbride	A. Nelson penstemon or Macbride scorpionplant	Hydrophyllaceae	T RT(NV) RT(UT)	Washington Co., UT. Lincoln Co., NV; Inyo & San Bern. Cos., CA	Shady places at the base of sandstone or limestone cliffs or among rocks in sandy to gravelly washes; warm desert shrub & Joshua tree community	2500-5000' (763-1373 m)	April-May	Annual. [illegible] Allen-Farner Meadow Valley Wash pop. may be affected by grazing [27,6] **
176a	*P. argillacea* Atwood	Clay phacelia	Hydrophyllaceae	E RE(UT) FE(UT)	Spanish Fork Canyon, Utah Co., UT.	Green R. shale formation, detritus slopes, rocky clay soil grassland & scattered mtn. shrub community.	6600' (2013 m)	June	Only one population of 4 individuals left. [20, 33]
177	*P. beatleyae* Reveal & Constance	Beatley phacelia	Hydrophyllaceae	E RT(NV)	Nye & Lincoln cos., NV (NTS)	Light-brown volcanic tuff, on loose talus & along washes with *Atriplex hymenelytra*	4000-5800' (1220-1770 m)	May	[4]
178	*P. cephalotes* Gray	Virgin scorpionplant	Hydrophyllaceae	T RT(UT)	Kane & Washington cos. UT; Mohave & Navajo cos., AZ	Chinle Formation, alluvium, bare clay soil, salt desert shrub community	2000-4500' (610-1373 m)	May	Annual [illegible]
179	*P. glaberrima* (Torr.) J.T. Howell	Smooth phacelia	Hydrophyllaceae	T RT(NV)	Lander Co., NV	Alkaline soils on talus slopes in Reese river valley	4000-5000' (1220-1524 m)	May-June	Heavily grazed* [8]
180	*P. inconspicua* Greene	Inconspicuous phacelia	Hydrophyllaceae	E SE(NV)	W. Humboldt Range, Pershing Co., NV; also Butte Co., ID	Steep slopes with tall sagebrush	5600-6800' (1707-2073 m)	June	Annual [27]
181	*P. mustelina* Coville	Weasel scorpionweed	Hydrophyllaceae	T RC(NV)	Widely but thinly distributed throughout Death Valley region & SW NV	On volcanic crevices of steep cliffs or on limestone substrates in rocky places with *Coloegyne*, *Artemisia*-pinyon-juniper to Creosote bush scrub	3000-6500' (915-1982 m)	March-June or June-Sept.	Annual [25,4] ** on NTS, TTR
182	*P. nevadensis* J. T. Howell	Nevada phacelia	Hydrophyllaceae	RE(NV)	E. Humboldt Mtns., Elko Co., NV	Under sagebrush and juniper	6500' (1981 m)	June	Not seen since 1867 [33,34,27]
183	*P. parishii* Gray	Parish phacelia	Hydrophyllaceae	Not listed RC(NV)	Nye Co (NTS), White Pine, Clark, NV; San Bern., CA	Light-colored calcareous sandstone or siltstone knolls of sparse shrub vegetation mainly shadscale & *Lycium pallidum*	3340' (1018 m)	April-June	ORV problem; NTS has only surviving population ** [4]

Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 15 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES*
184	*Phlox gladiformis* (M.E. Jones) E. Nels.	Red Canyon phlox or Musky phlox	Polemoniaceae	T RT(NV) RT(UT)	Garfield, Iron & Washington cos., UT NV?	Pink limestone Member of the Wasatch Formation, heavy clay soil, gravelly, scattered yellow-pine forest community.	6000-8000' (1830-2440 m)	May-June	An obligate calciphile [20]
185	*Pilostyles thurberi* Gray.		Rafflesiaceae	RC(NV)	SE CA, S. NV; SW AZ.	Minute stem parasite on *Dalea* especially on *D. emoryi*; creosote bush scrub.	< 4,000'	March-April	** [22]
186	*Polygala subspinosa* Wats. var. *heterorhynca* Barneby	Beaked spiny milkwort	Polygalaceae	RC(NV)	Nye Co., NV and east Inyo Co., CA.	Alkaline calcareous hills, shadscale scrub.	3000-4000' (914-1219 m)	April-May	** [22, 32]
187	*Primula capillaris* N. Holmgren & A. Holmgren	Lamoille Cyn. primrose	Primulaceae	E RE(NV) SE(NV)	Elko Co., NV; head of Lamoille Cyn. in Ruby Mtns.	North-facing slopes, on soils of granitic origin on high mtn meadows with *Selaginella* mats on grass sod; associated with white bark pine	10,000' (3,000 m)	Mid-July	Locally common. [12]
188	*P. nevadensis* N. Holmgr.	Nevada primrose	Primulaceae	E RT(NV)	E. Nye Co., & White Pine Co. Grant; Snake ranges & Troy Park	Limestone outcrops with *Pinus longaeva*, *Ribes montigenum*, *Eriogonum holmgrenii*	>11,000' (3353 m)	July	[illegible]
189	*Rorippa subumbellata* Roll.	Tahoe yellow-cress	Brassicaceae	T RE(NV)	Around Lake Tahoe	Moist places; Yellow Pine Forest	6000-8000' (1830-2440 m)	June-July	[22]
190	*Salvia funerea* M.E. Jones	Death Valley sage	Lamiaceae	T RC(NV)	S. Nye Co., NV Pahrump & Stewart Vly & Death Vly. region, Inyo Co.,CA	Common in shallow upland washes in limestone mountains	2600-3500' (793 - 1070 m)		[illegible]
191	*Sclerocactus polyancistrus* (Engel. & Bigel.) Britt. & Rose	Mojave fish-hook cactus	Cactaceae	Not listed RT(NV)	Mojave Desert from Kern Co. to SW NV & south to Mojave River; widely but thinly distributed	On gravelly slopes & near flatrock areas of igneous origin in *Artemisia*-pinyon-juniper & *Atriplex-Ceratoides* or creosote bush scrub; overlapping with populations of another threatened cactus *Coryphantha vivipara* var. *rosea*	2000-63000' 610-1921 m)	April-May or June	Threatened by collectors; it is conspicuous** [4,25]
192	*S. pubispinus* (Engelm) L. Benson	Great Basin fishhook cactus	Cactaceae	T RT(NV) RE(UT)	Box Elder, Beaver, Juab, Millard, Sevier & Tooele cos., UT & White Pine Co., NV	Ancient shoreline & islands of Pleistocene lake, rocky soil of hillsides	5000-6000' (1500-1800 m)	April-June	Exploited by collectors** [2[illegible]
193	*Selaginella utahensis* Flowers	Utah spike-moss	Selaginellaceae	RT(NV)	One collection from Washington Co., UT; one from east Charleston Mtns., Clark Co.,NV	On sandstone ledge near Pine Creek in NV	4700' (1433 m)		[27]
195	*Silene clokeyi* Hitchc. & Mag.	Clokey silene	Caryophyllaceae	T RT(NV)	Known only from Charleston Mtns., Clark Co., NV	Among rocks at timberline growing under *Ribes montigenum*	11,150' (3400 m)	July	[27]
196	*S. petersonii* Maguire var. *minor* Hitchc. & Mag.	Red Canyon catchfly	Caryophyllaceae	R RT(UT)	Garfield & Iron cos., UT; Zion National Pk	Pink Limestone Member of Wasatch Formation on bare gravelly clay & eroding slopes mixed ponderosa pine, fir & western bristle-cone pine communities	7000-10,400' (2135-3172 m)	July-August	Threatened by ORV use.

Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 16 of 20).

NO[1]	SPECIES[2]	COMMON NAME	FAMILY	STATUS[3]	KNOWN DISTRIBUTION	HABITAT	ELEVATION	FLOWERING TIME	REMARKS AND REFERENCES[4]
197	*S. scaposa* Robinson var. *lobata* Hitchc. & Mag.	Lobed-leaves silene	Caryophyllaceae	T RC(NV)	Nye Co., NV; SE Oregon & Idaho.	Ranges from rocky sagebrush flats & stony basalt slopes to deep loam with pinyon-juniper & sagebrush	5000-9000' (1524-2743 m)	May-July	[12, 11, 5, 31]**
198	*Smelowskia holmgrenii* Rollins	Holmgren smelowskia	Brassicaceae	E RC(NV)	Nye Co. (Toiyabe National Forest, Toquima Range).	Crevices of rocks (no associated species) in alpine tundra	10,000-11,400' (3048-3475 m)	July-August	[5,11,12]
199	*Sphaeralcea caespitosa* M.E. Jones	Jones or tufted globe mallow	Malvaceae	RT(NV) RT(UT)	Beaver & Millard cos., UT & Nye Co., NV (Toiyabe Mtns.)	Sevy dolomite, rocky calcareous soil, mixed shrub, pinyon-juniper, and grass community	5000-6500' (1525-1983 m)		Restricted to limestone** [20]
200	*Sphaeromeria compacta* (Hall) Holmgren	Charleston tansy	Asteraceae	E RT(NV)	Clark Co., NV, Charleston Mtns.	Timberline	10,000-11,200'		[34]
201	*S. ruthiae* Holm., Schultze and Lowrey	Zion tansy	Asteraceae	RT(UT)	Washington Co. (NPS) Zion National Park.	Navajo Sandstone Formation in crevices of canyon walls in loosely	4800' (1464 m)	August-September	[20]
202	*Streptanthus oliganthus* Roll.	Fewflower twistflower	Brassicaceae	T RT(NV)	NV; Mono Co., CA.	Rocky slopes, Red Fir Forest.	8000-8200;	June-July	[22]
203	*Synthyris ranunculina* Pennell	Charleston kittentails	Scrophulariaceae	E RE(NV)	Endemic to Charleston Mtns., Clark Co., NV.	Limestone cliffs.	(2880-3000 m)	June-August	[27, 33]
204	*Thelypodium laxiflorum* (Al-Shabaz)		Brassicaceae	RC(NV)	Lincoln and Nye cos., NV and CO.	Sandy soil.		May-September	** [32, 34]
205	*T. sagittatum* (Nutt.) Endl. var. *ovalifolium* (Rydb.) Welsh & Reveal	Oval-leaf thelypody	Brassicaceae	T RT(NV) RT(UT)	Garfield & Iron cos., UT; White Pine Co., NV	Clay soils		May-June	Biennial or short-lived perennial; urban development is a threat [20]**
206	*Townsendia jonesii* (Beaman) Reveal var. *tumulosa* Reveal	Charleston ground-daisy	Asteraceae	T RT(NV)	Endemic to Charleston Mtns., Clark Co., NV.	With Ponderosa pine.	10,000'	April-June	[33]
207	*Trifolium andersonii* Gray var. *beatleyae* Gillett	Beatley five-leaf clover	Fabaceae	E RC(NV)	Several locations in Nye & Mineral cos., NV ranging north to Douglas Co., NV	Volcanic outcrops, flat rock areas & along washes with black sage & pinyon-juniper	5800' (1768 m)	April-June	[25,5]**
207a	*T. a.* var. *friscanum*	Frisco clover	Fabaceae	Not listed in FR	E. slope of Frisco Range W. of Milford, Iron Co., UT.	Rocky outcrops with shadscale and bud-sage in scattered pinyon-juniper.	5500'	June	** [33]
208	*T. lemmonii* Gray		Fabaceae	E RT(NV)	Western NV, Sierra Co., CA	Slopes and valleys sagebrush scrub; Yellow Pine Forest	5000-7000' (1524-2134 m)	June-July	[22]
209	*Viola purpurea* Kellogg var. *charlestonensis* (Baker & Clausen) Welsh & Reveal	Limestone violet	Violaceae	T RT(NV) RT(UT)	Beaver Dam Mtns., Washington Co., UT and Charleston Mtns., Clark Co., NV.	Limestone outcrops & cliffs, humus soil, yellowpine forest & mixed mtn shrub community	6850-9800' (2074-2898 m)	May	[20]
209a	*Zigadenus vaginatus* (Rydb.) Baker & Clausen ex. Clokey Macbr.	Sheathed deathcamus	Liliaceae	RT(UT)	Grand, Kane & San Juan cos., UT; may occur in NV	Hanging gardens & canyon bottoms along seeps	3700-6200' (1129-1891 m)	August-September	At Lake Powell [20]

[1] Corresponds to legend on map showing known locations.

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[2] Based on information from Federal Register lists, July 1, 1975 and June 16, 1976; Northern Nevada Native Plant Society (NNNPS) 1980 and Welsh & Thorne, 1979.

[3] E = Listed as candidate endangered in FR, 1976; T = listed as candidate threatened in FR, 1975; FE = Federally protected as endangered (DOI); FT = Federally protected as threatened (DOI); SE = State protected as critically endangered (Nevada Forestry Division under NRS 527.270). Utah has no state protected rare plant species; RE = Recommended for endangered status by authorities in Nevada or Utah; RT = Recommended for threatened status by authorities in Nevada or Utah; RC = Recommended as species of special concern by authorities in Nevada or Utah; RD = Recommended to be delisted by authorities in Nevada or Utah.

[4] Numbers refer to reference list.

Note: Plants listed as "E" or "T" in status column were removed from federal candidate status effective November, 1980. A revised list is being prepared by the U.S. F. & W. S (MacBryde, Aug. 1980).

Appendix I. Rare and protected plant species in the Nevada/Utah study area (page 17 of 20).

NO.	SPECIES
210	*Abronia orbiculata (= A. turbinata)*
211	*Astragalus serpens* (widespread in Utah)
51a	*Camissonia parryi* (abundant in Utah)
212	*Carex whitneyi* (not known from Nevada)
52	*Castilleja linoides (= C. flava)*
54a	*C. scabrida* (widespread in Utah)
213	*Croton wigginsii* (not known from Nevada)
214	*Cymopterus newberryi* (broad range in Utah)
215	*C. rosei* (extensive range in Utah)
216	*Ditaxis diversiflora (= Argythamnia cyanophylla)*
217	*Draba lemmonii* var. *incrassata* (not known from Nevada)
218	*Geranium marginale* (widespread in Utah)
219	*Gilia mcvickerae* (widespread in Utah)
219a	*Haplopappus aberrans* (not known from Nevada)
220	*Haplopappus (= Hazardia)* cana
221	*H. scopulorum* (widespread in Utah)
222	*Isoetes bolanderi* var. *pygmaea* (not believed to occur in Nevada)
223	*Machaeranthera ammophila (= Psilactis coulteri)*
224	*Nitrophila mohavensis* (not known from Nevada)
225	*Penstemon abietinus* (broad range in Utah)
226	*P. caespitosus* var. *suffruticosus* (broad distribution in Utah)
227	*P. decurvus (= P. humilis)*
228	*P. leiophyllus* (widespread in Utah)
229	*P. nyensis (= P. kingii)*
230	*Polemonium nevadense (= P. pulcherrimum)*
194	*Senecio lynceus* var. *leucoreus (= S. multilobata)*

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APPENDIX I
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APPENDIX II KNOWN LOCATIONS OF RARE PLANTS BY HYDROLOGIC SUBUNIT

WATERSHED	NUMBER	SPECIES
Alkali Spring	(#142)*+	Asclepias eastwoodiana Sclerocactus polyancistrus
Antelope Valley	(#57)*	None known
Antelope Valley	(#151)	Machaeranthera grindelioides Silene scaposa var. depressa var. lobata
Antelope Valley	(#186)*	Haplopappus watsonii
Beaver Valley	(#48)	Castilleja parvula
Beryl-Enterprise District	(#53)*	Astragalus convallarius var. finitimus A. oophorus var. lonchoclyx Lupinus jonesii Viola purpurea var. charlestonensis
Big Smoky Valley-North	(#1378)*	Asclepias eastwoodiana Astragalus funereus Cymopterus goodrichii Draba arida Geranium toquimense Haplopappus alpinus Haplopappus brickellioides Lomoatium ravenii Mertensia toiyabensis Opuntia pulchella Silene scaposa var. lobata Smelowskia holmgrenii
Big Smoky Valley-Tonopah Flat	(#137A)*+	Asclepias eastwoodiana Astragalus funereus Astragulus pseudiodanthus A. serenoi var. sordescens A. toquimanus Coryphantha vivipara Frasera pahutensis Machaeranthera leucanthemifolia Penstemon arenarius Sclerocactus polyancistrus
Black Mountains Area	(#215)	Arctomecon californica

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WATERSHED	NUMBER	SPECIES
Buena Vista Valley	(#129)	Eriogonum anemophilum
Buffalo Valley	(#131)	None known
Butte Valley-North	(#178A)*	None known
Cactus Flat	(#148)	Asclepias eastwoodiana Coryphantha vivipara var. rosea Opuntia pulchella Penstemon pudicus var. modestus Sclerocactus polyancistrus
California Wash	(#218)	Astragalus nyensis Astragalus geyeri var. triquetrus Penstemon bicolor ssp. roseus
Carico Lake Valley	(#55)*	Phacelia glaberrima
Cave Valley	(#180)*	None Known
Clayton Valley	(#143)*	None known
Clover Valley	(#204)*	Thelypodium laxiflorum
Coal Valley	(#171)*	Coryphantha vivipara var. rosea
Coyote Spring Valley	(#210)*	Agave utahensis var. eborispina; Arenaria stenomeres Astragalus musimonum A. nyensis Coryphantha vivipara var. rosea
Crescent Valley	(#54)(NV)*	None known
Deep Creek Valley	(#3)*	Penstemon nanus Sclerocactus pubispinus
Delamar Valley	(#182)*	None known
Diamond Valley	(#153)*	Silene scaposa var. lobata
Dixie Valley	(#128)	None known
Dry Lake Valley	(#181)*	None known
Dugway Valley	(#8)*	None known
Eastgate Valley Area	(#127)	None known
Edwards Creek Valley	(#133)	None known

WATERSHED	NUMBER	SPECIES
Emigrant-Groom Lake	(#158A)	Coryphantha vivipara var. rosea Galium hilendiae var. kingstonense Thelypodium laxiflorum
Emigrant Valley	(#158)	Coryphantha vivipara var. rosea Galium hilendiae ssp. kingstonense Thelypodium laxiflorum
(Milford) Escalante	(#50)*	Sphaeralcea caespitosa
Fish Springs Valley	(#7)*	None known
Frenchman Flat	(#160)	Agave utahensis var. eborispina Astragalus funereus A. nyensis Camissonia megalantha (=C.heterochroma) Castilleja parvula Gilia ripleyi Phacelia beatleyae P. parishii
Garden Valley	(#172)*	Erigeron uncialis var. conjugans Lesquerella hitchcockii Lewisia maguirei Primula nevadensis Trifolium andersonii ssp. beatleyae Machaeranthera leucanthemifolia
Garfield Flat	(#120)	None known
Garnet Valley	(#216)	None known
Gold Butte Area	(#223)	None known
Goshute Valley	(#187)*	None known
Government Creek Valley	(#9)*	None known
Grass Valley	(#71)	None known
Grass Valley	(#138)*	None known
Gabbs Valley	(#122)	Astragalus pseudiodanthus Oxytheca watsonii
Gold Flat Valley	(#147)	Astragalus beatleyae Coryphantha vivipara var. rosea Haplopappus watsonii Opuntia pulchella

WATERSHED	NUMBER	SPECIES
		Thelypodium laxiforum Trifolium andersonii ssp. beatleyae
Great Salt Lake Desert-Western Desert	(#32b)	Astragalus lentiginosus var. latus Eriogonum nummulare Opuntia pulchella Penstemon nanus Sclerocactus pubispinus
Hamblin Valley	(#196)*+	Astragalus convallarius var. finitimus Coryphantha vivipara var. rosea (?) Eriogonum aramophilum E. eremicum E. holmgrenii oophorus var. lonchocalyx Machaeranthera grindelioides var. depressa Penstemon concinnus Primula nevadensis Sclerocactus pubispinus Sphaeralcea caespitosa
Hidden Valley	(#217)	Agave utahensis var. eborispina
Hot Creek Valley	(#156)*+	Astragalus callithrix Cryptantha insolita (?) Erigonum beatleyae Penstemon pudicus
Huntington Valley	(#47)*	Cryptantha interrupta
Huntoon Valley	(#113)	None known
Independence Valley	(#188)	None known
Indian Springs Valley	(#161)	Agave utahensis var. eborispina Astragalus aequalis Coryphantha vivipara var. rosea Gilia ripleyi Polygala subspinosa var. heteroryncha
Imlay Area	(#72)	Cordylanthus tecopensis Eriogeron anemophilum Machaeranthera leucanthemifolia Opuntia pulchella Phalcelia inconspicua
Ione Valley	(#135)*	Astragalus serenoi var. sordescens Eriogonum rubricaule

Jakes Valley	(#174)*	Lepidium nanum
Jersey Valley	(#132)	None known
Kane Springs Valley	(#206)*	None known
Kobeh Valley	(#139)*	Coryphantha vivipara Lomatium ravenii Oxytheca watsonii
Lake Valley	(#183)*	None known
Lamoille Valley	(#45)	Astragalus robbinsii var. occidentalis Haplopappus watsonii Penstemon procerus var. modestus
Las Vegas Valley	(#212)	Angelica scabrida Arctomecon californica Arenaria kingii var. rosea Astragalus aequalis A. merriami A. musimonum A. nyensis Calochortus striatus Cirsium clokeyi Coryphantha vivipara var. rosea Cryptantha insolita C. tumulosa Draba jaegeri Forsellesia pungens Gilia ripleyi Lesquerella hitchcockii Opuntia whipplei var. multigeniculata Penstemon bicolor var. bicolor P. bicolor var. roseus P. keckii P. thompsonae ssp. jaegeri Sphaeromeria compacta Townsendia jonesii var. tumulosa
Lida Valley	(#144)*	Crypthantha hoffmannii Heuchera duranii
Little Fish Lake Valley	(#150)*	Asclepias eastwoodiana Cymopterus nivalis (?) Haplopappus watsonii Silene scaposa var. lobata Trifolium andersonii var. beatleyae

WATERSHED	NUMBER	SPECIES
Little Smoky Valley (North, Central, and South+)	(#155A,B,C)*	Astragalus calycosus var. monophyllidius Machaeranthera grindelioides var. depressa
Long Valley	(#175)*	None known
Lower Meadow Valley Wash	(#205)*	Astragalus nyensis Draba crassifolia var. nevadensis Fraxinus cuspidata var. macropetala Machaeranthera leucanthemifolia Penstemon bicolor var. roseus Phacelia anelsonii Thelypodium laxiflorum
Lower Moapa Valley	(#220)	None known
Lower Reese River Valley	(#59)	Astragalus pterocarpus Opuntia pulchella
Lund District	(#52)*	Penstemon concinnus
Middle Reese River Valley	(#58)*	None known - look for Phacelia glaberrima
Milford	(#50)	Lepidium ostleri Penstemon nanus Sphaeralcea casespitosa
Monitor Valley	(#140)	Astragalus funereus Cymopterus nivalis Geranium toquimense Haplopappus watsonii Heuchera duranii Opuntia pulchella Oxytheca watsonii Silene scaposa var. lobata Smelowskia holmgrenii
Monte Cristo Valley	(#136)*	Eriogonum beatleyae
Muddy River Springs Area	(#219)*	None known
Newark Valley	(#154)*	None known
Pahranagat Valley	(#209)*+	Coryphantha vivipara Erigeron ovinus Machaeranthera leucanthemifolia Mirabilis pudica

WATERSHED	NUMBER	SPECIES
Pahroc Valley	(#208)*	Machaeranthera leucanthemifolia
Pahrump Valley	(#162)	Arctomecon merriamii Astragalus phoenix Calochortus sp. (unnamed) Centaurium namophilum Cordylanthus tecopensis Grindelia fraxino-pratensis Ivesia eremica Mentzelia leucophylla Penstemon fruticiformis ssp. amargosae
Panaca Valley	(#203)*	Thelypodium laxiflorum
Parowan Valley	(#49)	Astragalus lentiginosus var. ursinus A. perianus Draba subalpina Phlox gladiformis Thelypodium sagittatum var. ovalifolium
Patterson Wash	(#202)*	None known
Pavant Valley	(#47)	Cuscuta warneri
Penoyer (Sand Springs)	(#170)*	None known
Pilot Creek Valley	(#191)	Cryptantha interrupta Sclerocactus pubispinus
Pine Valley	(#53) (NV)*	Machaeranthera ammophila
Pine Valley	(#5)*+	Cryptantha compacta Cymopterus basalticus C. newberryi Eriogonum eremicum Lomatium ravenii Machaeranthera grindelioides var. depressa Machaeranthera leucanthemifolia Penstemon concinnus P. nanus Sphaeralcea caespitosa
Pleasant Valley	(#194)*	Cryptantha interrupta Machaeranthera grindelioides var. depressa Penstemon nanus

WATERSHED	NUMBER	SPECIES
		Sclerocactus pubispinus
Railroad Valley-North	(#173B)*+	Astragelus callithrix A. calycosus var. monophyllidius A. uncialis Camissonia nevadensis Coryphantha vivipara Erigeron uncialis var. conjugans Lesquerella hitchcockii Lewisia maguirei Machaeranthera leucanthemifolia Opuntia pulchella Primula nevadensis Sphaeralcea caespitosa Thelypodium laxiflorum
Railroad Valley-South	(#173A)*	None known
Ralston Valley	(#141)*+	Asclepias eastwoodiana Astragalus aequalis A. funereus A. serenoi var. sordescens A. toquimanus Coryphantha vivipara var. rosea Frasera pahutensis Geranium toquimense Lomatium ravenii Opuntia putchella Penstemen arenarius Sclerocactus polyancistrus Trifolium andersonii ssp. beatleyae
Rhodes Salt Marsh	(#119)	Astragalus lentiginosus var. sesquimetralis Opuntia pulchella
Rose Valley	(#199)*	None known
Ruby Valley	(#176)*	Cryptantha interrupta Eriogonum argophyllum Thelypodium sagittatum var. ovalifolium
Rush Valley	(#13)*	None known
Sevier Desert	(#46)*	Eriogonum natum Penstemon humilis var. obtusifolius Penstemon nanus Phacelia parishii Sphaeralcea caespitosa

WATERSHED	NUMBER	SPECIES
Sevier Desert (Dry Lake Subarea)	(#46A)*	Eriogonum natum
Skull Valley	(#10)	None known
Smith Creek Valley	(#134)*	None known
Snake Valley	(#4)*	Astragalus callithrix Cryptantha compacta C. newberryi Eriogonum ammophilum E. eremicum E. holmgrenii E. nummulare Haplopappus watsonii Machaeranthera grindelioides var. depressa Mimulus washoensis Opuntia pulchella Penstemon francisci-pennelli Penstemon nanus Sclerocactus pubispinus
Soda Springs Valley	(#121)	None known
South Fork Area	(#46)*	Astragalus robbinsii var. occidentalis Cryptantha interrupta Penstemon procerus var. modestus Primula capillaris
Spring Valley	(#184)*	Astragalus lentiginosus var. latus Coryphantha vivipara var. rosea Eriogonum darrovii E. holmgrenii Haplopappus watsonii Mimulus Washoensis Penstemon francisci-pennellii Primula nevadensis Sclerocactus pubispinus Silene scaposa var. lobata Thelypodium sagittatum var. ovalifolium
Spring Valley	(#201)*	Astragalus oophorus var. lonchocalyx; Gilia nyensis
Stephens Basin Valley	(#152)*	None known
Steptoe Valley	(#179)*	Astragalus convallarius var. finitimus Astragalus lentiginosus var. latus Castilleja salsuginosa

WATERSHED	NUMBER	SPECIES
		Centaurium namophilum Cryptantha interrupta Draba sphaeroides var. cusickii Eriogonum darrovii Haplopappus alpinus H. watsonii Lesquerella hitchcockii Penstemon francisci-pennelli Thelypodium sagittatum var. ovalifolium Zigadenus vaginatus
Stone Cabin Valley	(#149)*	Asclepias eastwoodiana Astragalus pseudiodanthus A. toquimanus Coryphantha vivipara var. rosea Eriogonum beatleyae Frasera pahutensis Machaeranthera leucanthemifolia Mirabilis pudica Opuntia pulchella Penstemon arenarius Sclerocactus polyancistrus Trifolium andersonii ssp. beatleyae
Stonewall Flat	(#145)	None known
Teels Marsh Valley	(#114)	Cryptantha hoffmanii Machaeranthera leucanthemifolia Opuntia pulchella Oryctes nevadensis
Three Lakes Valley-North	(#168)	Arctomecon merriami Erigeron ovinus
Three Lakes Valley-South	(#211)	Arctomecon merriami Astragalus aequalis A. mohavensis hemigyrus A. nyensis Coryphantha vivipara var. rosea Cryptantha tumulosa Erigeron uncialis var. conjugans
Tikaboo Valley	(#169A)*	Coryphantha vivipara var. rosea Erigeron ovinus
Tippett Valley	(#185)*	None known
Tule Desert	(#221)	None known
Upper Reese River Valley	(#56)*	Asclepias eastwoodiana

WATERSHED	NUMBER	SPECIES
		Cymopterus goodrichii
		Draba arida
		Eriogonum beatleyae
		Geranium toquimense
		Haplopappus aberrans
		H. watsonii
		Mertensia toiyabensis
		Phacelia anelsonii
		Phacelia glaberrima
		Silene scaposa var. lobata
		Smelowskia holmgrenii
Virgin River Valley	(#222)	Eriogonum viscidulum
Wah Wah Valley	(#54)(UT)*+	Astragalus callithrix
		Eriogonum ammophilum
		Lepidium ostleri
		Machaeranthera grindelioides var. depressa
		Penstenom concinnus
		P. nanus
		Sclerocactus pubispinus
		Sphaeralcea caespitosa
		Trifolium andersoni var. friscanum
Whirlwind Valley	(#60)	None known
White Valley	(#6)*	Astragalus callithrix
		Cymopterus newberryi
		Eriogonum ammophilum
		Lomatium ravenii
White River Valley	(#207)*+	Asclepias eastwoodiana
		Astragalus calycosus var. monophyllidius
		Coryphantha vivipara var. rosea
		Eriogonum darrovii
		Frasera gypsicola
		Haplopappus watsonii
		Lepidium nanum
		Machaeranthera grindelioides var. depressa
		Penstemon arenarius
		Phacelia parishii
Yucca Flat	(#159)	Astragalus funereus
		Gilia ripleyi
		Penstemon thurberi var. anestius
		Phacelia beatleyae

* within general project area delineated in Figure 2.1-1.
\+ currently being inventoried for rare plants.

APPENDIX III
QUANTIFICATION OF DIRECT EFFECT OF M-X DEPLOYMENT ON RARE PLANTS. IN NEVADA/UTAH

For proper impact analysis, it is necessary to quantify direct effects of M-X deployment on various biological resources. For the purpose of this analysis direct effects are defined as destruction or disturbance of habitat as a direct result of construction and operation of the system. Population-induced effects (e.g., recreation) are considered as indirect. Methodology for treating indirect effects is treated in a separate technical report. Excluded from this analyses are indirect effects associated with the DDA and DTN, and direct effects associated with the operating bases.

Most protected fish species and rare plant species in the study area exist in small area populations which, at the 1:500,000 scale of analysis, are point locations. For protected fish species locality data are known with some precision since their occurrence tends to be indiscrete localities (springs) that are typically plotted on U.S.G.S. quad sheets. For rare plants the data tend to be less precise and data for a point locality ranges from vague geographic references typical of early collections (e.g. Southern Railroad Valley, or the Toquima Range) to species references with township and range cordinate. Direct effect is estimate in terms of numbers of locations intersected by the project right-of-way. Because of the small scale of the map and plotting inaccuracies the quantity of disturbance is slightly exaggerated.

The general strategy of this analysis was to determine the amount of each resource disturbed, expressed as a percent of the total resource abundance in each hydrologic sub-unit (Tables I and II).

It is not clear at this time how to combine the various effects on various resources to yield a combined effect in each hydrologic sub-unit. Until an acceptable methodology is worked out, impact analysis must address these effects separately. it is anticipated that further analysis of these data will be performed to support analysis of expected impacts to some of the resources considered here.

Table 1. Direct disturbance to protected fish: combined long-term and short-term effects.

DDA RESOURCE		TOTAL HABITAT LOCATIONS	DISTURBED LOCATIONS	PERCENT OF TOTAL
VALLEY NAME	NO.			
Snake	4	13	2	15.4
Pine	5	0	0	0
White	6	2	0	0
Fish Spring	7	3	0	0
Dugway	8	0	0	0
Government Creek	9	0	0	0
Sevier Desert	46	0	0	0
Sevier/Dry Lake	46A	0	0	0
Wah Wah	54	0	0	0
Big Smoky	137A	1	0	0
Kobeh	139	0	0	0
Monitor	140A	2	0	0
Ralston	141	0	0	0
Alkali Spring	142	0	0	0
Cactus Flat	148	0	0	0
Stone Cabin	149	0	0	0
Antelope	151	0	0	0
Newark	154	2	0	0
Little Smoky	155	1	1	100
Hot Creek	156	0	0	0
Penoyer	170	0	0	0
Coal	171	0	0	0
Garden	172	0	0	0
Railroad	173	4	1	25
Jakes	174	0	0	0
Long	175	0	0	0
Butte	178	0	0	0
Cave	180	0	0	0
Dry Lake	181	0	0	0
Delamar	182	0	0	0
Lake	183	0	0	0
Spring	184	4	0	0
Hamlin	196	0	0	0
Patterson Wash	202	0	0	0
White River	207	0	0	0
Pahroc	208	9	0	0
Pahranagat	209	14	0	0

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Table 2. Rare and protected plants: combined short-term and long-term disturbance.

DDA RESOURCE		TOTAL LOCATIONS	NUMBER OF LOCATIONS WITHIN 1 MI.	PERCENT OF TOTAL	PERCENT OF TOTAL
VALLEY NAME	NO.				
Snake	4	37	6	16	24
Pine	5	36	6	17	36
White	6	6	2	33	83
Fish Spring	7	1	0	0	100
Dugway	8	0	0	0	0
Government Creek	9	0	0	0	0
Sevier Desert	46	0	0	0	0
Sevier/Dry Lake	46A	5	5	100	100
Wah Wah	54	11	3	27	55
Big Smoky	137A	19	3	16	47
Kobeh	139	3	2	67	100
Monitor	140A	3	3	100	100
Ralston	141	32	13	41	59
Alkali Spring	142	2	0	0	50
Cactus Flat	148	42	0	0	2
Stone Cabin	149	21	7	33	38
Antelope	151	2	0	0	0
Newark	154	1	0	0	100
Little Smoky	155	2	0	0	50
Hot Creek	156	17	9	53	100
Penoyer	170	0	0	0	0
Coal	171	2	0	0	50
Garden	172	6	2	33	83
Railroad	173	28	13	46	61
Jakes	174	1	0	0	0
Long	175	0	0	0	0
Butte	178	0	0	0	0
Cave	180	0	0	0	0
Dry Lake	181	0	0	0	0
Delamar	182	0	0	0	0
Lake	183	0	0	0	0
Spring	184	25	1	4	4
Hamlin	196	15	7	47	80
Patterson Wash	202	0	0	0	0
White River	207	27	8	30	59
Pahroc	208	1	0	0	100
Pahranagat	209	13	1	8	23

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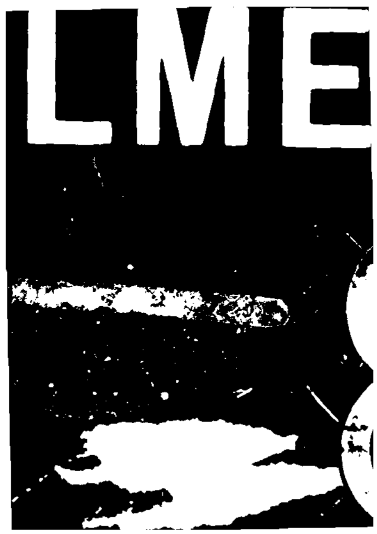
*U.S. GOVERNMENT PRINTING OFFICE : 1981 O-723/284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