RECOVERY PLAN FOR THE ENDANGERED AND THREATENED SPECIES OF ASH MEADOWS, NEVADA

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This plan covers the following federally listed species in Ash Meadows, Nevada and California:

Devil's Hole pupfish, Warm Springs pupfish, Ash Meadows Amargosa pupfish, Ash Meadows speckled dace, Ash Meadows naucorid, Ash Meadows blazing star, Ash Meadows ivesia, Amargosa niterwort, Spring-loving centaury, Ash Meadows sunray, Ash Meadows milk-vetch, and Ash Meadows gumplant.

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Total Estimated Costs of Recovery:

Costs: (000's)

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Total
1990	23	171	142	15	0	351
1991	223	273	146	17	0	659
1992	170	259	184	124	0	737
1993	170	78	183	99	0	530
1994	123	63	327	124	0	637
1995	123	63	328	51	0	565
1996	23	0	302	76	78	479
1997	23	0	295	51	20	389
1998	23	0	285	76	0	384
1999	23	0	197	206	0	426
2000	23	0	197	231	0	451
2001	23	0	197	215	0	435
2002	23	0	197	201	0	421
2003	23	0	197	185	0	405
2004	23	0	177	46	0	246
2005	23	0	177	30	0	230
Total Costs	1,062	907	3,531	1,747	98	7,345

Date of Recovery: **Delisting** should be initiated in 2005, if recovery criteria have been met.

EXECUTIVE SUMMARY

FOR THE ASH MEADOWS SPECIES RECOVERY PLAN

Current Status: Ash Meadows is sole habitat for 33 unique plants and animals. One fish is extinct; four fish species, and the Amargosa niterwort are listed as endangered; six plant species and the Ash Meadows naucorid are listed as threatened; and the Ash Meadows montane vole, two aquatic insects, 13 snails, and four plants are candidates. All of the species except the threatened spring-loving centaury and three candidate plants are endemic to Ash Meadows.

Habitat Requirments and Limiting Factors: In general, the endemic species are associated with the many springs and outflow channels within Ash Meadows. Most of this habitat is currently protected as part of the Ash Meadows National Wildlife Refuge. Introduced non-native aquatic animals and exotic terrestrial plants are currently the greatest threats to endemic species survival in Ash Meadows. Springs need to be protected and outflows restored to historic channels to enable free movement of listed fish between springs.

Recovery Objective: Delisting for all but Devil's Hole pupfish which can only be downlisted to threatened.

Recovery Criteria: All of the listed and candidate species are present in all locales they historically occupied within Ash Meadows; listed species have reached self-sustaining populations (as measured by sex ratios and adult-to-juvenile ratios for fishes and frequency values for plants on critical habitat); the essential habitat is free of threats from all non-native animals, exotic plants, and detrimental human disturbances; springs have returned to historic discharge rates and water flow is reestablished into historic channels; Devil's Hole minimum water level is 1.4 feet below the copper washer with a minimum pupfish population of 300 individuals during winter and 700 during late fall, two refugia population established for Devil's Hole pupfish; and native plant and aquatic communities have been reestablished to historic structure and compsition within all essential habitat.

Action needed:

1. Secure habitat and water sources for the Ash Meadows ecosystem.
2. Conduct research on the biology of the species.
3. Conduct management activities within essential habitat.
4. Reestablish populations/monitor new & existing populations.
5. Determine/verify recovery objectives.

ACKNOWLEDGMENTS: This plan results from the efforts of many who spent considerable time and energy to prevent the destruction of Ash Meadows and the extinction of its diverse endemic biota. Without these efforts the recovery program in Ash Meadows would have been narrowly focused on individual species and their maintenance in small, even artificial, refugia rather than being focused on recovery of an entire ecosystem. The Desert Fishes Council, E. P. Pister, Executive Secretary, and its Ash Meadows Education Fund comprised of Barbara Kelley, Cindy Williams, Buela Edmiston, and Tasker Edmiston, along with David Livermore of The Nature Conservancy, were most instrumental in focusing national attention on the critical problems in Ash Meadows. A number of other conservation organizations, including the National Audubon Society, American Fisheries Society, National Wildlife Federation, Sierra Club, Defenders of Wildlife, The Humane Society, and Natural Resources Defense Council were also deeply involved. Many individuals, too numerous to mention, were also dedicated to protecting the area during the long period of perturbation between 1960 and 1984. The Ash Meadows National Wildlife Refuge would not exist today without the activities of all of these people.

Members of the Eastern Mohave Desert Fishes Recovery Team prepared this recovery plan. This team is comprised of the following people:

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THIS IS THE COMPLETED ASH MEADOWS SPECIES RECOVERY PLAN. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF COOPERATING AGENCIES (AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS) WHO PLAYED THE KEY ROLE IN PREPARING THIS PLAN. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS, AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EkPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES, AND OTHER BUDGETARY CONSTRAINTS.

<u>LITERATURE CITATION SHOULD READ AS FOLLOWS:</u>

U.S. Fish and Wildlife Service. 1990. Recovery plan for the endangered and threatened species of Ash Meadows, Nevada. U.S. Fish and Wildlife Service, Portland, Oregon. 123 pp.

<u>Additional copies may be obtained from:</u>

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ASH MEADOWS SPECIES RECOVERY PLAN

I. INTRODUCTION

Ash Meadows is sole habitat for approximately 25 unique plants and animals. This historically included five distinct fishes, eight distinct varieties or species of plants, at least 12 distinct aquatic Rissoacean snails, one mammal, and two aquatic insects. Habitat alterations during agricultural, municipal, and mining development caused the extinction of one fish, at least one snail, and possibly the endemic mammal. Further surveys may document the extinction of additional taxa or rediscover those believed extinct. This plan specifically addresses the 12 species in the area currently federally listed as either threatened or endangered (Table 1). However, the intimate relationship of habitats occupied by these species and others endemic to Ash Meadows that are candidates for future recognition as either threatened or endangered, mandates that all recovery tasks be implemented only when they are designed to enhance the entire ecosystem. This recovery plan and the entire recovery effort must, therefore, be strongly oriented toward recovering the entire Ash Meadows ecosystem rather than individual species. Recovery plans were approved for the Warm Springs pupfish and Devil's Hole pupfish in 1976 and 1980, respectively. The tasks and goals of these plans are incorporated into this plan and this broader plan will thus

Table 1. Federal and State Listing Status of Plants and Animals in Ash Meadows, Nye County, Nevada and Inyo County, California. Federal status is followed by the date the listing was published in the Federal Register. * indicates species for which critical habitat is designated. Endangered status - E, threatened status T, candidate for future listing - C.

	Federal	Nevada	California
Devils Hole pupfish	E(3/11/67)		
Warm Springs pupfish	E(10/13/70)		
Ash Meadows Amargosa pupfish	E(5/10/82)*		
Ash Meadows speckled dace	E(5/10/82)*		
Ash Meadows naucorid	T(5/20/85)*		
Ash Meadows blazing star	T(5/20/85)*		
Amargosa niterwort	E(5/20/85)*		E(11/16/79)
Ash Meadows milk-vetch	T(5/20/85)*		
Ash Meadows sunray	T(5/20/85)*		
Spring-loving centaury	T(5/20/85)*		
Ash Meadows gumplant	T(5/20/85)*		
Ash Meadows ivesia	T(5/20/85)*		
Ash Meadows pebble snail	C		
Crystal Springs snail			
Distal-gland springsnail	C		
Elongate gland snail			
Fairbank Spring snail			
Longstreet spring snail	C		
Median-gland Nevada spring snail			
Oasis Valley springsnail			
Amargosa tryonia snail			
Minute tryonia snail			
Point of Rocks tryonia snail			
Sportinggoods tryonia snail			
Virile Amargosa snail			
Ash Meadows montane vole	C		
White-faced ibis			
Alkali Mariposa lily			
Ash Meadows lady's tresses			
Tecopa birds beak			
White bear poppy			
Amargosa naucorid bug			
Devils Hole warm spring riffle beetle			

take precedence in guiding these recovery actions to provide for all components of the ecosystem.

A. Location and History

Ash Meadows is situated at approximately 2,200 feet elevation in the Mojave Desert, 40 miles east of Death Valley National Monument headquarters at Furnace Creek, California, and 90 miles northwest of Las Vegas, Nevada (Figure 1). It includes approximately 50,000 acres of desert uplands and spring-fed oases that straddle the California-Nevada border. A creosote bush (Larrea tridentata) vegetation community predominates in the surrounding region and salt grass (Distichlis spicata), desert holly (Atriplex confertifolia), ash trees (Fraxinus velutina var. coriacea), mesquite (Prosopis julifera and Prosopis pubescens), and burro-weed (Ambrosia dumosa) dominate the vegetation within Ash Meadows (Beatley 1971, 1977a, b). Spring discharge maintains soil moisture in the lowlands while uplands receive water only from rainfall that averages less than 2.75 inches annually. Annual evaporation exceeds 98.50 inches.

Ash Meadows is essentially a watered island amidst the expansive Mojave Desert. The persistence of this water since the late Pliocene/early Pleistocene has provided a means for existence of relict plants and animals which gained access to the region during pluvial climates. The isolation of these species in this harsh environment permitted their differentiation from related taxa and resulted in the distinctive character of many present-day occupants (Miller 1948, Reveal 1979).

The water in Ash Meadows has lured man since prehistoric times. Shoshone Indians occupied the area to take advantage of its water and food (Mehringer and Warren 1976). The first biological inventory of the area was conducted by the Death Valley Expedition in 1891 (Merriam 1893). As a part of this survey, Dr. C. Hart

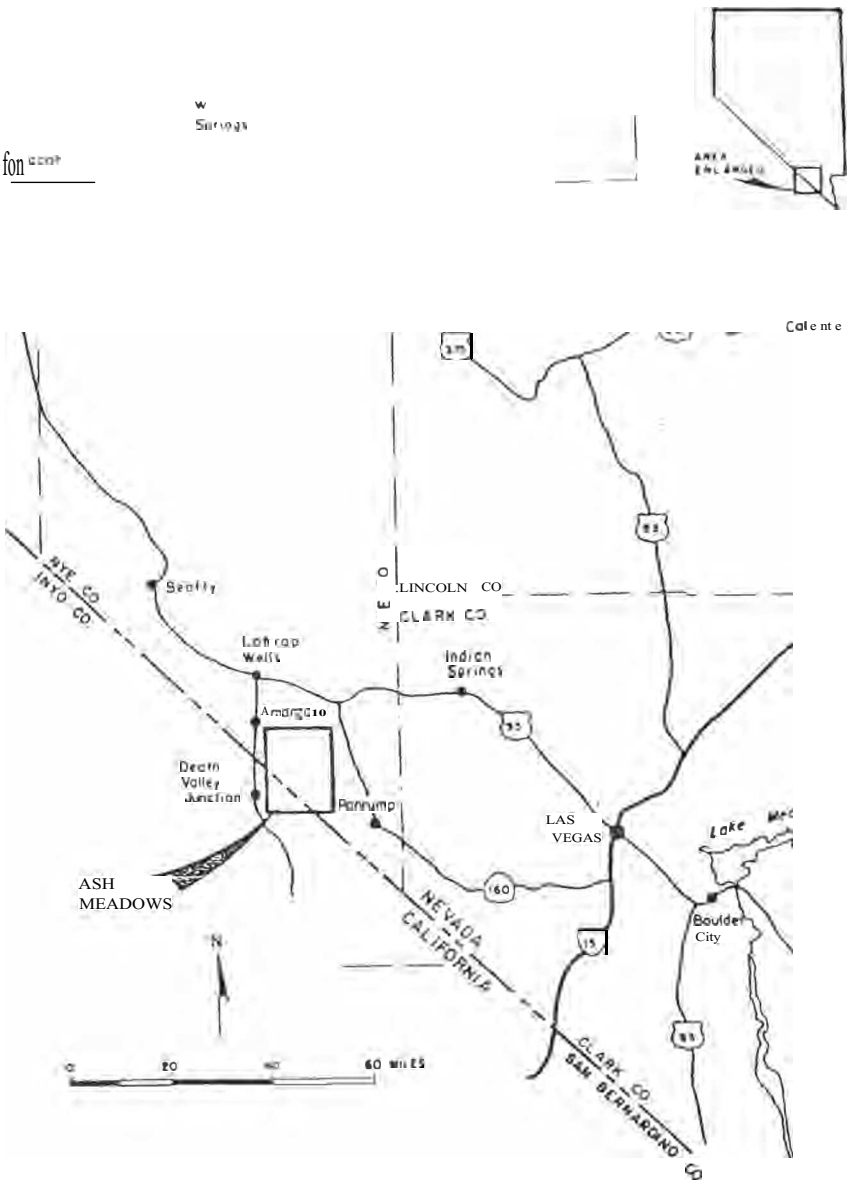

Figure 1. Location of Ash Meadows.

Merriam led the expedition into southern Nevada and California and spent several weeks recording observations and collecting plant and animal specimens in Ash Meadows. Collections made during this visit provide a basis for recognizing the assemblage of unique plants and animals in Ash Meadows.

Settlers occupied the area to utilize its waters for growing crops. Much of the area immediately adjacent to spring sources and along spring outflow channels was granted to private owners when Nevada was granted statehood in 1864. The disturbance of springs and terrestrial habitats during this period was comparatively local, and generally believed to minimally impact the area's biota. Large-scale disturbance did not occur until the early 1960's when aproximately 2,000 acres of marshland in Carson Slough was destroyed during peat mining. In the early 1970's many thousands more acres were disturbed, the discharge from all springs reduced, and many spring outflows were channelized when Spring Meadows Ranch, Inc., began raising alfalfa and cattle.

This ranching endeavor ceased operating in the late 1970's. During 1980 to 1983 municipal development activities disturbed additional land and further altered springs. In an effort to prevent extinction of the local endemic species, The Nature Conservancy purchased 12,654 acres of private land on February 7, 1984, then resold it to the U.S. Fish and Wildlife Service (Service) to establish the Ash Meadows National Wildlife Refuge (Refuge) on June 13, 1984. The future inclusion of adjacent public lands managed by the U.S. Bureau of Land Management (Bureau) and the possible acquisition of additional private lands is planned to create an Area of Management Concern for the Ash Meadows Refuge that encompasses 23,094 acres and much of the habitat occupied by the local endemic species (Sada 1984) (Figure 2).

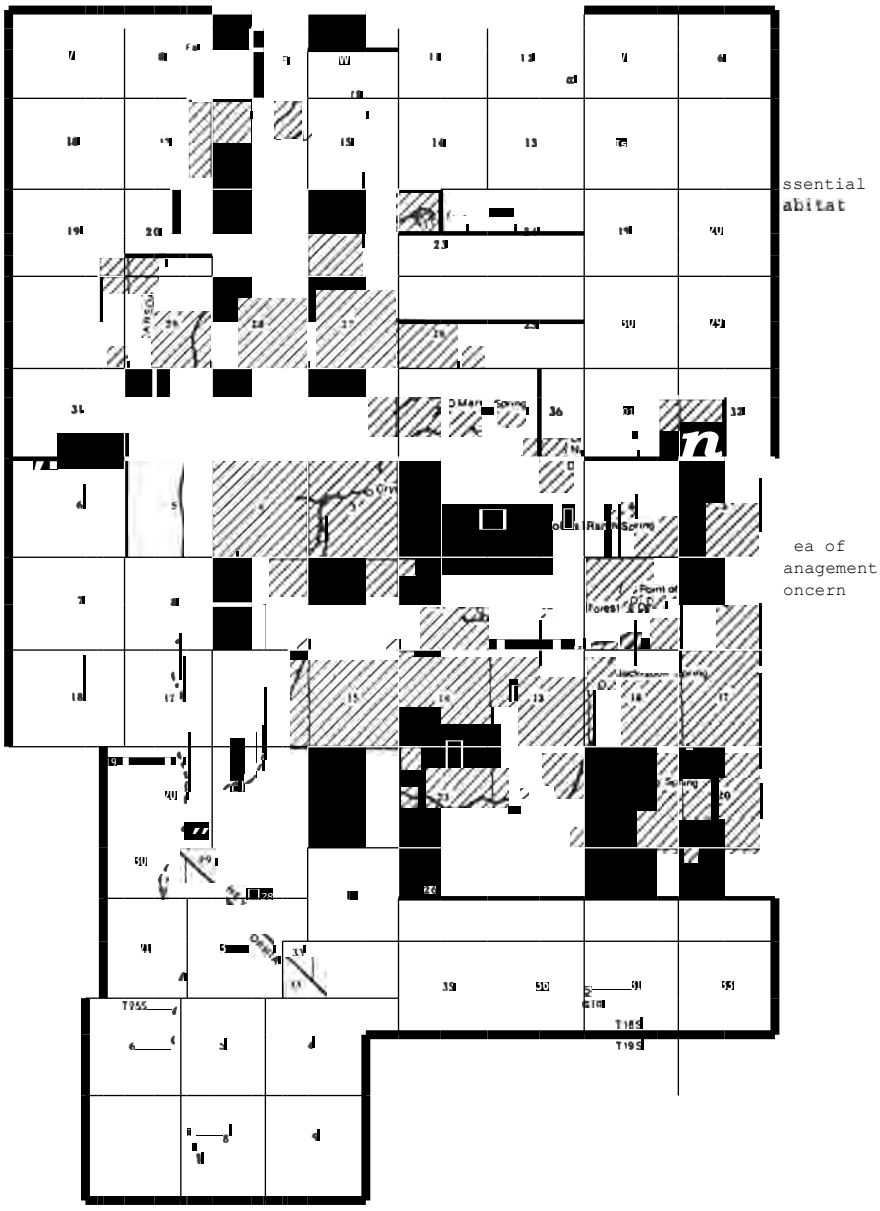

Figure 2. Area of Management Concern.

B. Natural History

Listed and candidate species occupy two distinct habitat types in Ash Meadows (Table 2). These can be generally described as aquatic/riparian and terrestrial. Ash Meadows is believed to support this unique biota because it is a relatively cool and well watered isolated oasis in an otherwise arid desert. Pluvial climates within the past two million years provided the mechanism for invasion and establishment of species ancestral to those presently occurring in the area. The onset of more xeric conditions isolated Ash Meadows from other cool and moist areas and thereby prohibited genetic exchange with nearby populations. This resulted in progressive differentiation of some plant and animal populations and the differentiated species now endemic to the area (Miller 1948, Reveal 1979).

Progenitors to animals endemic to Ash Meadows probably entered southern Nevada during different periods throughout the late Pliocene and early Pleistocene epochs (Smith 1981). Although the precise date of entrance is unknown, similarities between fossil and living mollusks and cyprinodont fishes in western North America indicate that those in Ash Meadows are most closely related to species known from regions lying to the south and east (Miller 1945, 1950, 1958, 1981, Taylor 1966). The speckled dace is more closely related to species associated with northern latitudes in North America, however, it is believed to have entered the Ash Meadows area from what is now the lower Colorado River basin in southern Nevada (Miller 1958, Smith 1978).

Composition of the present-day plant community in Ash Meadows is also attributed to climatic conditions occurring the past million years. Tidwell et al. (1972), Raven and Axelrod (1978), and Van

Table 2. Distribution and Habitat Requirements for Listed and Candidate Species in Ash Meadows, Nye County, Nevada.

Species	Distribution	Habitat Requirements
Listed Species		
Devil's Hole pup fish	Devil's Hole	Thermal spring with water chemistry and other environmental conditions similar to those in Devil's Hole
Warm Springs pupfish	N. Indian Spring S. Indian Spring Marsh Spring N. Scruggs Spring S. Scruggs Spring School Spring	Wide variety of habitats including shallow pools and streams from springs
Ash Meadows Amargosa pup fish	Big Spring Bradford Spring #2 Jack Rabbit Spring Point of Rocks Sp. Tubbs Spring Crystal Pool Crystal Reservoir Lower Crystal Marsh Longstreet Spring Five Springs Rogers Spring Fairbanks Spring Peterson Reservoir Clay pits spring Forest Spring	Wide variety of habitats including shallow and deep streams from springs
Ash Meadows speckled dace	Big Spring Jackrabbit Spring Bradford Spring #1 Bradford Spring #2 Bradford Spring #3 Tubbs Spring	Mostly flowing stream habitats
Ash Meadows naucorid	Point of Rocks Sp.	Flowing thermal water with rock and gravel substrate

Table 2. (continued). Distribution and Habitat Requirements for Listed and Candidate Species in Ash Meadows, Nye County, Nevada.

Species	Distribution	Habitat Requirements
Ash Meadows blazing star	Local at specific sites within Ash Meadows (Appendix A, Table XV)	Arid upland washes and bluffs
Amargosa niterwort	Carson Slough	Highly alkaline moist soils
Ash Meadows milk-vetch	Local at specific sites within Ash Meadows (Appendix A, Table XV)	Arid, highly alkaline soils
Ash Meadows sunray	South and Eastern Ash Meadows (Appendix A, Table XV)	Arid, alkaline soils Ambrosia dumosa plant community
Spring-loving centaury	Near all springs and seeps within Ash Meadows and south to Inyo County, CA (Appendix A, Table XV)	Highly alkaline soils near riparian zones, Juncus-Fraxinus plant community
Ash Meadows gumplant	Local at specific sites within Ash sites within Ash Meadows (Appendix A, Table XV)	Highly alkaline, moist soils frequently in swales not associated with springs
Candidate Species		
Ash Meadows montane vole	Unknown	Salt marsh
White-faced ibis	Peterson Reservoir	
Amargosa naucorid bug	Point of Rock Sp.	
Devil's Hole warm springs riffle beetle	Devil's Hole	Thermal spring with environment as that in Devil's Hole

Table 2. (continued). Distribution and Habitat Requirements for Listed and Candidate Species in Ash Meadows, Nye County, Nevada.

Species	Distribution	Habitat Requirements
Ash Meadows pebble snail	Point of Rocks Sp.	Rocky substrate in flowing thermal water
Crystal Spring snail	Crystal Pool	
Distal-gland spring snail	Collins Ranch Five Springs N. Collins Ranch Mary Scott Sp.	Soft substrates in thermal springs
Elongate-gland snail	Spring S. of clay pits	Soft substrates in thermal springs
Fairbanks Spring snail	Fairbanks Spring	Soft substrates in thermal springs
Longstreet Spring snail	Longstreet Spring	Unknown
Median-gland Nevada spring snail	N. Scruggs Springs Marsh Spring School Spring	Rocky substrate in flowing thermal water
Oasis Valley spring snail	Spring N. of Collins Purgatory Spring 2 springs S. of Rogers Spring Spring S. of Five Springs Shaft Spring Chalk Spring Spring N. of clay pits Spring at clay pits Spring S. of clay pits 2 springs near Crystal Reservoir Frenchy Spring Last Chance Spring	Soft sediments in segments of small spring brooks

Table 2. (continued). Distribution and Habitat Requirements for Listed and Candidate Species in Ash Meadows, Nye County, Nevada.

Species	Distribution	Habitat Requirements
Amargosa tryonia snail	**Devil's Hole** **Mary Scott Sp.** **N. Scruggs Spring** **S. Scruggs Spring** **Marsh Spring** **N. Indian Spring** **S. Indian Spring** **School Spring** **Spring *N.* of Collins Ranch** **Five Springs** **Chalk Spring** **Collins Ranch Sp.** **2 springs near Crystal Reservoir** **Point of Rock Sp.** Last Chance Sp.	**Soft substrates in thermal springs**
Minute slender tryonia snail	***N.* Scruggs Springs** **Spring N. of** Collins Ranch	**Soft substrates in thermal springs**
Point of Rocks tryonia snail	**Point of Rocks Springs**	**Soft substrates in thermal springs**
Sportinggoods tryonia snail	**Fairbanks Sp.** **Big Springs** **Crystal Pool**	**Soft substrates in thermal springs**
Virile Amargosa snail	Scattered springs in area-distribution not currently published as species has not been described	**Soft substrates in thermal springs**

Table 2. (continued). Distribution and Habitat Requirements for Listed and Candidate Species in Ash Meadows, Nye County, Nevada.

Species	Distribution	Habitat Requirements
Alkali mariposa lily	Alkaline meadows in S. Nevada	Moist, alkaline soils
Tecopa bird's beak	Scattered wetlands in Ash Meadows region	Moist, clay-like, alkaline soils
White bear poppy	Scattered dry ridges in Clark, Lincoln, and Nye Counties, NV, and Inyo County, CA	Arid, alkaline upland soils
Ash Meadows lady's tresses	Scattered wetlands in Ash Meadows (Appendix A, Table XV)	Moist, alkaline soils

Devender and Spaulding (1978) compiled evidence from packrat middens, fossil records, and pollen analyses showing the relationship between present and prehistoric plant distribution in southwestern North America. Reveal (1979) concluded that the Ash Meadows milk-vetch (Astragalus phoenix), Ash Meadows sunray (Mentzelia leucophylla), Ash Meadows gumplant (Grindelia fraxino-pratensis), and spring-loving centaury (Centaurium namophilum) are most closely related to congeners presently found in montane portions of the Intermountain Region. Their persistence to the present day is attributed to their successful adaptation to a more xeric environment, to the local persistence of water, and to relatively cool temperatures created by cool air drainage from the surrounding mountains (Beatley 1975, Reveal 1979).

Aquatic insects ancestral to those endemic forms now in Ash Meadows are also believed to have migrated into the area during pluvial climates. Their differentiation into unique forms probably involved the same mechanisms as those permitting differentiation of other taxa now endemic to Ash Meadows. Members of the genus including the Ash Meadows naucorid (Ambrysus amargosus) incidentally occupy scattered habitats in western North America, however, the distributional center of the genus is located in South America (La Rivers 1951). The Devil's Hole warm spring riffle beetle (Stenelmis calida calida) is also associated with species occupying southern latitudes in North America. Its progenitor probably also entered southern Nevada during a past pluvial period (La Rivers 1949). Two forms of Stenelmis calida are known to occupy spring habitats in southern Nevada; S. c. moapa is recorded from springs in the Moapa and Pahranagat Valleys (La Rivers 1949).

Little is known about the life history of local mollusks. They are all small species with shell diameters not exceeding 5 mm. Members of the genus Tryonia are typically grazers and members of

the genus Fluminicola are generally detritivores. Systematics of these populations have not been examined, however, their taxonomic uniqueness to Ash Meadows is recognized (Landye 1973). They occupy the springpools and immediate outflows of most local springs and seeps, but the exact distribution of taxa within the area or within single springs is unknown. Similarly, their habitat requirements are unknown. Comparison with related taxa in other regions indicates that habitats generally range from riparian grasses in close contact with water.

The Ash Meadows vole (Microtus montanus nevadensis) was collected in 1891 by E. W. Nelson at Watkin's Ranch in Ash Meadows (Hall 1935). The precise location of this collection site is unknown, however, Hall (1946) cites it as "lying 4.8 miles northwest of Devil's Hole". Bailey (1900) accorded this taxon full species ranking. Hall (1935) recognized it as a subspecies, which is the currently accepted taxonomic status. Its nearest relative is believed to be M. m. fucosus which is found only in the Pahranagat Valley of southern Nevada. The species Microtus montanus is distributed throughout western North America with 15 recognized subspecies (Hall 1981).

This vole has been seen infrequently since it was first collected. W. C. Russell and W. B. Davis were unable to locate it at Watkin's Ranch during a search in 1933. They were, however, successful in locating it at a site 3.5 miles further to the north (Hall 1935). Surveys for the vole conducted by C. W. Bradley and J. E. Deacon during the early 1960's did not locate any individuals. No recent collections have been attempted.

No quantitative information exists describing its habitat. Bailey (1900) described its habitat as "salt grass and tule marshes in alkaline valleys. Runways always found in wet muddy places and often extending through shallow water".

C. Species Accounts

Devil's Hole Pupfish (Cyprinodon diabolis)--This species is naturally restricted to a limestone cave situated on the east central border of Ash Meadows. Small refugium populations have been established in the Amargosa Pupfish Station in Ash Meadows and in facilities constructed by the Bureau of Reclamation located near the base of Hoover Dam along the Colorado River. This pupfish was described in 1930 by Joseph Wales (Wales 1930) as being distinguished from other members of the genus Cyprinodon by its lack of pelvic fins and scales in the preorbital region, and vertical crossbars in males; also its posterior dorsal fin, long anal fin, and large head and eye (Miller 1948).

The status of the species has improved considerably in the past 10 years, but its population is persistently small and localized (Soltz and Naiman 1978). Prior to this, the removal of ground water from wells pumping to support a cattle and alfalfa ranch reduced the water level within Devil's Hole. This decline was immediately evidenced in a decrease in the fish population attributed to the drying of areas utilized by the fish for feeding and reproduction (Deacon 1979). Litigation initiated by the U.S. Department of the Interior to protect Devil's Hole ended with a ruling by the U.S. Supreme Court which upheld a lower court decision mandating the maintenance of a minimum water level. The level being enforced today measures 2.7 feet below a datum point situated on the wall within Devil's Hole and adjacent to the water's surface. The Devil's Hole Pupfish Recovery Plan identifies that the water level must return to the pre-pumping level of 1.4 to meet recovery criteria (USFWS 1980).

The Devil's Hole pupfish is primarily an annual species whose population fluctuates during the course of each year. J. E. Deacon has noted natural population fluctuations from a maximum of 553 fish in the summer to a minimum of 127 fish in the winter

during his monthly and quarterly population estimates from 1972 - 1984 (Deacon and Baugh 1985).

Spawning occurs throughout the year, but reaches a peak during maximum photoperiod in the spring (Minckley and Deacon 1975). Fertilization occurs when eggs are singly deposited onto the substrate where they incubate. Growth during the spring varies between 0.00 and 0.025 inch/week, and little or no growth occurs during the winter (James 1969).

Maximum length of this pupfish rarely exceeds 0.98 inches (Soltz and Naiman 1978). Stomach analyses show they are opportunistic feeders whose diet includes Spirogyra or diatoms, depending on the season. Stomachs also contained invertebrates such as amphipods, ostracods, and protozoans (Minckley and Deacon 1975).

The Devil's Hole Pupfish Recovery Plan (USFWS 1980) identifies essential habitat for this species as including 21,760 acres encompassing the area where ground water removal most influences the water level in Devil's Hole (Appendix A, Figure I).

Warm Springs Pupfish (Cyprinodon nevadensis pectoralis)-- This pupfish was described in 1948 (Miller 1948), and it occupies six small springs within an area encompassing less than 0.77 square mile situated approximately 0.62 mile west of Devil's Hole (Miller and Deacon 1973). All of its habitats are isolated from other aquatic environments and none of the springs it occupies discharges more than 1.17 gallons/sec (Dudley and Larson 1976). The discharge from these springs surfaces into small spring holes then flows less than 1.25 miles before disappearing into the soil. It is regarded as the smallest subspecies in the C nevadensis complex, and is primarily distinguished by its high number of pectoral fin rays (Miller 1948).

Life history information has been collected for the Warm Springs pupfish by D. L. Soltz (1974). Population data collected at School Spring recorded that the population in November of 1972-1974 varied between 136 and 231 individuals (USFWS 1976). All of its populations are believed to be quite small because of the limited available habitat. Peak spawning occurs in the spring and the size of all populations fluctuates dramatically throughout the course of a year. Feeding habits have not been investigated; however, it is not believed that they differ substantially from other pupfishes in the region (Minckley 1973, Naiman 1974, Moyle 1976, Soltz and Naiman 1978).

The vulnerability of these habitats to alteration and the presence of predatory and/or competing species such as mosquito fish (Gambusia affinis), crayfish (Procambarus clarkii), and bullfrogs (Rana catesbeiana) combine to threaten the livelihood of this pupfish. Acquisition of these habitats into public ownership is one of the primary goals of the approved Warm Springs Pupfish Recovery Plan. With the establishment of Ash Meadows Refuge, four of the six habitats lie on public land withdrawn for wildlife management. Essential habitat for this species includes 2,240 acres surrounding all of its habitat (USFWS 1976). This area is within the borders of Devil's Hole pupfish essential habitat and represents the area in which ground water pumping is most likely to adversely affect spring discharge (Appendix A, Figure II).

Ash Meadows Amargosa Pupfish (Cyprindon nevadensis mionectes)--This pupfish occupies 10 spring areas within Ash Meadows, all of which are designated as critical habitat (Appendix A, Figure III). It is established outside of its native range in clay ponds located approximately 3.75 miles west of the Area of Management Concern **boundary (Baugh et al. 1986). Most of these habitats lie on public land within the boundaries of Ash Meadows Refuge and include spring sources and outflow channels occupied by the species. The size of its habitats range from Crystal Pool, with a spring pool measuring 49.25 feet in diameter**

and 19.7 feet deep and discharging 62.93 gal/sec, to small springs in the Five Springs complex that have no spring pool and discharge less than 0.023 gal/sec (Dudley and Larson 1976, Cook and Williams 1982). The outflows from many springs occupied by this pupfish combine with one another. These confluences, however, are restricted to springs lying relatively close together and do not occur between springs separated by great distances. As an example, the outflows from Big Spring and Jackrabbit Spring combine approximately 0.93 mile from the sources, but this does not combine with discharge from Fairbanks, Rogers, and Longstreet Springs in northern Ash Meadows (Miller 1948) (Figure 3). Discharge from springs occupied by this pupfish. Since habitats of this pupfish provide most of the surface water in the area, they were the most altered during agricultural development. All have been altered by diversion into earthen or concrete channels, impoundment, drying due to pumping of local ground waters, and/or elimination of riparian vegetation during ground leveling. They also support the widest variety of introduced organisms (Soltz and Naiman 1978, Williams and Sada 1985). These alterations eliminated fish populations from Soda Spring and Point of Rock Pool #1, and depressed the size of remaining populations by decreasing the amount of available habitat (Table 3).

Minimal life history information has been gathered for this pupfish. Population estimates made during June, 1982 and July, 1983 recorded 568 and 1,189, respectively, pupfish in Jackrabbit Spring and 1,189 and 1,822 pupfish, respectively, in Big Spring (Williams and Sada 1985). Quantitative estimates have not been made for other populations. Since the Ash Meadows Amargosa pupfish is within the C. nevadensis complex, its spawning, reproduction, feeding, and growth are believed to be similar to that discussed for Warm Springs pupfish (Naiman 1974, Soltz and Naiman 1978).

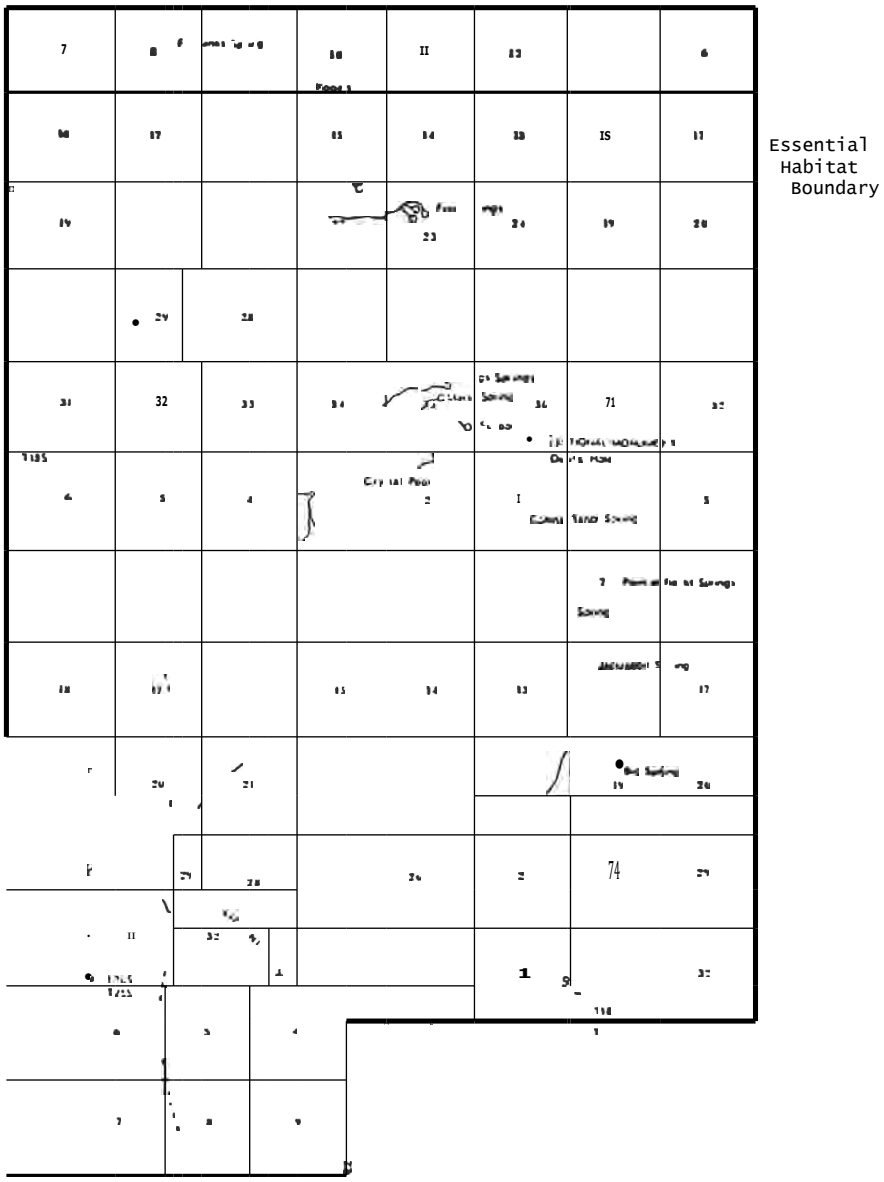

Figure 3. Essential Habitat.

Table 3. Estimated amount of habitat occupied before 1950 and amount of habitat presently occupied by listed species in Ash Meadows, Nye County, Nevada.

Species	Amount of Habitat (acres)		Cause of Decline
	Pre-1950	Presently	
Devil's Hole pup fish	0.019	0.019	Ground water removal
Warm Springs pup fish	0.49	0.439	Exotic species, habitat alteration
Ash Meadows Amargosa pup fish	599.90	7.09	Exotic species, habitat alteration
Ash Meadows speckled dace	599.11	1.16	Exotic species, habitat alteration
Ash Meadows naucorid	0.19	0.009	Habitat alteration
Ash Meadows blazing star	Unknown	1680.25	Habitat alteration
Ash Meadows milk-vetch	Unknown	1666.66	Habitat alteration
Amargosa niterwort	Unknown	959.97	Habitat alteration
Ash Meadows sunray	Unknown	2629.84	Habitat alteration
Spring-loving centaury	Unknown	3760.06	Exotic species, habitat alteration
Ash Meadows gumplant	Unknown	3779.83	Exotic species, habitat alteration
Ash Meadows ivesia	Unknown	1579.93	Exotic species, habitat alteration

Ash Meadows Speckled Dace (Rhinichthys osculus nevadaensis) --This speckled dace was initially described as Rhinichthys nevadensis by Gilbert (1893), then reduced to subspecific status (Rhinichthys osculus nevadensis) by Hubbs and Miller (1948) and others (La Rivers 1962, Hubbs et al. 1974). Speckled dace are members of the minnow family of fishes (Cyprinidae); various forms of speckled dace occur within many basins of western North America (Minckley 1973, Moyle 1976, Lee et al. 1980). Hydrographically isolated basins which it occupies in southern Nevada include the Amargosa River, White River, Meadow Valley Wash, Moapa River, and Colorado River (Miller 1984). Additional work is required to determine the taxonomic status of many populations (Miller 1984).

Collection records show that Ash Meadows speckled dace occupied many of the same springs and outflows historically occupied by Ash Meadows Amargosa pupfish (Appendix A, Table XIII). Manipulation of springs and their outflows reduced the number of populations so that speckled dace are presently found only in the Bradford Springs, Big Spring, Tubbs Springs, and Jackrabbit Spring (Williams and Sada 1985). The population in Jackrabbit Spring was estimated at zero and 11 in 1982 and 1983, respectively, and the population in Big Spring was estimated at 15 and 13 in these same two respective years (Williams and Sada 1985). Speckled dace populations continued downstream some distance from both of these springs when these estimates were made, however, no estimate of population size in these streams was attempted. Tubbs Spring spring pool population was estimated at 35. No population estimates have been made in Bradford Springs. The total population size of Ash Meadows speckled dace is estimated at 500. The habitats occupied by dace, and 50 meters on both sides of the aquatic environment, are designated critical habitat for the speckled dace (Appendix A, Figure IV). Much of this area is also critical habitat for the Ash Meadows Amargosa pupfish and spring-loving centaury. Critical habitat for the speckled dace includes approximately 36 acres.

Speckled dace generally prefer flowing streams where they feed on drifting insects (Moyle 1976). Spawning occurs primarily during the spring and summer over stream riffles where eggs are broadcast by females and fertilized as they drift to the substrate (Mueller 1984). Body coloration varies widely within a population. Generally, the dorsum is olive-gray blending ventrally to golden. Black spots frequently cover the body and there may be one or two distinct, black lateral strips (Hubbs et al. 1974). It reaches a maximum length of approximately 3.9 inches and may live as long as four years (John 1964).

Factors threatening its livelihood include its limited distribution and the presence of introduced competing and predatory species (La Rivers 1962, Williams and Sada 1985).

Ash Meadows Naucorid (Ambrysus amargosus) --This aquatic insect is known to occupy an extremely restricted habitat where flowing water passes over rock and pebble substrates at Point of Rocks Springs (La Rivers 1953). Although little is known about its life history or habitat requirements, food for closely related naucorids includes aquatic insect larvae that are preyed upon while the bug swims over and through the substrate (La Rivers 1951, Polhemus 1979). Reproduction occurs during early spring and summer. Female naucorid bugs deposit demersal eggs that adhere to the substrate during incubation (Usinger 1946). The small size and vulnerability of its habitats makes the naucorid highly susceptible to extirpation. Approximately 10 acres at Point of Rocks Springs are designated critical habitat for this species (Appendix A, Figure V).

Spring-Loving Centaury (Centaurium namophilum) --This centaury is the only listed plant taxon within Ash Meadows that is not endemic to the area. Reveal et al. (1973) described the species from collections taken at Ash Meadows, Nevada, and Tecopa and Furnace

Creek, California. Cronquist et al. (1984) concur with the taxonomic validity of this species and the consensus of its distribution. All of these sites are located along the southeastern periphery of the Death Valley region. Recent surveys, however, have not located the species at either Tecopa or Furnace Creek leaving Ash Meadows as the only area it now occupies.

Little is known about its life history or habitat requirements. **General** observations indicate it is an annual species that flowers during the late summer and autumn. It is typically found on the moist soils within riparian areas in a Distichlis spicata/Juncus sp. vegetation community. It is a member of the gentian family **and has a** low and branching habit and pinkish flowers (Mozingo and Williams 1980). Critical habitat is designated and includes 1,840 **acres scattered throughout Ash Meadows** in Nevada (Appendix A, **Figure VI).**

Ash Meadows Gumplant (Grindelia fraxino-pratensis) --This member of the aster family is frequently associated with the spring-loving centuary on moist soils strongly influenced by seeps **and springs** (Reveal and Beatley 1971). It is biennial or perennial, flowers during the summer and autumn, and may reach a height of 27.55 to 39.37 inches. Little is known about its life history or habitat requirements.

This species is widespread throughout Ash Meadows (Cochrane 1981). Extant populations are scattered throughout the area at sites that have not been disturbed or have been allowed to restabilized from disturbance for extended periods. Cochrane (1981) believes that its distribution was continuous prior to perturbation for agriculture. Critical habitat is designated and includes 1,968 acres in Nevada and California (Appendix A, Figure VII).

Ash Meadows Ivesia (Ivesia eremica)--This member of the Rosaceae family of plants flowers during the late summer and autumn (Mozingo and Williams 1980). It occupies highly alkaline, barren soils that remain moistened by water spreading outward from surface flow discharged by springs. Associated plants include Atriplex confertifolia and Juncus sp. (Mozingo and Williams 1980). Small, local populations are scattered throughout Ash Meadows in Nevada. Plants are perennial and occur as solitary clumps not exceeding 1.9 inches high and 9.75 inches in diameter. Little is known about its life history **or habitat requirements.**

Threats to this species have included trampling by wild horses, cattle, and sheep, and spring diversions and ground water pumping resulting in the drying of soils and elimination of its habitat. Critical habitat is designated to include approximately 880 acres in Nevada (Appendix A, Figure IIX).

Ash Meadows Blazing Star (Mentzelia leucophylla)--This biennial plant is probably the rarest of all plant species endemic to Ash Meadows. Although little is known about its life history or habitat requirements, it is known to occupy alkaline soils in dry washes and on barren bluffs distributed along the eastern edge of Ash Meadows. Flowering continues from June to September with bright yellow flowers arranged in open, **broad infloresences (Mozingo** and Williams 1980). The blazing star is associated with Atriplex confertifolia and another endemic plant species, the Ash Meadows sunray. It is always associated with dry soils apparently uninfluenced by seepage from springs or seeps (Reveal 1978a).

The local distribution of small populations suggests the species is vulnerable to any land disturbance. Past development for agriculture (e.g., roads and crop fields) is believed to have eliminated some populations (Reveal 1978a), and trampling by wild **horses and** livestock, and disturbance by off-road vehicle travel has disturbed other populations. Critical habitat for the

blazing star includes approximately 1,240 acres within Nevada (Appendix A, Figure IX). This area overlaps, in some instances, with critical habitat for the Ash Meadows sunray and Ash Meadows milk-vetch.

Ash Meadows Milk-Vetch (Astragalus phoenix) --Nothing is known about the life history and habitat requirements for this member of the pea (Fabaceae) family. It is a perennial species which flowers during mid-spring and grows as mounds on dry, alkaline soil (Mozingo and Williams 1980). Old plants are mounded into clumps as large as 5.85 inches high and 19.5 inches in diameter. Associated plant species include the Ash Meadows sunray, Atriplex confertifolia, and Haplopappus acradenius (Reveal 1978b).

Threats to this species are similar to those for the Ash Meadows blazing star. Critical habitat for the milk-vetch includes approximately 1,200 acres scattered throughout Ash Meadows in Nevada (Appendix A, Figure X). Portions of this critical habitat also include critical habitats of the Ash Meadows sunray and Ash Meadows blazing star.

Ash Meadows Sunray (Enceliopsis nudicaulis corrugata) --This member of the sunflower family (Asteraceae) is believed to be the most abundant and widespread of all the plant species endemic to Ash Meadows. Again, little is known about its life history and habitat requirements beyond the information gathered during floristic observations. It occupies habitats of the Ash Meadows milk-vetch and Ash Meadows blazing star in addition to areas that are more densely vegetated with Ambrosia dumosa. Individuals are restricted to dry, upland areas outside of the influence of water from seeps and springs (Mozingo and Williams 1980). It flowers coincidentally with the Ash Meadows milk-vetch during mid-spring. A single plant usually produces a number of flowering stalks, each supporting an individual yellow flower measuring approximately 2

inches in diameter. The flower stalk stands erect and measures 15.74 to 19.68 inches in length (Mozingo and Williams 1980).

Populations of this species were destroyed during road construction, land leveling for crops, and alterations for municipal development. Trampling by wild horses and disturbance caused by off-road vehicle travel also adversely affected its status (Reveal 1978b). Critical habitat for the species includes approximately 1,760 acres entirely within Nevada (Appendix A, Figure XI). Some of this area overlaps with critical habitats for the Ash Meadows milk-vetch and **Ash Meadows blazing star.**

Amargosa Niterwort (Nitrophila mohavensis)--This member of the Chenopodiaceae family occupies the most localized habitat of all plant species endemic to Ash Meadows. Its habitats are limited to highly alkaline, moist, salt-encrusted clay soils within the southern portion of Carson Slough in both Nevada and California. Although little is known about its life history or habitat requirements, observations indicate it is an extremely hardy species that is tolerant of high soil salinity and alkalinity (Mozingo 1977). As a result, no other plant species occupy this habitat in many locations. Distichlis spicata is, however, found either on the periphery, or occasionally intermixed within niterwort populations (Mozingo and Williams 1980). The plant rarely exceeds 4 inches in height and is perennial. Large, rhizomatous roots connect many seemingly individual plants within a colony. Flowering occurs in the late spring; flowers are small, apetalous, and axial (Munz and Roos 1955, Reveal 1978c).

Reveal (1978c) notes that the niterwort is sensitive to disturbance and does not reinvade sites where salt crust overlying the soil has been disturbed. Portions of the existing California population have been destroyed by road construction. The Nevada population lies in a remote area where the disturbance has been limited to trampling by wild horses and soil compaction

by off-road vehicles. Critical habitat is designated for the species and includes 1,360 acres (Appendix A, Figure XII). The critical habitat of no other species overlap this area.

D. Essential Habitat

The Ash Meadows essential habitat boundary is shown in Figure 3. This area includes the known distribution of all listed and candidate species endemic to Ash Meadows, all critical habitat and previously identified essential habitats, and the region where ground water removal will most affect spring discharge (refer to Appendix A for location of essential and critical habitats for each species). Activities conducted within this boundary may most affect the endemic flora and fauna. Activities that may cause adverse affects include those that alter spring discharge quantities and routes, stable soil conditions (including drainage patterns from surrounding topography), and native vegetation. Accomplishment of recovery tasks, for most species, will focus on this area.

E. Reasons for Decline

The presence of water in Ash Meadows has long attracted human activity and provided a refuge for man's survival in an arid desert. The magnitude of man's impact on the local environment has increased over time and resulted in the decline of local endemic species (Table 3). Initial human occupation by native Americans occurred because the area's water provided habitat for food, such as waterfowl (Wallace and Wallace 1978). Habitat disturbance during this period occurred primarily when marshlands were burned to enhance hunter access to small mammals captured for food. The arrival of settlers changed land use activities. Areas immediately adjacent to springs and their outflows were homesteaded and became private land when Nevada was granted statehood. The extent of habitat disturbance occurring during

this period is unknown, however, land was probably tilled, springs diverted and crops produced for local consumption. Although the lack of mechanized equipment to till farmland and the remoteness of Ash Meadows probably minimized the amount of land altered, several rare species in Ash Meadows were affected. Introductions of non-native species and habitat alterations combined to cause extinction of the Ash Meadows killifish (Empetrichthys merriami), which was endemic to six large springs in Ash Meadows (Minckley and Deacon 1968, Miller 1969, Soltz and Naiman 1978, Williams et al. 1985). It is believed **that the Ash Meadows vole was also affected** during early activity. This is indicated by **its absence** from its type locality in 1933, and its scarcity where it was found during this year at another site in Ash Meadows (Hall 1935). It has not been seen since 1933. Large-scale disturbance began in the early 1960's when approximately 2,000 acres of upper Carson Slough **was** mined for peat. This removed **approximately six feet of substrate** and eliminated on of the largest marshes in southern **Nevada (Soltz and** Naiman 1978). Although early surveys had not defined the distribution of Ash Meadows endemic species in upper Carson Slough, comparisons of early and recent collection records show that habitats of the spring-loving centaury, Ash Meadows gumplant, Ash Meadows Amargosa pupfish, Ash Meadows speckled dace, and Ash Meadows vole were eliminated by this mining (Hall 1935, Miller 1948, Soltz and Naiman 1978, Knight and Clemmer 1987). Only the Ash Meadows Amargosa pupfish and spring-loving centaury have begun to reestablish in this area. Also during this period, an illegal tropical fish aquaculture facility raised the predaceous arawana (Osteoglossum bicirrhosum) in ponds at Forest Spring (Soltz and Naiman 19778). Other introduced species were also established by this time, including salt cedar (Tamarix), mosquitofish, sailfin mollies (Poecelia latipinna), wild horses, bullfrogs, and crayfish. Collectively these species further **reduced endemic** plant and animal populations by displacement **through competition for food and space, and/or predation (Miller 1948**, Beatley 1977 a, b; Reveal 1978 a, b, c; Soltz and Naiman

1978, Schoenherr 1981, Knight and Clemmer 1987). Intensive habitat alteration did not resume for several years. By the late 1960's Spring Meadows Ranch, Inc., combined purchases of private land with a trade for approximately 5,603 acres of public domain lands to operate a 11,860 acre cattle/alfalfa ranch. This ranching altered most springs with heavy machinery, cleared extensive areas of riparian and marsh vegetation, decreased spring discharge by pumping surface and ground waters, and diverted water into earthen and concrete-lined ditches, and impounded waters. The adverse effects of these activities focused on the Devil's Hole pupfish, whose population declined to less than 150 individuals (USFWS 1980, Deacon 1979), and the Warm Springs pupfish whose spring habitats were reduced in volume (Dudley and Larson 1976). These effects justified Federal listing of these species as endangered.

Populations of all other endemic plants and animals were also eliminated or reduced at this time, although there was a lower level of concern for their livelihood. Ash Meadows Amargosa pupfish and Ash Meadows speckled dace populations disappeared from Jackrabbit and Forest Springs when the springs were dried, pumped, or their morphology severely altered. The drying of springs and/or diversion of spring outflows also eliminated Ash Meadows speckled dace populations from Point of Rocks, Longstreet, Rogers, and Fairbanks Springs (Soltz and Naiman 1978, Ono et al. 1983). Endemic plant populations were also reduced or eliminated when lands were cleared for crops and pasture, roads were constructed, and when impoundments were constructed then filled (Sanchez 1981). Impoundments now inundate several hundred acres of habitats believed to support the spring-loving centaury, Ash Meadows ivesia, Ash Meadows gumplant, and Tecopa bird's beak. Many roads were built through areas now designated as critical habitat for **plant species.** Approximately 65 miles of gravel and unimproved roads now exist within the essential habitat, directly affecting Ash Meadows blazing star, Ash Meadows milk vetch, Ash Meadows

ivesia, Ash Meadows sunray, and Ash Meadows gumplant populations. All of the endemic species were additionally affected by secondary impacts of these roads, which largely resulted from increased vehicular access to sensitive areas. The easy access facilitated introduction of non-native species (particularly aquatic species), and the detrimental influence of trampling caused by water-oriented recreation. Introduced species are now widespread throughout the area, and trampling has reduced populations of endemic mollusks and plant populations adjacent to springs. This phase of disturbance continued until the late 1970's when Spring Meadows Ranch, Inc., ceased operating because of restrictions placed on ground water removal by the U.S. Supreme Court (Sanchez 1976). These restrictions are designed to protect the public values of Devil's Hole, a disjunct portion of Death Valley National Monument.

Spring Meadows Ranch, Inc., sold all of their Ash Meadows' holdings in 1979 to Preferred Equities Corporation to construct a municipality for an estimated 55,000 inhabitants (Cook and Williams 1982). Construction of Calvada Lakes began in 1981 with additional land clearing for roads, irrigation, and municipal parks. Springs and their outflows were additionally altered to facilitate irrigation and/or construct municipal parks. These activities eliminated portions of Ash Meadows sunray, Ash Meadows milk-vetch, Ash Meadows Amargosa pupfish, Ash Meadows naucorid, and mollusk populations.

Other factors also contributed to the diminution of habitats and populations. Large herds of wild horses altered spring morphology and impacted endemic plant and snail populations (Hershler and Sada 1987, Landye 1973, Mozingo and Williams 1980). Because of all past activities, small populations of species endemic to Ash Meadows presently occupy a small portion of their historic habitat.

F. Conservation Efforts

A number of public agencies and private organizations have been involved with conservation programs in Ash Meadows since the 1950's. Initial efforts were primarily administrative and focused on protecting the area's fishes, particularly the Devil's Hole pupfish. Devil's Hole was designated as a National Monument by President Truman in 1952 in recognition of the site's unique geology. Although the Devil's Hole pupfish was only mentioned in this designation as a unique feature of Devil's Hole, inclusion of the habitat within the National Park System has provided de facto protection of this unique biotic feature.

Operation of the Spring Meadows Ranch, Inc., which degraded a number of habitats and caused the decline of many species, initiated a number of administrative and management actions designed to prevent extinction of endemic fishes. Ranch activities decreased habitat and populations of the Devil's Hole and Warm Springs pupfishes to the extent that they were listed as endangered in 1967 and 1970, respectively. The Pupfish Task Force was created by the Secretary of the Interior in 1969 as an advisory committee of knowledgeable government officials and ichthyologists to recommend programs necessary to prevent extinction of fishes in Ash Meadows (USDOI 1970). Later that year, the Desert Fishes Council was formed to assist in this effort with a broader focus on conservation of the large number of fishes in North American deserts whose existence were similarly threatened (Soltz and Naiman 1978, U.S. Congress 1986). Species management programs during this period focused on increasing the distribution of the Devil's Hole and Ash Meadows Amargosa pupfishes and enhancing populations of Warm Springs pupfish. Many attempts to establish additional Devil's Hole pupfish populations were unsuccessful, however, a population did become established in a specially-designed concrete tank constructed by the U.S. Bureau of Reclamation at the base of

Hoover Dam on the Colorado River (Williams 1977). This refugium population failed in recent years, and the tank contains no fish at present. A second refugium population was established in the Amargosa Pupfish Station in Ash Meadows during 1981. A population of Ash Meadows Amargosa pupfish was also established in the fishless Collins Ranch Spring within Ash Meadows. The Bureau was actively involved in increasing and protecting Warm Springs pupfish habitat at School Springs by constructing ponds, eliminating introduced fishes, and protecting the site from cattle and wild horse grazing (Myers 1971).

The first action resulting in strong protection of habitat occurred in 1976 when the U.S. Supreme Court ruled in favor of protecting Devil's Hole from the effects of nearby ground water pumping. This protection permitted the Devil's Hole pupfish to survive in its native habitat and probably prevented its extinction (Sanchez 1976). Later that same year, The Nature Conservancy purchased approximately 378 acres surrounding Big Spring for the protection of endemic plants and fishes.

Recovery teams for the Devil's Hole pupfish and Warm Springs pupfish were established in 1976 and 1974, respectively. The recovery plan for the Warm Springs pupfish was approved in 1976 and the Devil's Hole Pupfish Recovery Plan approved in 1980. In 1981 these teams were combined with the Pahrump Killifish Recovery Team to create the Eastern Mohave Desert Fishes Recovery Team.

The U.S. Geological Survey and others have monitored the water levels of Devil's Hole and a number of wells, and the discharge of many springs in Ash Meadows since the early 1950's. An organized approach to this monitoring did not occur, however, until ground water pumping by Spring Meadows Ranch, Inc., apparently began altering water levels in wells and spring discharges (Dudley and Larson 1976). Information accumulated during this monitoring guided the preparation of recommendations limiting the amount of

pumping possible without eliminating fish populations in springs. This monitoring program continues today at a reduced level. The National Park Service funded the monitoring of the Devil's Hole pupfish population in Devil's Hole on a monthly basis from 1976 to 1983 and on a quarterly basis from 1983 through 1985 (Deacon 1979, Deacon and Baugh 1985).

Approval of the Ash Meadows Habitat Management Plan by the Bureau initiated a number of more recent conservation programs on public domain lands (USBLM 1980). These include many of the Warm Springs Pupfish Recovery Plan recovery tasks, as well as more general programs intended to maintain the pristine character of the land and springs. The Bureau has withdrawn from mineral entry 2,681 acres of land within Warm Springs pupfish essential habitat and surrounding Jack Rabbit and Big Springs. This area includes critical habitat for the Ash Meadows Amargosa pupfish, Ash Meadows speckled dace, and several plant species. Barbed wire fencing was installed to prevent wild horses' entrance to approximately 425 acres surrounding Big and Jackrabbit Springs, and emergent vegetation has been periodically removed from School Springs. Wild horses were captured during August 1985 to eliminate trampling of springs, stream banks, and rare plants. The Bureau has also funded the U.S. Geological Survey to monitor the discharge of springs within the Warm Springs pupfish essential habitat, and installed fish barriers to prevent exotic fishes easy access into Warm Springs pupfish habitats through upstream migration.

The States of Nevada and California and the Service have been actively involved in recognizing the declining status of species endemic to Ash Meadows. These agencies variously list a number of local species as either threatened or endangered. Table 1 summarizes the listing history of all species in Ash Meadows. Personnel representing the Nevada Department of Wildlife, Service, and University of Nevada Las Vegas have been involved in other

conservation programs such as the removal of exotic fishes from Warm Springs pupfish habitats and the monitoring of fish populations in Big and Jackrabbit Spring. Numerous botanists affiliated with various universities and native plant societies throughout the nation have surveyed the area's vegetation and documented rare plant distribution. Although much work has been conducted, much of it has been directed toward preventing further loss of populations and habitat and not toward habitat or population enhancement. The purchase of much of the area by The Nature Conservancy and subsequent purchase of these lands by the Service to establish the Ash Meadows Refuge has been the single largest step toward providing security for these species. The direction of conservation programs can now change from those of the past, intended to slow the loss of species, to those that will begin increasing habitats and populations to levels where the threatened and endangered species are no longer faced with endangerment or extinction in the foreseeable future.

II. RECOVERY

A. Objectives

The prime objective of this recovery plan is to restore the six endangered and six threatened species to non-listed status, and protect the 20 candidate species so listing is not necessary, by securing, restoring and protecting viable, self-sustaining populations for these 32 species in the Ash Meadows ecosystem.

All of the following eight conditions must be met within essential habitat for a period of 5 years before downlisting of Devil's Hole pupfish, Warm Springs pupfish, Ash Meadows Amargosa pupfish, Ash Meadows speckled dace, Ash Meadows naucorid, and Ash Meadows niterwort to a threatened status may be considered:

1. All non-native animals and plant species must be eradicated from essential habitat. These non-native species currently include sailfin mollies, mosquitofish, largemouth bass, black bullheads, bullfrogs, crayfish, turban snails, wild horses, salt cedar and Russian olive.

2. Secure and protect the Ash Meadows aquifer so that all spring flows return to historic discharge rates, and the water level in Devil's Hole is maintained at a minimum level of 1.4 feet below the copper washer. Spring discharge rates will be determined by Task number 211 .

3. Reestablish water to historic springbrook channels which are free of barriers that eliminate genetic exchange between populations by preventing movement of native fishes **throughout** their historic range.

4. The essential habitat must be secure from detrimental human disturbances including mining, off-road vehicles, and introduction of non-native species.

5. All listed fish species are present in all the springs that they have occupied historically as identified in Appendix A, Table XIII.

6. Amargosa niterwort is present in all localities that it has occupied historically as identified in Appendix A, Table XV.

7. Establish and protect refugia populations of Devil's Hole pupfish at Hoover Dam and Amargosa Pupfish Station.

8. Maintain a population of not less than 300 Devil's Hole pupfish individuals during the winter and 700 during late summer and early autumn.

Devil's Hole pupfish is not delistable. Delisting of the remaining 11 species (Warm Springs pupfish, Ash Meadows Amargosa pupfish, Ash Meadows speckled dace, Ash Meadows naucorid, Ash Meadows niterwort, Ash Meadows blazing star, Ash Meadows milk-vetch, Ash Meadows sunray, **spring-loving centaury, Ash Meadows gumplant, and Ash** Meadows ivesia) will be **considered when the following** criteria are met for a five year period:

1. Criteria shown above for downlisting from endangered to threatened.

2. Secure, protect, and maintain in natural vegetation, corridors and adjacent buffer areas for gene flow and dispersal of listed plant species within the essential habitat.

3. Native plant communities and aquatic communities have been reestablished to historic structure and composition within all essential habitat.

4. Each individual spring or stream population of Warm Springs pupfish, Ash Meadows Amargosa pupfish, and Ash Meadows speckled dace have sex ratios and juvenile-to-adult ratios that support self-sustaining populations as determined by Task 626.

5. The listed Ash Meadows naucorid, the two candidate aquatic insects, and 13 candidate snails are present in all the locales that they have historically occupied as identified in Appendix A, Table XIII.

6. All of the listed plant species and the four candidate **plant** species are present in all the sites that they have historically occupied as identified in Appendix A, Table XV and within each critical habitat unit, the listed plant has a frequency value equal to or greater than the frequency value determined by Task number 644 needed as an indicator of a self-sustaining plant population.

B. Narrative

1. Secure and protect land and water.

The recovery of listed species in Ash Meadows requires an integrated program designed to reestablish ecosystems **supporting all rare plants and animals. Implementing programs not designed in this manner will adversely affect listed species as well as decrease the status of candidate endemic organisms to the level where their formal listing under the Endangered Species Act will be warranted. The large concentration of endemic species, many of which are restricted to extremely local habitats, makes the recovery program for listed species in Ash Meadows unique and more complicated than is usual for the recovery of individual species. The single most important requirement for recovery of these species is** the protection of their habitats. This can be accomplished by preventing activities that reduce populations by disturbing land and/or springs and their outflows. The complexity of this ecosystem and the overlying distribution of these listed species requires implementation of an integrated management program within the entire essential habitat to accomplish the goals.

11. Acquire and protect land and water within Area of Managment Concern.

The ecosystems supporting these listed species are extremely local and subject to deleterious alteration. This extremely restricted distribution makes protection of their entire habitat necessary. Habitats for these species are associated with both wetlands and terrestrial environments that are intimately associated so that any deleterious activity affecting one type of habitat is also likely to affect the other. The close association of these environments is strongly confirmed by the substantial overlap in areas designated as critical habitat for terrestrial and aquatic species (See Appendix A).

These environments are also extremely fragile and intolerant of perturbation. Evidence of disturbance is likely to last for many years and altered environments are quickly occupied by non-native plants and/or animals. Disturbance also initiates influences that further degrade habitats, such as changes in drainage patterns, soil compaction, and water availability. These factors combine to require special management of the area within an Area of Management Concern that includes approximately 23,094 acres (Figure 3). This Area encompasses most of the distribution of the listed species, except the Amargosa niterwort which is only found outside these boundaries, and will be the focus of recovery activities. It includes lands managed by the Bureau of Land

Management (Bureau) (9,243 acres), the Fish and Wildlife Service (12,438 acres), National Park Service (40 acres), and private lands (1,371 acres). Sada (1984) identifies these lands. Previous planning identifies the requirement that Bureau lands within this area be cooperatively managed by the Service and Bureau in a manner consistent with the management occurring within the Ash Meadows National Wildlife Refuge. The Bureau has withdrawn, or has proposed to withdraw, from mineral entry, 210 acres within the Area of Management Concern.

111. **Secure and protect Devil's Hole.**

It is important that the National Park Service retain legal responsibility for the 40 acres under their jurisdiction which surrounds Devil's Hole. Various management responsibilities may be implemented to designate the Service as a management cooperator. This delegation may function to reduce costs and increase protection by permitting on-site attention by the Service.

112. Withdraw Bureau lands.

A substantial portion of lands **managed by the Bureau in Ash** Meadows include critical **habitats for a number of** species. These lands are generally **surrounded by** National Wildlife Refuge lands. Some of these **lands** must be withdrawn from mineral entry to protect listed species and their critical habitats. Some parcels within the 2,681 acres requiring withdrawal have already been withdrawn. All of the parcels requiring withdrawal are identified in the Land Protection Plan (LPP) prepared by the Service (Sada 1984).

113. Secure private lands.

Approximately 1,310 acres of private land remain within the Area of Management Concern (Sada 1984). These parcels should be purchased to avoid conflicts with modification of critical habitats and/or listed species and to facilitatg Refuge management. Priority for purchase should be given to those areas including the greatest concentrations of listed species and critical habitats.

114. Protect subsurface waters, and acquire and protect surface waters.

Certified rights to ground waters were purchased **by the Service** when Ash Meadows Refuge was established. Substantial evidence collected by U.S. Geological Survey

shows that spring discharge is intimately related to the viability of the Ash Meadows aquifer. The rights to these waters must be maintained, in accordance with State law, in quantities adequate to maintain historic spring discharge (including the water level of Devil's Hole at 1.42 feet above the copper washer reference point). Maintenance of these rights will require periodic utilization of these resources. This utilization must occur in a manner consistent with the conservation of listed and candidate species. All surface waters presently in private ownership support listed species and/or critical habitats. These must be purchased and incorporated into the Refuge. Rights to surface waters held by the Service and the Nevada Department of Wildlife must be maintained and protected from perturbation.

115. Acquire mineral rights.

There are no known mining claims within Ash Meadows Refuge, but active claims exist within other areas inside of the Area of Management Concern. These claims should be purchased in order to permit reconstruction of native habitats and prevent additional loss of listed species' populations.

116. Post refuge.

The refuge should be posted to notify the public that this area is included within the National Wildlife Refuge System and activities are therefore subject to special regulation.

12. Secure and protect lands, and surface and ground waters outside the Area of Management Concern but within Ash Meadows essential habitat.

Although the Area of Management Concern contains most of **the** critical habitat for these listed species, there is a substantial amount of critical habitat outside of its boundary. All critical habitat is, however, within the Ash Meadows essential habitat. Protection of these outlying areas will occur by implementing appropriate management actions within the essential habitat.

121. Secure and protect critical habitats.

Section 7 of the 1973 Endangered Species Act (Act), as amended, requires Federal agencies to conduct their programs that may affect listed species in a manner that does not adversely modify critical habitat. These areas do not necessarily encompass the entire distribution of

a species and are considered as a minimum area necessary for the continued existence of these plants and animals. Protection of them is, therefore, not all that is required for recovery, but represents a minimum area that must be protected to prevent extinction. These areas will require special management to maintain their integrity.

1211. Bureau-managed lands.

The Bureau manages about 2,240 **acres of critical habitat in** T17S R5OE **Sections** 14, 15, **and** 26, T17S R51E **Section** 20, T18S R5OE **Sections** 5, 7, 8, 9, **and** 20, T25N R6E **Sections** 5, 6, 7, 8, **and** T26N R6E Section 30, that **are occupied by populations of Ash** Meadows gumplant, Ash Meadows milk-vetch, Ash Meadows sunray, Amargosa niterwort, and springloving centaury that are oustide the area **of** management Concern (Appendix A, Table XV). Thus Bureau programs must be conducted in a manner that benefits these species. Withdrawal of these Bureau lands from deleterious activities would be the best method to insure that these areas would be given the necessary protection.

1212. Private lands.

Portions of critical habitat (about 320 acres) in T17S R5OE Section 23 and 26 and T18S R5OE Section 7 are located on privately owned lands (Appendix A, Table XV). This privately owned Critical Habitat supports populations of Ash Meadows blazing star, Ash Meadows gumplant, Ash Meadows milk-vetch, and spring-loving centaury. Management of these areas for these species is important. These areas must be protected by encouraging necessary management by the owners or protecting them through land exchange, easements, or fee purchase. Prior to these private lands being studied for possible purchase, the Service will seek public participation. See Task 5 for the significance of these privately-owned lands.

122. Secure and protect subsurface and surface waters.

Most of the certified rights to surface and ground waters in the Ash Meadows area were purchased by the **Service when Ash Meadows Refuge was established. The acquisition of these waters is important to maintaining habitats within the Area of Management Concern and the outlying essential habitat. This is particularly true for the Amargosa** niterwort **that occupies soils whose**

moisture is maintained by spring flows discharging from the area's major springs. Decreases in these discharges would decrease the amount of seepage reaching lower Carson Slough and therefore alter habitat occupied by the niterwort. Existing rights to spring and ground waters must be maintained according to State of Nevada laws. Acquisition of additional rights will only further afford protection to these outlying populations, as well as secure habitats within the Area of Management Concern.

2. Manage Area of Management Concern lands and water.

Recovery activities identified in this section do not include tasks for Devil's hole which is discussed under 3. Most of the historic habitat for the 12 species occur within the area of Management Concern and thus intensive management identified below is necessary to recover 11 of these species. The Amargosa niterwort occurs outside the area of management concern in Inyo County, California, and will be recovered by tasks identified under 4.

21. Return spring flows to historic channels

Past agriculture and mining has resulted in alteration of spring flows, and substantial changes in biotic communities. In order to rehabilitate these areas, their natural character must be determined. Thorough mapping and sampling of remaining unaltered habitats will also indicate the character of unaltered environments.

211. Determine historic spring flow channels and discharge rates.

The U.S. Geological Survey has recorded the discharge of some springs and the level of water in Devil's Hole, and the depth to ground water in some wells. Most of this monitoring began, however, following indications that ground water pumping was impacting spring and aquifer viability. These records serve as a basis for indicating historic spring discharge. Examination of records maintained by the Nevada State Engineer and the Bureau of Reclamation may provide information recorded prior to development of the Ash Meadows aquifer.

The location of natural spring outflows must be determined to reestablish aquatic biota within their native habitat. Examination of aerial photographs and field notes recorded prior to development will provide guidance in determining the location of historic outflow channels. Survey work to locate desiccated channels by

identifying remains of aquatic species will also assist in identifying former spring channels.

212. **Develop** waterflow **restoration plan.**

Development within Ash Meadows resulted in construction of many structures which altered the physical environment. Structures adversely affecting the return of spring flows to original channels may have to be removed or altered in a manner consistent with conservation of listed and candidate species and critical habitat in order to fully rehabilitate the ecosystem. These structures include some berms and dams impounding waters and redirecting spring outflows, and some fences, buildings, roads, ditches and concrete canals diverting spring flows. Some powerlines may also be removed. All artificial structures are not detrimental. Detrimental structures should be identified by research determining the magnitude and mechanisms of detrimental effects. Some of these structures, such as dams and impoundments, should be managed to facilitate recovery of marshlands and waterfowl habitat. If reservoirs are retained, barriers must be installed on all stream tributaries to the reservoirs so that natural migration of introduced aquatic species into critical habitats can be prevented.

Some construction is necessary for proper management and monitoring. Water measuring flumes may be required to monitor spring discharge and culverts may be necessary to channel spring outflows under roads and prevent erosion. Trails should be placed along appropriate routes to provide for public access for interpretation and recreation. Vehicle parking areas should be placed in areas where the possibility of adverse impacts to listed and candidate species and critical habitats is avoided. These structures should be designed to avoid adverse impacts to the species as much as possible.

Maintenance will be required to prevent deterioration of structures necessary for recovery and/or required to operate the refuge. Without maintenance, wash-outs may occur, damaging critical habitats.

213. Implement waterflow restoration plan.

Once the water flow plan has been reviewed and approved **it** should be implemented. Implementation must be tied **to the** non-native species removal plan so that **non-native species are not allowed to invade newly reestablished** aquatic habitat.

22. Enhance/restore terrestrial ecosystems.

The absence of many native plants and animals from areas within their historic distribution, and the presence of many non-native animals and plants in Ash Meadows indicates that considerable effort will be required to manage species. This management will be most active following studies indicating the historic location of plant and animal communities. It will involve removing non-native species as well as reintroducing native species. It is anticipated that active management will be initially required. Following reestablishment, management will become less important as these systems mature and approach their historic character.

221. Determine historic plant communities and their distribution.

The flora of Ash Meadows was well described in 1971 (Beatley 1971). Little work has expanded on this knowledge to quantitatively describe plant communities. Existing disturbed and unaltered communities must be surveyed to identify existing conditions and guide rehabilitation programs. Field notes recorded by botanists while working in the Ash Meadows area will assist identification of native plant community composition. Other studies such as analysis of soil moisture, soil nutrients, soil type, drainage patterns, native animal presence and use, etc., are also necessary to determine historic communities' distribution and composition. Most rehabilitation should not proceed until historic plant communities have been determined.

2211. Prepare current vegetation map.

A map delineating the distribution of existing vegetation within the essential habitat including disturbed areas should be prepared using current aerial photography. This map will be a base for showing the changes to terrestrial ecosystems over time.

2212. Prepare a historic plant communities map.

A map delineating the historic distribution of plant communities within the essential habitat should be prepared. The previous map will be the base map for projecting what the vegetation was like in the past. Aerial photographs taken prior to major habitat alterations and farming within Ash Meadows should be located and used in reconstructing what the vegetation was historically and should be in the future when water has been

restored to the system and non-native species removed

222. Remove introduced non-native plant species.

Two species, salt cedar and Russian olive, have become established in Ash Meadows, and are known to adversely affect habitats occupied by species such as those that are listed and/or candidates in Ash Meadows. Salt cedar replaces native vegetation and is strongly hydrophyllic causing decreases in spring discharge. The distribution of salt cedar is rapidly increasing in the Ash Meadows area.

2221. Determine appropiate control methods.

A control program may accomplish elimination of these species by physical removal and/or chemical treatment. The agency most experienced with controlling salt cedar and Russian olive should be contacted for advice. Research may be necessary to determine which is the best method to control these two species and not impact the listed and candidate species present in Ash Meadows.

2222. Schedule and complete intial eradication of introduced non-native plant species.

Removal of salt cedar and Russian olive will be a long-term program requiring persistence and detailed planning to avoid adversely affecting listed species during control efforts. Control must begin as soon as possible and the intial focus should be on critical habitat areas that are around the springs. A schedule of control activities should be prepared as part of a introduce exotic plant eradication control plan.

2223. Schedule periodic control to prevent reestablishment of salt cedar and/or Russian olive.

Monitoring will be required to determine when re-invasion of salt cedar and Russian olive occurs. When this happens periodic control efforts will be needed to prevent further incursions of these two species.

223. Prevent reestablishment of wild horse herds.

Wild horses are known to adversely affect habitats occupied by species such as those that are listed and/or

candidates in Ash Meadows. Trampling and grazing by wild horses modifies vegetation communities by disturbing soils and browsing on preferred food items. Wild horses were completely removed from the Ash Meadows area by the Bureau during 1985; a population must not be permitted to reestablish in the area. Monitoring will be required to determine if and when wild horses re-invade the Area of Management Concern. When this happens the wild horses should be rounded up and removed.

224. Enhance/reestablish native plant communities.

Much of Ash Meadows has been altered so that vast areas are presently devoid of historic vegetation. Some areas have been actively cultivated, some grazed as pasture, and some cleared for road construction. Historic vegetation must be reestablished in all areas not requiring maintenance of structures for management purposes. This reestablishment is anticipated to require many years and may only be initiated following determination of historic plant communities and their distribution (Task 221) and research required to guide such reconstruction. No reconstruction should begin until salt cedar has been controlled at the site.

225. Reestablish seven listed plant species throughout historic habitats.

Once the biotic and physical characteristics of habitats required for conservation of these species are determined, transplant of species into their historic distribution will be necessary. Care must be taken during this program to minimize or alleviate the impact of removal of individuals for transplant on the parent populations. Research should be conducted to determine if propagation programs are necessary to provide plant stocks for these burgeoning populations. Substantial time will probably be required to determine the success of reestablishing each population, and several attempts may be necessary before success is realized. Techniques such as root and limb cuttings and/or greenhouse production of seedlings may be required to raise hearty individuals that will persist in reconstructed habitats. Planting should occur on a location-by-location basis rather than throughout all of the historic range at a single time. The priority for attention to areas will be guided by information provided from delineation of historic distributions of plant communities and the quality of particular reestablishment sites.

23. Enhance/restore aquatic ecosystems.

The absence of native aquatic animals from **areas within their historic distribution, and the presence of many non-native animals and plants in Ash Meadows indicates that considerable effort will be required to recover listed species. This management will be most active following studies indicating the historic location of aquatic animal communities. It will involve removing non-native species as well as reintroducing native** species. It is anticipated that active management will be initially required. Following reestablishment, management will become less important as these systems mature and approach their historic character.

231. Determine historic aquatic animal communities and their distribution.

Numerous workers have collected and/or recorded animals occurring in Ash Meadows. From this information a list of species found in Ash Meadows can be constructed. Little work has, however, occurred which describes the local distribution of these animals. Field notes recorded in the past and surveys of existing communities can provide insight into former distribution.

232. Remove non-native competitive/predatory aquatic species.

A number of non-native species known to adversely affect native fishes and mollusks in the southwestern United States have become resident in Ash Meadows. These include crayfish, bullfrogs, turban snails, as well as several species of fish (largemouth bass, black bass, sailfin mollies, and mosquitofish). Data on the recent distribution of these aquatic non-native species within 59 springs and other water bodies of Ash Meadows is found in Appendix A, Table XIII. The removal of these species is necessary to reestablish native species within their historic sites at historic population levels.

2321. Determine appropiate menhods for removal of non-native aquatic species.

Removal may be accomplished by physical means (e.g., nets, traps) or by chemical treatment. All removal programs must proceed with consideration toward conservation of listed and candidate species and critical habitats. Research may be necessary to determine which is the best method to control non-native aquatic species and not impact the

listed and candidate species present in Ash Meadows.

2322. Schedule and complete eradication of non-native aquatic species.

Removal of non-native aquatic species from essential habitat **will** be a long-term **program requiring persistence and detailed planning to avoid adversely affecting listed species during control efforts. Control must begin as soon as possible. If Crystal Reservoir is retained, barriers must be placed in the inflow channels to prevent the upstream migration of largemouth bass and other introduced species into Crystal Pool.** A schedule of control activities should be prepared as part of a non-native aquatic species control plan.

2323. Schedule periodic control to prevent reestablishment of non-native aquatic species.

Fishing for game species has occurred in several reservoirs in Ash Meadows for a number of years. Intentional and inadvertent introduction of these game fish into local aquatic habitats is known to have eliminated or caused substantial declines in native fish populations. There continues to be a possibility of future introduction into springs and reservoirs. Thus, all habitats must be periodically monitored to determine if reintroductions have occured. When this happens periodic control efforts will be needed to remove these reintroductions before population expansions of the non-native aquatic species impact native listed fishes. Management may include periodic drying of impoundments to eliminate populations of introduced species that have become reestablished.

233. Reestablish native aquatic communities.

Perturbation of aquatic communities frequently occurred concommitantly with alteration of plant communities. Aquatic environments have been dried by diversion, channelized, and impounded to the extent that many existing habitats bear little resemblance to those known prior to disturbance. Following determination of the character of each aquatic habitat (Task 211), spring flows must be directed into naturalized channels. Much reestablishment of the aquatic community will occur without particular management; however, there will be

instances where biota must be introduced into habitats from which they were extirpated. Extreme care is necessary to insure that only biota native to a particular habitat are reintroduced so that each habitat is only occupied by the compliment community supported prior to perturbation. Appendix A, Table XIII indicates which listed and candidate aquatic species have been extripated **from a particular spring and need to be reintroduced.**

234. Reestablish four listed fish throughout historic range.

Once the biotic and physical characteristics of habitats required for conservation of these species are determined, transplant of species into their historic distribution will be necessary. Care must be taken during this program to minimize or alleviate the impact **of** removal of individuals for transplant on the parent populations. Research should be conducted to determine if propagation programs are necessary to provide fish for reestablished populations. Substantial time will probably be required to determine the success of reestablishing each population, and several attempts may be necessary before success is realized. The mobility of aquatic species within their environments suggests that their reestablishment may occur quite easily. This mobility may permit these species to move into available habitat without the assistance of management. Stocking will be necessary, however, into those sites where natural migration cannot occur. Parental stocks for presently fishless habitats must be from a nearby site which is most likely to support a population that was historically sympatric with the fishless habitat being considered. Care must be taken to avoid mixing historically allopatric populations. Ash Meadows speckled dace has been extricated from all of the northern low elevation springs and only occurs today in six out of the 17 springs it has occupied historically (Appendix A, Table XIII).

24. Minimize human disturbance.

Some secondary effects of public use may adversely affect listed species, and will require special management actions. Examples of actions that may cause secondary impacts include soil compaction or disturbance by foot traffic **and/or off-road-vehicle use adjacent to springs and access roads, and the introduction of non-native species into Ash Meadow waters.** Special management will be required to discourage the possibility of such impacts. Monitoring will be necessary to quantify impacts and provide direction for

designing programs to minimize human disturbances to listed and candidate species and critical habitats. For example, monitoring may show human activities in a particular area is detrimental to listed species and/or critical habitats. Therefore, the program allowing the public use of this area must be modified, abandoned, or relocated to other sites on the refuge. Examples of management actions needed in the public use programs for the Refuge should include restricting vehicle travel to designated roads, restricting camping to particular sites outside of designated critical habitats, and requiring hunters to remove their own trash. To limit the amount of lead entering aquatic systems, hunting should be limited to steel shot. One of the focuses of public activity in Ash Meadows should be public education in concert with rare species protection. The unique assemblage of endemic plants and animals in Ash Meadows, and the history of their presence, provides an excellent opportunity to inform the public of relationships between biological and geological processes. Ash Meadows also represents one of the last remaining oases in the Mojave Desert that is frequented by a wide diversity of migratory birds.

25. Monitor enhanced/reestablished populations.

Continuous management of enhanced/reestablished populations **will** probably be necessary into the foreseeable future until communities are reestablished in natural condition. Until **this** occurs, monitoring of populations and habitats will be necessary to measure progress and indicate if additional management activities are necessary. Monitoring is also necessary to determine the condition of physical features in the area.

251. Physical condition of springs.

Monitoring of discharge must continue to satisfy the requirements of protecting Service and Nevada Department of Wildlife water rights.

252. Plant communities.

Study of newly established and existing plant communities is necessary to determine successional changes and stability. Monitoring is also required to determine how management may be improved to encourage reestablishment programs.

253. Warm Springs pupfish, Ash Meadows Amargosa pupfish, and Ash Meadows speckled dace.

Populations of the three listed fish species that occur in the area of management concern must also be monitored

to show their response to recovery activities. Monitoring may be conducted either quantitatively or qualitatively, depending on the habitat and situation. Ideally, monitoring should be initiated prior to any recovery actions then continued for sometime after actions have been implemented. This will provide a comparison of population status before and following recovery actions.

2531. Monitor representative populations every two years.

The number of populations within Ash Meadows make it difficult to monitor each of them on a scheduled basis. A schedule should be prepared which prioritizes populations in the sampling program. The priority list would include factors such as vulnerability of the populations, recovery actions conducted for populations, and the past history of sampling efforts.

2532. Determine factors controlling population size.

This monitoring will identify populations that are not responding to recovery activities in an anticipated manner. Further information will then be required to determine how the recovery program must be modified to remedy the problem.

254. Ash Meadows naucorid.

The restricted distribution of the naucorid indicates that regular monitoring is required to indicate its response to recovery efforts. Monthly monitoring will probably be necessary to determine the population size and distribution prior to implementation of recovery efforts and for a period of time afterward.

2541. Monitor population semi-annually.

Once information has been accumulated to indicate general trends of the population following implementation of the recovery program, a semi-annual monitoring program will probably be adequate.

2542. Determine factors controlling population size.

Consideration of life history and habitat preference information in conjunction with the

population's response to recovery programs should indicate the factors controlling the population. Practical management actions should then be taken to minimize these factors and permit the species to occupy all of the available habitat in densities necessary for its continued livelihood.

255. Monitor colonies of seven listed plant species.

Transect surveys, establishment of photography points, and analysis of population age class structure are methods that may be used to monitor the response of listed plant species to recovery programs.

2551. Monitor as appropriate for each species and its life history.

Differences in habitats and life history strategies of each species will require monitoring programs to be tailored to each taxon. Consideration should be given to flowering periods and vegetation communities occupied by each species.

2552. Determine factors controlling population size.

This monitoring will also show the success of recovery efforts and provide a method to determine factors limiting population size. Identification of controlling factors will provide information which management may incorporate into the recovery program to resolve the problem.

3. Manage Devil's Hole.

The management of Devil's Hole is unique due to its inclusion **within the National** Park system, the protection granted it by the U.S. Supreme Court (Cappert vs. U.S.), and its sensitivity to **outside** disturbance. The approved Devil's Hole Pupfish Recovery Plan identifies a number of tasks for recovery that are included within this recovery plan and identified by the following tasks. Although many threats to this pupfish have been minimized, the small size of the habitat and its population require that particular management be conducted. These factors also indicate that threats to the species will never be totally eliminated, only minimized, and therefore it may never be removed from the list of threatened and endangered plants and animals.

31. Monitor habitat conditions.

This task corresponds to Task 211 in the Devil's Hole pupfish recovery plan. A monitoring program is necessary to detect changes in physical and chemical parameters, then recommend methods to rectify the problem.

311. Monitor water levels, chemistry, and physical properties.

Monitoring of the water level has been conducted by the U.S. Geological Survey since 1962. This monitoring should be continued because it is the single best method available to indicate the condition of the habitat. Chemical characteristics of Devil's Hole are not known to change very much. Therefore, continuous monitoring is unnecessary, but a periodic analysis is appropriate to detect any long-term changes.

312. Monitor algae and invertebrates.

This program should focus on the food resources of the pupfish and should be conducted in concert with the water quality monitoring. Knowledge gained from this monitoring will enable management to take appropriate action to eliminate factors adversely affecting food resources.

313. Recommend maintenance measures as suzgested by monitoring program.

Continuous monitoring will indicate how the habitat responds to various conditions. This will make it possible to make recommendations insuring integrity of the habitat and protect the population from deleterious circumstances.

32. Restore and maintain natural conditions.

The small size of habitat within Devil's Hole and the small size of the pupfish population indicates that the species must be enhanced to the optimum natural state. Data collected since the late 1960's shows that the population expands in proportion to the amount of available habitat.

321. Establish interim minimum water level of 2.7, pending return to natural level of 1,4.

A level of 2.7 feet is the minimum required by court order. This, however, maintains the population at a lower level than when a natural level occurs.

Reclassification of the species may be considered when the natural level is reached and maintained. This should permit a minimum population of 700-900 individuals during the spring and summer.

322. Seek injunctions or cease and desist orders during emergency threats.

Past removal of ground waters created emergency situations which threatened the livelihood of this pupfish by lowering the level of Devil's Hole and drying the fish's breeding and feeding habitat. The severity of this threat was minimized by court actions limiting the impact to Devil's Hole by reducing the amount of ground water withdrawn. It is believed that the species would have become extinct had an injunction not been sought and granted.

323. Perform maintenance as required.

It will be necessary to maintain the condition of the **area** and monitoring equipment. A variety of mechanical equipment was installed in Devil's Hole during the early 1970's to monitor the habitat and enhance the population. As the water level rises as a result of decreased pumping, it will be unnecessary to maintain many of these items. When appropriate, they should be removed to return the area to its natural character.

324. Minimize human disturbance.

Some secondary effects of public use may adversely affect Devil's Hole pupfish, and will require special management actions. Examples of actions that may cause secondary impacts include soil compaction or disturbance by foot traffic adjacent to the spring, and the introduction of non-native species into Devil's Hole waters. Special management will be required to discourage the possibility of such impacts. Monitoring will be necessary to quantify impacts and provide direction for designing programs to minimize human disturbances. Today a protective fence surrounds Devil's Hole to reduce the impacts of vandalism. One of the focuses of public activity at Devil's Hole should be public education in concert with rare species protection.

325. Post informational signs at Devil's Hole.

Devil's Hole is a frequently visted location that would benefit by having a display showing the fish and discussing its environment.

33. Maintain populations of Devils Hole pupfish at Hoover Dam and **Amargosa Pupfish Station refugia.**

The local restriction of Devils Hole pupfish in its single historic locality makes the population extremely vulnerable to extirpation by unexpected events. Although a number of the Tasks in this recovery plan are oriented toward protecting all habitats and populations of listed species in Ash Meadows, the sensitivity of Devil's Hole requires that additional steps be taken to insure the integrity of its fish population. This can best be accomplished by maintaining populations in refugia that have already been constructed. These populations serve as genetic resources that may be utilized to replace the parent population in Devil's Hole should it be extirpated.

331. Preserve 10 fish annually and replace with fish from Devil's Hole to maintain genetic diversity.

The small size of refugium populations permits inbreeding that may alter population genetics so that their genetic composition may eventually differ from the parent population. This is not a desirable situation since these populations are being maintained as security for the parent population should it be extirpated. Excessive inbreeding may be prevented by annually supplementing refugium populations with 10 individuals from the parent population. This continual input of new genetic material will maintain the similarity of parent and refugium populations.

332. Analyze genetic status of refugium populations .

Past analysis of morphometry, body **colors**, and behavior in refugium populations indicate there are differences between refugium and parent populations. It is unknown whether these differences are a result of responses to the different environments of Devil's Hole and the refugia, or whether there have been genetic changes in refugium populations such that they no longer resemble the parent population. It is important to know this should it be necessary to introduce refugium fish into Devil's Hole. Also, it is of great scientific interest since it may indicate the rapidity of genetic change within closed, isolated populations. Genetic analysis by either electrophoresis or mitochondrial DNA would be appropriate.

333. Study possibility of habitat manipulation to determine cause and effect relationship.

The relationship between habitat characteristics and the size and morphology of refugium populations needs to be determined. This information is important so that changes may be made in refugium management that will permit these populations to reach the structure and morphologic characteristics of the parent population. Factors that may be influencing refugium populations include water temperature, amount of incident radiation, and food resources.

334. Install automatic temperature and flow regulating mechanisms.

Installation of these devices will permit managers to maintain the desired environment within refugia. They will be of greatest importance because water temperature is a primary factor since it may influence such factors as reproductive success and morphology.

335. Monitor and manage water chemistry, physical factors, and food production.

Food items, water chemistry and physical factors, such as substrate, algae cover and composition, and amount of incident radiation are important factors to monitor. Knowing these factors will enable management to respond **to** possibilities discussed above for Task 364, and provide insight into the adequacy of the environment for this pupfish.

34. Monitor populations of Devils Hole pupfish.

The response of this species to management will be determined by continuing the monitoring program that has continued, in part, since the early 1960's. Much of this monitoring will be accomplished by conducting Task 31; however, additional programs are necessary to compliment these by examining the fish population on a regular basis as has been done to the present time.

341. Monitor Devil's Hole population size.

The population monitoring program during recovery activities may be identical to population monitoring required for Task 361. The past program of making population estimates either monthly or quarterly will probably be adequate to indicate the effectiveness of recovery programs.

342. Determine factors controlling **population size.**

The smallness of the population and its restriction to Devil's Hole makes this species vulnerable to immediate declines by single events. Studies of population demography and habitat requirements should yield information that indicates which natural factors control the population size. With this information, management programs may be designed to prevent these controlling factors from acting strongly to reduce the population size to levels below those required for recovery.

3421. Analyze data from literature and population census.

Continual reconsideration of the monitoring program should occur by keeping informed about the population ecology of species similar to Devil's Hole pupfish. Population trends can only be determined by continuously reviewing data collected in the past.

3422. Conduct new studies as necessary to determine limiting factors.

The analysis of previously **collected data and/or** literature reviews may indicate that **limiting** factors can be determined only **by conducting** additional studies. These **studies may be proposed by either researchers or managers.**

343. Monitor refugium populations.

Monitoring is required to determine the viability of **refugium** populations. This information will also be important in determining methods to maintain genetic diversity within these populations and their genetic similarity with the parent population in Devil's Hole. This information is an extremely important aspect of maintaining the condition of these populations for the possibility of reestablishing the species in Devil's Hole following possible extirpation. This Task is similar to Task 33.

3431. Monitor populations regularly.

Monitoring of these populations on a regular basis is important to determine their status **and response to** management activities.

3432. **Determine factors controlling population size.**

Little is known about factors controlling refugium populations. Information is needed to increase the populations from the present size of less than 100 individuals each. Increasing the size may be important in maintaining genetic diversity and population viability.

3433. Modify refugia habitats as necessary.

Once the population-controlling factors are recognized, modifications may be necessary to allow for population expansion.

4. **Manage** lands that are under the jurisdiction of the Bureau **that are** within Ash Meadows essential habitat but outside the Area of Management Concern.

Approximately 2,240 acres of Bureau lands designated as critical **habitat occur outside the boundary of the Area of Management Concern but within** the essential habitat boundary. This area supports populations of the Ash Meadows gumplant, spring-loving centaury, Amargosa niterwort, Ash Meadows milk-vetch, and Ash Meadows sunray (Appendix A, Table XV). At least another 440 acres not designated as Critical Habitat supports additional populations of the above listed plants (Appendix A, Table XV). Requirements of the Endangered Species Act mandate all Federal agencies to conduct programs that conserve listed species. The Bureau is, therefore, required to participate in recovery activities involving critical habitats outside of the Area of Management Concern and under their jurisdiction.

Of the 35 locales supporting populations of Amargosa niterwort at some time in the past, only one is within the Area of Management concern and the rest are outside in two population centers on lands administered by the Bureau (Appendix A, Table XV). Furthermore, all of the Critical Habitat (1,040 acres) for Amargosa niterwort occurs at one location on Bureau lands in Inyo County, California, and is outside of the Area of Management Concern. Another 320 acres of habitat that is currently occupied by the Amargosa niterwort is located in Nye County, Nevada.

Ash Meadows gumplant has occurred historically on at least 48 locales within the essential habitat at Ash Meadows (Appendix A, **Table XV). Sixteen locales are on lands outside the Area of Management** Concern that are managed by the Bureau of which 15 locales have been designated as Critical Habitat.

41. **Schedule and complete intial eradication of introduced non-native plant species.**

Removal of salt cedar will be a long-term program requiring persistence and detailed planning to avoid adversely affecting listed species during control efforts. Control must begin as **soon as possible and the** intial focus should be on critical habitat areas that are around water courses. **A schedule of control activities should be prepared as part of an introduced exotic plant eradication control plan.**

42. **Schedule periodic control to prevent re-establishment of salt cedar.**

Monitoring will be required to determine when **reinvasion of salt** cedar occurs When this happens periodic control efforts will be needed to prevent further incursions of **this species.**

43. Prevent reestablishment of wild horse herds.

Wild horses are known to adversely affect habitats **occupied by species such** as those that are listed **and/or candidates in Ash Meadows. Trampling** and grazing by wild horses modifies **vegetation communities by disturbing soils and browsing on preferred food items. Wild horses were completely removed from** the Ash Meadows area by the Bureau **during 1985; a population** must not be permitted to reestablish **in the area. Monitoring will be required to determine if and when wild horses re-invade the essential habitat that is outside the Area of Management Concern. When this happens the wild horses should be rounded up and removed.**

44. **Minimize** human disturbance.

Some secondary effects of public use **adversely affect** Amargosa niterwort and Ash Meadows gumplant and **will require special** management actions. Soil compaction or disturbance resulting from off-road-vehicle use within and adjacent to wetland habitats supporting populations of Ash Meadows gumplant and Amargosa niterwort must be eliminated.

45. Monitor colonies of five listed plant **species.**

Transect surveys, establishment of photography points, **and analysis** of population age class structure are methods that **may** be used to monitor the response of listed plant species to recovery programs.

451. Monitor as appropriate for each species and its life history.

Differences in habitats and life history strategies of each species will require monitoring programs to be tailored to each taxon. Consideration should be given to flowering periods and vegetation communities occupied by each species.

452. Determine factors controlling population size.

This monitoring will also show the success of recovery efforts and provide a method to determine factors limiting population size. Identification of controlling factors will provide information which management may incorporate into the recovery program to resolve the problem.

5. Manage Private lands that are within the essential habitat but outside of the Area of Management Concern.

About 320 acres of private land that lie within the essential habitat but outside of the Area of Management Concern have populations of listed plants. Critical Habitat has been designated for 280 acres of the above private lands. Although private actions are not subject to the same restrictions as Federal agencies, it is important that these areas receive as much protection as possible in order to maintain minimum populations and provide for recovery. Critical habitat designations have no influence on private activity, unless there is Federal involvement in terms of funding or permit. However, attempts should be made to encourage private citizens to conduct their activities in a manner that will not adversely affect critical habitat. This may be accomplished by working cooperatively with private land owners to design their activities in a manner to conserve the habitat these species depend upon. Furthermore the 240 acres of private lands in Township 17S Range 50 E Sections 23 and 26 are extremely important as a gene flow corridor between upland plant populations in northern and southern Ash Meadows (Appendix A, Table XV). These two population centers of upland plants are seperated naturally by a limestone ridge of unsuitable habitat that is about a mile wide in the southern half of Section 26 and extends into Section 27 and then northwest into the SW 1/4 of the SW 1/4 of Section 22. Population and habitat needs to be secured and maintained in the NW 1/4 of Section 26 including Shaft Springs, and suitable habitat in the western half of Section 23.

51. Identify land ownership.

Land ownership within the essential habitat is known.

52. Pursue appropriate protective **management measures.**

The importance of these areas to the livelihood of **these species requires that attempts be made to insure their existence. This may be accomplished by notifying land owners of concerns and working with them to design their activities in a manner that will protect the listed species. Even though informal arrangements may be possible, methods such as purchase of fee title or conservation easements, and land exchanges should also be pursued. Protective management would include minimizing land disturbance, and permitting access to manage introduced** species and monitor populations.

6. Investigate biological factors affecting recovery.

Management of listed species must be consistent with management of natural ecosystems within Ash Meadows. Guidelines for management **of each taxon** will be provided by information collected during **research** designed to determine historic distributions, habitat requirements, community ecology, and life history. Continuing management will be required until communities (ecosystems) stabilize with a pristine character. Monitoring will be necessary to determine the level of management required for each species at each of its locations.

61. Determine historically and presently occupied habitats.

Agriculture and mining activities disturbed substantial areas within Ash Meadows prior to initiation and completion of early surveys identifying the distribution of listed species. Searches through field notes recorded by scientists visiting the area prior to disturbance and **analysis of materials such as aerial photographs should indicate former distributions.** Quantification of habitat requirements will also provide **insight** into possibly occupied habitats. The present distribution of most taxa is reasonably well known. However, **recent** location of previously unknown local populations indicates that surveys have not been as thorough as is necessary to guide management activities. Thorough surveys have been conducted outside the confines of Ash Meadows to show that all listed species, with exception of the spring-loving centaury, are local endemic species. Quantitative surveys are necessary to precisely identify locations of all taxa so that refuge activities may proceed without adverse effects. Quantification of habitats occupied by listed species includes examining both physical and biotic components of these environments. Surveys must, therefore, consider the entire community as well as factors such **as water** temperature, current velocities, and substrate and/or **soil** types, etc. These surveys are also extremely important

since they will provide information about the distribution of all endemic species. Management programs will be designed to protect and enhance habitats. Surveys may also locate endemic species currently believed extinct.

62. Determine ecology of four fishes.

Recovery programs conducted in other portions of the Intermountain Region show that rare taxa can only be successfully secured when adequate information is available to identify the physical and biotic components of ecosystems in which they occur. Most aquatic habitats in Ash Meadows have been disturbed during agricultural activities, and continue to be disturbed by exotic species. Recovery of the listed fishes will require reconstruction of historic habitat based on information about their habitat requirements and life history. Once these parameters are identified, habitat reconstruction may proceed so that ecosystems are reconstructed in the manner required for the livelihood of all populations.

621. Spawning habitats.

Parameters such as substrate composition, instream and bank cover, current velocities, water depths, and water temperatures are required for successful spawning to maintain populations. These data may be compiled during observations of spawning activity and microhabitat quantification.

622. Rearing habitats.

Particular habitats are required for juvenile fish. These may be backwaters, densely vegetated borders of streams, or spring pools that provide food and cover. Observations and quantification of microhabitats are necessary to identify rearing habitats.

623. Adult habitats.

Adults of a species frequently occupy habitats that are different from those occupied by juveniles. These habitats vary in depth, current velocity, cover, etc., with the species being considered, and they are frequently functions of food availability and protection from predation. Members of the Cyprinodontidae and Cyprinidae families of fishes generally occupy different habitats within a wide range of availability. Examination of habitats occupied by the listed species is necessary to determine how habitat construction must proceed and how habitats must be maintained (i.e., spring discharge, riparian

vegetation, etc.) to provide for the livelihood of these cohabitating species.

624. Age and growth.

Life history parameters such as these are required to determine the viability of populations. Populations can be considered healthy when growth and age-class structures are within bounds of known viable populations.

625. Food and feeding.

Habitats must contain environments that provide proper food items and areas conducive to feeding activities. The fishes in Ash Meadows are known to have different feeding habits; speckled dace generally prefer insect fauna in flowing water whereas pupfishes prefer diatoms and small invertebrates on algae and other soft substrates in quiet waters. Habitats must contain areas producing both of these general types of food and feeding sites.

626. Reproduction and fecundity.

Particular habitats that fulfill requirements for cover, substrate composition, current velocity, water depth, **etc.,** are necessary for successful spawning. These requirements vary with the fish species being considered, and each species usually has its own set of unique requirements. Similarly, each species follows a particular spawning strategy that depends on factors such as fecundity and age at maturity. These parameters must be quantified to properly reconstruct environments with necessary habitats in correct quantities. As two measures of a self-sustaining population, the sex ratios and juvenile-to-adult ratios values representative of a self-sustaining population need to be determined.

627. Associations with exotic species.

Crayfish, bullfrogs, and introduced fishes are exotic species occurring in local springs that are known to adversely affect populations of endemic aquatic species. Efforts to remove these species will be facilitated when interactions between endemic and exotic species are quantified. These data will indicate habitat requirements of exotic species and, therefore, suggest management that may detrimentally affect their populations by restricting the extent of **their suitable habitat. Manipulations of this type may permit native species to flourish and ultimately displace exotic**

species. Knowledge of exotic species' habitat requirements will permit reconstruction of habitat for the native species to be designed and constructed so that no exotic species habitat remains. This could be an extremely effective means of controlling and eliminating exotic species within Ash Meadows.

628. Interspecific interactions.

Caution must be taken to avoid developing habitat that favors one listed species over other cohabitating listed species. Careful examination of habitat preferences will help alleviate such favoritism; however, behavioral observations are necessary to further determine the influence of interspecific interactions on community structure. If care is not taken, such things as the placement of spawning habitat of one species within feeding habitat of a second species may seriously increase juvenile and/or egg mortality of the spawning species. The high mortality possible from this may limit reproduction and, therefore, limit population size.

63. Determine ecology of Ash Meadows naucorid.

No research has been conducted with this species since it was scientifically described in 1953. **Observations made at that date were extremely general and largely intuitive. Complete information** is needed in order to reconstruct its native habitats.

631. Habitat requirements.

This information will describe microhabitats it occupies. These data will include descriptions of substrate composition, water temperature and depth, cover, current velocities, etc., for adult **and juvenile** feeding, reproduction, rearing, and predator avoidance.

632. Life history.

Life history parameters include 'ongevity, fecundity, age to maturity, food items, and spawning behavior and timing.

633. Interspecific reaction to exotic and native predatory and competitive species.

The naucorid occupies habitats also supporting native **and introduced mollusks**, and is believed to have occupied habitats also supporting endemic fishes.

Determination of these species' interactions will guide reconstruction of riffle beetle habitats. Care must be taken not to develop habitat for any one native species at the expense of another. Total habitat development for native fishes, for example, may result in elimination of the naucorid.

64. Determine ecology of seven listed plants.

Little work has been conducted which quantifies the life history strategies, community associations, or habitat requirements of plant species endemic to Ash Meadows. Reestablishment of these species will be successful only when these characteristics are known and disturbed environments may, therefore, be appropriately managed. This information is closely aligned with that gathered under Tasks 221 and 61, however, the restriction of these listed plants to Ash Meadows implies they require peculiar habitats. Much of the basic information identifying these habitats may be gathered when Tasks 221 and 61 are conducted; however, additional species-specific information is necessary to properly manipulate habitats so the species may be reestablished.

641. Habitat requirements.

Knowledge of habitat requirements for these plant species is presently limited to that accumulated during floristic and community observation. Basic information must be collected identifying soils, nutrients, community associations, moisture, etc., in order to reestablish species within disturbed habitats.

642. Life history.

Determination of factors such as pollination, reproduction, seed production, age to maturity, and longevity are also needed in order to determine how reestablishment programs must be conducted. This information will also be important in monitoring populations and determining the viability of reestablised populations.

643. Community associations and interacticns.

Recovery of these species will only occur by conserving them within the ecosystems **of which they are a part. Reestablishment** must, **therefore, include successful establishment of cohabitating members of the community.** Accomplishing Task 221 will lay the ground work to **identify the communities associated with these species; further study is necessary to determine their community**

interactions and its influence on establishment of the listed plant taxa.

644. Determine frequency values for seven listed plants.

Data on the frequency of the listed plants from examples of vegetation that is unaltered needs to be gathered for quantifying the recovery objectives. Before gathering the frequency data, the sampling method needs to be determined including the size/shape of the sampling unit and the number of units need to accurately estimate frequency values for each listed species.

65. Determine population and habitat reconstruction goals for reclassification/delisting as appropriate.

Substantial information is needed to determine the number of populations and/or colonies and extent of occupied habitat necessary to provide security adequate for reclassification/delisting. This information will be provided by information accumulated during research. Some of this may be accumulated during fulfillment of Tasks 211, 221, and 231; however, additional information about genetics, population demography, and life history will be necessary to definitively describe the requirements for each species.

651. Determine the amount and location of areas needed to support self-sustaining populations for reclassification/delisting.

Surveys and research are required to identify the distribution and amount of habitat required to maintain populations. Much of this information will be provided by fulfillment of Tasks 62, 63, and 64. Once this information is available, it will be possible to identify the extent of areas where populations must be reestablished.

6511. Aquatic species.

Some information is available describing the distribution of listed aquatic species (Appendix A, Table XIII). These data show, however, that these species now occupy a small portion of historical habitat. Investigations are necessary to the determine the extent of habitat reconstruction and population reestablishment necessary to insure their perpetual livelihood.

6512. Terrestrial species.

Less is known about the amount of habitat required for the listed plant species than is known about the listed fishes. This is a function of the limited knowledge of these species' life history and habitat requirements. Surveys are necessary to determine the location, extent, and size of existing populations. Comparisons of present and historic distribution will guide consideration of the amount of habitat needed for recovery. Also, information describing the life history of these species will assist in making the determination about reclassification/delisting.

652. Determine population demography criteria so delisting criteria objectives can be set.

Viable populations can only be maintained when adequate numbers of individuals occur within an area to maintain sufficient genetic and age-class structure diversity. A minimum population is also necessary to insure a wide distribution that is buffered against catastrophic events which may eliminate local habitats. The local distribution of all endemic species in Ash Meadows indicates that populations adequate to insure the species survival must necessarily occupy most of their historic, local habitat.

6521. Aquatic species.

Our lack of understanding of shifts in the morphology of Devil's Hole pupfish refugium populations indicates how little is known about minimum populations and the effect of habitat on local fishes. It is reasonable to assume that all aquatic species must be reestablished throughout their native range in order to maintain the genetic diversity required for viable populations, geneflow between populations, and protection against elimination by catastrophic events. The size of required populations and the amount of habitat necessary within this historic range is, however, unknown. Information gathered in Task 626 will help determine this for fish species.

6522. Terrestrial species.

All terrestrial species must be reestablished throughout their native range in order to maintain the genetic diversity required for viable

populations, geneflow between populations, and protection against elimination by catastrophic events. The size of required populations, distribution of the individual plants within a site (frequency) and the amount of habitat necessary within this historic range is, however, unknown. The information gathered in task 644 will help determine recovery objectives for plant species.

66. Incorporate findings into management and recovery plans.

Once criteria for recovery are known, the information will be incorporated into this recovery plan to identify the requirements for securing the species so they may be reclassified/delisted. These data must also be used to guide more general refuge activities to be discussed in a management plan for public use of the refuge.

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IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for this recovery program. It is a guide to meet the objectives of the Recovery Plan for the Endangered and Threatened Species of Ash Meadows, as elaborated upon in Part II, Action Narrative Section. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform these tasks, a time-table for accomplishing these tasks, and the estimated costs to perform them. Implementing Part III is the action of the recovery plan, that when accomplished, will satisfy the prime objective. Initiation of these actions is subject to the availability of funds.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Recovery Plan Implementation Schedule for Ash Meadows

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
		Lands & water within Area of Management Conern										
1	111	Secure and Protect Devil's Hole	Ongoing	NPS*	80	5	5	5	5	5	5	Designated National Monument in 1952
1	114	Protect subsurface waters/acquire and protect surface waters	Ongoing	FWS-EN NDOW	80 48	5 3	5 3	5 3	5 3	5 3	5 3	
1	321	Establish interim minimum water level for Devil's Hole	1	FWS-EHC NPS*	0 0							Minimum established by Supreme Court in 1976
1	322	Seek injuction during emergencies at Devil's Hole	Ongoing	FWS-EHC	16 16	1 1	1 1	1 1	1 1	1 1	1 1	Injunction secured in U.S. Supreme Court ruled in favor of protecting fish
		Lands & water outside Area of Management Concern but within Essential Habitat										
1	122	Secure & protect subsurface & surface waters	Ongoing	FWS-EN NDOW	ou 48	-	5	3	3	3	3	
		Lands & water within Area of Management Conern										
2	112	Withdraw BLM lands	1	FWS-ACQ BLM	25 10		25 10					
2	113	Secure private lands	5	FWS-ACQ	500		100	100	100	100	100	
2	115	Acquire mineral rights	3	FWS-ACO	60		20	20	20			BLM has withdrawn from mineral entry 1,085 hectares
2	116	Post refuge	1	FWS-WR	25		25					

Recovery Plan Implementation Schedule for Ash Meadows

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
		Lands & water outside Area of Management Concern but within Essential Habitat										
2	1211	Secure BLM Critical Habitat lands	3	BLM	60		20	20	20			
2	1212	Secure Privately owned Critical Habitat	2	FUS-EHC	14			7	7			
		Cost Need 1 (Secure habitat & water)			1062	23	223	170	170	123	123	
2	231	Determine historic aquatic animal communities & distribution	3	FWS-EHC	30	10	10	10				
2	61	Determine historical & presently occupied habitat	3	FWS-EHC*	150	50	50	50				
				NDOW	30	10	10	10				
		Determine ecology of four listed fishes										
2	621	Spawning habitats	3	NDOW*	30	10	10	10				
				FWS-EHC	15	5	5	5				
2	622	Rearing habitats	3	NDOW*	15	5	5	5				
				FWS-EHC	15	5	5	5				
2	623	Adult habitats	3	NNW	15	5	5	5				
				FWS-EHC	3	1	1	1				
2	624	Age & growth	3	NDOW*	15	5	5	5				
				FWS-EHC	3	1	1	1				
2	625	Food & feeding	3	NDOW*	15	5	5	5				
				FWS-EHC	3	1	1	1				

Recovery Plan Implementation Schedule for Ash Meadows

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
2	626	Reproduction and fecundity	3	NDOW*	21	7	7	7				
				FWS-EHC	3	1	1	1				
2	627	Associations with exotic species	3	NDOW*	30	10	10	10				
				FWS-EHC	3	1	1	1				
2	628	Interspecific interactions	3	NDOW*	30	10	10	10				
				FWS-EHC	3	1	1	1				
		Determine ecology of Ash Meadows naucorid										
2	631	Habitat requirements	3	NDOW*	30	10	10	10				
				FWS-EHC	3	1	1	1				
2	632	Life history	3	NDOW*	30	10	10	10				
				FWS-EHC	3	1	1	1				
2	633	Interspecific reactions to exotic & competitive species	3	NDOW*	15	5	5	5				
				FWS-EHC	3	1	1	1				
		Determine ecology of seven listed plants										
2	641	Habitat requirements	5	FWS-EHC*	100		20	20	20	20	20	
				CDFG	5		1	1	1	1	1	
2	642	Life history	5	FWS-EHC*	100		20	20	20	20	20	
				CDFG	5		1	1	1	1	1	
2	643	Community associations & interactions	5	FWS-EHC*	100		20	20	20	20	20	
				CDFG	5		1	1	1	1	1	
2	644	Determine frequency values for seven listed plants	1	FWS-EHC	4		4					
2	211	Determine historic spring flow channels & discharge rates	1	FWS-EHC	10		10					

Recovery Plan Implementation Schedule for Ash Meadows

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
2	221	Determine historic plant communities and distribution	3	FWS-EHC	45		15	15	15			
2	2221	Determine appropiate exotic plant species control methods	2	FWS-WR	10		5	5				
2	2321	Determine appropiate methods for removal of non-native aquatic species	2	FWS-WR	10		5	5				
		Costs Need 2 (Preliminary research)			907	171	273	259	78	63	63	
		Manage lands & water in Area of Management Concern										
2	24	Minimize human disturbance	Ongoing	FWS-WR*	720	45	45	45	45	45	45	
				NDOW	80	5	5	5	5	5	5	
				BLM	80	5	5	5	5	5	5	
2	2541	Monitor Ash Meadows naucorid population	Ongoing	FWS-EHC*	48	3	3	3	3	3	3	
				FWS-WR	16	1	1	1	1	1	1	
2	223	Prevent reestablishment of wild horse herds	Ongoing	BLM	160	10	10	10	10	10	10	BLM had completely removed wild horses by 1985.
2	2542	Determine factors controlling naucorid population size	3	FWS-EHC	21			7	7	7		
2	212	develop waterflow restoration plan	2	FWS-WR	20			10	10			
				FWS-EHC	2			1	1			
2	213	Impliment waterflow restoration plan	Cont.	FWS-WR	390					50	50	

Recovery Plan Implementation Schedule for Ash Meadows

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
2	2222	Schedule & complete exotic plant species eradication	5	FWS-WR* FWS-EHC BLM	150 25 50					30 5 10	30 5 10	
2	2223	Schedule periodic control to prevent re-establishment of exotic plants	Cont.	FWS-WR* FWS-EHC BLM	20 10 20							
2	2322	Schedule & complete eradication of non-native aquatic species	5	FWS-WR* FWS-EHC NDOW	50 50 15					10 10 3	10 10 3	
2	2323	Schedule periodic control to prevent re-establishment of non-native aquatics	Cont.	FWS-WR* FWS-EHC NDOW	20 10 20							
		Manage Devil's Hole										
2	311	Monitor water levels,chemistry, & phisical properties	Ongoing	NPS	320	20	20	20	20	20	20	U.S.Geological Surve have monitored water levels in Devil's Ho & number of wells & springs since 1950. A broader program started in 1976.
2	312	Monitor algae and invertebrates	Ongoing	NPS	64	4	4	4	4	4	4	
2	313	Recommend measures suggested by monitoring	Ongoing	NPS* FWS-EHC	16 16	1 1	1 1	1 1	1 1	1 1	1 1	
2	323	Preform maintenance as required	Ongoing	NPS	96	6	6	6	6	6	6	
2	324	Minimize human disturbance	Ongoing	NPS	80	5	5	5	5	5	5	

Recovery Plan Implementation Schedule for Ash Meadows

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
2	341	Monitor population size at Devil's Hole	Ongoing	NPS*	80	5	5	5	5	5	5	NPS has funded monitoring since 197 to present
				FWS-EHC	16	1	1	1	1	1	1	
				NDOW	80	5	5	5	5	5	5	
2	3421	Analyze data from Monitoring & Literature	1	FWS-EHC*	5			5				
				NPS	1			1				
				NDOW	1			1				
2	3422	Conduct new studies as necessary	3	FWS-EHC	30				10	10	10	
		Hoover Dam & Amargosa Pupfish Station Refugias										
2	331	Maintain genetic diversity	Ongoing	FWS-EHC*	32	2	2	2	2	2	2	
				NDOW	8	0.5	0.5	0.5	0.5	0.5	0.5	
2	332	Analyze genetics	1	FWS-EHC	7					7		
2	333	Study affects of habitat manipulation	2	FWS-EHC	14						7	
2	334	Install tempature & Flow devices	1	USBR	0							Task completed
2	335	Monitor physical factors & food prod.	Ongoing	FWS-EHC	8	0.5	0.5	0.5	0.5	0.5	0.5	
				FWS-WR*	16	1	1	1	1	1	1	
				NDOW	16	1	1	1	1	1	1	
				USBR	16	1	1	1	1	1	1	
2	3431	Monitor populations regularly	Ongoing	FWS-EHC*	48	3	3	3	3	3	3	
				NDOW	16	1	1	1	1	1	1	
2	3432	Determine factors controlling population size	3	FWS-EHC*	21			7	7	7		
				NDOW	18			6	6	6		
2	3433	Modify refugia habitats as needed	1	FWS-WR*	10						10	
				FWS-EHC	1						1	
				USBR	10						10	

Recovery Plan Implementation Schedule for Ash Meadows

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
		Manage BLM lands within essential habitat that are outside tha Area of Management Concern										
2	43	Prevent reestab-lishment of wild horse herds	Ongoing	BLM	160	10	10	10	10	10	10	
2	44	Minimize human disturbance	Ongoing	BLM	80	5	5	5	5	5	5	
2	41	Schedule & complete exotic plant species eridicat ion	5	BLM*	120					25	25	
				FWS-EHC	25					5	5	
2	42	schedule periodic control to prevent re-establishment of exotic plants	Cont.	BLM*	70							
				FWS-EHC	35							
		Manage private lands within essential habitat that are outside tha Area of Management Concern										
2	51	Identify ownership on private lands	2	FWS-EHC*	4		2	2				
				BLM	4		2	2				
2	52	Pursue appropiate management measures	2	NDOW	10							
		Cost need 3 (Manage habitat/populations)			3531	142	146	184	183	327	328	
		Lands & water within Area of Management Conern										
3	251	Monitor physical conditions of springs	10	FWS-EHC	100			10	10	10	10	
				FWS-WR*	100			10	10	10	10	
				NDOW	100			10	10	10	10	

Recovery Plan Implementation Schedule for Ash Meadows

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
3	252	Monitor plant communities	10	FWS-EHC	70			10		10		
				FWS-WR*	70			10		10		
				NDF	70			10		10		
3	2531	Monitor listed fish species	Ongoing	FWS-WR*	24		3		3		3	
				NDOW	35		1		1		1	
				FWS-EHC	8		1		1		1	
3	2532	Determine factors controlling population size	3	FWS-RES*	30			10	10	10		
				NDOW	3			1	1	1		
3	2541	Monitor Ash Meadows naucorid	Ongoing	FWS-WR*	48	3	3	3	3	3	3	
				FWS-EHC	16	1	1	1	1	1	1	
3	2542	Determine factors controlling population size	3	FWS-EHC	21			7	7	7		
3	2551	Monitor six listed plant species	Ongoing	FWS-EHC	16	1	1	1	1	1	1	
				FWS-WR*	80	5	5	5	5	5	5	
				NDF	32	2	2	2	2	2	2	
3	2552	Determine factors controlling population size	3	FWS-EHC*	30			10	10	10		
				FWS-WR	3			1	1	1		
				NDF	12			4	4	4		
		Devils' Hole National Monument										
3	325	Post informational signs	1	NPS	3	3						
		BLM lands within essential habitat but outside Area of Management Concern										
3	451	Monitor five listed plant species	Cont.	BLM	56			4	4	4	4	

Recovery Plan Implementation Schedule for Ash Meadows

PRIOR-ITY	TASK	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
3	452	Determine factors controlling population size	3	FWS-EHC* BLM NDF	30 3 12			10 1 4	10 1 4	10 1 4		
		Lands & water within Area of Management Conern										
3	224	Enhance/re-establish native plant communities	Cont.	FWS-EHC FWS-WR* BLM	25 125 75							
3	225	Reestablish seven plant species	10	FWS-EHC FWS-WR*	25 100							
3	233	Re-establish aquatic communities	Cont.	FWS-EHC FWS-WR* BLM NDOW	50 150 25 75							
3	234	Re-establish four list fish species	10	FWS-EHC FWS-WR* NDOW	25 50 50							
		Cost need 4 (Monitoring/Reintroductions)			1747	15	17	124	99	124	51	
		Determine amount and location of habitat needed for recovery										
3	6511	Aquatic species	1	FWS-EHC* NDOW	1 15							
3	6512	Terrestrial species	1	FWS-EHC* CDFG NDF	1 10 30							
		Determine population demography criteria for delisting										
3	6521	Aquatic species	1	FWS-EHC* NDOW	5 5							

Recovery Plan Implementation Schedule for Ash Meadows

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURA-TION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments
3	6522	Terrestrial species	1	FWS-EHC*	5							
				NDF	5							
				CDFG	1							
3	66	Incorporate findings into recovery plan	1	FWS-EHC	20							
		Cost need 5 (Determine Objectives)			98	0	0	0	0	0	0	
				Total yearly cost	7345	351	659	737	530	637	565	

Cont. = Once a task is begun, it will continue indefinitely.

Ongoing = Currrently underway

* = Lead Agency

TOTAL COST = Projected cost of task from start to completion.

Acronyms for Agencies on Implementation Schedule

BLM = Bureau of Land Management

CDFG = California Department of Fish and Game

FWS-ACQ = U.S. Fish & Wildlife Service, Region 1 Division of Realty

FWS-RES = U.S. Fish & Wildife Service, Region 8 Research

FWS-ENC = U.S. Fish & Wildife Service, Region 1 Fish & Wildlife Enhancement

FWS-WR = U.S. Fish & Wildife Service, Region 1 Refuges and Wildlife

Recovery Plan Implementation Schedule for Ash Meadows

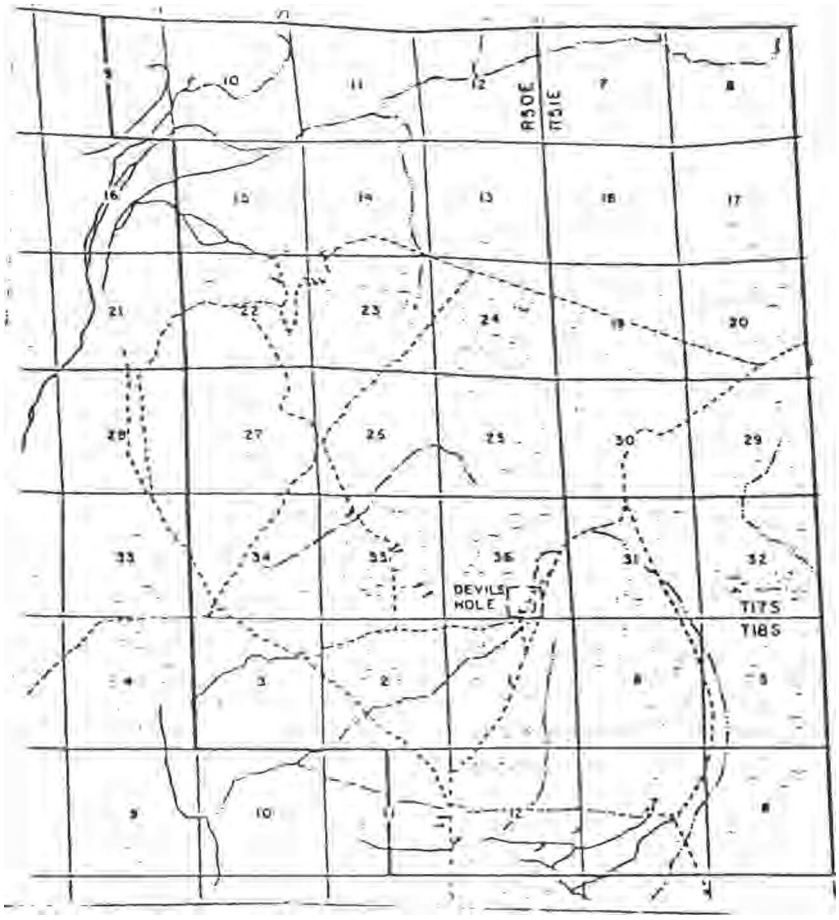
PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES (S1,000) FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	Comments

NDF = Nevada Division of Forestry

NDOW = Nevada Department of Wildlife

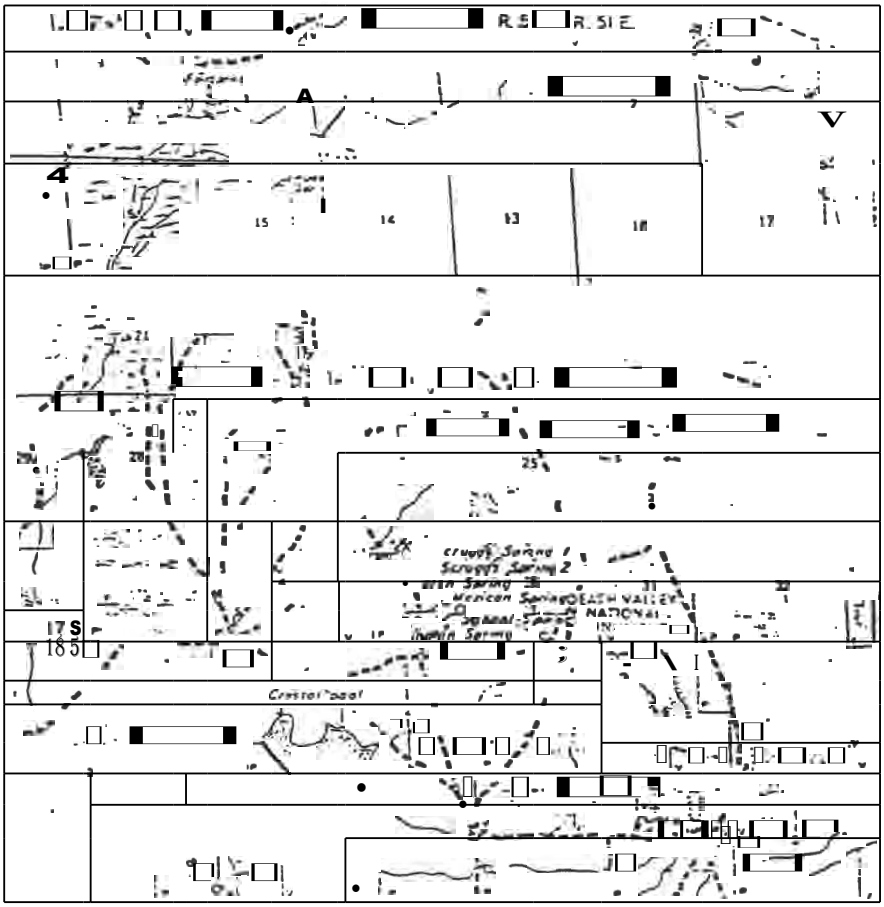
NPS = National Park Service

USBR = U.S. Bureau of Reclamation



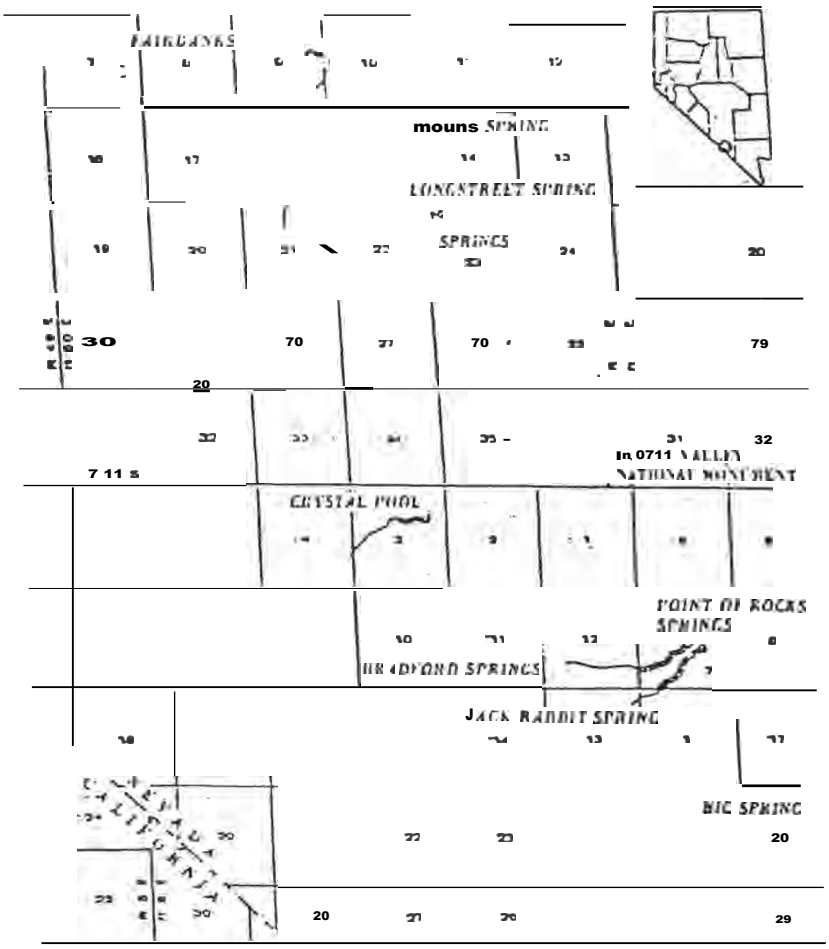
Description: Nye County, Nevada: E1/2 S9; S10; S11; S12; S13; S14; S15; S22; S23; S24; S25; S26; S27; S34; S35; S36, T17S, R50E. S7; S8; S17; S18; S19; S20; S29; S30; S31; S32, T17S, R51E. S1; S2; S3; E1/2 S11; S12, T18S. R50E. S5; S6; S7; S8, T17S, R51E.

I. Devil's Hole Pupfish Essential Habitat.



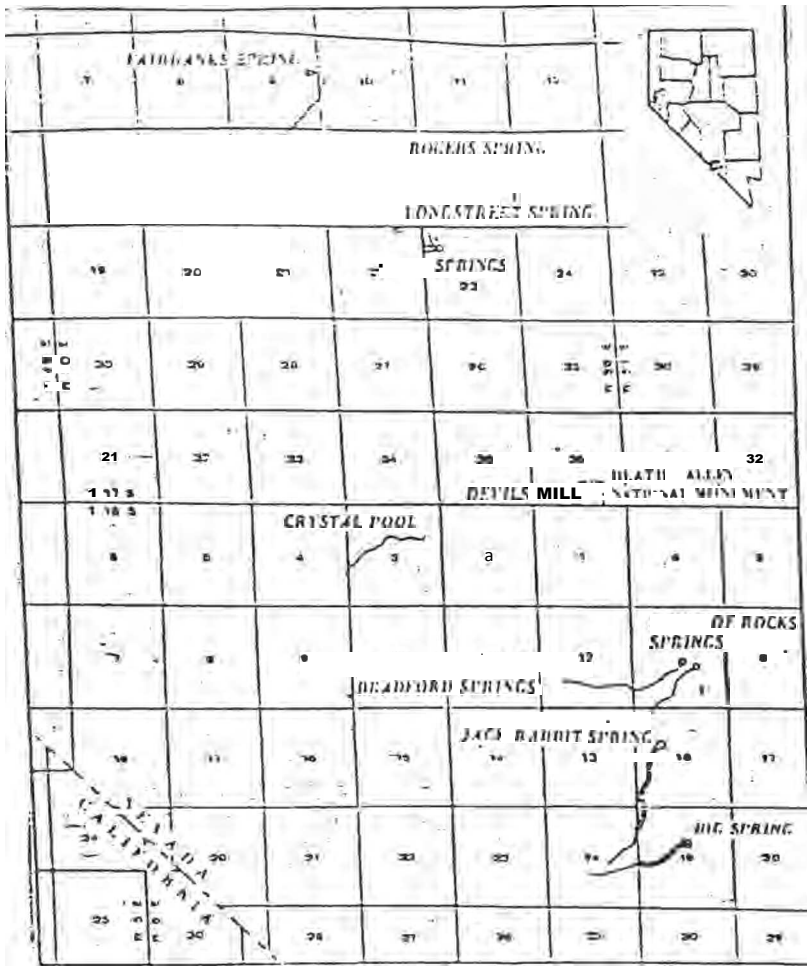
Description: Nye County, Nevada: S1/2 S26; E1/2 S34; S35; W1/2 S36, T17S, R50E. NW1/4 S1; N1/2 S2; NE1/4 S3, T18S, R50E.

II. Warm Springs Pupfish Essential Habitat.



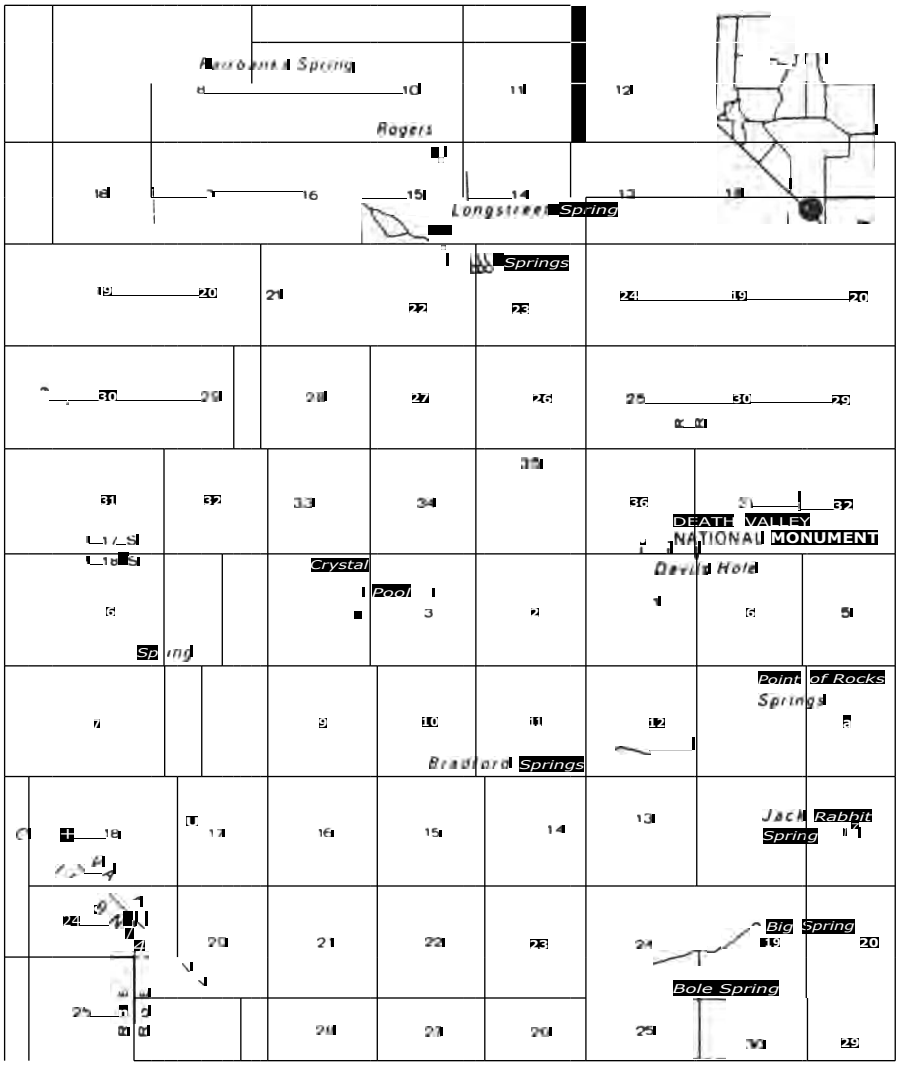
Description: Nye County, Nevada: Each of the springs shown in the map plus their outflows and the surrounding land areas for a distance of 50 meters. Note Final Rule for listing for thorough description of area.

III. Ash Meadows Amargosa Pupfish Critical Habitat.



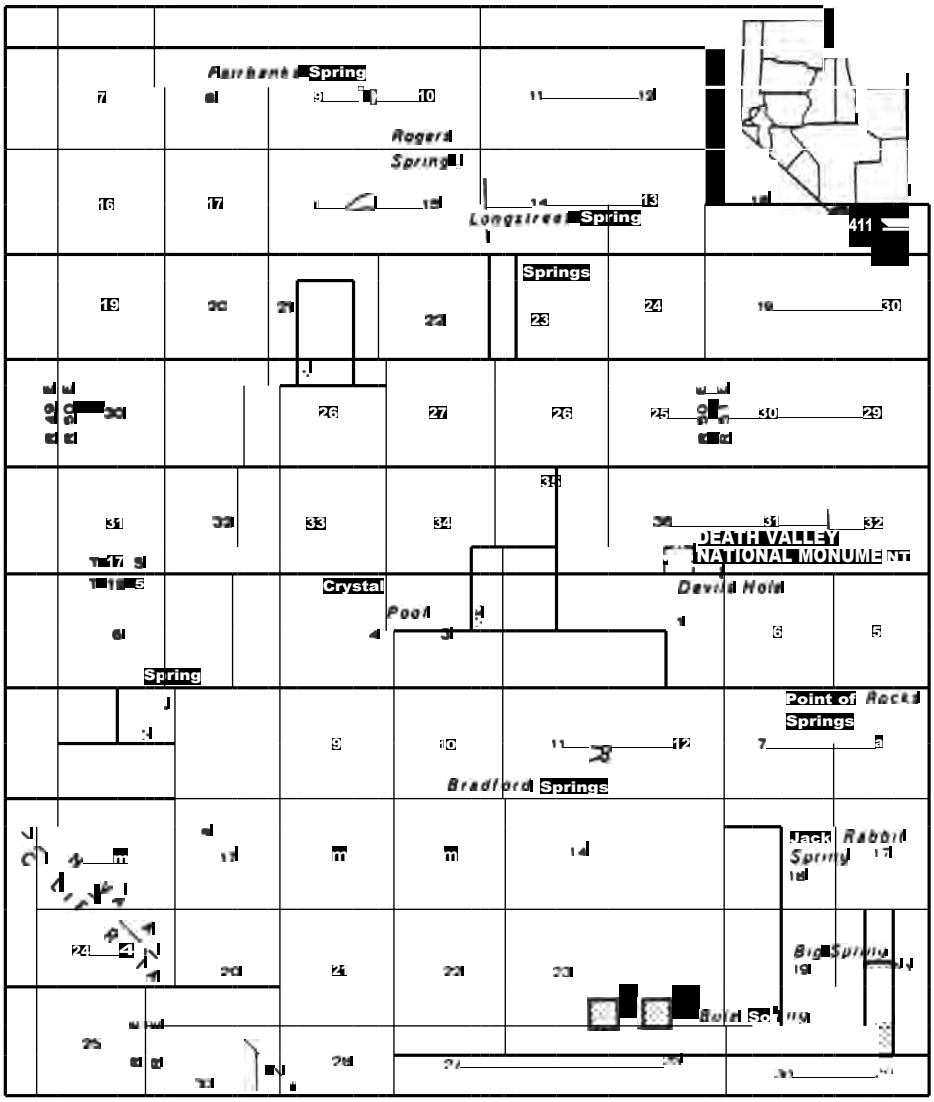
Description: Nye County, Nevada: Each of the following springs plus surrounding land areas for a distance of 50 meters from them and their outflows; Bradford Springs; S11, T18S, R50E and the outflow for 300 meters. Jackrabbit Spring and its outflow to boundary between S24, T18, R5OE and S19, T18S, R51E. Big Spring and its outflow to boundary between S19, T18S, R51E and S24, T18S, R51E.

IV. Ash Meadows Speckled Dace Critical Habitat.



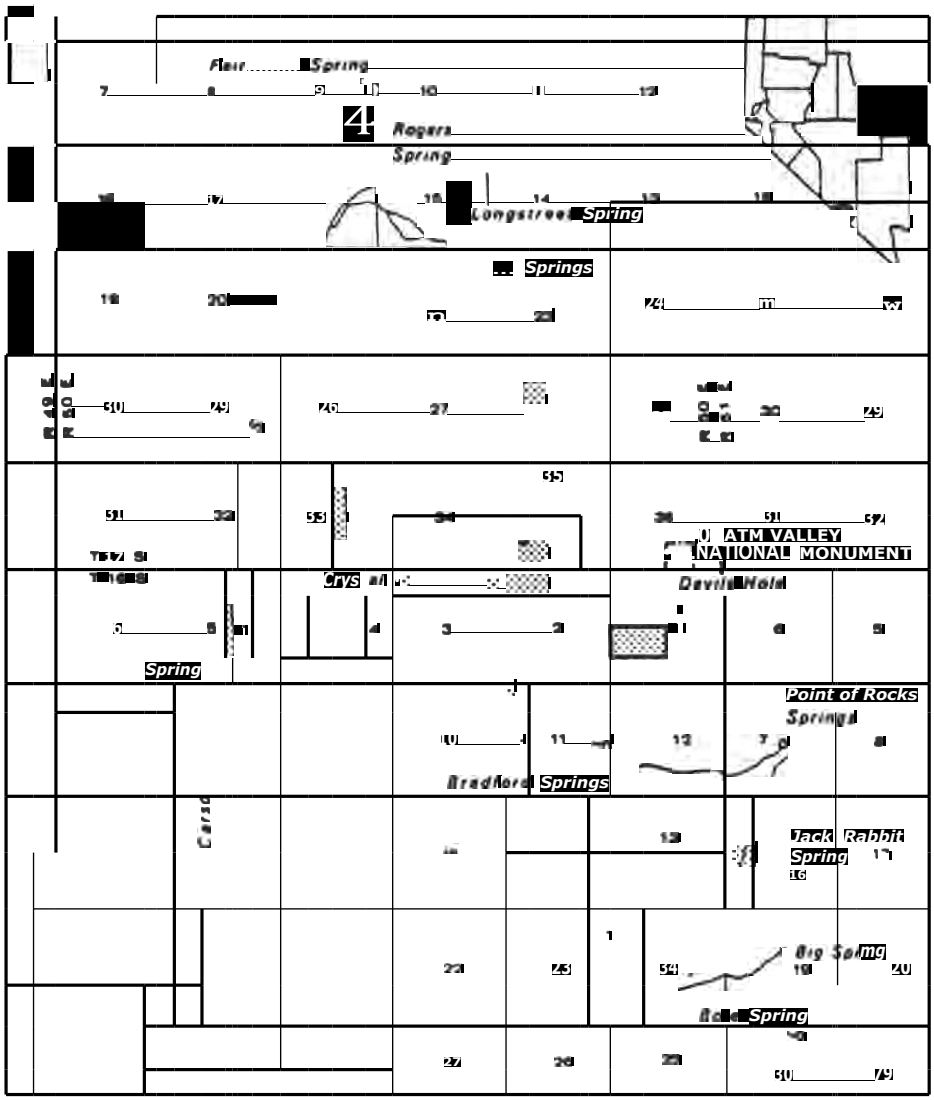
Description: Nye County, Nevada: SE1/4 S7, T18S, R51E.

V. Ash Meadows Naucorid Critical Habitat.



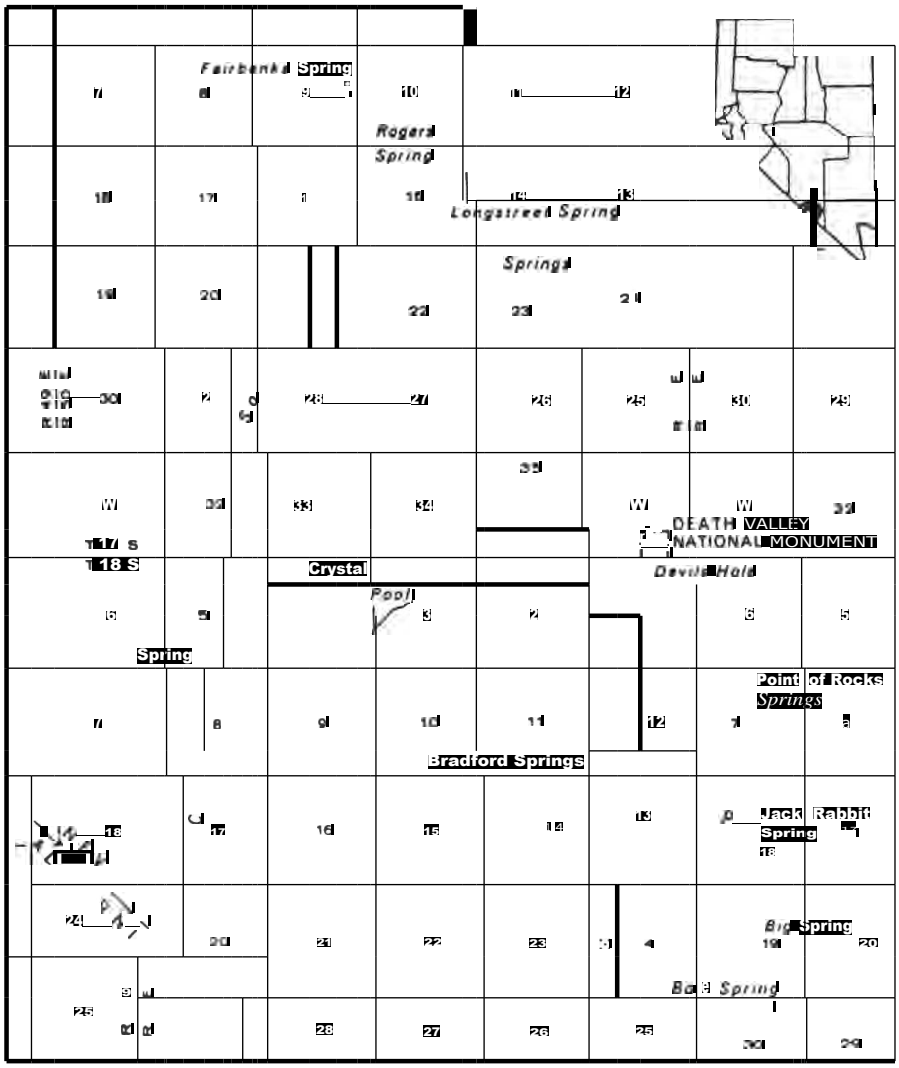
Description: Nye County, Nevada: SW1/4NE1/4, SE1/4NW1/4, E1/2SW1/4, and W1/2SE1/4 S21; W1/2NW1/4 S23; NW1/4NE1/4 and NE1/4NW1/4 S28; SE1/4SE1/4 S34; SW1/4SW1/4 and E1/2SW1/4 S35, T17S, R50E. SW1/2 S1; NE1/4NW1/4 and W1/2NW1/4 S2; E1/2NE1/4 S3; NE1/4 S7; SE1/4SE1/4 S23; SE1/4SW1/4 S24, T18S, R50E. NW1/4SE1/4 S7; S1/2NW1/4 and SW1/4 S18; NW1/4 and NE1/4SE1/4 S20; N1/2NNW1/4 S29; NE1/4NW1/4 S30, T18S, R51E.

VI. Spring-loving Centaury Critical Habitat.



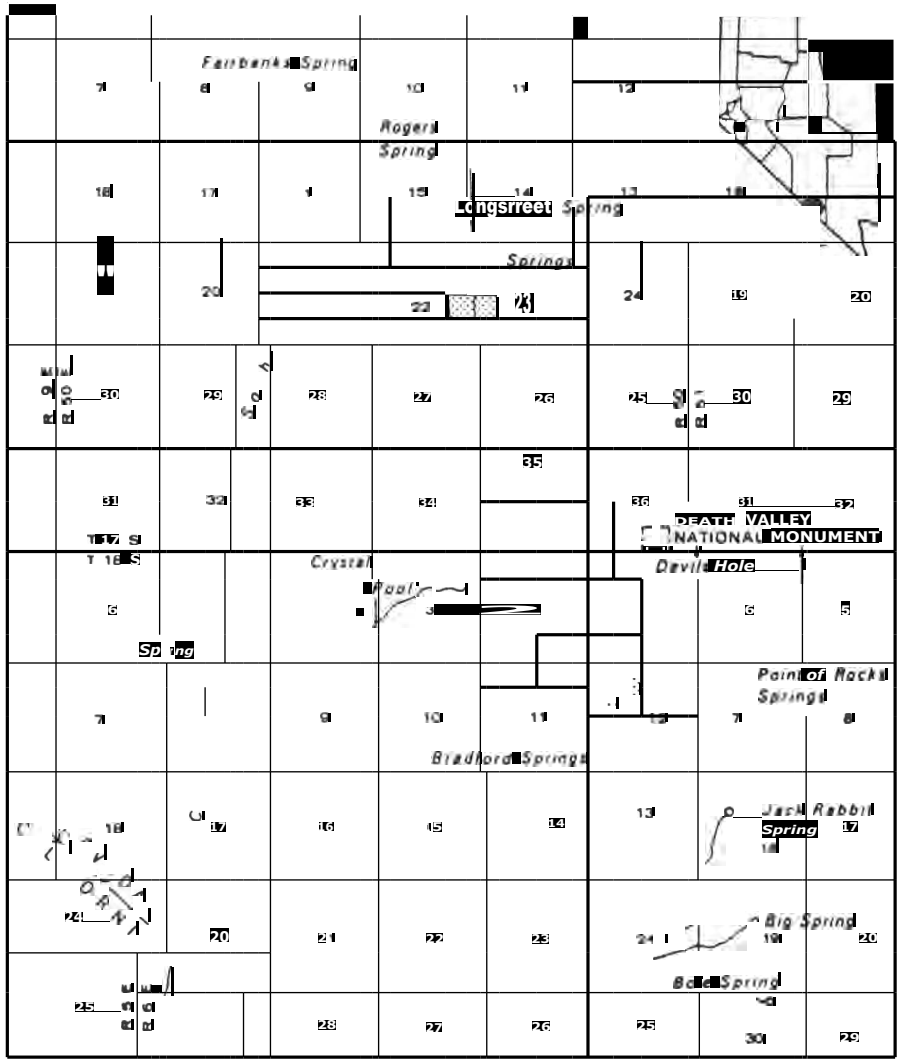
Description: Inyo County, California: NE1/4, Ee1/2NW1/4, SW1/4NW14, N1/2SW1/4, and NW1/4SE1/4 S30, T26N, R6E. Nye County Nevada: SE1/4NW1/4 S26; W1/3SW1/4 NE1/4 and W1/2NW1/4 SE1/4 S33; W1/2NW1/4, SW1/4SW1/4, E1/2SE1/4, and W1/2SE1/4 S35, T17S, R50E. N1/2SW1/4 S1, N1/2 NW1/4 S2; NE1/4NE1/4 and NW1/4NW1/4 S3; SW1/4NE1/4, SE1/4NW1/4, NE1/4SW1/4, and NW1/4SE1/4 S4; W1/2 NE1/4 and NW1/4SE1/4 S5; N1/2NE1/4 S7; NE1/4SE1/4 S10; W1/2NW1/4 and NW1/4SW1/4 S11; SW1/4NE1/4 and E1/2SE1/4 S14; SW1/4NW1/4, SW1/4SE1/4, W1/2SW1/4, and SE1/4SW1/4 S20 northeast of Nevada/California boundary; E1/2NE1/4 and E1/2SE1/4 S23; W1/2SW1/4 S24; NW1/4NE1/4 S29 northeast of Nevada/California boundary, T18S, R50E. SW1/4NW1/4 and NW1/4SW1/4 S18, T18S, R51E.

VII. Ash Meadows Gumplant Critical Habitat.



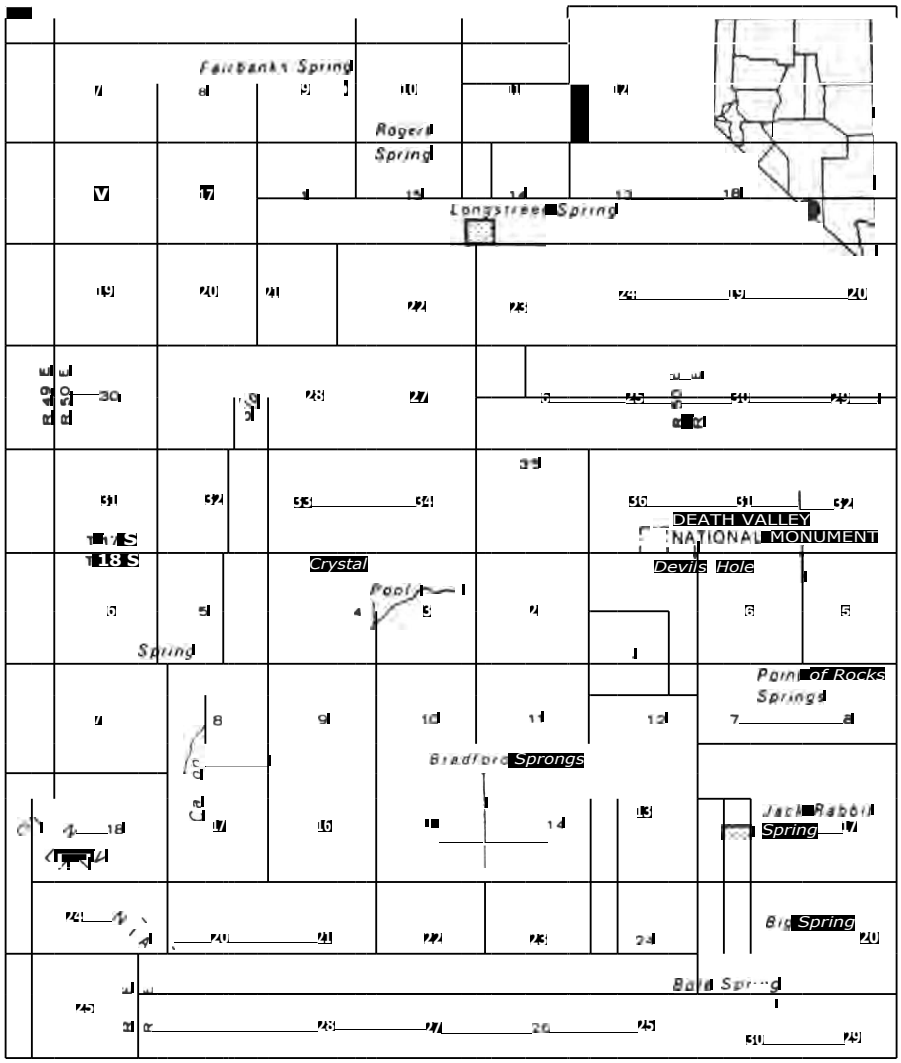
Description: Nye County, Nevada: SW1/4NE1/4 and W1/2SE1/4 S21; S1/2SW1/4 and SW1/4SE1/4 S35, T17S, R50E. SW1/4 S1; N1/2NNNW1/4 and SW1/4SW1/4 S2; NE1/4NE1/4 S3; NW1/4NE1/4 S12; N1/2NE1/4 and SE1/4NE1/4 S23; N1/2NW1/4, SW1/4NW1/4, and NW1/4SW1/4 S24, T18S, R50E.

VIII. Ash Meadows Ivesia Critical Habitat.



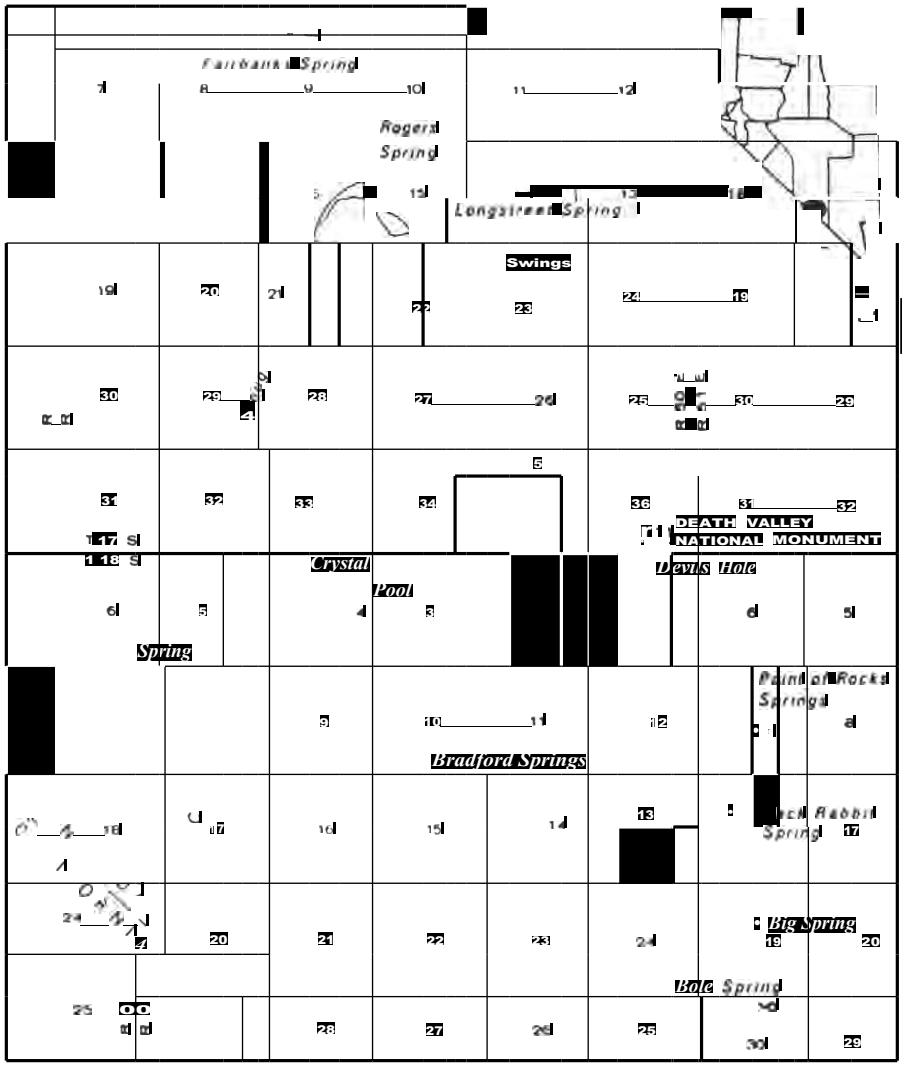
Description: Nye County, Nevada: SW1/4SW1/4 S15; S1/2NE1/4, N1/2SE1/4, and SW1/4SE1/4 S21; NW1/4NW1/4, S1/2NW1/4, and NE1/4SE1/4 S22; NW1/4SW1/4 S23; NW1/4NE1/4 S28; SE1/4SW1/4 and SE1/4 S35; SW1/4SW1/4 S36, T17S, R50E. NW1/4NW1/4, SW1/4SW1/4, and E1/2SW1/4 S1; NE1/4NE1/4 and S1/2SE1/4 S2; N1/2NE1/4 S11; NW1/4 S12, T18S, R50E

IX. Ash Meadows Blazing Star Critical Habitat.



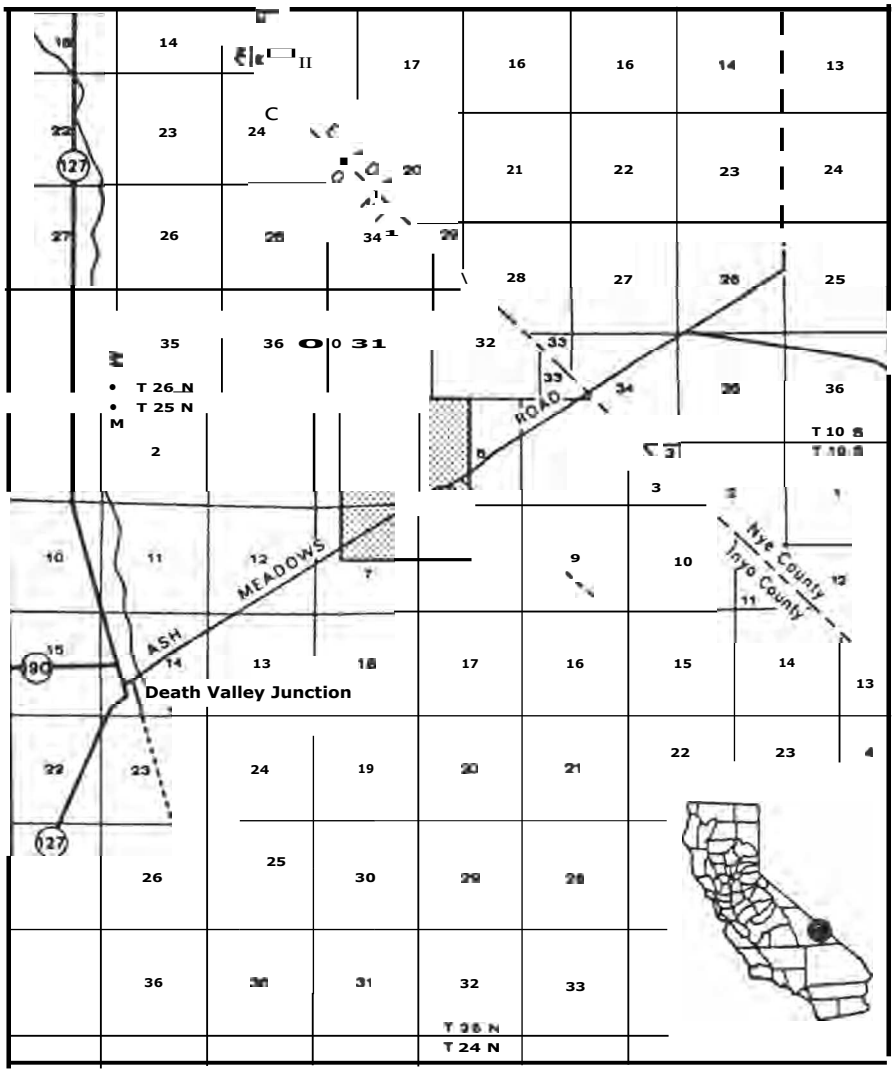
Description: Nye County, Nevada: W1/2NW1/4 and SW1/4SW1/4 S14; SW1/4NE1/4 S21; NE1/4SE1/4 S22; NW1/4 S26, T17S, R50E. SW1/4 and W1/2SE1/4 S1; NW1/4NE1/4 and N1/2NW1/4 S12; SW1/4SW1/4 S13; W1/2NW1/4 S13; W1/2NW1/4 S24, T18S, R50E. SE1/4SW1/4 and SW1/4SE1/4 S7; N1/2NW1/4 and E1/2SW1/4 S18; NE1/4NW1/4 S19, T18S, R51E.

X. Ash Meadows Milk-Vetch Critical Habitat.



Description: Nye County, Nevada: SW1/4SE1/4 S15, SW1/4NE1/4 and W1/2SE1/4 S21, NW1/4NE1/4 S22, E1/2SE1/4 S34, SW1/4NE1/4, S1/2NW1/4, SW1/4 and W1/2SE1/4 S35, T17S, R50E. SE1/4 S20, T17S, R51E. NW1/4SW1/4 and W1/2SE1/4 S1, E1/2NE1/4, SW1/4NW1/4, NW1/4SW1/4, and E1/2SE1/4 S2, NE1/4NW1/4 S12, E1/2SW1/4 and W1/2SE1/4 S13, T18S, R50E. SW1/4SE1/4 S7, NW1/4NE1/4 and SE1/4SW1/4 S18, T18S, R51E.

XI. Ash Meadows Sunray Critical Habitat.



Description: Inyo County, California: W1/2 S5; E1/2 S6; NE1/4 and E1/2NW1/4 S7; NW1/4 S8, T25N, R6E.

XII. Amargosa Niterwort Critical Habitat.

Appendix A, Table XIII. Distribution of Aquatic Animals in Ash Meadows.

Sada spring #	Location	T/R/Section	Native listed aquatic species					
			Devil's Hole Pupfish	Warm Spr. pupfish	Ash Meadow pupfish	Ash Meadow speckled dace	Ash Meadow poolfish	Ash Meadow naucorid
	High Elevation Springs							
21	Devil's Hole	T17S/R50E/S36/SE1/4	x					
	Mid Elevation Springs							
13	Mary Scott Spring	T17S/R50E/S35/NW1/4						
14	No. Scruggs Spring	T17S/R50E/S35/NE1/4						
15	So. Scruggs Spring	T17S/R50E/S35/NE1/4						
16	Marsh Spring	T17S/R50E/S35/SE1/4						
17	No. Indian Spring	T17S/R50E/S35/SE1/4						
18	So. Indian Spring	T17S/R50E/S35/SE1/4						
19	Mexican Spring	T17S/R50E/S35/SE1/4						
20	School Spring	T17S/R50E/S35/SE1/4						
22	N of Collins Ranch	T18S/R50E/S01/NE1/4						
23	N of Collins Ranch	T18S/R50E/S01/SE1/4						
	Low Elevation Springs							
1	Fairbanks Spring	T17S/R50E/S09/NE1/4		x		*	*	
2	Soda Spring	T17S/R50E/S10/NW1/4		*				
	Mud Lake	T17S/R50E/S11/SW1/4						
8	Purgatory Spring	T17S/R50E/S14/SW1/4						
3	Rogers Spring	T17S/R50E/S15/NE1/4		x		*	*	

Appendix A, Table XIII. Distribution of Aquatic Animals in Ash Meadows.

Sada spring	Location	T/R/Section	Native listed aquatic species					
			Devil's Hole Pupfish	Warm Spr. pupfish	Ash Mead pupfish	Ash Mead speckled dace	Ash Mead poolfish	Ash Mead naucorid
4	Spring .2 km S of Rogers Spring	T17S/R50E/S15/SE1/4						
5	Spring .3 km S of Rogers Spring	T17S/R50E/S15/SE1/4						
10	Cold Spring	T17S/R50E/S21/SE1/4						
6	Longstreet Spring	T17S/R50E/S22/NE1/4						
7	Five Spring	T17S/R50E/S23/NW1/4						
9	Spring 1 km S of Five Springs	T17S/R50E/S23/SW1/4						
11	Shaft Spring	T17S/R50E/S26/NW1/4						
12	Chalk Spring	T17S/R50E/S26/NW1/4						
	Peterson Reservoir	T17S/R50E/S28/SW1/4						
24	Collins Ranch Spr.	T18S/R50E/S01/SW1/4						
25	Crystal Pool	T18S/R50E/S03/NE1/4						
26	Spring N of Clay pits	T18S/50E/S06/SW1/4						
27	Spring at Clay pits	T18S/R50E/S06SW1/4						
28	Spring S of Clay pits	T18S/R50E/S07/NE1/4						
	Horseshoe Reservoir	T18S/R50E/S09/NE1/4						
	Crystal Reservr:r	T18S/R50E/S10/NE1/4						
	Lower Crystal Marsh	T18S/R50E/S10/SW1/4						

Appendix A, Table XIII. Distribution of Aquatic Animals in Ash Meadows.

Sada spring	Location	T/R/Section	Native listed aquatic species					
			Devil's Hole Pupfish	Warm Spr. pupfish	Ash Meadows pupfish	Ash Meadows speckled dace	Ash Meadows poolfish	Ash Meadows naucorid
29	Spring Near Crystal Reservoir	T18S/R50E/S11/NW1/4						
30	Spring 200 m east of spr. near Crystal Res	T18S/R50E/S11/NW1/4						
	Bradford Spring #1	118S/R50E/S11/NE1/4						
31	Bradford Spring #2	118S/R50E/S11/SE1/4						
	Bradford Spring #3	T18S/R50E/S11/SE1/4						
32	Tubbs Spring	T18S/R50E/S12/SW1/4						
	Davis Spring	T18S/R50E/S12/SE1/4						
33	Forest Spring	T18S/R51E/SO7/SW1/4						
34	Kings Pool	T18S/R51E/SO7/SE1/4						
35	spring 150m E of 34	118S/R51E/SO7/SE1/4						
36	spring 60 m E of 35	118S/R51E/SO7/SE1/4						
37	spring 30m E of 36	T18S/R51E/SO7/SE1/4						
38	seep 100 m N of 35	T18S/R51E/SO7/SE1/4						
39	spring 4m N of 38	T18S/R51E/SO7/SE1/4						
40	spring 7m N of 39	118S/R51E/SO7/SE1/4						
	Point of Rock pool#1	118S/R51E/SO7/SE1/4						
	Point of Rock pool#2	T18S/R51E/SO7/SE1/4						
	Point of Rock pool#3	118S/R51E/SO7/SE1/4						
	Point of Rock pool#4	T18S/R51E/SO7/SE1/4						
	Point of Rock pool#5	T18S/R51E/SO7/SE1/4						

Appendix A, Table XIII. Distribution of Aquatic Animals in Ash Meadows.

Sada spring	Location	T/R/Section	Native listed aquatic species							
			Devil's Hole Pupfish	Warm Spr. pupfish	Ash Mead pupfish	Ash Mead speckled dace	Ash Mead poolfish	Ash Mead naucorid		
41	Jackrabbit Spring	T18S/R51E/S18/NW1/4			x	x				
42	Big Spring	T18S/R51E/S19/NE1/4			x	x	*			
43	Brahma Spring	T18S/R51E/S29/NW1/4								
44	Bole Spring	T18S/R51E/S30/NE1/4								
45	Frenchy Spring	T18S/R51E/S30/NW1/4								
47	Last Chance Spring	T18S/R51E/S30/CENTER								

* = Species extripated from site

x = Species currently present at site

Appendix A Table XIII Distribution of Aquatic Animals In Ash meadows

Sada Spring	Location	T/R/Section	Native candidate aquatic species: Amargosa naucorid bug	Devil's Hole Rill beetle	Longstr spring snail	Fairbank Spring snail	Crystal Spring snail	Elongate-gland spr snail	Ash Mead Pebble snail	Median: gland spr snail	Distal gland spr snail	Oasis Valley spr snail	virile amargosa snail	Point of Rocks Try onia snail	sporting good snail	Minute slender try snail	Amargosa tryonia snail
	High Elevation Springs																
21	Devil's Hole	7175/1250E/S36/SE1/4															
	Mid Elevation Springs																
13	Mary Scott Spring	T17S/R50E/S35/NW1/4															
14	NO Scruggs Spring	T17S/R50E/S35/NE1/4															
15	So Scruggs Spring	T17S/R50E/S35/NE1/4															
16	Marsh Spring	T17S/R50E/S35/SE1/4															
17	NO Indian Spring	T17S/R50E/S35/SE1/4															
18	So Indian Spring	T17S/R50E/S35/SE1/4															
19	Mexican Spring	T17S/R50E/S35/SE1/4															
20	School Spring	T17S/R50E/S35/SE1/4															
22	N of Collins Ranch	T18S/R50E/S01/NE1/4															
23	N of Collins Ranch	T18S/R50E/S01/SE1/4															
	Low Elevation Springs																
	Fairbanks Spring	T17S/R50E/S09/NE1/4															
2	Soda Spring	7175/R50E/S10/W1/4															
	Mud Lake	T175/1250E/S11/5W1/4															
8	Purgatory Spring	TI7S/1250E/St4/SW1/4															
3	Rogers Spring	7175/R50E/S15/N(1/4															
4	Spring 2 km s 01 Rogers Spring	717S/R50E/S1S/SE1/4															
5	Spring .3 km S ol Rogers Spring	T17S/950E/S15/SE1/4															
10	Cold Spring	1I75/850E/S21/SE1/4															
6	Longitreel Spring	717S/R50E/S22/NE1/4															
7	Five Spring	II7S/R50E/S23/NW1/4															

Appendix A Table XIII Distribution of Aquatic Animals in Ash Meadows

Sada spring	Location	T/R/Section	Native candidate aquatic species: Amargosa naucorid bug	Devil's Hole Riffle beetle	Longstreet spring snail	Fairbank Spring snail	Crystal Spring snail	Elongate-gland spr snail	Ash Mead Pebble snail	Median-gland spr snail	Distal gland spr snail	Oasis Valley spr snail	Virile amargosa snail	Point of Rocks Tryonia snail	Sporting good snail	Minute slender try snail	Amargosa tryonia snail
9	Spring 1 km S of Five Springs	T17S/R50E/S23/SW1/4															
11	Shaft Spring	T17S/R50E/S26/NW1/4															
12	Chalk Spring	T17S/R50E/S26/NW1/4															
	Peterson Reservoir	T17S/R50E/S28/SW1/4															
24	Collins Ranch spr	T18S/R50E/S01/SW1/4															
25	Crystal Pool	T18S/R50E/S03/NE1/4															
26	Spring N of Clay pits	T18S/50E/S06/SW1/4															
27	Spring at Clay pits	T18S/R50E/S06SW1/4															
28	Spring S of Clay pits	T18S/R50E/S07/NE1/4															
	Horseshoe Reservoir	T18S/R50E/S09/NE1/4															
	Crystal Reservoir	T18S/R50E/S10/NE1/4															
	Lower Crystal Marsh	T18S/R50E/S10/SW1/4															
29	Spring Near Crystal Reservoir	T18S/R50E/S11/NW1/4															
30	Spring 200 m east of spr near Crystal Res	T18S/R50E/S11/NW1/4															
	Bradford Spring #1	T18S/R50E/S11/NE1/4															
31	Bradford Spring #2	T18S/R50E/S11/SE1/4															
	Bradford Spring #3	T18S/R50E/S11/SE1/4															
32	Tubbs Spring	T18S/R50E/S12/SW1/4															
	Davis Spring	T18S/R50E/S12/SE1/4															
33	Forest Spring	T18S/R51E/S07/SW1/4															
34	Rings Pool	T18S/R51E/S07/SE1/4															
35	Spring 150m E of 34	T18S/R51E/S07/SE1/4															
36	spring 60 m E of 35	T18S/R51E/S07/SE1/4	x														

Appendix A Table XIII Distribution of Aquatic Animals in Ash Meadows.

Sada spring	Location	T/R/Section	Native candidate aquatic species: Amargosa naucorid bug	Devil's Hole Riffle beetle	Longsnout spring snail	Fairbank Spring snail	Crystal Spring snail	Elongate-gland spr snail	Ash Mead Pebble snail	Median-gland spr snail	Distal gland spr snail	Oasis Valley spr snail	virile amargosa snail	Point of Rocks Try snail	sporting good snail	Minute slender try snail	Amargosa tryonia snail
37	spring 30m E of 36	T18S/R51E/S07/SE1/4															
38	seep 100 m N of 35	T18S/R51E/S07/SE1/4															
39	spring 4m N of 38	T18S/R51E/S07/SE1/4															
40	spring 7m N of 39	T18S/R51E/S07/SE1/4															
	Point of Rock pool#1	T18S/R51E/S07/SE1/4															
	Point of Rock pool#2	T18S/R51E/S07/SE1/4															
	Point of Rock 000103	T18S/R51E/S07/SE1/4															
	Point of Rock pool#4	T18S/R51E/S07/SE1/4															
	Point of Rock pool#5	T18S/R51E/S07/SE1/4															
41	Jackrabbit Spring	T18S/R51E/S18/NW1/4															
42	Big Spring	T18S/R51E/S19/NE1/4															
43	Brahma Spring	T18S/R51E/S29/NW1/4															
44	Bole Spring	T18S/R51E/S30/NE1/4															
45	Trenchy Spring	T18S/R51E/S30/NW1/4															
47	Last Chance Spring	T18S/R51E/S30/CENTER															

• = Species extirpated from site

x = Species currently present at site

Appendix A, Table XIII. Distribution of Aquatic Animals in Ash Meadows.

			Introduced non-native species							
Sada spring	Location	T/R/Section	sailfin mollies	mosquito fish	large mouth bass	black bass	black bullhead	crayfish	bullfrog	red-rim melania
	High Elevation Springs									
21	Devil's Hole	T17S/R50E/S36/SE1/4								
	Mid Elevation Springs									
13	Mary Scott Spring	T17S/R50E/S35/NW1/4								
14	No. Scruggs Spring	T17S/R50E/S35/NE1/4								
15	So. Scruggs Spring	T17S/R50E/S35/NE1/4								
16	Marsh Spring	T17S/R50E/S35/SE1/4								
17	No. Indian Spring	T17S/R50E/S35/SE1/4								
18	So. Indian Spring	T17S/R50E/S35/SE1/4								
19	Mexican Spring	T17S/R50E/S35/SE1/4								
20	School Spring	T17S/R50E/S35/SE1/4								
22	N of Collins Ranch	T18S/R50E/S01/NE1/4								
23	N of Collins Ranch	T18S/R50E/S01/SE1/4								
	Low Elevation Springs									
1	Fairbanks Spring	T17S/R50E/S09/NE1/4								
2	Soda Spring	T17S/R50E/S10/NW1/4								
	Mud Lake	T17S/R50E/S11/SW1/4								
8	Purgatory Spring	T17S/R50E/S14/SW1/4								
3	Rogers Spring	T17S/R50E/S15/NE1/4								

Appendix A, Table XIII. Distribution of Aquatic Animals in Ash Meadows.

			Introduced non-native species							
Sada spring	Location	T/R/Section	sailfin mollies	mosquito fish	large mouth bass	black bass	black bullhead	crayfish	bullfrog	red-rim melania
4	Spring .2 km S of Rogers Spring	T17S/R50E/S15/SE1/4								
5	Spring .3 km S of Rogers Spring	T17S/R50E/S15/SE1/4								
10	Cold Spring	T17S/R50E/S21/SE1/4								
6	Longstreet Spring	T17S/R50E/S22/NE1/4								
7	Five Spring	T17S/R50E/S23/NW1/4								
9	Spring 1 km S of Five Springs	T17S/R50E/S23/SW1/4								
11	Shaft Spring	T17S/R50E/S26/NW1/4								
12	Chalk Spring	T17S/R50E/S26/NW1/4								
	Peterson Reservoir	T17S/R50E/S28/SW1/4								
24	Collins Ranch Spr.	T18S/R50E/S01/SW1/4								
25	Crystal Pool	T18S/R50E/S03/NE1/4								
26	Spring N of Clay pits	T18S/50E/S06/SW1/4								
27	Spring at Clay pits	T18S/R50E/S06SW1/4								
28	Spring S of Clay pits	T18S/R50E/S07/NE1/4								
	Horseshoe Reservoir	T18S/R50E/S09/NE1/4								
	Crystal Reservoir	T18S/R50E/S10/NE1/4								
	Lower Crystal Marsh	T18S/R50E/S10/SW1/4								

Appendix A, Table XIII. Distribution of Aquatic Animals in Ash Meadows.

Sada spring	Location	T/R/Section	Introduced non-native species						
			sailfin mollies	mosquito fish	large mouth bass	black bass	black bullhead	crayfish	bullfrog	red-rim melania
29	Spring Near Crystal Reservoir	T18S/R50E/S11/NW1/4								
30	Spring 200 m east of spr. near Crystal Res	T18S/R50E/S11/NW1/4								
	Bradford Spring #1	T18S/R50E/S11/NE1/4								
31	Bradford Spring #2	T18S/R50E/S11/SE1/4								
	Bradford Spring #3	T18S/R50E/S11/SE1/4								
32	Tubbs Spring	T18S/R50E/S12/SW1/4								
	Davis Spring	T18S/R50E/S12/SE1/4		x	x		x			
33	Forest Spring	T18S/R51E/S07/SW1/4		x						
34	Kings Pool	T18S/R51E/S07/SE1/4		x						
35	spring 150m E of 34	T18S/R51E/S07/SE1/4								
36	spring 60 m E of 35	T18S/R51E/S07/SE1/4								
37	spring 30m E of 36	T18S/R51E/S07/SE1/4								
38	seep 100 m N of 35	T18S/R51E/S07/SE1/4								
39	spring 4m N of 38	T18S/R51E/S07/SE1/4								
40	spring 7m N of 39	T18S/R51E/S07/SE1/4								
	Point of Rock pool#1	T18S/R51E/S07/SE1/4								
	Point of Rock pool#2	T18S/R51E/S07/SE1/4								
	Point of Rock pool#3	T18S/R51E/S07/SE1/4								
	Point of Rock pool#4	T18S/R51E/S07/SE1/4								
	Point of Rock pool#5	T18S/R51E/S07/SE1/4								

Appendix A, Table XIII. Distribution of Aquatic Animals in Ash Meadows.

			Introduced non-native species							
Sada spring #	Location	T/R/Section	sailfin mollies	mosquito fish	large mouth bass	black bass	black bullhead	crayfish	bullfrog	red-rim melania
41	Jackrabbit Spring	T18S/R51E/S18/NW1/4	x						x	x
42	Big Spring	T18S/R51E/S19/NE1/4	x						x	
43	Brahma Spring	T18S/R51E/S29/NW1/4								
44	Bole Spring	T18S/R51E/S30/NE1/4								
45	Frenchy Spring	T18S/R51E/S30/NW1/4								
47	Last Chance Spring	T18S/R51E/S30/CENTER								

* = Species extripated from site

x = Species currently present at site

Appendix A, Table XIV. Rare Plant Species Association Table.

	Dry Ridges				Saturated soils near water					
Scientific name	ARME	MELE	ENNU	ASPH	NIMO	CAST	GRFA	CENA	COTE	IVER
Status	C2	T	T	T	E	C2	T	T	C2	I
Species restricted to dry uplands										
Ambrosa dumosa	x									
Haplopappus brickellioides	x									
Larrea tridentata	x									
Arctomecon merriamii	+	x	x	x						
Mentzelia leucophylla	x	+	x	x						
Enceliopsis nudicaulis	x	x		x						
Astraglus phoenix	x	x	x	+						
Cryptantha confertiflora		x	x							
Species found in both dry uplands and wetlands										
Atriplex confertifolia	x	x	x	x	x		x		x	x
Haplopappus acradenius		x	x	x			x	x	x	x
Distichlis spicata stricta				x	x	x	x	x	x	x
Species restricted to wetlands										
Nitrophila mohavensis					+					
Cleomella brevepes					x	x				
Calochortus striatus						+				
Dodecatheon pulchellum pulchellum						x				
Iva acerosa						x	x			
Anemopsis californica						x	x			
Tamarix spp.							x			
Fraxinus velutina coriaceae							x	x		
Baccharis emoryi							x	x		
Grindelia fraxino-pratensis							+	x	x	
Centaurium namophilum							x	+	x	x
Cordylanthus tecopensis							x	x	+	x
Prosopis pubescens								x		
Ivesia eremica								x	x	
Cirsium mohavense									x	
Eleocharia spp.									x	
Juncus balticus									x	x
Spartina gracilis										x

Appendix A Table XV Distribution of Listed and Candidate Plants in Ash Meadows

T/R	Section	critical habitat	Locality name	Or Ridge plants				Plants of Saturated soils near water						
				Arctomecon merriamii	mentzella leucophylla	Enceliopsis nudicaulis	Astraglus phoenix	Nitrophila mohavensis	Calochortus striatus	Spiranthes infernalis	Grindelia fraxino-pra	Centaurium namophilum	Cordylanthus tecopensis	lvesia eremica
Fish & Wildlife Managed lands within the Area of Management Concern in Nye County, Nevada														
T17S/R50E	10	NW1/4 of SW1/4												
		SE1/4 of SW1/4												
	15	NW1/4 of NE1/4	Magnesia Spring											
		SE1/4 of SW1/4												
		SW1/4 of SE1/4												
		SW1/4 of SE1/4												
		SE1/4 of SE1/4												
	20	NW1/4 of SE1/4												
	21	SE1/4 of NW1/4	yes											
		SW1/4 of NE1/4	yes											
		SE 1/4 of NE1/4												
		NE 1/4 of SW1/4	yes											
		SE1/4 of SW1/4	yes											
		NW1/4 of SE1/4	yes											
		NE1/4 of SE1/4	yes											
		SW1/4 of SE1/4	yes	Cold Springs										
	22	NW1/4 of NE1/4	yes											
		SW1/4 of E1/2 NE1/4	yes											
		SE1/4 of NW1/4	yes											
		NW1/4 of NE1/4	yes	Longstreet Springs										
		SE1/4 of NW1/4												
		NE1/4 of SE1/4	yes											
	23	NW1/4 of NW1/4	yes											
		SW1/4 of NW1/4	yes											
	33	SW1/4 of NE1/4	yes											
		NW1/4 of SE1/4	yes											

Appendix A. Table XV. Distribution of Listed and Candidate Plants in Ash Meadows.

T/R	Section	critical Habitat	Locality name	Dry Ridge plants				Plants of saturated soils near water						
				Arctomecon merriamii	Menzelia leucophylla	Enceliopsis nudicaulis	Astraglus phoenix	Nitrophila mohavensis	Calochortus striatus	Spiranthes infernalis	Grindelia fraxino-pra	Centaurium namophilum	Cordylanthus tecopensis	Ivesia eremica
	34	NE1/4 OF SE1/4	yes			X								
		SE1/4 OF SE1/4	yes											
	35	N 1/4 OF 1414 1/4	yes	Scott Spring		X				X	X		X	
		SW1/4 OF NW1/4	yes											
		SE1/4 OF NW1/4	yes											
		SW1/4 OF NE1/4	yes	North Spring Spring										
		NW1/4 Of SW1/4	ye											
		NE1/4 Of SW1/4	yes							X	X			
		SW1/4 OF SW1/4	yes								X			
		SE1/4 OF SW1/4	yes			X				X	X			
		NW1/4 OF SE1/4	yes	Marsh Springs										
		NE1/4 Of SE1/4	yes											
		SW1/4 OF SE1/4	yes											
		511/4 OF SE1/4	yes	School Spring;										
T18S/R50E		NW1/4 OF NW1/4	yes											
		NE1/4 OF NW1/4	yes											
		SW1/4 OF NW1/4	yes											
		SE1/4 OF NW1/4	yes											
		NW1/4 OF SW1/4	yes											
		NE1/4 OF SW1/4	yes	Collins Ranch Spring										
		SW1/4 OF SW1/4	yes											
		SE1/4 OF SW1/4	yes											
		NW1/4 OF SE1/4	yes											
		SWI/4 OF SE1/4	yes											
	2	NW1/4 OF NW1/4	yes											
		NE1/4 OF NW1/4	yes											
		SW1/4 OF NW1/4	yes											
		NWI/4 OF NE1/4			X									
		NE1/4 OF NE1/4	yes											

Appendix A Table xv. Distribution of Listed and Candidate Plants in Ash Meadows

T/R	Section	Critical Habitat	Locality name	Dry Ridge plants				Plants of saturated soils near water						
				Arctomecon merriamii	Mentzelia leucophylla	Enceliopsis nudicaulis	Astragalus phoenix	Nitrophila mohavensis	Calochortus striatus	Spiranthes Internalis	Grindelia fraxino-pra	Centaurium namophilum	Cordylanthus tecopensis	Ivesia eremica
	NW1/4 OF SW1/4	yes												
	SW1/4 OF SW1/4	yes												
	NE1/4 OF SE1/4													
	SW1/4 OF SE1/4	yes												
	SE1/4 OF SE1/4	yes												
3	NW1/4 OF NW1/4	yes												
	NE1/4 OF NE1/4													
	SE1/4 OF NE1/4	yes	Crystal Phil											
	NE1/4 OF SE1/4													
4	Sf1/4 OF SW1/4	yes												
	SW1/4 OF NE1/4	yeS												
	NE1/4 OF SW1/4	yes												
	NW1/4 OF SE1/4	yes												
8	SE1/4 OF NW1/4													
	SW1/4 OF NE1/4													
	NW1/4 OF SE1/4													
1O	SE1/4 OF NE1/4													
	NE1/4 OF SE1/4	yes									A			
	SE1/4 Of 511/4										X			
11	N 1/4 OF NW1/4	yes												
	SW1/4 OF NW1/4	yes												
	N 1/4 Of NE1/4	yes												
	NE1/4 OF NE1/4	yes												
	NW1/4 OF SW1/4	yes												
12	NW1/4 Of NW1/4	yes												
	NE1/4 Of NW1/4	yes												
	SW1/4 OF NW1/4	yes												
	SE1/4 Of NW1/4	yes												
	NW1/4 Of NE1/4	yes												X

Appendix A. Table XV. Distribution of Listed and Candidate Plants in Ash meadows.

T/R	Section	Critical Habitat LoCality name	Dry Ridge plants				Plants of Saturated soils near water						
			ArCtomecon merriami	MentZelia leucophylla	Enceliopsis nudicaulis	Astragalus phoenix	Nitrophila mohavensis	Calochortus striatuS	Spiranthes internaliS	Grindelia traxino-pra	Centaurium naMOphilum	Cordylanthus tecopensis	ivesla eremica
13	NE1/4 OF SW1/4	yes											
	SW1/4 OF SWI/4	yes											
	NW1/4 OF SE 1/4	yes											
	SWI/4 OF SE1/4	yes											
14	SE 1/4 OF NW1/4												
	NE 1/4 OF NE 1/4												
	SW1/4 OF NE1/4	yes											
	NE1/4 OF SW1/4												
	SE1/4 OF SW1/4												
	NW1/4 OF SE 1/4												
	NE 1/4 OF SE1/4	yes											
	SW1/4 OF SE1/4												
	SEI/4 O1 SE1/4	yes											
1E	SE 1/4 OF NW1/4												
	NE 1/4 of SW1/4												
	SW1/4 OF SW1/4												
23	NE 1/4 OF N 1/4												
	SE1/4 OF NW1/4												
	NWI/4 OF NE 1/4	yes											
	NE 1/4 OF NEI/4	yes											
	SWI/4 OF NE 1/4												
	SE 1/4 OF NE 1/4	yes											
	NE 1/4 OF SWI/4												
	SW1/4 OF SW1/4												
	NW1/4 OF SE1/4												
	NE 1/4 OF SE1/4	yes											
	SW1/4 OF SE1/4												
	SE1/4 OF SE1/4	yes											

Appendix A. Table XV. Distribution of Listed and Candidate Plants in Ash Meadows

T/R	Section	Critical Habitat	Locality name	Do Ridge plants				Plants of saturated soils near water						
				Arctomecon merriamii	mentzelia leucophylla	Enceliopsis nudicaulis	Astraglus phoenix	Nitrophila mohavensis	Calochortus striatus	Spiranthes infernalis	Grindelia fraxino-pra	Centaurium namophilum	Cordylanthus tecopensis	ivesia eremica
	24 5515 1/4 Of NW1/4	yes												
	NE1/4 Of NW1/4	yes												
	SW1/4 Of NW1/4													X
	NW1/4 Of SE /4	yes												
	SW1/4 Of NE1/4	ye												
	7 NE1/4 Of SW1/4	yes												
	NW1/4 Of Sf1/4	yes	Mouth of Rock Spring											
	SW1/4 Of SE1/4													
	18 NW1/4 Of SW1/4	ye												
	SE1/4 01 NW1/4	yes					N							
	NW1/4 01 SW1/4													
	NE1/4 Of NW1/4		Jack Rabbit Spring							X				
	SF /4 Of NW1/4	yes												
	NW1/4 Of NE1/4	yts												
	NW1/4 01 SW1/4	yes												
	NE1/4 Of SW1/4	yES												
	SW1/4 Of SW1/4	yeS												
	SE1/4 OF SW1/4	yes												
	19 NW1/4 OF NW1/4	yes												
	NE1/4 OF NW1/4	yes												
	SW1/4 01 NW1/4	yes												
	SE1/4 01 NW1/4	yes	Big Spring											X
	NW1/4 Of NE1/4													
	NE1/4 01 SW1/4	yes												
	20 NE1/4 Of SWI/4	yes												
	SE1/4 Of SW1/4	yes												
	27 NW1/4 Of NW1/4	yeS												
	NE1/4 Of NW1/4	yeS												

Appendix A. Table XV. Distribution of Listed and Candidate Plants in Ash Meadows.

T/R	Section	Critical Habitat	Locality name	Dry Ridge plants				Plants of saturated soils near water						
				Arctomecon merriamii	Mentzelia leucophylla	Enceliopsis nudicaulis	Astraglus phoenix	Nitrophila mohavensis	Calochortus striatus	Spiranthes infernalis	Grindelia fraxino-pra	Centaurium namophilum	Cordylanthus tecopensis	Ivesia eremica
	30 NE1/4 OF NW1/4	yes	French, Springs											
	SW1/4 OF NE1/4		[illegible] Chance Spring											
BLM managed lands outside Area of Management Concern but within essential habitat in Nye County Nevada														
T17S/R50E	14 NW1/4 OF NW1/4	yes												
	SW1/4 OF NW1/4	yes		X	X	X								
	NW1/4 OF SW1/4			X										
	SW1/4 OF SW1/4	yes					X							
	26 SW1/4 OF NW1/4	yes	Chalk Spring											
	SE 1/4 OF NW1/4	yes												
T17S/R51E	20 NW1/4 OF SE1/4	yes												
	NE 1/4 OF SE1/4	yes				X								
	SW1/4 OF SE1/4	yes												
	SE1/4 OF SE1/4	yes												
T18S/R50E	5 NE 1/4 OF NW1/4													
	NW1/4 OF NE1/4	yes												
	NE1/4 OF NE1/4													
	SW1/4 OF NE 1/4	yes												
	NW1/4 OF SE1/4	yes												
	NE1/4 OF SE1/4													
	7 SW1/4 OF NE 1/4	yes												
	SE 1/4 OF NE 1/4	yes												
	SE1/4 OF NW1/4													
	SW1/4 OF NE 1/4													
	NE1/4 OF SW1/4													
	SE1/4 OF SW1/4								X					
	NW1/4 OF SE1/4													
	NE1/4 OF SE1/4								X					

Appendix A. Table XV. Distribution of Listed and Candidate Plants in Ash Meadows.

T/R	Section	Critical Habitat	Locality name	Dry Ridge plants				Plants of saturated soils near water						
				Arctomecon merriamii	Menzelia leucophylla	Tiquilia nuttallii	Astraglus phoenix	Nitrophila mohavensis	Catochorus striatus	Spiranthes infernalis	Grindelia fraxino-pra	Centaurium namophilum	Cordylanthus tecopensis	Ivesia eremica
	SW1/4 OF St 1/4							X						
	SE1/4 OF St /4													
	NE /4 Of SW1/4											X	X	
	SW1/4 01 SA1/4													
20	SW1/4 Of NW1/4	yes												
	NW1/4 of SW1/4													
	SWI/4 of SW1/4	es												
	SE1/4 of SW1/4													
	SW1/4 Of NE1/4	yes												
22	SW1/4 of SE1/4													

[illegible] managed lands outside Area of Management Control but within essential habitat in Inyo County, California

T25S/R48E														
	5 NW1/4 Of NW1/4	yes						X						
	NE 1/4 OF NW1/4	yes						X						
	SW1/4 OF NWI/4	yes						X						
N3	SE1/4 Of NW1/4	yes						N						
	NW1/4 Of SW1/4	yes												
	NE1/4 Of SW1/4	yes						X						
	SWI/4 OF SW1/4	yes						X						
	SE 1/4 Of SWI/4	yes												
	6 SW1/4 Of NW1/4							X						
	SE1/4 Of NW1/4							X						
	NW1/4 Of NE1/4	yes												
	NE1/4 Of NE1/4	ACE												
	SW1/4 OF NE1/4	yes												
	SE1/4 Of NE1/4	yes												
	NW1/4 Of SW1/4													
	NE1/4 Of SW1/4													
	SW1/4 OF SW1/4													
	SE1/4 Of SW1/4											N		

Appendix A. Table XV. Distribution of Listed and Candidate Plants in Ash Meadows.

T/R	Section	Critical Locality name Habitat	Dry Ridge plants				Plants of saturated soils near water						
			Arctomecon merriamii	mentzelia leucophylla	Enceliopsis nudicaulis	Astraglus phoenix	Nitrophila mohavensis	Calochortus striatus	Spiranthes infernalis	Grindelia fraxino-pra	Centaurium namophilum	Cordylanthus tecopensis	tvesia eremica
		NW1/4 OF SE1/4 yes											
		NE1/4 OF SE1/4 yes											
		SW1/4 OF SE1/4 yes											
		SE1/4 OF SE1/4 yes											
	7	NW1/4 OF NW1/4						X					
		NE1/4 OF NW1/4 yes											
		SW1/4 OF NW1/4											
		SE1/4 OF N 1/4 yes						X					
		NW1/4 OF NE 1/4 yes											
		NE1/4 OF NE1/4 yes											
		SW1/4 OF NE1/4 yes											
		SE1/4 OF NE1/4 yes											
		NW1/4 OF SW1/4						X					
		NE1/4 OF SW1/4											
		SW1/4 OF SW1/4											
		SE1/4 OF SW1/4											
		NW1/4 OF SE1/4											
		NE1/4 OF SE1/4											
		SW1/4 OF SE1/4											
	8	NW1/4 OF NW1/4 yes											
		NE1/4 OF NW1/4 yes											
		SW1/4 OF NW1/4 yes											
		SE1/4 OF N 1/4 yes											
T26N/R06E	30	NW1/4 OF NW1/4 yes											
		NE1/4 OF NW1/4 yes											
		SW1/4 OF NW1/4 yes											
		SE1/4 OF NW1/4 yes											

Appendix A Table XV. Distribution of Listed and Candidate Plants in Ash Meadows.

	Section	Critical Habitat	Locality name	Dry Ridge plants			Plants of saturated soils near water						
				Arctomecon merriamii	mentzelia leucophylla	Enceliopsis nudicaulis	Astraglus phoenix	Nitrophila mohavensis	Calochortus striatus	Spiranthes infernalis	Crindelia fraxino-pra	Centaurium nampphilum	Cordylanthus tecopensis	Iversia eremica
		NW1/4 OF NE1/4	yes											
		NE1/4 OF NE1/4	yes											
		NW1/4 OF NE1/4	yes											
		SW1/4 OF NE1/4												
		SW1/4 OF SW1/4												
		NE 1/4 OF NW1/4	yes											
		SW1/4 OF SW1/4												
		NW1/4 OF SE 1/4												

[illegible] lands that are not [illegible] management [illegible] will in [illegible] habitat in NYE County, Nevada

[illegible]	23	NW1/4 OF SW1/4	yes		
	26	NW1/4 OF NW1/4	yes	Shaft Spring	
[illegible]		NE 1/4 OF NW1/4	yes		
		SW1/4 OF NW1/4	yes	Chalk Spring	
		SE1/4 OF NW1/4	yes		
[illegible]	7	NW1/4 OF NE1/4	)es		
		NE 1/4 OF NE1/4	yes		

APPENDIX **B**

Agencies From Whom Comments Were Requested

U.S. Bureau of Reclamation, Boulder City, Nevada
U.S. National Park Service, Death Valley National Monument
U.S. Bureau of Land Management, Reno, Nevada
U.S. Geological Survey, Carson City, Nevada
U.S. Fish and Wildlife Service, Las Vegas, Nevada, Sacramento, California, and Seattle, Washington
Nevada Department of Wildlife, Reno, Nevada
Nevada Division of Forestry, Carson City, Nevada
California Department of Fish and Game, Sacramento, California