Technical/Agency Review Draft

BIG SPRING SPINEDACE

Lepidomeda mollispinis pratensis

RECOVERY PLAN

U.S. Fish and Wildlife Service
Region 1
Portland, Oregon

January 1993

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Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views, official positions, nor approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S.. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and completion of recovery tasks.

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EXECUTIVE SUMMARY OF THE BIG SPRING SPINEDACE RECOVERY PLAN

Current Status: The only population of threatened Big Spring spinedace occurs in a 5-mile section of Meadow Valley Wash in Condor Canyon, near Panaca, Lincoln County, Nevada. This population is vulnerable to catastrophic natural events, adverse habitat modification, and nonnative species introductions. Population size has not been determined.

Habitat Requirements and Limiting Factors: Big Spring spinedace life history and habitat requirements, and factors limiting population expansion are poorly understood.

Recovery Objective: Delist

Recovery Criteria: Big Spring spinedace may be delisted when three self-sustaining populations exist for 5 consecutive years in habitats secured from all threats. Two additional populations need to be established.

Actions Needed:
1. Secure Condor Canyon essential habitat.
2. Identify ecological parameters.
3. Establish additional populations.
4. Monitor all populations and their habitats.
5. Establish and maintain public information program.

Total Estimated Cost of Recovery ($1,000's):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Total
1993	6	16		1	5	28
1994	6	21		1	3	31
1995	6	31		1	1	39
1996	1		3	1	1	6
1997	1		5	1	1	8
1998	1		7	1	1	10
1999	1		3	2	1	7
2000	1		3	2	1	7
2001	1		3	2	1	7
2002	1		1	2	1	5
2003	1		1	2	1	5
2004	1		1	2	**1**	**5**
2005	1		1	2	1	5
2006	1		1	2	1	5
Total:	29	68	29	22	20	168

Date of Recovery: **Delisting of the Big Spring spinedace should be initiated in 2006, if recovery criteria are met.**

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Lepidomeda mollispinis pratensis

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I. INTRODUCTION

A. Brief Overview

Big Spring spinedace (Lepidomeda mollispinis pratensis) are one of three native fishes occupying the stream habitat of Meadow Valley Wash in eastern Nevada. Meadow Valley Wash desert sucker (Catostomus clarki ssp.) and Meadow Valley Wash speckled dace (**Rhinichthys** osculus ssp.) are widespread throughout the approximately 120-mile-long drainage, but Big Spring spinedace are restricted to a 5-mile section of stream which flows through Condor Canyon, north of Panaca, Lincoln County, Nevada. Modification of the outflow from Big Spring, the type locality of Big Spring spinedace, along with the introduction of nonnative fish species resulted in the extirpation of Big Spring spinedace from this habitat. Big Spring spinedace are relatively abundant within Condor Canyon, but this population is vulnerable to natural catastrophic events, human-induced habitat modifications, and nonnative species introductions. Any reduction in Big Spring spinedace population density or distribution, loss or modification of occupied habitat, or increased threats could warrant changing the subspecies' status to endangered.

Meadow Valley Wash desert sucker and Meadow Valley Wash speckled dace are category 2 candidates for possible future Federal listing as threatened or endangered species. The U.S. Fish and Wildlife Service (Service) has information indicating that proposing to list these fishes is possibly appropriate, but substantial data on biological vulnerability and threats are not currently available to support preparation of a proposed rule. Consequently, this recovery plan addresses the needs of Big Spring spinedace and the

entire aquatic **ecosystem** of Meadow Valley Wash near Panaca, Nevada.

B. Species Description

The Plagopterini tribe of cyprinid fishes includes the monotypic genera Meda (spikedace) and Plagopterus (woundfin), and the polytypic genus Lepidomeda (spinedace). Members of this tribe (Table 1) are distinguished from other cyprinids by: 1) The spinelike character of the pelvic and pectoral fin rays, and the two anterior dorsal fin rays; 2) a membranous connection between the inner most ray of the pelvic fins and the belly; 3) bright silver coloration; and 4) the absence or diminutive development of body scales (Miller and Hubbs 1960). Plagopterin fishes are among the few North American cyprinids that are not known to hybridize with other genera (Hubbs 1955).

Spinedace are the most generalized and diverse of the plagopterin genera. Spikedace and woundfin presumably arose from spinedace within the Colorado River system (Miller and Hubbs 1960). Spinedace chromosome morphology more closely resembles that of the fishes in the genus Gila or some other similar genus, then that of spikedace or woundfin (Uyeno and Miller 1973). Spinedace have weakly developed dorsal and pectoral fin spines, as compared to the strongly developed spines of spikedace and woundf in. Spinedace also possess diminutive scales, whereas spikedace and woundfin are scaleless (Miller and Hubbs 1960).

Big Spring spinedace were described by Miller and Hubbs (1960) following a review of the existing classification of the various spinedace populations. Three new species of spinedace, one with two subspecies, were identified, and the two previously recognized spinedace species were synonymized into one. The Middle Colorado spinedace (Table 1) are distinguished by: 1) A pharyngeal tooth

Table 1: Members of the Plagopterini tribe of cyprinid fishes, as described by Miller and Hubbs (1960), with their status and historic distribution.

Common Name / Scientific Name	Status*	Distribution
Spikedace, Meda fulgida	Threatened	-Gila River system; Arizona, New Mexico
Woundfin, Plagopterus argentissimus	Endangered	-Virgin River system; Utah, Arizona, Nevada -lower Gila River system, Arizona (extirpated)
Little Colorado spinedace, Lepidomeda vittata	Threatened	-headwaters Little Colorado River system, Arizona
Pahranagat spinedace, Lepidomeda altivelis	Extinct	-Ash Spring outflow and Upper Pahranagat Lake, Lincoln County, Nevada (extirpated)
White River spinedace, Lepidomeda albivallis	Endangered	-North Flag Spring, Nye County, Nevada -Preston Big Spring, Nicholas Spring, Arnoldson Spring, Cold Spring, Lund Spring, and the White River; White Pine County, Nevada (extirpated)
Middle Colorado spinedace, Lepidomeda mollispinis		
Virgin River spinedace, L. m. mollispinis	Candidate	-Virgin River system; Utah, Arizona, Nevada
Big Spring spinedace, L. m. pratensis	Threatened	-Meadow Valley Wash (Condor Canyon section), Lincoln County, Nevada -Big Spring outflow, Lincoln County, Nevada (extirpated)

*as listed under the Endangered Species Act of 1973, as amended (50 CFR §17.11)

formula of 5-4 in the main row; 2) a relatively weak and soft-tipped second dorsal spine; 3) 9 anal rays; 4) typically less than 90 scales in the lateral line; 5) length of the dorsal fin when depressed is less than head length; 6) sides of the body mostly silvery; and 7) melanophores confined to the upper half of the opercle and to the upper part of the ascending limb of the preopercle (Miller and Hubbs 1960). Big Spring spinedace are differentiated from Virgin River spinedace by having a higher, more pointed dorsal fin; longer pelvic fins; and a smaller, more oblique mouth (Miller and Hubbs 1960). None of the members of the spinedace genus have overlapping distributions; therefore, they can be identified in the field based on location.

Big Spring spinedace are bright silver in color, with some individuals having yellow-to-orange at the axils of paired fins, base of the anal fin, upper edge of the shoulder girdle, vertical arm of the preopercular bone, and above the mouth. Specimens collected from the outflow of Big Spring in 1938 ranged from 48 to 56 millimeters total length (Miller and Hubbs 1960). Allan (1985) captured Big Spring spinedace from Meadow Valley Wash in Condor Canyon varying from 48 to 93 millimeters total length. Two male Big Spring spinedace collected from within Condor Canyon in 1986 exceeded 110 millimeters total length (Withers 1986).

The presence of nuptial tubercles on Big Spring spinedace was not specifically noted by Miller and Hubbs (1960), although this feature was common on the Virgin River spinedace specimens they examined. Nuptial tubercles were noted on Big Spring spinedace collected from Meadow Valley Wash in Condor Canyon in 1990 (Langhorst 1991).

C. Distribution and Population Status

Members of the Plagopterini tribe are restricted to the Colorado River drainage system of Arizona, New Mexico, Nevada, and Utah

(Miller and Hubbs 1960). These fishes were widespread until manipulation of habitats and introduction of nonnative fish species caused severe population declines (Miller 1961). Within this tribe, one species is extinct (Miller and Hubbs 1960) and all but one of the remaining six taxa are federally listed as threatened or endangered species (50 CFR 17.11) (Table 1).

The highly localized distribution of the various spinedace species and subspecies indicates a limited ecological tolerance within the genus Lepidomeda and that its previous distribution was more extensive (Miller and Hubbs 1960). Big Spring spinedace currently persist in a portion of Meadow Valley Wash, a remnant of the pluvial Lake Carpenter system. Pluvial Lake Carpenter existed 10,000 to 40,000 years ago in what is now called Lake Valley. Lake Carpenter was drained by the pluvial Carpenter River, along the course of present day Meadow Valley Wash, which combined with the pluvial White River to flow into the Colorado River (Hubbs and Miller 1948; Hubbs, et al. 1974). As the Lake Carpenter system dried, the resident fish species were restricted to those remnant habitats which contained water. Today, Meadow Valley Wash is formed by the confluence of streams from Camp Valley and Duck (Lake) Valley, and extends south to join the Muddy River at Moapa, Nevada (Hubbs and Miller 1948). Historically, the Big Spring outflow joined with Meadow.Valley Wash.

Big Spring spinedace were first collected in 1938 from the outflow stream of Big Spring (also referred to as Panaca Spring and Panaca Big Spring) (Figure 1) and its adjacent wet meadow near Panaca, Nevada (Miller and Hubbs 1960). At that time, prolonged seining effort produced only seven Big Spring spinedace, indicating this fish was already uncommon. No Big Spring spinedace were collected from the Big Spring pool. Thirty-one Meadow Valley Wash desert suckers and 312 Meadow Valley Wash speckled dace were also collected.

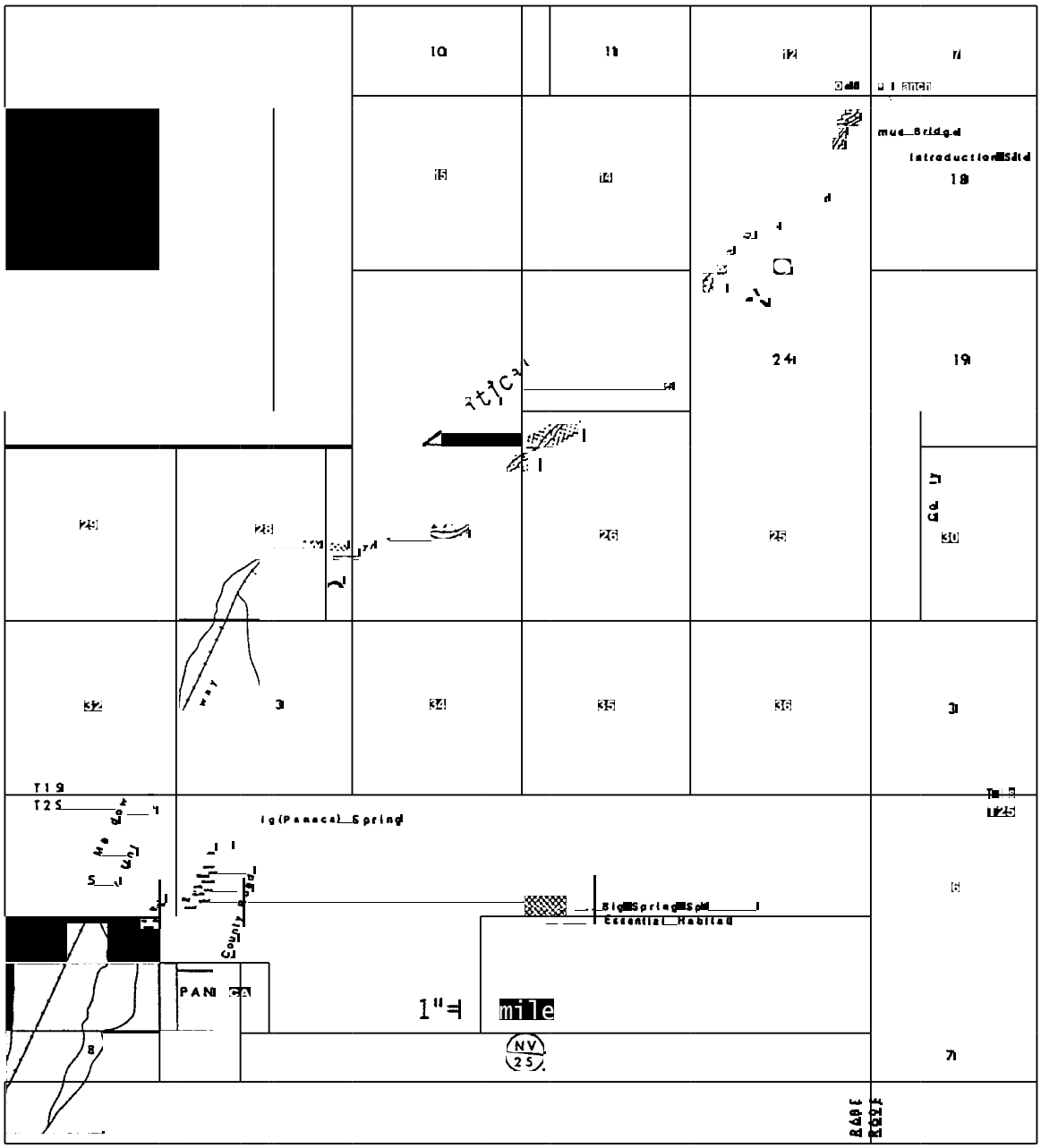

Figure 1: Big Spring spinedace type locality, designated critical habitat, and the Condor Canyon essential habitat area.

Miller and Hubbs (1960) reported that field studies conducted between 1938 and 1959 indicated that no populations of Big Spring spinedace persist in any remnant of the pluvial Carpenter River. Their field studies covered almost 100 miles of the Meadow Valley Wash drainage, and included sample sites above and below Big Spring. North of Big Spring, sample sites included the headwaters and springs of Camp Valley Wash, and the unnamed waters in the canyon between Spring Valley and Eagle Valley. Meadow Valley Wash was sampled 2 miles south of Panaca, at Caliente, and at additional points downstream to within 14 miles of Moapa. Meadow Valley Wash desert suckers and Meadow Valley Wash speckled dace were the only native fish species collected. Clover Creek, the primary eastern tributary to Meadow Valley Wash, was thoroughly sampled in 1950 and 1959 but no Big Spring spinedace were collected. The Big Spring spinedace was considered extinct before it was described (Miller and Hubbs 1960). The survey reports suggest, however, that Meadow Valley Wash through Condor Canyon, immediately north of Big Spring, was not inventoried.

While conducting a fisheries inventory of Meadow Valley Wash in September 1977, Nevada Department of Wildlife (NDOW) personnel collected juvenile Big Spring spinedace from a large plunge pool beneath a 50-foot waterfall in Condor Canyon, approximately 1.5 miles north of Big Spring (Allan 1983). Juvenile Big Spring spinedace were abundant although apparently under environmental stress based on their small size and thin bodies. In 1980, larval Big Spring spinedace were transplanted from the waterfall plunge pool to small instream pools 1 mile above the waterfall (Allan 1985).

Adult Big Spring spinedace were collected from the transplant site during the spring of 1981, but it is not known if Big Spring spinedace occurred above the waterfall prior to the transplant (Allan 1985). The waterfall itself may have been created during the construction of the Union Pacific Railroad Company track

through Condor Canyon. Regardless, the original stream gradient in this section of the canyon may have been steeper than adjacent areas and impeded upstream fish migration (Allan 1985).

During 1984, five sites within Condor Canyon were sampled, but Big Spring spinedace were only present at the transplant site (Allan 1985). Meadow Valley Wash desert suckers and Meadow Valley Wash speckled dace were present at all sites. A total of 204 Big Spring spinedace were collected from 11 of 15 sites sampled in May 1986 along approximately a 4.5-mile section of Meadow Valley Wash above and within Condor Canyon (Withers 1986). Big Spring spinedace were most abundant in and near the transplant site pools; 97 were captured from two **pools.** Meadow Valley Wash desert suckers and Meadow Valley Wash speckled dace were collected throughout the canyon. A total of 546 Big Spring spinedace were captured from 13 sample sites within Condor Canyon during November 1990, but a total population estimate is unavailable (Langhorst 1991). No searches have been conducted to determine if Big Spring spinedace have moved out of Condor Canyon to recolonize the Big Spring outflow.

D. Critical and Essential Habitats

Critical habitat, as defined by section 3 of the Endangered Species Act of 1973, as amended (Act), includes: 1) the specific areas, within the geographical area occupied by a species at the time of its listing under the Act, which contain those physical or biological features essential to the conservation of the species and which may require special management considerations or protection; and 2) specific areas, outside the geographical area occupied by the species at the time it is listed, which are determined to be essential for the conservation of the species.

Big Spring spinedace critical habitat, designated under the same rule listing the fish as a threatened species (50 Federal **Register**

12298), encompasses 4 stream miles of Meadow Valley Wash and a 50-foot riparian zone along each side of the stream as it flows through Condor Canyon (T. 1 S., R. 68 E., sections 13, 23, 24, 26, 27, and 28; Mount Diablo Meridian) (Figure 1). Critical habitat begins at the north end of the canyon and continues downstream through the canyon, crossing land managed by the Bureau of Land Management (Bureau) and private land. The primary constituent elements of this critical habitat include: 1) Clean, permanent, flowing, spring-fed stream habitat with deep pool areas and shallow marshy areas along the shore; and 2) the absence of exotic fishes.

For the purposes of this recovery plan, additional stream habitat at Condor Canyon and two other presently unidentified stream habitats disjunct from Condor Canyon are deemed essential for the recovery of the Big Spring spinedace. Condor Canyon essential habitat extends beyond the Big Spring spinedace critical habitat approximately 0.75-mile upstream and 0.25-mile downstream, for a total length of 5 miles (Figure 1). Essential habitat begins at that point where water flow in Meadow Valley Wash surfaces north of Condor Canyon and terminates at that point where water is currently diverted by water right holders. Essential habitat includes the springs within or adjacent to the stream which sustain the flow in this section of Meadow Valley Wash and the pools into which Big Spring spinedace were transplanted in 1977. Big Spring spinedace are present throughout the essential habitat area at Condor Canyon.

Recovery of Big Spring spinedace requires the establishment of two additional populations, preferably with at least one population within the Meadow Valley Wash drainage system but disjunct from Condor Canyon. Big Spring and its associated meadow is the only historic habitat known for Big Spring spinedace. The feasibility of reestablishing a population of Big Spring spinedace in its type locality should be determined. Introduction sites should be

located so that a catastrophic event will not simultaneously eliminate or significantly reduce more than one population. Selection of suitable sites should be guided by the results of research delineating Big Spring spinedace life history and habitat requirements.

E. Life History and Habitat Requirements

Life history and habitat requirements of Big Spring spinedace are poorly understood. What little information is available comes from field observations made during collecting efforts or status surveys. Results from research conducted on other spinedace taxa should only be cautiously applied to Big Spring spinedace because the habitats selected by other spinedace may differ. Research specifically designed to identify the life history and habitat requirements of Big Spring spinedace is critical to the recovery of this subspecies.

Meadow Valley Wash presently flows through Condor Canyon as a small perennial stream, averaging 9 feet wide and 0.6-foot deep with an average gradient of 1.6 percent (Bureau of Land Management 1990). The stream is well confined within steep rock and soil formations, and often moderately to deeply entrenched. The meander of the **stream is** further restricted by a railroad bed levee.

The course of Meadow Valley Wash is interrupted by several reservoirs and irrigation diversions, and often becomes subterranean for varying distances. Those stretches which remain watered throughout the year depend on spring discharge to maintain water flow. Delmue Springs, just above the northern end of Condor Canyon, provides a base flow of approximately 200 gallons per minute (gpm) (Garside and Schilling 1979). Flow measurements taken during a 1987 aquatic inventory of Condor Canyon ranged from 2.2 cubic feet per second (cfs) (980 gpm) to 6.9 cfs (3,100 gpm)

(Bureau of Land Management 1990). Unpublished U.S. Geological Survey records indicate that Big Spring (referred to as Panaca Spring) produced 6,300 gpm in 1946, but had dropped to 4,900 gpm by 1963.

Big Spring spinedace collected in 1938 occupied the outflow stream and associated marsh areas below Big Spring, but not the springhead itself (Miller and Hubbs 1960). On July 10, 1938, with an air temperature of 94° Fahrenheit, water temperature of the stream within the meadow area was 84° Fahrenheit in a channel 1 to 3 feet wide and up to 2 feet deep. The current was slight over most of the stream course, but occasionally swift. Stream bottom substrate consisted of firm to soft clay with some gravel. Aquatic vegetation consisted of watercress (Rorippa), pondweed (Potamageton), and rushes (Scirpus). By 1959, when the Big Spring spinedace was reported extirpated, the stream channel had become clogged with silt and a variety of submergent and emergent vegetation which had not been present in 1938 (Miller and Hubbs 1960). Big Spring spinedace collected in Condor Canyon by Allan (1985) were found in areas 1 to 3 feet deep, with moderate to slow currents, undercut banks, and floating aquatic vegetation. Big Spring spinedace's apparent preference for vegetated habitats is suggested by its subspecific epithet, pratensis, which is of Latin derivation and means "pertaining to or growing in a meadow" (Miller and Hubbs 1960).

Big Spring spinedace spawning has never been observed, and spawning habitat requirements are unknown. Rinne (1971) observed Virgin River spinedace (Lepidomeda mollispinis mollispinis) spawning in the Santa Clara River of Utah in May and June. According to Minckley (1973), Virgin River spinedace spawn during spring and early summer. Juvenile Big Spring spinedace (15 millimeters total length) were observed in Condor Canyon in September 1980 (Allan 1985). Langhorst (1991) reported that 18 of 39 Big Spring spinedace collected during late May 1990 exhibited

some form of spawning condition, such as tuberculation on the head or orange coloration on the paired fins. No spawning activity or young-of-the-year Big Spring spinedace were observed. By early July 1990, only 1 of 14 Big Spring spinedace collected exhibited spawning condition. Again no spawning was observed, but young-of-the-year Big Spring spinedace were collected from dense watercress patches along the stream banks. Less than 1 percent of 241 Big Spring spinedace collected during the first week of August 1990 exhibited spawning conditions, but young-of-the-year Big Spring spinedace (average 37 millimeters total length) were common.

Big Spring spinedace food preferences and feeding habits are unknown. However, the closely-related Virgin River spinedace is an opportunistic feeder. It forages primarily on aquatic insect larvae, but also consumes algae and other plant material when insects are scarce (Rinne 1971; **Minckley** 1973). Allan (1985) suggested that vegetation, especially watercress, is important in providing habitat for aquatic insects and other invertebrates which Big Spring spinedace consume for food. Little is known about the life history and habitat relationships between Big Spring spinedace, Meadow Valley Wash desert suckers, and Meadow Valley Wash speckled dace.

F. **Reasons for Decline and Current Threats**

The Service determined the Big Spring spinedace to be a threatened species and designated its critical habitat on March 28, 1985 (50 Federal Reaister 12298) because one population had been eliminated and the remaining population was potentially threatened by habitat alteration and introduction of exotic species. In addition, the limited distribution of the existing Condor Canyon population makes the Big Spring spinedace vulnerable to extirpation by a major flood or severe drought. The Service determined that threatened status was appropriate for this subspecies because it was **in no immediate danger of extinction, but was likely to become**

endangered if trends in population declines and habitat alteration continued.

Miller and Hubbs (1960) attributed the eradication of Big Spring spinedace and Meadow Valley Wash desert suckers from the outflow of Big Spring to the introduction of nonnative species and the diversion of water, with occasional desiccation of both the original outflow and the diversion ditch. By 1959, Big Spring had been dammed and a ditch constructed to divert the spring outflow for irrigation. The abandoned natural channel had become clogged with silt and vegetation. Intensive and thorough seining of all remaining open water in 1959 revealed large concentrations of Meadow Valley Wash speckled dace but no other native fishes. The nonnative mosquitofish (Gambusia affinis) had become firmly established, and nonnative bullfrogs (Rana catesbiana) greatly outnumbered the native leopard frog (Rana pipens) (Miller and Hubbs 1960).

Because of the limited distribution of Big Spring spinedace, it vulnerable to events which may severely reduce or extirpate the population within Condor Canyon. Several potential threats to the population have been identified. At the time the Big Spring spinedace was listed as a threatened species, no nonnative species were known to occur in the Condor Canyon section of Meadow Valley Wash. Since then, an unidentified nonnative crayfish has become firmly established throughout Condor Canyon, and limited numbers of largemouth bass (Micropterus salmoides), rainbow trout (Oncorhynchus mykiss), and white crappie (Poxomis annularis) have been collected from Condor Canyon (Withers 1986, 1987a, 1987b, 1988). There is no indication that the nonnative fishes have become established. Nonnative aquatic species may be detrimental to the native fishes due to predation, competition for available resources, and transmission of parasites or diseases.

Landownership in Condor Canyon consists of a checkerboard of Bureau and private land. Some property boundary fences have been constructed within Condor Canyon. These fences may concentrate livestock use within the riparian corridor and result in degraded aquatic habitat. Cooperation of the private landowners will be essential to a long-term maintenance of the riparian corridor.

In 1984, the Union Pacific Railroad removed the tracks from its railway that passed through Condor Canyon. Although the railroad tracks were removed, the trestles and railroad levee were left intact, creating a road through the canyon where none had been previously. Because the Union Pacific Railroad has not formally abandoned its 200-foot-wide right-of-way through Condor Canyon, it is still responsible for the right-of-way. The Bureau cannot impose management on the right-of-way until it is relinquished back to the Federal government (Bureau of Land Management 1990).

Public use of the canyon has significantly increased since the railroad tracks were removed. The riparian habitat of Condor Canyon has been impacted by vehicle use off the railroad bed and from tree cutting. Two railroad trestles have been destroyed by suspected arson fire. The effect of these fires on the aquatic environment has not been evaluated. Easy access into the canyon also increases the risk of nonnative species introductions.

Several empty pesticide containers were found in the stream at the Delmue Bridge, above the north end of Condor Canyon. No evidence of a fish kill was observed, but the incident emphasizes the vulnerability of this single population to the release of toxic substances into the stream.

An unidentified individual modified the stream channel in the lower end of Condor Canyon with a bulldozer. No reason for this activity could be determined, other than it may have been an

attempt to create a crossing for the bulldozer, which was too large to cross a nearby trestle.

Three valid mining claims exist in Condor Canyon. The legal descriptions of all claims overlap with Big Spring spinedace critical habitat. These claims are presently inactive, and the exact locations of the work sites are unknown (Bureau of Land Management 1990). Should these mining claims be activated, stream habitat may be disturbed or destroyed.

Because maintenance of adequate water flow in Meadow Valley Wash through Condor Canyon depends on adequate spring flow, future ground water depletion due to development of water wells within the ground water system supporting the Condor Canyon springs could adversely affect the aquatic ecosystem. Due to the nature of the canyon, diversion of water from the stream channel is not feasible. Four water rights have been granted by the Nevada State Water Engineer for Meadow Valley Wash water at Condor Canyon. One is an instream flow right, reserved for Big Spring spinedace; the remaining three are for irrigation of lands below the south end of the canyon. Irrigation water is diverted from the stream course at the lower end of the canyon.

G. Conservation Efforts

The Big Spring spinedace was federally listed as a threatened species with critical habitat in March 1985. The final rule (50 Federal Register 12298) included a special rule allowing take of Big Spring spinedace for scientific purposes in accordance with State laws and regulations, which prohibit taking of protected species without a valid State collecting permit. The Nevada Board of Wildlife Commissioners recognizes the Big Spring spinedace as a protected species (Nevada Revised Statutes 503.065).

Conservation efforts for the Big Spring spinedace have been ongoing since the subspecies was rediscovered. The Nature Conservancy purchased 40 acres in Condor Canyon immediately below the waterfall plunge **pool** in December 1981. This property includes 0.16 miles of Meadow Valley Wash. The Nature Conservancy was also granted an instream flow water right of 0.31 cubic feet per second, which applies to the stream through the entire length of Condor Canyon to the point of diversion for the other water rights. This water right was based on measured flow during low-flow conditions in midsummer.

The Bureau began a thorough inventory of the aquatic habitat and associated riparian zone within Condor Canyon in 1987. This effort included implementation of stream survey and riparian transect methodology, an aerial infrared photographic survey, water quality monitoring, and a botanical inventory. The Bureau contracted the University of Nevada, Las Vegas and The Nature Conservancy to monitor water quality and to conduct a botanical inventory, respectively. The botanical inventory found a high diversity of vegetative species within both the riparian and upland communities (Bureau of Land Management 1990).

In July 1987, 75 Big Spring spinedace were released into a refugium pond within the **Bureau's** Shoshone Pond Resource Area in White Pine County (Withers 1987b). This transplant was undertaken as an emergency protective measure after largemouth bass were found in Big Spring spinedace habitat. The success of the July 1987 release has not been determined. Although no Big Spring spinedace were captured from the refugium pond in July 1988 or July 1991 (Withers 1988, Heinrich 1991), six adult Big Spring spinedace were reportedly captured in August 1989 (Sjoberg 1989).

NDOW personnel have manually removed all nonnative fish encountered in Condor Canyon (Withers 1986, 1987a, 1987b). In 1989, NDOW initiated a study of the population status and habitat

preference of the Big Spring spinedace. This study was partially funded by the Service through section 6 of the Act. The final project report is still pending.

The Bureau published the Condor Canyon Habitat Management Plan (HMP) in 1990. This HMP is designed to maintain or improve habitat conditions for Big Spring spinedace, and includes objectives to enhance the quality and quantity of habitat elements needed by Big Spring spinedace. The Bureau recognizes that the continued existence of Big Spring spinedace depends on maintaining the Condor Canyon ecosystem. The **HMP** identifies the Bureau's intent to: 1) Exclude livestock grazing within Condor Canyon between March 15 and November 15, and limit allowable vegetation utilization; 2) limit casual vehicle use to the railroad bed and prohibit organized competitive or non-competitive vehicle events; 3) file for unappropriated spring water and instream flow rights; and 4) install stream flow gauging stations (Bureau of Land Management 1990).

The Bureau has sought the consultation of the Service relative to actions which may affect the Big Spring spinedace, including livestock grazing, the **HMP,** and equestrian endurance rides. The Federal Highway Administration, through the Nevada Department of Transportation, consulted with the Service prior to authorizing the use of Federal cost-share monies to replace the Delmue Bridge, which crosses the Meadow Valley Wash above the north end of Condor Canyon.

II. RECOVERY

A. Objective

The objective of the Big Spring Spinedace Recovery Plan is to enhance the status of the subspecies so that it may be removed from the Federal list of endangered and threatened species. Big **Spring** spinedace may be delisted when: 1) The Condor Canyon population is self-sustaining and secure from all threats for at least 5 consecutive years; and 2) two additional self-sustaining populations are established and secured from all threats for at least 5 consecutive years. At least one population should be located within the Meadow Valley Wash drainage system, but disjunct from Condor Canyon, to minimize the likelihood of a catastrophic event significantly affecting more than one population. Emphasis should be placed on reestablishing a population at Big Spring.

The characteristics of each population and the extent of habitat needed to support it will be determined by research conducted during the course of this .recovery effort. These objectives will be accomplished with full consideration given to the needs of the Meadow Valley Wash desert sucker and Meadow Valley Wash speckled dace such that no activity taken.to improve the status of Big Spring spinedace will be detrimental to the long-term status of these candidate species.

The recovery criteria are preliminary and may be revised on the basis of new information, including that obtained from research specified as recovery tasks in this plan. The recommended chronology for each of the recovery tasks identified in the Narrative is found in the Implementation Schedule. The estimated date of recovery is 2006.

B. Narrative

1. Secure Condor Canyon essential habitat

Survival of Big Spring spinedace depends on protection of the existing population and its habitat in Meadow Valley Wash at Condor Canyon.

11. Obtain private landowner cooperation

Continuous and consistent protection of Big Spring spinedace essential habitat at Condor Canyon requires securing the cooperation of all private landowners within the area. Conservation agreements may be negotiated with landowners to ensure habitat protection and access for management activities. Private land parcels may also be acquired in fee title from willing sellers.

12. Acquire instream flow water rights

Although The Nature Conservancy maintains an instream flow water right through Condor Canyon, this flow may be insufficient to meet the needs of Big Spring spinedace. Research delineating instream water flow requirements of Big Spring spinedace will be needed. If research indicates that additional base flows are needed, management agencies should pursue acquisition of additional nonconsumptive, instream flow water rights. The ground water aquifer supporting the springs which provides the base flow for the Condor Canyon segment of Meadow Valley Wash should also be protected.

13. Implement Condor Canyon Habitat Management Plan

The Bureau's Condor Canyon HMP includes objectives, planned actions, and facilitating actions which, when implemented, should protect Big Spring spinedace habitat on land managed by the Bureau.

14. Control nonnative aquatic species

Diligent efforts must be made to remove or control individuals or populations of nonnative aquatic species to eliminate or minimize predation on and/or competition with Big Spring spinedace and the other native fish species. Eradication methods selected must fully consider direct and indirect effects on the entire aquatic ecosystem. Methods to prevent immigration of nonnative *fish* species from upstream reservoirs and impoundments should be evaluated and implemented if feasible.

2. Identify **ecological** parameters

Knowledge of the ecological parameters of the Condor Canyon Big Spring spinedace population is necessary to: 1) Identify factors limiting the Condor Canyon population; 2) guide management activities; 3) evaluate possible sites for the establishment of additional Big Spring spinedace populations; and 4) assess the potential impacts of future proposed actions on the subspecies.

21. Determine life history and habitat requirements

Data specific to Big Spring spinedace habitat and feeding requirements, reproductive behavior, and demographic parameters such as reproductive rates, age structure, and population growth rates need to be acquired.

22. Determine species interactions

Caution must be exercised to avoid implementing management actions which benefit Big Spring spinedace at the expense of any cohabiting native species. Determination of life history and habitat requirements of Meadow Valley Wash desert sucker and Meadow Valley Wash speckled dace will be necessary to identify possible conflicts. Behavioral observations will be necessary to **determine** the influence of interspecific interactions on community structure and its implications to the establishment of additional Big Spring

spinedace populations. Removal and/or control of **nonnative** species, without detrimental effects to native fish populations, will be facilitated by an understanding of the life history and habitat requirements of the **nonnative** species, and interactions between native and **nonnative** species.

23. Evaluate **genetic** status

The genetic status of Big Spring spinedace existing both above and below the Condor Canyon waterfall should be evaluated. The results of such an effort may dictate future management of the Condor Canyon population.

24. Conduct minimum viable population analysis

A population viability analysis should be conducted to determine: 1) The size of habitat necessary to maintain a self-sustaining population of Big Spring spinedace; 2) the number of Big Spring spinedace needed to establish a new population; 3) the number of Big Spring spinedace that can be removed from the parent population at any one time without risking extirpation; and 4) the parameters of a self-sustaining Big Spring spinedace population.

3. Establish additional populations

Due to the vulnerability of the Condor Canyon population of Big Spring spinedace to catastrophic natural events or human-induced habitat perturbations, this recovery **effort** requires the establishment of two additional populations. At least one should be established within the Meadow Valley Wash drainage system, but disjunct from the Big Spring-Condor Canyon system. Big Spring spinedace have been extirpated from the Big Spring outflow stream and its associated marsh, the only documented historic habitat that is currently unoccupied. Efforts should be made to return this subspecies to this habitat.

31. Select introduction habitats

Information collected during life history and habitat requirements research will be utilized to evaluate stream systems as potential introduction sites. Selection of suitable habitats should consider existing habitat conditions, aquatic species composition, land and water uses, landownership, and other potential conflicts. Suitable habitats must be of sufficient size to support a self-sustaining population of Big Spring spinedace, and conflicts must be resolvable. Habitats receiving Big Spring spinedace should be free of or possess only those fish diseases, parasites, or other pathogens which also occur in Condor Canyon and are not detrimental to other native fishes. Measures should be implemented to prevent the spread of diseases and parasites.

32. Secure selected habitats

Cooperation of all landowners and/or Federal land management agencies within the introduction area must be secured to ensure continuous and consistent protection of the habitat. Conservation agreements may be negotiated with landowners to ensure habitat protection and access for management activities. Private land parcels may also be acquired in fee title from willing sellers- Federal land management agencies should pursue acquisition of non-consumptive instream flow water rights to ensure sufficient water remains in introduction habitats to meet the needs of Big Spring spinedace. The ground water aquifer which supports each habitat should also be protected.

33. Prepare and implement habitat management plan

If introduction habitats include lands administered by a Federal agency, habitat management plans should be prepared to provide protection and management guidelines. The plans should be based on the most recent data available on Big

Spring spinedace, flexible enough to be modified as new data are acquired, and should consider the effects of management activities on all native species.

34. Rehabilitate introduction habitats

Introduction habitats may need improvement prior to release of Big Spring spinedace. Information on life history and habitat requirements of Big Spring spinedace will guide these efforts. Nonnative species should be removed or controlled, and steps should be taken to prevent further invasions of nonnative aquatic species.

35. Establish populations

Big Spring spinedace transplanted should be free of parasites and diseases. Mortality of transplanted fishes has been attributed to the activation of latent infections or parasite infestations due to handling and other stress-related factors. Selection of fish to release and timing of the release should take into consideration reproduction potential and natural mortality factors. Several releases may be necessary to establish each population. Positive evidence of population establishment may not be realized for several years.

4. Monitor all populations and habitats

The stability and health of Big Spring spinedace populations can only be assessed by annual monitoring to determine population size, age-class structure, and distribution. Monitoring will be necessary to determine the success of efforts to establish Big Spring spinedace populations. Monitoring should be scheduled during the spring and autumn to evaluate over-winter survival and recruitment. Regular monitoring will also provide information relative to occurrence and abundance of coexisting native and nonnative species. Habitat quality and quantity should also be evaluated regularly. Information collected will be utilized to

identify potential problems in a timely manner, guide management activities, and permit an analysis of the effectiveness of recovery programs. Ultimately this information will be utilized to determine whether or not recovery has been accomplished.

5. Establish and maintain a public information program

A public information program should be developed to inform local residents and other interested parties of the protected status of Big Spring spinedace and the importance of ongoing recovery efforts. The Lincoln County Board of Commissioners, Nevada State Office of the Bureau, and NDOW, as well as appropriate local area offices, will be continually involved in and updated on all aspects of this recovery effort. Appropriate information relative to the status of Big Spring spinedace and the ongoing recovery effort should be provided for release via newspapers, television, radio, etc.

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III. IMPLEMENTATION SCHEDULE

This implementation schedule outlines actions and estimated costs for the recovery of Big Spring spinedace. It is a guide for meeting the objective discussed in Part II of this recovery plan. This schedule indicates task priorities, numbers, and descriptions; duration of each task; responsible agencies; and estimated costs. These actions, when accomplished, should bring about the recovery of Big Spring spinedace and protect its habitat. It should be noted that the estimated monetary needs for all parties involved in recovery are identified and, therefore, this schedule reflects the total estimated financial requirements for the recovery of this species.

In the implementation schedule, tasks are arranged in priority order. The assigned priorities are defined as follows:

Priority 1 - An action that must be undertaken to prevent extinction or to prevent Big Spring spinedace from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be undertaken to prevent a significant decline in Big Spring spinedace population distribution or size, or habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to meet the recovery objective.

The following abbreviations are utilized in the implementation schedule:

Task Duration

Cont. = The action will be implemented continually once begun.

Ongoing	=	Currently being implemented and will continue until no longer necessary for recovery.
Responsible Party		
		Lead Agency
BLM	=	U.S. Bureau of Land Management, Reno, Nevada
FWS-APA	=	U.S. Fish and Wildlife Service, Public Affairs Office, Region 1
FWS-EHC	=	U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation, Region 1
FWS-EN	=	U.S. Fish and Wildlife Service, Division of Engineering, Region 1
FWS-RE	=	U.S. Fish and Wildlife Service, Division of Realty, Region 1, Portland, Oregon
NDOW	=	Nevada Department of Wildlife, Reno
TNC	=	The Nature Conservancy, Salt Lake City, Utah
Total Cost	=	Projected cost of task from start to finish.
TDB	=	To Be Determined at a later date

Recovery Plan Implementation Schedule for Big Spring Spinedace

OR-Y	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
	11	Obtain landowner cooperation	TBD	FWS-EHC* BLM	TBD	TBD	TBD	TBD											
	12	Acquire instream water rights	3	BLM* TNC NDOW FWS-EN	6	2	2	2											
	13	Implement Habitat Management Plan	Ongoing	BLM	14	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	14	Control nonnative species	3	NDOW* FWS-EHC	9	3	3	3											
		Cost need 1 (Secure Condor Canyon essential habitat)			29	6	6	6	1	1	1	1	1	1	1	1	1	1	
	21	Determine life history & habitat requirements	3	NDOW* FWS-RES	36	12	12	12											
	22	Determine species interactions	3	NDOW* FWS-RES	12	4	4	4											
	23	Evaluate genetic status	1	NDOW* FWS-RES	5		5												
	24	Conduct minimum viable population analysis	1	NDOW* FWS-RES	15			15											

Recovery Plan Implementation Schedule for Big Spring Spinedace

OR-DER	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
		Cost need 2 (Identify ecological parameters)			68	16	21	31	0	0	0	0	0	0	0	0	0	0	0
	31	Select introduction habitats	3	FWS-EHC* NDOW BLM	9				3	3	3								
	32	Secure selected habitats	TBD	FWS-EHC* BLM	TBD					TBD	TBD	TBD							
	33	Develop and implement habitat management plans	Cont.	BLM* FWS-EHC	12					2	2	1	1	1	1	1	1	1	1
	34	Rehabilitate intro-duction habitats	TBD	BLM* FWS-EHC NDOW	TBD					TBD	TBD	TBD	TBD						
	35	Establish populations	4	NDOW* FWS-EHC	8						2	2	2	2					
		Cost need 3 (Establish additional populations)			29	0	0	0	3	5	7	3	3	3	1	1	1	1	1
	4	Monitor populations and habitats	Cont.	NDOW* BLM FWS-EHC	22	1	1	1	1	1	1	2	2	2	2	2	2	2	2
		Cost need 4			22	1	1	1	1	1	1	2	2	2	2	2	2	2	2

Recovery **Plan Implementation Schedule** for Big Spring Spinedace

IOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES ($1,000) FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
		(Monitor **all populations** and habitats)																	
3	5	**Establish** information program	Cont.	**FWS-APA*** NDOW	20	5	3	1	1	1	1	1	1	1	1	1	1	1	1
		Cost need 5 **(Establish** and maintain **public information** program)			20	5	3	1	1	1	1	1	1	1		1	1	1	
				Total Costs:	168	28	31	39	6	8	10	7	7	7	5	5	5	5	5