Railroad Valley Springfish
Crenichthys nevadae

5-Year Review:
Summary and Evaluation

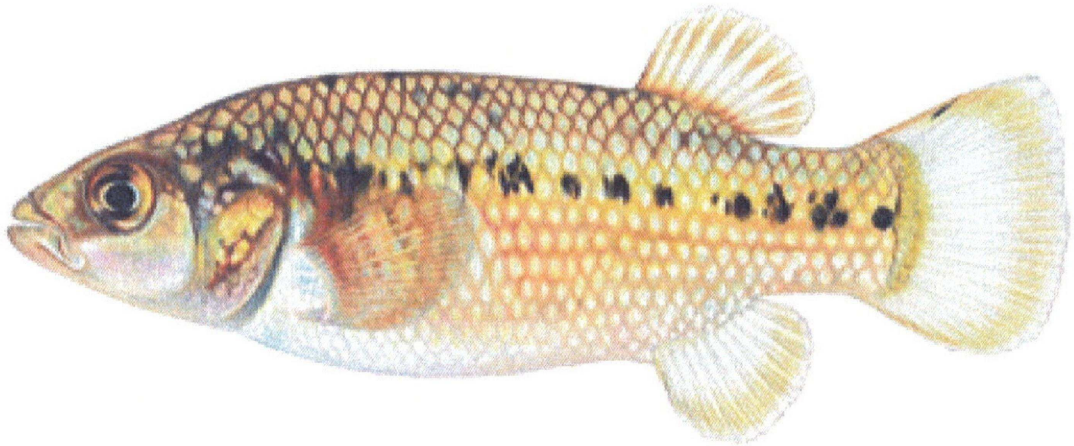

Illustration by Joseph R. Tomelleri

U.S. Fish and Wildlife Service
Nevada Fish and Wildlife Office
Reno, Nevada

August 18, 2009

5-YEAR REVIEW

Railroad Valley springfish (*Crenichthys nevadae*)

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Species Overview:

The Railroad Valley springfish (*Crenichthys nevadae*; RRVS) is a member of an unusual taxonomic group (*Empetrichthyidae*) comprised of the genera *Crenichthys* and *Empetrichthys*, both endemic to Nevada (Scoppettone 2002). Railroad Valley springfish have distinct coloration from other species of springfish because of a single row of lateral dark spots along their sides. The average total length of RRVS varies between 22.9 and 38.1 millimeters (mm) (0.9 and 1.5 inches [in]) depending on the population, although individuals may attain a total length exceeding 71.1 mm (2.8 in). This species historically is known from six spring systems, in two areas of Nye County, Nevada, representing the remnants of pluvial Lake Railroad. Railroad Valley springfish are indiscriminant and opportunistic feeders, which is demonstrated by their change in food sources from season to season (Williams 1986). They are uniquely adapted to survive in an environment of high water temperatures and low dissolved-oxygen content (Service 1997). Where water temperatures would be lethal under extended exposure, RRVS adjust their body temperatures by moving in and out of such habitats (Williams 1986). Because RRVS are omnivorous and able to tolerate a wide range of water temperatures, they can inhabit a range of habitats within spring pools and outflow channels. Railroad Valley springfish typically spawn from spring through summer into early fall (Service 1997).

Methodology used to complete the review:

The Service based this review on the 1997 Recovery Plan and information in our files including multi-year population monitoring surveys completed by the Nevada Department of Wildlife (NDOW) and the U.S. Geological Survey-Biological Resources Division (USGS-BRD). Information was also obtained from the Railroad Valley Recovery Implementation Team (RRVRIT). Members of this team include the Service, NDOW, USGS-BRD, Duckwater Shoshone Tribe (Tribe), Nevada Natural Heritage Program, Nye County Commission, U.S. Forest Service (USFS), Bureau of Land Management (BLM), and Southern Nevada Water Authority (SNWA). The RRVRIT meets twice a year to monitor recovery implementation and to evaluate and establish goals for achieving recovery criteria.

Contact Information:

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Federal Register (FR) Notice Citation Announcing Initiation of This Review: On February 14, 2007, the Service announced initiation of the 5-year review for Railroad Valley springfish and asked for information from the public regarding the species' status (72 FR 7064, Service 2007). No information was received as a result of this announcement.

Listing History

Original Listing
FR Notice: 51 FR 10857
Date of Final Listing Rule: March 31, 1986
Entity Listed: Railroad Valley springfish (*Crenichthys nevadae*), a fish species
Classification: Threatened

Associated Rulemakings: Critical habitat was designated for this species at the time of listing on March 31, 1986 (51 FR 10857, Service 1986). Six historical spring habitats are designated as critical habitat: Big Warm Spring, Little Warm Spring, Hay Corral Spring, Big Spring, Reynolds Spring, and North Spring. A 4(d) rule was published at the time of listing allowing take to occur for educational or scientific purposes, the enhancement of propagation or survival of the species, zoological exhibition and other conservation purposes consistent with the Act without the need for a Federal permit if a State collection permit is obtained and all other State wildlife conservation laws and regulations are satisfied.

Review History: No formal status reviews have been conducted for this species.

Species' Recovery Priority Number at Start of 5-Year Review: The recovery priority number for RRVS is 2C according to the Service's Recovery Data Call for the Nevada Fish and Wildlife Office. This is based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (48 FR 43098, Service 1983). This number indicates that the taxon is a species that faces a high degree of threat and has a high potential for recovery. The "C" indicates conflict with construction or other development projects or other forms of economic activity.

Recovery Plan or Outline:

Name of Plan: Railroad Valley Springfish Recovery Plan
Date Issued: March 17, 1997

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) policy

The Endangered Species Act defines "species" as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. The 1996 Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Endangered Species act (61 FR 4722, Service 1996) clarifies the interpretation of the phrase "distinct population segment" for the purposes of listing, delisting, and reclassifying species under the Act.

The Railroad Valley springfish is not listed as a DPS, nor is there any relevant new information regarding the application of the 1996 policy that suggests this species should be listed as a DPS.

Information on the Species and its Status

Species Biology and Life History

The springfish genus *Crenichthys* includes Railroad Valley springfish and five subspecies of White River springfish (*C. baileyi*). The genus and the RRVS species were described from specimens collected in 1930 from Big Warm Spring, Duckwater, Nye County, Nevada (Hubbs 1932). The genus *Crenichthys* is a member of an unusual taxonomic group (*Empetrichthyidae*) comprised of the genera *Crenichthys* and *Empetrichthys*, both endemic to Nevada (Scoppettone 2002).

Railroad Valley springfish have distinct coloration from other species of springfish because of a single row of dark spots along their sides. They are yellow to olive to gray on the dorsal half of the body with a dark stripe extending along the dorsal surface from snout to tail, and are silver on the ventral half (La Rivers 1962), which is similar to the White River springfish subspecies.

The RRVS has a chunky body that is two-thirds as wide as deep with a relatively large head. This fish lacks pelvic fins, while its dorsal and anal fins are set far back on the body, and the

pectoral fins are set low with a vertical base. Jaw teeth occur in a single row and are bicuspid (Hubbs 1932). The average total length of RRVS varies between 22.9 and 38.1 mm (0.9 and 1.5 in) depending on the population, although individuals may attain a total length exceeding 71.1 mm (2.8 in).

Reproductive behavior has never been studied in RRVS, but it is likely similar to White River springfish (Kopec 1949). Typically, springfish spawn from spring through summer into early fall. Reproductive behavior occurs when water temperatures are between 28 and 35 degrees Celsius (°C) (82 and 95 degrees Fahrenheit [°F]), with maximum spawning activity at 30 °C (86 °F). Females release 10-17 eggs in each spawning event. After 5-7 days of incubation, larval springfish hatch with an average total length 5.1 mm (0.2 in) (Williams 1986).

Railroad Valley springfish are indiscriminant and opportunistic feeders, which is demonstrated by their change in food sources from season to season. During the spring, they are primarily herbivorous, consuming filamentous algae (Williams 1986). In the summer, animal-based foods comprise 74 percent of their diet with ostracods representing the bulk of their diet (Williams 1986).

Spatial Distribution

Railroad Valley springfish were historically found in six spring systems distributed in two areas of Nye County, Nevada, representing the remnants of pluvial Lake Railroad (Figures 1-3). Big Warm Spring and Little Warm Spring are located on the Duckwater Shoshone Indian Reservation in Nye County, Nevada. Approximately 43.0 kilometers (km) (26.7 miles [mi]) to the south of the Reservation, Big Spring, Hay Corral Spring, North Spring, and Reynolds Spring originate on Lockes Ranch. Lockes Ranch is owned and managed by NDOW; however, outflows from these springs also cross BLM lands.

Railroad Valley springfish were extirpated from Big Warm Spring by 2003 due to the introduction of red-bellied tilapia (*Oreochromis zillii*). Springfish were restored to Big Warm Spring on September 26, 2007, following the signing of a Safe Harbor Agreement between the Service and the Tribe and subsequent habitat restoration efforts. Currently, RRVS are found in the springhead to approximately 914 meters (m) (1,000 yards) below in the outflow (Gilmore, pers. comm. 2009).

Railroad Valley springfish persist at Little Warm Spring; however, the population's distribution is fragmented due to physical in-stream barriers such as culverts and velocity gradient barriers. Because of the fragmentation, RRVS distribution throughout the Little Warm Spring system was concentrated at the downstream end of the spring outflow in road-induced impoundments. Recent restoration efforts have redirected the outflow stream back into the historical channel and through a series of created wetlands to restore the spring system to a more natural state. In December 2008, RRVS were utilizing the newly restored historical channel and wetlands (T. Gilmore, Service, pers. obs. 2008).

The four springfish populations at Lockes Ranch continue to persist; however, springfish abundance in Hay Corral Spring declined significantly due to habitat manipulation in 2001 when

the spring outflow was diverted (NDOW 2003). Prior to the diversion, RRVS were found almost exclusively in the spring pool. After the outflow was diverted the majority of RRVS were distributed in the newly created ditch which provides less than optimal habitat conditions. North Spring, Big Spring and Reynolds Spring have had relatively stable habitat conditions since the Recovery Plan was published in 1997, and distributions of springfish in these spring systems also appear to be relatively stable (NDOW 2007).

Three additional populations of RRVS have been documented on the Reservation since the publication of the 1997 Recovery Plan. The best available information suggests that these RRVS are historical populations that were part of a once larger population found throughout the Duckwater Creek watershed when the natural historical flow patterns of many spring systems provided habitat connectivity. These populations are in close proximity to other historical sites on the Reservation, and the associated headwater springs are relatively isolated. One population is in several small unnamed spring systems that flow from the Duckwater Falls bluff (hereafter referred to as bluff). The northern most spring along the bluff, School Spring, produces less than 0.04 cubic meter per second (ms^{-1}) (1.5 cubic feet per second [cfs]) of water and flows from the bluff towards the west and then turns to the south where it flows under the main road. It then becomes highly channelized and is eventually diverted for flood irrigation to pasture land on the central part of the Reservation. The other two additional springs containing RRVS are located on Sugar Shack Road to the south of Duckwater Falls Road. One spring originates from the bluff to the east of Sugar Shack Road and the other originates to the west of the road. They are collectively known as the Sugar Shack Road Springs by locals; however, there is no official name for them on historic maps. Less than 0.03 ms^{-1} (1 cfs) of water originates from the Sugar Shack Road Springs; therefore, traditional springfish survey methods are virtually impossible due to shallow water depths. Visual observations of springfish distribution in 2005 indicated that the populations at the Sugar Shack Road Springs were present only in the spring pools (Hobbs 2007a).

To establish refugia populations, RRVS have been introduced into spring systems outside of their historical range by biologists. Such sites include Sodaville Springs in Mineral County, Nevada, and Hot Creek Canyon (Old Dugan Ranch) and Chimney Spring in Nye County, Nevada (Figures 1, 3, 4, 5). Additional populations outside of their historical range have also been created through either presumed natural events (Terrace Hot Spring, Nye County; Figure 3) or by unknown means (Warm Spring, Nye County; Figure 1). These populations fluctuate from year to year and in some cases have been extirpated, as noted below.

No fish surveys of the Sodaville Springs have been conducted since 2002. This spring system is owned by a private landowner who operated an Australian lobster (*Metanephrops australiensis*) aquaculture facility downstream of the spring pools. Springfish populations were significantly reduced within the spring pools and outflow channels because of habitat modification, but some fish were able to access and survive in the facility raceways. Springfish were observed in the raceways during 2002 (B. Nielsen, Service, pers. obs. 2002). In 2004, NDOW revoked the landowner's State aquaculture permit. NDOW assisted the landowner with decommissioning the facility by removing a portion of the raceways and pipelines and eradicating the lobster. The RRVS have likely been extirpated at Sodaville Springs because of the removal of the raceways and the lack of suitable habitat in the spring pools.

The population of RRVS in Hot Creek Canyon at the Old Dugan Ranch was established as a result of unauthorized transplant in the early to mid 1980's (Allan 1983). No formal surveys have been conducted at Hot Creek Canyon; however, sampling in 1984 and from 1996 to 2001 indicated that RRVS were present (NDOW 2001). Visual surveys in 2007 documented that the RRVS population was still present (B. Hobbs, NDOW, pers. comm. 2007). Two other sites west of the Old Dugan Ranch were also visually surveyed in 2007 and had RRVS populations despite the small size of the springs (Hobbs, pers. comm. 2007).

The Chimney Spring system consists of a natural springhead and a series of three artificial ponds on the outflow. The outflow is subject to ongoing natural modification caused by deposition of minerals contained in the spring water. Mineral deposits tend to gradually divert the water flow away from the ponds containing RRVS, and dense stands of emergent aquatic vegetation make the ponds smaller and shallower over time. The ponds were excavated in 1997 by the BLM as part of a habitat improvement plan for RRVS. Prior to excavation, RRVS were found in two out of three ponds; July 1998 surveys documented RRVS in all three ponds (Stein 1997). The population at Chimney Spring is currently present in all three ponds (Morrel *et al.* 2007).

Terrace Hot Spring is located on BLM lands approximately 799.8 m (2,624 ft) from Chimney Hot Spring where it is believed that a flash flood event transported RRVS from Chimney Hot Spring to Terrace Hot Spring sometime between 1995 and 1998. The population there was discovered in 1998 (Stein 1999). Terrace Hot Spring is visited approximately every other year where visual observations have verified that this population's distribution remains stable (Morrel *et al.* 2007).

Warm Spring is on private land and is used for cattle watering. The RRVS population at Warm Spring was doing well until a backhoe was used to clean the channel, which severely altered the outflow and eliminated much of the habitat (Heinrich 1993). By the late 1980's, the Warm Spring refugium population of RRVS was extirpated (J. Sjoberg, NDOW, pers. comm. 2009).

Abundance

Surveys have been conducted periodically, with different sampling methods, among the various RRVS-occupied sites since the Recovery Plan was published in 1997. A limited number of population estimates (mark-recapture) have been performed, primarily for the springs at Lockes Ranch, and those data are presented below. However, there are no recent population estimates for the species by occupied spring system or range-wide. Surveys have most often been conducted by placing various numbers of standard minnow traps in each spring for 3-5 hours. The RRVS captured in each trap are counted and a catch per unit effort (number of RRVS captured per hour the traps were set) is then calculated for each spring. These survey data allow some general conclusions about the current status and trends of the species' abundance by population, as described below. It should be noted, however, that the catch per unit effort is not an estimate of abundance but an index of abundance (i.e., as the number of fish captured per trap hour increases, it is likely that the population estimate is also increasing), and there is no way to estimate error or otherwise explain variation in the data.

The NDOW and the Service were only allowed sporadic access to the Duckwater Shoshone Indian Reservation for RRVS surveys from 1985 to 2003. Annual surveys have been conducted since 2003. As previously stated, RRVS were extirpated from Big Warm Spring by 2003. Railroad Valley springfish were restored to Big Warm Spring on September 26, 2007, subsequent to the signing of a Safe Harbor Agreement between the Service and the Tribe. Stocking of RRVS has been ongoing since then and, to date, 988 RRVS have been relocated from Little Warm Spring, School Spring and Sugar Shack Spring into Big Warm Spring (Hobbs 2007b, 2008). Visual observations and surveys of RRVS at Little Warm Spring indicate that the population's abundance is low and fluctuates from year to year, but has remained relatively stable since 2003 (Hobbs, pers. comm. 2007) (Figure 6). In 2005 and 2006, NDOW (Hobbs, pers. comm. 2007) visually estimated the population in School Spring to be 100-300 fish. Visual estimates in 2005 of the two populations of RRVS at the Sugar Shack Road Springs ranged from 50 to 200 fish in each spring. Subsequent visual surveys indicate that all three of these recently identified locations continue to support populations of springfish (Table 1) (Morrell *et al.* 2007).

Prior to listing, surveys at Lockes Ranch springs were completed infrequently. The populations of RRVS ranged from nearly 10,000 in Big Spring to approximately 2,600 in Reynolds Spring (Service 1997). Annual or biannual surveys have occurred for the RRVS populations at Lockes Ranch since 1996; however, data are only reported from 1998 to current because of inconsistencies in the 1996-1997 survey data (Table 1). Springfish abundance at Hay Corral Spring sharply declined between 2001 and 2002 when the private landowner modified the habitat. Since 2002, the population has increased in numbers with the catch per unit effort increasing ten fold (Figure 7). The catch per unit effort of RRVS at Reynolds Spring has decreased by more than 50 percent since 2001 (Figure 8). There have been no habitat modifications at this site, so it is unknown why the population is declining. The population of RRVS at Big Spring has fluctuated, but is relatively stable in size since 1999 with small changes in catch per unit effort. The catch per unit effort has ranged from a high of 4.3 fish caught per hour to a low of 1.68 fish per hour (Figure 9). The abundance of springfish at North Spring declined sharply between 1998 and 1999, and since 1999 the catch per unit effort has declined by over 50 percent (Figure 10). It is possible that the variability in the catch per unit effort at North Spring is due to changes in available habitat, the ability to set traps in dense vegetation, and/or the quality of the habitat (Hobbs, pers. comm. 2007).

Several refugia populations continue to support moderately sized RRVS populations. The Chimney Hot Spring ponds are each surveyed independently. Prior to the 1997 pond excavation, RRVS numbered less than 1,000 fish total in two ponds (Stein 1997). July 1998 surveys documented an estimated 1,500 RRVS among the three ponds (Stein 1998). As many as 43 RRVS were caught per unit effort in 1998 to as few as 1.3 in 2005 (Figure 11). The populations in all three ponds showed similar trends from year to year and overall the refugium population's numbers were stable until 2007, when Chimney Hot Spring and the ponds went dry and no RRVS survived.

Terrace Hot Spring is not physically surveyed (trapped) because of the high water temperatures in the spring pool and along the outflow. Trapping RRVS under those conditions could cause heat stress and eventual death. In 1998, the population at Terrace Hot Spring was estimated to be in the thousands (Stein 1998). Annual visual surveys conducted since 1998 have documented

approximately 500 fish along the outflow (Table 2).

The springfish population in Hot Creek Canyon recently had several age classes and hundreds of fish have been observed (Hobbs, pers. comm. 2007). Two other sites in Hot Creek Canyon west of the Old Dugan Ranch were visually surveyed in 2007 and had springfish populations numbering in the hundreds despite the small size of the springs (Hobbs, pers. comm. 2007).

Habitat or Ecosystem

Railroad Valley springfish are uniquely adapted to survive in an environment of high water temperatures (30-37.8°C [86-100 °F] at the spring source) and low dissolved-oxygen content 1.5-6.0 milligram per liter (1.5-6.0 parts per million) (LaRivers 1962). When water temperatures reach 38.9°C (102 °F), the fish begin to lose equilibrium, become stressed, and eventually die. Springfish adjust their body temperatures by moving in and out of areas where the water temperature would be lethal under extended exposure (Williams 1986). To survive in spring systems with higher water temperatures, the spring source and outflow must be connected so that the springfish can seasonally move within the system to remain within their preferred temperature range. Since RRVS are omnivorous and able to tolerate a wide range of water temperatures, they can inhabit a range of habitats within spring pools and outflow channels.

Loss of suitable habitat through the excavation of stream channels for water diversion, and predation by and competition with nonnative fishes has contributed to the decline of RRVS and continues to affect recovery of the species. All six historical habitats for RRVS have been dramatically altered and without restoration and rehabilitation, recovery of the species at several of these sites is not possible. Impacts to habitat and conservation actions taken to preserve, enhance, or restore habitat are described below.

Changes in Taxonomic Classification or Nomenclature

No taxonomic changes have been made for the Railroad Valley springfish.

Genetics

An evaluation of the genetic status of species and subspecies within the *Crenichthys* genus was initiated in 1995. Preliminary results of this evaluation suggest that the RRVS at the Reservation are distinct from those at Lockes Ranch such that they warrant consideration of the populations as separate conservation units (G. Scoppettone, USGS-BRD, pers. comm. 2007). This information should be considered when establishing or maintaining refugia and stocking RRVS in historical habitats; for example, fish from separate conservation units should not be mixed.

Species-specific Research and/or Grant-supported Activities

Railroad Valley fishes monitoring and recovery plan implementation-NDOW: The Service has provided funding annually to NDOW through section 6 of the Endangered Species Act for recovery and monitoring since the 1986 listing. Specifically, NDOW is tasked with:

- Monitoring of RRVS populations to assess population levels, status and trend through implementation of the population monitoring plan. Monitoring includes six populations within the historical range and four populations representing refugium or introduced populations.

- Implementing site management plans for refugium and historical populations of RRVS located on public lands, in cooperation with BLM.

- Pursuing development of cooperative agreements, conservation easements, or conservation agreements for management of RRVS habitats located on private lands.

Acquisition of Lockes Ranch-NDOW: In 2003, the Service provided funding to NDOW through a Recovery Land Acquisition grant for the purchase of Lockes Ranch. This acquisition helped secure 186 hectares (ha) (460 acres [ac]) of key habitats including source pools and/or outflows for four major spring systems containing identified recovery populations and critical habitat essential for the recovery of RRVS.

Spring and Stream Channel Restoration of Little Warm Spring-Tribe: In 2007, the Service provided funding to the Tribe through a Tribal Landowner Incentive Program grant for desert spring and wetland habitat restoration to directly benefit the RRVS, endemic aquatic invertebrates, migratory waterfowl, and riparian bird species. Habitat restoration at Little Warm Spring is necessary to accomplish the recovery objective of recovering and restoring RRVS to historical habitat. The Tribe has created signs designed to educate tribal members and visitors about tribal culture and the threatened species found on tribal lands with the funds.

Five-Factor Analysis

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

The final listing rule, published in 1986, identified impacts from habitat alteration, introduced nonnative fishes, small-scale groundwater pumping for agriculture, and oil exploration activities as threats to the RRVS (51 FR 10857, Service 1986). Since then, diking, ditching, water diversions, and channelization of stream channels dramatically reduced RRVS populations at Big Warm Spring and Little Warm Spring. In addition, the introduction of nonnative fishes caused the extirpation of RRVS at Big Warm Spring (Hobbs, pers. comm. 2003). The four historical populations of RRVS at Lockes Ranch have suffered population declines due to overgrazing by cattle and the construction of irrigation channels and plastic lined pools (Service 1997).

Tribal Lands

The Big Warm Spring population of RRVS has been more severely impacted by various physical and biological alterations than the other five major historical sites. Historically, the property surrounding Big Warm Spring (Figure 2) and the associated outflow was heavily grazed by cattle and horses, used to support a catfish rearing facility, modified to provide agricultural irrigation, and utilized by hot-spring recreationists. The Big Warm Spring population was described as

teeming and abundant during the 1930's, but declined to exceedingly rare between 1981 and 1982, following introduction of nonnative fishes and installation of a catfish (*Ictaluras punctatus*) rearing facility (Service 1997). Two irrigation diversion structures historically impounded and controlled the spring source and divided the outflow stream into two channels. The north channel flowed into an underground pipe approximately 350 m (1,148 ft) from the diversion. The south channel followed the original outflow stream course to the catfish facility where concrete raceways and diversion structures were constructed within the channel in 1982. Catfish escaped the facility through open concrete ditches and invaded Big Warm Spring and its entire outflow. After 1982, RRVS population numbers plummeted and predation by the catfish was presumed to be the cause (51 FR 10857, Service 1986). Guppies (*Poecilia reticulata*), sailfin mollies (*Poecilia latipinna*), and mosquitofish (*Gambusia affinis*) were also introduced which further contributed to the reduction of RRVS through competition for resources. During 1986-2000, Big Warm Spring and the associated outflows were modified annually to maintain and improve the catfish aquaculture facility and maintain flows for irrigation. In 2003, the red-bellied tilapia was the dominant fish species in Big Warm Spring with catfish and mollies being the other most common fish species (Nielsen, pers. obs. 2003). NDOW confirmed that RRVS had been extirpated from Big Warm Spring in 2003 following an intensive minnow-trapping effort within the spring pool, outflow channels, and at the catfish facility.

Habitat restoration and nonnative fish eradication activities were implemented at Big Warm Spring during 2005 and 2006 through the Service's Partners for Fish and Wildlife, Tribal Wildlife Grant and Tribal Landowner Incentive Programs, NDOW's Fisheries Bureau, and the Natural Resources Conservation Service's Wildlife Habitat Incentives Program. In November 2005, NDOW led an extensive nonnative species eradication effort which effectively removed both the catfish and tilapia from Big Warm Spring. However, due to their small size, mollies and mosquitofish were able to find refuge within the spring system and were not eradicated during this effort (Hobbs, pers. comm. 2007). A newly constructed fence surrounds approximately 69 ha (170 ac) of upland, spring, and stream habitat that constitutes the enrolled lands. Within the fenced boundaries, approximately 30 ha (75 ac) of wetlands (the "dry lakes") receive water through the newly constructed diversion intake along the Big Warm Spring outflow. The Big Warm Spring pool is approximately 18 m (59 ft) in diameter and the water flows into a single thread channel from the source pool downstream approximately 2.4 km (1.5 mi) west to a bluff where it flows over a natural waterfall (Duckwater Falls) approximately 9.1-12.2 m (30-40 ft) in height and then continues into Duckwater Creek. Big Warm Spring is the largest spring in Railroad Valley with a discharge that has varied from 0.40 ms^{-1} (14 cfs) in 1912 to 0.43 ms^{-1} (15.3 cfs) in 2005. Along the outflow, there are two water diversion intakes located approximately 200 m (656 ft) from the spring pool. Irrigation Diversion #1 can divert a maximum of 0.23 ms^{-1} (8 cfs) and transports water approximately 150 m (492 ft) to an open water channel that is 399 m (1,312 ft) in length. At the end of this open water channel, the water flows into Irrigation Diversion #2 which can also transport a maximum of 0.23 ms^{-1} (8 cfs). This underground pipeline functions as the Tribe's primary irrigation water source. The diversion that provides water to the wetlands can transport up to 0.23 ms^{-1} (8 cfs) and is located downstream and directly adjacent to the irrigation pipeline diversion. Over five and one half km of fencing (3.5 mi) protect the spring source and the outflow from cattle and vehicular traffic for the entire 2.4 km (1.5 mi) of stream to Duckwater Falls. In addition, two wooden deck platforms and a narrow gravel trail were constructed to provide opportunities to view aquatic species at Big

Warm Spring. The habitat at Big Warm Spring is free of nonnative predatory fish and now provides suitable habitat for RRVS.

The RRVS population at Little Warm Spring has fluctuated in response to habitat modifications that have occurred periodically since 1984. Little Warm Spring is part of the Tribe's land assignment system where assignment holders maintain and farm each assignment. The outflow from Little Warm Spring was diverted into two channels in 1984 and its associated marsh was drained to improve water delivery to downstream agricultural lands and allow farming of the marsh (Williams 1986). The channels are routinely cleaned with heavy equipment and hand tools to remove aquatic vegetation and weeds (V. Sanchez, Tribe, pers. comm. 2004). The outflow of Little Warm Spring was also modified to support catfish through the construction of three ponds and three culverts sometime between 2001 and 2003 (T. Thompson, Tribe, pers. comm. 2003). The installation of the culverts prevented upstream migration of the catfish, while also preventing the upstream migration of RRVS. Current restoration efforts have redirected the outflow stream back to the historical channel and through a series of created wetlands in an attempt to restore the Little Warm Spring system to a more natural state. These efforts will not be deemed fully successful until sinuosity and connectivity to the habitat are fully restored, which is expected to occur by fall 2009. Visual observations in December 2008 have shown that RRVS are utilizing the newly created historical channel and wetlands (T. Gilmore, Service, pers. obs. 2008).

Beginning in 2002, the Tribe approached the Service with the intent of re-establishing a conservation relationship. As a result of these efforts, in 2003, the Tribe entered into a Memorandum of Understanding with the Service that states that both parties will work collaboratively to implement habitat management and restoration projects to recover RRVS while meeting the economic and cultural needs of the Tribe. In addition, Big Warm Spring and Little Warm Spring are protected through long-term Partners for Fish and Wildlife program agreements, a grant agreement, and a Safe Harbor Agreement. The tribe initiated the recovery of the RRVS at Big Warm Spring by implementing a $650,000 habitat restoration project in 2005 and 2006. Designated critical habitat at both Big Warm Spring and Little Warm Spring have an additional layer of protection through a grant agreement in which the Tribe agreed not to introduce nonnative fish species for aquaculture or recreational purposes within designated critical habitat. Future agreements will be drafted with the Tribe to ensure that recovery and habitat conservation and protection will be implemented at Little Warm Spring and other locations where RRVS are found. As described above, the habitat conditions have been restored from previously degraded conditions to support a minimum of 3,000 RRVS. The efforts to recover the species on Tribal lands have been successful due to the positive working relationship and coordination between the Tribe and the Service. The Tribe currently manages two designated critical habitat areas and three isolated populations of RRVS that were recently discovered along bluff area, all of which are vital to recovery of the species. As tribal council, agency personnel, and habitat conditions change, continued nurturing of this partnership will be necessary to ensure the long-term recovery of the species.

State and Private Lands

Historically, Lockes Ranch was used for raising cattle and throughout the years, the four springs and their outflows were manipulated to facilitate irrigation of the meadows (Service 1997). In 1994, the outflow from Big Spring was altered to create a pond adjacent to Highway 6 to provide water for a highway improvement project (Service 1997). The pond soon became inhabited by RRVS. Since 1996, conditions at Big Spring have not changed significantly. North Spring and Reynolds Spring have not been manipulated since 1996, resulting in relatively stable habitat conditions for RRVS populations.

In 2002, Hay Corral Spring was excavated to divert water for livestock watering. This activity resulted in the dramatic decline of RRVS populations. An open earthen ditch was excavated 4.9 m (16 ft) to the west of the spring pool where it flowed past Reynolds Spring into a small pond that was created for stock watering. While the Service and NDOW were unable to document "take" of fish, as defined by the Endangered Species Act, the subsequent monitoring efforts demonstrated that the Hay Corral population had severely declined.

The private landowner, NDOW, and the Service began negotiations for purchase of the property under a Service Recovery Land Acquisition Grant and State of Nevada Question 1 Bond in 2002. In 2005, the Lockes Ranch complex of historical habitat (Figure 3) was purchased by the State of Nevada. The NDOW and the Service partnered with the Trust for Public Lands to secure the funding. This purchase significantly contributed to the accomplishment of one of the recovery criteria for RRVS – that all six historical spring habitats are protected from adverse modifications through conservation agreements, easements, or fee title acquisitions.

Shortly after the purchase of Lockes Ranch, NDOW, with consultation from the RRVRIT, started to develop a habitat restoration and management plan for the four springs and their associated outflows. This plan was completed in April 2006, and restoration activities were completed in fall 2008. NDOW restored much of the historical outflows and, most importantly, restored them to the historical widths and depths that facilitate transport of thermal water which will improve habitat conditions for the RRVS. Restoration activities included creation of a new sinuous channel, improvement of existing channels, dewatering of a man made irrigation ditch that was previously used for stock watering, and removal of nonnative vegetation surrounding the four spring systems. The implementation of habitat restoration at the Lockes Ranch complex of springs provides additional habitat for the RRVS which we anticipate will increase the four populations.

As of late 2007, Chimney Spring was dry and held no RRVS (Hobbs, pers. comm. 2007). Habitat at Sodaville Springs is so severely degraded that springfish no longer reside in the spring pools or along the outflow.

According to visual surveys conducted by NDOW in 2007, conditions at the Old Dugan Ranch in Hot Creek Canyon have changed since the last visit in 2001. American bullfrogs (*Rana catesbeiana*) and Australian red-claw crayfish (*Cherax quadricarinatus*) have been introduced where the RRVS occur, which has likely had a negative impact on RRVS. However, the habitat is in sufficient condition to support a small population of less than 1,000 springfish (Hobbs, pers.

comm. 2007). Two other sites were also confirmed to contain springfish in Hot Creek Canyon by NDOW in 2007. One site, just a few miles west of the Old Dugan Ranch, was previously documented by NDOW in the mid 1990's; however, in 2007 the population was widespread and visually estimated to be at least in the hundreds with all age classes present (Hobbs, pers. comm. 2007). Another site, also within a few miles west of the Old Dugan Ranch, was previously unknown and has a small population (less than 300) of springfish comprised of multiple age classes. The latter two sites do not contain bullfrogs or crayfish (Hobbs, pers. comm. 2007).

Water Development

The increasing demand for water in Southern Nevada poses a new threat to the RRVS. Groundwater withdrawal and exportation has the potential of either modifying or destroying occupied RRVS designated critical habitat by reducing the total output of water from springs in Railroad Valley. Refugia habitat could be impacted as well. The SNWA has applied for 1,190,309,973 cubic meters (m^3) (956,000 acre feet [ac-ft]) per year of water in the Railroad Valley groundwater basin to ease some of Southern Nevada's municipal water resource needs. The SNWA has already proposed the Clark, Lincoln, and White Pine Counties Groundwater Development Project, which has applied for water rights to up to 207,224,949 m^3 (168,000 ac-ft) per year in Spring, Snake, Cave, Delamar, Dry Lake, and Coyote Springs Valleys. The proposed development of a 459 km (285 mi) long water pipeline and associated groundwater pumping stations has the potential to affect the eastern Nevada groundwater flow systems. A tremendous amount of effort is being expended by multiple entities to determine the effects of groundwater pumping on the natural resources of the Spring and Snake Valleys. The Basin and Range Carbonate Aquifer System Studies will help with determining discharge and recharge characteristics of these systems. The collaborating entities may not be able to accurately predict the effects of this landscape level project in the near future because the only way to estimate the output of these aquifers is through test pumping. The Nevada State Water Engineer (Engineer) recently approved Southern Nevada Water Rights applications for half of the requested amounts in Snake and Spring Valleys. While SNWA has not developed a formal plan for pumping groundwater from the Railroad Valley groundwater flow systems, they have already applied to the Engineer for these water rights and it could affect the survival and potentially the recovery of the RRVS in the next decade.

Oil and Mineral Activities

Oil pumping from historical wells and additional oil exploration activities continue to occur throughout Railroad Valley. However, these activities have never posed a direct threat to any population of springfish. While oil companies continue to apply for BLM exploration permits and drill pads, the early coordination between BLM and the Service has proven to be effective in reducing the potential threat to the species. The increased activity in the valley in relation to oil development could potentially affect groundwater supplies over the long term. Typically, groundwater is pumped from the drill site to increase success of oil extraction, which could cause spring flows to be adversely affected if these activities are permitted to occur within 2.6-12.9 square km (1-5 square mi) of the Lockes Ranch springs. Therefore, the cumulative effects of groundwater pumping for oil extraction and for SNWA could prove detrimental to the survival of RRVS.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The final listing rule and the Recovery Plan do not identify commercial, recreational, scientific, or educational threats to this species, and this has not changed since the time of listing.

FACTOR C: Disease or Predation

Nonnative fish species have been implicated in the decline and listing of RRVS due to predation and competition for available resources (51 FR 10857, Service 1986). Nonnative fish species have been introduced into most habitats historically occupied by RRVS and the presence of nonnative fish in the extremely limited habitat of the springfish represents a serious threat to the species (51 FR 10857, Service 1986). Under a partnership between the Service, Tribe, and NDOW, predatory nonnative fishes (catfish and red-bellied tilapia) have been eradicated at Big Warm Spring in addition to successfully isolating the stream and spring from upstream migration of nonnative fishes. However, catfish and tilapia are still present downstream of Big Warm Spring in Duckwater Creek and could possibly threaten the continued existence of springfish at Big Warm Spring, Little Warm Spring, School Spring, and Sugar Shack Road Springs, should a human-induced introduction of nonnative species occur. While all of these springs are currently isolated from Duckwater Creek, diking of springpools, diversion of outflows, and channelization of outflow creeks could facilitate connectivity to Duckwater Creek which would allow the invasion of nonnative fishes. The springs on the Reservation currently support nonnative mollies and mosquitofish. Based on information gathered from interactions between other springfish subspecies and poecilids, RRVS can likely coexist with these species (Scoppettone 2002). Nonnative fish species are unable to access the Sugar Shack Road Springs because they are diverted for flood irrigation and there is limited connectivity to Duckwater Creek.

The only other fish species documented to occur in School Spring are sailfin mollies (Hobbs, pers. comm. 2007). A 13.7 m (45 ft) long culvert and the intermittent flow of water to Duckwater Creek makes it difficult for nonnative fishes to access School Spring, therefore, it is moderately secure from the invasion of nonnative fishes, but not from predatory American bullfrogs which were observed in fall 2008 (Gilmore, pers. obs. 2008).

Despite recent introductions of American bullfrogs and Australian redclaw crayfish, there are still RRVS present at Hot Creek Canyon (Wulf and Morrell 2007). The other two small springs west of the Old Dugan Ranch visually surveyed in 2007 were devoid of nonnative predators (Hobbs, pers. comm. 2007).

The springs at Lockes Ranch are all currently devoid of nonnative fishes. Public access was limited when Lockes Ranch was privately owned. Now that the property is owned by NDOW there is an increase in the possibility that a human-induced introduction of nonnative fish species could occur when it is opened to public access. Intentional introduction of nonnative species at thermal springs continues to be a threat to native fish species throughout Nevada. Only constant vigilance and education of landowners can minimize these activities. Annual or bi-annual monitoring is needed to determine if nonnative fishes have been introduced. Early detection of nonnative fishes can facilitate the eradication process, minimizing harm to native species. The

Tribe is constructing interpretive facilities at Big Warm Spring to educate the local community and visiting public about how nonnative fishes can destroy native aquatic communities. In addition, the Tribe is working within the school curriculum to discuss RRVS and nonnative fishes with school children. Constant monitoring, signage, and education needs to be the primary focus for NDOW to prevent this from occurring.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

Existing regulatory mechanisms appear to be adequate at this time. Federal laws aimed at protecting RRVS and their habitat include the National Environmental Policy Act, Clean Water Act, National Environmental Policy Act, and the Endangered Species Act. State laws which protect RRVS include the Nevada Revised Statute 503.584 et seq.; 244.386 that protects Nevada's listed species, and Nevada Revised Statute 445A.305 that protects the water quality of Nevada's rivers, springs, and streams.

Federal Protections

National Environmental Policy Act
The National Environmental Policy Act (NEPA) provides some protection for the RRVS. For activities undertaken, authorized, or funded by federal agencies, NEPA requires the project be analyzed for potential impacts to the human environment prior to implementation (42 U.S.C. 4371 et seq.). For instances where that analysis reveals significant environmental effects, the Federal agency must propose mitigations that could offset those effects (40 CFR 1502.16). However, NEPA does not require that adverse impacts be fully mitigated, and so some impacts could still occur. Additionally, NEPA is only required for projects with a Federal nexus (i.e., Federal funding, authorization, or permitting), and therefore actions taken by private landowners generally are not required to comply with this law.

Clean Water Act
Under section 404 of the Clean Water Act, the U.S. Army Corps of Engineers (ACOE) regulates the discharge of fill material into waters of the United States, which include navigable and isolated waters, headwaters, and adjacent wetlands (33 U.S.C. 1344). In general, the term "wetland" refers to areas meeting the ACOE criteria of having hydric soils, hydrology (either sufficient flooding or water on the soil surface), and hydrophytic vegetation (plants specifically adapted for growing in wetlands). Any actions within RRVS habitat that have the potential to impact waters of the United States would be reviewed under the Clean Water Act as well as NEPA and the Endangered Species Act. These reviews would require consideration of impacts to the springfish and its habitat, and when significant impacts could occur, mitigations would be recommended.

Endangered Species Act
The Act is the primary Federal law providing protection for the RRVS. Since its listing, the Service has analyzed the potential effects of projects under section 7(a)(2) of the Act, which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both

the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 CFR § 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of RRVS from a project. Incidental take refers to taking that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by a Federal agency or applicant (50 CFR § 402.02). In instances where some incidental take is unavoidable, the Service requires that additional measures be performed by the project proponents to compensate for negative impacts.

State Protections

Nevada Revised Statute
The purpose of Nevada Revised Statute (NRS) 503.584 to 503.589, inclusive, is to provide a program for the: (a) conservation, protection, restoration and propagation of selected species of native fish and other vertebrate wildlife, including migratory birds; and (b) perpetuation of the populations and habitats of such species. The purpose of NRS 445A.305 is to provide a program to legally regulate water pollution in the state of Nevada if it: (a) adversely affects public health and welfare; (b) is harmful to wildlife, fish, and other aquatic life; an (c) impairs domestic, agricultural, industrial, recreational and other beneficial uses of water.

Summary of Regulatory Protections

A number of State and Federal Laws exist that provide protections to RRVS and its habitat. Therefore, the inadequacy of existing regulations is not considered to be a threat to the species at this time. However, these regulations, and particularly the Act, are still needed to ensure the recovery of the species.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

The final listing rule, published in 1986, identified nonnative species as a natural or manmade threat affecting RRVS continued existence. This is still considered a threat and is addressed above in listing factor C. Climate change is a new threat that was not identified at the time of listing. Some of the potential affects of climate change on RRVS are discussed below.

Climate Change

Research has shown that the annual mean temperature in North America has increased from 1955 to 2005; however, the magnitude varies spatially across the continent, is most pronounced during spring and winter months, and has affected daily minimum temperatures more than daily maximum temperatures (Field *et al.* 2007). Other effects of climate change include, but are not limited to, changes in types of precipitation (Knowles *et al.* 2006), earlier spring run-off (Stewart *et al.* 2005), longer and more intense fire seasons (Brown *et al.* 2004, Westerling *et al.* 2006, Bachelet *et al.* 2007), and more frequent extreme weather events (Diffenbaugh *et al.* 2005, Rosenzweig *et al.* 2007). These changes in climate and subsequent effects can be attributed to the combined effects of greenhouse gases, sulphate aerosols, and natural external forcing (Karoly *et al.* 2003, Barnett *et al.* 2008).

Warming trends seen over the past 50 years in the United States are predicted to continue to increase (Field *et al.* 2007). The Intergovernmental Panel on Climate Change (IPCC) states that of all ecosystems, freshwater ecosystems will have the highest proportion of species threatened with extinction due to climate change (Kundzewicz *et al.* 2007). However, quantifying the potential site-specific effects to the RRVS, and the time scale at which they would occur, is problematic. The species is geographically isolated and dependent on groundwater discharge to maintain its spring system habitats. Difficulties remain in reliably simulating and attributing climate change effects at such small, localized scales. Natural climate variability is relatively larger-scaled, thus making it harder to distinguish changes expected due to external, human-related sources (IPCC 2007). Our concern with this threat is linked to the extent that climate change may affect the water supply of RRVS through lowering groundwater levels and increasing the frequency/intensity of wildfires in the area.

III. RECOVERY CRITERIA

A final, approved recovery plan has been published for RRVS (Service 1997). Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all Recovery Plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the Recovery Plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a Recovery Plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

Recovery Objective: Recommend measures needed to improve and secure the species' status so that it may be removed from the Federal list of endangered and threatened species.

Recovery Criteria: Railroad Valley springfish may be considered for delisting when the following criteria are met:

1) All six historical spring habitats are permanently protected from adverse modifications through conservation agreements, easements, or fee title acquisitions.

This criterion has been partially achieved.

The four historical spring habitats at Lockes Ranch (North, Hay Corral, Reynolds, and Big Springs) were permanently protected when NDOW purchased the land and water rights through fee-title acquisition from a private landowner in 2005. NDOW received funding through the Service's Recovery Land Acquisition Grant Program and the State of Nevada's Question 1 Bond Program to purchase Lockes Ranch specifically for the recovery of RRVS and other associated endemic species. The RRVRIT has worked collaboratively to implement a habitat restoration and management plan to restore and maintain all four spring systems to maximize high quality habitat and increase springfish populations. In 2008, the four spring systems at Lockes Ranch were restored to historical conditions (Gilmore, pers. comm. 2009).

The land and the water rights associated with the other two historical spring systems (Big Warm and Little Warm Springs) are owned and managed by the Tribe, a sovereign nation. "Permanent" protection of these resources may never be achievable, as the Tribal Council can change membership every 2 years resulting in different tribal priorities. However, the Tribe is committed to the recovery of the RRVS. A Safe Harbor Agreement was signed on September 26, 2007, between the Tribe (permittee) and the Service, allowing the reintroduction of RRVS into Big Warm Spring and providing for maintenance of the habitat over the next 25 years. The Tribe received a Recovery Lands Acquisition Grant from the Service to restore habitat at Little Warm Spring and educate tribal members and the public about tribal culture and the threatened species found on tribal lands. The existing partnership between the Service and the Tribe will need to be maintained to ensure that this habitat remains secure from negative impacts and that the recovery of the RRVS is accomplished.

This recovery criterion adequately addresses listing factor A (the present or threatened destruction, modification, or curtailment of its habitat or range) and listing factor E (other natural or manmade factors affecting its continued existence) by requiring that all six historical habitats must be secured from adverse modifications. The Safe Harbor Agreement partially addresses listing factor C (Disease or Predation), by requiring the Tribe not to intentionally introduce any nonnative species into Big Warm Spring or Little Warm Spring. However, this criterion does not fully address any of the other three listing factors.

2) At least 21,000 adult RRVS are present among the 6 springs, with each population containing at least 1,000 adults and documented annual reproduction and recruitment, for 5 consecutive years.

This criterion has not been met.

Rigorous population estimate studies are not currently being conducted at any of the six historically occupied spring habitats (North, Hay Corral, Reynolds, Big, Little Warm, and Big Warm Springs). The Safe Harbor Agreement, signed on September 26, 2007, between the Tribe and the Service, resulted in the stocking of RRVS into Big Warm Spring. Subsequent natural reproduction has likely increased the population size, but it has not been estimated. Under the Safe Harbor Agreement, Big Warm Spring is expected to support 3,000 RRVS. In the other five spring systems, relative abundance, presence/absence, and visual surveys have been conducted periodically since 1996, and they provide only general information about the fish communities, age class, and relative abundance at each location. This information is not sufficient to

determine if this recovery criterion has been met because it does not give true population estimates. In order to meet this criterion, we need consistent survey data for all six spring systems for 5 consecutive years.

This criterion addresses listing factor A (the present or threatened destruction, modification, or curtailment of its habitat or range), listing factor C (disease or predation), and listing factor E (other natural or manmade factors affecting its continued existence) by requiring that there is a sufficient number of RRVS at all six historically occupied spring habitats. Until all spring systems are free of nonnative fishes, it is likely this criterion will never be achieved. Thus, all six habitats must be restored to a suitable condition to enable these population sizes to persist.

IV. SYNTHESIS

There are five historical populations of RRVS that have been self-sustaining for the past 10 years, and fish were restored to the sixth historical location, Big Warm Spring, in fall 2007. However, the abundance and distribution of these six populations over time has not been well analyzed with existing survey methodologies. A rigorous, consistent monitoring protocol must be designed and implemented annually to document trends in RRVS abundance and distribution within all six historical locations.

The primary threats to the RRVS and its habitat at the time of listing were habitat destruction and nonnative fish introductions. Since the time of listing, habitat destruction has been significantly reduced or eliminated. As discussed above, habitat restoration has been completed at all six historical habitats. Subsequent to the signing of the Safe Harbor Agreement in fall 2007, RRVS were restored to Big Warm Spring. Stocking efforts continue along with removal of nonnative sailfin mollies and mosquitofish. Habitat restoration was implemented at Lockes Ranch in fall 2008, which is expected to expand the distribution and abundance of four historical populations over time through natural reproduction. Restoration efforts in fall 2008 redirected the outflow of Little Warm Spring back into the historical channel and through a series of created wetlands. This restoration allows RRVS access to more habitat, which will likely increase the abundance of the Little Warm Spring population.

Impacts from nonnative fish introductions since the time of listing have been significantly reduced by the removal of aquaculture facilities, elimination of nonnative predatory fish in Big Warm Spring and Little Warm Spring, and by implementing a Safe Harbor Agreement with the Tribe to ensure that nonnative fish are not intentionally introduced into these springs. In addition, through NDOW's acquisition and management of Lockes Ranch, four historically occupied habitats are likely to remain free of nonnative fishes. Close monitoring of all spring systems on an annual basis must be completed to assure that there are no new threats posed by nonnative fishes. This monitoring can be performed in association with annual population surveys.

In order for restoration efforts to be successful, the RRVRIT must continue partnership efforts with cooperating entities. State and Federal regulatory mechanisms available at the time of listing are still in place for the protection of the species and are still needed to inspire conservation ethics throughout the species' range.

Large-scale groundwater pumping is a threat that was not considered at the time of listing. The threat of groundwater pumping for urban development should be evaluated carefully to ensure the long-term survival of RRVS. Water project negotiations must include provisions to perpetually protect and preserve RRVS within their native, historical habitats. Climate change was also not a threat considered at the time of listing and must be considered in evaluating the species' status.

Efforts to protect and restore habitat, remove nonnative predatory fish, and restore RRVS to historical habitat on Tribal lands have resulted in significant progress towards recovery. These efforts will have to be monitored for several years to determine their success in meeting the recovery criteria. Therefore, we recommend retaining the current Endangered Species Act classification for this species. However, in Section IV below we recommend actions that should be implemented over the next 5 years to enable us to consider removing the RRVS from the List of Threatened and Endangered Wildlife. We conclude that the RRVS continues to meet the definition of threatened, and no status change is recommended at this time.

V. RESULTS

Recommended Listing Action:

____ **Down list to Threatened**
____ **Up list to Endangered**
____ **Delist** (*Indicate reasons for delisting per 50 CFR 424.11):*
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
__X__ **No change is needed**

New Recovery Priority Number ___8___

Based upon the preceding analysis, the RRVS faces a moderate degree of threat. Threats from habitat modification at Lockes Ranch have been eliminated because the property is now owned by the State. Threats caused by nonnative predatory fish have been significantly reduced by eradication of these fish at Big Warm Spring. However, a new potential threat from groundwater withdrawal has yet to be evaluated. Despite this moderate level of threat, the species needs are relatively well understood with the known threats easily addressed through partnership efforts; therefore, it has a high potential for recovery. An aquaculture facility and ranching operations were previously considered to be in conflict with the conservation needs of the species, but these conflicts have been eliminated through NDOW's purchase of Lockes Ranch and the decommissioning and removal of the aquaculture facilities on Tribal lands. We conclude, therefore, that the recovery priority of the RRVS should be changed from its current 2C to a new recovery priority number of 8. This new recovery priority number reflects a species under a moderate degree of threat with a high potential for recovery.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

The Service recommends that funding continue to be provided to NDOW through section 6 of the Act for monitoring of RRVS and continued implementation of the Recovery Plan. The Service also recommends the following actions be implemented over the next 5 years.

- Develop a consistent, scientifically based survey protocol and ensure that annual comprehensive surveys are completed within historical habitat to document the status of the species and determine trends in population abundance and distribution. Consistent surveys are needed to monitor threats posed by nonnative species introductions, unauthorized habitat modification, and other actions that may jeopardize RRVS populations.

- Continue implementing the recovery actions in the 1997 Recovery Plan to further the expansion of all six historical populations of RRVS. Priority actions to benefit recovery are continued RRVS stocking at Big Warm Spring. The RRVRIT should continue to assist the Tribe with habitat restoration and protection activities at Little Warm Spring and other springs throughout the Reservation.

- Continue to actively participate in the collaborative partnership with the Duckwater Shoshone Tribe to ensure that recovery actions that have been previously implemented are continued into the future and are successful. The Service should encourage collaborative conservation activities utilizing the Service's Partners for Fish and Wildlife Program, Tribal Wildlife Grants Program, and Tribal Landowner Incentives Program to further these activities. The Service also should maintain positive working relationships with the Duckwater Shoshone Tribe by ensuring that a designated representative to attend regular Tribal Council meetings and other associated meetings that pertains to the recovery of the species.

- Work with the SNWA to determine and alleviate any potential impacts and effects of groundwater pumping on RRVS in the Railroad Valley groundwater flow systems.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW
Railroad Valley Springfish
(*Crenichthys nevadae*)

Current Classification ___Threatened_____

Recommendation Resulting from the 5-Year Review:

____ Down list to Threatened
____ Up list to Endangered
____ Delist
_X__ No change is needed

Appropriate Listing/Reclassification Priority Number, if applicable __NA___

Review Conducted By ____Todd Gilmore, Nevada Fish and Wildlife Office_____

Date Submitted to Region 8: ___August 14, 2009_____

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve _____ Date 8/14/09

REGIONAL OFFICE APPROVAL:

Lead Regional Director, U.S. Fish and Wildlife Service, Region 8

Approve _____ Date 8/17/09

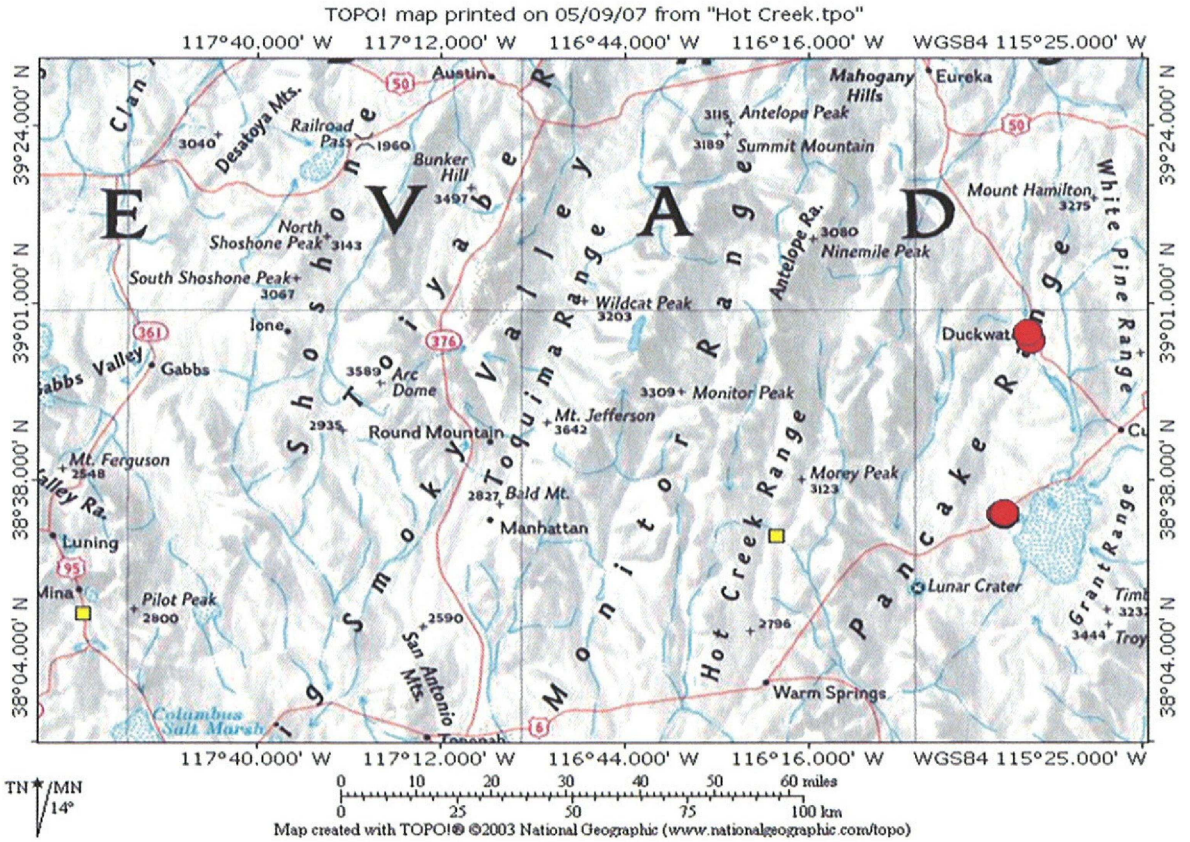

Figure 1. Rangewide Distribution of Railroad Valley Springfish (*Crenichthys nevadae)*. Red circles indicate historic populations and yellow squares indicate introduced, refugia populations.

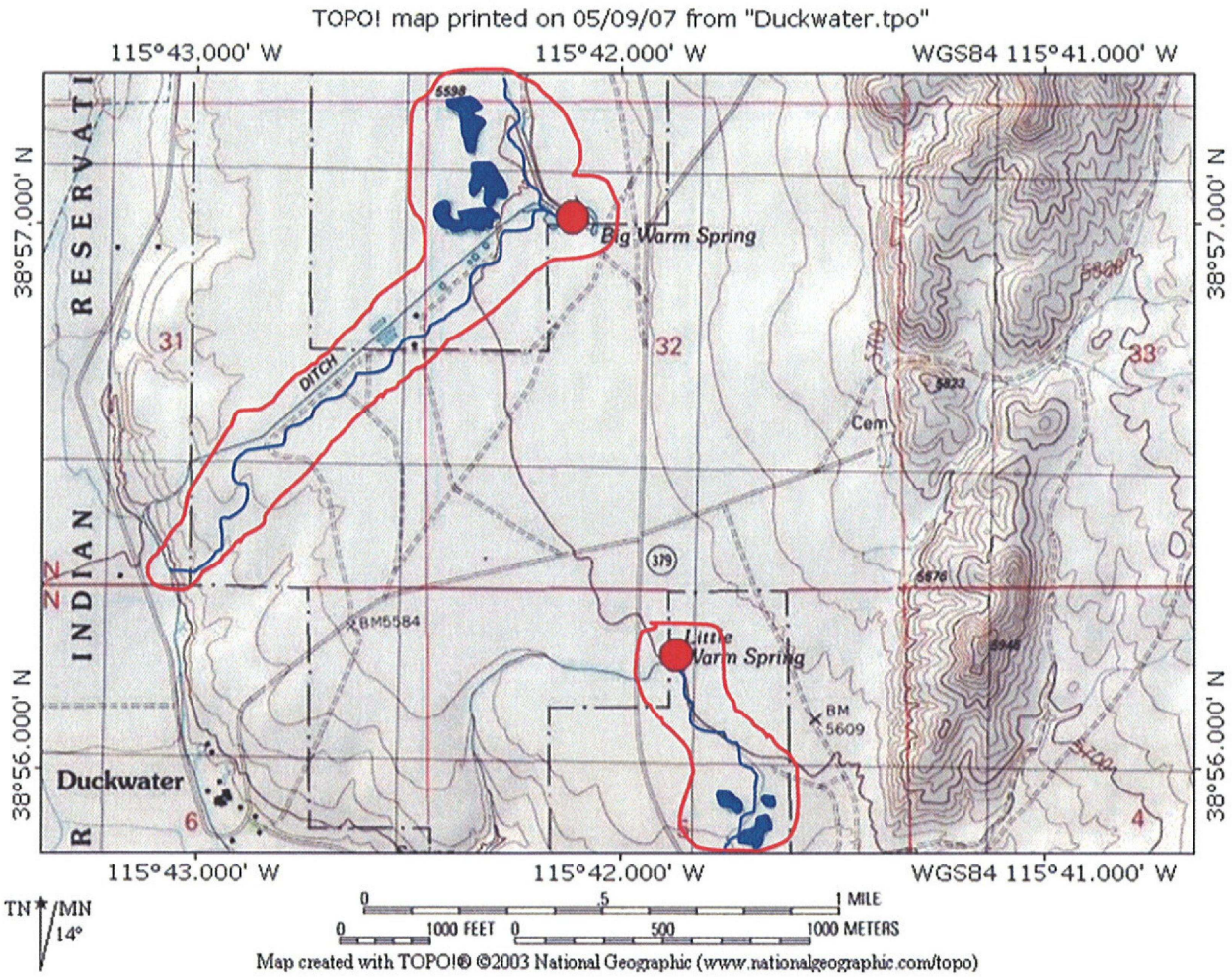

Figure 2. Big Warm Spring and Little Warm Spring at the Duckwater Shoshone Tribe Reservation. Red lines indicate extent of designated critical habitat.

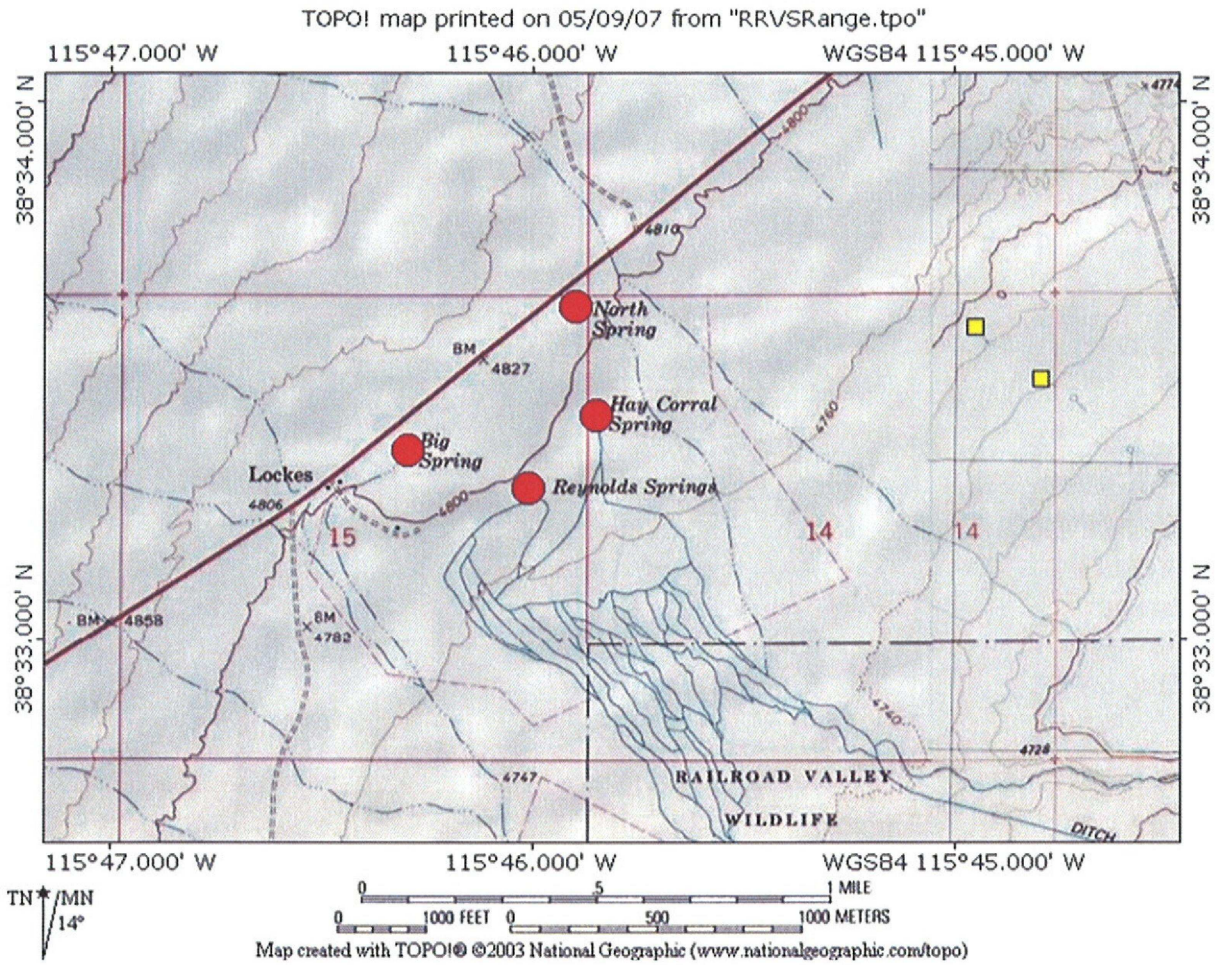

Figure 3. Big Spring, Reynolds Spring, Hay Corral Spring, and North Spring at Nevada Department of Wildlife's Lockes Ranch. Red lines indicate extent of designated critical habitat. Yellow squares indicate two introduced populations at Chimney Hot Spring and Terrace Hot Spring.

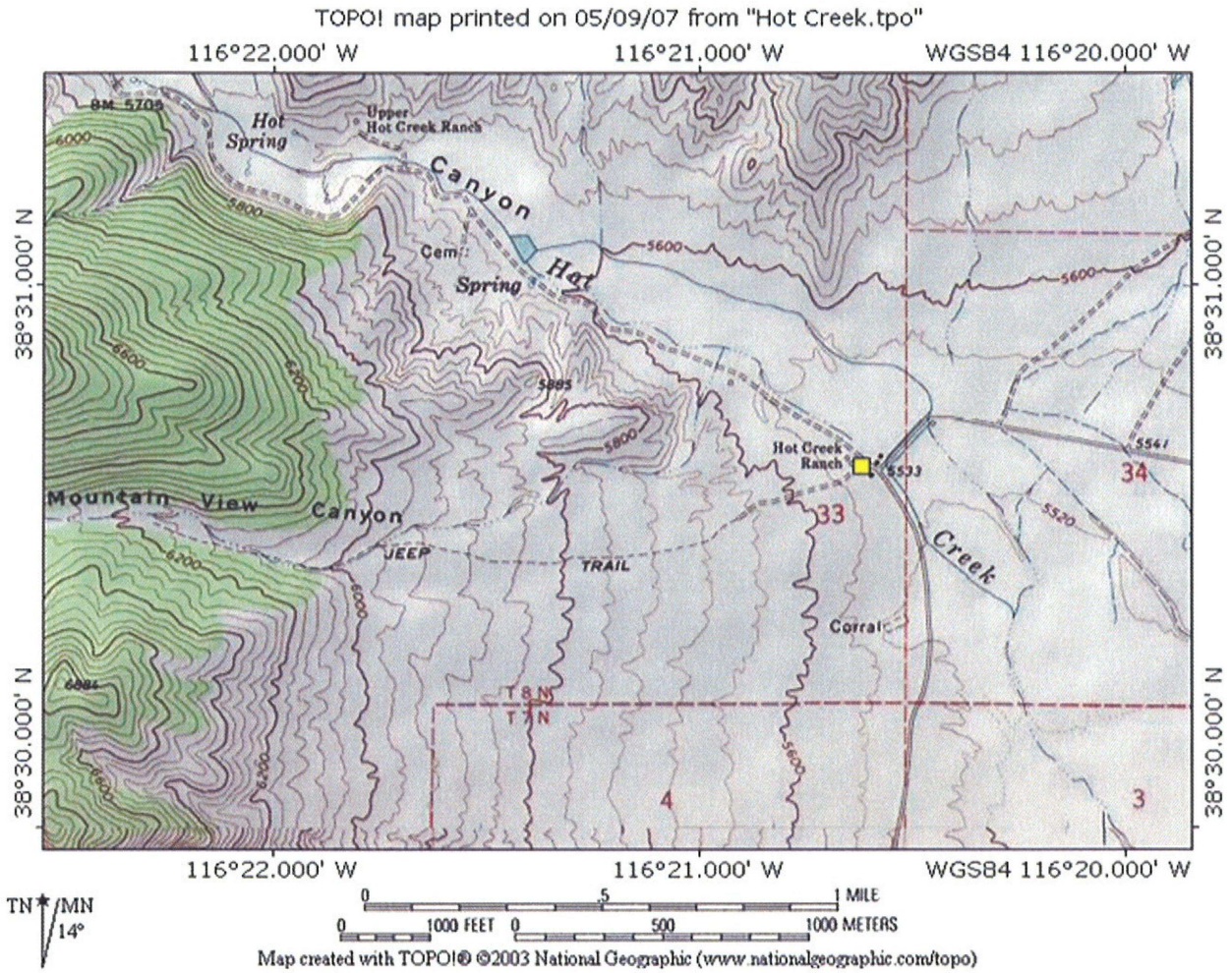

Figure 4. Introduced population at Hot Creek Ranch. Yellow square indicates general locations.

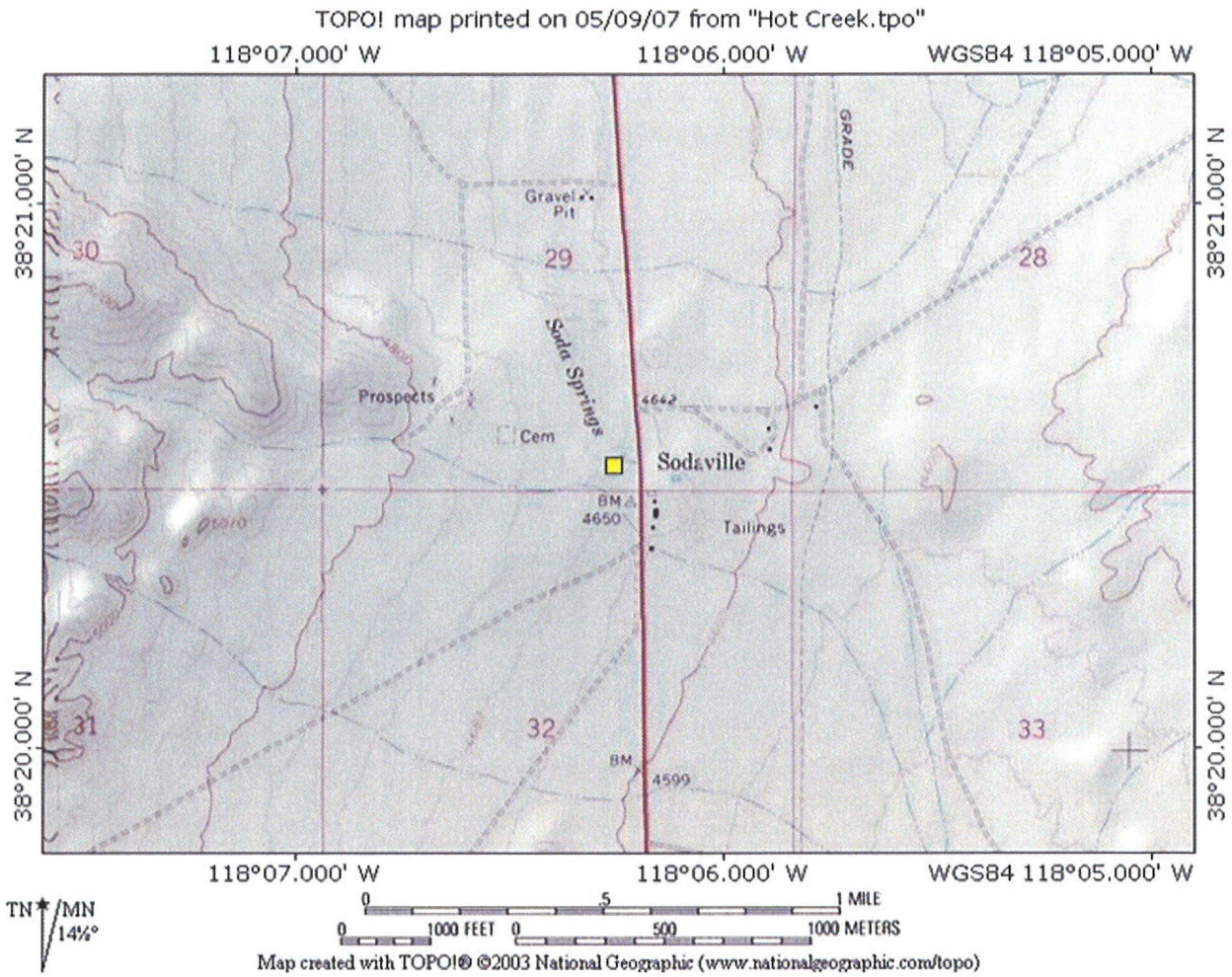

Figure 5. Sodaville population of introduced Railroad Valley springfish. Yellow square indicates general location.

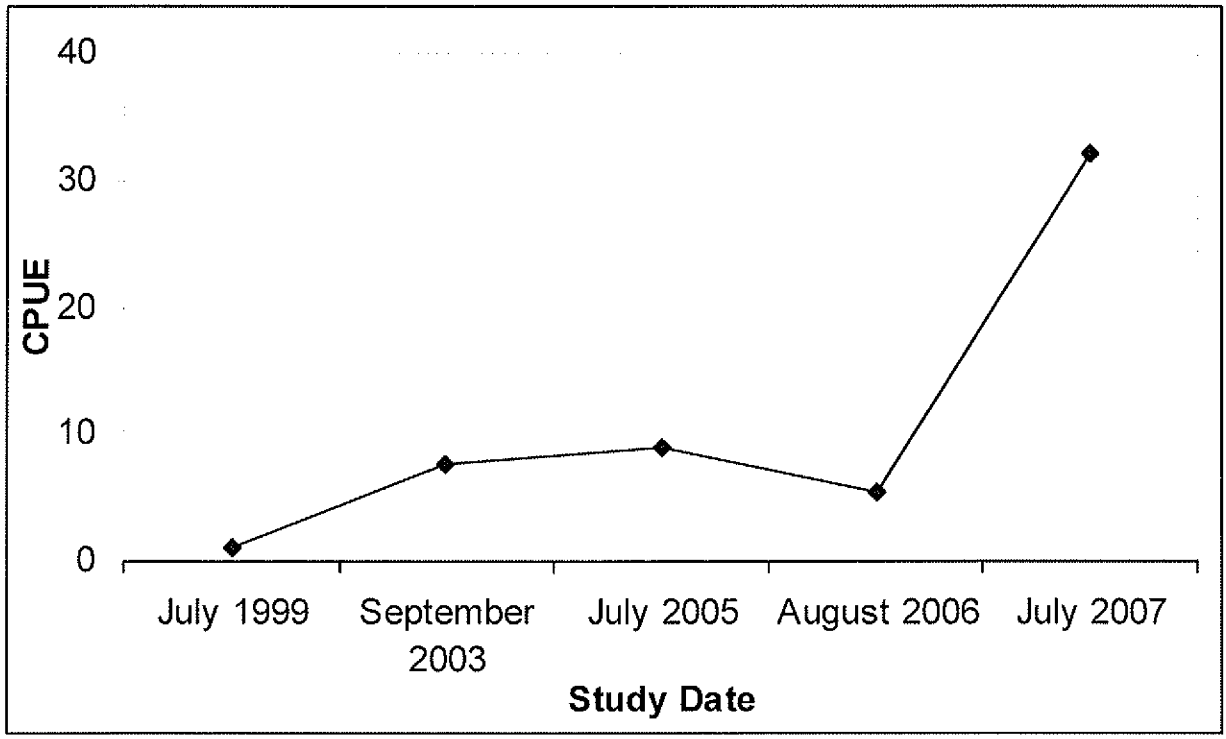

Figure 8. Catch per unit effort (CPUE) for RRVS at Little Warm Spring, Nye County, Nevada.

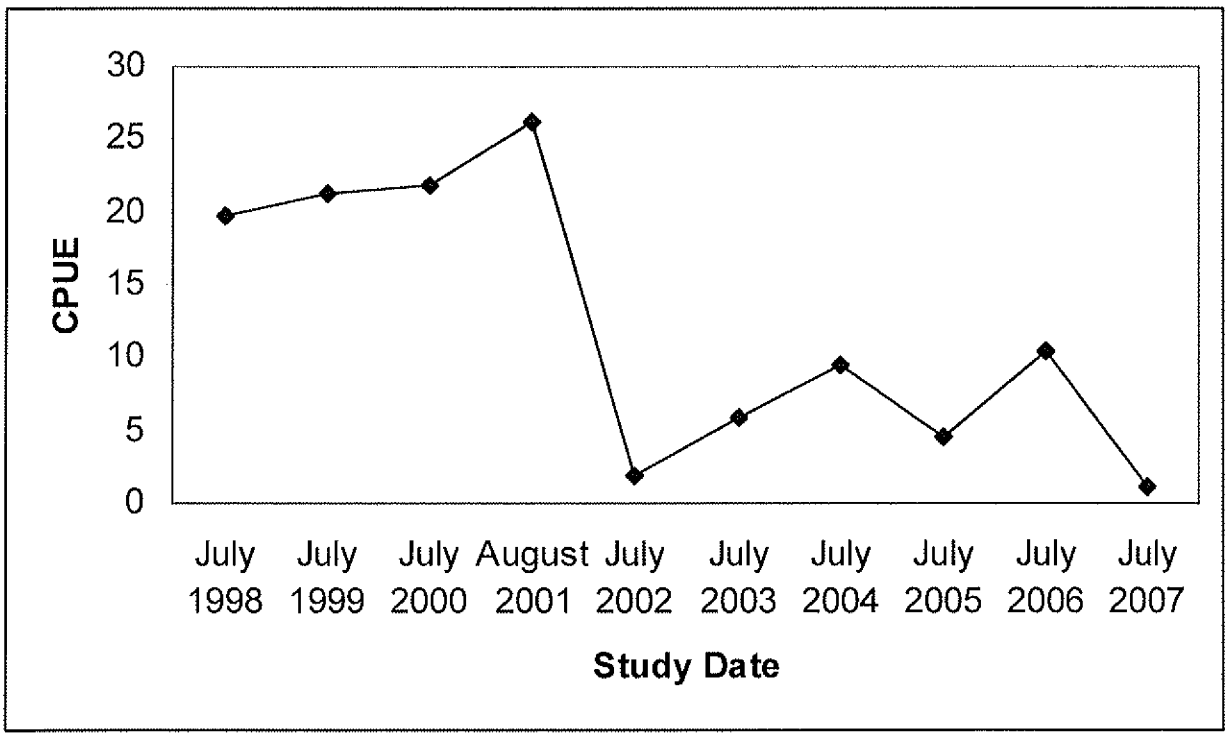

Figure 9. Catch per unit effort (CPUE) for RRVS at Hay Corral Spring, Nye County, Nevada.

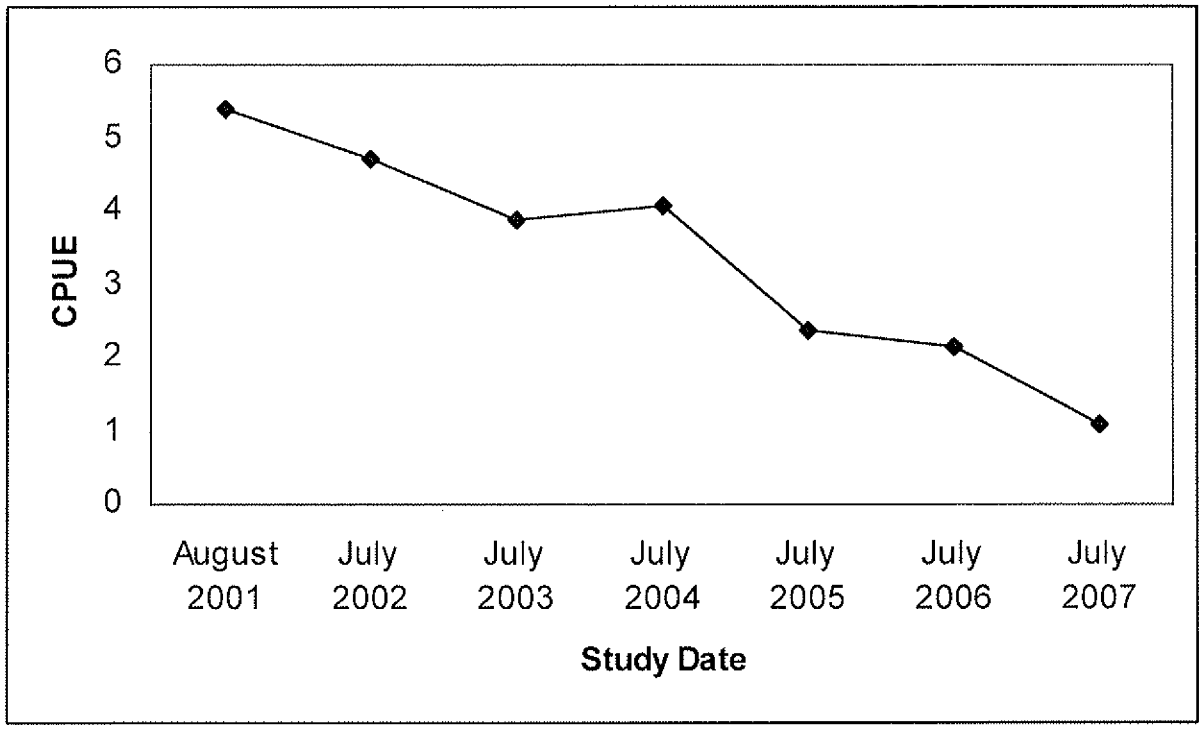

Figure 10. Catch per unit effort (CPUE) for RRVS at Reynolds Spring, Nye County, Nevada.

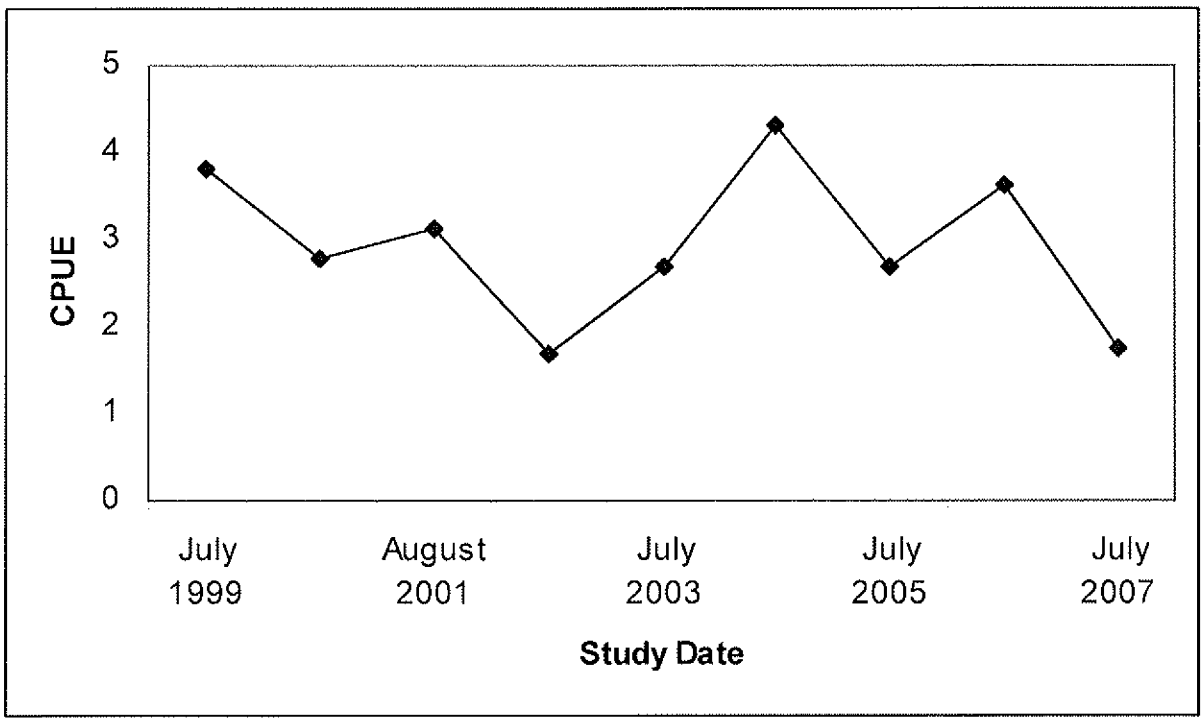

Figure 11. Catch per unit effort (CPUE) for RRVS at Big Spring, Nye County, Nevada.

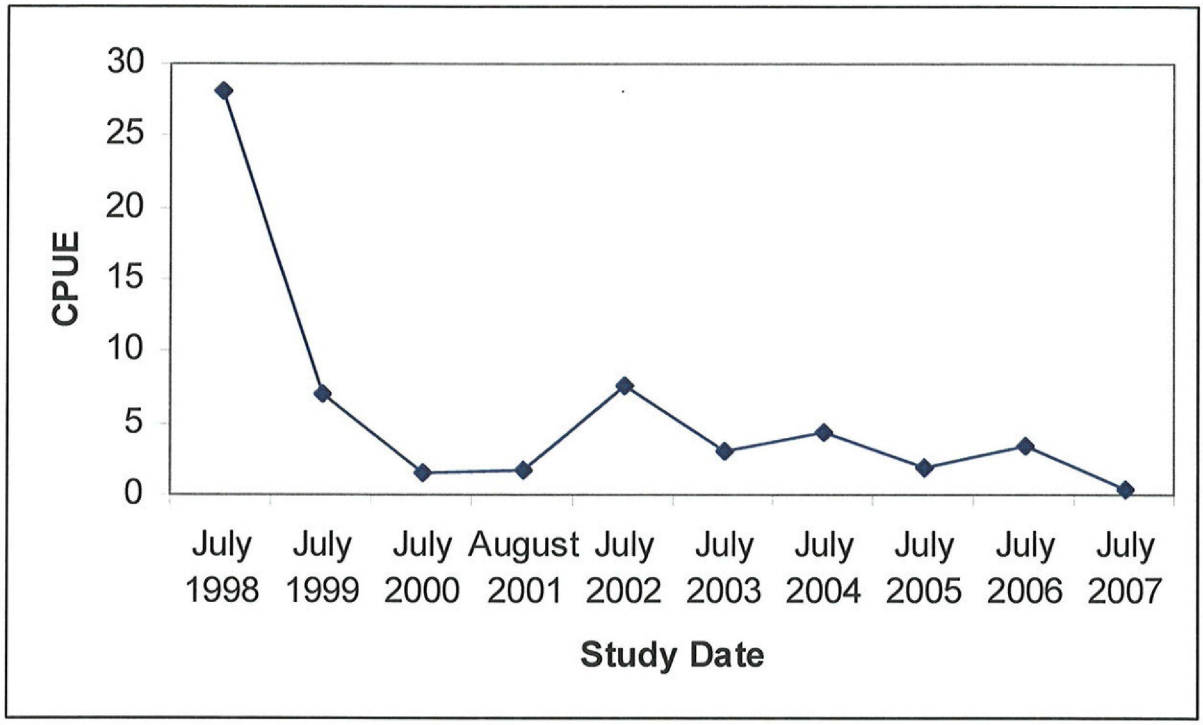

Figure 12. Catch per unit effort (CPUE) for RRVS at North Spring, Nye County, Nevada.

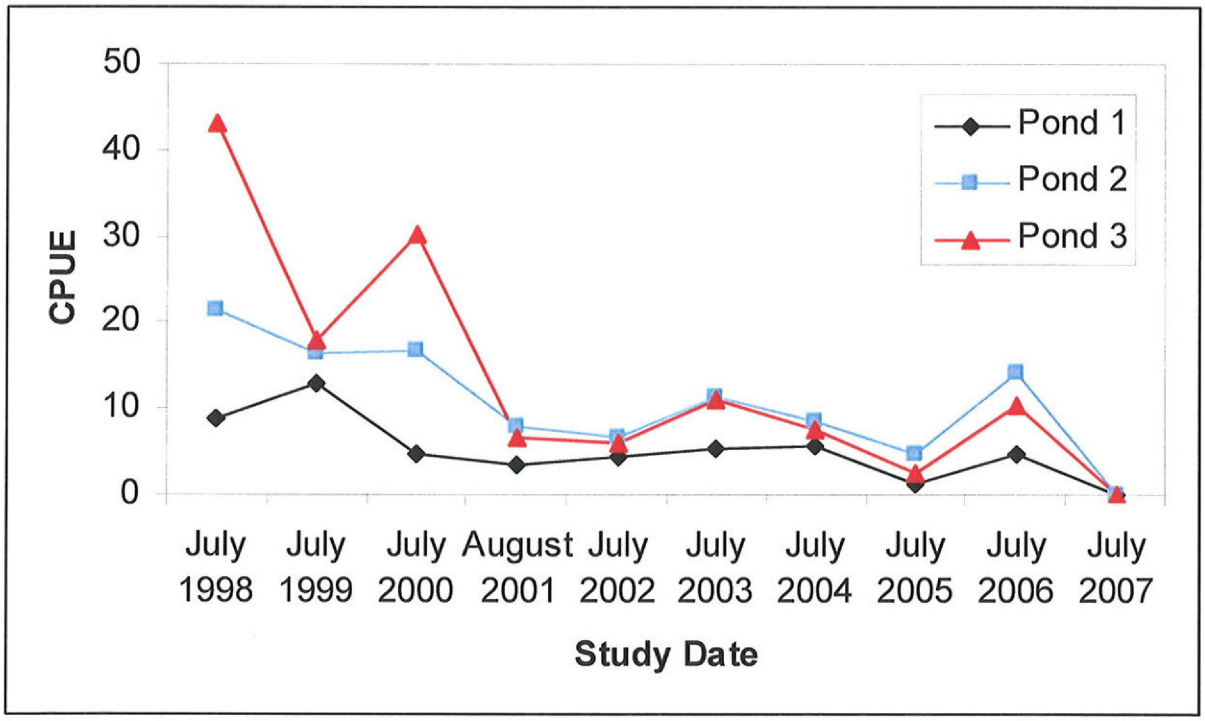

Figure 13. Catch per unit effort (CPUE) for RRVS at Chimney Hot Spring, Nye County, Nevada.

Table 1. Catch per unit effort and locations of Railroad Valley springfish (*Crenichthys nevadae*) calculated during annual minnow trapping surveys of historical habitat at Big Warm Spring, Little Warm Spring, North Spring, Hay Corral Spring, Reynolds Spring, and Big Spring.

Lockes Ranch Complex						Duckwater Complex				
Survey Year	Survey Month	Hay Corral	North Spring	Reynolds Spring	Big Spring	Big Warm Spring	Little Warm Spring	School Spring	Sugar Shack Road Springs	
									Spring 1	Spring 2
1998	July	19.8	28.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1999	July	21.2	7.1	N/A	3.8	N/A	1.2	N/A	N/A	N/A
2000	July	21.8	1.43	N/A	2.77	N/A	N/A	N/A	N/A	N/A
2001	August	26.2	1.67	5.4	3.12	N/A	N/A	N/A	N/A	N/A
2002	July	1.88	7.64	4.7	1.68	N/A	N/A	N/A	N/A	N/A
2003	July	5.9	3	3.87	2.79	N/A	N/A	N/A	N/A	N/A
2003	September	N/A	N/A	N/A	N/A	0	7.7	15.3	Present	Present
2004	July	9.57	4.3	4.06	4.3	N/A	N/A	Present	Present	Present
2005	July	4.5	1.87	2.38	2.69	N/A	N/A	Present	Present	Present
2006	July	10.5	3.51	2.15	3.64	N/A	9.07	Present	Present	Present
2006	August	4.53	1.23	1.85	2.11	N/A	5.44	Present	Present	Present
2007	July	1.12	0.39	1.08	1.74	N/A	32.2	Present	Present	Present

Table 2. Catch per unit effort and locations of Railroad Valley springfish (*Crenichthys nevadae*) calculated during annual minnow trapping surveys of refugium populations.

Refugium Populations								
Survey Year	Survey Month	Chimney Spring			Terrace Hot Spring		Hot Creek Canyon Spring	Sodaville Springs
		Upper Pond	Middle Pond	Lower Pond	Spring	Outflow		
1998	July	8.9	21.5	43	N/A	Present	N/A	N/A
1999	July	12.8	16.3	17.8	N/A	Present	N/A	N/A
2000	July	4.63	16.77	30.33	N/A	Present	N/A	N/A
2001	August	3.47	7.71	6.56	N/A	Present	N/A	Present
2002	July	4.25	6.75	6.13	N/A	Present	N/A	Present
2003	July	5.28	11.33	11.13	N/A	Present	N/A	N/A
2003	September	N/A	N/A	N/A	N/A	Present	N/A	N/A
2004	July	5.74	8.44	7.39	N/A	Present	N/A	N/A
2005	July	1.3	4.73	2.51	N/A	Present	N/A	N/A
2006	July	4.56	14.3	10.46	N/A	Present	N/A	N/A
2006	August	2.25	5.45	10.45	N/A	Present	N/A	N/A
2007	July	0	0	0	N/A	N/A	N/A	N/A