

**VIRGIN SPINEDACE**  
*(Lepidomeda mollispinis mollispinis)*  
**CONSERVATION STRATEGY**

(Revised January 2002)

Prepared by:

Leo D. Lentsch  
M. Jane Perkins  
Henry Maddux  
Todd C. Hogrefe

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Utah Division of Wildlife Resources  
1594 West North Temple, Ste. 2110  
Salt Lake City, Utah 64116-3193  
Kevin Conway, Director

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# VIRGIN SPINEDACE

(*Lepidomeda mollispinis mollispinis*)

## CONSERVATION STRATEGY

Revised January 2002

### 1. Introduction

The Virgin spinedace (*Lepidomeda mollispinis mollispinis*) Conservation Agreement (CA) was executed in 1995, in an effort to bring state, local, and federal resources to bear on threats to the continued existence of the species, which had been proposed for listing as threatened under the Endangered Species Act of 1973, as amended (ESA). The CA reflects the expectation that maximum benefit to Virgin spinedace would be achieved through a combined, voluntary effort in accordance with the federal policy of cooperation with state and local governments set forth in the ESA, in place of strict reliance on unilateral federal actions which might otherwise be required under the ESA.

An assessment of the initial five-year term of the CA revealed that considerable efforts had been expended toward the conservation of Virgin spinedace (Hogrefe 2000). Some of the significant actions included efforts to acquire instream flows in approximately 36 km of Virgin spinedace habitat, habitat enhancement projects along approximately 65 stream km, control of non-indigenous fishes, re-introduction of Virgin spinedace into historic habitat, population monitoring, and development of mitigation protocols. In addition, the Virgin River Resource Management and Recovery Program (VRRMRP, Utah Department of Natural Resources 2002) was formally approved in 2001, representing the culmination of many years of effort by the United States Fish and Wildlife Service (FWS), United States Bureau of Land Management (BLM), National Park Service (NPS), Utah Department of Natural Resources (UDNR), and Washington County Water Conservancy District (WCWCD). While the VRRMRP was under review, participants undertook the implementation of several recovery and conservation actions, including elements of the CA. Due to these actions, the signatories agreed that sufficient progress had been made toward the conservation of Virgin spinedace and that an extension of the CA was warranted. Consequently, the signatories renewed the CA through a Memorandum of Understanding on June 16, 2000 (Appendix A).

The CA calls for modifications of the associated Conservation Strategy as required, based upon periodic reviews. As the Strategy has been implemented since the CA was first executed in 1995, the parties have been able to evaluate the provisions of the Strategy for their practical implications, considering where resources might best be applied to the benefit of the Virgin spinedace. As a result of these evaluations, this Conservation Strategy has been modified from the original.

## 2. Purpose

The purpose of this document is to describe specific procedures and strategies required for conservation of Virgin spinedace. The general conservation approach focuses on two objectives. The first objective is to eliminate or reduce threats to Virgin spinedace to the greatest extent possible. The second objective is to enhance and/or stabilize instream flows in specific reaches of historic Virgin spinedace habitat. Though the primary focus of this strategy is conservation and enhancement of Virgin spinedace populations, it could also eliminate or reduce threats and improve habitat for many other species, which could preclude the need for federal listing pursuant to ESA.

## 3. Definitions

**Occupied Habitat** Stream reaches containing self-sustaining Virgin spinedace populations.

**Historic Habitat** Stream reaches that have been shown, can be shown, and/or can logically be deduced as historically being occupied by Virgin spinedace. This area is approximately 226 km (141 mi). The exact extent of historic habitat is unknown. Historically, spinedace habitat probably fluctuated with changing environmental conditions.

**Population Maintenance Flows** flows of sufficient magnitude to maintain self-sustaining Virgin spinedace populations during low-flow periods. These flows are dependent on flow events of sufficient magnitude, timing, and duration to maintain channel characteristics and provide environmental cues.

**Self-Sustaining Population** Population with sufficient numbers, age class structure, and natural reproductive success to provide for its long-term persistence.

**Non-indigenous** Not native, or not occurring naturally in a specific area or environment.

## 4. Background

The Virgin River basin is characterized by a diverse landscape with unique communities of fauna and flora. The basin encompasses approximately 15,600 km<sup>2</sup> (6,000 mi<sup>2</sup>). The Virgin River headwaters are in Washington and Kane County, Utah, and the stream generally flows southwest to Lake Mead on the Colorado River in Nevada. Elevations range from 3,300 m (10,000 ft) above mean sea level near the headwaters to less than 700 m (2000 ft) at Littlefield, Arizona. The river varies from reaches with narrow, steep-walled canyons and steep gradients to low deserts with broad open canyons and low gradients. Mean annual precipitation ranges from about 20 cm (8 in) at low elevations to about 100 cm (40 in) at higher elevations.

Due to the diverse topography, this river and its associated riparian area and floodplain provide habitat for more than 363 wildlife species (Appendix B). The six fish species indigenous to the basin include: speckled dace (*Rhinichthys osculus*), the Utah State sensitive flannelmouth sucker (*Catostomus latipinnis*), desert sucker (*Catostomus clarki*), and Virgin spinedace (Utah Division of Wildlife Resources 1997a), and the federally endangered woundfin (*Plagopterus argentissimus*) and Virgin River chub (*Gila seminuda*) (U.S. Fish and Wildlife Service 1994).

Virgin spinedace was recognized in 1979 as a threatened species by the scientific community. The Endangered Species Committee of the American Fisheries Society added it to its list of threatened and endangered fish after assessing criteria consistent with the ESA (Deacon et al. 1979). The determination of that status was based on review of original data and discussions with pertinent agencies and knowledgeable scientists. On May 18, 1994, FWS proposed the species for listing as a threatened species pursuant to the ESA (59 FR 25875). In 1996, FWS withdrew the proposal to list Virgin spinedace (61 FR 4401) because the execution of the Conservation Agreement provided a mechanism to significantly reduce or eliminate the threats that warranted listing.

### 4.1 Systematics and Description

Virgin spinedace is a member of an endemic tribe of western cyprinids, the Plagopterini (Miller and Hubbs 1960). The group is comprised of three genera: *Meda*, *Plagopterus*, and *Lepidomeda*. The first two genera are monotypic, represented by spikedace (*M. fulgida*) and woundfin. *Lepidomeda* is a polytypic genus containing four species: White River spinedace (*L. albivallis*), Pahranaagat spinedace (*L. altivelis*), Little Colorado spinedace (*L. vittata*), and Middle Colorado River spinedace (*L. mollispinis*). *L. mollispinis* is classified into two subspecies: Big Springs spinedace (*L. m. pratensis*) and Virgin spinedace (*L. m. mollispinis*). Current work suggests leatherside chub may be in *Lepidomeda* (Johnson and Jordan 2000, Dowling et al. 2002)

Extant members of the Plagopterini tribe are rare. The Pahranaagat spinedace is considered extinct (Miller and Hubbs 1960; Valdez et al. 1991). The woundfin and

White River spinedace are listed as endangered (35 CFR 16047 and 50 FR 37198, respectively). The spikedace (51 FR 23781), Big Springs spinedace (50 FR 12302), and the Little Colorado River spinedace (52 FR 35040) are listed as threatened.

Spinedace received its name from the fusion of two anterior, hardened spiny rays of the dorsal fin and a similar structure located in the pelvic fin. The Virgin spinedace derives its specific name from the Latin words *mollis*, meaning soft, and *spinis*, meaning spine, both referring to the soft-tipped second dorsal spine (Miller and Hubbs 1960).

The body of the Virgin spinedace is silvery with a brassy sheen and occasionally with light sooty blotches dorso-laterally. During breeding, bases of the paired fins are reddish-orange. The Virgin spinedace is characterized by a terminal mouth, rounded head and belly, and a body size typically ranging from 60 mm to 120 mm (2.4 to 4.7 in) (Rinne 1971; Addley and Hardy 1993). The species has a well-scaled body, with 77-91 scales on the lateral line and two rows of pharyngeal teeth which typically number 2, 5-4, 2 (Sigler and Miller 1963; Valdez et al. 1991; Addley and Hardy 1993). The dorsal fin has eight rays and the anal fin usually includes nine rays, but may vary from eight to ten rays.

## 4.2 Life History

The life history of the Virgin spinedace was described by Rinne (1971). Having a life-span of about three years, the fish reaches sexual maturity at about one year. Populations typically are comprised mostly of young-of-the-year (YOY) and age-1 fish. Because of the mild climate of Virgin spinedace habitat, age determination after one year can be difficult. However, Rinne (1971) indicated that fairly accurate estimates could be made using total length: young-of-the-year <55 mm; age-1 55-76 mm; age-2 77-85 mm; age-3 >85 mm.

Although sexual dimorphism is not apparent most of the year, sexes can be distinguished during peak breeding season. Females tend to be more robust and plump, whereas males remain streamlined. Furthermore, the vent of the female becomes swollen and the ovipositor becomes a reddish color (Rinne 1971). Both sexes exhibit the reddish-orange coloration at the bases of the paired fins.

Annual spawning of Virgin spinedace has been observed from April through June at mean daily water temperatures of 13-17°C and day lengths of about 13 hours. Rinne (1971) found that age-1 females had the lowest mean relative fecundity, averaging 459 eggs, whereas age-2 and age-3 females averaged an increase in mean between 42% to 34% of relative fecundity over age-1 females, respectively. Since populations are comprised primarily of age-1 fish, they often comprise 90% of the spawning population (Addley and Hardy 1993).

Virgin spinedace are typically found in clear, cool, swift streams that have interspersed pools, runs, and riffles (Deacon et al. 1979, Valdez et al. 1991). Upper

thermal preference has been reported as 23.1 °C (Deacon et al. 1987). Rinne (1971) found Virgin spinedace most frequently in pools with some type of protection such as undercut banks, boulders, or debris; however, variations in habitat preferences have been noted. For example, in Beaver Dam Wash, Virgin spinedace utilize narrow, shallow runs with large amounts of emergent vegetation, and in North Fork of the Virgin River, they most often occupy quiet pools (Rinne 1971). Virgin spinedace have also been documented to prefer shear zones between high (100 cm/sec) and low (10 cm/sec) velocities containing cover (Deacon et al. 1979, Hardy et al. 1989, Deacon et al. 1991). Nursery habitat preferences, however, remain unclear.

Virgin spinedace are primarily insectivorous, feeding on a wide range of insects and occasionally plant material and organic debris (Rinne 1971, Greger and Deacon 1988; Angradi et al. 1991). Virgin spinedace feed on drifting prey in midwater and at the surface. They usually maintain equilibrium in the midwater column, darting to the surface to capture prey in a manner similar to drift-feeding salmonids (Rinne 1971, Addley and Hardy 1993).

### **4.3 Historic Distribution**

The historic distribution of Virgin spinedace is not well documented. Holden (1977) suggested that historic occurrence was in most of the clearwater tributaries and several mainstem reaches of southwestern Utah, northwestern Arizona, and southeastern Nevada (Figure 1). Museum records from the University of Nevada at Las Vegas, Brigham Young University, University of Michigan Museum of Zoology, and the United States National Museum support Holden (Rinne 1971; Cross 1975; Valdez et al. 1991; Addley and Hardy 1993). The earliest survey records indicated this species was common in the Santa Clara River and North Fork of the Virgin River, but probably less common in the mainstem Virgin River (Tanner 1932, Tanner 1936). C.L. Hubbs (unpublished data) collected Virgin spinedace near Bunkerville, Nevada, in 1938, but surveys in 1942 in the same area did not detect Virgin spinedace (Cross 1975). Furthermore, the species was absent from surveys below Littlefield, Arizona between 1942 and 1975 (Cross 1975).

### **4.4 Current Distribution**

Populations of Virgin spinedace currently exist in the mainstem Virgin River and eleven of its tributaries including East Fork Virgin River, Shunes Creek, North Fork Virgin River, North Creek, La Verkin Creek, Ash Creek, Santa Clara River, Beaver Dam Wash, Coal Pits Wash, Moody Wash and Magotsu Creek (Table 1). According to Addley and Hardy (1993), the largest populations occur in the upper mainstem above Quail Creek diversion and in drainages of the Santa Clara River and Beaver Dam Wash. Small populations exist in Ash Creek, La Verkin Creek, and the lower mainstem below Pah Tempe Springs. The remaining areas contain intermediate-sized populations.

## **5. Threats to Virgin Spinedace at time of Proposed Federal Listing**

At the time of the proposed listing under ESA, Virgin spinedace populations had been reduced to approximately 60-63 percent of their historic distribution. Historically, Virgin spinedace distribution included several Virgin River mainstem reaches and tributaries in southwestern Utah, northwestern Arizona, and southeastern Nevada and encompassed approximately 231 stream km (Valdez et al. 1991, Addley and Hardy 1993). By 1994, the distribution had been reduced to approximately 140.0 stream kilometers and was limited to the Virgin River mainstem and several tributaries in Utah (Valdez et al. 1991, Addley and Hardy 1993). In addition, 24% of currently occupied habitat had experienced some degree of adverse modification (Table 1). The distribution decline was attributed to habitat destruction and degradation due to water depletions and livestock grazing, adverse interactions with nonnative species, inadequacy of regulatory mechanisms, and other natural or human induced factors including drought, mining, and recreational use (Lentsch et al. 1995). In 1994, FWS described pertinent problems and threats they perceived as facing the Virgin spinedace based on criteria for federal listing as required by Section 4(a)(1) of the ESA (59 FR 25875). The following discussion summarizes the significant threats to Virgin spinedace that have been or will be addressed by this Strategy.

### **5.1 Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range**

Virgin spinedace habitat modification and/or elimination has occurred primarily through human activities such as dam and diversion construction, water depletion or diversion, and agricultural practices (Table 1). Approximately 7 km (4 mi) of Virgin spinedace historic habitat have been inundated by reservoirs including Quail Creek Reservoir on Quail Creek, Gunlock Reservoir on the Santa Clara River, and Schroeder Reservoir on Beaver Dam Wash (Figure 1). Approximately 60 km (37 mi) of historic habitat have been de-watered by diversions; furthermore, diversions have depleted water in approximately 31 km (19 mi) of occupied habitat. Lack of stable instream flows and low water levels due to diversions cause changes in water temperature, affect aquatic vegetation, and alter water chemistry and dissolved oxygen levels. Dams and diversions also act as barriers to fish movement within the system and fragment Virgin spinedace habitat and populations. In areas of extensive habitat fragmentation, migration is virtually non-existent.

Agricultural practices have also modified several areas of Virgin spinedace habitat through alteration of the riparian zone. Riparian alterations often cause stream bank erosion, siltation, and de-vegetation. Evaluation of the Virgin River basin riparian zone (Fridell, Hansen, Leany, and Douglas, personal communication, 1994) indicated that some alterations from crop production are occurring along lower La Verkin Creek, lower Ash Creek, and middle Virgin River reaches. Several reaches are impacted by livestock,

including the Santa Clara River below Gunlock Reservoir, lower Santa Clara River, lower North Creek, lower La Verkin Creek, lower Ash Creek, and portions of the Virgin River mainstem. The remaining riparian zones appear to be relatively intact.

## **5.2 Predation, Competition, and Disease**

Aquatic species introduced into the Virgin River basin have contributed to reductions of native fish populations (Addley and Hardy 1993). Several non-indigenous fish species occupy the same habitat as Virgin spinedace (Table 2) and several of these species prey on Virgin spinedace. Other non-indigenous species (Table 2), such as crayfish (i.e., Astacidae), may prey on larval and young-of-year life stages in lower reaches of several tributaries (Addley and Hardy 1993). Some non-indigenous species may also affect Virgin spinedace habitat by competing for limited resources such as food and space. Disease and parasites do not appear to have had significant roles in the initial decline of Virgin spinedace; however, they may have adverse effects when coupled with other threats and stress factors (Addley and Hardy 1993).

## **5.3 Other Natural or Manmade Factors**

Several other natural and manmade factors have contributed to the decline of Virgin spinedace. Natural limiting factors include drought, flood, and in some instances, natural barriers and native species interactions. The extent to which natural factors affect Virgin spinedace is unclear.

Pollution from municipal drain and agriculture return flows is a potential problem for all native species within the basin. Return flows from municipal drains and agriculture can comprise a significant portion of total stream flow. Water from these return flows can be polluted with pesticides and herbicides as well as other wastes. Mining along Beaver Dam Wash may contribute to habitat degradation. Low flows, caused naturally or by diversions, increase the impacts that pollution, erosion, siltation, and mineral springs have on the chemical composition of the water.

Recreational use (e.g. off-road vehicles) significantly impacted several reaches including the Santa Clara River below Gunlock Reservoir, the lower Santa Clara, and the lower mainstem Virgin River (Fridell et al., personal communication.).

## **6. Conservation Actions Implemented: 1995-2000**

Seven classes of conservation actions were outlined in the original Strategy to reduce the threats described in the previous section. Many of these conservation actions were successfully implemented during the initial five-year term of the Agreement. These actions are described in more detail in the five-year assessment (Hogrefe 2000). The actions that were implemented as described in the original Strategy are briefly described below.

### **6.1 Establish Existing Conditions as Baseline**

- Baseline conditions in the mainstem Virgin River were described as part of the Proposed VRRMRP (Lentsch et al. 1998). Four primary attributes were used to describe existing conditions: 1) basin hydrology; 2) channel geomorphology; 3) water rights and depletions; and 4) ecology.
- Proposed modifications to existing conditions were evaluated. The Utah Division of Wildlife Resources (UDWR) and FWS reviewed Stream Channel Alteration (SCA) permits for projects that could have altered current stream channel conditions. The SCA application review process was modified to consider and prevent potential impacts to Virgin spinedace.

### **6.2 Re-establish Population Maintenance Flows**

- WCWCD provides and maintains a minimum flow of three cubic feet per second (cfs) in the Virgin River Narrows below the Quail Creek diversion. This action has restored approximately 4.5 km of Virgin spinedace habitat. Due to this restored flow, year-round downstream connectivity to this reach has been re-established for the first time in approximately 80 years, and small numbers of Virgin spinedace currently persist there.
- Considerable preparations were made to restore flows on the Santa Clara River below Gunlock Reservoir using a pipeline. Funds are in place to complete this project and an environmental assessment (EA) for this project was initiated. The engineering plans and contract specifications for the pipeline have been completed and agreements have been negotiated with local irrigation companies. The Shivwits Band of the Paiute Indian Tribe of Utah Water Rights Settlement Act (Water Rights Settlement) was proposed in Congress and signed into federal law on August 18, 2000. The Water Rights Settlement is intended to be locally implemented through the St. George Water Reuse Project Agreement, the

Santa Clara Project Agreement, and a settlement agreement. As the parties to the CA undertook actions to provide instream flows in the Santa Clara River, it became apparent that the Water Rights Settlement was essential to accomplishment of the project. The Water Rights Settlement is the product of years of negotiations involving a number of stakeholders, including irrigation companies, municipalities, the Shivwits Band, the state of Utah, and others. Negotiations were also conducted to obtain a fraction of the Gunlock Reservoir conservation pool to provide a portion of the additional flows downstream. With the completion of these negotiations, the environmental review can proceed, and will be followed by the completion of the Santa Clara pipeline and the provision of instream flows in the Santa Clara River.

- WCWCD purchased water rights to restore flow throughout La Verkin Creek. The purchase adds approximately five cfs of year-round flow and restores approximately 11.4 km of historic Virgin spinedace habitat.
- Zion National Park (ZNP) issued a decision and Finding Of No Significant Impact for modifying a water diversion structure on Shunes Creek. Prior to construction, the water right owner made a commitment to move the diversion downstream 0.75 miles to a location outside the park. As currently planned, fish passage would be improved by replacing the older earthen diversion dam with a new diversion.

### **6.3 Enhance and Maintain Habitat**

- ZNP, the State of Utah, WCWCD, and the Kane County Water Conservancy District signed the Zion National Park Water Rights Settlement Agreement. This action recognized both the federal reserved and appropriative water rights for Zion National Park, while limiting additional water development upstream of the park. The result will be the preservation of essentially natural flow conditions in the Virgin River and its tributaries in the park, including natural patterns of floods, seasonal high and low flows, annual yield, and year-to-year variability.
- BLM developed the Virgin Town Park Management Agreement to improve conditions at the recreation area on the Virgin River west of Virgin Town. This agreement will provide protection and management of 0.8 km of aquatic and riparian habitat along the Virgin River.
- BLM acquired and retained aquatic and riparian habitats along 3.4 km of the Virgin River and its tributaries to protect and manage Virgin spinedace populations and habitat.
- BLM completed six fire rehabilitation, vegetative manipulation, and

mining rehabilitation projects to maintain and/or improve water quality in the Virgin River and tributaries.

- BLM completed Grazing Allotment Health Assessments for four allotments on 11.3 km of the North Fork of the Virgin River. These assessments were conducted to ensure that stream and riparian habitats are functioning properly and, if not, to identify necessary changes to restore ecosystem function.
- BLM designated four Areas of Critical Environmental Concern in the Dixie Resource Area Resource Management Plan (U.S. Bureau of Land Management 1999). The four areas include: 1,822 acres on 6.4 km of the Lower Virgin River, 33,063 acres on 14.5 km of the West Fork Beaver Dam Wash watershed, 1,645 acres near Land Hill, and 1,998 acres below Gunlock Reservoir on 7.2 km of the Santa Clara River.
- BLM developed the Santa Clara Reserve Cooperative Agreement with the City of Santa Clara. This agreement would restrict recreational camping, off-road vehicle (ORV) use along the river, and other conflicting land uses along approximately 4.0 km of the Santa Clara River.
- BLM constructed a protective fence enclosure on 0.8 km of the Santa Clara River below Gunlock Reservoir. This enclosure restricts recreational and livestock use in the area.
- WCWCD completed a project to provide year-round connectivity for native fish from lower to upper La Verkin Creek. This project provided approximately 5.6 additional stream kilometers of fully connected Virgin spinedace habitat. The passage functioned as intended from early summer 1998 until it was damaged by a large flood in July 1999.
- WCWCD, BLM, and other agencies repaired a natural sink hole that developed in Virgin spinedace habitat in La Verkin Creek in July 1996. The sink hole drained approximately seven cfs and the channel downstream was without flow for about 6.4 km kilometers. Subsequent sampling indicated that Virgin spinedace had persisted downstream of the sink hole by seeking refuge in the pools that developed in the channel as it dried.
- ZNP funded a study to assess recreational impacts on native fish communities within the park (Sappington 1998). In response to the results of this study and other factors, ZNP imposed limitations on recreational tubing on the North Fork of the Virgin River within park boundaries. Subsequently, additional safety and resource concerns

prompted ZNP to ban tubing completely.

- VRRMRP committed funds for the acquisition of land and water associated with 4.8 km of habitat along the Virgin River, La Verkin Creek, and Ash Creek. A conservation easement will be issued for the property to assure it will be retained in its natural condition and to prevent potential future impacts to Virgin spinedace and other native species.
- ZNP proposed Research Natural Area status for Parunuweap Canyon (ZNP 2001). This status will protect the East Fork of the Virgin River through implementation of a management approach intended to maintain resources in as near natural condition as possible, for the primary purpose of providing opportunities to study unaltered natural ecosystems. No developments for visitor use or other purposes will be permitted. Visitation will be limited to approved researchers and educational visits associated with the research.
- ZNP conducted Wild and Scenic Rivers planning as part of the General Management Plan for the park. Several portions of the Virgin River and its tributaries were found to be eligible and suitable for wild and scenic rivers designation, including all reaches that provide Virgin spinedace habitat in the park. Due to this finding, the National Park Service will manage these reaches to preserve the resources that contribute to their wild and scenic character. This management approach would differ from general park management by preventing some possible park actions or developments.
- ZNP began inventory and planning for restoring two miles of the North Fork of the Virgin River in Zion Canyon that have been channelized since the 1920s. Where channelized, the river has a reduced capacity to maintain a variety of fish habitats and diverse bank vegetation because it cannot maintain a functioning floodplain. Through this project, ZNP will attempt to restore a more natural channel slope, meander pattern, and floodplain. Following planning and compliance for the project, actual restoration may begin in 2003 if funding is secured.
- ZNP and UDWR funded the establishment and maintenance of a stream gauge on the East Fork of the Virgin River in the park.

#### **6.4 Selectively Control Non-indigenous Fish**

- UDWR approved and implemented the policy for Fish Stocking and Transfer Procedures (UDWR 1997b). The policy indicates that all fish stocking activities in Utah are to be consistent with ongoing recovery and

conservation actions for sensitive species. Fish stocking and introductions into the Virgin River basin by UDWR were not conducted unless they were consistent with this policy, the procedures outlined in the original Strategy, and the American Fisheries Society procedures for nonnative fish introductions (Kohler and Courtenay 1986).

- The process for approval of fish introductions into private ponds was modified due to the CA. Only bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), and rainbow trout (*Oncorhynchus mykiss*) introductions were permitted. Requests for the introduction of other nonnative species were not approved. Species that were denied included: channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomieu*), yellow perch (*Perca flavescens*), walleye (*Stizosedion vitreum*), carp (*Cyprinus carpio*), brown trout (*Salmo trutta*), white bass (*Morone chrysops*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), mosquitofish (*Gambusia affinis*), and fathead minnow (*Pimephales promelas*).
- An NDOW proposal to change fishing regulations on Beaver Dam Wash and Schroeder Reservoir was accepted by the Nevada Board of Wildlife Commissioners. Since March 1998, only artificial lures are allowed for sport fishing. These regulations will help prevent the introduction of undesirable aquatic species in the drainage.
- UDWR ceased stocking brown trout in the Santa Clara River below Veyo to minimize predation on Virgin spinedace.
- NDOW selectively removed rainbow trout from a tributary of Beaver Dam Wash below Schroeder Reservoir prior to Virgin spinedace re-introduction to minimize predation.
- National Environmental Policy Act requirements for a chemical treatment of Baker Reservoir were completed in the form of an EA (UDWR 1996). As part of this process, UDWR initiated analysis of options to remove green sunfish from the Santa Clara River.
- A plan was developed and partially implemented to systematically eradicate red shiner (*Cyprinella lutrensis*) from the Virgin River and its tributaries. UDWR conducted chemical treatments between Washington Fields diversion and Johnson diversion on the Virgin River, on Fort Pearce Wash, and in the Washington Fields drains and canals (Comella and Fridell 1998a, Comella and Fridell 1998b).

## 6.5 Maintain genetic viability

- Virgin spinedace were re-introduced into a small tributary of Beaver Dam Wash below Schroeder Reservoir. The source fish for the transfer were collected from Lytle Ranch and Mormon Well. These sites are located on Beaver Dam Wash and represent the closest populations to the re-introduction site. Fish were released in sufficient numbers to prevent the loss of fitness due to inbreeding depression (Lerner 1954) and the loss of rare alleles due to random genetic drift (Wright 1965). Subsequent monitoring of the introduced population detected numerous adults, but did not verify recruitment.

## 6.6 Population and Habitat Monitoring

- Standardized population monitoring was conducted annually since 1994. In 1994, eleven stations were monitored, and in 1995, a twelfth station located between Quail Creek diversion and Pah Tempe Springs was created in response to re-establishment of minimum flows in this reach. Complete monitoring methodology and results are summarized in Comella et al. (1998) and Fridell et al. (2000).
- NDOW monitored the re-established population in the Beaver Dam Wash tributary in 1997, 1998, 1999, and 2000. Adult spinedace were abundant but no recruitment was observed.
- In response to the restored three cfs flow below Quail Creek diversion, WCWCD funded Utah State University (USU) to establish four fish monitoring sites within the reach to assess native fish response. These sites were monitored by USU and UDWR approximately five times per year in 1996, 1997, and 1998 (Hardy and Addley 1998).
- WCWCD contracted USU to develop and maintain the Virgin River Fishes Database. As part of this effort, field data from monitoring activities within the Virgin River mainstem and tributaries collected by state, federal, and private investigators were verified and input to the database. Using these data, USU examined long-term trends in fish populations within the Virgin River at standardized monitoring locations. Data are provided in Hardy and Addley (1998).
- WCWCD contracted USU to conduct several habitat analyses. The types and locations of habitats utilized by native species during the winter period were determined. This information allows a better understanding of winter habitat use by native species and serves as a baseline for evaluating altered flow regimes during the winter period. To address the

concern that Quail Creek Reservoir operations may affect the thermal regime of the mainstem Virgin River, USU characterized the thermal regimes above and below the reservoir. USU also delineated the spatial distribution of available habitat types at each of the population monitoring sites. Summaries of these efforts are provided in Hardy and Addley (1998).

### **6.7 Develop Mitigation Plan and Protocols for Future Activities**

- The plan for mitigating future activities was completed as part of the VRRMRP. A recovery bank was established to promote woundfin, Virgin River chub, and Virgin spinedace recovery and conservation, while including measures for water development to sustain human needs. The proposal process, recovery banking standards, and acquisition of recovery units are described in the Program Document for the VRRMRP (Utah Department of Natural Resources 2002).

### **6.8 Additional Actions**

- ZNP completed a study of the effects of hiking in the Zion Narrows section of the Virgin River (Shakarjian and Stanford 1998). The study concluded that the current volume of hikers diminishes the integrity of the river ecosystem by limiting zoobenthos and may negatively impact overall productivity of the river.
- BLM completed field work for the Virgin River Instream Flow Study. This study identifies and quantifies water dependent resources and needs on approximately 193 km of public land segments of the Virgin River. The study will include an analysis of fish water quantity needs, river morphology, and riparian and recreational resources on public land segments of the Virgin River in Utah, Arizona, and Nevada.

## **7. Conservation Actions to be Implemented: 2000-2005**

Conservation measures needed for the continued existence of Virgin spinedace focus on two objectives: 1) to eliminate or reduce threats to the maximum extent possible, and 2) to stabilize, restore and enhance specific reaches of historic habitat. The goal of these measures is to expand the range so that the species occupies at least 80% (approximately 181 km/112 mi) of its historic habitat. Attainment of the goal and objectives of this Strategy should be achieved by implementing the following management actions: 1) establish existing conditions as a baseline 2) re-establish population maintenance flows 3) enhance and maintain habitat 4) selectively control non-indigenous fish 5) re-establish Virgin spinedace populations; 6) monitor populations; and 7) mitigate for projects that impact Virgin spinedace. The conservation actions required under this Strategy are based on the current needs of Virgin spinedace. Actions that were completed under the original Strategy are not included.

### **7.1 Complete Description of Existing Baseline Conditions**

The description of baseline conditions will be completed to include all historic Virgin spinedace habitat. Three primary attributes will be used to describe existing conditions: 1) basin hydrology averaged over the last 20 years, 2) water rights and depletions, and 3) Virgin spinedace populations.

### **7.2 Re-establish Population Maintenance Flows**

Existing flow patterns currently meet the habitat requirements of the Virgin spinedace in approximately 164 km (102 mi) of the species historic habitat in terms of flow quantity, timing, duration, and frequency (Table 1). Stream channels are dry or flows are significantly depleted during the late-summer and early-fall periods in approximately 89 km (56 mi) of historic habitat (Table 1). Population maintenance flows will be re-established and maintained in approximately 39 km (24 mi) of these de-watered or depleted historic habitats to reduce habitat fragmentation and to restore populations. Two reaches have been identified as priority areas for re-establishing flows. The first reach encompasses approximately five km (3 mi) of the Virgin River between Quail Creek Diversion and Pah Tempe Springs. The second reach encompasses approximately 31 km (19 mi) of the Santa Clara River between Gunlock Reservoir and the confluence with the Virgin River. Flows will also be restored in one or a combination of other reaches listed in Table 3. The process of re-establishing flows will adhere to the following outline:

#### **1) Estimate Population Maintenance Flows**

Population maintenance flows were defined by identifying empirical relationships among stream flows, habitat characteristics, and Virgin spinedace population numbers throughout the drainage (Valdez et al 1991, Addley and Hardy 1993).

## **2) Provide Population Maintenance Flows**

Provision of population maintenance flows will be achieved through developing river operating agreements, securing minimum instream flow rights, developing agreements to modify irrigation practices, and recognizing federal reserved water rights.

## **3) Evaluate Population Maintenance Flows**

The response of Virgin spinedace populations and habitat to population maintenance flows will be evaluated over a five-year period.

## **4) Finalize Population Maintenance Flows Required**

A final recommendation for re-establishing population maintenance flows in specific reaches will be developed after completion of the evaluations. Information obtained from other instream flow studies will be considered in making those recommendations.

## **5) Protect Population Maintenance Flows**

Flow protection measures will be implemented that are consistent with state laws.

Table 4 summarizes progress that has been made toward re-establishing population maintenance flows for each of these reaches.

## **7.3 Enhance and Maintain Habitat**

Enhancement procedures will be implemented where degradation has occurred along approximately 26 km (16 mi) of historic habitat (Table 1). Conditions will be maintained in other non-degraded habitats where Virgin spinedace currently occur (Table 1, Figure 1). Projects will focus on specific factors that contribute to Virgin spinedace habitat degradation including: agricultural activities, mining activities, recreational use of riparian zones, and activities that affect water quality (Table 5). Enhancement projects will include maintenance and construction of boundary-line fences between federal and private parcels to control unauthorized grazing and recreational (i.e.: ORV, hiking, etc.) use along the riparian zones, establishment of grazing management programs for federal lands along streams, and development of barriers and conservation easements within the Virgin River floodplain to reduce additional agricultural, recreational, and developmental impacts. Any future projects which alter habitat will be addressed through the mitigation process developed by VRRMRP.

## **7.4 Selectively Control Non-indigenous Fish**

Detrimental effects on Virgin spinedace due to non-indigenous fish populations listed in Table 2 will be evaluated. Management and control of non-indigenous fish will be achieved through implementation of stocking and introduction procedures and control and/or eradication of selected populations of these fish in the Virgin River basin.

Specific management actions will be developed on a reach-by-reach basis to remove the threats to Virgin spinedace associated with non-indigenous species.

#### **7.4.1 Control Fish Stocking and Introductions**

The following basin-wide procedures for controlling stocking, introduction, and spread of non-indigenous aquatic species will be followed by the appropriate agencies. These procedures have been developed using adapted versions of the American Fisheries Society procedures for nonnative fish introductions (Kohler and Courtenay 1986).

##### **Stocking of Non-indigenous Species Already Present in the Basin:**

Several species of salmonids are routinely stocked in the Virgin River basin. Stocking of salmonids is to be restricted to areas in association with existing salmonid populations or new areas only where they will not conflict with native species of special concern. Areas where salmonids are routinely stocked are presented in Table 6.

- Rainbow Trout: New stockings are prohibited where self-sustaining populations would establish in association with native fishes of special concern or where stocking would cause conflicts with native species of special concern.
- Brown Trout, Brook Trout (*Salvelinus fontinalis*), Cutthroat Trout (*Oncorhynchus clarki*), Other Hybrid Trout: Stocking will not occur in the Santa Clara River drainage below Veyo. In all other areas, stocking is prohibited under 4,500 feet elevation or at higher elevations where stocking would cause conflicts with native species of special concern, unless otherwise approved by the Virgin Spinedace Conservation Team (VSCT).

##### **Other non-indigenous species:**

- Channel Catfish: Stocking is prohibited except in isolated ponds and reservoirs as determined on a case-by-case basis.
- Largemouth Bass, Bluegill: Stocking is to be restricted to standing water impoundments, including existing mainstream reservoirs and other isolated ponds and reservoirs. Direct conflicts with native fish species of special concern will be avoided.

##### **Introduction of a New Species:**

Guidelines for introducing a new species to the drainage will follow the Introduction of Aquatic Species, Environmental Policy Statement of the American Fisheries Society (Kohler and Courtenay 1986) and the Non-indigenous Aquatic Nuisance/Prevention and Control Act of 1990 (16 U.S.C. 4701 et seq.; revised 1996).

##### **Prohibited Species:**

The introduction of the following species into the Virgin River basin is prohibited: Non-indigenous minnows (Family: Cyprinidae), smallmouth bass, green sunfish, black crappie, crayfish species, and all other non-indigenous aquatic species prohibited by

respective state regulations or recommended for prohibition by the Colorado River Fish and Wildlife Council.

#### **7.4.2 Selectively Remove Non-indigenous Fish**

##### **Beaver Dam Wash:**

As part of Virgin spinedace re-establishment efforts in upper Beaver Dam Wash initiated in 1996, rainbow trout were removed from a small tributary stream in Beaver Dam Wash State Park prior to release of adult spinedace in that tributary. Monitoring and removal of rainbow trout in that tributary will continue in conjunction with monitoring to evaluate spinedace survival and recruitment. Selective removal or depletion of resident rainbow trout in the mainstream of Beaver Dam Wash between Schroeder Dam and the Utah state line has not been attempted but may be considered in the future dependent on success of the existing tributary re-establishment effort and observed movement of adult spinedace into the Beaver Dam Wash mainstream channel.

##### **Santa Clara River:**

UDWR will continue efforts to control and manage green sunfish in the Virgin River basin in ways to benefit native fishes, including Virgin spinedace. The feasibility of chemical renovation projects in the Santa Clara River drainage will continue to be evaluated with respect to controlling or eliminating green sunfish and other non-indigenous fishes that are determined to be a problem. If upstream sources of green sunfish above Baker Reservoir can be eliminated, then chemical renovation projects could be conducted to remove non-indigenous fish from the reach between the reservoir and the confluence with Moody Wash and from Moody Wash downstream to Gunlock Reservoir. Control of green sunfish in the Santa Clara River below Gunlock Reservoir may be necessary after population maintenance flows are re-established. In this case, chemical treatments to temporarily reduce non-indigenous fish while Virgin spinedace are re-introduced and become established may be needed. Such work could be conducted regardless of upstream occurrence of non-indigenous fishes.

Reaches that may require control of non-indigenous fishes are listed in Table 5.

##### **Virgin River:**

Chemical treatments to eradicate the red shiner from areas within the Virgin River basin have been conducted in the past. These treatments have been successful at temporarily eradicating red shiner from the reach between Washington Fields diversion and Johnson diversion and preventing the expansion of red shiner populations into reaches above Washington Fields diversion. Chemical treatments to eradicate non-indigenous fish from the Virgin River will continue. As additional fish barriers are constructed, chemical treatments will be conducted in a step-wise fashion to systematically eradicate red shiner from the Washington Fields diversion downstream to the Mesquite diversion. Methods used for chemical treatments are provided in Comella and Fridell (1998a).

## **7.5 Re-establish Virgin Spinedace Populations**

### **7.5.1 Develop Propagation and Re-introduction Plan**

Virgin spinedace populations will be re-established in areas within the historic distribution when suitable habitat conditions have been restored. Natural colonization will likely be the primary mechanism to re-establish populations. Artificial re-introduction will be necessary, however, when natural colonization is unlikely due to habitat fragmentation. A propagation and re-introduction plan for woundfin, Virgin River chub, and Virgin spinedace will be developed under the guidance of the VRRMRP. This plan will outline protocols for developing genetically viable brood stocks, re-introduction, and genetic monitoring.

Protocols for fish transfer from a wild population to hatchery facilities and/or refugia will be outlined. The protocols will include methodology for numbers of fish, timing of transfers, transportation, preventing inadvertent transfers of non-indigenous species, and disease treatment. Recommended founding of any captive population sizes will be based on maintaining effective population sizes that are sufficiently large to minimize the effects of random genetic drift and to prevent the effects of inbreeding depression. Periodic supplementation of brood stocks with wild fish will likely be necessary to prevent divergence from the wild populations and to increase effective population size.

The plan will outline stocking protocols designed to maintain the genetic viability and population genetic structure of Virgin spinedace to the greatest extent possible. The plan will include guidelines for numbers of stocked fish, timing of stocking, age and size of stocked fish, frequency of stocking, suitable stocking conditions, and prevention of inadvertent transfers of non-indigenous species. VRRMRP has already identified specific reaches for re-establishing Virgin spinedace populations (Utah Department of Natural Resources 2002). These reaches will be prioritized according to recovery needs. Other appropriate stocking purposes may include wild population augmentation and research. Production goals will be based on these appropriate stocking needs.

Protocols for genetic monitoring of brood stocks and wild populations will be established. Objectives for brood stock monitoring may be to track changes in population size and to monitor genetic variability through generations. Objectives for genetic monitoring of wild populations may include tracking the genetic influence of stocked fish on wild populations, determining levels of variability and adaptability, and tracking movement among different population segments.

### **7.5.2 Beaver Dam Wash**

A project to re-establish a reproducing and recruiting population of Virgin spinedace in upper Beaver Dam Wash below Schroeder Reservoir began in 1997 and will continue through 2004. Fish release will continue to occur in a tributary to the main wash from which trout are absent, upstream of a fish barrier. Periodic monitoring will

continue to evaluate adult spinedace survival, recruitment and movement into other available habitats including the mainstream wash channel. A total of 1,085 adult spinedace have been transferred to the wash tributary site from donor sites at Mormon Well, Ariz., and Lytle Ranch, Utah, in the lower Beaver Dam Wash. Dependent on availability of Virgin spinedace from the two donor sites, adult fish transfers will be continued at least annually through 2003. Monitoring surveys to assess spinedace survival, reproduction, and recruitment will be conducted at least twice annually in the spring and fall periods with additional monitoring efforts scheduled as necessary. Re-establishment efforts focused on the mainstream channel of Beaver Dam Wash below Schroeder Dam are not scheduled, but may be considered in conjunction with selective removal of non-native trout. Future actions will be determined based on an observed positive response to re-establishment efforts at the tributary site, and/or evidence of Virgin spinedace occupancy and use of mainstream habitats.

#### **7.5.3 Monitor Populations**

Virgin spinedace population monitoring will continue. Information obtained from the monitoring process will be used to determine if current management actions are attaining the objectives set forth in this Strategy. In addition, a general assessment of the overall response of other species occurring in the Virgin River basin will be conducted. Sampling will be conducted annually in the fall. Methods used for sampling are provided in Fridell et al. (2000).

Data obtained on population responses to management actions from the monitoring process will be assessed and evaluated annually by the VSCT. The effectiveness of the management actions will be measured using empirical criteria to be established for this Strategy.

#### **7.5.4 Mitigate for Projects that Impact Virgin Spinedace**

The mitigation plan developed by the VRRMRP will be utilized to mitigate the adverse impacts of potential projects. Prior to implementation, any new water depletion or habitat alteration of baseline conditions of historic habitat will require prior evaluation, assessment, and approval. Mitigation will be determined based on an evaluation of how baseline conditions would be altered.

## **8. Virgin River Resource Management and Recovery Program Participation**

The VRRMRP is currently the primary funding source for conservation and recovery actions within the Virgin River basin. Given the availability of funding through VRRMRP, it is likely the majority of actions described in this document will be coordinated and implemented not only by the signatories to the Conservation Agreement, but also by other VRRMRP participants.

This strategy was developed prior to the development of VRRMRP, and the conservation actions outlined in the previous section have been designed to specifically benefit Virgin spinedace. However, as the entity that seeks to restore and maintain ecosystem function within the Virgin River basin, VRRMRP develops work plans that address the needs of aquatic species throughout the basin, including Virgin spinedace. Accordingly, there are several similar actions outlined in this strategy and the Recovery Action Plan of the VRRMRP (Utah Department of Natural Resources 2002). The Recovery Action Plan also includes other actions not listed in this strategy that will benefit Virgin spinedace by restoring ecosystem function. Elements of the Recovery Action Plan are provided in Table 7.

## 9. Desired Outcome

Implementation of the Strategy should provide for the continued existence and conservation of Virgin spinedace. It is anticipated that the range of the species will be increased to occupy 80% of its historic habitat (Figure 2). The most significant threat to the species has been identified as de-watered-historic habitat (60 km/37 mi). This threat will be significantly reduced by providing flows in approximately 39 km (24 mi) of stream channel. This single action should greatly enhance current populations of Virgin spinedace by reducing habitat and population fragmentation, enhancing stream productivity, enhancing water quality, and enhancing the riparian communities. Actions such as non-indigenous fish management and habitat improvement should provide additional benefits by removing negative fish interactions and enhancing impacted habitats.

## LITERATURE CITED

- Addley, R.C. and T.B. Hardy. 1993. The current distribution of spinedace in the Virgin River basin. Report to Wash. Co. Water Conserv. Dist. Logan, UT.
- Angradi, T.R. J.S. Spaulding, and E.D. Koch. 1991. Diet and food utilization by the Virgin River spinedace, *Lepidomeda mollispinis mollispinis*, and speckled dace, *Rhinichthys osculus*, in the Beaver Dam Wash, Utah. *Southwestern Naturalist* 36(2):157-170.
- Comella, K.M. and R.A. Fridell. 1998a. Virgin River treatment projects March 1996 August 1996 December 1996. Publication Number 98-11. Utah Division of Wildlife Resources, Salt Lake City, UT.
- Comella, K.M. and R.A. Fridell. 1998b. Fort Pearce Wash treatment project. Publication Number 98-12. Utah Division of Wildlife Resources, Salt Lake City, UT.
- Comella, K.M., J.L. Nickolai, R.A. Fridell, and L.D. Lentsch. 1998. Virgin spinedace population monitoring summary, fall 1995. Publication Number 98-08. Utah Division of Wildlife Resources, Salt Lake City, UT.
- Cross, J.N. 1975. Ecological distribution of the fishes of the Virgin River (Utah, Arizona, Nevada). M.S. Thesis, Univ. Nev. Las Vegas.
- Deacon, J.E., G. Kobetich, J.D. Williams, and S. Contreras. 1979. Fishes of North America, endangered, threatened, or of special concern: 1979. *Fisheries* 4(2):29-44
- Deacon, J.E., P.B. Schumann, and E.L. Stuenkel. 1987. Thermal tolerances and preferences of fishes of the Virgin River System (Utah, Arizona, Nevada). *Great Basin Naturalist* 47(4):538-546.
- Deacon, J.E., A. Rebane, and T.B. Hardy. 1991. Final report to National Park Service: A habitat preference analysis of the Virgin spinedace in Zion National Park, Utah, Univ. of Nevada, Las Vegas.
- Dowling, T.E., C.A. Tibbets, W.H. Minckley, and G.R. Smith. 2002. Evolutionary relationships of the Plagopterus (Teleostei: Cyprinidae) from cytochrome to sequences. *Copeia* 2002 (3):655-678.
- Fridell, R.A., K.M. Comella, and T.C. Hogrefe. 2000. Virgin spinedace (*Lepidomeda mollispinis mollispinis*) population monitoring summary 1994-1998. Publication Number 00-05. Utah Division of Wildlife Resources, Salt Lake City, UT.
- Greger, P.D. and J.E. Deacon. 1988. Food partitioning among fishes of the Virgin River. *Copeia* 1988(2):312-323.
- Hardy, T.B., B. Bartz, and W. Carter. 1989. Population dynamics of the fishes in the Virgin

River from 1984 through 1987 and impact analysis of the Quail Creek and North Creek Reservoir systems. Dept. Civil and Environmental Engineering, Utah State University, Logan.

- Hardy, T.B. and C. Addley. 1998. Maintenance of the Virgin River Fishes Data Base and technical coordination for the Virgin River Basin Integrated Resource Management and Recovery Program (Phase I); Winter habitat utilization by native species of the Virgin River (Phase II); Population and habitat monitoring in the Virgin River and automation of the VRBIRMRP analysis system (Phase III). Prepared for Washington County Water Conservancy District by the Institute for Natural Systems Engineering, Utah Water Research Laboratory, Utah State University, Logan, UT.
- Hogrefe, T.C. 2000. Virgin Spinedace (*Lepidomeda mollispinis mollispinis*) Conservation Agreement and Strategy five-year assessment. Publication Number 00-20. Utah Division of Wildlife Resources, Salt Lake City, UT.
- Holden, P.B. 1977. Investigation of the status and critical habitat of the Virgin River chub. PR-11-1. Bio/West, Inc. Logan, Utah.
- Johnson, J.B. and S. Jordan. 2000. Phylogenetic divergence in leatherside chub (*Gila copei*) inferred from mitochondrial cytochrome and sequences. *Molecular Ecology* 9:1029-1035.
- Kohler, C.C. and W.R. Courtenay, Jr. 1986. American Fisheries Society position on introductions of aquatic species. *Fisheries* 11(2):34-38.
- Lentsch, L.D., M.J. Perkins, N. Stauffer, T. Adams, T. Hardy, and C. Addley. 1998. Description of baseline conditions for the Virgin River Resource Management and Recovery Program. Draft Report, Utah Division of Wildlife Resources, Salt Lake City, UT.
- Lentsch, L.D., M.J. Perkins, and H. Maddux. 1995. Virgin Spinedace Conservation Agreement and Strategy. Publication Number 95-13. Utah Division of Wildlife Resources, Salt Lake City, UT.
- Lerner, I.M. 1954. Genetic Homeostasis. Oliver and Boyd, Edinburgh.
- Miller, R.R. and C.L. Hubbs. 1960. The spiny-rayed cyprinid fishes (Plagopterini) of the Colorado River system. *Misc. Publ. Mus. Zool. Univ. Mich.* 115:1-39.
- Rinne, W.E. 1971. The life history of *Lepidomeda mollispinis mollispinis* (The Virgin River spinedace) a unique western cyprinid. M.S. Thesis, Univ. Nev. Las Vegas.
- Sappington, J.M. 1998. Recreational disturbance of a desert stream fish community: detecting ecological effects of environmental impact. M.S. thesis, University of Nevada, Las Vegas.

- Shakarjian, M. and J.A. Stanford. 1998. Effects of trampling by hikers on zoobenthos of the North Fork of the Virgin River, Zion National Park, Utah. Prepared by Flathead Lake Biological Station for the National Park Service, Zion National Park. Open File Report number 145-97.
- Sigler, W.F., and R.R. Miller. 1963. Fishes of Utah. Utah State Department of Fish and Game, Salt Lake City, Utah.
- Tanner, V.M. 1932. A description of *Notolepidomyzon utahensis*, a new catostomid from Utah. *Copeia* 3:135-136.
- Tanner, V.M. 1936. A study of the fishes of Utah. *Proc. Utah Acad. Sci., Arts, Lett.* 13:155-178.
- U.S. Bureau of Land Management. 1999. Dixie Resource Area Resource Management Plan. Utah State Office, Salt Lake City, UT.
- U.S. Fish and Wildlife Service. 1994. Virgin River fishes recovery plan. Salt Lake City, Utah.
- Utah Department of Natural Resources. 2002. Program document for the Virgin River Resource Management and Recovery Program. Utah Department of Natural Resources, Salt Lake City, UT.
- Utah Division of Wildlife Resources. 1996. Environmental assessment for use of rotenone in southwestern Utah waters. Utah Division of Wildlife Resources, Southern Region Office, Cedar City, UT.
- Utah Division of Wildlife Resources. 1997a. Utah Sensitive Species List. Effective date: March 20, 1997.
- Utah Division of Wildlife Resources. 1997b. Policy Number W2ADM-1. Fish Stocking and Transfer Procedures. Effective date: September 24, 1997.
- Valdez, R.A., W.J. Masslich, R. Radant, and D. Knight. 1991. Status of the Virgin spinedace (*Lepidomeda mollispinis mollispinis*) in the Virgin River drainage, Utah. Report to Utah Div. Wildl. Res. Salt Lake City, Ut. BIO/WEST Report No. PR-197-1.
- Wright, S. 1965. The interpretation of population structure by F-statistics with special regard to systems of mating. *Evolution* 19:395-420.
- Zion National Park. 2001. Final General Management Plan and Environmental Impact Statement (Visitor Management and Resource Protection Plan). United States Department of the Interior, National Park Service, Zion National Park.

Table 1. Estimated historic and current occupied Virgin spinedace habitat and estimated lengths of impacted stream reaches. (Modified from Addley and Hardy, 1993).

REACH	Occupied Habitat		Water Development		Other Habitat Alteration	
	Historic (km/mi)	Current (km/mi)	Area De-watered (km/mi)	Area Depleted (km/mi)	Non-Indigenous Species (km/mi)	* Habitat Degradation (km/mi)
<b>Beaver Dam Wash</b>						
Below Schroeder Reservoir	13.8 (8.6)	0.0	-	-	13.8 (8.6)	-
Upper Beaver Dam Wash	13.0 (8.1)	13.0 (8.1)	-	-	13.0 (8.1)	-
Upper Lytle Ranch	4.0 (2.5)	4.0 (2.5)	-	-	-	1.0 (0.6)
Lower Lytle Ranch	4.8 (3.0)	4.8 (3.0)	-	-	-	-
Littlefield	1.3 (0.8)	1.3 (0.8)	-	-	1.3 (0.8)	1.3 (0.8)
East Fork	6.9 (4.3)	0.0	2.1 (1.3)	-	2.9 (1.8)	-
<b>Santa Clara River</b>						
Moody Wash	11.3 (7.0)	11.3 (7.0)	-	-	-	-
Magotsu Creek	5.0 (3.1)	1.0 (0.6)	4.0 (2.5)	-	-	-
Below Veyo	6.0 (3.7)	6.0 (3.7)	-	6.0 (3.7)	6.0 (3.7)	-
Above Gunlock Reservoir	12.2 (7.6)	12.2 (7.6)	-	12.2 (7.6)	12.2 (7.6)	3.0 (1.9)
Below Gunlock Reservoir	30.6 (19.0)	0.0	30.6 (19.9)	-	-	5.2 (3.2)
Lower Santa Clara	10.0 (6.2)	6.3 (3.9)	3.7 (2.3)	6.3 (3.9)	-	6.3 (3.9)
<b>Leeds Creek</b>	6.8 (4.2)	0.0	6.8 (4.2)	-	-	-
<b>Quail Creek</b>	5.3 (3.3)	0.0	-	-	-	-
<b>Ash Creek</b>						
Upper	4.3 (2.7)	0.0	4.3 (2.7)	-	-	-
Lower	4.0 (2.5)	4.0 (2.5)	-	1.6 (1.0)	-	4.0 (2.5)



REACH	RBT	BT	GSF	LMB	CCF	BG	MF	RS	GS	GC	KOI	TP	GP	BB	CF
Santa Clara River	-	X	X	X	-	-	-	-	-	-	-	-	-	-	X
Moody Wash	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Magotsu Creek	X	X	X	X	-	-	-	-	-	-	-	-	-	-	X
Below Veyo	-	X	X	X	-	-	-	-	-	-	-	-	-	-	X
Above Gunlock Reservoir	-	-	X	X	-	-	-	-	-	-	-	-	-	-	X
Below Gunlock Reservoir	-	-	X	-	-	-	X	-	-	-	-	-	-	-	X
Lower Santa Clara	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Leeds Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quail Creek	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Upper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
La Verkin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Upper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lower	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
Virgin River	-	-	-	X	-	-	-	-	-	-	-	-	-	X	X
Above Pah Tempe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
North Creek	X	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Upper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Lower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
North Fork Virgin	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
East Fork Virgin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shunes Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

RBT = Rainbow trout, BT = Brown trout, GSF = Green sunfish, LMB = Large mouth bass, CCF = Channel catfish, BG = Bluegill, MF = Mosquitofish, RS = Red shiner, GC = Grass carp, KOI = Koi, TP = Tilapia, GP = Guppy, BB = Black Bullhead, GS = Golden shiner, CF = Crayfish

Table 3. Area de-watered, area depleted, low flows, and target population maintenance flows in reaches where flows may be re-established (Modified from Addley and Hardy, 1993).

REACH	Area De-watered (km/mi)	Area Depleted (km/mi)	Low Flows (cfs)	Target Population Maintenance Flows (cfs)
<b>Beaver Dam Wash</b> East Fork	2.1 (1.3)	-	1	1
<b>Santa Clara River</b> Magotsu Creek	4.0 (2.5)	-	1	1
Below Veyo	-	6.0 (3.7)	3-4	3.5
Above Gunlock Reservoir	-	12.2 (7.6)	2-4	3
Below Gunlock Reservoir	30.6 (19.9)	-	0-1	3*
Lower Santa Clara	3.7 (2.3)	6.3 (3.9)	1-3	3
<b>Leeds Creek</b>	6.8 (4.2)	-	0	1.5
<b>Quail Creek</b>	-	-	2-4	1.5*
<b>Virgin River</b> Above Pah Tempe (Below Quail Creek Diversion)	-	-	0	3
<b>North Creek</b> Lower	3.9 (2.4)	1.6 (1.0)	0	2
<b>Shunes Creek</b>	-	2.6 (1.6)	0	0.5*

\*Work in progress

Table 4. Area de-watered/depleted and progress for each step of the process to re-establish population maintenance flows (PMF).

REACH	Area De-watered/ Depleted (km/mi)	1. Estimate PMF	Re-establish PMF Process				
			2. Provide PMF	3. Evaluate PMF	4. Finalize PMF	5. Protect PMF	
<b>Beaver Dam Wash</b> East Fork	2.1(1.3)	C	-	-	-	-	
<b>Santa Clara River</b>							
Magotsu Creek	4.0 (2.5)	C	-	-	-	-	
Below Veyo	6.0 (3.7)	C	-	-	-	-	
Above Gunlock Reservoir	12.2 (7.6)	C	-	-	-	-	
Below Gunlock Reservoir	30.6 (19.9)	C	O	-	-	-	
Lower Santa Clara	10.0 (6.2)	C	-	-	-	-	
<b>Leeds Creek</b>	6.8 (4.2)	C	-	-	-	-	
<b>Quail Creek</b>	-	C	-	-	-	-	
<b>Virgin River</b>							
Above Pah Tempe (Below Quail Creek Diversion)	-	C	C	O	-	-	
<b>North Creek</b>							
Lower	5.5 (3.4)	C	-	-	-	-	
<b>Shunes Creek</b>	2.6 (1.6)	C	O	-	-	-	

C = completed action; O = ongoing action; - = action not yet implemented.

Table 5. Agency involvement for potential management actions by reach.

REACH	Re-establish flows	Enhance and Maintain Habitat	Control Non-indigenous Fish	Re-establish populations
<b>Beaver Dam Wash</b>	-	NDOW, UDWR, FWS, BLM	NDOW, UDWR, FWS	NDOW, UDWR, FWS
Below Schroeder Reservoir	-	-	NDOW, UDWR, FWS	-
Upper Beaver Dam Wash	-	-	UDWR, FWS	-
Upper Lytle Ranch	-	-	UDWR, FWS	-
Lower Lytle Ranch	-	-	BLM, UDWR, FWS	-
Littlefield	UDNR, FWS, WCWCD, BLM	BLM, UDWR, FWS, UDWR, FWS, BLM	UDWR, FWS	UDWR, FWS
East Fork				
<b>Santa Clara River</b>				
Moody Wash	-	-	UDWR, FWS	-
Magotsu Creek	UDNR, WCWCD, FWS, BLM	-	UDWR, FWS	UDWR, FWS
Below Veyo	UDNR, WCWCD, FWS, BLM	-	UDWR, FWS	-
Above Gunlock Reservoir	UDNR, WCWCD, FWS, BLM	UDWR, FWS, BLM	UDWR, FWS	-
Below Gunlock Reservoir	UDNR, WCWCD, FWS, BLM	-	UDWR, FWS	UDWR, FWS
Lower Santa Clara	UDNR, WCWCD, FWS, BLM	UDWR, FWS, BLM	UDWR, FWS, BLM	-
<b>Leeds Creek</b>	UDNR, WCWCD, FWS, BLM	-	UDWR, FWS	UDWR, FWS
<b>Quail Creek</b>	UDNR, WCWCD, FWS, BLM	-	UDWR, FWS	UDWR, FWS
<b>Ash Creek</b>				
Upper	-	-	-	UDWR, FWS
Lower	-	UDWR, FWS, BLM	UDWR, FWS	-

<b>La Verkin</b>					
Upper	-	-	-	UDWR, FWS	-
Lower	-	-	UDWR, FWS, BLM	UDWR, FWS	-
<b>Virgin River</b>					
Above Pah Tempe	UDNR, WCWCD, FWS, BLM	-	-	UDWR, FWS, BLM	UDWR, FWS
<b>North Creek</b>					
Upper	-	-	-	UDWR, FWS	-
Lower	UDNR, WCWCD, FWS, BLM	-	UDWR, FWS, BLM	UDWR, FWS	UDWR, FWS
<b>North Fork Virgin</b>					
	-	-	-	UDWR, FWS	-
<b>East Fork Virgin</b>					
	-	-	-	UDWR, FWS	-
<b>Shunes Creek</b>					
	NPS	-	-	-	-

\* Represents lead agency for management action(s) to be implemented

Table 6. Routinely stocked salmonids in the Virgin River basin.

Area/Reach	Rainbow Trout	Brown Trout	Brook Trout	Yellowstone Cutthroat Trout
Baker Reservoir	X	X <sup>a</sup>		
Schroeder Reservoir	X			
Pine Valley Reservoir	X		X	
Upper Sand Cove Reservoir	X			
Upper Santa Clara River (Above Veyo)	X			
Quail Creek Reservoir	X			
Kolob Reservoir	X		X	X
Upper East Fork Virgin River (Above Glendale)	X	X		
Navajo Lake	X		X	
Private Ponds	X		X	

<sup>a</sup> Stocking conducted only after reservoir draining.

Table 7. Actions described in the Recovery Action Plan of the Virgin River Resource Management and Recovery Program (adapted from Utah Department of Natural Resources, 2002).

Objectives	Actions
Provide and protect instream flows sufficient for conservation and recovery of native species.	<p>Seek acquisition of instream flows consistent with water rights.</p> <p>Evaluate existing and acquired flows.</p> <p>Recommend instream flows consistent with water rights.</p> <p>Protect flows consistent with water rights.</p> <p>Monitor population responses.</p>
Protect and enhance aquatic, riparian, and 100-year floodplain habitat.	<p>Identify habitat enhancement actions.</p> <p>Develop habitat and protection plans.</p> <p>Implement habitat enhancement actions.</p>
Protect and enhance native species communities.	<p>Eliminate nonnative fish species and re-establish native species communities.</p> <p>Establish additional populations of native species within historically occupied habitat.</p>
Maintain genetically appropriate brood stocks.	<p>Develop a viable propagation program in Utah.</p>
Determine ecological factors limiting abundance of native species.	<p>Determine and enhance native species migration movements.</p>
Monitor habitat conditions and populations of native species.	<p>Review and update existing monitoring protocols and sampling stations.</p> <p>Monitor native species populations.</p> <p>Monitor habitat conditions.</p> <p>Prepare a standardized report on population and habitat trends.</p> <p>Maintain and update Virgin River Fishes Data Base.</p>
Improve education and communication on resources.	<p>Promote open space values within the river corridor.</p> <p>Promote public education regarding the values of the Program.</p> <p>Enhance communication among the Program participants and interested parties.</p>

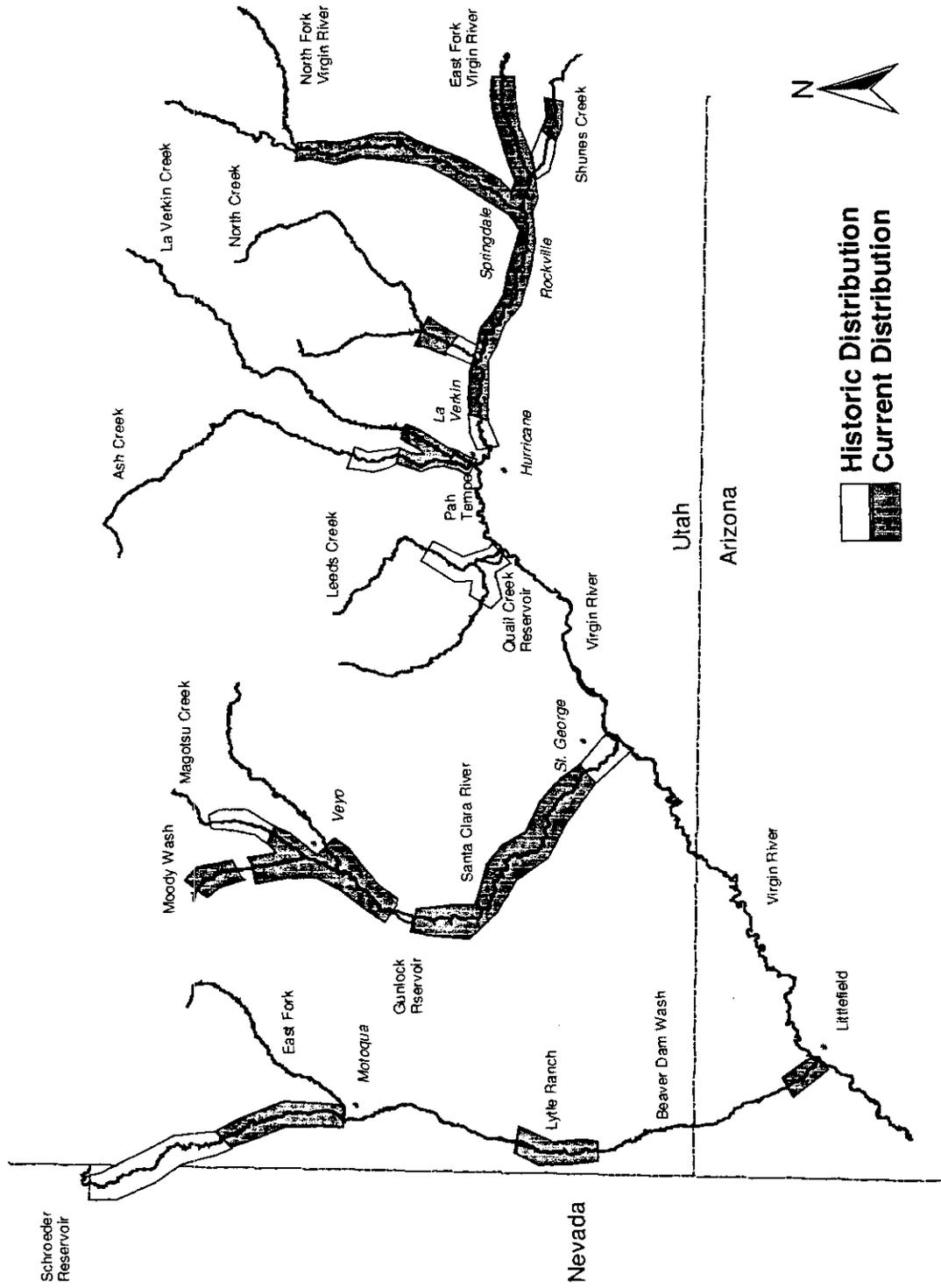


Figure 1. Estimated historic and current Virgin spinedace distribution (modified from Valdez et al. 1991)

## **APPENDIX A**

Memorandum of Understanding among the signatory agencies to extend the Virgin Spinedace Conservation Agreement and Strategy for an additional five year term, effective June 17, 2000.

# MEMORANDUM OF UNDERSTANDING

## BETWEEN

### UTAH DEPARTMENT OF NATURAL RESOURCES, UNITED STATES FISH AND WILDLIFE SERVICE, UNITED STATES BUREAU OF LAND MANAGEMENT, UNITED STATES NATIONAL PARK SERVICE, NEVADA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, WASHINGTON COUNTY WATER CONSERVANCY DISTRICT, AND ARIZONA GAME AND FISH DEPARTMENT

This Memorandum of Understanding (MOU) is made and entered into by and between the Utah Department of Natural Resources, United States Fish and Wildlife Service, United States Bureau of Land Management, United States National Park Service, Nevada Division of Wildlife, Washington County Water Conservancy District, and Arizona Game and Fish Department, referred to herein collectively as "Signatory Parties".

WHEREAS, the Virgin Spinedace Conservation Agreement and Strategy (Agreement) was developed to expedite conservation measures needed for the continued existence and recovery of the species, and full implementation of the Virgin Spinedace Conservation Agreement and Strategy will reduce threats to Virgin spinedace that warrant its listing as a sensitive species by state and federal agencies, and as threatened or endangered under the Endangered Species Act of 1973, as amended (ESA); and

WHEREAS, the Signatory Parties entered into the Agreement under federal and state law, as applicable, including but not limited to Section 2(c)(2) of ESA, which states that "the policy of Congress is that federal agencies shall cooperate with state and local agencies to resolve water resources issues in concert with conservation of endangered species"; and

WHEREAS, all Signatory Parties recognize that they each have specific statutory responsibilities that cannot be delegated, particularly with respect to the management and conservation of wildlife and the management, development, and allocation of water resources, and nothing in the Agreement is intended to abrogate any of the parties' respective responsibilities; and

WHEREAS, the initial five-year term of the Agreement will expire on June 16, 2000, and a total of ten years is anticipated for full implementation of actions identified and specified in the Conservation Strategy; and

WHEREAS, the Signatory Parties agree that sufficient progress has been made towards the conservation and recovery of Virgin spinedace; and

WHEREAS, a second five-year term is necessary to complete ongoing actions and to initiate new projects to further reduce threats and enhance habitat conditions.

NOW THEREFORE, the Signatory Parties agree to extend the Virgin Spinedace Conservation Agreement and Strategy for an additional five year term, effective as of June 17, 2000. Under the second five-year term, the Signatory Parties will retain the same responsibilities assumed during the previous term. Any Signatory Party may withdraw from this MOU on sixty days written notice to the other parties.

This MOU may be executed in several counterparts, each of which shall be an original, and all of which shall constitute one and the same agreement.

### Signatures

Utah Department of Natural Resources  
Utah Division of Wildlife Resources  
1594 West North Temple  
Salt Lake City, UT 84116

---

Kathleen Clarke	Date
Executive Director	

USDI Fish and Wildlife Service  
P.O. Box 25486  
Denver, CO 80225

---

Ralph O. Morgenweck	Date
Regional Director	

USDI Bureau of Land Management  
324 South State Street  
Salt Lake City, UT 84111

---

Sally Wisely	Date
State Director	



## APPENDIX B

Virgin Spinedace (*Lepidomeda mollispinis mollispinis*) Conservation Agreement

VIRGIN SPINEDACE  
CONSERVATION AGREEMENT AND STRATEGY

Prepared by:

Leo D. Lentsch  
Native Fish and Herpetile Coordinator  
Utah Division of Wildlife Resources

M. Jane Perkins  
Aquatic Biologist  
Utah Division of Wildlife Resources

Henry Maddux  
Biologist  
United States Fish and Wildlife Service

Publication Number 95-13

Utah Division of Wildlife Resources  
1596 West North Temple  
Salt Lake City, Utah 84116  
Robert G. Valentine  
Director

June 1995

## ACKNOWLEDGEMENTS

We wish to thank the Virgin Spinedace Conservation Team (VSCT) and the technical advisors for their assistance in both the development of this agreement and strategy.

### Virgin Spinedace Conservation Team

Leo D. Lentsch, Utah Division of Wildlife Resources  
Henry Maddux, USDI Fish and Wildlife Resources  
Bob Douglas, USDI Bureau of Land Management, Utah  
Michael Herder, USDI Bureau of Land Management, Arizona  
Ralph Moore, USDI National Park Service, Zion National Park  
Jon Sjoberg, Nevada Division of Wildlife  
Ron Thompson, Washington County Water Conservancy District  
Rob Betasso, Arizona Game and Fish Department

### Technical Advisors to VSCT:

Richard A. Fridell - Utah Division of Wildlife  
M. Jane Perkins - Utah Division of Wildlife  
Morgan Jensen - Washington County Water Conservancy District  
Craig Addley - Utah State University  
Thomas Hardy - Utah State University  
Paul Marsh - Arizona State University  
Wendell Minckley - Arizona State University  
James Deacon - University of Nevada Las Vegas  
Heidi McIntosh - Southern Utah Wilderness Alliance  
Scott Groene - Southern Utah Wilderness Alliance  
Pamela Hyde - American Rivers  
Paul Holden - Bio/West Inc.  
Richard Valdez - Bio/West Inc.  
Larry Anderson - Utah Division of Water Resources  
Norm Stauffer - Utah Division of Water Resources

## CONSERVATION AGREEMENT

### Virgin spinedace

*Lepidomeda mollispinis mollispinis*

This Conservation Agreement for the Virgin spinedace *Lepidomeda mollispinis mollispinis* has been developed in order to expedite conservation measures needed for the continued existence and recovery of the species. These measures will be taken in accordance with the Endangered Species Act of 1973 as amended (ESA). The Agreement focuses on two objectives. The first is to reduce and eliminate significant threats. The second is to enhance and/or stabilize specific reaches of occupied and unoccupied historic habitat. These objectives will be reached through implementation of the Conservation Strategy for the species. Full implementation of this Agreement and the associated strategy will reduce threats to the Virgin spinedace that warrant its listing as a sensitive species by State and Federal agencies, and as threatened or endangered under the ESA.

The Virgin spinedace is a small minnow endemic to the Virgin River basin in Utah, Arizona, and Nevada. Shoreline-land ownership within the flood plains of Virgin spinedace habitat is approximately 38% federal, 3% state, 5% Paiute Tribe-managed and 54% private. Past and present human activities such as water development projects, agriculture, mining, urbanization, and the introduction of non-indigenous fishes have altered the Virgin River ecosystem. There has been a 37-40% reduction (approximately 84 km/52 mi) in Virgin spinedace historic range (approximately 226 km/140 mi). Current populations are fragmented, and occur almost exclusively within Utah. Due to these reductions and perceived threats to the species, the United States Fish and Wildlife Service (FWS) proposed listing the species as threatened, pursuant to the ESA, on May 18, 1994 (59 FR 25875).

#### I. OTHER SPECIES INVOLVED

The primary focus of this Agreement is the conservation and

enhancement of the Virgin spinedace and its habitat; however, other species occurring within or adjacent to Virgin spinedace habitat may also benefit. Three hundred sixty three species of fish, amphibians, reptiles, birds, and mammals are known to co-exist in the same or adjacent habitat of the Virgin spinedace (Appendix B in Conservation Strategy). Using an ecosystem approach, the Virgin spinedace Conservation Agreement could reduce or possibly eliminate threats for several of these species, which could preclude their need for federal listing pursuant to the ESA.

## II. INVOLVED PARTIES

Utah Department of Natural Resources  
Division of Wildlife Resources  
1596 West North Temple  
Salt Lake City, UT 84116  
(801) 538-7227

United States Department of Interior  
Fish and Wildlife Service  
P.O. Box 25486  
Denver Federal Center  
Denver, CO 80225  
(303) 236-7920

Bureau of Land Management  
Utah State Office  
324 South State Street  
Salt Lake City, UT 84111  
(801) 539-4072

Bureau of Land Management  
Arizona State Office  
3707 North 7th Street  
Phoenix, AZ 85011  
(602) 650-0260

National Park Service  
Rocky Mountain Regional Office  
P.O. Box 25287  
Denver, CO 80225-0287  
(303) 969-2500

Nevada Department of Conservation and Natural Resources  
Division of Wildlife  
1100 Valley Road  
Reno, NV 89520-0022  
(702) 688-1500

Washington County Water Conservancy District  
136 N. 100 East, Suite 1  
St. George, UT 84770  
(801) 673-3617

Arizona Game and Fish Department  
2221 W. Greenway Road  
Phoenix, AZ 85023-4312  
(602) 942-3000

Separate Memorandum(a) of Understanding and Cooperative Agreements will be developed with additional parties as necessary to ensure implementation of specific conservation measures.

### III. AUTHORITY

\* The signatory parties hereto enter into this Conservation Agreement and the attached Conservation Strategy under federal and state law, as applicable, including but not limited to Section 2(c)(2) of the Endangered Species Act of 1973, as amended, which states that "the policy of Congress is that Federal agencies shall cooperate with State and local agencies to resolve water resource issues in concert with conservation of endangered species."

\* All parties to this Agreement recognize that they each have specific statutory responsibilities that cannot be delegated, particularly with respect to the management and conservation of wildlife and the management, development and allocation of water resources. Nothing in this Agreement or the Strategy is intended to abrogate any of the parties' respective responsibilities.

\* This Agreement is subject to and is intended to be consistent with all applicable Federal and State laws and interstate compacts.

### IV. STATUS AND DISTRIBUTION OF VIRGIN SPINEDACE

In 1979 and 1989, the Virgin spinedace was identified as

threatened by the American Fisheries Society, Endangered Species Committee. Criteria used for determining this status were consistent with the ESA. Their determination was based on review of original data and discussions with pertinent agencies and knowledgeable scientists. On May 18, 1994, the FWS proposed the species for listing as threatened under the ESA (59 FR 25875).

The Virgin spinedace currently occupies approximately 60-63% of historic habitat, nearly all being in Utah. Populations no longer exist in Nevada and few individuals remain in Arizona.

The species occupies approximately 117 km (73 mi) of tributary streams and 25 km (16 mi) of the mainstem Virgin River. Occupied streams include three reaches of Beaver Dam Wash, two reaches of the Santa Clara River, isolated reaches in Moody Wash and Magotsu Creek, one reach of Ash Creek, two reaches of La Verkin Creek, two reaches of North Creek, the North and East Forks of the Virgin River, and Shunes Creek. Occupied habitat in the mainstem Virgin River is considered to be limited to the area above Quail Creek Diversion. Occasionally, Virgin spinedace have been collected in the Virgin River between Pah Tempe Springs and Littlefield, Arizona. Their occurrence has generally been associated with tributary inflows. This area is not considered to be historic habitat because this reach does not have the same habitat components found in reaches supporting self-sustaining populations. A detailed description of the status and distribution for this species is presented in the Conservation Strategy.

#### **V. PROBLEMS FACING THE SPECIES**

The FWS assessed real and/or potential problems facing the species based on five criteria as required by Section 4(a)(1) of the ESA. Within each of these criteria, several factors which may have contributed to the elimination or degradation of Virgin spinedace habitat and its populations were identified (59 FR 25875 dated May 18, 1994). The threats identified and described by the FWS (59 FR 25875) do not necessarily reflect the views of all signatories to this Agreement. The Conservation Strategy provides a detailed review of problems and threats to the species that signatories to this Agreement will address with management actions.

#### **VI. CONSERVATION ACTIONS TO BE IMPLEMENTED**

In order to meet the objectives of this Agreement, seven

conservation actions will be implemented. These actions, as defined and detailed in the Strategy, include: establish existing conditions as a baseline; re-establish population maintenance flows; enhance and maintain habitat; selectively control non-indigenous fish; maintain genetic viability; monitor populations and habitat; and develop a mitigation plan and protocol for future activities. In addition, four general administrative actions, as outlined below, will be implemented: coordinate conservation activities; implement the conservation schedule; fund conservation actions; and assess conservation progress.

#### ***Coordinating Conservation Activities***

\* Administration of the Conservation Agreement will be conducted by the Virgin Spinedace Conservation Team (VSCT). The team will consist of a designated representative from each signatory to this Agreement and may include technical and legal advisors and other members as deemed necessary by the signatories.

\* Since the majority of the areas of concern covered by this Agreement are located in Utah, and since the State of Utah presently has primary jurisdiction over Virgin spinedace within the State, the designated team leader will be the Utah Department of Natural Resources, Division of Wildlife Resources representative.

\* Authority of VSCT shall be limited to making recommendations for the conservation of Virgin spinedace to the Director, Utah Division of Wildlife Resources.

\* The VSCT will meet annually to develop yearly conservation schedules, review the Strategy, and modify the Strategy as required.

\* The VSCT will meet on a quarterly basis to report on the progress of implementing the Conservation Strategy.

\* VSCT meetings will be open to the public. Minutes of the meetings will be kept and distributed to any interested party.

#### ***Implementing Conservation Schedule***

\* A total of 10 years is anticipated for full implementation of actions identified and specified in the Conservation Strategy. Nevertheless, the parties agree that significant actions to benefit the Virgin spinedace will be implemented

within the first five (5) years. These actions will be determined by the VSCT.

\* Conservation actions will be scheduled on a yearly basis. Activities that will be implemented in 1995 are listed in Table 1.

\* As leader of the VSCT, the Utah Division of Wildlife Resources, Department of Natural Resources, will coordinate conservation activities and monitor conservation actions taken by participants of this Agreement to determine if all actions are being implemented and carried out in accordance with the Conservation Strategy and annual schedule.

#### ***Funding Conservation Actions***

\* It is anticipated that expenditures to implement this Agreement could exceed \$3,000,000 (Table 2). It is projected that the actions implemented for the re-establishment of population maintenance flows to stream channels will incur the greatest expense and occur during the first three to five years of the Agreement.

\* Funding for the Conservation Agreement will be provided by a variety of sources. Federal, state, and local sources will need to provide or secure funding for initiative procedures of the Conservation Agreement.

- Federal sources include, but will not be limited to, the FWS, U.S. Bureau of Land Management, Land and Water Conservation funds, and the Natural Resource Conservation Service.

- State funding sources include, but will not be limited to, direct appropriation of funds by the legislature, Community Impact Boards, Water Resources Revolving funds, State Department of Agriculture (ARD), and State Resource Management Agencies.

- Local sources of funding will be provided by the Habitat Conservation Plan, Washington County Water Conservancy District, cities and towns, Washington County, and local irrigation companies.

\* In-kind contributions in the form of personnel, field equipment, supplies, etc. will be provided by participating agencies (Table 3). In addition, each agency will have specific task responsibilities and proposed actions/commitments related to their in-kind contributions.

\* It is understood that all funding commitments made under this Agreement are subject to approval by the appropriate local, state, or federal entities.

#### **Conservation Progress Assessment**

\* A quarterly assessment of progress towards implementing actions identified in this Agreement will be provided to the Director, Utah Division of Wildlife Resources by the VSCT. This assessment will be based on updates and evaluations by VSCT members. Copies of this assessment will also be provided to the signatories of this document.

\* An annual assessment of conservation accomplishments identified in Table 1 and subsequent yearly schedules will be made by the VSCT. This assessment will determine the effectiveness of this Agreement and whether revisions are warranted. It will be provided to the Director, Utah Division of Wildlife Resources by the VSCT. Copies of this assessment will also be provided to the signatories of this document.

\* If threats to the survival of the Virgin spinedace become known that are not or cannot be resolved through this or any Conservation Agreement, the Utah Division of Wildlife Resources will immediately notify all signatories.

#### **VII. DURATION OF AGREEMENT**

The initial term of this Agreement shall be 5 years. Prior to the end of each 5 year period, a thorough analysis of actions implemented for the species will be conducted by the VSCT. If all signatories agree that sufficient progress has been made towards the conservation and recovery of the Virgin spinedace, this Agreement shall be extended for an additional five (5) years. Any party may withdraw from this Agreement on sixty (60) days written notice to the other parties.

#### **VIII. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) COMPLIANCE**

Signing of this Agreement is covered under authorities outlined in section III listed above. We anticipate that any survey, collection, or research activities for implementation and maintenance of the Conservation Agreement will not entail significant federal actions under the NEPA and will be given a categorical exclusion designation. All other actions will be

evaluated prior to implementation and will comply with NEPA regulations.

#### **IX. FEDERAL AGENCY COMPLIANCE**

\* During the performance of this Agreement, the participants agree to abide by the terms of Executive Order 11246 on non-discrimination and will not discriminate against any person because of race, color, religion, sex, or national origin.

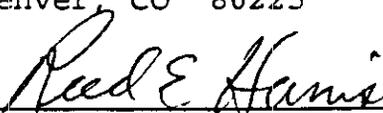
\* No member or delegate to Congress or resident Commissioner shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Agreement if made with a corporation for this its general benefit.

**X. SIGNATURES**

Utah Department of Natural Resources  
 Utah Division of Wildlife Resources  
 1596 West North Temple  
 Salt Lake City, UT 84116

  
 \_\_\_\_\_ 4/11/95  
 Ted Stewart Date  
 Executive Director

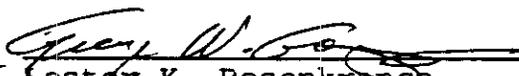
USDI Fish and Wildlife Service  
 P.O. Box 25486  
 Denver, CO 80225

  
 \_\_\_\_\_ 4/11/95  
 for Ralph O. Morgenweck Date  
 Regional Director

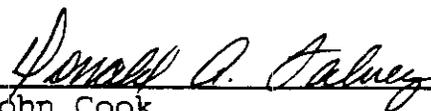
USDI Bureau of Land Management  
 324 South State Street  
 Salt Lake City, UT 84111

  
 \_\_\_\_\_ 4/11/95  
 for Mat Millenbach Date  
 State Director

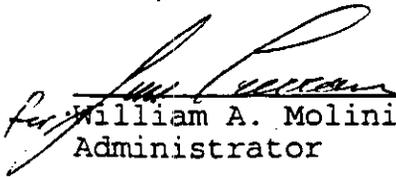
USDI Bureau of Land Management  
 3707 North 7th Street  
 Phoenix, AZ 85011

  
 \_\_\_\_\_ April 11, 1995  
 for Lester K. Rosenkrantz Date  
 State Director

USDI National Park Service  
 (Rocky Mountain Regional Office)  
 P.O. Box 25287  
 Denver, CO 80225

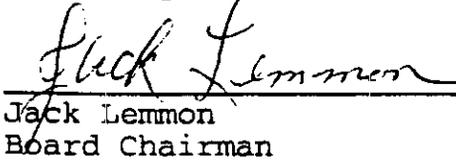
  
 \_\_\_\_\_ 4/11/95  
 for John Cook Date  
 Regional Director

Nevada Department of Conservation and Natural Resources  
Division of Wildlife  
1100 Valley Road  
Reno, NV 89520-0022

  
\_\_\_\_\_  
William A. Molini  
Administrator

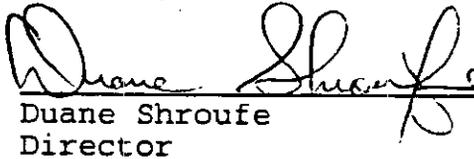
*4/14/95*  
\_\_\_\_\_  
Date

Washington County Water Conservancy District  
136 N. 100 East Suite 1  
St. George, UT 84770

  
\_\_\_\_\_  
Jack Lemmon  
Board Chairman

*4-11-95*  
\_\_\_\_\_  
Date

Arizona Game and Fish Department  
2221 W. Greenway Road  
Phoenix, AZ 85023-4312

  
\_\_\_\_\_  
Duane Shroufe  
Director

*6-16-95*  
\_\_\_\_\_  
Date

Table 1. Conservation actions to be implemented in calendar year 1995.

Reach	Date	Lead	Action
<b>Basin-Wide:</b>	Immediate*	States	- Establish existing conditions as a baseline for historic habitat
	Immediate	States	- Maintain all existing population maintenance flows
	Continuing 12/31	States All	- Identify methods for flow protection - Develop mitigation protocols for future activities
	Immediate	States	- Implement procedures to control the introduction of non-indigenous species
	4/30 4/30 4/30 12/31	States States States All	- Implement sport fish stocking procedures - Implement genetic management protocols - Implement population and habitat monitoring - Identify funding mechanisms
<b>Beaver Dam Wash:</b>			
Below Schroeder Res.	10/31	NDOW	- Selective removal of rainbow trout - Re-introduce Virgin spinedace
	10/31	NDOW	
<b>Santa Clara River:</b>			
Below Veyo (Baker Dam)	Immediate	UDWR	- Cease brown trout stocking
Below Gunlock Res.	12/31	WCWCD	- Develop cooperative agreements for providing flows - Identify methods for flow protection - Initiate recreation management - Initiate feasibility analysis for green sunfish removal
	12/31	UDNR	
	4/30 Immediate	BLM UDWR	
<b>Mainstem Virgin River:</b>			
Below Quail Creek Div.	4/30	WCWCD	- Letter of commitment to provide flows - Finalize cooperative agreements for providing flows - Develop evaluation study plan for population maintenance flows - Provide population maintenance flows (5 km/3 mi) - Evaluate population maintenance flows - Identify methods for flow protection
	5/30	WCWCD	
	6/30	WCWCD	
	4/30	WCWCD	
	6/30 4/30	All UDNR	
Below Washington Div.	9/30	UDWR	- Initiate removal of red shiner
Below Johnson Div.	11/30	UDWR	- Initiate removal of red shiner

\* Actions implemented upon signing of the Conservation Agreement

Table 2. Estimated costs for implementing the Virgin Spinedace Conservation Agreement over a 10 year period.

Conservation Agreement Actions	Estimated Costs (\$)
<i>Habitat Maintenance and Enhancement:</i> Determination of Flow Requirements Establish Existing Conditions as a Baseline Re-establishment and/or Enhancement of Flows Formalize Flow Protection Implement Habitat Improvements	200,000 30,000 2,000,000 200,000 100,000
<i>Population Genetics Management:</i> Develop and Implement Protocols	2,500
<i>Non-Indigenous Fish Management:</i> Implement Introduction/Stocking Procedures Control/Eradication of Non-indigenous Fish	2,500 300,000
<i>Population and Habitat Monitoring:</i> Implement Monitoring Plans	300,000
<i>Administration:</i> Annual Review of Activities	100,000

Table 3. Estimated agency in-kind contributions, actions, and responsibilities for implementation of the Virgin Spinedace Conservation Agreement.

Agency	Brief Description of Tasks and Responsibilities *
Utah Department of Natural Resources, Utah Division of Wildlife Resources	Serve as Virgin spinedace conservation group team leader (e.g. oversee administrative responsibilities of agencies, reports, meetings, etc.). Consult on water protection issues. Assist in obtaining and/or securing water rights and land within Virgin spinedace habitat. Assist in funding basin-wide enhancement projects. Plan and implement eradication/control projects of non-indigenous species within the basin (e.g. red-shiners, green sunfish, brown trout, and crayfish). Serve as lead agency for population and habitat enhancements, re-introductions, and monitoring projects in Utah.
Nevada Department of Conservation and Natural Resources, Division of Wildlife	Serve as lead agency for funding, monitoring, Virgin spinedace re-introductions, and non-indigenous control/eradication in Upper Beaver Dam Wash. Cooperate and assist in basin-wide habitat enhancement and population monitoring projects.
Arizona Game and Fish Department	Cooperate and assist in eradication/control projects of non-indigenous species in lower basin reaches, and cooperate and assist in basinwide habitat enhancement and population monitoring projects.
U.S. Fish and Wildlife Service	Advise and assist implementation of conservation agreement in regard to existing laws (e.g. ESA, NEPA regulations, etc.). Cooperate and assist in eradication/control projects of non-indigenous species, cooperate and assist in basinwide habitat enhancement and population monitoring projects. Maintain Virgin River fishes data base. Assist in funding basin-wide enhancement projects.
National Park Service	Serve as lead agency in funding and implementation of population and habitat enhancement and monitoring projects within Zion National Park. Cooperate and assist in basin-wide habitat enhancement and population monitoring projects.
Bureau of Land Management (Utah)	Cooperate and assist in basin-wide habitat enhancement and population monitoring projects. Assist in funding basin-wide enhancement projects. Cooperate and assist in eradication/control projects of non-indigenous species, cooperate and assist in basinwide habitat enhancement and population monitoring projects.
Bureau of Land Management (Arizona)	Serve as lead agency for planning and locating, and cooperate in securing funding for construction of, and constructing migration barriers for red shiner eradication in Arizona reaches of Virgin River as well as cooperate and assist in eradication/control projects of other non-indigenous species. Cooperate and assist in basinwide habitat, enhancement, and monitoring projects.
Washington County Water Conservancy District	Assist and facilitate in obtaining and/or securing water rights within Virgin spinedace habitat. Assist in planning, funding, and construction of non-indigenous fish migration barriers and diversion enhancements. Cooperate and assist in monitoring of fish populations and habitat responses to management actions.

\* All agencies will participate in and provide technical and administrative assistance to the Virgin Spinedace Conservation Team.

## **APPENDIX C**

Native Vertebrate Species of the Virgin River Basin  
(Compiled by R. A. Fridell)

**Fish:**

Desert sucker	( <i>Catostomus clarki</i> )
Flannelmouth sucker	( <i>Catostomus latipinnis</i> )
Speckled dace	( <i>Rhinichthys osculus</i> )
Virgin River chub	( <i>Gila seminuda</i> )
Virgin spinedace	( <i>Lepidomeda mollispinis</i> )
Woundfin	( <i>Plagopterus argentissimus</i> )

**Amphibians:**

Canyon treefrog	( <i>Hyla arenicolor</i> )
Great Basin spadefoot	( <i>Spea intermontanus</i> )
Lowland leopard frog	( <i>Rana yavapaiensis</i> )
Northern leopard frog	( <i>Rana pipiens</i> )
Red-spotted toad	( <i>Bufo punctatus</i> )
Relict leopard frog	( <i>Rana onca</i> )
Southwestern toad	( <i>Bufo microscaphus</i> )
Tiger salamander	( <i>Ambystoma tigrinum</i> )
Woodhouse's toad	( <i>Bufo woodhousei</i> )

**Reptiles:**

Banded gila monster	( <i>Heloderma suspectum</i> )
California kingsnake	( <i>Lampropeltis getulus</i> )
Collared lizard	( <i>Crotaphytus collaris</i> )
Desert horned lizard	( <i>Phrynosoma platyrhinos</i> )
Desert iguana	( <i>Dipsosaurus dorsalis</i> )
Desert night lizard	( <i>Xantusia vigilis</i> )
Desert spiny lizard	( <i>Sceloporus magister</i> )
Desert tortoise	( <i>Gopherus agassizii</i> )
Eastern fence lizard	( <i>Sceloporus undulatus</i> )
Glossy snake	( <i>Arizona elegans</i> )
Great Basin gopher snake	( <i>Pituophis melanoleucus</i> )
Great Basin rattlesnake	( <i>Crotalus viridis</i> )
Great Basin skink	( <i>Eumeces skiltonianus</i> )
Ground snake	( <i>Sonora semiannulata</i> )
Long-nosed leopard lizard	( <i>Gambelia wislizenii</i> )
Long-nosed snake	( <i>Rhinocheilus lecontei</i> )
Long-tailed brush lizard	( <i>Urosaurus graciosus</i> )
Mojave desert sidewinder	( <i>Crotalus cerastes</i> )
Mojave patch-nosed snake	( <i>Salvadora hexalepsis</i> )
Mojave rattlesnake	( <i>Crotalus scutulatus</i> )
Night snake	( <i>Hypsiglena torquata</i> )
Plateau striped whiptail	( <i>Cnemidophorus velox</i> )
Red coachwhip	( <i>Masticophis flagellum</i> )
Regal ringneck snake	( <i>Diadophis punctatus</i> )
Sagebrush lizard	( <i>Sceloporus graciosus</i> )
Short-horned lizard	( <i>Phrynosoma douglassii</i> )
Side-blotched lizard	( <i>Uta stansburiana</i> )
Sonoran lyre snake	( <i>Trimorphodon biscutatus</i> )
Southwest speckled rattlesnake	( <i>Crotalus mitchellii</i> )
Striped whipsnake	( <i>Masticophis taeniatus</i> )
Tree lizard	( <i>Urosaurus ornatus</i> )
Utah banded gecko	( <i>Coleonyx variegatus</i> )
Utah black-headed snake	( <i>Tantilla utahensis</i> )
Utah mountain kingsnake	( <i>Lampropeltis pyromelana</i> )
Wandering garter snake	( <i>Thamnophis elegans</i> )
Western blind snake	( <i>Leptotyphlops humilis</i> )
Western chuckwalla	( <i>Sauromalus obesus</i> )

Western fence lizard	( <i>Sceloporus occidentalis</i> )
Western leaf-nosed snake	( <i>Phyllorhynchus decurtatus</i> )
Western whiptail	( <i>Cnemidophorus tigris</i> )
Zebra-tailed lizard	( <i>Callisaurus draconoides</i> )

**Birds:**

Abert's towhee	( <i>Pipilo aberti</i> )**
American avocet	( <i>Recurvirostra americana</i> )
American bittern	( <i>Botaurus lentiginosus</i> )
American coot	( <i>Fulica americana</i> )
American crow	( <i>Corvus brachyrhynchos</i> )
American dipper	( <i>Cinclus mexicanus</i> )
American goldfinch	( <i>Carduelis tristis</i> )
American kestrel	( <i>Falco sparverius</i> )
American robin	( <i>Turdus migratorius</i> )
American tree sparrow	( <i>Spizella arborea</i> )
American white pelican	( <i>Pelecanus erythrorhynchos</i> )
American wigeon	( <i>Anas americana</i> )
Ash-throated flycatcher	( <i>Myiarchus cinerascens</i> )
Baird's sandpiper	( <i>Calidris bairdii</i> )
Bald eagle	( <i>Haliaeetus leucocephalus</i> )
Band-tailed pigeon	( <i>Columba fasciata</i> )
Bank swallow	( <i>Riparia riparia</i> )
Barn swallow	( <i>Hirundo rustica</i> )
Bell's vireo	( <i>Vireo bellii</i> )**
Belted kingfisher	( <i>Ceryle alcyon</i> )
Bendire's thrasher	( <i>Toxostoma bendirei</i> )
Bewick's wren	( <i>Troglodytes bewickii</i> )
Black phoebe	( <i>Sayornis nigricans</i> )**
Black tern	( <i>Chlidonias niger</i> )
Black-capped chickadee	( <i>Parus atricapillus</i> )
Black-chinned hummingbird	( <i>Archilochus alexandri</i> )
Black-chinned sparrow	( <i>Spizella atrogularis</i> )**
Black-crowned night-heron	( <i>Nycticorax nycticorax</i> )
Black-headed grosbeak	( <i>Pheucticus melanocephalus</i> )
Black-necked stilt	( <i>Himantopus mexicanus</i> )
Black-tailed gnatcatcher	( <i>Polioptila melanura</i> )**
Black-throated gray warbler	( <i>Dendroica nigrescens</i> )
Black-throated sparrow	( <i>Amphispiza bilineata</i> )
Blue grosbeak	( <i>Guiraca caerulea</i> )
Blue-gray gnatcatcher	( <i>Polioptila caerulea</i> )
Blue-winged teal	( <i>Anas discors</i> )
Bohemian waxwing	( <i>Bombycilla garrulus</i> )
Bonaparte's gull	( <i>Larus philadelphia</i> )
Brewer's blackbird	( <i>Euphagus cyanocephalus</i> )
Brewer's sparrow	( <i>Spizella breweri</i> )
Broad-tailed hummingbird	( <i>Selasphorus platycercus</i> )
Brown creeper	( <i>Certhia americana</i> )
Brown-crested flycatcher	( <i>Myiarchus tyrannulus</i> )**
Brown-headed cowbird	( <i>Molothrus ater</i> )
Bufflehead	( <i>Bucephala albeola</i> )
Bullock's oriole	( <i>Icterus galbula</i> )
Bushtit	( <i>Psaltriparus minimus</i> )
Cactus wren	( <i>Campylorhynchus brunneicapillus</i> )**
California Condor	( <i>Gymnogyps californianus</i> )
California gull	( <i>Larus californicus</i> )
Canada goose	( <i>Branta canadensis</i> )

Canvasback	( <i>Aythya valisineria</i> )
Canyon wren	( <i>Catherpes mexicanus</i> )
Caspian tern	( <i>Sterna caspia</i> )
Cassin's finch	( <i>Carpodacus cassinii</i> )
Cassin's kingbird	( <i>Tyrannus vociferans</i> )
Cattle egret	( <i>Bubulcus ibis</i> )
Cedar waxwing	( <i>Bombycilla cedrorum</i> )
Chipping sparrow	( <i>Spizella pallida</i> )
Cinnamon teal	( <i>Anas cyanoptera</i> )
Clark's grebe	( <i>Aechmophorus clarkii</i> )
Clark's nutcracker	( <i>Nucifraga columbiana</i> )
Cliff swallow	( <i>Hirundo pyrrhonota</i> )
Common moorhen	( <i>Gallinula chloropus</i> )
Common barn-owl	( <i>Tyto alba</i> )
Common black-hawk	( <i>Buteogallus anthracinus</i> )
Common goldeneye	( <i>Bucephala clangula</i> )
Common loon	( <i>Gavia immer</i> )
Common merganser	( <i>Mergus merganser</i> )
Common nighthawk	( <i>Chordeilus minor</i> )
Common poorwill	( <i>Phalaenoptilus nuttallii</i> )
Common raven	( <i>Corvus corax</i> )
Common snipe	( <i>Gallinago gallinago</i> )
Common yellowthroat	( <i>Geothlypis trichas</i> )
Cooper's hawk	( <i>Accipiter cooperii</i> )
Cordillean flycatcher	( <i>Empidonax occidentalis</i> )
Costa's hummingbird	( <i>Calypte costae</i> )**
Crissal thrasher	( <i>Toxostoma crissale</i> )**
Dark-eyed junco	( <i>Junco hyemalis</i> )
Double-crested cormorant	( <i>Phalacrocorax auritus</i> )
Downy woodpecker	( <i>Picoides pubescens</i> )
Eared grebe	( <i>Podiceps nigricollis</i> )
Evening grosbeak	( <i>Coccothraustes vespertinus</i> )
Ferruginous hawk	( <i>Buteo regalis</i> )
Flammulated owl	( <i>Otus flammeolus</i> )
Forster's tern	( <i>Sterna forsteri</i> )
Franklin's gull	( <i>Larus pipixcan</i> )
Gadwall	( <i>Anas strepera</i> )
Gambel's quail	( <i>Callipepla gambelii</i> )**
Golden eagle	( <i>Aquila chrysaetos</i> )
Golden-crowned kinglet	( <i>Regulus satrapa</i> )
Grace's warbler	( <i>Dendroica graciae</i> )
Gray flycatcher	( <i>Empidonax wrightii</i> )
Gray vireo	( <i>Vireo vicinior</i> )
Great blue heron	( <i>Ardea herodias</i> )
Great egret	( <i>Casmerodius albus</i> )
Great horned owl	( <i>Bubo virginianus</i> )
Greater roadrunner	( <i>Geococcyx californianus</i> )**
Greater white-fronted goose	( <i>Anser albifrons</i> )
Greater yellowlegs	( <i>Tringa melanoleuca</i> )
Great-tailed grackle	( <i>Quiscalus mexicanus</i> )
Green heron	( <i>Butorides striatus</i> )**
Green-tailed towhee	( <i>Pipilo chlorurus</i> )
Green-winged teal	( <i>Anas crecca</i> )
Hairy woodpecker	( <i>Picoides villosus</i> )
Hammond's flycatcher	( <i>Empidonax hammondii</i> )
Hermit thrush	( <i>Catharus guttatus</i> )
Herring gull	( <i>Larus argentatus</i> )

Hooded merganser	( <i>Lophodytes cucullatus</i> )
Hooded oriole	( <i>Icterus cucullatus</i> )**
Horned grebe	( <i>Podiceps auritus</i> )
Horned lark	( <i>Eremophila alpestris</i> )
House finch	( <i>Carpodacus mexicanus</i> )
House wren	( <i>Troglodytes aedon</i> )
Inca Dove	( <i>Columbina inca</i> )**
Juniper titmouse	( <i>Parus inornatus</i> )
Killdeer	( <i>Charadrius vociferus</i> )
Ladder-backed woodpecker	( <i>Picoides scalaris</i> )**
Lark sparrow	( <i>Chondestes grammacus</i> )
Lazuli bunting	( <i>Passerina ciris</i> )
Least sandpiper	( <i>Calidris minutilla</i> )
LeConte's thrasher	( <i>Toxostoma lecontei</i> )**
Lesser goldfinch	( <i>Carduelis psaltria</i> )
Lesser nighthawk	( <i>Chordeilus acutipennis</i> )**
Lesser scaup	( <i>Aythya affinis</i> )
Lesser yellowlegs	( <i>Tringa flavipes</i> )
Lewis' woodpecker	( <i>Melanerpes lewis</i> )
Lincoln's sparrow	( <i>Melospiza lincolni</i> )
Loggerhead shrike	( <i>Lanius ludovicianus</i> )
Long-billed curlew	( <i>Numenius americanus</i> )
Long-billed dowitcher	( <i>Limnodromus scolopaceus</i> )
Long-eared owl	( <i>Asio otus</i> )
Lucy's warbler	( <i>Vermivora luciae</i> )**
MacGillivray's warbler	( <i>Oporornis tolmiei</i> )
Mallard	( <i>Anas platyrhynchos</i> )
Marbled godwit	( <i>Limosa fedoa</i> )
Marsh wren	( <i>Cistothorus palustris</i> )
Merlin	( <i>Falco columbarius</i> )
Mexican spotted owl	( <i>Strix occidentalis</i> )
Mountain bluebird	( <i>Sialia currucoides</i> )
Mountain chickadee	( <i>Parus gambeli</i> )
Mountain plover	( <i>Charadrius montanus</i> )
Mourning dove	( <i>Zenaida macroura</i> )
Nashville warbler	( <i>Vermivora ruficapilla</i> )
Northern flicker	( <i>Colaptes auratus</i> )
Northern goshawk	( <i>Accipiter gentilis</i> )
Northern harrier	( <i>Circus cyaneus</i> )
Northern mockingbird	( <i>Mimus polyglottos</i> )
Northern pintail	( <i>Anas acuta</i> )
Northern pygmy owl	( <i>Glaucidium gnoma</i> )
Northern rough-winged swallow	( <i>Stelgidopteryx serripennis</i> )
Northern shoveler	( <i>Anas clypeata</i> )
Northern shrike	( <i>Lanius excubitor</i> )
Nothern waterthrush	( <i>Seiurus noveboracensis</i> )
Olive-sided flycatcher	( <i>Contopus borealis</i> )
Orange-crowned warbler	( <i>Vermivora celata</i> )
Osprey	( <i>Pandion haliaetus</i> )
Pectoral sandpiper	( <i>Calidris melanotos</i> )
Peregrine falcon	( <i>Falco peregrinus</i> )
Phainopepla	( <i>Phainopepla nitens</i> )**
Pied-billed grebe	( <i>Podilymbus podiceps</i> )
Pine siskin	( <i>Carduelis pinus</i> )
Pinyon jay	( <i>Gymnorhinus cyanocephalus</i> )
Plumbeous vireo	( <i>Vireo solitarius</i> )
Prairie falcon	( <i>Falco mexicanus</i> )

Pygmy nuthatch	( <i>Sitta pygmaea</i> )
Red crossbill	( <i>Loxia curvirostra</i> )
Red-breasted merganser	( <i>Mergus serrator</i> )
Red-breasted nuthatch	( <i>Sitta canadensis</i> )
Redhead	( <i>Aythya americana</i> )
Red-naped sapsucker	( <i>Sphyrapicus nuchalis</i> )
Red-necked phalarope	( <i>Phalaropus lobatus</i> )
Red-tailed hawk	( <i>Buteo jamaicensis</i> )
Red-winged blackbird	( <i>Agelaius phoeniceus</i> )
Ring-billed gull	( <i>Larus delawarensis</i> )
Ring-necked duck	( <i>Aythya collaris</i> )
Rock wren	( <i>Salpinctes obsoletus</i> )
Rough-legged hawk	( <i>Buteo lagopus</i> )
Ruby-crowned kinglet	( <i>Regulus calendula</i> )
Ruddy duck	( <i>Oxyura jamaicensis</i> )
Rufous crowned sparrow	( <i>Aimophila ruficeps</i> )**
Rufous hummingbird	( <i>Selasphorus rufus</i> )
Sage sparrow	( <i>Amphispiza belli</i> )
Sage thrasher	( <i>Oreoscoptes montanus</i> )
Savannah sparrow	( <i>Passerculus sandwichensis</i> )
Say's phoebe	( <i>Sayornis saya</i> )
Scott's oriole	( <i>Icterus parisorum</i> )
Scrub jay	( <i>Aphelocoma coerulescens</i> )
Semipalmated plover	( <i>Charadrius semipalmatus</i> )
Sharp-shinned hawk	( <i>Accipiter striatus</i> )
Short-eared owl	( <i>Asio flammeus</i> )
Snow goose	( <i>Chen caerulescens</i> )
Snowy egret	( <i>Egretta thula</i> )
Snowy plover	( <i>Charadrius alexandrinus</i> )
Solitary sandpiper	( <i>Tringa solitaria</i> )
Song sparrow	( <i>Melospiza melodia</i> )
Sora	( <i>Porzana carolina</i> )
Southwest willow flycatcher	( <i>Empidonax traillii</i> )
Spotted sandpiper	( <i>Actitis macularia</i> )
Spotted towhee	( <i>Pipilo erythrophthalmus</i> )
Stellar's jay	( <i>Cyanocitta stelleri</i> )
Summer tanager	( <i>Piranga rubra</i> )**
Swainson's hawk	( <i>Buteo swainsoni</i> )
Swainson's thrush	( <i>Catharus ustulatus</i> )
Townsend's solitaire	( <i>Myadestes townsendi</i> )
Tree swallow	( <i>Tachycineta bicolor</i> )
Tundra swan	( <i>Cygnus columbianus</i> )
Turkey vulture	( <i>Cathartes aura</i> )
Verdin	( <i>Auriparus flaviceps</i> )**
Vermilion flycatcher	( <i>Pyrocephalus rubinus</i> )**
Vesper sparrow	( <i>Pooecetes gramineus</i> )
Violet-green swallow	( <i>Tachycineta thalassina</i> )
Virginia rail	( <i>Rallus limicola</i> )
Virginia's warbler	( <i>Vermivora virginiae</i> )
Warbling vireo	( <i>Vireo gilvus</i> )
Water pipit	( <i>Anthus spinoletta</i> )
Western bluebird	( <i>Sialia mexicana</i> )
Western burrowing owl	( <i>Athene cunicularia</i> )
Western grebe	( <i>Aechmophorus occidentalis</i> )
Western kingbird	( <i>Tyrannus verticalis</i> )
Western least bittern	( <i>Ixobrychus exilis</i> )
Western meadowlark	( <i>Sturnella neglecta</i> )

Western sandpiper	( <i>Calidris mauri</i> )
Western screech owl	( <i>Otus kennicottii</i> )
Western tanager	( <i>Piranga ludoviciana</i> )
Western wood-pewee	( <i>Contopus sordidulus</i> )
Whimbrel	( <i>Numenius phaeopus</i> )
White-breasted nuthatch	( <i>Sitta carolinensis</i> )
White-crowned sparrow	( <i>Zonotrichia albicollis</i> )
White-faced ibis	( <i>Plegadis chihi</i> )
White-throated swift	( <i>Aeronautes saxatalis</i> )
White-winged dove	( <i>Zenaida asiatica</i> )**
Wild turkey	( <i>Meleagris gallopava</i> )
Willet	( <i>Catoptrophorus semipalmatus</i> )
Wilson's phalarope	( <i>Phalaropus tricolor</i> )
Wilson's warbler	( <i>Wilsonia pusilla</i> )
Winter wren	( <i>Troglodytes troglodytes</i> )
Wood duck	( <i>Aix sponsa</i> )
Yellow warbler	( <i>Dendroica petechia</i> )
Yellow-billed cuckoo	( <i>Coccyzus americanus</i> )
Yellow-breasted chat	( <i>Icteria virens</i> )
Yellow-headed blackbird	( <i>Xanthocephalus xanthocephalus</i> )
Yellow-rumped warbler	( <i>Dendroica coronata</i> )

**Mammals:**

Allen's big-eared bat	( <i>Idionycteris phyllotis</i> )
Badger	( <i>Taxidea taxus</i> )
Beaver	( <i>Castor canadensis</i> )
Big brown bat	( <i>Eptesicus fuscus</i> )
Big free-tailed bat	( <i>Nyctinomops macrotis</i> )
Black-tailed jackrabbit	( <i>Lepus californicus</i> )
Bobcat	( <i>Lynx rufus</i> )
Brush mouse	( <i>Peromyscus boylii</i> )
Bushy-tailed woodrat	( <i>Neotoma cinerea</i> )
Cactus mouse	( <i>Peromyscus eremicus</i> )
California leaf-nosed bat	( <i>Macrotus californicus</i> )
California myotis	( <i>Myotis californicus</i> )
Canyon mouse	( <i>Peromyscus crinitus</i> )
Chisel-toothed kangaroo rat	( <i>Dipodomys microps</i> )
Cliff chipmunk	( <i>Tamias dorsalis</i> )
Coyote	( <i>Canis latrans</i> )
Deer mouse	( <i>Peromyscus maniculatus</i> )
Desert bighorn sheep	( <i>Ovis canadensis</i> )
Desert cottontail	( <i>Sylvilagus auduboni</i> )
Desert kangaroo rat	( <i>Dipodomys deserti</i> )
Desert pocket mouse	( <i>Perognathus penicillatus</i> )
Desert shrew	( <i>Notiosorex crawfordi</i> )
Desert woodrat	( <i>Neotoma lepida</i> )
Dusky shrew	( <i>Sorex monticolis</i> )
Fringed myotis	( <i>Myotis thysanodes</i> )
Golden-mantled ground squirrel	( <i>Spermophilus lateralis</i> )
Gray fox	( <i>Urocyon cinereoargenteus</i> )
Great Basin pocket mouse	( <i>Perognathus parvus</i> )
Hoary bat	( <i>Lasiurus cinereus</i> )
Kit fox	( <i>Vulpes macrotis</i> )
Least chipmunk	( <i>Tamias minimus</i> )
Long-eared myotis	( <i>Myotis evotis</i> )
Long-legged myotis	( <i>Myotis volans</i> )
Long-tailed pocket mouse	( <i>Perognathus formosus</i> )

Long-tailed vole	( <i>Microtus longicaudus</i> )
Long-tailed weasel	( <i>Mustela frenata</i> )
Merriam's kangaroo rat	( <i>Dipodomys merriami</i> )
Merriam's shrew	( <i>Sorex merriami</i> )
Mexican free-tailed bat	( <i>Tadarida brasiliensis</i> )
Mountain cottontail	( <i>Sylvilagus nuttalli</i> )
Mountain lion	( <i>Felis concolor</i> )
Mule deer	( <i>Odocoileus hemionus</i> )
Muskrat	( <i>Ondatra zibethicus</i> )
Northern grasshopper mouse	( <i>Onychomys leucogaster</i> )
Northern water shrew	( <i>Sorex palustris</i> )
Ord's kangaroo rat	( <i>Dipodomys ordii</i> )
Pallid bat	( <i>Antrozous pallidus</i> )
Pinyon mouse	( <i>Peromyscus truei</i> )
Porcupine	( <i>Erethizon dorsatum</i> )
Pygmy rabbit	( <i>Brachylagus idahoensis</i> )
Raccoon	( <i>Procyon lotor</i> )
Red squirrel	( <i>Tamiasciurus hudsonicus</i> )
Ringtail	( <i>Bassariscus astutus</i> )
Rock squirrel	( <i>Spermophilus variegatus</i> )
Silver-haired bat	( <i>Lasionycteris noctivagans</i> )
Small-footed myotis	( <i>Myotis ciliolabrum</i> )
Southern grasshopper mouse	( <i>Onychomys torridus</i> )
Spotted bat	( <i>Euderma maculatum</i> )
Striped skunk	( <i>Mephitis mephitis</i> )
Townsend's big-eared bat	( <i>Corynorhinus townsendii</i> )
Virgin little pocket mouse	( <i>Perognathus longimembris</i> )
Virgin River montane vole	( <i>Microtus montanus</i> )
Virgin River pocket gopher	( <i>Thomomys bottae</i> )
Western harvest mouse	( <i>Reithrodontomys megalotis</i> )
Western pipistrelle	( <i>Pipistrellus hesperus</i> )
Western red bat	( <i>Lasiurus blossevillii</i> )
Western spotted skunk	( <i>Spilogale gracilis</i> )
White-tailed antelope squirrel	( <i>Ammospermophilus luecurus</i> )
Yellow-bellied marmot	( <i>Marmota flaviventris</i> )
Yuma myotis	( <i>Myotis yumanensis</i> )

\*\* = Species that breeds primarily in Washington County

