DRAFT CONSERVATION AGREEMENT

Virgin spinedace

Lepidomeda mollispinis mollispinis

This Conservation agreement for the Virgin spinedace *Lepidomeda mollispinis mollispinis* has been initiated in order to ensure that conservation measures needed for the continued existence and recovery of the species are initiated and carried out. 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 (Attachment A). Full implementation of this agreement and it's 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 drainage 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 nonnative fishes have altered the Virgin River ecosystem. There has been a 37-40% reduction (approximately 83.9 km/52.1 mi) in Virgin spinedace historic range (approximately 226.4 km/140.4 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 ESA, on May 18, 1994 (50 CFR Part 17).

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 and sixty-six species of fish, amphibians, reptiles, birds, and mammals are known to co-exist in the same or adjacent habitat of the Virgin spinedace. Eighty-one of these species are listed as sensitive in either Utah, Arizona or Nevada and/or are listed under ESA by FWS (Appendix A in Conservation Strategy). An additional eight sensitive plant and seven sensitive invertebrate species also co-exist in the same or adjacent habitat of the Virgin spinedace. Using an ecosystem approach, the Virgin spinedace agreement could reduce or possibly eliminate threats for several of these species

which could preclude their need for federal listing pursuant to ESA.

II. INVOLVED PARTIES

Utah Department of Natural Resources
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(801) 538-7227

United States Department of Interior
Fish and Wildlife Service
P.O. Box 25486
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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, Nevada 89520-0022
(702)688-1500

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

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

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

III. ROLE AND AUTHORITY

Utah Department of Natural Resources - Division of Wildlife Resources (UDWR):

UDWR has the responsibility to protect the health, welfare, safety and integrity of wild and free-roaming wildlife. This agency has agreed to work cooperatively through memoranda of understanding and conservation agreements with other state agencies, federal agencies, states, educational institutions, municipalities, counties, corporations, organized clubs, landowners, associations, and individuals in order to accomplish these goals of mutual concern and shared responsibilities.

Fish and Wildlife Service (FWS):

FWS is responsible for conserving, enhancing, and protecting fish and wildlife and their habitats for the continuing benefit of people through Federal programs relating to wild birds, endangered species, certain mammals, inland sport fisheries, and specific fishery and wildlife research activities. This agency has agreed to work cooperatively through memoranda of understanding in order to accomplish these goals of mutual concern and shared responsibilities. The U.S. Fish and Wildlife Service has the authority to enter into the voluntary Conservation Agreement under the Endangered Species Act of 1973, as amended, the Fish and Wildlife Act of 1956, the Fish and Wildlife Coordination Act of 1964 and the National Memorandum of Understanding (94(SMU-058)).

Bureau of Land Management (ELM):

BLM has two primary objectives for the management of threatened or endangered species (BLM Manual 6840): a) to conserve T/E species and the ecosystems on which they depend; and b) to ensure that actions authorized on BLM administered lands do not contribute to the need to list any other special status species under the provisions of the ESA. Using existing authorities, BLM is committed to plan and implement programs for the conservation of threatened or endangered species that occur on public lands and direct maximum effort toward carrying out programs that will restore habitat and populations to the point that the provisions of the ESA are no longer necessary.

National Park Service (NPS):

NPS is responsible for promoting and regulating the use of federal areas known as national parks, monuments, and reservations.. .by such means and measures as conform to the fundamental purpose of these areas, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations. (NPS Organic Act, 16 USC1)

Zion National Park is responsible for preserving the scenic, natural, and cultural values that led to the reservation of the lands included within the boundaries of the park; to develop an understanding of these values through research and study; and to translate this sense of

understanding through a dedicated, caring staff to those visiting the park, in a manner that leads to an appreciation of, and care for, the park and its resources (1992 Statement for Management, Zion National Park)

Nevada Department of Conservation and Natural Resources - Division of Wildlife (NDOW):

NDOW has statutory authority and responsibility to maintain, manage, enhance, and protect Nevada's wildlife resources, including fisheries resources, as directed by the State Board of Wildlife Commissioners, and has a stated goal to ensure the perpetuation of all aquatic resources in cooperation with landowners and land management agencies.

Arizona Game and Fish Department (AGFD):

The responsibility of AGFD is to conserve, enhance, and restore Arizona's diverse wildlife resources and habitats through aggressive protection and management programs, and to provide wildlife resources and safe watercraft and off-highway vehicle recreation for the enjoyment, appreciation, and use by present and future generations.

Washington County Water Conservancy District (WCWCD):

The primary responsibility of the WCWCD is to develop safe and dependable water supplies to foster the continued economic, environmental and cultural growth and health in Washington County. The WCWCD was established pursuant to Utah Law with broad authority for watershed, floodplain, drought management, flood control and hydropower management and development and other functions as provided for in the Utah Water Conservancy Act.

IV. STATUS AND DISTRIBUTION OF THE 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 ESA. Their determination of this status 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 ESA (50 CFR 17).

The Virgin spinedace currently occupies approximately 60-63% of it's historic habitat, nearly all being in Utah. Populations of the species no longer exist in Nevada and few remain in Arizona. The species occupies approximately 117.2 km (72.7 mi) of tributary streams and 25.4 km (15.8 mi) of the mainstem Virgin River. Occupied streams include three reaches of Beaver Dam Wash, two sections 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, the

Virgin spinedace has been collected in the Virgin River between Pah Tempe Springs and Littlefield, Arizona. This area is not considered to be historic or occupied habitat because collections are infrequent and generally associated with tributary inflows. 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 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. The descriptive statements below reflect the problems and threats identified by the FWS (50 CFR Part 17). The Conservation Strategy provides a detailed review of these problems and threats and their affect on Virgin spinedace populations. The strategy also presents specific actions that the signatories to this agreement will take to reduce or eliminate threats that warrant its listing as a sensitive species by state and federal agencies, and as threatened or endangered by the ESA.

Present or threatened destruction, modification, or curtailment of its habitat or range

* Alterations to habitat due to water development and storage projects have had an impact on the Virgin spinedace range.
    - Approximately 6.8 km (4.2 mi.) of Virgin spinedace habitat has been inundated by dams and reservoirs.
    - Approximately 59.9 (37.1 mi) of historic habitat has been dewatered.
    - Approximately 30.9 km (19.2 mi.) of currently occupied habitat has experienced flow depletions
    - Dams and diversions have often functioned as migration barriers and have caused fragmentation of habitat and populations.

* Agricultural activities such as grazing and cultivation practices have contributed to alterations of Virgin spinedace habitat.

* Deterioration of water quality from historic levels has occurred in several reaches. Water depletions have been the primary factor altering water quality in the basin. Other contributing factors include runoff, and contaminated return flows in isolated areas.

Competition, *Predation, and Disease*

* Several species of nonnative fish occur in the Virgin River Basin; many of which negatively interact with Virgin spinedace.

* Diseases and parasites such as the Asian Tapeworm have been introduced into the Virgin River Basin.

Other* natural *or manmade factors affecting the species' continued existence

* Drought often limits usable habitat and isolates individual populations.

* Potential loss of instantaneous flow events (ie: floods) could reduce stream integrity.

Over-utilization for commercial, recreational, scientific, or educational purposes

* Over-utilization has not been identified as a factor in the decline of Virgin spinedace populations.

* There is no indication that recent research studies have negatively impacted Virgin spinedace populations.

Inadequacy of existing regulatory mechanisms

* Ownership of Virgin spinedace habitat in the Virgin River Basin is complex and consists of a diverse number of parties.

* Impacts are difficult to monitor and protection for the Virgin spinedace is limited and difficult to enforce.

VI. CONSERVATION ACTIONS TO BE IMPLEMENTED

In order to meet the objectives of this agreement, five general management actions (outlined below and detailed in the Conservation Strategy) and four general administrative actions, must be implemented. These actions include: re-establishing and maintaining required flows; enhancing and maintaining habitat; selectively controlling nonnative fish; maintaining genetic viability; monitoring populations and habitat; coordinating conservation activities; implementing the conservation schedule; funding conservation actions; and assessing conservation progress.

Re-establishment and Maintenance of Required flow

* Existing flow conditions will be maintained in all reaches occupied by Virgin spinedace. These conditions are described by hy rograp s in w quantity, timing, duration, and frequency. Two critical components of hydrographs required for Virgin spinedace include:

- Channel-maintenance flows are high flows that are expected to prevent vegetation growth in the channel and remove sediments. These flows are thought to exist in all occupied reaches.

- Fish maintenance flows are those flows required during a low flow period to maintain a self-sustaining fish population. These flows currently occur in 15 occupied stream reaches totaling 168.6 km (104.5 mi).

* Interim fish maintenance flows will be re-established and maintained in approximately 38.7 km (24 mi) of Virgin spinedace historic habitat that is dewatered in order to restore populations and reduce habitat fragmentation.

* The response of Virgin spinedace populations and habitat to re-established flows will be evaluated based on reach specific study plans for a five year period.

* A final recommendation for re-establishing fish maintenance flows in specific reaches will be developed after evaluations of these flows have been completed.

* Protection measures for maintained and re-established flows will be implemented that are consistent with state laws. These measures may include, but will not be limited to, river operating agreements, instream flow rights, and irrigation rights.

Habitat Enhancement and Maintenance

* Habitat enhancement procedures as detailed in the Conservation strategy, will be implemented in approximately 25.4 km (15.8 mi) of occupied habitat.

* The potential impact of future development projects to Virgin spinedace habitat will be evaluated based on the degree to which the project affects the continued existence and recovery of Virgin spinedace (ie: population fragmentation, viability, etc.).

* Mitigation for acceptable projects affecting occupied habitat will be based on a one to one replacement of historic habitat.

Nonnative Fish Management

* Basin-wide procedures for controlling the introduction and spread of undesirable aquatic species of vertebrates and invertebrates will be implemented by the appropriate agencies.

* Basin-wide protocols for stocking and maintenance of existing non-indigenous sport fish populations will be implemented.

* Removal of detrimental nonnative fish in the basin will be implemented where feasible.

Population Genetics Management

* Protocols for introduction, re-introduction, and sub-basin transfer of Virgin spinedace will be established and utilized.

Population and Habitat Monitoring

* A monitoring plan will be implemented to assess Virgin spinedace population and habitat responses to specific management actions.

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, technical advisors, and other members as necessary. The designated team leader will be the Utah Department of Natural Resources, Division of Wildlife Resources representative.

* The VSCT will meet annually to develop yearly conservation schedules.

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

* VSCT meetings will be open to interested parties. Minutes of the meetings will be kept and distributed.

Implementing Conservation Schedule

* A total of 10 years is anticipated for full implementation of actions identified in this agreement and specified in the Conservation Strategy. Significant actions for ensuring the survival of the Virgin spinedace, however, will be implemented within the first five years.

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

* The Utah Division of Wildlife Resources, Department of Natural Resources will supervise and monitor all participants of this agreement to insure that all conservation actions are being implemented and carried out according to the conservation schedule.

Funding Conservation Actions

* It is anticipated that expenditures associated with implemented this agreement could exceed $3,000,000 (Table 2). It is projected that the actions implemented for the restoration of minimum-low 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 funding for initiative procedures of the Conservation Agreement.

  - Federal sources would include, but will not be limited to, the FWS, **BLM**, Land and Water Conservation funds, and the Soil Conservation Service.

  - State funding sources would include, but 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 would be provided by the Habitat Conservation Plan, Water 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.

Conservation Progress Assessment

* A quarterly assessment of progress towards implementing actions identified in this agreement will be provided to FWS by UDWR. This assessment will be based on updates and evaluations summarized by VSCT members.

* An annual assessment of conservation accomplishments identified in Table 1 and subsequent yearly schedules will be made by VSCT. This assessment will determine the effectiveness of this agreement and whether revisions are warranted. It will be provided to FWS by UDWR.

* If it becomes known that there are threats to the survival of the Virgin spinedace that are not or cannot be resolved through this or any Conservation Agreement, the FWS will initiate actions to list this species under Section 4 of ESA through an emergency rule.

VII. DURATION OF AGREEMENT

The duration of this Conservation Agreement is for 5 years following the date of the last signature. Prior to the end of the 5th year, a thorough analysis of actions implemented for the species will be conducted. If all signatories agree that progress towards implementation of all actions identified in the Conservation Strategy are acceptable, renewal of the Conservation Agreement will be automatically extended for an additional 5 years. If some portion of this agreement cannot be carried out or if cancellation is desired, the party requesting such action will notify the other parties within 1 month of the changed circumstances. At such time, the FWS would recognize actions taken by individual signatories to this agreement. The FWS would determine if and to what degree mitigation could be applied to future development projects for those actions.

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.

IV. SIGNATURES

Utah Department of Natural Resources
Utah Division of Wildlife Resources
1596 West North Temple
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Ted Stewart Date
Executive Director

USDI Fish and Wildlife Service
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Ralph 0. Morganwick Date
Regional Director

USDI Bureau of Land Management
324 South State Street
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_____

Mat Millenbach Date
State Director

USDI Bureau of Land Management
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Phoenix, AZ 85011

_____

Lester K. Rosenkrance Date
State Director

USDI National Park Service
(Rocky Mountain Regional Office)
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John Cook Date
Regional Director

Nevada Department of Conservation and Natural Resources
Division of Wildlife
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William A. Molini Date
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Duane Shroufe Date
Director

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

_____

Ron Thompson Date
Director

Table 1: Conservation Actions to be Implemented in Calendar Year 1995

Reach	Date	Lead	Action
Basin-Wide:	Immediate*	States	- Maintain all existing fish maintenance flows
	12/31	States	- Identify methods for flow protection
	Immediate	ALL	- Implement mitigation protocols for projects
	Immediate	States	- Implement procedures to control the introduction of undesirable species
	Immediate	States	- Implement sport fish stocking procedures
	Immediate	States	- Implement genetic management protocols
	Immediate	States	- Implement population and habitat monitoring
	12/31	All	- Identify funding mechanisms
Beaver Dam Wash:			
Below Schroeder Res.	10/31	NDOW	- Selective removal of rainbow trout
	10/31	NDOW	- Re-introduce Virgin spinedace
Santa Clara River:			
Below Veyo (Baker Dam)	Immediate	UDWR	- Cease brown trout stocking
Below Gunlock Res.	12/31	WCWCD	- Develop cooperative agreements for providing flows
	12/31	WCWCD	- Identify methods for flow protection
	4/30	BLM	- Initiate recreation management
	Immediate	UDWR	- Initiate feasibility analysis for green sunfish removal
Mainstem Virgin River:			
Below Quail Creek Div.	4/30	WCWCD	- Develop cooperative agreements for providing flows
	6/30	WCWCD	- Develop 5 year flow evaluation study plan
	4/30	WCWCD	- Provide fish maintenance flows (4.5km/2.8mi)
	6/30	WCWCD	- Evaluate fish maintenance flows
	4/30	WCWCD	- Identify methods for flow protection
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 greemen

Table 2. Estimated Costs for Implementing the Virgin spinedace Conservation Agreement over 10 year period.

Conservation Agreement Actions	**Estimated Costs($)**
Habitat Maintenance and Enhancement:	
Determination of Flow Requirements	200,000
Maintenance of Existing Flows	30,000
Re-establishment and/or Enhancement of Flows	2,000,000
Formalize Flow Protection	200,000
Implement Habitat Improvements	100,000
Population Genetics Management:	
Develop and Implement Protocols	2,500
Nonnative Fish Management:	
Implement Introduction/Stocking Procedures	2,500
Control/Eradication of Detrimental Fish	300,000
Population and Habitat Monitoring:	
Implement monitoring plans	300,000
Administration:	
Annual Review of Activities	100,000

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Table 3: Estimated agency in-kind contributions, actions, and responsibilities for implementation of the Vir_in 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 (eg: 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 nonnative species within the basin *(eg:* 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 nonnative 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 nonnative species in lower basin reaches, and cooperate and assist in basin-wide habitat enhancement and population monitoring projects.
U.S. Fish and Wildlife Service	Advise and *assist* implementation of conservation agreement in regards to existing laws (eg: ESA, NEPA regulations etc.). Cooperate and assist in eradication/control projects of nonnative species, cooperate and *assist* in basin-wide 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 nonnative species, cooperate and assist in basin-wide habitat enhancement and population monitoring projects.
Bureau of Land Management (Arizona)	Serve as lead agency in funding, developing and constructing migration barriers for red-shiner eradication in Arizona reaches of Virgin River. Cooperate and assist in basin-wide funding, enhancement and monitoring projects.
Washington County Water Conservancy District	Obtain and/or secure water rights and land within Virgin spinedace habitat. *Assist* in planning, funding, and construction of nonnative fish migration barriers and diversion enhancements. Cooperate and *assist* in monitoring of fish populations and habitat responses to management actions.

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Spinedace Conservation Team

ATTACHMENT A

Draft Conservation Strategy

Virgin spinedace

(Lepidomeda mollispinis mollispinis)

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INTRODUCTION

The Virgin River basin is characterized by a diverse landscape with unique communities of fauna and flora. The basin encompasses approximately 15,600 km^2 (6000 mi^2). Virgin River headwaters are in Washington and Kane County, Utah and the stream flows in a general southwesterly direction to empty into Lake Mead on the Colorado River in Nevada. Elevations range from 3300 m (10,000 ft) above mean sea level (msl) 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 desertland with broad open canyons and low gradients. The 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 provides habitat for over 366 species of wildlife (Appendix A). Of these, 81 species have been identified as sensitive. There are six fish species indigenous to the basin: woundf in, Virgin River chub, flannelmouth sucker, desert sucker, speckled dace, and Virgin spinedace. Five of these have been listed or are candidates for federal listing under the amended Endangered Species Act of 1973 (ESA).

The 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 their list of threatened and endangered fish after assessing criteria consistent with the ESA (Deacon et al., 1979). Their determination of the species status was based on review of original data and discussions with pertinent agencies and knowledgeable scientists. On May 18, 1994, the United States Fish and Wildlife Service (FWS) proposed the species for listing as a threatened species pursuant to the ESA (50 CFR Part 17).

The purpose of the present document is to describe specific procedures and strategies required for conservation of Virgin spinedace. The general conservation approach focuses on two main objectives. The first objective is to eliminate tfreaEs where possible, and reduce those that c eliminated entirely. The second is to enhance and/or stabilize instre flows in specific reaches of occupied and uno upied habitat. oug the primary focus of this strategy is conservation and enhancement of the Virgin spinedace, it could also reduce or eliminate threats and improve habitat for many other species, which could preclude their need for federal listing pursuant to the ESA.

Systematics and Description

The Virgin spinedace, ***Lepidomeda*** *mollispinis mollispinis* 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 are monotypic, represented by the spikedace **(*M. fulgida*)** and woundfin *(P. argetissimus). Lepidomeda* is a polytypic genus containing four species: the White River spinedace *(L. albivallis),* the Pahranagat spinedace *(L. altivelis),* the Little Colorado spinedace *(L. vittata),* and the Virgin spinedace *(L. mollispinis). L. mollispinis* is further classified into two subspecies; *L. m. pratensis* (Big Springs spinedace) and *L. m. mollispinis* (Virgin spinedace). The Pahranagat spinedace is considered extinct (Miller and Hubbs, 1960; Valdez et al.,1991). Extant members of the tribe Plagopterini are rare. 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 get their 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 on the dorso-lateral half. 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 60mm to 120mm (2.4 to 4.7 in SL)(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 (Addley and Hardy, 1993; Sigler and Miller, 1963; Valdez et al., 1991). The dorsal fin has eight rays and the anal fin usually includes nine rays, but may vary from eight to ten rays.

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 one-year-old 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 SL: 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 while 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 the Virgin spinedace has been observed from April through June at mean daily water temperatures of 13-17°C and day lengths of about 13 hrs. Rinne (1971) found that one-year-old females had the lowest mean relative fecundity averaging 459 eggs, while two and three-year-old females averaged a 42% and 34% increase in mean relative fecundity over one-year-olds, respectively. Since populations are comprised primarily of one year olds, 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 preferences have 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, while 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/second) velocities containing cover as well (Deacon et al., 1979; Deacon et al., 1991; Hardy et al, 1989). 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 (Angradi et al., 1991; Gregor and Deacon, 1988; Rinne, 1971). Virgin spinedace feed on drifting prey in midwater and at the surface. Usually, however, they maintain equilibrium in the midwater column darting to the surface to capture prey in a manner similar to drift-feeding salmonids (Addley and Hardy, 1993; Rinne, 1971).

Historic Distribution

The historic distribution of the Virgin spinedace is not well documented. Holden (1977) speculated 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 (Addley and Hardy, 1993; Cross 1975; Rinne, 1971; Valdez et al., 1991). 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 Virgin (Tanner 1932, 1936). Hubbs (unpub. data) collected Virgin spinedace near Bunkerville, Nevada, in 1938, but surveys in 1942 in the same area lacked Virgin spinedace (Cross, 1975). Furthermore, the species was absent from surveys below Littlefield, Arizona between 1942 and 1975 (Cross 1975).

PROBLEMS FACING THE SPECIES

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 are 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.

The present distribution of the Virgin spinedace is significantly smaller than historically, with approximately 37-40% (83.9 km/52.1 mi.), now unoccupied (Table 1). In addition, 24% of currently occupied habitat has experienced some degree of adverse modification (Table 1). Dewatered streams, water depletions, introductions of nonnative fish, and habitat degradation through agricultural and recreational uses have been identified as the primary factors involved in the reduction of range of the species (Valdez et al., 1991; Addley and Hardy, 1993).

Following is a synopsis of pertinent problems facing the Virgin spinedace which address the criteria for federal listing as required by Section 4(a)(1) of ESA. Those factors, as identified by the signatories to the Conservation Agreement, which may have contributed to the degradation or elimination of Virgin spinedace historic habitat and its populations, are discussed.

Present or threatened destruction, modification, or curtailment of its 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 6.8 km (4.2 mi) of Virgin spinedace historical habitat has been inundated by reservoirs including Quail Creek Reservoir on Quail Creek, Gunlock on the Santa Clara River, and Schroeder Reservoir on

Beaver Dam Wash (Figure 1). Approximately 59.9 km (37.1 mi) of historic habitat has been dewatered by diversions. Furthermore, diversions have depleted water in approximately 30.9 km (19.2 mi) of currently occupied habitat. Lack of stable instream flows and low water levels as a result of 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 becomes 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, devegetation. A recent evaluation of the Virgin River basin riparian zone (Fridell, Hansen, Leany, and Douglas, pers. comm., 1994) indicated that some alterations from crop production is 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.

Predation, Competition, and Disease

Aquatic species introduced into the Virgin River system have been identified as contributing to reductions of native fish populations (Addley and Hardy, 1993; USFWS, 1993). Several nonnative fish species have been identified as occupying the same habitat as Virgin spinedace (Table 2). Several of these prey on the Virgin spinedace. Other nonnatives (Table 2), such as crayfish (ie: Astacidae), may be preying on larval and young-of-year life stages in lower reaches of several tributaries (Addley and Hardy, 1993). Some nonnative species also may 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 declining status of the Virgin spinedace; however, they may have adverse effects when coupled with other threat and stress factors (Addley and Hardy, 1993).

Other manmade factors affecting the species' continued existence.

Several other natural and manmade factors play a role in the declining status of the Virgin spinedace. Natural limiting factors include drought, flood and in some instances, natural barriers and native species interactions. The extent that natural factors effect Virgin spinedace is unclear.

Pollution from return flows, municipal drains and agriculture is

a potential problem for all native species within the basin. Return flows from municipal drains and agriculture can make up a significant portion of a stream's total flow. Water from these return flows can be polluted with pesticides as well as other wastes. Historically, mining along Beaver Dam and Moody Wash probably contributed to habitat degradation; however mining practices do not currently effect Virgin spinedace habitat. Low flows, caused naturally or by diversions, increase the impact of pollution, erosion, siltation and mineral springs have on the chemical composition of the water.

Recreational use (e.g. off-road vehicles) have been documented (Fridell et al., pers comm.) as significantly impacting several reaches including the Santa Clara below Gunlock Reservoir, the lower Santa Clara, and the lower mainstem Virgin River.

Inadequacy of existing regulatory mechanisms

Lands in the Virgin River drainages are administered by several entities including Bureau of Land Management, National Park Service, U.S. Forest Service, Paiute Indian Tribe, States of Utah, Arizona, and Nevada, and private landowners. This mosaic ownership complicates regulation, monitoring, and basin wide protection of the Virgin River drainage and Virgin spinedace. In Utah, the Virgin spinedace is protected against direct take, but the state does not have the authority to adequately protect its habitat. The State of Nevada and Arizona has enacted regulations prohibiting the illegal take of Virgin spinedace. According to USFWS (50 CFR Part 17), due to continuing habitat destruction, the present level of protection for the Virgin spinedace is inadequate to prevent the species from becoming endangered and eventually extinct.

CONSERVATION ACTIONS TO BE IMPLEMENTED

Conservation measures required for the continued existence of Virgin spinedace focus on two objectives: 1) to eliminate significant threats or re those that cannot be completed eliminated, and 2) to stabilizè and enhance specific reaches of occupied and unoccupie ric habitat. The goal of these measures is to ensure the species occupies at least 80% (181.1 km/112.3 mi) of its historic range. Attainment of the goal and objectives of this strategy would be achieved by implementing the following management actions: 1) re-establishing and maintaining required flows, 2) enhancing and maintaining habitat, 3) selectively controlling nonnative fish, 4) maintaining genetic viability, and 5) monitoring populations and habitat parameters to ensure that actions 1 through 4 are effective.

Re-establish* and *Maintain Required Flows

Providing flows needed to ensure continued existence of the Virgin spinedace will require that: 1) existing flow conditions (ie: hydrographs in terms of flow quantity, timing, duration, and frequency) be maintained in all reaches, and 2) flow conditions required for the species be re-established in appropriate reaches to reduce habitat fragmentation and allow for re-expansion of range. Flow requirements for the species will be determined using an empirical approach by incorporating the conceptual framework outlined by Hill et al. (1991). The empirical process of determining flow requirements while maintaining existing conditions will adhere to the following step-wise approach:

Maintain Existing Flows

Two critical components of hydrographs required for Virgin spinedace have been identified: 1) Channel maintenance flows; those high flows expected to prevent vegetation growth in the channel and remove sediments (Hill et al. 1991, Reiser et al. 1989), 2) Fish maintenance flows; those flows required during a low flow period to maintain a self-sustaining fish population.

Channel-maintenance flows:
Channel-maintenance flows are currently thought to exist in all reaches. These flows or natural conditions will be maintained. Most channel-maintenance flow methods suggest that bankfull discharge is a simple discriminator for differentiating between channel-forming and floodplain-forming processes (Wesche and Rechard, 1980). Rosgen et al. (1986) determined that a sediment rating curve and a frequency curve of daily discharges, based on Andrews (1980), could be used to define effective flow. Andrews determined that effective discharge was nearly equivalent to bankfull stage. Leopold and Emmett (1983) suggested that a 1.5 year recurrence interval is required for perpetuating channel maintenance processes. Chorley et al. (1984), however, indicated that bankfull recurrence intervals may vary from 1 to 32 years in some systems. These conditions have not been determined or described for Virgin River streams.

Any new water depletion or alteration of existing conditions for channel-maintenance flows would require prior evaluation, assessment, and approval. This evaluation would need to describe existing channel-maintenance flows and determine how existing conditions would be altered. Descriptions would include details on the timing, duration, magnitude, slope, and frequency of high-flow events in selected streams along with analyses to determine an average annual hydrograph for timing and slopes of rising and falling limbs. The HEC-2 analysis (U.S. Army Corps of Engineers 1982) would be used to estimate bankfull flows. A frequency-of-occurrence curve would be required to describe the return period for peak flows. A flow duration curve would also be required to

describe the flow duration associated with specific exceedence values. Finally, the assessment would need to determine the impact on Virgin spinedace and its habitat. Mitigation for any habitat loss would generally be based on a one-to-one replacement of historic habitat.

Fish Maintenance Flows:
Fish maintenance flows currently occur in approximately 15 occupied stream reaches (Table 3). These flows or natural conditions will be maintained. Any additional water depletions within a reach would require an in-depth assessment of the impact of the action on Virgin spinedace in that reach. This assessment would include an evaluation of impacts on low flow conditions. The analysis would include an assessment of the relationship of channel-maintenance flows and low flow conditions.

Re-establish Interim Fish Maintenance Flows

Interim fish maintenance flows will be established and maintained in approximately 38.7 km (24 mi) of historic habitat of the Virgin spinedace in order to reduce habitat fragmentation and to restore populations. These flows were determined by comparing Virgin spinedace population numbers, stream flows, and habitat characteristics throughout the drainage for empirical relationships (Addley and Hardy, 1993; Valdez et al, 1991). Estimated cubic feet per second (cfs) targets for interim fish maintenance flow requirements are presented in Table 3. A total of 10 reaches have been identified as potential sites for fish maintenance flow re-establishment (Table 4). These reaches were selected because they were identified as areas that are completely dewatered or experience significant depletions (Table 1). Two reaches have been designated as priority areas. The first encompasses 30.6 km (19.0 mi) of the Santa Clara River between Gunlock Reservoir and the confluence with the Virgin River. The second encompasses 4.5 km (2.8 mi) of the Virgin River between Quail Creek Diversion and Pah Tempe Springs. Historically, these areas supported common to abundant populations of Virgin spinedace. The remaining 3.6 km (2.2 mi) of Virgin spinedace habitat to have flows restored will include one or a combination of the other reaches listed in Tables 1 and 4.

Evaluate Interim Fish Maintenance Flows

The response of Virgin spinedace populations and habitat to interim fish maintenance flows will be evaluated for a five year period. A detailed study plan will be developed for each stream reach. The study plan will include, but not be limited to, estimations of population abundance, recruitment, habitat utilization and availability. An annual report will be provided with a completion report at the end of the five year period.

Finalize Flows Required

A final recommendation for re-establishing permanent fish maintenance flows in specific reaches will be developed after completion of the interim fish maintenance flow evaluations.

Protection of Flows

As required flows are determined and established for each reach, protection measures will be implemented that are consistent with state laws (river operating agreements, minimum instream flow rights, irrigation rights, etc.).

E M H

Habitat enhancement procedures will be implemented in approximately 25.4 km (15.8 mi) of occupied habitat. Enhancement projects will focus on specific factors that contribute to Virgin spinedace habitat degradation including, agricultural activities, recreational use of riparian zones, and activities that affect water quality (Table 4). Enhancements projects will include maintenance and construction of boundary-line fences between federal and private parcels to control unauthorized grazing and recreational (ie: ORV, hiking, etc.) use along the riparian zones, establishment of intensive grazing management programs for federal lands along streams, and development of conservation easements and barriers within the Virgin River floodplain to reduce additional agricultural, recreational, and developmental impacts.

Mitigation for acceptable future project in occupied habitat will generally be based on a one to one replacement of historic habitat.

S C N F

Nonnative fish populations identified in Table 2 will be evaluated in order to identify detrimental effects on Virgin spinedace populations. Management and control of nonnative fish will focus on stocking and introduction procedures as well as control and/or eradication of nonnative 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 nonnative species. Table 4 summarizes reaches where nonnative fish management actions will be implemented.

Control Fish Stockina and Introductions

The following basin-wide procedures for controlling stocking, introduction, and spread of undesirable aquatic species of vertebrates and invertebrates will be implemented by the

appropriate agencies. These procedures have been developed using adapted versions of The American Fisheries Society procedures for nonnative fish introductions.

Stocking of Native Species:
Stocking of native species will be accomplished as identified in Conservation Agreements or in concert with the FWS as part of conservation or recovery efforts for native fish species. Stocking will be consistent with standard state protocols for stocking and Utah Resource Development Coordinating Committee (RRDC) requirements for introductions into the Virgin River Basin including private ponds and aquaculture.

Stocking of Nonnative Species Already Occurring:
SALMONIDS:
Several species of salmonids are routinely stocked in the Virgin River Basin. Stocking of these is to be restricted to areas in association with existing populations and where they will not conflict with native species of special concern. Areas where salmonids are routinely stocked are presented in Table 5.

Rainbow Trout (*Onchorhynchus_mykiss*)
Stocking to establish new self-sustaining populations in association with native fishes of special concern is prohibited.

Brown Trout (*Salmo* trutta)
In general, not to be stocked. However, consideration should be given to replacing existing populations in ▯▯▯ - event they are lost. This should be restricted to areas above 5,000 feet elevation where it can be demonstrated that there would not be conflicts with native species of special concern.

Brook Trout (*Salvelinus fontinalis)*
Same as the rainbow trout

OTHER NONNATIVES:

Channel Catfish (*Ictalurus punctatus):*
In general, not to be stocked. Stocking should be considered in isolated ponds or reservoirs on a case-by-case basis.

Largemouth bass (*Micropterus* ***salmoides***):
Stocking 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 should be avoided.

Bluegill sunfish (*Lepomis macrochirus):*
Stocking 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 should be avoided.

Introduction of a New Species:
Guidelines for introducing a new species to the drainage will follow the "Introduction of Aquatic Species, Environmental Polic Statement of the American Fisheries Society".

Prohibited Species:
Nonnative Minnows (Family: Cyprinidae), Smallmouth Bass *(Micropterus dolomieni)*, Green sunfish *(Lepomis cyanellus)*, Black crappie *(Pomoxis nigromaculatus)*, all crayfish species (ie: Astacidae) and all other non-indigenous aquatic species prohibited by respective state regulations or recommended for prohibition by the Colorado River Fish and Wildlife Council.

Selective Removal of Nonnative Fish

Eradication of detrimental nonnative fish will be implemented where feasible, and controlled to the maximum extent possible where eradication is not possible (Table 4). Several species have already been targeted for control and/or eradication including rainbow trout in the upper reaches of Beaver Dam Wash, green sunfish from the Santa Clara River and the red shiner in the mainstem Virgin River below the Washington Fields Diversion (see below for details). Engineering feasibility for fish barrier structures to control nonnative fish is currently being developed.

Upper Beaver Dam Wash:
NDOW will have lead responsibility for an interagency effort to re-introduce Virgin spinedace into historic habitat in Nevada below Schroeder Reservoir. Efforts will be focused on re-creating the historic species matrix which occurred in this reach prior to dam construction, through selective removal of rainbow trout from the reach below Schroeder Reservoir. Virgin spinedace will be obtained from other populations within the Beaver Dam Wash drainage. The anticipated date of re-introduction will be early Summer 1995 following the normal peak spring runoff period for upper Beaver Dam Wash. NDOW will provide pre-project assessments, documentation and monitoring of re-introduction efforts.

Santa Clara River:
UDWR will initiate 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 be evaluated in respect to controlling or eliminating green sunfish and other exotic fishes that are determined to be a problem.

The overall project will be divided into workable segments that can be treated separately. For example, if upstream sources of green sunfish can be eliminated above Baker Reservoir then, in turn, the stream segment between Baker Reservoir and Moody Wash

could be renovated to remove exotic fishes. Providing that upstream treatments are feasible, this area could also be isolated from contamination by exotic fishes from downstream sources. Other project segments could include Moody Wash downstream to Gunlock Reservoir, and from Gunlock Reservoir downstream to the confluence of the Virgin River.

Control of green sunfish in the Santa Clara River below Gunlock Reservoir might be necessary after fish maintenance flows are established. In this case, chemical treatments to temporarily reduce exotic fish while Virgin spinedace are re-introduced and become established might be needed. Such work could be conducted regardless of upstream occurrence of nonnative fishes.

Virgin River:
Attempts to eradicate the red shiner from the Virgin River basin, particularly from the Washington Fields diversion downstream to the Mesquite diversion, have been conducted in the past. Though these attempts were not 100% effective, they were successful at eliminating red shiners between Washington Fields and Johnson diversions. These attempts included construction of fish barriers and chemical treatments with the pesticide rotenone.

Chemical procedures to eradicate red shiners will be implemented in 1995 and followed up by subsequent treatments as needed. General chemical treatment methodology will involve 1) approximately 20 drip stations where rotenone will be introduced into the river, 2) spraying Noxfish in standing water areas along stream channels, 3) d xifying the rotenone in the Virgin River with potassium perman ate. Temporary fish barriers will be constructed at strate B sites in 1995 to prevent upstream migration of red shiners. These barriers will also assist in dividing the chemical treatments into manageable treatment areas.

Population Genetics Management

Protocols for introduction, re-introduction, and sub-basin transfer of Virgin spinedace will be established and utilized.

Population and Habitat Monitoring

The final management action to be implemented is the monitoring of the populations and habitat of the Virgin spinedace. Information obtained from the monitoring process will be used to determine if current management actions are attaining the objectives set forth in the Conservation Agreement.

Population and habitat monitoring will be implemented cooperatively by participating agency personnel. Agency responsibilities regarding monitoring actions are described in Table 2 of the attached Conservation Agreement. Protocols for monitoring will be similar to those established by the Virgin

River Recovery Team. A general overview of the methodology is presented below.

Monitoring Plan Methodology:
A minimum of 10 stations will be chosen as monitoring points throughout the basin. Once re-establishment procedures have been completed, the number of stations established may increase to include the new areas. Sampling will be conducted annually in the fall.

Seining will consist of repeated hauls of a 15' wide x 6' deep mesh seine until depletion (the number of fish captured in a haul is 10% or less of the highest seine catch for that sample site). Samples will be taken from preferred Virgin spinedace microhabitats approximately 10 meters in length. This repetitive seining technique will primarily provide that the population in a given habitat has been thoroughly sampled. It secondarily provides depletion information for population estimates.

All native fish will be identified to species, counted, measured, and returned to site of capture. All nonnative fish will be identified to species, counted, measured and generally returned to site of capture.

In addition to these samplings, Virgin spinedace population information will be obtained from data acquired in the bi-annual sampling by the Virgin River Recovery Team.

Data obtained on responses of populations and habitat to management actions from the monitoring process will be assessed and evaluated annually by the Virgin spinedace conservation team. Empirical criteria will be established in order to measure the effectiveness of the management actions.

DESIRED OUTCOME

Implementation of the Conservation Agreement and Strategy will initiate management actions that should provide for the continued existence and recovery of Virgin spinedace. We anticipate 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 dewatered-historic habitat (59.9 km or 37.1 mi). This threat will be significantly reduced by providing flows in 38.6 km (24 mi) of stream channel. We anticipate that this single action will 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 nonnative fish management and habitat improvement should provide additional benefits by removing negative fish interactions and enhancing impacted habitats.

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Figure 1: Estimated historic and present distribution of the Virgin Spinedace in the Virgin River Basin (modified from Valdez et al. 1991).

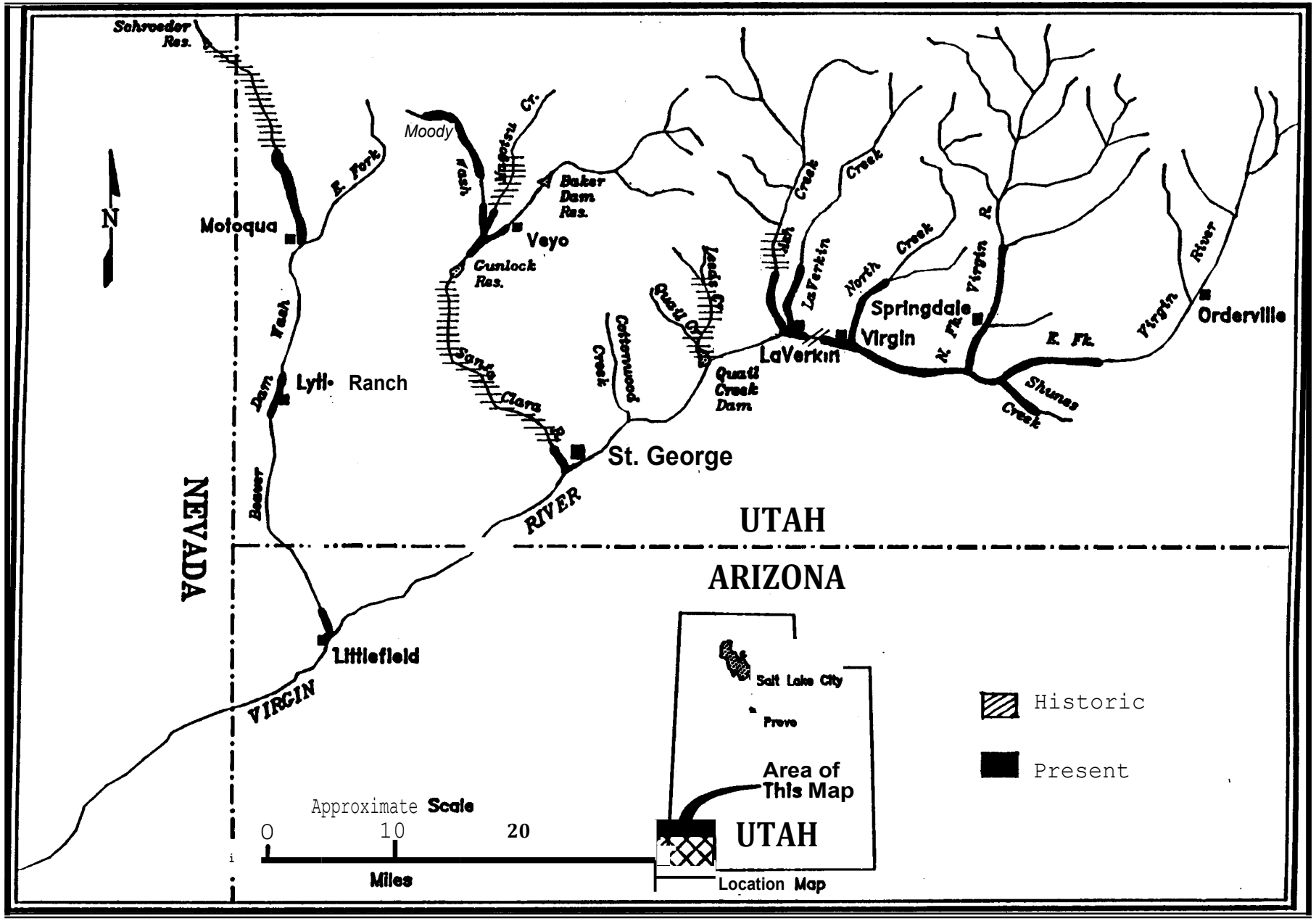

Figure 2: Projected Virgin spinedace distribution in ti
of the Conservation Agreement.

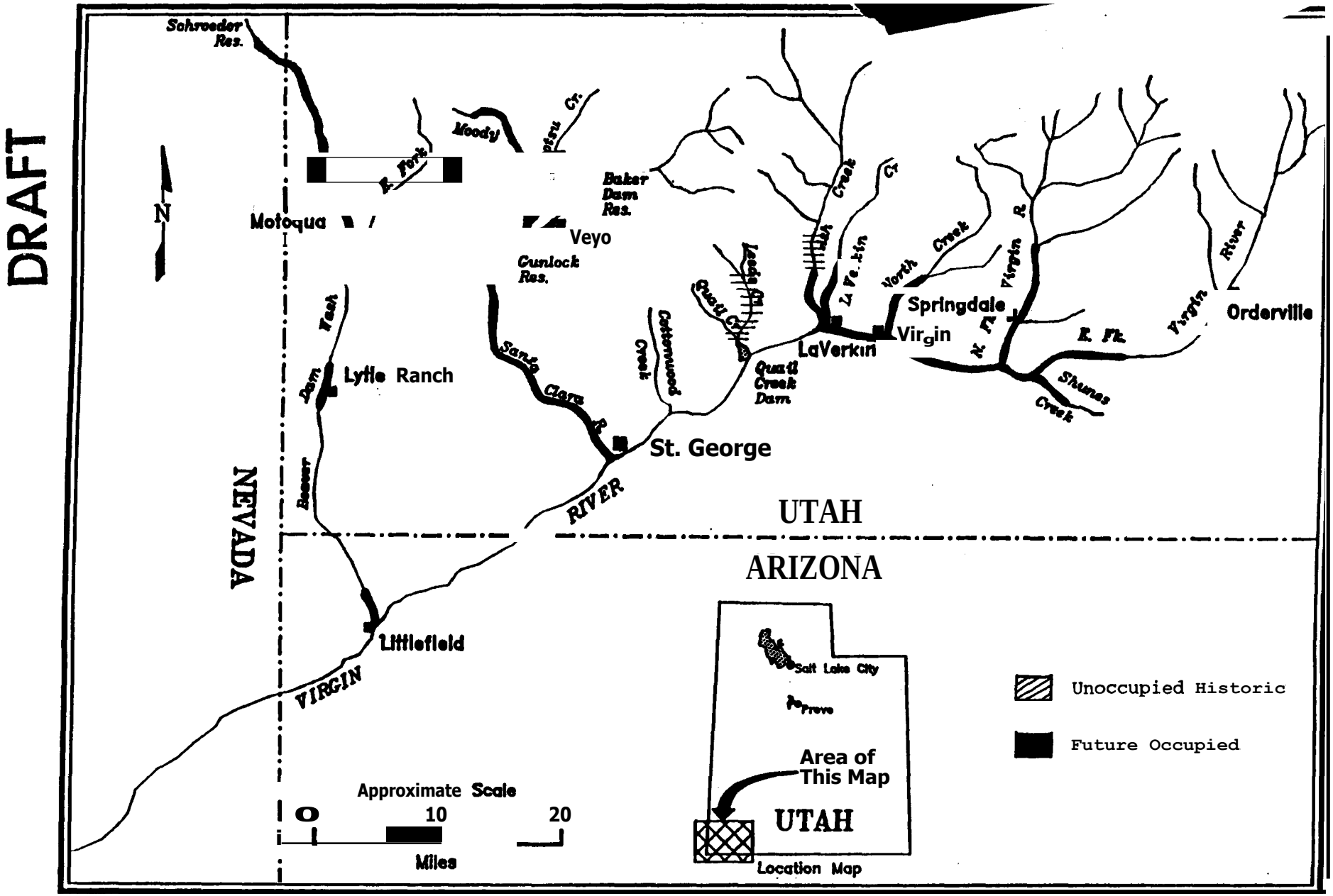

Table 1: Estimated historic and present occupied Virgin spinedace habitat and estimated kilometers (miles)of impacted stream reaches.

REACH	**Occupied Habitat**		**Water Development**		**Other Habitat Alteration**	
	Historic (km/mi)	**Current (km/mi)**	**Area Dewatered (km/mi)**	**Area Depleted (km/mi)**	**Nonnative Species (km/mi)**	*** Habitat Degradation (km/mi)**
Beaver Dam Wash						
Below Shroeder Res.	13.8(8.6)	0.0			13.8(8.6)	-
Upper BDW	13.0(8.1)	13.0(8.1)	-		-	-
Upper Lytle Ranch	4.0(2.5)	4.0(2.5)	-		-	-
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)	-
Santa Clara River						
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 Res.	12.2(7.6)	12.2(7.6)	-	12.2(7.6)	12.2(7.6)	3.0(1.9)
Below Gunlock Res.	30.6(19.0)	0.0	30.6(19.9)		-	-
Lower Santa Clara	10.0(6.2)	6.3(3.9)	3.7(2.3)	6.3(3.9)	-	6.3(3.9)
Leeds Creek	6.8(4.2)	0.0	6.8(4.2)	-		-
Quail Creek	5.3(3.3)	0.0	-	-	-	-
Ash Creek						-
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)
La Verkin						-
Upper	8.7(5.4)	8.7(5.4)	-		-	-
Lower	3.2(2.0)	3.2(2.0)	-	3.2(2.0)	-	3.2(2.0)
North Creek						-
Upper	6.9(4.3)	6.9(4.3)	-	-		-
Lower	5.5(3.4)	1.6(1.0)	3.9(2.4)	1.6(1.0)		1.6(1.0)
North Fork Virgin	18.5(11.5)	18.5(11.5)	-		-	
East Fork Virgin	14.7(9.1)	14.7(9.1)	-	-	-	-
Upper Virgin River	29.9(18.6)	25.4(15.8)	4.5(2.8)	-	-	-
Shunes Creek	4.5(2.8)	4.5(2.8)	-	-	-	
TOTAL	226.4(140.7)	142.6(88.6)	59.9(38.1)	30.9(19.2)	36.2(22.5)	25.4(15.8)

ncludes one oracom ina ion of agriculture, recreational, eeom, c elza io , of barriers eoms and diversions.

Table 2: Nonnative species which occur in the Virgin River Basin. An **"x"** indicates where these species occupy Virgin spinedace habitat.

Reach	RBT	BT	GSF	LMB	CCF	BG	MF	RS	GS	GC	KOI	TP	GP	BB	CF
Beaver Dam Wash															
Below Shroeder Res.	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Upper BDW	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Upper Lytle Ranch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Lower Lytle Ranch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Littlefield	-	-	X	X	-	-	X	X	-	-	-	-	-	X	-
East Fork	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Santa Clara River															
Moody Wash	-	X	X	X	-	-	-	-	-	-	-	-	-	-	X
Magotsu Creek	-	-	-	-	-	-	-	-	-	-	-	-		-	X
Below Veyo	X	X	X	-	-	-	-	-	-	-	-	-	-	-	X
Above Gunlock Res.	-	X	X	X	-	-	-	-	-	-	-	-		-	X
Below Gunlock Res.	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Lower Santa Clara	-	-	X	-	-	-	X	-	-	-	-			-	X
Leeds Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Quail Creek	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Creek															
Upper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lower	-	-	-	-	-	-	-	-	-		-	-	-	-	X
La Verkin															
Upper	-	-	-	-	-	-	-	-	-	-	-	-			-
Lower	-	-		-	-	-	X	-	-	-	-	-	-	-	-
North Creek															
Upper	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
North Fork Virgin	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
East Fork Virgin	-	X	-								-	-	-	-	-
Upper Virgin River	-	-	-	x	-	-	-	-	-	-	-	-	-	x	x
Shunes Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

W trout, BT=Brown trout, GSF=Green sun is , LMB=Large mouth bass, CCF=Channel catfish, BG=Bluegill, MF=Mosqu O S , RS=Re shiner, GC=Grass carp, KOI=Koi, TP=Tilapia, GP=Guppy, BB=Black Bullhead, GS=Goldenshiner, CF=Crayfish,

Table 3. Estimated existing and target flows for each reach of Virgin spinedace habitat

LOCATION	EXISTING CONDITIONS						
	Low Flows (cfs)	Density (#/10m) Adult	YOY	Density (#/100m) Adult	YOY	Sign. Deplet.Y/ N	Interim Fish Maintenance Flows
Beaver Dam Wash							
Below Shroeder Res.	1-2	-	-	-		N	2
Upper BDW	1-2	4.4	3.5	16	12.6	N	2
Upper Lytle Ranch	3	10.7	123	58.9	677	N	3
Lower Lytle Ranch	0	-	-	-		N	0
Littlefield	2-3	-	-	-	-	N	2.5
East Fork	1	-	-	-		Y	1
Santa Clara River							
Moody Wash	1.5	27.9	119	143.1	203	N	1.5
Magatsu Creek	1	-	-	-	-	Y	1
Below Veyo	3-4	2.1	0.8	5.6	2.1	Y	3.5
Above Gunlock Res.	2-4	27.9	119	143.1	203	Y	3
Below Gunlock Res.	0-1	0.0	0.0	0.0	0.0	Y	3
Lower Santa Clara	1-3	.42	.98	2.9	6.9	Y	3
Leeds Creek	0	0.0	0.0	0.0	0.0	Y	1.5
Quail Creek	2-4					Y	1.5
Ash Creek							
Upper	0	0.0	0.0	0.0	0.0	Y	2
Lower	2-4	10.1	11.3	48.9	55.1	Y	3
La Verkin							
Upper	5-6	0.4	0.3	1.2	0.8	N	2
Lower	1	0.0	2.0	0.0	5.5	Y	3
North Creek							
Upper	3	23.3	12.5	59.9	32.2	N	3
Lower	0	-	-	-	-	Y	2
North Fork Virgin	40	2.9	12.4	4.7	20.1	N	40
East Fork Virgin	40	7.9	7.0	10.2	9.1	N	40
Upper Virgin River	0	-	_	_		Y	3
Shunes Creek	1	0.2	8.5	1.0	47.8	N	1

Table 4: Management actions to be implemented by reach and agency involvement

REACH	Flow Re-establishment	Habitat Enhancement	VS Introduction	Nonnative Management
Beaver Dam Wash				
Below Shroeder Res.	-	*NDOW, UDWR, FWS, BLM	*N W, UDWR, FWS	*NDOW, UDWR, FWS
Upper BDW	-	-	-	*NDOW, UDWR, FWS
Upper Lytle Ranch	-	-	-	*UDWR, FWS
Lower Lytle Ranch	-	-	-	*UDWR, FWS
Littlefield	-	*BLM, UDWR, FWS,	-	*BLM, UDWR, FWS
East Fork	*UDWR, FWS, WCWCD, BLM	*UDWR, FWS, BLM	*UDWR, FWS	*UDWR, FWS
Santa Clara River				
Moody Wash	-	-	-	*UDWR, FWS
Magatsu Creek	*UDNR, WCWCD, FWS, BLM	-	*UDWR, FWS	*UDWR, FWS
Below Veyo	*UDNR, WCWCD, FWS, BLM	-	-	*UDWR, FWS
Above Gunlock Res.	*UDNR, WCWCD, FWS, BLM	*UDWR, FWS, BLM	-	*UDWR, FWS
Below Gunlock Res.	*UDNR, WCWCD, FWS, BLM	-	*UDWR, FWS	*UDWR, FWS
Lower Santa Clara	*UDNR, WCWCD, FWS, BLM	*UDWR, FWS, BLM	-	*UDWR, FWS, BLM
Leeds Creek	*UDNR, WCWCD, FWS, BLM	-	*UDWR, FWS	*UDWR, FWS
Quail Creek	*UDNR, WCWCD, FWS, BLM	-	*UDWR, FWS	*UDWR, FWS
Ash Creek				
Upper	-	-	*UDWR, FWS	
Lower	-	*UDWR, FWS, BLM	-	*UDWR, FWS
La Verkin				
Upper	-	-		*UDWR, FWS
Lower	-	*UDWR, FWS, BLM		*UDWR, FWS
North Creek				
Upper	-	-	-	*UDWR, FWS
Lower	*UDNR, WCWCD, FWS, BLM	*UDWR, FWS, BLM	*UDWR, FWS	*UDWR, FWS
North Fork Virgin	-	-		*UDWR, FWS
East Fork Virgin	-	-		*UDWR, FWS
Upper Virgin River	*UDNR, WCWCD, FWS, BLM	-	*UDWR, FWS	*UDWR, FWS, BLM
Shunes Creek	-	-		

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

Table 5: Routinely stocked Salmonids in the Virgin River Basin

Area/Reach	Rainbow Trout	Brown Trout	Brook Trout	Cutthroat Trout
Baker Reservoir	X	X[a]		
Pine Valley Reservoir	X		X	
Upper Sand Cove Reservoir	X			
Upper Santa Clara River	X			
Kolob Reservoir	X		X	X
Upper East Fork Virgin River	X	X		
Navajo Lake	X	X		

Stocking could be delete

APPENDIX A

Native Species of the Virgin River Basin

		Status		
	ESA	UT	NV	AZ
Plants:*				
Holmgren milkvetch *(Astragalus holmgreniorum)*	C1			
Beaver Dam milkvetch	**C2**			
Hay's sedge	C2			
Virgin thistle *(Cirsium virginensis)*	C2			
Zion tansy (***Sphaeromeria*** *ruthiae)*				
Cliff jamesia *(Jamesia americana)*	C2	S		
Nevada goldenrod				
Virgin phacelia *(Phacelia* ***cephalotes***)				
Invertebrates:*				
Tiger beetle (***Cicindela*** *oregona)*	C2	S		
Utah hydroporous diving beetle (***Hygrotus*** *utahensis)*	C2			
Utah minute moss beetle *(Limnebius crassalus)*	C2			
Utah water scavenger beetle *(Chaetarthria utahensis)*	C2	S		
MacNeil sooty wing skipper (***Hesperopsis*** *gracielae)*	C2	S		
Zion canyon snail *(Physa zionis)*	C2	S		
Desert spring snail				
Fish:				
Virgin spinedace *(Lepidomeda mollispinis)*	PT	E	P	E
Woundfin *(Plagopterus argentissimum)*	**E**	E	E	E
Virgin River chub *(Gila seminuda)*	**E**	E	S	E
Flannelmouth sucker *(Catostomus latipinnis)*	C2	S		
Desert sucker *(Catostomus clarki)*	C2	S		
Speckled dace *(Rhinichthys osculus)*				

Note: Only federal candidate species of plants and invertebrates are included.

Amphibians:				
Tiger salamander *(Ambystoma tigrinum)*				
Southwestern toad *(Bufo microscaphus)*	C2			
Red-spotted toad *(Bufo punctatus)*				
Woodhouse's toad *(Bugo woodhousei)*				
Great Basin spadefoot *(Scaphiopus intermontanus)*				
Canyon treefrog (***Hyla*** *arenicolor)*				
Pacific treefrog (***Hyla*** *regilla)*				
Northern leopard frog *(Rana* ***pipiens***)				
Lowland leopard frog *(Rana yavapaiensis)*	C2	S		
Relict leopard frog *(Rana onca)*	3A	S		
Reptiles:				
Desert tortoise *(Gopherus agassizii)*	**T**	E	T	C
Utah banded gecko *(Coleonyx variegatus)*				
Desert night lizard *(Xantusia vigilis)*				
Desert iguana *(Dipsosaurus dorsalis)*				
Western chuckwalla *(Sauromalus obesus)*	C2	T		
Collared lizard *(Crotophytus collaris)*				
Long-nosed leopard lizard *(Gambelia wislizenii)*				
Zebra-tailed lizard *(Callisaurus* ***draconoides***)				
Desert spiny lizard *(Sceloporus magister)*				
Western fence lizard *(Sceloporus occidentalis)*				
Eastern fence lizard *(Sceloporus undulatus)*				

Sagebrush lizard *(Sceloporus graciosus)*			
Tree lizard *(Urosaurus ornatus)*			
Long-tailed brush lizard *(Urosaurus graciosus)*			
Side-blotched lizard *(Uta stansburiana)*			
Short-horned lizard *(Phrynosoma douglassi)*			
Desert horned lizard *(Phrynosoma platyrhinos)*			
Great Basin skink *(Eumeces skiltonianus)*			
Western whiptail (***Cnemidophorus*** *tigris)*			
Plateau striped whiptail (***Cnemidophorus*** *velox)*			
Banded gila monster (***Heloderma*** *suspectum)*	C2	E	S
Western blind snake *(Leptotyphlops humilis)*			
Regal ringneck snake *(Diadophis punctatus)*			
Western leaf-nosed snake *(Phyllorhynchus decurtatus)*			
Red coachwhip *(Masticophis flagellum)*			
Striped whipsnake *(Masticophis taeniatus)*			
Mojave patch-nosed snake *(Salvadora hexalepsis)*			
Great Basin gopher snake *(Pituophis melanoleucus)*			
Glossy snake *(Arizona elegans)*			
California kingsnake *(Lampropeltis getulus)*			
Utah mountain kingsnake *(Lampropeltis pyromelana)*			
Long-nosed snake *(Rhinocheilus lecontei)*			
Wandering garter snake *(Thamnophis elegans)*			
Ground snake *(Sonora semiannulata)*			
Utah black-headed snake *(Tantilla utahensis)*			
Night snake (***Hypsiglena torquata***)			
Sonoran lyre snake (***Trimorphodon*** *biscutatus)*			
Great Basin rattlesnake *(Crotalus viridis)*			
Mojave desert sidewinder *(Crotalus cerastes)*			
Southwest speckled rattlesnake *(Crotalus mitchellii)*			
Mojave rattlesnake *(Crotalus scutulatus)*			
Birds:			
Common loon *(Gavia immer)*			
Pied-billed grebe (***Podilymbus*** *podiceps)*			
Horned grebe *(Podiceps auritus)*			
Eared grebe (***Podiceps*** *nigricollis)*			
Western grebe *(Aechmophorus occidentalis)*			
Clark's grebe *(Aechmophorus clarkii)*			
American white pelican *(Pelecanus erythrorhynchos)*			
Double-crested cormorant *(Phalacrocorax* ***auritus***)			
American bittern *(Botaurus lentiginosus)*			
Western least bittern *(Ixobrychus exilis)*	C2		
Great blue heron *(Ardea herodias)*			
Great egret *(Casmerodius albus)*			
Snowy egret *(Egretta thula)*			
Cattle egret *(Bubulcus ibis)*			
Green-backed heron *(Butorides striatus)*			
Black-crowned night-heron *(Nycticorax nycticorax)*			
White-faced ibis *(Plegadis chihi)*	C2		
Tundra swan *(Cygnus columbianus)*			
Greater white-fronted goose *(Anser albifrons)*			
Snow goose *(Chen caerulescens)*			
Canada goose *(Branta canadensis)*			
Wood duck *(Aix sponsa)*			
Green-winged teal *(Anas crecca)*			
Mallard *(Anas platyrhynchos)*			
Northern pintail *(Anas acuta)*			
Blue-winged *teal (Anas discors)*			
Cinnamon *teal (Anas cyanoptera)*			
Northern shoveler *(Anas clypeata)*			
Gadwall *(Anas stepera)*			
American wigeon *(Anas americana)*			
Canvasback *(Aythya* ***valisineria***0			
Redhead *(Aythya americana)*			

Ring-necked duck *(Aythya collaris)*
Lesser scaup *(Aythya affinis)*
Common goldeneye *(Bucephala clangula)*
Buff lehead *(Bucephala albeola)*
Hooded merganser *(Lophodytes cucullatus)*
Common merganser (*Mergus* merganser)
Red-breasted merganser *(Mergus serrator)*
Ruddy duck *(Oxyura jamaicensis)*
Turkey vulture *(Cathartes* **aura)**
Osprey *(Pandion haliaetus)*
Bald eagle *(Haliaeetus leucocephalus)*
Northern harrier *(Circus cyaneus)*
Sharp-shinned hawk *(Accipiter striatus)*
Cooper's hawk *(Accipiter cooperii)*
Northern goshawk *(Accipiter gentilis)* **C2**
Common black-hawk *(Buteogallus anthracinus)*
Swainson's hawk *(Buteo swainsoni)*
Red-tailed hawk *(Buteo jamaicensis)*
Ferruginous hawk *(Buteo regalis)* **C2**
Rough-legged hawk *(Buteo lagopus)*
Golden eagle *(Aquila chrysaetos)*
American kestrel *(Falco sparverius)*
Merlin *(Falco* ***columbarius*****)**
Peregrine falcon *(Falco peregrinus)*
Prairie falcon *(Falco mexicanus)*
Wild turkey (*Meleagris* gallopava)
Gambel's quail *(Callipepla gambelii)*
Virginia *rail (Rallus limicola)*
Sora *(Porzana carolina)*
Commen moorhen *(Gallinula chloropus)*
American coot *(Fulica* ***americana*****)**
Snowy plover *(Charadrius* ***alexandrinus*****)** **C3**
Mountain plover *(Charadrius montanus)* **C2**
Semipalmated plover *(Charadrius semipalmatus)*
Killdeer *(Charadrius vociferus)*
Black-necked stilt *(Himantopus mexicanus)*
American avocet *(Recurvirostra americana)*
Greater yellowlegs (*Tringa* melanoleuca)
Lesser yellowlegs (*Tringa* flavipes)
Solitary sandpiper (*Tringa solitaria*)
Willet *(Catoptrophorus semipalmatus)*
Spotted sandpiper *(Actitus macularia)*
Whimbrel *(Numenius phaeopus)*
Long-billed curlew (*Numenius* americanus)
Marbled godwit *(Limosa fedoa)*
Western sandpiper (*Calidris* mauri)
Least sandpiper (*Calidris* minutilla)
Baird's sandpiper *(Calidris bairdii)*
Pectoral sandpiper *(Calidris melanotos)*
Long-billed dowitcher *(Limnodromus scolopaceus)*
Common snipe *(Gallinago gallinago)*
Wilson's phalarope *(Phalaropus tricolor)*
Red-necked phalarope *(Phalaropus lobatus)*
Franklin's gull *(Larus pipixcan)*
Bonaparte's gull *(Larus philadelphia)*
Ring-billed gull *(Larus delawarensis)*
California gull *(Larus californicus)*
Herring gull *(Larus argentatus)*
Caspian tern *(Sterna caspia)*
Forster's tern *(Sterna forsteri)*
Black tern *(Chlidonias niger)* **C2**
Band-tailed pigeon (*Columba* fasciata)
White-winged dove (*Zenaida* asiatica)
Mourning dove *(Zenaida macroura)*

Yellow-billed cuckoo *(Coccyzus americanus)*
Greater roadrunner *(Geococcyx californianus)*
Common barn-owl (Tyto *alba)*
Flammulated owl *(Otus flammeolus)*
Western screech owl **(*Otus*** *kennicotti)*
Great horned owl *(Bubo virginianus)*
Northern pygmy owl **(*Glaucidium*** *gnoma)*
Western burrowing owl **(*Athene*** *cunicularia)* C2
Mexican spotted owl *(Strix occidentalis)*
Long-eared owl *(Asio otus)*
Short-eared owl *(Asio flammeus)*
Lesser nighthawk **(*Chordeilus*** *acutipennis)*
Common nighthawk *(Chordeilus minor)*
Common poorwill *(Phalaenoptilus nuttalii)*
White-throated swift *(Aeronautes saxatalis)*
Black-chinned hummingbird *(Archilochus* ***alexandri*****)**
Costa's hummingbird *(Calypte costae)*
Broad-tailed hummingbird *(Selasphorus* ***platycercus*****)**
Rufous hummingbird *(Selasphorus rufus)*
Belted kingfisher *(Ceryle alcyon)*
Lewis' woodpecker *(Melanerpes lewis)*
Red-naped sapsucker *(Sphyrapicus nuchalis)*
Ladder-backed woodpecker *(Picoides scalaris)*
Downy woodpecker **(*Picoides*** *pubescens)*
Hairy woodpecker *(Picoides villosus)*
Northern flicker *(Colaptes auratus)*
Olive-sided flycatcher *(Contopus borealis)*
Western wood-pewee *(Contopus* ***sordidulus*****)**
Southwest willow flycatcher **(*Empidonax*** *traillii)* PE
Hammond's flycatcher *(EMpidonax hammondii)*
Gray flycatcher **(*Empidonax*** *wrightii)*
Cordillean flycatcher **(*Empidonax*** *occidentalis)*
Black phoebe *(Sayornis nigricans)*
Say's phoebe *(Sayornis saya)*
Vermilion flycatcher **(*Pyrocephalus*** *rubinus)*
Ash-throated flycatcher *(Myiarchus tyrannulus)*
Cassin's kingbird **(*Tyrannus*** *vociferans)*
Western kingbird *(Tyrannus verticalis)*
Horned lark **(*Eremophila*** *alpestris)*
Tree swallow *(Tachycineta bicolor)*
Violet-green swallow *(Tachycineta thalassina)*
Northern rough-winged swallow **(*Stelgidopteryx*** *serripennis)*
Bank swallow *(Riparia riparia)*
Cliff swallow **(*Hirundo*** *pyrrhonota)*
Barn swallow **(*Hirundo*** *rustica)*
Stellar's jay *(Cyanocitta stelleri)*
Scrub *jay (Aphelocoma coerulescens)*
Pinyon *jay (Gymnorhinus cyanocephalus)*
Clark's nutcracker *(Nucifraga columbiana)*
American crow *(Corvus brachyrhynchos)*
Common raven *(Corvus corax)*
Black-capped chickadee *(Parus atricapillus)*
Mountain chickadee *(Parus gambeli)*
Plain titmouse *(Parus inornatus)*
Verdin *(Auriparus flaviceps)*
Bushtit *(Psaltriparus minimus)*
Red-breasted nuthatch *(Sitta* ***canadensis*****)**
White-breasted nuthatch *(Sitta* ***carolinensis*****)**
Pygmy nuthatch *(Sitta pygmaea)*
Brown creeper *(Certhia americana)*
Cactus wren *(Campylorhynchus brunneicapillus)*
Rock wren *(Salpinctes obsoletus)*
Canyon wren *(Catherpes mexicanus)*
Bewick's wren **(*Troglodytes*** *bewickii)*

House wren **(*Troglodytes*** *aedon)*
Winter wren **(*Troglodytes*** *troglodytes)*
Marsh wren *(Cistothorus palustris)*
American dipper *(Cinclus mexicanus)*
Golden-crowned kinglet *(Regulus* satrapa)
Ruby-crowned kinglet *(Regulus* ***calendula*****)**
Blue-gray knatcatcher *(Polioptila caerulea)*
Western bluebird *(Sialia* ***mexicana*****)**
Mountain bluebird *(Sialia currucoides)*
Townsend's solitaire **(*Myadestes*** *townsendi)*
Swainson's thrush *(Catharus ustulatus)*
Hermit thrush *(Catharus guttatus)*
American robin **(*Turdus*** *migratorius)*
Northern mockingbird *(Mimus polyglottos)*
Sage thrasher *(Oreoscoptes montanus)*
Bendire's thrasher **(*Toxostoma*** *bendirei)*
Crissal thrasher **(*Toxostoma*** *crissale)*
LeConte's thrasher **(*Toxostoma*** *lecontei)*
Water pipit *(Anthus spinoletta)*
Bohemian waxwing *(Bombycilla garrulus)*
Cedar waxwing *(Bombycilla cedrorum)*
Phainopepla *(Phainopepla nitens)*
Northern shrike *(Lanius excubitor)*
Loggerhead shrike *(Lanius ludovicianus)*
Bell's vireo *(Vireo bellii)*
Gray vireo *(Vireo vicinior)*
Solitary vireo *(Vireo solitarius)*
Warbling vireo *(Vireo gilvus)*
Orange-crowned warbler *(Vermivora celata)*
Nashville warbler *(Vermivora ruficapilla)*
Virginia's warbler *(Vermivora virginiae)*
Lucy's warbler *(Vermivora luciae)*
Yellow warbler **(*Dendroica*** *petechia)*
Yellow-rumped warbler *(Dendroica coronata)*
Black-throated gray warbler *(Dendroica nigrescens)*
Grace's warbler *(Dendroica graciae)*
Nothern waterthrush *(Seiurus noveboracensis)*
MacGillivray's warbler *(Oporornis tolmiei)*
Common yellowthroat *(Geothlypis trichas)*
Wilson's warbler *(Wilsonia pusilla)*
Yellow-breasted chat *(Icteria virens)*
Summer tanager *(Piranga rubra)*
Western tanager *(Piranga ludoviciana)*
Black-headed grosbeak *(Pheucticus melanocephalus)*
Blue grosbeak *(Guiraca caerulea)*
Lazuli bunting *(Passerina ciris)*
Green-tailed towhee *(Pipilo chlorurus)*
Rufous-sided towhee *(Pipilo erythrophthalmus)*
Abert's towhee *(Pipilo aberti)*
American tree sparrow *(Spizella arborea)*
Chipping sparrow *(Spizella pallida)*
Brewer's sparrow *(Spizella breweri)*
Black-chinned sparrow *(Spizella atrogularis)*
Vesper sparrow *(Pooecetes gramineus)*
Lark sparrow *(Chondestes grammacus)*
Black-throated sparrow *(Amphispiza bilineata)*
Sage sparrow *(Amphispiza belli)*
Savannah sparrow *(Passerculus sandwichensis)*
Song sparrow **(*Melospiza*** *melodia)*
Lincoln's sparrow **(*Melospiza*** *lincolnii)*
White-crowned sparrow *(Zonotrichia albicollis)*
Dark-eyed junco **(*Junco*** *hyemalis)*
Red-winged blackbird *(Agelaius phoeniceus)*
Western meadowlark *(Sturnella neglecta)*

Yellow-headed blackbird *(Xanthocephalus xanthocephalus)*
Brewer's blackbird *(Euphagus cyanocephalus)*
Great-tailed grackle *(Quiscalus mexicanus)*
Brown-headed cowbird *(Molothrus* ater)
Hooded oriole *(Icterus* ***cucullatus*****)**
Northern oriole **(*****Icterus*** *galbula)*
Scott's oriole *(Icterus parisorum)*
Cassin's finch *(Carpodacus cassinii)*
House finch *(Carpodacus mexicanus)*
Red crossbill *(Loxia curvirostra)*
Pine siskin **(*****Carduelis*** *pinus)*
Lesser goldfinch **(*****Carduelis psaltria*****)**
American goldfinch *(Carduelis tristis)*
Evening grosbeak *(Coccothraustes vespertinus)*

Mammals:

Merriam's shrew *(Sorex merriami)*	
Dusky shrew *(Sorex monticolis)*	
Northern water shrew *(Sorex palustris)*	
Desert shrew *(Notiosorex* ***crawfordi*****)**	
California leaf-nosed bat *(Macrotus californicus)*	C2
Little brown myotis **(*****Myotis*** *lucifugus)*	
Yuma myotis *(Myotis yumanensis)*	C2
Long-eared myotis **(*****Myotis*** *evotis)*	C2
Fringed myotis *(Myotis thysanodes)*	C2
Long-legged myotis *(Myotis volans)*	C2
California myotis *(Myotis californicus)*	
Western small-footed myotis **(*****Myotis*** *ciliolabrum)*	C2
Silver-haired bat *(Lasionycteris noctivagans)*	
Western pipistrelle *(Pipistrellus hesperus)*	
Big brown bat *(Eptesicus fuscus)*	
Western red bat *(Lasiurus blossevillii)*	
Hoary bat *(Lasiurus cinereus)*	
Spotted bat **(*****Euderma*** *maculatum)*	C2
Pale Townsend's big-eared bat *(Plecotus townsendii)*	C2
Allen's lappet-browed bat *(Idionycteris phyllotis)*	C2
Pallid bat *(Antrozous* ***pallidus*****)**	
Brazilian free-tailed bat **(*****Tadarida*** *brasiliensis)*	
Big free-tailed bat *(Nyctinomops macrotis)*	C2
Pygmy rabbit *(Brachylagus* ***idahoensis*****)**	**C2**
Black-tailed jackrabbit *(Lepus californicus)*	
Mountain cottontail *(Slyvilagus nuttalli)*	
Desert cottontail *(Slyvilagus audoboni)*	
Least chipmunk *(Tamias minimus)*	
Cliff chipmunk *(Tamias dorsalis)*	
Yellow-bellied marmot *(Marmota flaviventris)*	
White-tailed antelope squirrel *(Ammospermophilus luecurus)*	
Rock squirrel *(Spermophilus variegatus)*	
Golden-mantled ground squirrel *(Spermophilus lateralis)*	
Red squirrel *(Tamiasciurus* ***hudsonicus*****)**	
Virgin River pocket gopher **(*****Thomomys*** *bottae)*	
Virgin little pocket mouse *(Perognathus* ***longimembris*****)**	
Great Basin pocket mouse *(Perognathus parvus)*	
Long-tailed pocket mouse *(Chaetodipus formosus)*	
Desert pocket mouse *(Chaetodipus penicillatus)*	
Ord's kangaroo *rat (Dipodomys ordii)*	
Chisel-toothed kangaroo *rat* **(*****Dipodomys*** *microps)*	
Merriam's kangaroo *rat (Dipodomys merriami)*	**C2**
Desert kangaroo rat **(*****Dipodomys deserti*****)**	
Beaver *(Castor canadensis)*	
Western harvest mouse *(Reithrodontomys megalotis)*	
Canyon mouse *(Peromyscus crinitus)*	
Cactus mouse *(Peromyscus eremicus)*	
Deer mouse **(*****Peromyscus*** *maniculatus)*	

Brush mouse (***Peromyscus*** *boylii)*	
Pinyon mouse *(Peromsycus* truei)	
Northern grasshopper mouse *(Onychomys leucogaster)*	
Southern grasshopper mouse *(Onychomys torridus)*	
Desert woodrat *(Neotoma lepida)*	
Bushy-tailed woodrat *(Neotoma cinerea)*	
Virgin River montane vole *(Microtus montanus)*	C2
Long-tailed vole *(Microtus longicaudus)*	
Muskrat (***Ondatra*** *zibethicus)*	
Porcupine (***Erethizon*** *dorsatum)*	
Coyote *(Canis latrans)*	
Kit fox (***Vulpes*** *macrotis)*	
Gray fox *(Urocyon cinereoargenteus)*	
Ringtail *(Bassariscus astutus)*	
Raccoon *(Procyon lotor)*	
Long-tailed weasel (***Mustela*** *frenata)*	
Badger *(Taxidea taxus)*	
Western spotted skunk *(Spilogale gracilis)*	
Striped skunk *(Mephitis mephitis)*	
Mountain lion *(Felis concolor)*	
Bobcat *(Lynx rufus)*	
Mule deer *(Odocoileus hemionus)*	
Desert bighorn sheep *(Ovis canadensis)*	

Status
E = Endangered
T = Threatened
Cl = Candidate species (Category 1)
C2 = Candidate species (Category 2)
C3 = Candidate species (Category 3)
3A = Extinct
PE = Proposed as endangered
PT = Proposed as threatened
S = Sensitive
P = Protected
C = Candidate for state list

Figure 1: Estimated historic and present distribution of the Virgin Spinedace in the Virgin River Basin (modified from Valdez et al. 1991).

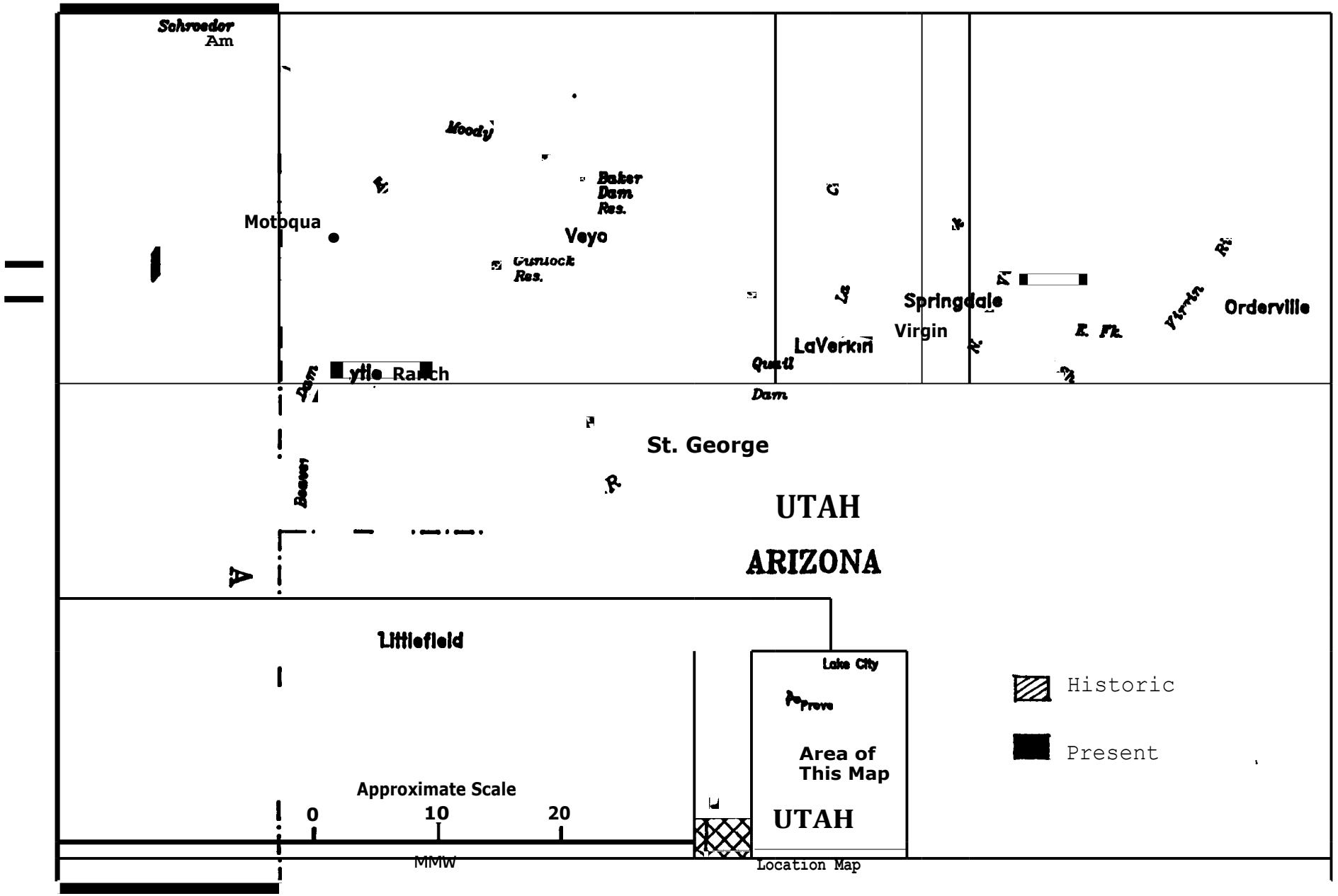

Figure 2: Projected Virgin spinedace distribution in the Virgin River Basin as a result of the Conservation Agreement.