Ash Meadows Amargosa pupfish *Cyprinodon nevadensis mionectes*

WAP 2012 species due to impacts from introduced detrimental aquatic species, habitat degradation, and federal endangered status.

Agency Status	
NV Natural Heritage	G2T2S2
USFWS	LE
BLM-NV	Sensitive
State Prot	Threatened Fish NAC 503.065.3
CCVI	Presumed Stable

TREND: Trend is stable to increasing with continued on-going restoration activities.

DISTRIBUTION: Springs and associated springbrooks, outflow stream systems and terminal marshes within Ash Meadows National Wildlife Refuge, Nye Co., NV.

GENERAL HABITAT AND LIFE HISTORY:

This species is isolated to warm springs and outflows in Ash Meadows NWR including Point of Rocks, Crystal Springs, and the Carson Slough drainage. Pupfishes feed generally on substrate; feeding territories are often defended by pupfishes. Diet consists of mainly algae and detritus however, aquatic insects, crustaceans, snails and eggs are also consumed. Spawning activity is typically from February to September and in some cases year round. Males defend territories vigorously during breeding season (Soltz and Naiman 1978).

In warm springs, fish may reach sexual maturity in 4-6 weeks. Reproduction variable: in springs, pupfish breed throughout the year, may have 8-10 generations/year; in streams, breeds in spring and summer, 2-3 generations/year (Moyle 1976). In springs, males establish territories over sites suitable for oviposition. Short generation time allows small populations to be viable. Young adults typically comprise most of the biomass of a population. Compared to other C. nevadensis subspecies, this pupfish has a short deep body and long head with typically low fin ray and scale counts (Soltz and Naiman 1978).

CONSERVATION CHALLENGES:

Being previously threatened by agricultural use of the area (loss and degradation of habitat resulting from water diversion and pumping) and by impending residential development, the TNC purchased property, which later became the Ash Meadows NWR. The majority of pupfish habitats in Ash Meadows were significantly altered during agricultural development through the modification of spring pools and outflows and the construction of Crystal Reservoir and irrigation ditches. Introduced aquatic animals (fishes, crayfish, bullfrogs, snails) remain a problem in some sites. Largemouth bass eliminated the pupfish from the main pool of Crystal Spring, but pupfish that survived in the outflow reoccupied the spring when bass were eradicated (Minckley and Deacon 1991). Habitat may be threatened by groundwater pumping demands in adjacent and regional aquifers.

NEEDS:

Research Needs: Continue assessment of habitat requirements to direct ongoing habitat restoration efforts. A genetic management plan is currently in progress (Martin, A. In press).

Monitoring and Existing Plans: Status monitoring is conducted annually by NDOW and USFWS to assess trend and response to ongoing habitat restoration efforts. There is an existing Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada. Recent land acquisitions and continued habitat restoration efforts have enhanced populations in many of the outflow springs.

Approach: Periodically monitor populations and habitat. Ensure the perpetuation of multiple populations. Current efforts for planning and restoration of occupied and historic habitats within Ash Meadows NWR will be continued. Key elements of the approach include continued efforts for control and removal of invasive species including largemouth bass, green sunfish and cichlids, reconstruction of altered spring outflows and marsh habitats to approximate historic conditions, and restoring connectivity between various outflow systems.

WAP HABITAT LINKS: Springs and Springbrooks, Marshes.

Ash Meadows speckled dace *Rhinichthys osculus nevadensis*

WAP 2012 species due to impacts from introduced detrimental aquatic species and federal endangered status.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Small populations with limited recruitment.

DISTRIBUTION: Springs and associated springbrooks, outflow stream systems within Ash Meadows National Wildlife Refuge, Nye Co., NV.

GENERAL HABITAT AND LIFE HISTORY:

In Ash Meadows dace historically occupied many of the same habitats as the Ash Meadows Amargosa pupfish. Current distribution is largely limited to cooler spring source pools and springbrook outflows. Preferred habitat is flowing outflow streams for drift feeding on debris and invertebrates. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge.

The speckled dace eats various small aquatic animals.

The speckled dace is one of the most morphologically (and ecologically) variable fishes in western North America (Miller and Miller 1948, Minckley 1973). This variability is due to geologic events that have resulted in numerous isolated populations. Spawning occurs in spring and summer over stream riffle habitat. Adult maximum length is 10 cm (4 inches) and longevity up to 4 years (USFWS 1990b).

CONSERVATION CHALLENGES:

Extremely limited population size and distribution. Previously threatened by agricultural use of the area (loss and degradation of habitat resulting from water diversion and pumping) and by impending residential development; TNC purchased the property, which later became the Ash Meadows NWR. The majority of dace habitats in Ash Meadows were significantly altered during agricultural development through the modification of spring pools and outflows and the construction of irrigation ditches. The loss of connectivity between dace habitats within Ash Meadows has significantly impacted this subspecies. Introduced aquatic animals (fishes, crayfish, bullfrogs, snails) remain a problem. Habitat may be threatened by groundwater pumping demands in adjacent and regional aquifers.

NEEDS:

Research Needs: Effective methods for control of introduced species. Additional life history and habitat requirements information to guide habitat restoration efforts. Continue to monitor re-introduction populations.

Monitoring and Existing Plans: Annual monitoring by USFWS and NDOW. Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada. Recent restoration of spring outflow systems and consequent re-introduction of dace show encouraging results and limited recruitment. Recent purchase of private inholdings on AMNWR have further enhanced dace habitat.

WAP HABITAT LINKS: Springs and Springbrooks.

Approach: Current efforts for planning and restoration of occupied and historic habitats within Ash Meadows NWR will be continued. Key elements of the approach include continued efforts for control and removal of invasive species including largemouth bass, green sunfish and cichlids, reconstruction of altered spring and outflows habitats, and restoring connectivity between various outflow systems. Non-native crayfish/dace interactions appear to be one of the largest challenges to persistence.

WAP HABITAT LINKS: Springs and Springbrooks.

Big Smoky Valley speckled dace — *Rhinichthys osculus lariversi*

WAP 2012 species due to habitat degradation from detrimental grazing practices and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	No Status
State Prot	Sensitive Fish NAC 503.067
CCVI	Highly Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Known from 3 locations in Big Smoky Valley, Nye Co.

GENERAL HABITAT AND LIFE HISTORY:

Preferred habitat is flowing outflow streams for drift feeding on debris and invertebrates. Speckled dace occupy an extraordinary array of habitats; springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well as zooplankton; diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age three. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. The speckled dace eats various small aquatic animals.

CONSERVATION CHALLENGES:

Known locations may all be on private lands; access for assessment and monitoring is difficult. Habitat is degraded.

NEEDS:

Research Needs: Current and detailed information on distribution, habitat quality and habitat suitability, current status.

Monitoring and Existing Plans: No specific monitoring in place. No species specific planning or applicable plans in place.

Approach: To be determined.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian, Intermountain Riparian.

Big Spring spinedace *Lepidomeda mollispinis pratensis*

WAP 2012 species due to its limited distribution in NV, habitat degradation, vulnerability to climate change, and federal threatened status.

Agency Status	
NV Natural Heritage	G2T1S1
USFWS	LT
BLM-NV	Sensitive
State Prot	Threatened Fish NAC 503.065.3
CCVI	Moderately Vulnerable

TREND: Trend unknown.

DISTRIBUTION: Very small range in Meadow Valley Wash, NV.

GENERAL HABITAT AND LIFE HISTORY:

Adults inhabit runs and pools with a depth of at least 0.25 m. Individuals are often collected in association with instream cover, slow moving runs, quiet eddies downstream of riffles, or below minor barriers. Young-of-the year and larvae occupy quiet pools and runs. Reproduction occurs between April and early July at water temperatures from 10° C (April) to 15°C (July). Gravid females had 100-1,400 maturing eggs. Larvae were present from early May to August. Exceptional individuals may live to four years and obtain a length of 120 mm. Adults feed on invertebrates on the surface and substrate. Piscivory occurs in larger individuals as one individual had a tiny speckled dace in a stomach content analysis (Minckley and Marsh 2009). Allan (1983) also noted a preference for areas where leafy aquatic vegetation and/or overhanging banks were present.

These fish probably feed opportunistically, mainly on aquatic insect larvae and also on algae and other plant material. Watercress may be an important habitat for food organisms.

Individuals positioned behind stream cover, particularly watercress along the stream margin, have been observed to dart into the current to inspect or ingest potential food items and quickly return to their original positions (Langhorst, pers. obs.). Big Spring spinedace lives sympatrically with two other native fish species: speckled dace (Rhinichthys osculus subsp.) and desert sucker (Catostomus clarki subsp.). Non-native species have been illegally released and include rainbow trout (Oncorhynchus mykiss), largemouth bass (Micropterus salmoides), white crappie (Pomoxis annularis), and a crayfish (species unknown). Only the crayfish is known to reproduce in the Condor Canyon reach of Meadow Valley Wash. Spawning sites are in lower ends of pools where males congregate and females move to the males to spawn on or near the bottom.

CONSERVATION CHALLENGES:

This sub-species is restricted in distribution to a single isolated 5 km (3.1 mile) reach of Meadow Valley Wash, and vulnerable to extirpation from natural causes (e.g., major flood, severe drought), habitat alteration, ground water depletion, release of toxic substances, or introduction of exotic species. It was listed as threatened by the U.S. Fish and Wildlife Service in 1985. Although this area is closed to livestock grazing and has limited public access, a major rangeland fire event in 1999 removed much of the riparian cover associated with occupied spinedace habitat and also upland vegetation in the immediate watershed. Initial post-fire rehabilitation efforts were limited in effectiveness; the loss of large riparian overstory has increased emergent vegetation such as cattails impacting aquatic habitat quality and the loss of upland vegetation has increased sediment and silt deposition negatively affecting substrate in occupied aquatic habitats. Potential locations for establishment of a second spinedace population are limited.

NEEDS:

Research Needs: Research is needed on life history, ecology, interactions with non-native species, and reactions to man-made disturbances. The upper reaches of the range (Kill Wash) need to be further studied and surveyed as all native fishes in the system in all age classes were present.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian.

Monitoring and Existing Plans: Annual monitoring of the single extant population is conducted by NDOW with assistance from the Recovery Implementation Team (RIT). Management and recovery needs are described in the Big Spring Spinedace Recovery Plan and the supplementary Recovery Implementation Plan.

Approach: Nonnative species control is conducted in association with population monitoring. RIT team is developing habitat management and restoration strategy. Efforts to establish a second population within the Meadow Valley Wash drainage are ongoing. Recovery Implementation Plan (NDOW 2000a) provides guidance for conservation actions. BLM has designated the immediate watershed as an ACEC. Planning has been completed for additional restoration of key habitat reaches with funding to start in 2012.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian.

bonytail chub *Gila elegans*

WAP 2012 species due to federal endangered status and possible exinction of the Lower Colorado River wild population.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
USFS-R4	Endangered
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend unknown.

DISTRIBUTION: Distribution is restricted to the Colorado River system. In Nevada, distribution is limited to Lake Mohave and possibly the Colorado River below Davis Dam.

GENERAL HABITAT AND LIFE HISTORY:

Bonytail chub are found in the main stream of the Colorado River and large tributaries, usually in or near deep swift water, in flowing pools and backwaters, over mud or rocks. They are most frequently associated with eddies just outside the main current, and have a high tolerance for turbidity (Matthews and Moseley 1990). They also occupy mainstem Colorado River reservoirs. Available data suggest that habitats required for conservation include river channels and flooded, ponded, or inundated riverine habitats, especially those where competition from non-native fishes is absent or reduced (USFWS 1994b).

This species is a surface feeder. Adults primarily eat terrestrial insects, plant debris, and algae, but can be an active predator on early life stages of other native and nonnative fishes. Young feed mainly on aquatic insects.

Bonytail chub spawned in Lake Mohave (1954) over a gravel bar in 9 m (29.5 ft) of water. They spawn in schools over rocky shoals of smaller tributaries (Matthews and Moseley 1990).

CONSERVATION CHALLENGES:

Only a few scattered remnant populations remain in the wild. Reproduction and recruitment in the wild is extremely limited and may be almost entirely absent in the lower Colorado River Basin. Declines have apparently been caused mainly by the effects of dams and reservoir construction, channelization and loss of seasonal floodplain habitats in remaining riverine reaches, and the establishment of nonnative predators and competitors in altered habitats. Wild populations have declined greatly since the 1960s. The wild population in Lake Mohave consisted of older adult individuals with little or no recruitment and is likely extirpated. Population size and recruitment is similarly very limited throughout the species range although efforts to release larger (>300mm (1 ft)) reared fish from captive stock have shown some success. Future conservation efforts are dependent on captive individuals held at Dexter NFH, New Mexico and other facilities. Hybridization may occur between bonytail, humpback chub and/or roundtail chub where they co-occur (USFWS 2002a).

NEEDS:

Research Needs: Intraspecific and habitat relationships, culture methods, and habitat restoration strategies are needed.

Monitoring and Existing Plans: Annual monitoring of the Lake Mohave population is conducted by the Native Fish Work Group including USBR, USFWS, NDOW, AGFD and ASU. Available planning documents include the Bonytail Chub Recovery Plan & Recovery Goals Addendum; Lower Colorado River Basin Native Fish Management Strategy; Management Plan for the Big River Fishes of the Colorado River Basin; Covered Species in the Lower Colorado River MSCP.

WAP HABITAT LINKS: Warm Desert Riparian.

Approach: Current efforts for bonytail conservation are focused on re-establishment of persistent adult populations in mainstem reservoirs, and riverine habitats where available, primarily using cultured adult broodstock to produce large juvenile (>300mm (1 ft)) fish for release to the wild because of the absence of wild stocks. See Minckley and Deacon (1991) for information on hatchery culture of bonytail. The future potential for re-establishing wild reproducing populations is dependent on limited areas where seasonal floodplain habitats and flow regimes can be reconstructed to some degree, integrating some level of control on nonnative predators and competitors, primarily in relic mainstem riverine areas and tributaries. Some limited success has been demonstrated in establishing off channel refuge populations in ponds and wetlands (Mueller et al 2004). Conservation strategies for Nevada bonytail habitats are being implemented by the Lower Colorado River MSCP program and the Native Fish Work Group to both of which NDOW is a cooperator. Recovery and conservation strategies for this species are outlined in the species recovery goals (USFWS 2002a) and Lower Colorado River Basin native fish management plan (USFWS 2005). Wild (non-cultured) fish may be extinct in lower Colorado River, maintenance of existing recovery efforts (repatriate adults) is critical to prevent extinction.

WAP HABITAT LINKS: Warm Desert Riparian.

bull trout (Jarbidge River basin pop) *Salvelinus confluentus pop. 4*

WAP 2012 species due to its federal threatened status, limited spawning and rearing habitat, and climate change vulnerability.

Agency Status	
NV Natural Heritage	G4T2QS1
USFWS	LT
BLM-NV	Sensitive
USFS-R4	Threatened
State Prot	Game Fish NAC 503.060
AFS	Threatened
CCVI	Highly Vulnerable

TREND: Trend is stable.

DISTRIBUTION: In NV, distribution is believed to consist of a single population in the East Fork, West Fork, and mainstem Jarbidge River and headwater tributaries; isolated from other bull trout by a large expanse of unsuitable habitat (USFWS 1999).

GENERAL HABITAT AND LIFE HISTORY:

Bull trout inhabit the bottom of deep pools in cold rivers and large tributary streams, often in moderate to fast currents with temperatures of 7-10° C (45-50° F), in addition to, large coldwater lakes and reservoirs. In the contiguous U.S., they are now extirpated in most large rivers that historically were inhabited, and confined mostly to headwater streams. Conditions that favor the persistence of populations include stable channel, relatively stable stream flow, low levels of fine substrate sediments, high stream channel complexity with various cover types, temperatures not exceeding about 15 C (59 F), and the presence of suitable corridors for movement between suitable winter and summer habitats and for genetic exchange among populations (Rieman and McIntyre 1993). Available information indicates that bull trout and other native fishes use different resources, reducing direct competition (Rieman and McIntyre 1993).

Bull trout usually spawn in gravel riffles of small tributary streams, including lake inlet streams. Spawning sites often are associated with springs (Rieman and McIntyre 1993). Young are closely associated with stream channel substrates (Rieman and McIntyre 1993). Areas with large woody debris and rubble substrate are important as juvenile rearing habitat (Spahr et al. 1991). Bull trout spawn in late summer or fall, with falling temperatures between 5-9° C (41-48° F). Eggs hatch in late winter or early spring. Fry emerge from gravel in April-May. Most information indicates that sexual maturity is attained in 5-7 years. Spawning populations may comprise 4 or more year classes, though 1-2 year classes may dominate. See Rieman and McIntyre (1993).

CONSERVATION CHALLENGES:

Small range, low abundance, and disjunct distribution are all conservation issues. Past activities, such as mining, road development and maintenance, stream channelization and removal of large woody debris, residential development, and road and campground development of USFS lands, still negatively impact populations (USFWS 2004). Road construction and associated maintenance activities threaten habitat. Introduced brown trout and rainbow trout have been associated with bull trout declines, apparently due to competitive interactions. Lake trout may have a negative impact on bull trout, due to predation by lake trout on juvenile bull trout, probable competitive interactions, and increased harvest associated with increased fishing pressure for lake trout (see Rieman and McIntyre 1993). Bull trout are threatened by activities that damage riparian areas and cause stream siltation. Logging, road construction, mining, and overgrazing may be harmful to spawning habitat. Habitat fragmentation may be a problem, but it is unclear whether the fragmented distribution is natural due to specific habitat requirements or caused by human impacts (Rieman and McIntyre 1993).

NEEDS:

WAP HABITAT LINKS: Intermountain Riparian.

Research Needs: It is necessary to Identify and assess trends in habitat conditions and bull trout abundance (Rieman and McIntyre 1993). Top priority should be given to areas with the greatest threats. Research is needed to determine the range of conditions (especially temperature) tolerated by stable populations. Similarly, investigation is needed on metapopulation structure, dynamics, and dispersal, the role of the resident and migratory forms in population persistence, and the interactions between these forms.

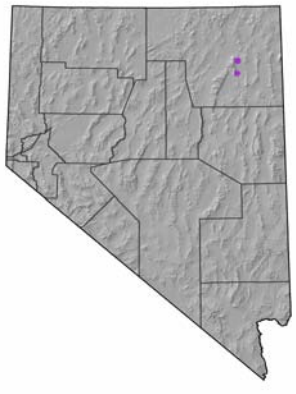
Monitoring and Existing Plans: Monitored during NDOW stream surveys. Existing plans include the Bull Trout Recovery Plan and Bull Trout Species Management Plan.

Approach: Conservation of bull trout will require maintenance or restoration of multiple, high-quality, connected habitats distributed throughout conservation areas, which in turn should be distributed throughout the species range (Rieman and McIntyre 1993). Effective conservation of the species and its inherent diversity requires an interregional approach (Rieman and McIntyre 1993). Rieman and Allendorf (2001) concluded that cautious long-term management goals for bull trout populations should include an average of at least 1,000 adults spawning each year. Where local populations are too small, managers should seek to conserve a collection of interconnected populations that is at least large enough in total to meet this minimum (Rieman and Allendorf 2001). Also, full expression of life history variation and the natural processes of dispersal and gene flow should be provided (Rieman and Allendorf 2001). Continue the long-term monitoring plan as identified by the Jarbidge River Bull Trout Recovery Team.

WAP HABITAT LINKS: Intermountain Riparian.

Clover Valley speckled dace *Rhinichthys osculus oligoporus*

WAP 2012 species due to its federal endangered status, low population numbers, limited distribution, and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G5T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Highly Vulnerable

TREND: Trend unknown.

DISTRIBUTION: Three spring systems in Clover Valley, Elko Co., NV.

GENERAL HABITAT AND LIFE HISTORY:

Clover Valley speckled dace are found primarily in reservoirs and outflows of the three spring systems: Clover Valley Warm Springs, Wright Ranch Spring, and Bradish Spring. There do not appear to be any associated marshes with these springs, only the outflows that have been heavily modified.

The speckled dace is one of the most morphologically (and ecologically) variable fishes in western North America (Miller and Miller 1948, Minckley 1973). This variability is due to geologic events that have resulted in numerous isolated populations. Details of Clover Valley speckled dace seasonal habitat requirements, population size, distribution over time, reproductive potential, and available habitat are unknown because access to the properties to conduct studies was not permitted in the past. Generally, speckled dace are characterized as diurnal (active during the daytime), bottom browsers that feed primarily on small invertebrates (such as aquatic insects), plant material, and zooplankton (floating, microscopic aquatic animals). Specific reproductive patterns of the Clover Valley speckled dace have not been examined. Generally, speckled dace mature in their second summer. They are capable of spawning throughout the summer, but peak activity usually occurs in the months of June and July at water temperatures of 18° C (65° F) (USFWS 1998a).

CONSERVATION CHALLENGES:

Primary threats at the time of listing were a limited distribution, habitat manipulation, small population size, and nonnative fish (e.g., rainbow trout) introductions. All occupied habitats are on private lands with limited access ability.

NEEDS:

Research Needs: Determine life history characteristics and habitat requirements.

Monitoring and Existing Plans: Monitoring and inventory of this subspecies has been conducted by USGS-BRD and USFWS. NDOW conducts annual population monitoring. Included in the Recovery Plan for the Endangered Species of Clover & Independence Valleys.

Approach: Work with private landowners to develop conservation strategies. Secure water rights where necessary to protect spring flows and spring outflows. Exclude sensitive springs from direct impacts of grazing, recreation, other disturbance sources. Eliminate groundwater pumping that threatens surface flows at critical springs. Eliminate introduced species that compete with dace.

WAP HABITAT LINKS: Springs and Springbrooks.

Cui-ui *Chasmistes cujus*

WAP 2012 species due to its federal endangered status and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Moderately Vulnerable

TREND:

DISTRIBUTION: Occurs only in Pyramid Lake and Truckee River, NV.

GENERAL HABITAT AND LIFE HISTORY:

Cui-ui prefer inshore areas of the lake with extensive shoals and shallow bars. They generally avoid deep-water areas and inshore areas with steep dropoffs (though Page and Burr [1991] described the habitat as "deep water"). Usually this is at less than 46 m (Sigler and Sigler 1987). The cui-ui spawns in the Truckee River over gravel beds in relatively shallow water (21-140 cm) where flow is rapid. When runs are disturbed by low water levels, they may spawn at the river mouth. Cui-ui may spawn in Pyramid Lake, but extreme alkalinity and elevated salinity preclude successful reproduction there (Scoppettone and Vinyard 1991). Newly emerged young remain a few days or weeks in the spawning stream.

The cui-ui feeds mainly on bottom-oriented zooplankton and macroinvertebrates such as ostracods, CYCLOPS, and chironomid larvae and pupae (Scoppettone and Vinyard 1991). Cui-ui feed somewhat above the bottom in water 10-30 m deep. (Sigler and Sigler 1987).

Most adult mortality probably occurs during spawning runs (Sigler et al. 1985). Direct predation by humans was a significant cause of mortality until the 1970s. In recent years white pelicans have become a significant source of mortality (Scoppettone and Vinyard 1991).

CONSERVATION CHALLENGES:

Endangered status is due to habitat alteration (siltation, pollution) and declining flow in Truckee River (dam construction and water diversion). Current threats include, as previously stated, inadequate water flow in the Truckee River (this being a major threat), declining water quality resulting from the expanding urban population, and increased salinity in the lake that could result from mass water diversions. Ownership of water rights in the Truckee basin has been in dispute and subject to litigation for many years (Scoppettone and Vinyard 1991).

NEEDS:

Research Needs: None identified.

Monitoring and Existing Plans: The cui-ui is Monitored by USFWS and covered in the Cui-ui Recovery Plan.

Approach: Maintain adequate water level in Pyramid Lake is necessary to meet the life history needs (especially spawning) of this species. Adequate flow of less than 14 C should be maintained during spawning. Spawning gravel and shaded riparian zone in lower Truckee River should be protected and enhanced, and access to the river should be maintained (Sigler et al. 1985).

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs.

desert dace *Eremichthys acros*

WAP 2012 species due to its federal threatened status, endemism, impacts from detrimental aquatic species, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LT
BLM-NV	Sensitive
State Prot	Threatened Fish NAC 503.065.3
CCVI	Moderately Vulnerable

TREND: Despite small, isolated populations, currently the entire population is considered stable. However, many threats still persist in its range.

DISTRIBUTION: Restricted to thermal habitats in the Soldier Meadow area, an elevated basin (1,524 m) in western Humboldt County, NV (Lee et al. 1980). Currently it occupies 8 thermal spring and related outflows consisting of 3.1 miles of total habitat.

GENERAL HABITAT AND LIFE HISTORY:

Desert dace occupy habitat in 8 thermal springs and their outflow consisting of 3.1 miles total, in areas with temperatures of 18-40° C (64-104° F). They are most common in temperatures of 23-29° C (73 - 84° F), downstream of spring orifices. It was found that desert dace are distinguished as having the highest temperature tolerance for minnows (Hubbs and Miller 1948). From recent survey work, desert dace appear to favor open water where little or no vegetation exist.

Desert dace are omnivorous, but eat mainly periphyton and filamentous algae (1996 draft recovery plan).

Temperatures of 21-24° C (70 - 75° F) are required for spawning. Desert dace probably breed throughout early and midsummer (Sigler and Sigler 1987), or year round (Matthews and Moseley 1990).

CONSERVATION CHALLENGES:

Habitat formerly was threatened by channelization and water diversion (which change thermal environment and reduce food supply) and potential geothermal and/or mineral development. Existing and potential threats include exotic species (predatory fishes such as green sunfish and catfish, parasites associated with non-native fishes), trampling and overgrazing by livestock and wild horses and burros, and increasing recreational use of habitat. Habitat alteration by ungulates has been addressed in the majority of dace habitats through BLMs exclosure fencing in 2004. Effectiveness at excluding grazers has yet to be determined.

NEEDS:

Research Needs: Research is needed to determine interdependency of the springs.

Monitoring and Existing Plans: Included in the Recovery Plan for the Rare Species of Soldier Meadows (USFWS 1997d). There was a comprehensive survey and inventory of the entire system by USGS in 2003. A livestock grazing plan was implemented in 2007. NDOW conducts annual monitoring surveys and a RIT team exists. Gabion barriers have been installed to prevent non-native green sunfish from existing habitat.

Approach: The entire aquifer should be treated as a unit. Habitat should be restored and threats from grazing ungulates and exotic aquatic organisms should be eliminated. For specific recovery objectives, see the Recovery Plan for the Rare Species of Soldier Meadows (USFWS 1997d). Vinyard (1996) recommended that irrigation diversion should be discontinued and water returned to the original channel.

WAP HABITAT LINKS: Springs and Springbrooks.

Devils Hole pupfish *Cyprinodon diabolis*

WAP 2012 species due to its federal endangered status, limited distribution, and water level threats.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: The number of fishes in Devils Hole has declined since the mid 1990's. Refugia populations at Hoover Dam and Ash Meadows NWR have been lost due to hybridization, invasive species, water supply issues, and other problems. Intense management actions have been implemented in the form of a Devil's Hole pupfish Incident Command Team (ICT) to direct efforts intended to preclude this species from extinction. The population in Devils Hole appears to have stabilized at slightly over 100 adult fish after reaching a low of 38 fish in 2006.

DISTRIBUTION: Wild population occurs only in Devils Hole, Ash Meadows area, Death Valley National Park, NV.

GENERAL HABITAT AND LIFE HISTORY:

Devils Hole pupfish exist in a deep limestone pool, about 15 m (49 ft) below the land surface. Water temperature is 32.8-33.9°C (91-93°F), and dissolved oxygen is 1.8 to 3.3 ppm (Lee et al. 1980). The species relies predominantly on an algae-covered, shallow shelf for food resources and spawning substrate for reproduction. The Devils Hole pupfish eats mainly algae. It is also known to ingest small invertebrates, but these items may be ingested secondarily while it grazes over rocks (La Rivers 1962). Pupfish also use the deep cavern habitat but move onto the shallow shelf daily to access food resources. Devils Hole pupfish are short-lived with few if any fish living more than one year in the wild.

There is a relatively stable population of slightly over 100 adult fish. The population fluctuates seasonally with lower numbers in winter. Reproduction occurs throughout the year with the bulk of recruitment occurring in the late spring to early summer period.

CONSERVATION CHALLENGES:

This site is vulnerable to vandalism and factors that affect substrate, water level, or water quality. There is a high susceptibility towards extinction due to possible impacts from groundwater pumping or catastrophic events affecting the single occupied habitat. All off-site refuge populations have been lost from water supply problems or hybridization with other pupfish. Quality and suitability of essential spawning habitat in Devils Hole has been impacted from storm events and excess sediment deposition, with substantial reduction in the population size within Devils Hole. Water level decline and exposure of shelf, is a major concern as there is only a single wild population.

NEEDS:

Research Needs: Life history studies are needed to identify opportunities for maintenance and enhancement of habitat and population size. Genetic management planning for future refuge populations is under development. The causes for recent population declines in Devils Hole are still not well understood but may be related to dynamic changes in the food web and energy balance in Devils Hole. A new "Desert Fish Research Facility" has been constructed on Ash Meadows NWR which will house a Devils Hole pupfish refuge population.

Monitoring and Existing Plans: This site is surveyed semi-annually in April and October by NPS, USFWS, and NDOW and is under intense management. Monitoring of larval production is conducted by NPS annually in the spring. Devils Hole pupfish is included in the Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada.

WAP HABITAT LINKS: Springs and Springbrooks.

Approach: Continue to monitor population. Maintain aquifer to sustain water levels in Devils Hole. Monitor water rights applications for potential effects. Maintain a refuge population. Goals and objectives are addressed in the species' Recovery Plan (USFWS 1990b), and actions are reviewed periodically by the Devils Hole ICT and the Devils Hole Pupfish Recovery Team. Current conservation and research efforts are focused on developing a strategy to rectify recent population declines in Devils Hole, and determining the role and appropriate management of refuge populations.

WAP HABITAT LINKS: Springs and Springbrooks.

Diamond Valley speckled dace *Rhinichthys osculus ssp. 10*

WAP 2012 species due to its unknown population status, endemism, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5THSH
USFWS	No Status
CCVI	Highly Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Known from at least two locations in Diamond Valley, Eureka County.

GENERAL HABITAT AND LIFE HISTORY:

Preferred habitat is flowing outflow streams for drift feeding on debris and invertebrates. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. The speckled dace eats various small aquatic animals.

CONSERVATION CHALLENGES:

This is an endemic and its population status is unknown. Some populations may occur on private lands with access challenges.

NEEDS:

Research Needs: Information on life history, habitat requirements, and distribution is needed.

Monitoring and Existing Plans: No specific monitoring in place. No species specific planning or applicable plans in place.

Approach: Management approach to be determined.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian, Warm Desert Riparian.

flannelmouth sucker *Catostomus latipinnis*

WAP 2012 species due to low population numbers and fragmented distribution.

Agency Status	
NV Natural Heritage	G3G4S1
USFWS	No Status
CCVI	Presumed Stable

TREND: Virgin River populations are low. but this is the most abundant native fish in Nevada reaches of that river. Lower Colorado River populations are stable but fragmented in distribution.

DISTRIBUTION: Endemic to tributary streams and rivers in the Colorado River basin. Nevada populations occur in the Virgin River and mainstem Colorado River below Davis Dam; occasional individuals are encountered in Lake Mead but are likely displaced from the Grand Canyon upstream and not resident.

GENERAL HABITAT AND LIFE HISTORY:

The flannelmouth sucker inhabits moderate to large rivers. It is seldom found in small creeks and is absent from impoundments. This species is typical of pools and deeper runs and often enters mouths of small tributaries (Lee et al. 1980) in addition to riffles and backwaters (Sublette et al. 1990). Young are usually found in shallower water than are adults (Sigler and Miller 1963). It spawns in riffles, usually over a substrate of coarse gravel (Lee et al. 1980).

The flannelmouth sucker is a bottom feeder. It is reported to feed on diatoms, algae, fragments of higher plants, seeds, and benthic invertebrates (Sigler and Miller 1963, Lee et al. 1980). See Tyus and Minckley 1988 for possible importance of Mormon cricket as a food source.

Flannelmouth sucker adults can be highly mobile, traveling several hundred miles in undammed river systems such as the Green River. Studies of flannelmouth below Davis Dam in the lower Colorado River have shown seasonal movement of up to 16 miles (Best and Lantow 2010).

CONSERVATION CHALLENGES:

The flannelmouth sucker currently occupies only about 45% of its historic range with 14 extant populations in the Colorado River Basin (Bezzerides and Bestgen 2002). Stable recently in the Little Colorado River (Douglas and Marsh 1998). This species is one of the few large-bodied native species that persist in the lower Colorado River basin, but it has been extirpated from the Gila River Basin and most of the mainstem Colorado River below Lake Havasu, CA/AZ. Apparently stable within the Navajo Nation, AZ (David Mikesic, pers. comm., 1997). Threats include alteration of the hydrologic, physical and thermal characteristics of river habitats (Clarkson and Childs 2000, Ward et al. 2002), blockage of migration routes due to dam construction, predation and competition by non-native aquatic species, and hybridization with other Catostomus species (Arizona Game and Fish Department 1995, 1996). Young suckers that exit warm tributaries and enter cold hypolimnetic water released from major dams may experience increased susceptibility to predation by rainbow trout and other predators (Ward and Bonar 2003). Extant populations in the Virgin River NV consist mostly of larger adults and the presence of nonnative predators combined with reduced base flows and altered habitats likely limits reproduction.

NEEDS:

Research Needs: Updated population information to determine trends is needed. It is necessary to determine abundance across range. Research is needed to determine effects of water temperature on ecology and life history and to determine effects of fluctuating water flows on movement, habitat use and preference, and recruitment in the Colorado River below Davis Dam. Additional information on seasonal habitat needs and use by juvenile fish is needed to guide restoration efforts on the lower Colorado River. Additional research needs have been identified for Grand Canyon populations which would be applicable to Nevada (Arizona Game and Fish Department 1995).

WAP HABITAT LINKS: Warm Desert Riparian.

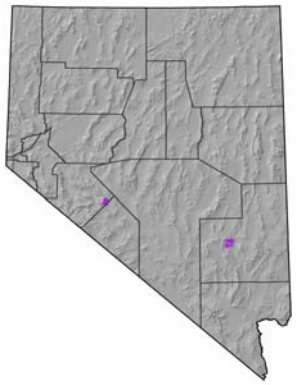
Monitoring and Existing Plans: NV Populations are monitored at least annually. Virgin River monitoring is included as part of other species efforts but could be expanded to better assess distribution, recruitment, demographics, population estimate. In the Colorado River annual monitoring efforts are led by USBR and USGS as part of the Lower Colorado Multispecies Conservation Program (LCR-MSCP) implementation program (Flannelmouth sucker is an LCR-MSCP covered species). The flannelmouth sucker is included in the Range-wide Conservation Agreement for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker; Lower Virgin River Recovery Implementation Strategy (draft), and the LCRMSCP Conservation Plan. It is also a High Priority Evaluation Species in the Clark County MSHCP.

Approach: The Range-wide Conservation Agreement for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker (UDWR 2004) outlines conservation program needs for this species. There are a number of multi-party conservation teams and plans in place to implement conservation for this species, including a range-wide agreement working group, the LCR-MSCP, and the Lower Virgin River Recovery Implementation Team (RIT) which directs and implements conservation actions on the Virgin River in Nevada. Key conservation elements include maintenance of flows, habitat protection and restoration, and the control of nonnative competitors and predators.

WAP HABITAT LINKS: Warm Desert Riparian.

Hiko White River springfish *Crenichthys baileyi grandis*

WAP 2012 species due to its federal endangered status, limited distribution, small population size, and threats from groundwater development and nonnative species.



Agency Status	
NV Natural Heritage	G2T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend varies by site with both natural populations declining substantially since 2000 with the introduction of nonnative crayfish. Hiko Spring is very low but stable, Crystal Spring is low but increasing, and the refuge population has been stable in the absence of introduced nonnative species.

DISTRIBUTION: Endemic to Crystal and Hiko springs of the pluvial White River drainage in White River system, Pahranagat Valley, Lincoln County, southeastern NV.

GENERAL HABITAT AND LIFE HISTORY:

Hiko White River springfish inhabit vegetated warm springs and their outflows and marshes (Minckley et al. 1991). They are able to survive extremes in temperature and dissolved oxygen.

It is an opportunistic omnivore. Other subspecies, according to Sigler and Sigler (1987), are primarily herbivorous overall but also eat invertebrates (e.g., caddisfly larvae). Filamentous algae is the most important food.

Hiko White River springfish spawn in warm summer months. Apparently 10-17 eggs constitute a spawning. Eggs are laid and fertilized one at a time. Incubation lasts 5-7 days.

CONSERVATION CHALLENGES:

Distribution is limited to two sites on private land in Pahranagat Valley, and a refuge population on public land in Mineral County. Private land sites do not have protection or agreements in place for long term security of populations. The Hiko White River springfish is impacted by alteration and loss of occupied and historic habitat, invasive species, including severe impacts from introduced nonnative fishes and crayfish, water regulation for agriculture in occupied habitats, and potential effects of future ground and surface water development.

NEEDS:

Research Needs: Research is needed regarding habitat preference and requirements, interspecific competition, genetic management of isolated populations, the impacts of crayfish and nonnative species introductions, and control strategies for invasive aquatic species and plants.

Monitoring and Existing Plans: Population and status monitoring is conducted at least annually by NDOW at all sites. Existing plans include, Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley and the Pahranagat Valley Native Fishes Management Plan.

Approach: Pahranagat Valley Native Fishes Recovery Implementation Team (RIT) meets semi-annually to review conservation status and actions and coordinate activities. The RIT team implements the Pahranagat Valley Native Fish Management Plan (NDOW 2000b) which identifies key goals, objectives, and actions. Key conservation elements include habitat restoration and protection, and aggressive control and removal of introduced nonnative fishes in occupied habitats. NDOW is pursuing development of landowner agreements to provide long term security for habitat through implementation of the Pahranagat Valley Programmatic Safe Harbor Agreement.

WAP HABITAT LINKS: Springs and Springbrooks.

Independence Valley speckled dace *Rhinichthys osculus lethoporus*

WAP 2012 due to its federal endangered status, limited distribution, threats from introduced detrimental aquatic species, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Highly Vulnerable

TREND: Trend is a stable, small, isolated population.

DISTRIBUTION: Isolated spring and marsh/outflow system in Independence Valley, Elko Co., NV.

GENERAL HABITAT AND LIFE HISTORY:

Independence Valley speckled dace are found in a temperate, permanent desert stream/marsh fed by six spring areas. Although known as Independence Valley (Ralph's) Warm Springs (Marsh), these springs are not cited as thermal waters. The species great adaptability and ability to inhabit a broad range of habitat types (Moyle 1976) allowed it to survive areas of the marsh system that were inaccessible to largemouth bass (Micropterus salmoides), and bluegill (Lepomis macrochirus), either do to shallowness or density of emergent vegetation (Rissler et al 2001). No data exists on the flow velocities or temperatures of habitat currently occupied by Independence Valley speckled dace. But recent survey work has shown that speckled dace occupy approx. 219 hectares of the springs and canals of the marsh (Rissler et al 2001).

Independence Valley speckled dace are bottom browsers that feed primarily on small invertebrates (such as aquatic insects), plant material, and zooplankton (floating, microscopic aquatic animals).

The speckled dace is one of the most morphologically (and ecologically) variable fishes in western North America (Miller and Miller 1948, Minckley 1973). This variability is due to geologic events that have resulted in numerous isolated populations. Generally, speckled dace are characterized as diurnal (active during the daytime). Specific reproductive patterns of the Independence Valley speckled dace have not been examined. Generally, speckled dace mature in their second summer. They are capable of spawning throughout the summer, but peak activity usually occurs in the months of June and July at water temperatures of 18°C (65°F) (USFWS 1998a).

CONSERVATION CHALLENGES:

Primary threats at the time of listing were a limited distribution, habitat manipulation, small population size, and nonnative fish introductions. All occupied habitats are on private lands with limited access ability.

NEEDS:

Research Needs: Research is needed to determine life history characteristics and habitat requirements. Genetic analysis funding was proposed at RIT meeting (2008).

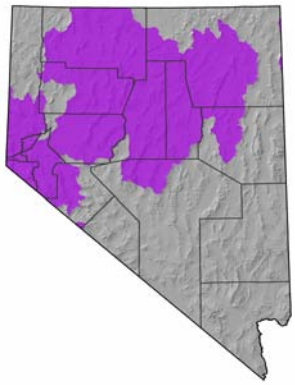
Monitoring and Existing Plans: Extensive inventory of this subspecies was completed by USGS-BRD in 1997-1998 (Rissler et al 2001). No scheduled monitoring is occurring at this time. There is a Recovery Plan for the Endangered Speckled Dace of Clover and Independence Valleys (USFWS 1998a).

Approach: Work with private landowners to develop conservation strategies. Secure water rights where necessary to protect spring flows and spring outflows. Exclude sensitive springs from direct impacts of grazing, recreation, other disturbance sources. Eliminate groundwater pumping that threatens surface flows at critical springs. Eliminate introduced species that compete with dace.

WAP HABITAT LINKS: Intermountain Riparian, Springs and Springbrooks, Marshes.

Lahontan cutthroat trout *Oncorhynchus clarkii henshawi*

WAP 2012 species due to its federal threatened status, habitat fragmentation, threats from exotic species and water development, and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G4T3S3
USFWS	LT
BLM-NV	Sensitive
USFS-R4	Threatened
State Prot	Nevada State Emblems
State Prot	Game Fish NAC 503.060
CCVI	Moderately Vulnerable

TREND: Currently categorized as declining. Historically, 11 lacustrine populations occupied about 334,000 acres of lakes and an estimated 400-600 fluvial populations inhabited more than 5,800 km (3,600 miles) of streams. The Lahontan cutthroat trout currently exists in about 155 streams and 6 lakes and reservoirs (USFWS 1994f).

DISTRIBUTION: Formerly abundant in lakes and streams throughout the physiographic Lahontan basin of northern NV, eastern CA, OR, and UT. It currently exists in about 0.4% of former lake habitat and 11% of former stream habitat within its native range. In NV, the present range includes Pyramid Lake and the Truckee River (Washoe County); both forks of the Walker River and Walker Lake (Mineral County); Summit Lake and Carson River and its tributaries (Douglas and Lyons counties); Humboldt River and tributaries (Elko County); Lander, Eureka, Nye, and Humboldt Counties; and out-of-basin populations in Elko, Lander, Nye, and Clark counties. Independence and Summit Lakes support the only remaining reproducing lacustrine form within the native range. It has been introduced outside its native range, primarily for recreational fishing purposes (USFWS 1994f). Native populations are extirpated from Tahoe, Pyramid, Walker, and Donner lakes. The present population in Pyramid Lake derives from individuals of the same subspecies introduced from Summit Lake, Heenan Lake (Echelle 1991, Behnke 1992).

GENERAL HABITAT AND LIFE HISTORY:

The LCT inhabits lakes and streams and requires cool, well-oxygenated water. It is adapted to highly mineralized waters. In streams, the LCT uses rocky areas, riffles, deep pools, and areas under logs and overhanging banks. Optimally, cover should be available in at least 25% of the stream area. The LCT spawn in streams, generally in riffle areas over gravel substrate. Spawning and nursery habitat is characterized by cool water, approximate 1:1 pool-riffle ratio, well-vegetated and stable stream banks, and relatively silt-free rocky substrate in riffle-run areas (USFWS 1994f).

The LCT is an opportunistic feeder (Behnke 1992). Small individuals eat small invertebrates such as crustaceans and aquatic insects. Larger fishes eat large invertebrates and small fishes. Fishes dominate the diet of large, lake-dwelling adults.

Fry may move out of spawning tributaries shortly after emergence (Summit Lake population) or may remain in nursery streams for 1-2 years (USFWS 1994f).

CONSERVATION CHALLENGES:

This species is detrimentally affected by damage to spawning areas caused by timber harvesting, forest fires, and grazing livestock. It is also detrimentally affected by damming and water diversion for irrigation and municipal uses, water pollution downstream from Reno and Carson City, and by construction of Marble Bluff Dam which closed off spawning areas in the Truckee River headwaters (fish ladder now allows access). USFWS (1994f) stated that principal threats are habitat loss due to urbanization, reclamation, mineral development, livestock grazing, hybridization with non-native trout, and competition with exotic species of fishes. Many populations occupy isolated stream segments of large river systems with no opportunity for natural recolonization. Existing climate change models suggest increasing temperatures and altered precipitation patterns may substantially impact some populations through altered habitat suitability and increased habitat fragmentation.

NEEDS:

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs.

Research Needs: Continued hybrid and phylogenetic analysis on populations of concern. Determine success of mechanical removal of non-native trout (in terms of removal success and LCT population response) from LCT occupied waters. Determine LCT seasonal movement patterns/preferred habitat in the larger metapopulations/rivers.

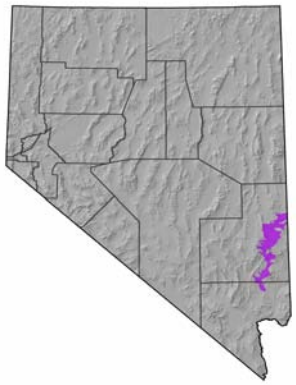
Monitoring and Existing Plans: The LCT is monitored annually, with individual populations on a 3-5 year survey rotation. Existing plans include the LCT SMP for the Upper Humboldt River Drainage Basin, LCT SMP for the Quinn River/Black Rock Basins and the North Fork Little Humboldt River Sub-Basin.

Approach: Rehabilitate streams, construct fish ladders, and restock (Spahr et al. 1991). Use fencing and grazing controls to protect spawning tributaries from sedimentation (Behnke 1992). Identify and coordinate interagency activities to secure, manage, and improve habitat for all existing populations. Develop and implement reintroduction plans, regulate harvest to maintain viable populations, and manage self-sustaining populations existing out of native range until their need is completed (USFWS 1994f).

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs.

Meadow Valley speckled dace *Rhinichthys osculus ssp. 11*

WAP 2012 species due to existing surface water development impacts and habitat alteration.



Agency Status	
NV Natural Heritage	G5T2S2
USFWS	No Status
BLM-NV	Sensitive
CCVI	Presumed Stable

TREND: Trend appears to be stable.

DISTRIBUTION: Occupies suitable habitat in middle and upper reaches of Meadow Valley Wash, Clover Creek and the Condor Canyon portion of Meadow Valley Wash.

GENERAL HABITAT AND LIFE HISTORY:

Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. Studies on fish movement in Condor Canyon revealed that all native fishes supported greater densities upstream of Delmue Falls, also that Kill Wash supported critical habitat for spawning in the upper canyon section (Jezorek et al 2011).

CONSERVATION CHALLENGES:

Conservation challenges for the Meadow Valley speckled dace include, existing surface water development impacts, habitat alteration, unknown effects from climate change, non-native species, rainbow trout and heavy impacts from crayfish, water diversion, and flood effects in the Meadow Valley Wash populations.

NEEDS:

Research Needs: Further annual surveys are needed to monitor dace distribution and abundance throughout range, particularly upstream from Delmue Road Bridge in Condor Canyon where important native fish habitat exists (Jezorek 2011).

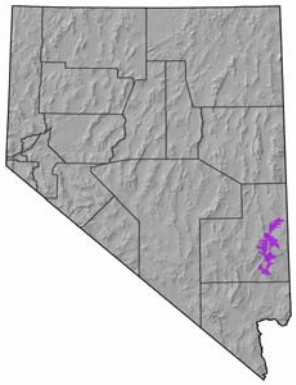
Monitoring and Existing Plans: Meadow Valley Wash RIT was established in 2000, TNC property in Condor Canyon ensures conservation measures appropriate for continued persistence. Co-occurs with Big Spring spinedace in Condor Canyon a USFWS Threatened Species with delineated Critical Habitat. USFWS Recovery Plan (covering Big Spring spinedace) 1993 affords the speckled dace defacto protection for that part of its range. NDOW conducts annual population monitoring.

Approach: Non-native crayfish present the highest threat to the native fish fauna in many parts of their range, particularly in Condor Canyon. Non-native rainbow trout also pose a risk throughout its range.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Meadow Valley Wash desert sucker — *Catostomus clarkii ssp. 2*

WAP 2012 species due to existing surface water development impacts and habitat alteration.



Agency Status	
NV Natural Heritage	G3G4T2S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Presumed Stable

TREND: Appears to be stable with isolated populations.

DISTRIBUTION: Known to occur in middle and upper reaches of Meadow Valley Wash, Clover Creek, and Condor Canyon.

GENERAL HABITAT AND LIFE HISTORY:

The Meadow Valley Wash desert sucker occurs in suitable habitat in Meadow Valley Wash, Clover Creek, and portions of Condor Canyon. In Clover Creek and Meadow Valley Wash below the Clover Creek confluence, suitable habitat is dynamic because of frequent flood events and populations can be isolated because of ephemeral summer flows and water diversions. Sucker growth was measured in the Condor Canyon section of Meadow Valley Wash, with lengths ranging from 20-39mm in June. By September and into early October, fork lengths ranged from 31-39 mm. Desert sucker movement was, in one instance, shown to be over 1km in Condor Canyon (Jezorek 2011). Spawning related movement was detected in late March to early May.

CONSERVATION CHALLENGES:

Conservation challenges include, existing surface water development impacts, habitat alteration, unknown effects from climate change, non-native species, particularly crayfish, threats due to railroad activities such as hazardous material spills, floods, and fire.

NEEDS:

Research Needs: Pursue continued efforts at conservation easements, and long term monitoring of existing populations. Explore, survey, and identify native fish habitat in Kill Wash in the upper portion of Condor Canyon.

Monitoring and Existing Plans: Meadow Valley Wash RIT was established in 2000. TNC property in Condor Canyon ensures conservation measures appropriate for continued persistence. Co-occurs with Big Spring spinedace in Condor Canyon a USFWS Threatened Species with delineated Critical Habitat. The USFWS Recovery Plan (covering Big Spring spinedace) 1993 affords the Meadow Valley speckled dace and Meadow Valley Wash desert sucker defacto protection. NDOW conducts annual population monitoring.

Approach: Continue or pursue conservation agreements with Union Pacific Railroad, and directed habitat restoration with NDOT, as Meadow Valley Wash is prone to frequent high intensity flooding.

WAP HABITAT LINKS: Warm Desert Riparian.

Moapa dace *Moapa coriacea*

WAP 2012 species due to its federal endangered status, impacts from exotic invasive species, and threats from groundwater development.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Species has increased since the all-time historic low in 2008, with an increase in numbers over past few years. Dace numbers continue to increase but are still approximately half of pre-2007 numbers.

DISTRIBUTION: Endemic to the warm spring area at headwaters of Muddy River, northern Clark County, southeastern NV.

GENERAL HABITAT AND LIFE HISTORY:

Moapa dace are a thermally endemic species, restricted to clear pools and outlet streams of moderate to high temperatures (19.5-33.9°C; 67-93°F) (Lee et al. 1980). Moapa dace inhabit spring pools, spring feeders, small outflow streams, and main river channels, again, usually in warmer waters (28-32°C; 82-89.6°F) (USFWS 1995a). Substrate may be mud, sand, gravel, or pebble. Waters contain abundant algae and are shaded or bordered by mesquite, saltcedar, or fan palm.

Adult diet consists of invertebrates (75%) and plants and detritus (25%) (Scoppettone et al. 1992).

Adults occur near the bottom of the water column, in focal velocities of 0-55 cm/sec (0-1.8 ft/sec). Largest individuals occur in areas with the greatest flow. Juveniles occupy a narrower range of depths and velocities, and larvae occur in slack water (Scoppettone et al. 1992). The Moapa dace spawns in headwater tributaries of the Muddy River, within 150 m (492 ft)of warm water spring discharge in water temperatures of 30-32°C (86-89.6°F) (Scoppettone et al. 1992). It breeds year-round, with the peak in spring and the lowest level in fall. Females sexually mature at 41-45 mm (1.6-1.8 inches) in fork length. Life spans are up to at least 4+ years (Scoppettone et al. 1992).

CONSERVATION CHALLENGES:

Recent studies found this species in low numbers only in restricted portions of 3 springs and in less than 3.2 km (2 miles) of spring outflow and river. Present status is due to loss and alteration of habitat due to groundwater pumping, the introduction of exotic fish (tilapia, shortfin molly) and invasive plants, and the restriction of distribution to small headwater streams. Palm crown fires on Moapa National Wildlife Refuge and other headsprings areas have caused population declines from elevated water temperatures and ash flow, demonstrating its vulnerability to catastrophic events. Tilapia and other invasive plant and animal species continue to be a major concern as is current and future water development; Moapa Dace are the most sensitive to water development of the four Muddy River endemic fish species.

NEEDS:

Research Needs: More research is needed regarding tilapia and other non-native fish interactions, effects of invasive submergent and emergent plants on habitat quality, behavior/migration of riverine versus tributary fish (effects of barriers on population fragmentation and genetic or management strategy to resolve), and minimum flow requirements to maintain habitat quality.

Monitoring and Existing Plans: Dive counts are completed system wide each February and August. There is a need to evaluate use, entrainment, and distribution in agricultural diversions. This species is included in the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem and the Draft Muddy River Recovery Implementation Program (MRRIP) plan.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Approach: USFWS has acquired key headspring areas as the Moapa National Wildlife Refuge to protect habitat. Several springs with occupied dace habitat now have protected flows. Streams on and immediately below the refuge provide the only remaining spawning habitat (USFWS 1994). SNWA purchase of key northern Muddy Springs area land for conservation purposes will assist in persistence of species. Pattern of habitat use by different life history stages indicates that all remaining habitat is necessary for the survival of this species (Scoppettone et al. 1992). Conservation emphasis is on restoration of spring and outflow habitats, and control and/or eradication of detrimental invasive species. Additional barriers may be needed to continue these eradication efforts downstream in the main Muddy River channel. Additional landowner agreements are needed to protect habitats and gain access for recovery efforts in key habitats. Removal of exotic species from the mainstem Muddy River is essential to allow dace access to those habitats and restoration of full life history functions. The MRRIP Biological Action Committee was established in 2009 to direct and coordinate monitoring, recovery actions, and habitat restoration.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Moapa speckled dace *Rhinichthys osculus moapae*

WAP 2012 species due to impacts from exotic invasive species.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Presumed Stable

TREND: Populations declining.

DISTRIBUTION: Middle Muddy River, Clark County, NV downstream of Warm Springs headwaters.

GENERAL HABITAT AND LIFE HISTORY:

Preferred habitat is flowing main river channel for drift feeding on debris and invertebrates. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. The speckled dace eats various small aquatic animals.

CONSERVATION CHALLENGES:

Impacts from tilapia and other invasive aquatic species, groundwater and surface water development, and fragmentation of habitat from dams and diversion.

NEEDS:

Research Needs: Information on life history, habitat requirements, and distribution is needed.

Monitoring and Existing Plans: Muddy River speckled dace are monitored annually using hoop nets and other methods. Existing plans include the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem and the Muddy River Recovery Implementation Program (RIP) Implementation Plan. Conservation efforts are identified and implemented through the Muddy River RIP Biological Action Committee.

Approach: Muddy River efforts have emphasized control of invasive tilapia and saltcedar and identification of off-site refuge locations to maintain speckled dace adult populations and genetics.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian.

Moapa White River springfish *Crenichthys baileyi moapae*

WAP 2012 species due to impacts from exotic invasive species.

Agency Status	
NV Natural Heritage	G2T2S2
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is stable.

DISTRIBUTION: Endemic to five springs in the upper Muddy River system, Clark County.

GENERAL HABITAT AND LIFE HISTORY:

Moapa White River springfish inhabit vegetated warm springs and their outflows and marshes (Minckley et al. 1991).

Moapa White River springfish have evolved to tolerate high water temperatures and low dissolved oxygen levels. In the Muddy River system, this subspecies occupies headwater spring and outflow habitats similar to those used by Moapa dace. Moapa White River springfish spawn in warm summer months. Apparently 10-17 eggs constitute a spawning and eggs are laid and fertilized one at a time. Incubation lasts 5-7 days.

CONSERVATION CHALLENGES:

Within the Muddy River system distribution and numbers appear to have declined significantly since 1980 although good baseline data for comparison of changes is lacking. Much of the species habitat has been lost to groundwater pumping and alteration. In addition, competition for food and predation by non-native fishes continue to threaten the species. Like other Muddy River endemic species, key concerns include habitat degradation, alteration, and fragmentation, competition and predation from nonnative aquatic species including tilapia and mollies. Current and potential future threats from surface and groundwater development are also key concerns. Some key habitats occur on private lands but landowner agreements for protection and long-term security do not include all private land habitats.

NEEDS:

Research Needs: Research is needed regarding tilapia and other non-native fish interactions. Management guidance and requirements for existing and refuge populations are needed.

Monitoring and Existing Plans: Semi-annual monitoring is incorporated into dive counts for Moapa dace where habitats overlap. A more intensive comprehensive range-wide status survey is scheduled every 3 to 4 years. Existing plans include the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem. The springfish is an included species in the Muddy River Recovery Implementation Program and implementation plan for the MRRIP.

Approach: Conservation and management for Moapa White River springfish is incorporated into recovery implementation actions for Moapa dace and other upper Muddy River species. Key elements include monitoring, fish eradication projects, fish barriers construction, fish reintroduction, habitat restoration. Private landowner agreements need to be pursued to develop better security for some occupied habitats. The MRRIP Biological Action Committee established in 2009 to direct and coordinate monitoring, recovery actions, and habitat restoration for the upper Muddy River also addresses needs for this species.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Monitor Valley speckled dace *Rhinichthys osculus ssp. 5*

WAP 2012 species due to lack of knowledge about the subspecies, impacts from exotic invasive species and groundwater development, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Highly Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Two locations in Monitor Valley, Nye County.

GENERAL HABITAT AND LIFE HISTORY:

Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. The speckled dace eats various small aquatic animals. Specific life history information on speckled dace inhabiting small, isolated spring and outflow habitats is less well understood.

CONSERVATION CHALLENGES:

Conservation issues include non-native species (crayfish), groundwater development, and little current knowledge on status and specific life history requirements.

NEEDS:

Research Needs: Information on life history and habitat requirements is needed.

Monitoring and Existing Plans: No specific monitoring currently in place although populations have been monitored occasionally for presence/absence. No species specific planning or applicable plans in place.

Approach: Management approach to be determined.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian, Intermountain Riparian.

Moorman White River springfish *Crenichthys baileyi thermophilus*

WAP 2012 species due to its limited distribution and susceptilbilty to water development.

Agency Status	
NV Natural Heritage	G2T1S1
USFWS	No Status
State Prot	Protected Fish NAC 503.065.1
CCVI	Presumed Stable

TREND: Trend is unknown, but appears stable.

DISTRIBUTION: Endemic to three thermal spring systems in upper White River Valley, Nye County, NV.

GENERAL HABITAT AND LIFE HISTORY:

Moorman White River springfish inhabit vegetated warm springs and their outflows and marshes (Minckley et al. 1991). They are able to survive extremes in temperature and dissolved oxygen. Temperature and minimum oxygen values vary considerably among spring habitats, from 31°C (87.8°F) and 6.6 ppm oxygen at Moon River Spring to 37°C (98.6°F) at Moorman Spring. The Moorman White River springfish spawns in warm summer months. Apparently 10-17 eggs constitute a spawning. Eggs are laid and fertilized one at a time. Incubation lasts 5-7 days. This subspecies occupies the warmest headwater spring habitats of any White River springfish, and utilizes outflow/springbrook habitats downstream to the lower limit of thermal tolerance.

CONSERVATION CHALLENGES:

Distribution is limited to three spring and outflow habitats in White River Valley, only one of which is secure under public control (Kirch WMA). Although populations in private lands habitats are relatively stable they do not have agreements or easements in place to provide long term security and protection. All occupied habitat have some level of degradation and alteration and competition from introduced species. Introduced nonnative predators have been a periodic problem at Hot Creek (Kirch WMA) due to illegal introductions. Potential threats exist from proposed groundwater development actions.

NEEDS:

Research Needs: Habitat preference/requirements, genetic management of isolated populations, impacts of crayfish introduction and control strategies should be studied.

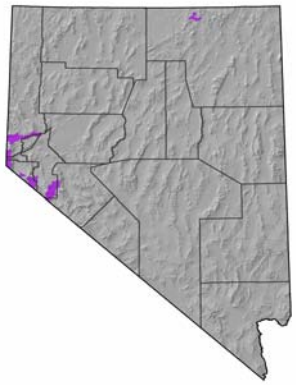
Monitoring and Existing Plans: Biennial or annual status monitoring is completed by NDOW depending on the location. The Moorman White River springfish is included in the White River Native Fishes Management Plan.

Approach: Conservation actions are reviewed and implemented through the White River Native Fishes RIT which meets semi-annually. The White River Native Fishes Management Plan (NDOW 2001) provides management guidance. Current efforts are focused on the restoration and enhancement of habitats, control of nonnative predators/competitors, and developing agreements with private landowners to insure long-term protection and management of occupied habitats. NDOW is developing a Programmatic Candidate Conservation Agreement with Assurances to assist in the development of landowner agreements for private land conservation.

WAP HABITAT LINKS: Springs and Springbrooks, Marshes, Lakes and Reservoirs.

mountain whitefish *Prosopium williamsoni*

WAP 2012 species due to habitat degradation and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
State Prot	Game Fish NAC 503.060
CCVI	Moderately Vulnerable

TREND: Unknown trend, however low numbers generally turn up in many surveys in comparison to other stream fishes, indicating a potential decline (Lawrence and Seiler 2002).

DISTRIBUTION: Known populations are restricted to larger Sierra front streams (Truckee, Walker, and Carson). Limited distribution in the Carson River, where suitable habitat runs out near Minden. Also occurs in the Jarbidge, Bruneau, and South Fork and East Fork Owyhee Rivers.

GENERAL HABITAT AND LIFE HISTORY:

Lahontan Basin whitefish are morphologically conserved throughout its range, and its distribution is geographically limited by water temperatures and salinity (Whiteley et al 2006). Fish require streams with a minimum pool depth of 4 feet in season of least flow. They feed primarily on insects and tend to live in cold water in larger streams and rivers. Spawning time depends on the latitude and temperature of the stream or river, but it is usually between October and December in riffles (Sigler and Sigler 1987). The average length of mountain whitefish is 23-30 cm (9-12 inches; Behnke 2002).

CONSERVATION CHALLENGES:

Under current conditions, spawning, incubation, and rearing habitat for native mountain whitefish and non-native brown and rainbow trout in Donner and Prosser Creeks and the Little Truckee River is relatively degraded and reduced in extent compared to historic conditions (CDFG 1996). In the Truckee River, spawning and fry rearing habitat also is degraded, and many of the complex pool habitats critical to juvenile survival have been lost. In the upper Truckee drainage it was found that after the construction of upstream water storage dams, the populations of whitefish in Sagehen and Prosser Creeks severely declined (Moyle 2002).

NEEDS:

Research Needs: Mountain whitefish specific surveys need to be conducted, particularly on the Walker and Carson Rivers. Whitefish numbers and abundance do not appear strong in comparison to other fishes during surveys.

Monitoring and Existing Plans: Unknown if there are any specific conservation plans or actions for mountain whitefish.

Approach: Protection of larger pools, particularly in the low flow seasonal months and a minimum instream flow throughout the year to provide suitable habitat is needed. Flow regimes selected in the Truckee River have generally been based on the needs of non-native brown and rainbow trout.

WAP HABITAT LINKS: Intermountain Riparian.

Oasis Valley speckled dace — *Rhinichthys osculus ssp. 6*

WAP 2012 species due to threats from exotic invasive species and groundwater development, habitat alteration, and habitat fragmentation.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Presumed Stable

TREND: Trend is stable.

DISTRIBUTION: Limited populations exist in a few springs and outflows including portions of the Amargosa River within Oasis Valley.

GENERAL HABITAT AND LIFE HISTORY:

The Oasis Valley speckled dace has highly isolated populations throughout Oasis Valley with minimal connectivity. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise. A high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge.

CONSERVATION CHALLENGES:

Small local populations are vulnerable to habitat alteration and exotic species. Reasons for decline include dewatering of springs, headwaters, and middle portions of major streams, water impoundment, channelization, diversion, regulation of discharges, and interactions with non-native species particularly crayfish and bullfrogs (Minckley 1985, Moyle et al. 1989). See Taylor et al. (1989) for information on negative impact of cattle on desert spring populations (chemical alteration of water).

NEEDS:

Research Needs: Continued efforts to inventory all potential waters capable of containing speckled dace are needed.

Monitoring and Existing Plans: Annual monitoring is conducted by NDOW. Amargosa Toad Working Group, Beatty Habitat Committee, and Storm-OV have contributed to multiple conservation efforts to secure toad habitat which indirectly provides security for speckled dace. TNC properties have on-going restoration efforts. Bi-annual NDOW surveys of known populations. There are continuing efforts to obtain private lands for habitat enhancement and private landowner access (USFWS Partners and NDOW LIP Programs).

Approach: Continued efforts to secure dace habitat throughout Oasis Valley, continued crayfish and bullfrog eradication efforts are needed. Landowner and conservation agreements to further improve and secure habitat.

WAP HABITAT LINKS: Springs and Springbrooks.

Pahranagat roundtail chub *Gila robusta jordani*

WAP 2012 species due to its federal endangered status, population declines, habitat alteration, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G3T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend is declining; possibly extinct in the wild.

DISTRIBUTION: Historically thought to occur in outflows of thermal springs in Pahranagat Valley including Ash, Crystal, and Hiko Springs as well as the Pahranagat River. The only wild population is currently restricted to a single spring outflow in Pahranagat Valley, Lincoln County, NV. Refugium populations exist at Dexter National Fish Hatchery, an artificial pond at Key Pitman State Wildlife Management Area, and a pond on Pahranagat NWR.

GENERAL HABITAT AND LIFE HISTORY:

Current known distribution of the Pahranagat roundtail chub in the wild is limited to an approximately 3/4-mile reach of the Pahranagat River (Ditch) below the Ash Springs outflow on private property. It has not been observed in either Crystal or Hiko springs since the early 1950s, and suitable lotic habitats at both those locations have been severely reduced or eliminated. Presumed distribution within the Pahranagat River (Ditch) is reduced from that found historically because much of the former river channel has been lined with concrete to facilitate irrigation, or lost as a result of agricultural development. It is thought to seek thermal refuge closer to the thermophilic outflows during winter, but spawns in the cooler portions of the outflows in late spring. They are omnivores, feeding mostly on aquatic insects with larger adult occasionally feeding on smaller fishes and other aquatic vertebrates.

Pahranagat roundtail chub primarily eat drifting invertebrates, but also occasionally consume food off the bottom. They eat some plant material and rarely eat other fish.

Spawning typically occurs in late January and peaks in early to mid-February. Water temperatures during this period range from 17-24°C (63-76°F). Areas up to 3 feet deep with gravel substrate and relatively swift flows are used. Each spawning female may be attended by a group of 2-10 males. Spawning occurs intermittently over several days. The eggs are broadcast and drop into spaces between the rocks. Larvae swim-up in approximately 28 days. They likely live from 3-5 years.

CONSERVATION CHALLENGES:

This subspecies is restricted in distribution in the wild to a single location on private land. Access for monitoring has been infrequent. A 2010 survey revealed only 2 fish, both young adults in the 1 to 2 year old range, indicating that successful reproduction has recently occurred. Managed refuge populations exist on public land in Pahranagat Valley and at Dexter NFH, New Mexico. Historically occurred in outflow systems at Hiko and Crystal springs prior to their alteration. Downstream alterations of existing habitats have restricted available habitat and distribution in the Ash Spring outflow system. Thermal loading from spring discharge in summer months impacts habitat suitability. Existing agricultural practices have likely negative effects on flows and temperatures in occupied habitat. Also, competition exists from nonnative species including mollies and cichlids, in addition, there are potential threats from proposed future groundwater development.

NEEDS:

Research Needs: Taxonomic status needs to be clarified. Additional life history and habitat relationship information is needed to assist in restoration of historic unoccupied habitats.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian.

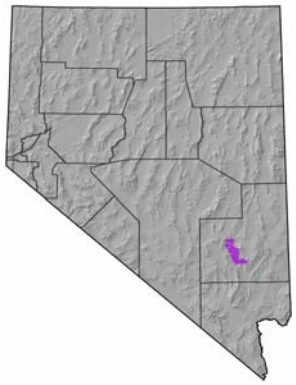
Monitoring and Existing Plans: Monitoring was conducted semiannually until 2001. Since then, access from landowner has been infrequent and surveys were conducted in 2006, when a few adults and juvenile fish were observed, and in 2011, when only 8 adult fish were observed. To prevent extinction of the species, two refuge populations have been created on public lands in the native range of the Pahranagat Valley. The Pahranagat roundtail chub is included in the Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley (FWS 1998) and the Pahranagat Valley Native Fishes Management Plan (NDOW 2000b).

Approach: Pahranagat Valley Native Fishes Recovery Implementation Team (RIT) meets semi-annually to review conservation status and actions and coordinate activities. RIT team implements Pahranagat Valley Native Fish Management Plan (NDOW 2000b) which identifies key goals/objectives/actions. Refuge populations were established at Key Pitman WMA in Pahranagat Valley in 2004 and on Pahranagat NWR in 2011 using captive fish from Dexter NFH. Priority actions include development of agreements with landowners to gain access to the existing wild population and allow restoration of historic unoccupied habitats.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian.

Pahranagat speckled dace *Rhinichthys osculus velifer*

WAP 2012 species due to limited distribution and endemism.



Agency Status	
NV Natural Heritage	G5T1QS1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Presumed Stable

TREND: Declining from historic range. Pahranagat speckled dace have been recently reintroduced to spring systems in Pahranagat Valley.

DISTRIBUTION: Restricted to a few spring systems in the Pahranagat Valley, NV.

GENERAL HABITAT AND LIFE HISTORY:

This subspecies has been identified as one of the"Swift-morph" of the speckled dace complex, with the body form being more terete and slender (Gilbert 1893). Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, and intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age three. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge.

CONSERVATION CHALLENGES:

Pahranagat speckled dace are a narrowly endemic subspecies restricted to a few springs in the lower White River in the Pahranagat Valley. Highly susceptible to predation from invasive bass and sunfish. Other potential anthropogenic factors such as groundwater withdraws, water diversions and drought can significantly reduce habitat and population numbers.

NEEDS:

Research Needs: In the pluvial Pahranagat River, one or more unnamed "chubby-bodied" dace, possessing unique fin morphology, have been reported (LaRivers 1962). These populations warrant more attention.

Monitoring and Existing Plans: Active conservation is currently in progress on Pahranagat NWR to restore habitat and re-establish populations of this species. Annual or semi-annual surveys are conducted by NDOW. The Pahranagat Valley Native Fishes RIT includes this species in conservation planning.

Approach: Restore and actively manage existing populations and habitats including eradication of invasive species. Only one or two natural populations remain. Continue active conservation on Pahranagat NWR and other suitable locations in Pahranagat Valley to develop and re-establish populations in its range.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Pahrump poolfish *Empetrichthys latos latos*

WAP 2012 species due to its federal endangered status, limited distribution, threats from groundwater development, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	
USFWS	No Status

TREND: Of the three extant refuge populations, two remain stable and the third (Corn Cr. Springs) remains below 200 fish.

DISTRIBUTION: Introduced populations now exist at three refuge sites in Clark and White Pine counties. They are extirpated from native range in three springs in Pahrump Valley, NV and now exist only outside the Pahrump Valley (Page and Burr 1991).

GENERAL HABITAT AND LIFE HISTORY:

Pahrump poolfish inhabit shallow warm springs (Lee et al. 1980), including alkaline mineral springs and outflow streams (Matthews and Moseley 1990). In their natural habitat, larger individuals frequented more open deeper waters, while young were in shallower more weedy areas (Kobetich et al. 1980).

Pahrump poolfish are described as omnivorous, apparently feeding on a wide variety of available plant and animal material (Kobetich et al. 1980).

Females move to remote areas of springs during the breeding periods (Kobetich et al. 1980). Pahrump poolfish apparently spawn at any time of year, but spawning activities peak in the spring (probably March-April). In transplanted populations young appear more active during the day, adults appear more active at night (Kobetich et al. 1980). They are inactive in winter and early spring (USFWS 1993b). These fish were originally restricted to three separate springs in Pahrump Valley, southern Nye County, NV. They are now extirpated from native range in those three springs and now exist only outside the Pahrump Valley (Page and Burr 1991). They formerly occurred in Raycraft Ranch Spring (ssp. concavus) and Pahrump Springs (ssp. pahrump). E. l. latos is extirpated from its native habitat at Manse Ranch Spring (dewatered). Transplanted populations of subspecies latos occur at three locations: Corn Creek Springs on the Desert National Wildlife Refuge, Clark County; Shoshone Springs (Ponds), Spring Valley, White Pine County (on BLMs Shoshone Ponds Natural Area), and an irrigation reservoir, fed by Sandstone Spring, at Spring Mountain State Park, Clark County (Minckley et al. 1991, USFWS 1993b). All are on public lands.

CONSERVATION CHALLENGES:

The Pahrump Ranch poolfish (E. l. pahrump) and Raycraft Ranch poolfish (E. l. concavus) subspecies are now extinct due to desiccation of their native springs from groundwater pumping and modifications to springheads. Pahrump poolfish (E. latos) was extirpated from its natural, native habitat due to the desiccation of the springs as a result of groundwater pumping for irrigation. They now occur only in refugium populations located on public lands. The three extant refuge populations are relatively secure but could be threatened by proposed groundwater development actions at Corn Creek Springs and Shoshone Ponds. Additional concerns include predation and competition from exotic fishes and amphibians and encroachment of vegetation at Spring Mountain Ranch and Shoshone Ponds. The potential to re-establish this species within its native range is limited due to the loss or severe alteration of all historic habitats in Pahrump Valley.

NEEDS:

Research Needs: Additional life history information is needed to assist in management of refuge environments.

Monitoring and Existing Plans: Population and status monitoring is completed annually by NDOW at all three locations. Existing plans include, the Recovery Plan Pahrump Killifish and the Spring Mountain Ranch HCP. A RIT Team was established in 2009 and a genetic management plan is proposed.

WAP HABITAT LINKS: Springs and Springbrooks.

Approach: The Corn Creek refuge was reconstructed in 2003 and is managed jointly by NDOW and USFWS. Genetic management protocols have been developed and implemented for the three refuge sites. Management emphasis at the Spring Mountain Ranch and Shoshone Ponds sites is on monitoring for and control of introduced competitors and predators, and actions to insure long-term maintenance of aquatic habitat quality. Research is currently funded to develop more formal refuge and genetic management strategies.

WAP HABITAT LINKS: Springs and Springbrooks.

Preston White River springfish *Crenichthys baileyi albivallis*

WAP 2012 species due to population loss and threats from water development and exotic invasive species.

Agency Status	
NV Natural Heritage	G2T1S1
USFWS	No Status
State Prot	Protected Fish NAC 503.065.1
CCVI	Presumed Stable

TREND: Trend unknown.

DISTRIBUTION: Restricted to thermal spring systems in upper White River Valley, White Pine County, NV.

GENERAL HABITAT AND LIFE HISTORY:

Preston White River springfish inhabit vegetated warm springs and their outflows and marshes (Minckley et al. 1991).

The Preston White River springfish is able to survive extremes in temperature and dissolved oxygen. Temperature and minimum oxygen values vary considerably among spring habitats. Preston Big Spring has been measured at 21°C (69.8° F) and 3.3 ppm oxygen. It spawns in warm summer months. Apparently 10-17 eggs constitute a spawning and eggs are laid and fertilized one at a time. Incubation lasts 5-7 days. This subspecies occupies the coolest headwater spring and outflow/springbrook habitats of any of the White River springfish.

CONSERVATION CHALLENGES:

Distribution and abundance of this subspecies have declined since 1981 and it now occurs in only 4 of 6 spring systems where it historically occurred. The range-wide total population was estimated at <5,000 individuals in 1999 (Scoppettone and Rissler 2002). Primary impacts have been from alteration, fragmentation and loss of spring and outflow habitats, loss of connectivity between these habitats, and the introduction of nonnative competitors and predators. Potential future threats exist from proposed ground and surface water development projects. The majority of locations for this subspecies are on private lands with restricted access which are not included under any type of agreements or easements which would assure long-term security and protection.

NEEDS:

Research Needs: Mechanisms for restoring historic habitat while meeting existing water delivery needs and protecting existing populations need to be researched and implemented using an adaptive management approach.

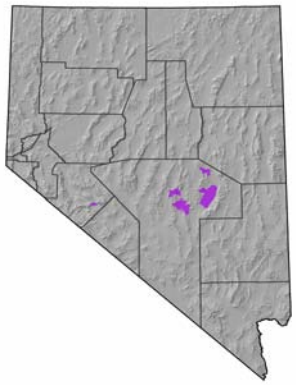
Monitoring and Existing Plans: Semi-annual monitoring is conducted at Indian Spring and other locations are monitored bi-annually where access permission can be obtained. Existing plans are the White River Native Fishes Management Plan and the Indian Spring CCAA.

Approach: Conservation actions are reviewed and implemented through the White River Native Fishes RIT which meets semi-annually. The White River Native Fishes Management Plan (NDOW 2001) provides management guidance. Current efforts are focused on the restoration and enhancement of habitats, control of nonnative predators/competitors, and developing agreements with private landowners to insure access to all extant populations and long-term protection and management of occupied habitats. A more comprehensive scheduled monitoring strategy is needed to gauge success of conservation efforts (Scoppettone and Rissler 2002). NDOW is developing a Programmatic Candidate Conservation Agreement with Assurances to assist in the development of landowner agreements for private land conservation.

WAP HABITAT LINKS: Springs and Springbrooks.

Railroad Valley springfish *Crenichthys nevadae*

WAP 2012 species due to its federal threatened status, limited distribution, habitat fragmentation, and threats from water development and exotic invasive species.



Agency Status	
NV Natural Heritage	G2S2
USFWS	LT
BLM-NV	Sensitive
USFS-R4	Threatened
State Prot	Threatened Fish NAC 503.065.3
CCVI	Presumed Stable

TREND: Stable except for Big Warm Spring population.

DISTRIBUTION: Endemic to thermal springs and outflows in Railroad Valley, Nye County, NV.

GENERAL HABITAT AND LIFE HISTORY:

Railroad Valley springfish inhabit warm spring pools, outflow streams, and adjacent marshes. They are able to tolerate high temperatures and low dissolved oxygen. Duckwater and Lockes Ranch springs have outflow temperatures of 32.3 and 37.3°C and minimum oxygen concentrations of 0.5 and 0.9 ppm, respectively (Lee et al. 1980).

Diet predominantly consists of invertebrates in Railroad Valley, with gastropods most important in June. These fish also eat substantial amounts of plant material, especially filamentous algae (Sigler and Sigler 1987).

Historically occurred in four springs (Big, North, Hay Corral, and Reynolds) near Lockes Ranch and two springs (Big Warm and Little Warm) on the Duckwater Shoshone Indian Reservation, and in the outflow systems associated with these spring complexes. The Big Warm Spring population has been recently extirpated but efforts are currently underway to re-establish it. Three introduced populations occur in Nye and Mineral counties outside of historic range but are not actively managed as species refuges.

CONSERVATION CHALLENGES:

All Railroad Valley springfish habitats have been altered from historic condition to some degree by ditching, diversion, impoundment and other modifications. At Duckwater, extensive populations of non-native fishes including catfish and tilapia in Big Warm Spring, in combination with physical modifications, resulted in the extirpation of springfish at that site. Existing and potential future threats exist at all locations from water diversions, habitat alteration, proposed groundwater development projects, and oil exploration.

NEEDS:

Research Needs: Additional life history and habitat requirements information is needed to assist in the development of habitat restoration strategies.

Monitoring and Existing Plans: Annual monitoring is conducted at all Railroad Valley sites by NDOW, and at Duckwater in cooperation with the Duckwater Tribe and the USFWS. The Railroad Valley springfish is included in the Railroad Valley Springfish Recovery Plan.

Approach: Conservation actions are reviewed and implemented through the Railroad Valley Fishes RIT which meets semiannually. At Duckwater sites, actions to restore the Big Warm Spring site including removal of non-native fishes and restoration of the spring and outflow have been completed by the Duckwater Tribe, NDOW, USFWS, and other cooperators. Additional restoration is ongoing at Little Warm Spring. For Lockes Ranch occupied habitats, the private lands containing the majority of springfish habitats have been acquired by NDOW (in 2005) and initial restoration efforts have been completed including restoration of degraded and altered spring outflow systems. Cooperative maintenance and habitat quality monitoring at North Spring (headspring) is completed annually in coordination with BLM.

WAP HABITAT LINKS: Springs and Springbrooks.

razorback sucker *Xyrauchen texanus*

WAP 2012 species due to its federal endangered status, altered habitats, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
USFS-R4	Endangered
State Prot	Endangered Fish NAC 503.065.2
CCVI	Increase Likely

TREND: Declining (USFWS 1997b). See Minckley et al. (1991) and USFWS (1997b) for a detailed account of the historical status, decline, present status, and threats. See Marsh and Minckley (1989) for a discussion of status in the lower Colorado River.

DISTRIBUTION: A Colorado River endemic. Largest extant population occurs in Lake Mohave, AZ/NV. In NV small populations also occur in Lake Mead and the Colorado River below Davis Dam.

GENERAL HABITAT AND LIFE HISTORY:

The razorback sucker is found in the main stream of the Colorado River and large tributaries. Habitats include slow areas, backwaters, and eddies of medium to large rivers and their impoundments (3 of the 4 remaining populations of greater than 100 individuals are in reservoirs). This fish is often associated with sand, mud, and rock substrate in areas with sparse aquatic vegetation, where temperatures are moderate to warm (Sigler and Miller 1963). Limited data indicate that young tend to remain along shorelines, in embayments along sandbars, or in tributary mouths (see Minckley et al. 1991). In Lake Mohave, individuals were associated with inshore habitats except during the hotter months when they moved offshore possibly to avoid warmer water temperatures (Mueller et al. 2000). Spawning occurs most commonly near shore in streams over silty sand, gravel, or rock substrate at depths of up to about 6 meters (often in water less than 0.6 meter deep). Known and suspected spawning sites in the Green and other upper-basin rivers all are in broad, flat-water segments (Minckley et al. 1991). Ripe individuals often have been taken over or near coarse sand, or gravel or cobble bars, in flowing water. In reservoirs, spawning occurs on gravel bars swept clean by wave action, and also along shorelines over mixed substrates ranging from silt to cobble (USFWS 1994b). Spawning has been observed downstream from major impoundments, below Davis Dam and Hoover Dam (Mueller 1989). Larvae appear to remain in gravel until swim-up (USFWS 1990a). Apparently they prefer the shallow littoral zone for a few weeks after hatching, then disperse to deeper waters (USFWS 1994b). Seasonally inundated flood plains provide favorable feeding areas for young.

The razorback sucker is a planktivorous and benthic feeder, eating algae, planktonic crustaceans, and aquatic insect larvae. In Lake Mohave, Arizona-Nevada, diet of adults was dominated by planktonic crustaceans, diatoms, filamentous algae, and detritus (Marsh 1987).

In Lake Mead at least three sub-populations exist all associated with reservoir inflow areas. The Lake Mead population likely comprises less than 2,000 adult fish but this is the only wild population of the species known to show consistent and substantial successful natural recruitment. Reasons for this are not fully understood but might be associated with seasonal turbidity or other reservoir physical characteristics (Shattuck et al 2011). Recaptures and radio-tracking indicate that individuals may remain in one area (a few km long) for several months (USFWS 1990a), but individuals may move 100-200 km or or more over several years (Wick et al. 1982). In Lake Mohave, linear range lengths of 10 adults over 14 months were 18-72 km (mean 39 km) (Mueller et al. 2000). The razorback sucker usually swims in schools.

CONSERVATION CHALLENGES:

WAP HABITAT LINKS: Warm Desert Riparian, Lakes and Reservoirs.

Successful recruitment is low or absent across much of occupied range despite successful spawning and larval emergence. Impoundment of Colorado River reservoirs has fragmented range and altered habitats and water quality. Remaining river has been affected by altered flow regimes and disconnection from historic backwater and seasonal floodplain habitats due to entrainment and channelization. With the exception of limited evidence from Lake Mead NV/AZ, essentially no recruitment to reservoir populations has been detected since 1963 in the lower Colorado River basin. Other problems include competition and predation on larvae and juveniles by introduced fishes and crayfish, which thrive in altered habitats (USFWS 1990a; Lenon et al. 2002), paucity of spawning adults, and hybridization with other suckers (Tyus and Karp 1990, Minckley et al. 1991). See USFWS (1990a) for many details on habitat changes that have affected this species.

NEEDS:

Research Needs: Habitat relationships and habitat utilization in impoundments, culture methods, interspecific interactions with other native and game fish species, habitat restoration strategies and methods, techniques for effective control of nonnative competitors and predators, and specific research efforts on Lake Mead to determine factors responsible for limited natural recruitment in the wild, are all areas for research.

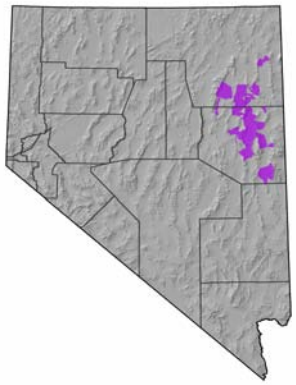
Monitoring and Existing Plans: Lake Mohave monitoring is conducted semiannually by the cooperative Native Fish Work Group including NDOW and AGFD, while USBR/USGS conduct monitoring below Davis Dam. Lake Mead annual monitoring is conducted primarily by BIO/WEST (contractor to USBR) with assistance by NDOW and other agencies. Plans include the Lower Colorado River MSCP, Razorback Sucker Recovery Plan & Recovery Goals Addendum, Lower Colorado River Basin Native Fish Management Strategy, and the Management Plan for the Big River Fishes of the Colorado River Basin.

Approach: In the lower basin mainstem Colorado River basin where opportunities for habitat and flow restoration are limited, efforts for razorback sucker conservation are focused on maintenance and re-establishment of persistent adult populations in mainstem reservoirs, and riverine habitats where available, primarily using wild-caught larvae to produce large juvenile (>300mm) fish for release to the wild. The future potential for re-establishing wild reproducing populations is largely dependent on limited areas where seasonal floodplain habitats and flow regimes can be reconstructed to some degree, integrating some level of control on nonnative predators and competitors, primarily in relic mainstem riverine areas and tributaries. Some limited success has been demonstrated in establishing offchannel refuge populations in ponds and wetlands (Mueller et al 2004) and in using seasonally connected wetlands and backwaters to "head-start" sub-adult fish (Wydoski and Wick 1998). In Lake Mead NV, evidence that limited wild recruitment is occurring (Welker and Holden 2004) may indicate some potential to further develop persistent wild stocks there or in other Colorado River reservoirs. Conservation strategies for Nevada razorback sucker habitats are being implemented by the Lower Colorado River MSCP program, the Native Fish Work Group, and the Lake Mead Razorback Sucker Work Group to all of which NDOW is a cooperator; Recovery and conservation strategies for this species are outlined in the species recovery goals (USFWS 2002b) and Lower Colorado River Basin native fish management plan (USFWS 2005).

WAP HABITAT LINKS: Warm Desert Riparian, Lakes and Reservoirs.

relict dace *Relictus solitarius*

WAP 2012 species due to threats from groundwater development, habitat alteration, nonnative species introducions, and climate change.



Agency Status	
NV Natural Heritage	G2G3S2S3
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
IUCN	Endangered
CCVI	Moderately Vulnerable

TREND: Most populations are stable.

DISTRIBUTION: Multiple locations in Spring, Steptoe, Ruby, Butte, and Goshute valleys, east-central Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Relict dace are a unique genus of endemic cyprinid minnow occurring only in several isolated basin valleys in east-central Nevada. Occupied habitats are springs, spring-fed streams, ponds, intermittent lakes and marshes, with mud or stone bottoms. Typically concentrates in well-vegetated pools where banks are undercut. Relict dace are midwater swimmers taking cover in soft bottom or vegetation (Sigler and Sigler 1987).

Knowledge on the life history and behavioral characteristics of the species is limited. Like other cyprinids, relict dace appear to be opportunistic omnivores. Common food items include amphipods, gastropods, insects, ostrocods, and leeches. Size varies tremendously among different populations. Environmental conditions may affect growth and size of fish in localized populations but adults are typically 60mm to 100mm SL. The relict dace is an extremely prolific fish that has a long breeding season, extending from late-June to late-September. Reproductive strategies likely vary with respect to environment, especially thermal regime. Both sexes likely spawn as yearlings with the smallest yearlings spawning in their second year of life. In addition, many females reproduce when 2+ years old while few males breed at ages older than 1 or 2. Fecundity as well as spawning behavior of the species remains unknown. It is speculated that the fish are vegetative broadcast spawners since soft mud substrates typical to relict dace habitats are often anaerobic. The relict dace is a highly secretive species. When held in laboratory tanks, the species spend most of its time hiding. In a natural environment, it is a mid-water swimmer that is seldom observed at the surface or resting on the bottom. This may be in response to potential predators such as birds. When alarmed, however, the relict dace is known to dive into the soft mud substrate or submerged vegetation of its habitat. Vegetation is a key component of the relict dace's habitat. Heavy growth of Chara, Nasturtium, Potamogeton, Utricularia, filamentous algae, rush (bull and spike), moss, and Carex are characteristic of relict dace habitats (Crookshanks 2006; Hubbs and Miller 1975; Sigler and Sigler 1987).

CONSERVATION CHALLENGES:

Although relict dace occur at multiple locations, all populations are isolated except within larger spring complex systems. Many sites are on private lands and do not have agreements in place to insure persistence and prevent alteration. Several sites have been impacted by the introduction of warm-water and cold-water game fish species, and sites in Spring and Goshute valleys are subject to future threats from surface and groundwater development. Spring Valley is likely not within the historic distribution of the species and all extant Spring Valley populations are introduced, but those sites represent important conservation for the species. Occupied sites not associated with deep carbonate aquifer flow sources may be particularly threatened by future climate change scenarios.

NEEDS:

Research Needs: Additional information on life history and habitat requirements; impacts of flow changes on habitat availability and suitability are needed.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian, Marshes.

Monitoring and Existing Plans: A sub-set of relict dace populations in Spring Valley are included in the Biological Monitoring Plan for the Spring Valley Stipulation (BWG 2009) but no comprehensive monitoring or management plan exists for the species range-wide. Annual monitoring is conducted for populations included in the BWG plan but other populations are monitored only on a biennial or less frequent basis. The most recent range-wide assessment of the species was completed in 2006 (Crookshanks 2006).

Approach: Monitoring will be continued at least annually at sites included within the Spring Valley Stipulation monitoring requirements. Although annual monitoring is likely not needed for all populations, a comprehensive management strategy and plan should be developed to insure periodic monitoring of isolated populations and the persistence of the species across its range. A mechanism is needed to cooperatively protect important populations on private lands to prevent their future loss or alteration.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian, Marshes.

Virgin River chub *Gila seminuda*

WAP 2012 species due to its federal endangered status, degraded habitat quality, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Population declining.

DISTRIBUTION: In NV, the Virgin River chub historically occupied all of the Virgin River to its confluence with the Colorado River. Current occupancy includes 80 km of the Virgin River's main river channel at and above Mesquite NV, with only occasional occurrence below that point. Chub are rare in NV reaches of the Virgin River but occur with increased frequency upstream in AZ and UT reaches.

GENERAL HABITAT AND LIFE HISTORY:

The Virgin River chub prefers rocky runs, rapids, and pools. It is most common in deeper areas where waters are swift but not turbulent and generally associated with boulders or other cover.

Virgin River chub feed mainly on debris and chironomids in February; cladophora and debris in June; debris, spirogyra, and cladophora in September; and unidentified drift animals, dragonfly larvae, debris, and cladophora in December. Young feed almost exclusively on macroinvertebrates whereas adults (>110 mm TL) feed almost entirely on algae and debris (Greger and Deacon 1988). Cross (1978) found that the diet was up to 90% algae.

Eggs possibly may be laid in gravel or cobble substrates of pools or moderate velocity runs (Sublette et al. 1990). The Virgin River chub spawns late spring to early summer. Eggs hatch in 4-7 days at 19° C (66° F).

CONSERVATION CHALLENGES:

Virgin River chub distribution and abundance has declined severely in the Virgin and Muddy rivers since at least the 1970s. On the Virgin River recent drought conditions and invasive saltcedar have altered aquatic habitats, but a major element in the decline of the Virgin River population has been introduced red shiner (Cyprinella lutrensis) and tilapia (Tilapia aurea). River modifications, including diversions and channelization, have fragmented habitats and directly altered aquatic habitat quality. Additional potential stressors include further habitat alteration, disease, Virgin spinedace (Lepidomeda mollispinis mollispinis) competition with or predation by introduced species, and groundwater and surface water development actions.

NEEDS:

Research Needs: Life history, distribution, recruitment, effect of agricultural diversions, non-native fish impacts and control strategies, efficacy of and strategy for population augmentations are all areas for research. Monitoring protocols (partially completed) are also needed.

Monitoring and Existing Plans: Semi-annual monitoring is conducted in the Virgin River in conjunction with the Lower Virgin River Recovery Implementation Team (RIT) and by NDOW and SNWA contractors. Existing plans include the Virgin River Fishes Recovery Plan, Draft Lower Virgin River Recovery Implementation Strategy, and Virgin River HCRP draft program plan.

Approach: Virgin River conservation activities are implemented by the Lower Virgin River RIT, under the guidance of the Virgin River Fishes Recovery Plan (USFWS 1995b). Current efforts are focused on control and containment of nonnative fishes, primarily red shiner and tilapia, restoration of habitat including control of saltcedar and other invasive plants which alter and stabilize river habitats, maintaining flows and water quality, and stocking of cultured sub-adult fish to re-establish population numbers. The Virgin River HCRP is currently under development and may provide additional resources for conservation efforts for this species.

WAP HABITAT LINKS: Warm Desert Riparian.

Virgin River chub (Muddy River pop.) *Gila seminuda pop. 2*

WAP 2012 species due to its federal endangered status, degraded habitat quality, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G1T1QS1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067

TREND: Population declining.

DISTRIBUTION: Generally found from the Paiute Diversion to Wells Siding Diversion, middle Muddy River.

GENERAL HABITAT AND LIFE HISTORY:

Virgin River chub are most often associated with deep runs or pool habitats of slow to moderate velocities, with large boulders or instream cover such as root snags. Larger adults are often collected in deeper pool habitats. Adults prefer temperatures that are approximately 24°C.

Virgin River chub are omnivorous showing considerable dietary shifts with age. They feed on debris and chironomids and other macroinvertebrates in the drift. Adults feed almost exclusively on algae and debris, up to 90% filamentous algae.

Scoppettone et al. (1996), determined the downstream distribution of native fishes of the Muddy River and its five spring-fed tributaries (Warm Springs area). Approximately 15,600 Virgin River chub were determined to be in the Warm Springs area and up to 17.1 km downstream. More recent distribution and numbers are significantly reduced with chub absent from the Warm Springs area and rare below the Wells Siding Diversion (Scoppettone et al 1999; Shattuck et al 2012). Originally thought to be a separate subspecies, Muddy River chub have been identified as Virgin River chub through recent genetic analyses (USFWS 2008b).

CONSERVATION CHALLENGES:

Observed declines of the Muddy River population may be related to cumulative effects of parasitism, changes in flow, water quality, and substrate, channelization, and the establishment of non-native fish species (USFWS, Federal Register, 24 July 1995). More recently both crayfish (Procambaris clarki) and red shiner (Cyprinella lutrensis) have become established in the middle Muddy River within the range currently occupied by chub (Shattuck et al. 2012).

NEEDS:

Research Needs: Life history, distribution, recruitment, effect of agricultural diversions, non-native fish impacts and control strategies, and efficacy of and strategy for population augmentations are all areas for research. Monitoring protocols (partially completed) are also needed.

Monitoring and Existing Plans: Muddy River chub are monitored annually using hoop nets and other methods. Existing plans include the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem and the Muddy River Recovery Implementation Program (RIP) Implementation Plan. Conservation efforts are identified and implemented through the Muddy River RIP Biological Action Committee.

Approach: Muddy River efforts have emphasized control of invasive tilapia and saltcedar and development of off-site refuge locations to maintain chub adult populations and genetics.

WAP HABITAT LINKS: Warm Desert Riparian.

Virgin River spinedace *Lepidomeda mollispinis mollispinis*

WAP 2012 species due to habitat degradation, habitat fragmentation, and water diversion.

Agency Status	
NV Natural Heritage	G2T2S1
USFWS	No Status
State Prot	Protected Fish NAC 503.065.1
CCVI	Presumed Stable

TREND: Trend stable or increasing.

DISTRIBUTION: Tributary streams of the Virgin River basin and rarely in the mainstem Virgin River. In NV, occurs only in Beaver Dam Wash, Lincoln County.

GENERAL HABITAT AND LIFE HISTORY:

This species is most often found in rocky riffles, runs, and pools associated with headwaters (springs), creeks, and small rivers. It prefers water temperatures from 9-11°C (48-52°F). The Virgin River spinedace is usually found in shaded pools (0.5-2.0 m (1.6-6.6 ft) deep), but can also be found in runs (e.g., at Beaver Dam Wash) and in shear zones between high and low velocities with cover such as boulders, undercut banks, or vegetation. Occasionally is found in riffles in winter (Angradi et al. 1991).

The Virgin River spinedace is an opportunistic feeder. It feeds seasonally on aquatic and terrestrial insects, insect larvae, and floating plant material. It feeds at or near the surface of the water (Minckley 1973), but reportedly also feeds on the bottom. In Beaver Dam Wash, Utah, they are primarily insectivorous in late winter. Important foods include stratiomyid and hydropsyche larvae, and adult ephemeropterans and trichopterans (Angradi et al. 1991).

The Virgin River spinedace usually spawns over gravel and sand substrates at the lower ends of pools on or near the bottom (Minckley 1973). It spawns April-June and reaches maturity after one year. One- and two-year-old females spawn once/season. Three-year-old females may spawn twice in a season (Lee et al. 1980).

CONSERVATION CHALLENGES:

About 40% of the historic habitat has been lost due to human impacts, including habitat fragmentation, introduction of non-native fishes, and dewatering associated with agriculture, mining, and urbanization. These impacts continue to threaten populations (USFWS, Federal Register, 18 May 1994, 30 June 1994). In NV, the Virgin River spinedace was extirpated from historic habitat in Beaver Dam Wash in the early 1960s for unknown reasons, possibly related to dewatering associated with the construction of Schroeder Reservoir or thermal effects from storage of water in the reservoir upstream of occupied spinedace habitat.

NEEDS:

Research Needs: Extent of trout predation/competition, survival of reintroduced fish, and recruitment of reintroduced fish all require research.

Monitoring and Existing Plans: Semi-annual surveys are conducted by NDOW and UDWR to evaluate the reintroduction effort in Beaver Dam Wash. Existing plans include the Virgin Spinedace CAS and the Watch List species in the Clark County MSHCP.

Approach: Rangewide conservation efforts are directed by implementation of the Virgin Spinedace Conservation Agreement and Strategy (UDWR 2002). This will reestablish and maintain required water flows and restore 50% of lost historical habitat. For NV, identified actions are re-establishment of a viable population in Beaver Dam Wash within historic habitat, using fish from the lower Beaver Dam Wash populations in UT and AZ. Reestablishment efforts have been ongoing since 1997 and appear to be successful with evidence of a persistent recruiting population in Nevada reaches of Beaver Dam Wash.

WAP HABITAT LINKS: Warm Desert Riparian.

Wall Canyon sucker — *Catostomus sp. 1*

WAP 2012 species due to threats from exotic invasive species and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G1S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Fish NAC 503.065.1
CCVI	Moderately Vulnerable

TREND: Declining population due to invasive crayfish and non-native brown trout.

DISTRIBUTION: Known distribution from Wall Canyon Creek and a single tributary (Mountain View Cr.) Washoe County.

GENERAL HABITAT AND LIFE HISTORY:

Known only from Wall Canyon and Mountain View creeks.

CONSERVATION CHALLENGES:

Stream banks and riparian vegetation are subject to damage from overgrazing. Annual stream surveys in these waters indicated that the Wall Canyon Sucker was being displaced and moving further up into headwater sections. Efforts to physically eradicate non-native piscivorus trout were unsuccessful. Although trout stocking has ceased, self-sustaining populations remain and are moving further upstream.

NEEDS:

Research Needs: Monitor impact of grazing practices on habitat. Need information on suitable habitat and reproduction.

Monitoring and Existing Plans: Annual surveys are conducted by NDOW. A Wall Canyon Sucker Working Group was created to address issues impacting the sucker, and a Wall Canyon Sucker Conservation Agreement and Strategy was written in 2002.

Approach: One of the major accomplishments in June of 2007 was building a trout barrier to prevent them from moving any farther into the suckers current habitat. In 2010, additional grant funding for assisting and construction of a barrier on Mountain View Creek to further reduce impacts from non-native species, was procured from the Desert Fish Habitat Partnership non-native fish and crayfish impacts.

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs.

Warm Springs Amargosa pupfish *Cyprinodon nevadensis pectoralis*

WAP 2012 species due to its federal endangered status, small population size, degraded habitat, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G2T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Small stable to increasing population.

DISTRIBUTION: Endemic to several small thermal spring systems within Ash Meadows National Wildlife Refuge, Nye County NV. This subspecies of Amargosa pupfish occurs only within a complex of 7 small thermal springs within an area of less than 2.6 km2 (1 square mile), near Devils Hole.

GENERAL HABITAT AND LIFE HISTORY:

Habitats are small springs with source pools <2m diameter or absent (Soltz and Naiman 1978). These low-discharge, warm (30-31° C (86-88 F)) and constant temperature thermal springs and their outflows are largely isolated from each other.

The Warm Springs Amargosa pupfish represents one of the world's smallest self-sustaining vertebrate populations ranging from 20 to 150 individuals each. It is the smallest of the C. nevadensis subspecies with a shorter, deeper body, more numerous pectoral fin rays and general absence of pelvic fins. It spawns most of year, with the peak in April-June.

CONSERVATION CHALLENGES:

Primary threats are lowering of water table and competition and predation by introduced fishes and crayfish. Threats related to water development (for agriculture and residential development) have been decreased with the establishment of the Ash Meadows NWR, but potential future threats continue from proposed groundwater development activities. Threats posed by introduced fishes and crayfish remain. This pupfish subspecies occurs in small spring outflow habitats and more aggressive active management may be required to maintain habitat quality and avoid loss from encroachment of dense vegetation and sedimentation.

NEEDS:

Research Needs: Continued monitoring of populations and habitat is necessary. Research is needed to determine effective genetic population size, develop design/habitat parameters for site restorations.

Monitoring and Existing Plans: Surveys are conducted annually by Ash Meadows NWR and NDOW. Included in the Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada. Ongoing restoration activities include, exotic crayfish removal and recent land acquisition to increase protected habitat. A genetic management plan was completed (Martin 2010).

Approach: Ensure the perpetuation of multiple viable populations. Continue focused restoration efforts on key habitats. Monitor and control occurrence of introduced aquatic species. Monitor habitat quantity and quality and implement maintenance activities to preserve habitat characteristics as required. Monitor spring flows. See Ash Meadows Species Recovery Plan (USFWS 1990b). Maintenance of the full complex of source pools and headwaters is essential to prevent extinction of the species (Minckley et al. 1991).

WAP HABITAT LINKS: Springs and Springbrooks.

Warner sucker *Catostomus warnerensis*

WAP 2012 species due to its limited range, habitat modifications, and ESA listing status, and moderate vulnerability to climate change.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LT
BLM-NV	Sensitive
State Prot	Protected Fish NAC 503.065.1
CCVI	Moderately Vulnerable

TREND: Trend is stable however, the distribution of this taxon was found to be patchy with distinct areas of relatively high abundance.

DISTRIBUTION: Although it occurs more extensively within the Warner Basin, Oregon, currently within Nevada it is found in patchy distributions in Twelvemile Creek and, most likely, a few of its tributaries most notably Rock Creek.

GENERAL HABITAT AND LIFE HISTORY:

Historically abundant and widely distributed in the basin, the Warner sucker still maintains sizable numbers in a few habitats. It is still known to occur in most lakes, sloughs, and potholes, except during drought years. Stream resident populations are found in Honey and Twentymile creeks and tributaries (including Twelvemile Cr. in NV). In most habitats the Warner sucker is rare, although aggregations of spawning adults or young-of-the-year may be encountered. The Warner sucker inhabits the lakes and low gradient stream reaches of the Warner Valley. The metapopulation of Warner suckers is comprised of two life history forms: lake and stream morphs (Scheerer 2009). Larvae are found in shallow backwater pools or on stream margins where there is no current, often among or near macrophytes (aquatic plants). Young-of-the-year use deep still pools, but also move into faster flowing areas near the heads of pools. Adults use stretches of stream where the gradient is low enough to allow the formation of long, >50 meters (>164 feet), pools. These pools tend to have undercut banks, large beds of aquatic macrophytes, root wads or boulders, a vertical temperature differential of at least 2º C (35.6º F), a maximum depth >1.5 meters (>5 feet), and over-hanging vegetation (Richardson 2009).

CONSERVATION CHALLENGES:

General stream channel and watershed degradation from livestock grazing has caused hydrologic impacts to sucker habitat. In addition, numerous small, agricultural diversion dams on creeks reduce stream flows and prevent migrations of adults and young. The Warner sucker has a limited range, with only one stream in NV. It is listed as ESA Threatened.

NEEDS:

Research Needs: There is an ongoing study of PIT Tagging adults for movement studies.

Monitoring and Existing Plans: Existing plans include the Recovery Plan for Threatened, the Rare Native Fishes of Warner Basin 1998 and USESA Threatened Fish with Critical Habitat delineated. Yearly population and distribution surveys are done by ODFW. Construction of a fishway for passage over a diversion dam on Twentymile Creek. The Bureau of Land Management and the USDA Forest Service have altered their grazing and forest management practices to improve habitat for Warner suckers. Additional conservation measures are needed, including improvement of stream habitat and watershed conditions throughout the Warner Basin, re-establishing migration corridors, screening irrigation diversions, controlling exotic fishes, and maintaining adequate water supplies for fish.

Approach: Current restoration and connectivitiy measures of Twentymile and Twelvemile Creeks should continue.

WAP HABITAT LINKS: Intermountain Riparian.

Warner Valley redband trout — *Oncorhynchus mykiss pop. 4*

WAP 2012 species due to limited distribution and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5T2QS1
USFWS	No Status
USFS-R5	Sensitive
CCVI	Highly Vulnerable

TREND: Warner Valley redband trout abundance declined by 23% since last surveyed intensively in 2007. However, 2010 estimates show over a 50% decline from the previous two level sampling years (Miller et al 2010).

DISTRIBUTION: Restricted to the Twelvemile Creek and its tributary Rock Creek in extreme northwestern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Redband trout (O. m. newberrii) inhabit streams in arid environments, ranging from montane forests to desert shrub and grasslands (Benhke 1992), where extreme fluctuation in flow and temperature are common. Great Basin redband trout populations persist in fragmented habitats and are isolated from core riverine groups. Redband trout populations in all of these pluvial lake basins have evolved adfluvial life histories, such that many populations may have further adapted to these unique environments.

CONSERVATION CHALLENGES:

Factors, other than seasonal flow, that likely affect trout productivity are flow diversions, migration barriers, riparian habitat, competition with exotic salmonids, and climate regime. Continued habitat fragmentation, degraded habitat quality and limited connectivity may hinder movement and reduce abundance. Protection of current populations requires increasing the size and extent of populations, maintaining genetic and life history diversity, increasing connectivity, minimizing anthropogenic stressors, and improving adaptive management.

NEEDS:

Research Needs: Multi-year intensive monitoring by Oregon Department of Wildlife is ongoing.

Monitoring and Existing Plans: Annual population surveys are done by ODFW and will continue through 2012 at which time the program will be reassessed by ODFW. Limited access, due to denial from private land owners (roughly 60%), has been an issue for surveying and determining entire distribution (Dambacher et al. 1999). This species was proposed for federal listing in 1998 but found "Not Warranted." Warner Valley redband trout are currently studied under Oregon's State Management Unit (SMU) program to address conservation needs, recovery efforts and management actions on native fishes in the state.

Approach: Continue yearly sampling, particularly at the stratum level and at annual established survey sites. Continue to study the yearly effects of natural variation. Redband are limited by flow diversions, migration barriers, degraded riparian habitat, competition with nonnative salmonids, and climate regime. Protection of current populations requires increasing the size and extent of populations, maintaining genetic and life history diversity, increasing connectivity, minimizing anthropogenic stressors such as water withdrawals, nonnative salmonids, and improving adaptive management.

WAP HABITAT LINKS: Intermountain Riparian.

White River desert sucker — *Catostomus clarkii intermedius*

WAP 2012 species due to loss of historic populations, habitat fragmentation, threats from water development and exotic invasive species, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G3G4T1T2QS1S2
USFWS	No Status
State Prot	Protected Fish NAC 503.065.1
CCVI	Highly Vulnerable

TREND: Population declining except for Flag Spring population at Kirch WMA.

DISTRIBUTION: Limited to isolated spring, stream and spring outflow systems in White Pine and Nye Counties, NV.

GENERAL HABITAT AND LIFE HISTORY:

No specific life history information is available for this sub-species. Basic life history requirements are assumed to be similar to other desert suckers which inhabit isolated pond and spring outflow systems

CONSERVATION CHALLENGES:

Distribution and abundance of this subspecies have declined since 1981, with some isolated populations apparently lost in spring/outflow systems in the Preston/Lund area, White Pine County. Primary impacts have been from alteration, fragmentation and loss of spring and outflow habitats, loss of connectivity between these habitats, and the introduction of nonnative competitors and predators. Potential future threats exist from proposed ground and surface water development projects. The majority of locations for this subspecies are on private lands which are not included under any type of agreements or easements which would assure long-term security and protection.

NEEDS:

Research Needs: Life history information to assist in development of habitat restoration strategies is needed, in addition to, a better definition of taxonomic relationship to other desert suckers (Starnes 1995).

Monitoring and Existing Plans: Desert sucker are monitored periodically in conjunction with other efforts for White River native fishes, by NDOW, USFS and USFWS, but there is no monitoring program specifically for this species. White River Native Fishes Management Plan.

Approach: Conservation actions are reviewed and implemented through the White River Native Fishes RIT which meets semi-annually. The White River Native Fishes Management Plan (NDOW 2001) provides management guidance. Current efforts are focused on the restoration and enhancement of habitats, control of nonnative predators/competitors, and developing agreements with private landowners to insure access to all extant populations and long-term protection and management of occupied habitats. A more comprehensive scheduled monitoring strategy is needed to gauge success of conservation efforts. (Scoppettone and Rissler 2002). NDOW is developing a Programmatic Candidate Conservation Agreement with Assurances to assist in the development of landowner agreements for private land conservation.

WAP HABITAT LINKS: Intermountain Riparian, Springs and Springbrooks, Lakes and Reservoirs.

White River speckled dace — *Rhinichthys osculus ssp. 7*

WAP 2012 species due to loss of historic populations, habitat fragmentation, threats from water development and exotic invasive species, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5T2T3QS2S3
USFWS	No Status
BLM-NV	Sensitive
CCVI	Moderately Vulnerable

TREND: Trend is unknown except for Flag Spring population at Kirch WMA, which is stable.

DISTRIBUTION: Found in upper portions of pluvial White River including Flag Springs outflow, a select few springs in the Lund area and portions of the upper White River.

GENERAL HABITAT AND LIFE HISTORY:

No specific life history or habitat use information is available for this subspecies. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge.

CONSERVATION CHALLENGES:

Small local populations are vulnerable to habitat alteration and exotic species. Reasons for decline include dewatering of springs, headwaters, and middle portions of major streams, water impoundment, channelization, diversion, regulation of discharges, and interactions with non-native species (Minckley 1985, Moyle et al. 1989). See Taylor et al. (1989) for information on negative impact of cattle on desert spring populations (chemical alteration of water).

NEEDS:

Research Needs: Annual monitoring and surveys at established locations, in addition to, a comprehenisve inventory of all potential waters that have suitable habitat, are needed.

Monitoring and Existing Plans: The Upper White River RIT team was formed in 2000. Protections exist within the critical habitat as it co-occurs with White River spinedace. Annual NDOW surveys occur on some known populations.

Approach: Continue habitat enhancements and conservation measures including reintroduction efforts.

WAP HABITAT LINKS: Intermountain Riparian.

White River spinedace *Lepidomeda albivallis*

WAP 2012 species due to its federal endangered status, loss of historic populations, limited population size, limited distribution, and threats of groundwater development.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend is stable.

DISTRIBUTION: Upper White River drainage, Nye and White Pine Counties NV. Presently occurs only within a single spring and outflow system at Kirch Wildlife Management Area, Nye Co.

GENERAL HABITAT AND LIFE HISTORY:

The White River spinedace occurs in cool, clear springs and their outflow systems, over sand and gravel substrate. It seems to prefer shallow areas (0.5-1.5 m (1.6-4.9 ft) deep) (Lee et al. 1980). The most common aquatic plants in its habitat are watercress, pondweed, rush, and cattail. Surrounding vegetation is needed for shade and as habitat for insects upon which the spinedace feeds (Matthews and Moseley 1990).

This species is omnivorous but feeds primarily on aquatic invertebrates. It also ingests plant material, algae, and detritus (Scoppettone et al. 2004).

The White River spinedace is believed to have evolved in clear, cool waters within Pluvial White River System, NV (Lee et al. 1980). It is highly localized in a small area. Its range in mid-1900s included Preston Big Spring; Nicholas, Arnoldson, Cold, Lund, and Flag springs; and the White River near its confluence with Ellison Creek.

CONSERVATION CHALLENGES:

This species occurred in at least seven locations in the 1930s but is now reduced to a single secure population in the wild (Scoppettone et al 2004). Principal threats resulting in loss of populations include habitat alteration (channelization, diversion of springs) and introductions of nonnative competitors and predators including mosquitofish, guppies, and largemouth bass. Development and alteration of spring outflows has fragmented remaining habitats. Because of bright coloration and behavior this species is especially vulnerable to aquatic and avian predators. Potential future threats exist from proposed ground and surface water development projects. The majority of historic habitats for this species are on private lands which are not included under any type of agreements or easements which would assure long-term security and protection.

NEEDS:

Research Needs: Habitat utilization and relationship studies are needed to assist in developing restoration strategies for historic habitats.

Monitoring and Existing Plans: Semiannual status and population monitoring is conducted by NDOW and USFWS. White River Native Fishes Management Plan.

Approach: Conservation actions are reviewed and implemented through the White River Native Fishes RIT which meets semi-annually. The White River Native Fishes Management Plan (NDOW 2001) provides management guidance. Current efforts are focused on maintenance of existing occupied habitat and the restoration and enhancement of historic habitats to support re-establishment efforts, control of nonnative predators and competitors, and developing agreements with private landowners to provide locations to re-establish populations and provide long-term protection and management of those historic habitats. Efforts are ongoing to establish a second population on public lands in upper White River Valley.

WAP HABITAT LINKS: Intermountain Riparian, Springs and Springbrooks.

White River springfish *Crenichthys baileyi baileyi*

WAP 2012 species due to its federal endangered status, habitat degradation, and threats from exotic invasive species and recreational activities.

Agency Status	
NV Natural Heritage	G2T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend is stable.

DISTRIBUTION: Endemic to pluvial White River drainage in Pahranagat Valley, this subspecies baileyi occurs only in Ash Spring and outflow, Lincoln County NV.

GENERAL HABITAT AND LIFE HISTORY:

According to Tuttle et al (1990) few springfish were observed in the Ash Springs outflow; no more than three were sighted in any one season in three years of study. Virtually the entire White River springfish population occurred in Ash Springs pool. Population estimates varied considerably over the three year study and ranged from 1,050 in the fall of 1986 to 2,685 in the winter of 1988. Only adults (> 25 mm TL) were counted. There was no apparent seasonal pattern for abundance. Adult White River springfish were found in a wide range of total water depths, reflective of the wide range of depths available in Ash Springs pool. Focal depth (depth from bottom) and relative depth (percent of total water depth) suggest the majority were closer to the bottom. Juveniles (10 to 25 mm TL) and larvae (< 10 mm TL) generally occurred in shallower water, and were more vertically dispersed than adults. Virtually all springfish occurred in pool habitat at zero velocity. Other life history characteristics for White River springfish are similar to other C. baileyi subspecies.

CONSERVATION CHALLENGES:

This subspecies of White River springfish occurs at only a single spring and spring outflow location with the majority of occupied habitat on private lands. Stresses and threats exist from alteration to occupied habitats, recreational uses, and the presence of nonnative competitors and predators including convict cichlids (Cichlasoma nigrofasciatum), shortfin mollies (Poecilia mexicana), and mosquitofish (Gambusia affinis) (Courtenay et al. 1985; Tippie et al. 1991). Potential future threats exist from proposed ground and surface water development projects. The private lands containing the majority of habitat are not included under any type of agreements or easements which would assure long-term security and protection.

NEEDS:

Research Needs: Habitat preference and interspecific competition research is needed.

Monitoring and Existing Plans: Annual dive count surveys are conducted by NDOW, but access has been periodically limited on private lands. A more comprehensive survey protocol is needed to be inclusive of entire occupied habitat. Existing plans include the Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley and the Pahranagat Valley Native Fishes Management Plan.

Approach: Pahranagat Valley Native Fishes Recovery Implementation Team (RIT) meets semi-annually to review conservation status and actions and coordinate activities. RIT team implements Pahranagat Valley Native Fish Management Plan (NDOW 2000b) which identifies key goals/objectives/actions. Key conservation elements include habitat restoration and protection, and control/removal of introduced nonnative fishes in occupied habitats. Efforts to physically remove nonnative fishes from Ash Spring and its outflow are ongoing. NDOW is pursuing development of landowner agreements to provide long term security for habitat through development of a Pahranagat Valley Programmatic Safe Harbor Agreement. Priority actions include development of agreements with landowners to insure access to the single wild population and allow restoration of occupied habitats.

WAP HABITAT LINKS: Intermountain Riparian, Springs and Springbrooks.

woundfin *Plagopterus argentissimus*

WAP 2012 species due to its federal endangered status and near extirpation.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE, XN
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend unknown. May be extirpated from NV reaches of the Virgin River.

DISTRIBUTION: Occurs only in the Virgin River UT, AZ, and NV, from Pah Tempe (La Verkin) Springs, Washington County, UT, downstream through Mohave County, AZ, to Lake Mead, Clark County, NV. Occurrence of woundfin is currently rare in river reaches downstream of Littlefield, AZ.

GENERAL HABITAT AND LIFE HISTORY:

The woundfin occupies main channels of seasonally swift, highly turbid, extremely warm, small to medium rivers, with sandy, constantly shifting bottoms (Lee et al. 1980, Page and Burr 1991). It prefers runs and quiet waters adjacent to shallow riffles (Matthews and Moseley 1990). Larvae utilize shallow areas lateral to the main current. Young usually are in quiet sections or isolated pools in clear water where algae is present (USFWS 1995b). The woundfin spawns in swifter flowing water over beds of cobble or gravel. Females return to pools after spawning (Matthews and Moseley 1990).

The woundfin apparently feeds on aquatic insects, detritus and algae. Near Mesquite, Nevada, it feeds primarily on ceratopogonid larvae in February, mayflies in June, chironomids and ceratopogonids in December. Near Beaver Dam Wash, it feeds primarily on chironomid larvae and organic debris in February, Tamarix seeds, simuliid larvae, organic debris, and mayflies in June, chironomid larvae, organic debris, and spirogyra in September, and ceratopongonids, simuliid pupae, chironomid larvae, and organic debris in December (Greger and Deacon 1988).

The life span of the woundfin is apparently seldom, if ever, more than 4 years. Its reproductive cycle probably is triggered by increasing temperature and declining spring runoff in late May (Matthews and Moseley 1990). In captivity, most spawn the second spring after hatching and most survive two reproductive seasons (Minckley and Deacon 1991).

CONSERVATION CHALLENGES:

Woundfin distribution and abundance has declined severely in Nevada reaches of the Virgin River and catch rates declined significantly beginning in the 2000s. Woundfin are now extremely rare in any NV reach and apparently absent below Mesquite NV. Recent drought conditions, water diversions, and invasive salt cedar have altered aquatic habitats, but a major element in the decline of this fish in the Virgin River has been introduced red shiner (Cyprinella lutrensis) and tilapia (Tilapia aurea). More recently, gizzard shad have been detected upstream to the Mesquite area. Existing fish barriers to prevent upstream movement of nonnative species from Lake Mead are inadequate or absent. River modifications including diversions and channelization have fragmented habitats and directly altered aquatic habitat quality. Additional potential stressors include further habitat alteration, disease, competition with or predation by introduced species, and groundwater and surface water development actions.

NEEDS:

Research Needs: Artificial propagation methods, introduction techniques, habitat requirements and preferences, and interspecific interaction with other native and nonnative fishes are all areas for research. Efforts are ongoing at the Dexter National Fish Hatchery and Technology Center to research temperature tolerance levels of the species. This facility also provides the sole source of woundfin for the restocking efforts that occur in the Utah reaches of the Virgin River.

WAP HABITAT LINKS: Warm Desert Riparian.

Monitoring and Existing Plans: Semiannual monitoring surveys occur through the Virgin River Fishes Recovery Team. Additional periodic monitoring is conducted by NDOW and SNWA contractors. This species is addressed in the Virgin River Fishes Recovery Plan, the Draft Lower Virgin River Recovery Implementation Strategy, and the Virgin River HCRP draft program plan.

Approach: Virgin River conservation activities are implemented by the Recovery Team and Lower Virgin River RIT, under the guidance of the Virgin River Fishes Recovery Plan (USFWS 1995b). Current efforts are focused on control and containment of nonnative fishes, primarily red shiner and tilapia, restoration of habitat including control of salt cedar and other invasive plants which alter and stabilize river habitats, creating effective fish barriers to preclude upstream establishment of new nonnative species, maintaining flows and water quality, and stocking of cultured sub-adult fish to re-establish population numbers. Re-introduction efforts in NV to date have been limited to areas above the Bunkerville Diversion near Mesquite NV. The Virgin River HCRP is currently under development and may provide additional resources for conservation efforts for this species.

WAP HABITAT LINKS: Warm Desert Riparian.

Yellowstone cutthroat trout *Oncorhynchus clarkii bouvieri*

WAP 2012 species due to competition with brook trout, habitat issues, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G4T2S1
USFWS	No Status
USFS-R4	Sensitive
State Prot	Game Fish NAC 503.060
CCVI	Moderately Vulnerable

TREND: Although Yellowstone cutthroat populations are broadly distributed and many remain robust in headwater streams, migratory populations in large rivers and lakes have declined substantially (Meyer et al. 2006b, May et al. 2007).

DISTRIBUTION: Found only in extreme northeast NV, in Goose Creek and its tributaries, including Little Goose, Trout, Piney, and Coon creeks.

GENERAL HABITAT AND LIFE HISTORY:

Headwater populations frequently occur above migration barriers that protect them from competition, predation, and introgression from non-indigenous trout, and many of these populations are believed to be large enough to be resilient to stochastic disturbance (Kruse et al. 2001, Meyer et al. 2006b, May et al. 2007). In a recent study, Cegelski et al. (2006) determined that Yellowstone cutthroat trout were genetically structured at the major river drainage level, but evidence suggested that habitat fragmentation had altered that structure. For example, the system with the least altered migration corridors (11 major river drainages examined in the study) exhibited the highest levels of genetic diversity and low levels of genetic differentiation. High levels of genetic differentiation were observed at similar or smaller geographic scales in stream networks that have been more altered by anthropogenic activities (Cegelski et al. 2006).

CONSERVATION CHALLENGES:

Threats include introduced fishes, hybridization with rainbow trout, habitat degradation, water diversions, grazing, mineral extraction, road construction, migration barriers, streambank instability, habitat fragmentation, wildfire, and climate change. Unfortunately, isolation and fragmentation, especially in small headwater drainages, substantially increase the risk of demographic collapse (Kruse et al. 2001) following catastrophic disturbances (e.g., wildfire and subsequent flooding and debris flow events).

NEEDS:

Research Needs: Recent unpublished information suggests that Yellowstone cutthroat trout are currently present at 47 percent of 961 sites in the historical range of Idaho, Utah, and Nevada (84 percent of the sample sites were randomly selected). Recent efforts to evaluate Yellowstone cutthroat trout abundance have evolved from a qualitative assessment of density to population estimates of mature individuals in each habitat segment. Standard mark-recapture and depletion techniques are more frequently used to provide estimates of abundance and precision (Budy et al. 2007). More specifically, information concerning life-history diversity and its relationship to genetic variation are critical to the protection of the remaining populations of Yellowstone cutthroat trout.

Monitoring and Existing Plans: In 2000 an MOU among fish management agencies of all five states that YCT historically occur in was initiated to insure its persistence. A major effort of this MOU is to identify genetically unaltered populations of YCT.

WAP HABITAT LINKS: Intermountain Riparian.

Approach: It appears that the proportion of the range that supports healthy, secure core conservation populations (genetically unaltered and suspected genetically unaltered) is low. Core populations are currently found on 10 percent of its historical range, or 35 percent of the currently occupied range. Only four populations (24 km of stream habitat) exist where non-indigenous salmonids do not occur. Given the array of potential factors that are negatively affecting Yellowstone cutthroat trout populations, persistence of core populations is not certain. Conservation of the subspecies may benefit from a hierarchical approach that includes (1) protection of the strongest core conservation populations; (2) enhancement by reconnecting and replicating the core populations whenever possible; and (3) restoration of populations when practical.

WAP HABITAT LINKS: Intermountain Riparian.

Amargosa toad *Anaxyrus nelsoni*

WAP 2012 species because it is an endemic species with a very small range and relatively small population numbers.

Agency Status	
NV Natural Heritage	G2S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Amphibians NAC 503.075.2
IUCN	Endangered
CCVI	Presumed Stable

TREND: Overall stable; combined adult population estimates for sites monitored annually by NDOW have fluctuated between 1,100 and 3,000 individuals between 1998 and 2011 (USFWS 2010a).

DISTRIBUTION: Amargosa toads are endemic to the Amargosa River drainage in southwestern Nevada. Estimated known and potential Amargosa toad habitat as delineated by the Amargosa Toad Working Group in 2007 was approximately 8,440 acres (USFWS 2010a).

GENERAL HABITAT AND LIFE HISTORY:

Habitat requirements for breeding and population recruitment include the presence of open, ponded, or flowing water, with riparian vegetative cover in an early-to-intermediate successional stage to form a partial canopy for shade with minimal emergent vegetation at the water's edges. Immature (metamorphs or toadlets) and adult Amargosa toads are dependent upon the areas described above, as well as areas they can use for shelter, including burrows, debris piles, spaces under logs or rocks, and areas of dense vegetation. Adult toads also require adjacent vegetated uplands for nocturnal foraging (USFWS 2010a).

The breeding season begins in mid-February and may extend into July, during which time adults congregate at breeding sites. Amargosa toad tadpoles require relatively open water that persists long enough for the completion of metamorphosis and development into toadlets, which occur over approximately 30 days. Predation and early desiccation of wetlands needed for breeding may affect success at entire breeding sites. Although Amargosa toads typically live 4 to 5 years, individual toads are known to live up to 17 years based on data from NDOW's population monitoring program (USFWS 2010a).

CONSERVATION CHALLENGES:

Some occupied and potential habitats have been degraded by feral animal impacts, physical alteration, and development. Access for monitoring and management is restricted for some habitats on private lands. Some habitats are adversely affected by overgrowth of emergent vegetation. Some degree of disturbance may be important for toad persistence, particularly at small, isolated spring sites. Occurrence and effects of amphibian diseases (esp. Bd) are largely unknown.

NEEDS:

Research Needs: Research needs include developing methods for control of nonnative species (esp. crayfish and bullfrogs); obtaining life history information including migration and movements; researching habitat relationships including methods for maintaining habitat quality, and research on genetic relationship to other toads in lower Amargosa River drainage system. Some assessment of diseases has been conducted but additional surveys to assess occurrence and susceptibility to Bd would be useful.

Monitoring and Existing Plans: Semi-annual monitoring directed by NDOW, with assistance from partners including BLM, USFWS, NNHP, TNC, community volunteers, and others. Conservation actions are directed by the cooperative Amargosa Toad Conservation Agreement and Strategy (NDOW 2000) and the multi-agency Amargosa Toad Working Group. Amphibian disease (Bd) assessment is ongoing by UNLV in conjunction with monitoring surveys.

WAP HABITAT LINKS: Marshes, Warm Desert Riparian, Wet Meadow, Springs and Springbrooks, Lakes and Reservoirs, Desert Playas and Ephemeral Pools.

Approach: Majority of habitat is on private property, thus private-public-NGO partnerships are critical. The Town of Beatty is developing a community based conservation program which will protect toad habitat on surrounding public lands while accommodating public recreation in lieu of BLM Area of Critical Environmental Concern (ACEC) designation. TNC has purchased two ranches near Beatty for experimental habitat management (Burroughs 1999). Nye County is a cooperator with state and federal agencies in the conservation agreement (Burroughs 1999). Other private and public partners are assisting with management actions on public and private land (e.g. STORM-OV). Active management of occupied habitats to maintain intermediate seral stages and shallow water areas for breeding, and control of nonnative species, are key conservation actions.

WAP HABITAT LINKS: Marshes, Warm Desert Riparian, Wet Meadow, Springs and Springbrooks, Lakes and Reservoirs, Desert Playas and Ephemeral Pools.