Prepared in cooperation with the U.S. Bureau of Land Management

Big Spring Spinedace and Associated Fish Populations and Habitat Conditions in Condor Canyon, Meadow Valley Wash, Nevada

Open-File Report 2011–1072

U.S. Department of the Interior
U.S. Geological Survey

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Conversion Factors

SI to Inch/Pound

Multiply	By	To obtain
Length		
centimeter (cm)	0.3937	inch (in)
millimeter (mm)	0.03937	inch (in)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
kilometer (km)	0.5400	mile, nautical (nmi)
meter (m)	1.094	yard (yd)
Area		
square meter (m^2)	0.0002471	acre
square meter (m^2)	10.76	square foot (ft^2)
Volume		
cubic meter (m^3)	264.2	gallon (gal)
cubic meter (m^3)	0.0002642	million gallons (Mgal)
cubic meter (m^3)	1.308	cubic yard (yd^3)
Flow rate		
cubic meter per second (m^3/s)	70.07	acre-foot per day (acre-ft/d)
cubic meter per second (m^3/s)	35.31	cubic foot per second (ft^3/s)
cubic meter per second (m^3/s)	22.83	million gallons per day (Mgal/d)
Mass		
gram (g)	0.03527	ounce, avoirdupois (oz)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:
°F=(1.8×°C)+32
Vertical coordinate information is referenced to the insert datum name (and abbreviation) here, for instance, “North American Vertical Datum of 1988 (NAVD 88)”
Horizontal coordinate information is referenced to the insert datum name (and abbreviation) here, for instance, “North American Datum of 1983 (NAD 83)”
Altitude, as used in this report, refers to distance above the vertical datum.

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Executive Summary

This project was designed to document habitat conditions and populations of native and non-native fish within the 8-kilometer Condor Canyon section of Meadow Valley Wash, Nevada, with an emphasis on Big Spring spinedace (*Lepidomeda mollispinis pratensis*). Other native fish present were speckled dace (*Rhinichthys osculus*) and desert sucker (*Catostomus clarki*). Big Spring spinedace were known to exist only within this drainage and were known to have been extirpated from a portion of their former habitat located downstream of Condor Canyon. Because of this extirpation and the limited distribution of Big Spring spinedace, the U.S. Fish and Wildlife Service listed this species as threatened under the Endangered Species Act in 1985. Prior to our effort, little was known about Big Spring spinedace populations or life histories and habitat associations.

In 2008, personnel from the U.S. Geological Survey's Columbia River Research Laboratory began surveys of Meadow Valley Wash in Condor Canyon. Habitat surveys characterized numerous variables within 13 reaches, thermologgers were deployed at 9 locations to record water temperatures, and fish populations were surveyed at 22 individual sites. Additionally, fish were tagged with Passive Integrated Transponder (PIT) tags, which allowed movement and growth information to be collected on individual fish. The movements of tagged fish were monitored with a combination of recapture events and stationary in-stream antennas, which detected tagged fish.

Meadow Valley Wash within Condor Canyon was divided by a 12-meter (m) waterfall known as Delmue Falls. About 6,100 m of stream were surveyed downstream of the falls and about 2,200 m of stream were surveyed upstream of the falls. Although about three-quarters of the surveyed stream length was downstream of Delmue Falls, the highest densities and abundance of native fish were upstream of the falls. Big Spring spinedace and desert sucker populations were highest near the upper end of Condor Canyon, where a tributary known as Kill Wash, and several springs, contribute flow and moderate high and low water temperature. Kill Wash and the area around its confluence with Meadow Valley Wash appeared important for spawning of all three native species. Detections of PIT-tagged fish indicated that there were substantial movements to this area during the spring.

Our surveys included about 700 m of Meadow Valley Wash upstream of Kill Wash. A small falls about 2 m high was about 560 m upstream of Kill Wash. This falls is likely a barrier to upstream fish movement at most flows. Populations of all three native species were found upstream of this small falls. Age-0 fish of all three species were present, indicating successful spawning. The maximum upstream extent of native fish within Meadow Valley Wash was not determined.

There was a limited population of Big Spring spinedace downstream of Delmue Falls, primarily concentrated in the first 2,000 m downstream. No Big Spring spinedace and very few speckled dace or desert sucker were found within the lower 3,200 m of Condor Canyon.

A population of non-native rainbow trout (*Oncorhynchus mykiss*) was found within the 2,000 m of stream immediately downstream of Delmue Falls. Non-native crayfish were very common both upstream and downstream of Delmue Falls. We were not able to quantify crayfish populations, but they compose a significant portion of the biomass of aquatic species in Condor Canyon.

There were some distinctive habitat features that may have favored native fish upstream of Delmue Falls. Upstream of the falls, water temperatures were moderated by inputs from springs, turbidity was lower, pool habitat was more prevalent, substrate heterogeneity was higher, and there was less fine sediment than downstream of Delmue Falls. Additionally, watercress (*Nasturtium* spp.) was more common and bulrush (*Scirpus* spp.) and cattail (*Typha* spp.) were less common upstream of than downstream of Delmue Falls. Differences in these habitat variables likely make Meadow Valley Wash upstream of Delmue Falls more favorable to native fish than downstream of the falls.

Managers may wish to take steps to protect and preserve the areas currently providing habitat for robust populations of native fish at the upstream end of Condor Canyon, including Kill Wash and the section of Meadow Valley Wash upstream of its confluence with Kill Wash. Restoration actions may be warranted in areas downstream of Delmue Falls to attempt to improve habitat conditions there. Additional investigations into the role and effects of non-native rainbow trout and crayfish would be helpful, and control measures to reduce their populations may be desirable.

Introduction

Big Spring spinedace (*Lepidomeda mollispinis pratensis*) is a species whose entire known range lies within an 8-kilometer (km) section of Meadow Valley Wash (MVW), mostly within the confines of Condor Canyon, near the town of Panaca, Nevada. Big Spring spinedace were first documented in 1938 in the outflow stream of Big Spring (also referred to as Panaca Spring), which flows into MVW just downstream of the downstream end of Condor Canyon (Miller and Hubbs, 1960). At the time, only seven individuals were found. Surveys of Big Spring and MVW in 1959 failed to find any Big Spring spinedace, and they were believed extinct (Miller and Hubbs, 1960), although Condor Canyon was not surveyed. In 1977, a population was found in MVW just downstream of a large waterfall (Delmue Falls) in Condor Canyon (Allan, 1983). Some larval Big Spring spinedace were transplanted to sites about 1.5 km upstream of the falls in 1980 (R.C. Allen, Nevada Department of Wildlife, unpub. data, 1985). In 1981, adult Big Spring spinedace were found upstream of the waterfall (R.C. Allen, Nevada Department of Wildlife, unpub. data). There is some evidence in the literature that spinedace may be able to mature in 1 year (Scoppettone and others, 2004); thus, it is not known if Big Spring spinedace were present upstream of the falls prior to 1980. Big Spring spinedace were listed as threatened under the Endangered Species Act in 1985 (Federal Register, 1985). This listing also identified “critical habitat” for the Big Spring spinedace as MVW within Condor Canyon. The listed critical habitat does not extend upstream of the Canyon.

The Ely District of the Bureau of Land Management (BLM) is required to design and implement studies to characterize and identify essential habitat of juvenile and adult Big Spring spinedace and to describe their reproductive habits and population dynamics. Some initial planning documents and assessments have been produced [Condor Canyon Habitat Management Plan (Bureau of Land Management, 1990); Big Spring Spinedace Recovery Plan (U.S. Fish and Wildlife Service, 1993)] agency. In 2004, the BLM Ely District submitted the “Meadow Valley Wash T&E Habitat Restoration/Noxious Weed Control” project proposal with objectives to implement some portions of the Condor Canyon Habitat Management Plan and the Big Spring Spinedace Recovery Plan. The proposal was funded as a Round 6, Southern Nevada Public Land Management Act Conservation Initiative. The current Ely District requirement is related to implementation of this Conservation Initiative.

In 2008, BLM contracted the U.S. Geological Survey’s Columbia River Research Laboratory (USGS-CRRL) to conduct an assessment of fish populations and habitat in MVW with an emphasis on Big Spring spinedace. Other native fish species present were speckled dace (*Rhinichthys osculus*) and desert sucker (*Catostomus clarki*). Although it is the last known location of a population of Big Spring spinedace, Meadow Valley Wash had experienced a number of disturbances prior to our study. Beginning in the late 1800s, railroad activity had confined much of the channel in Condor Canyon. In places, the channel was diked and straightened to protect the railroad. A wildfire in 1999 burned much of Condor Canyon, and many trees and shrubs in the riparian corridor were lost. In 2008, we found that cattail (*Typha* spp.) and bulrush (*Scirpus* spp.) (both native species) had become extremely dense in portions of the channel, forming mats of live and dead material. Crayfish were introduced to MVW (date of introduction unknown) and were extremely common in Condor Canyon and the 700-m portion of MVW upstream of the canyon during our study. Rainbow trout (*Oncorhynchus mykiss*) had also been introduced to MVW and were found in portions of MVW downstream of Delmue Falls in our study. Largemouth bass (*Micropterus salmoides*) and white crappie (*Poxomis annularis*) had been reported in Condor Canyon (U.S. Fish and Wildlife Service, 1993). Tamarisk (*Tamarix rammosissima*), an introduced tree species, was common in the riparian area despite ongoing efforts to control it. Cattle and sheep grazing had occurred in the study area (due to available access to unfenced stream and riparian areas) and continued during our work.

The objectives of the contracted study were to: (1) assess the stream-habitat conditions of MVW within Condor Canyon; (2) determine abundance and distribution of native and non-native fish within Condor Canyon, with emphasis on Big Spring spinedace; (3) assess age structure, growth rate, and movement of native and non-native fishes within Condor Canyon, with emphasis on Big Spring spinedace; and (4) summarize findings to assist managers with options for restoration efforts and management actions that are most likely to increase the probability of persistence of the native fish species of MVW in Condor Canyon. This summary report details field work completed from June 2008 through January 2010. We provide descriptive data and baseline information that should elucidate further management options. This work also provides a foundation for further analysis and research.

Description of Study Site

The 8-km section of MVW in and above Condor Canyon is a scenic, rugged, steep-walled canyon located northeast of the town of Panaca, Lincoln County, Nevada, in sagebrush steppe. The canyon’s elevation at stream level ranges from 1,400 to 1,600 m and air temperatures typically vary from -18°C in winter to 38°C in summer. Our study section began at the downstream end of the canyon [for purpose of this study we reference it as river kilometer (rkm) 0.0] and ended at Delmue Ranch Road (rkm 8.2; fig. 1). An abandoned railroad grade followed MVW for the length of our study section and in many places confined the stream channel. Within our study section, MVW was often deeply entrenched.

A 12-m-high falls was located at rkm 6.1 (hereafter referred to as “Delmue Falls”). Delmue Falls was a barrier to upstream fish movement. At rkm 7.2, a spring at the base of a cliff to the west (hereafter referred to as “Box Spring” because of the constructed wooden trough present there) created a small marsh. This marsh was disconnected from MVW by the railroad grade but likely contributed subterranean flow. Kill Wash, a small tributary, entered MVW from the east at rkm 7.4, and several springs entered from the pasture to the west. Upstream of rkm 7.4, Meadow Valley Wash was no longer within Condor Canyon but flowed through a landscape of pasture on the west side and rolling hills to the east. A second falls was located at rkm 7.9. It was about 2 m high with several distinct ledges. This falls is most likely a barrier to upstream movement of native fish at most flows.

Methods

Habitat Sampling

To assess habitat occupied by Big Spring spinedace, we surveyed MVW within the fish’s known range (approximately 8 km) from June through September 2008 (figs. 2 and 3; appendix A). We divided the study area into 12 different reaches and included Kill Wash as a separate reach (“Trib” in fig. 2). We measured temperature and flow and conducted reach-scale and habitat-unit-scale habitat surveys. Additional habitat measures were taken at fish-sampling sites.

Temperature

We installed and maintained nine temperature-data loggers (Onset Hobo Water Temp Pro v2; hereafter “thermologgers”) throughout MVW. Deployment locations were selected to determine the influence of major spring inputs throughout Condor Canyon and to assess temperature differences within the study area (figs. 4 and 5; appendix A). Thermologgers were placed at the lower end of the sampled area (TR09), downstream of Delmue Falls (TR05), in the mainstem just downstream of Kill Wash (TR01), in Kill Wash (TTR1), in the mainstem upstream of Kill Wash (TRBL), and at the upper end of the sampled area (TR0A). Additionally, two thermographs were placed downstream of the input of two spring systems (TRBU and TR02) and in the box spring (TBOX). Seven units were installed in June 2008 and two units were installed in August 2008 (appendix A). Water temperature was recorded once per hour. Data were downloaded in October 2008, March 2009, October 2009, and February 2010.

Streamflow

Streamflow sites were located in the upper (FSU), middle (FSM), and lower (FSB) portions of the canyon (figs. 6 and 7; appendix A). An additional streamflow site was located in Kill Wash (FST). We measured streamflow on a weekly basis at these four sites from July 8 through November 18, 2008. During 2009, we measured streamflow in March and October, when we were present for fish surveys. Flow measurement followed the protocol of Gallagher and Stevenson (1999). We measured water depth with a top-setting wading rod and water velocity with a Marsh-McBirney Flo-Mate flow meter. Because water depths were always less than 0.75 m, water velocities were measured at 60 percent of the depth from the surface at each interval.

To provide a more continuous measure of flow and capture timing of high and low flow, three water-level loggers (Onset HOBO Water Level Logger) were deployed on September 8, 2008 (figs. 6 and 7; appendix A). One was placed near the upstream end of the canyon (WLRB), one in the downstream end of the canyon (WLR9), and one in Kill Wash (TRIB). The water-level loggers recorded water-level data every 15 minutes. A fourth logger (also a HOBO Water Level Logger) recorded data for barometric pressure compensation. All units were protected with a PVC stilling well, which provided a protective sleeve, and were mounted on fence posts driven into the streambed.

Turbidity

We periodically measured turbidity in Nephelometric Turbidity Units (NTU; Earhart, 1984) at the four flow sites (figs. 6 and 7; appendix A). Turbidity was measured concurrently with flow during autumn 2008 on about a 2-week interval. Turbidity also was measured three times during March 2009. We used a Hach 2100P Turbidimeter to read turbidity in cleaned vials filled with stream water at each site.

Reach Survey

Before surveying the canyon, we delineated 13 reaches that were based on geomorphic features. Ten of these reaches were described in PBS&J (2007). Our study area contained two additional reaches in mainstem MVW from the north end of Condor Canyon to the Delmue Ranch Road culvert (rkm 8.2). Additionally, we added one reach in Kill Wash, which entered MVW from the east at the northern end of Condor Canyon (rkm 7.4). Reach surveys were conducted from mid-June through mid-August 2008.

Reach-survey data were divided into two measurement categories: transect and interval. Starting at the downstream end of each reach, we took transect measurements every 20 m along the thalweg and interval measurements over the 20 m of stream between transects. At each transect, we measured wetted width, then measured distance from wetted to bankfull, from bankfull to confinement, and from bankfull to hillslope on each bank. The type of confinement agent was recorded (terrace, hillslope, etc). We calculated the confinement ratio at each transect as confinement width divided by bankfull width (Arend, 1999). A confinement ratio less than 2 was considered confined, 2 to 4 moderately confined, and greater than 4 unconfined. Due to the length of Reaches 9 and 10, we increased distance between confinement measures to 100 m. We measured depth and substrate-type (mud/clay/silt, sand, gravel, cobble, boulder, and other) at three points across the wetted width of the stream (0.25x, 0.50x, 0.75x, x = wetted width). At the transect midpoint, we used a densitometer to record percent coverage of three canopy types: conifer, hardwood, and shrub. In the 20-m intervals between transects, we measured thalweg gradient, counted large woody debris (LWD: classified as diameter greater than 25 cm and length at least 1 m), and counted boulders (diameter greater than or equal to 0.5 m). Dominant and subdominant aquatic and riparian vegetation were identified to genus. Percent stream cover of watercress was estimated and recorded. We noted any springs or tributaries and measured the length of any side channels.

Habitat-Unit Survey

A habitat unit survey was conducted from late August 2008 through mid-September 2008. Beginning at the lower end of the canyon and working upstream, we identified habitat units by type (pool, glide, riffle, and step), recorded habitat unit dimensions (length, width, and maximum depth), and estimated cover (in-stream and overhead) for each unit. Pools were defined as units with low water velocity, smooth surface, and a depth such that the unit would hold water even if flow ceased

(Kaufmann and others, 1999). Glides were defined as having laminar flow, medium velocity, and would not hold water if flow ceased. Riffles were defined as shallow and turbulent with higher gradient. A step was defined as a short unit, generally less than 0.5 m long, with a vertical or near vertical drop (for example, a small falls over a downed log).

Habitat at Fish-Sampling Sites

During autumn 2008, spring 2009, and autumn 2009, we took habitat measurements concurrently with fish population sampling at 22 sites (figs. 8 and 9; appendix A). We measured site length, width, depth, and substrate types at each site. During autumn 2008, we took these data at five transects within the site (0.0x, 0.25x, 0.50x, 0.75x, and 1.0x the length of site). Wetted width was recorded. Depth and substrate type (mud/clay/silt, sand, gravel, cobble, boulder, and other) were recorded at three points (0.25x, 0.50x, 0.75x wetted width). During spring and autumn 2009, we increased the number of transects to seven per sampling site (0.0x, 0.17x, 0.33x, 0.50x, 0.67x, 0.83x, and 1.0x the length of site). These population site habitat data are presented in appendix A.

Fish Sampling

Populations

We established 22 fish population sampling sites (figs. 8 and 9; appendix A) in autumn 2008. Each site was about 25 m long. We included 7 existing Nevada Department of Wildlife (NDOW) sites in our sampling design and established 15 additional sites so that each geomorphic reach would contain at least 1 fish sampling site. Eleven sites were located upstream of Delmue Falls and 11 sites were downstream of the falls. To choose new fish sampling sites, we selected habitat that generally was representative of the reaches where they would be located, which was dependent on professional opinion. We repeated population sampling in spring 2009 using the same sites as used in 2008. We added a site in Reach 6 because BLM personnel were contemplating using it as a template for restoration of other areas of MVW and because we wanted to insure that Reach 6 was well represented. Population sampling was repeated for a third time in autumn 2009. We did not repeat sampling in Reach 7 during either spring 2009 or autumn 2009 because the site was incorrectly measured in 2008 and contained a side channel that could not be sampled due to thick vegetation, but that likely contained fish.

Population sampling sites were blocknetted during each population-sampling effort to prevent immigration or emigration. A backpack electrofisher was used to conduct three to five passes under the removal-depletion methodology (Zippin, 1956; Bohlin, 1982; and White and others, 1982). Electrofishing settings were 160 Volts (V), 30–60 Hertz (Hz). The NDOW sites were sampled with NDOW personnel according to their protocols, which called for three passes at each site. At USGS sites, we based the number of passes on the pattern of reduction. We calculated length frequencies by species to determine age class (age-0, age-1 or older) and then used the field guides of Connolly (1996) to ensure a controlled level of precision in the population estimate was achieved (CV less than 25 percent for the youngest age class; CV less than 12.5 percent for older fish). This approach served to lessen the chance that individual fish will be exposed to potentially harmful effects of electrofishing while ensuring a high degree of precision in our site estimates.

We estimated populations for two age classes because determining age breaks other than for the youngest year class is nearly impossible in the field and frequently there are not enough fish in older year classes to generate a valid estimate for each year class. After each pass, all fish captured were identified, measured for fork length to the nearest millimeter, and weighed to the nearest 0.1 g. Fish that were large enough (≥ 70 mm) were scanned for PIT tags and potentially tagged if they were not already. All fish were allowed to recover in ambient temperature stream water until sampling was concluded, when they were released at the sample site. During autumn 2009, lengths and weights were not taken at the NDOW sites with the exception of recaptured PIT-tagged fish. Because fish at the NDOW sites could not be categorized by age, the results from these sites are presented separately in the results section.

Genetics

We collected caudal fin clips from a sample of Big Spring spinedace to allow future assessment of their population genetic population. Using sterilized scissors, we removed a small portion of the caudal fin (1 by 3 mm) and preserved the fin clips in 100 percent ethanol. We collected samples from upstream of and downstream of Delmue Falls, from Kill Wash, and from Reach A (appendix B). The samples were transported to USGS-CRRL. Date, site, length, weight, unique genetics code, and PIT tag code data for individual fish are presented in appendix B.

Passive Integrated Transponder Tagging

We PIT-tagged fish to assess growth rate and movement within MVW. Use of PIT tags offers a definitive way to assess the growth rate and track movement of individual fish (Ombredane and others, 1998; Connolly and others, 2008). Fish can be rapidly tagged, and the small size of the tags (as little as 8.5 mm length) allows relatively small fish to be tagged (Carlson and Letcher, 2003), including cyprinid species (Skov and others, 2005; Ward and others, 2008). We PIT tagged spinedace (100 per year) that were 70 mm or greater in fork length with 8.5-mm PIT tags [134.2 kilohertz (kHz), full duplex]. For other species (sucker, dace, and trout), we used 12-mm and 8.5-mm PIT tags (134.2 kHz, full duplex) depending on fish size and condition. We used a surgical scalpel to create small incisions and prevent tissue damage (Gries and Letcher, 2002). For larger suckers and trout, we occasionally used needles to insert tags. After insertion, we treated the incision with Stress Coat™. The instruments and tags were sterilized in alcohol, following protocols established by the Columbia Basin Fish and Wildlife Authority (1999).

Passive Integrated Transponder Tag Interrogation System

Five single-antenna PIT tag interrogation systems (PTISs) were installed on October 18–19, 2008. Stationary PTISs offer the potential for full-year, 24-hour (hr) monitoring of fish movement in and out of a stream system (Armstrong and others, 1996; Nunnallee and others, 1998; Zydlewski and others, 2001; Connolly and others, 2008). Each PTIS in MVW consisted of a Destron-Fearing 2001F ISO transceiver, powered by a 12-V battery charged with a solar panel, and an antenna placed in-stream. The antennas were housed in 3-in. diameter PVC pipe (3-inch diameter, sch. 80) rectangles, which were 0.6 m high and from 1.0 to 1.8 m long. The antennas spanned the stream width and were oriented upright as a “window” for fish to pass through. We installed three PTISs upstream of Delmue Falls (fig. 10), one each in Reach B (AB), Reach 1 (A1), and in Kill Wash (AT). The PTISs upstream of Delmue Falls were arranged so that we could determine if fish were moving from upstream or downstream areas to access Kill Wash. We installed two PTISs downstream of Delmue Falls (fig. 11), one in Reach 5 (A5) and one in Reach 9 (A9). The site in Reach 5 was monitored to determine if any fish were passing downstream over the falls. The site in Reach 9 was placed to determine if any fish were moving downstream of the primary areas known to harbor the most fish. The sites were checked and site data were downloaded weekly; batteries were replaced as needed.

Results

Habitat

Temperature

Although we began collecting water temperature data in June 2008, September 2008 was the first full month with all thermologgers (n = 9) deployed. Water temperature throughout our study section ranged from -0.9°C in Reach 9 (TR09; rkm 3.1) to 28.4°C in lower Reach B (TRBL; rkm 7.5) during the period covered by this report. Maximum, mean, and minimum water temperatures recorded at each site during July, August, and September and during December, January, and February are shown in tables 1 and 2.

During summer, water tended to warm in Reach B and was then cooled by the influence of Kill Wash and Box Spring (figs. 12 and 13). Temperatures were very stable through the study period in both Kill Wash (TTRI; range 13.3°C to 18.5°C) and Box Spring (TBOX; range 12.5°C to 15.9°C). The water warmed between Reach 1 (TR01; rkm 7.4) and Reach 2 (TR02; rkm 6.7), though the warming was very slight in 2008. Between Reach 2 and Reach 5 (TR05; rkm 5.9), mean summer temperatures increased slightly, but maximum temperatures were lower in Reach 5. Between Reach 5 and Reach 9 (TR09; rkm 3.6), there was little change in summer water temperatures. The temperature range was less at Reach 9, with maximum temperatures often being slightly lower than at Reach 5 (tables 1 and 2).

During winter, water cooled through Reach B and was warmed by the input from Kill Wash and the Box Spring. Below those inputs, the water continued to cool to TR09, where water temperatures as much as 9.9°C colder than at TR01 were recorded. Winter mean water temperature at TR05 averaged 2.6°C less that at TR02. Winter mean temperatures at TR09 averaged at least 5.6°C below mean at any monitored site above Delmue Falls.

The warmest site in our study area was in lower Reach B (TRBL), which had 157 days when temperature equaled or exceeded 22°C (table 3). Water temperature upstream of this site rarely exceeded 22°C. Water temperatures in Kill Wash only exceeded 18°C on 24 days of the study period and never equaled or exceeded 20°C. Water temperature in Box Spring never exceeded 18°C. Water temperatures at the thermologger in Reach 9 (TR09) only equaled or exceeded 22°C on nine days during our study period. Water temperatures at TR09 were frequently colder than any other site (134 days less than or equal to 2°C; table 3). The only other sites where water temperatures were less than or equal to 2°C were in Reach 5 (TR05), with 17 days, and lower Reach B (TRBL), with 8 days.

The greatest annual range in water temperature occurred in Reach B at TRBL (rkm 7.5) just above the confluence of MVW and Kill Wash (Figures 12 and 13). During September 2008, the first month we had full coverage by all thermologgers, water temperature range at TRBL was 13.2°C (table 1). At all other sites in MVW during September 2008, water temperature range was less than or equal to 11°C. Cool flow from Kill Wash, Box Spring, and other springs helped reduce temperature range downstream of TRBL. During September 2008, water temperature range in Kill Wash was 2.5°C and in the Box Spring was 2.1°C.

Streamflow

Our flow measures in MVW and Kill Wash represent the general pattern of flow at mid-range levels, but they do not represent the entire range of flows that occurred. To gage the range of flow and timing of high and low flow events through the year, we relied upon water level loggers. The actual flow measures that we took (fig. 14) fell within the mid-range of depths recorded by the water level loggers. Thus, there was more variation in flow than indicated by our flow measurements.

Streamflow measurements did indicate an interesting pattern of discharge (fig. 14). Our uppermost flow site was in Reach B (FSU; rkm 7.5), where flow measurements ranged from 0.0213 m^3/s to 0.0392 m^3/s. Downstream of FSU, the Kill Wash tributary and several springs contributed water to MVW. These contributions increased the measured flow at our middle site in Reach 2 (FSM; rkm 6.9) where they ranged from 0.0296 m^3/s to 0.0648 m^3/s. Measured flow at our middle site in Reach 2 was always greater than at FSU (mean 58 percent greater; standard deviation (SD) 30). Flow decreased between the flow site in Reach 2 and the most down-stream flow site in Reach 9 (FSB; rkm 3.2). Measured flow at FSB ranged from 0.0118 m^3/s to 0.0485 m^3/s. At all times that we measured flow at FSB and FSM, flow was greater at FSM (mean 39 percent greater; SD 12). Measured flow in Kill Wash ranged from 0.0023 m^3/s to 0.0061 m^3/s.

The water level loggers captured the variability of depth at each site. Because we did not capture discharge measures at the full range of depths recorded, we were unable to produce a meaningful flow-depth relationship. The depth measures do provide a record of daily and seasonal fluctuations (fig. 15). Numerous flow spikes were recorded at the water level site in Reach B (WLRB; rkm 7.5) during the spring and summer of 2009. Though many of these spikes were apparent at the water level site in Reach 9 (WLR9; rkm 3.2), the magnitude was dampened. There were two flow spikes apparent at WLR9 during mid-winter of both years that are not reflected at WLRB (fig. 15). These may be the result of water input from flooded fields, which enters MVW below the WLRB site.

Turbidity

Turbidity was generally low at the three sites above Delmue Falls. The lowest measures were obtained in Kill Wash (FST; fig. 16), where our measures never exceeded 4.8 NTU. Turbidity was similar in the two mainstem sites (FSU and FSM; fig. 16), where our measures ranged from 7.2 to 23.1 NTU. Turbidity range at the mainstem site in Reach 9 (FSB) was 14.2 to 67.5 NTU, which was much higher than the sites above Delmue Falls (fig. 16). For all times that we had measures from both sites, turbidity at FSB was at least 60 percent higher than at FSM and was often much higher (mean 248 percent higher; SD 201).

Reach Survey

We surveyed six mainstem reaches below Delmue Falls and six mainstem reaches above Delmue Falls. Stream length was greater below Delmue Falls (6,089 m) than above (2,071 m; table 4). Wetted and bankfull widths were greater in the reaches below Delmue Falls. Both above and below Delmue Falls, most of the stream was incised and disconnected from the floodplain. Eleven of the mainstem reaches were measured as confined or moderately confined at 78 percent or more transects. Reach 8 was the exception with 69 percent of transects measured as unconfined. Though the mainstem of MVW was very confined both above and below Delmue Falls, gradient was higher in the section below. Four mainstem reaches above Delmue Falls had gradient less than or equal to 0.25 percent. All six reaches below Delmue Falls had gradients from 0.28 percent to as high as 1.00 percent (table 4).

Throughout the system, LWD was relatively rare. Reach 9 was an exception with 43.2 pieces per 100 m (table 4). Much of Condor Canyon and the riparian area within it had burned in a 1999 wildfire and large trees were relatively rare, but Reach 9 had an extensive gallery of riparian black willow, which contributed LWD to the system.

There were some differences in substrate composition between the reaches above Delmue Falls and those below. Overall, the reaches above Delmue had a higher percent of gravel substrate compared to those reaches below (means, weighted by reach length, 24.1 percent above, 11.8 percent below; table 5). Gravel was very scarce in Reach 9 (found in 8 percent of measures) and in Reach 10 (found in 5 percent of measures). The highest percentage of gravel substrate found in any reach was in the TRIB Reach with 83 percent. The mean percent of substrate consisting of gravel, cobble, and boulder (weighted by reach) was 31.8 percent above Delmue Falls and 17.3 percent below. Reaches 8, 9, and 10 had total percentages of gravel, cobble, and boulder of 12 percent or less. Fine substrates, consisting of mud and sand, were more common in the reaches below Delmue Falls (means, weighted by reach length, 66 percent above, 75 percent below).

The most common forms of aquatic vegetation found within Condor Canyon were cattail and bulrush, with watercress a distant third (table 6). In the reaches above Delmue Falls, cattail or bulrush were rated the dominant aquatic species in 70 percent of measures. Below Delmue Falls, cattail or bulrush were dominant in 88 percent of measures. Watercress was the dominant aquatic vegetation in 21 percent of the measures above Delmue Falls but was dominant less than 2 percent of the time below the falls. Percent bank coverage by watercress was higher in the reaches above Delmue Falls than below (percent, weighted by reach length; 16 percent above, 6 percent below). Reaches 9 and 10, at the lower end of the canyon, had almost no watercress (table 6).

Riparian vegetation within Condor Canyon was varied. Grasses, coyote willow (*Salix exigua Nutt.*), tamarisk and black willow (*Salix nigra*) were the most common species (table 7). Non-native tamarisk was particularly common in Reach 2 and Reach 3. Black willow was common in Reaches 8, 9, and 10. In Reach 9, black willow was rated as the dominant riparian vegetation species 98 percent of the time. Black willow was very rare upstream of Delmue Falls. Due in part to the differences in prevalence of black willow, percent overstory cover of the stream was less in the reaches above Delmue Falls than below (mean, weighted by reach length; 5 percent above, 33 percent below).

Habitat Unit Survey

Pool frequency was generally low in MVW. The greatest number of pools per 100 m was 3.1 in Reach 9. All other reaches had less than 2.7 pools per 100 m, with as few as 0.3 in Reach 10 (table 4). The mean number of pools per 100 m was less above Delmue Falls than below (means, weighted by reach length, 1.3 above, 1.6 below). However, pools made up a greater percentage of stream length above Delmue Falls where the ratio of pool to non-pool length was 1.7:1. Below Delmue Falls the ratio was 1:3 (table 4). Reach complexity (defined as number of habitat units per 100 m) was 4.7 above Delmue Falls and 7.4 below the falls.

Habitat at Fish-Sampling Sites

Our fish-sampling sites were about 25 m long and varied in width and depth (appendix A). Specific measures of length, width, and depth allowed us to calculate area and volume, which permitted us to calculate densities of fish. Area of our sample sites ranged from 22.0 m^2 to 81.6 m^2 and volume ranged from 0.7 m^3 to 17.2 m^3 (appendix A)

Life-History Aspects of Big Spring Spinedace

Distribution

Big Spring spinedace were found in all reaches except Reaches 9 and 10 (table 8). Spinedace were much more common above Delmue Falls than below. Spinedace were found in Reach A, above a small falls, which is likely a barrier to upstream passage.

Populations

Variability of Big Spring spinedace populations was high at sample sites within reaches and between reaches (figs. 17–20; appendix B). This high variability resulted in broad estimates of total populations, despite precise estimates at individual sites (tables 9 and 10). Big Spring spinedace were much more common above Delmue Falls than below. Throughout the length of our study section, Big Spring spinedace were less common than speckled dace but were more common than desert sucker or rainbow trout.

The greatest number of spinedace at any individual sample site was 14.6 fish/m at RB_ND1 during fall 2009. Because we lacked length data from these fish, we did not know the proportions of age-0 or age-1 fish, though during fall 2008, 48 percent of the spinedace at RB_ND1 were age-0. For sites where we had length data and thus an age break, age-0 spinedace populations were as high as 3.0 fish/m (site R1_US1; fall 2009) and age-1 or older spinedace populations were as high as 2.6 fish/m (site RB_ND1; fall 2008).

Above Delmue Falls, Big Spring spinedace were particularly common at the sites close to the confluence of MVW and Kill Wash and they were also frequent at the site just below the small falls at the boundary of Reaches A and B. Spinedace below Delmue Falls were most common in Reach 6 (age-0 population range in R6 sites during fall = 0.1–2.9 fish/m; age-1 or older population range in R6 sites during fall = 0.1–1.3 fish/m). Spinedace were present in Reaches 5, 7, and 8, though much less common than in Reach 6 (age-0 population range in R5 and R8 sites during fall = 0–0.04 fish/m; age-1 or older population range in R5 and R8 sites during fall = 0–0.3 fish/m).

Age and Growth

The fork length (FL) of Big Spring spinedace found within our study area ranged from 15–115 mm (tables 11–13). During June 2009, age-0 Big Spring spinedace fork-length range was from 15–37 mm. By late September and early October of 2009, age-0 Big Spring spinedace fork length range had increased to 38–67 mm.

Because we tagged fish with PIT tags, we were able to recapture, identify, and measure growth of individual fish. Mean change in length of spinedace PIT tagged above Delmue Falls from fall 2008 to fall 2009 was +0.020 mm/day (n = 8, SD = 0.006). Mean change in weight for the same time period was +0.004 g/day (n = 8, SD = 0.003). Big Spring spinedace tagged above Delmue Falls in October 2008 and recaptured in March 2009 experienced a higher growth rate of +0.024 mm/day (n = 21, SD = 0.017) and +0.021 grams per day (g/day) (n = 21, SD = 0.012). Growth slowed for Big Spring spinedace over the summer. Fish captured in June 2009 and again in October 2009 grew at a rate of +0.016 mm/day (n = 6; SD = 0.030) and +0.008 g/day (n = 6; SD 0.025). There were Big Spring spinedace both above and below Delmue Falls that lost weight over the course of spring and summer (fig. 21). Between March and June 2009, 10 of the 16 Big Spring spinedace that we recaptured had lost weight (mean = 12 percent), and between June and October 2009, 4 of 6 Big Spring spinedace that we recaptured had lost weight (mean = 5 percent).

Spawning

During fall of 2008 and fall 2009, age-0 Big Spring spinedace were distributed throughout the area occupied by age-1 and older Big Spring spinedace, indicating likely spawning at multiple locations. Age-0 spinedace were much less common below Delmue Falls than above the falls. During fall 2008, we found very few age-0 spinedace below Delmue Falls (total of six fish), but during fall 2009, we found many in Reach 6 (total of 85 fish). Age-0 Big Spring spinedace were present in Reach A, which is upstream of the small falls, indicating that Big Spring spinedace spawned above the small falls. They were more abundant at RA_US1, which was immediately above the falls, than at RA_US2, which was near the Delmue Road crossing (fig. 8).

Tagged Big Spring spinedace moved into Kill Wash (PTIS site AT) during spring 2009, presumably for spawning (fig. 22). Big Spring spinedace were first detected moving in during early March and were detected into May. Peak detections were in mid-April.

Spinedace detected at the three PTISs around the confluence with Kill Wash indicate movements from March through May that may be spawning related. Exact timing of spawning is not known, though a ripe female spinedace (71 mm FL) was found in Reach 3 on June 22, 2009.

Movement

Big Spring spinedace tagged with PIT tags were detected making substantial movements. Movement of spinedace to the area around the confluence of MVW with Kill Wash and into Kill Wash was common (tables 14 and 15); some fish moved over 1,000 m. Spinedace moved into Kill Wash from all reaches above Delmue Falls except Reach A, which is above the small falls. Though Big Spring spinedace from Reach B were detected in Kill Wash, none were detected moving downstream of Kill Wash. Many Big Spring spinedace that were PIT tagged in Reaches 2 through 4 were detected at the PTIS in Reach 1 (A1) and the PTIS in Kill Wash (AT; fig. 23). These fish were detected from early March through late May 2009. Detections at A1 peaked in early April, followed by a peak in Kill Wash in mid-April. A second pulse of detections at A1 in May could have been fish returning downstream. Spinedace may have been moving to spawning areas, but other factors could also cause these movements. During spring, both speckled dace and desert sucker were seen spawning in Reach B and in the area around the Kill Wash's confluence with MVW. Spinedace may have been moving into these areas to consume eggs released by spawning females.

Only one Big Spring spinedace was PIT tagged in Kill Wash, and it was later detected downstream in Reach 1. Only 2 of the 95 spinedace PIT-tagged downstream of Kill Wash were detected by the reader upstream in Reach B, but 40 were detected by the reader downstream in Reach 1, and 18 were detected by the PTIS in Kill Wash (fig. 24). One spinedace tagged in Reach 3 was detected by the reader in Reach 5, below Delmue Falls. Because we only had one tag-detection event at the Reach 5 reader from fish tagged above Delmue Falls, we cannot rule out the possibility predation by a bird or mammal or the possibility of a dead fish washing downstream. Only one spinedace was tagged in Reach 5, and we detected it on the reader in Reach 5. Two of 23 spinedace tagged in Reach 6, and 1 of 8 tagged in Reach 7, were detected by the reader in Reach 5.

Life History Aspects of Other Fish Species in Meadow Valley Wash

Distribution

Speckled dace were found in all reaches (table 8). Desert sucker were found in all reaches except Reach 7, but they were found upstream and downstream of this reach. Our sampling effort was limited in Reach 7, so it is likely desert sucker were present. Speckled dace and desert sucker were all found in Reach A, above a small falls, which is likely a barrier to upstream passage. Rainbow trout were found only in Reaches 5 and 6, never upstream of Delmue Falls (table 8).

Populations

The variability of all fish populations was high at sample sites within reaches and between reaches (figs. 25–35; appendix B). This high variability resulted in broad estimates of total populations, despite precise estimates at individual sites. Speckled dace and desert sucker were more common above Delmue Falls than below. Rainbow trout were found only below Delmue Falls in Reaches 5 and 6. Speckled dace were the most common fish in MVW (tables 9 and 10).

Age-0 speckled dace populations were as high as 15.2 fish/m (site RA_US1; fall 2009) and age-1 or older speckled dace populations were as high as 5.2 fish/m (site R2_US1; fall 2008). Age-0 desert sucker populations were as high as 11.0 fish/m (site RB_ND1; fall 2008) and age-1 or older desert sucker populations were as high as 4.6 fish/m (site RB_ND1, fall 2008). Speckled dace were relatively uniformly distributed above Delmue Falls; however, age-0 populations were largest at the sites just above (RA_US1) and below (RB_ND1) the small falls. Desert suckers were also very common in RB_ND1, immediately below the small falls, and at RA_US1, just above the small falls (fig. 8).

Desert sucker were rare below Delmue Falls, where their distribution was very patchy. Speckled dace were also less common below Delmue Falls but were distributed fairly uniformly among sites.

Age and Growth

Fork length of speckled dace ranged from 25- 91 mm (tables 11–13). Age-0 speckled dace fork length range was 20–39 mm during June 2009 and increased to 25–61 mm by late September and early October. Fork length of desert sucker ranged from 33-203 mm (tables 11–13). During June 2009, age-0 desert sucker had fork lengths from 31-37 mm. By September and October, the fork lengths were from 37-75 mm. Fork length of rainbow trout that we encountered ranged from 78-450 mm (tables 11–13). We believe that rainbow trout found in fall 2008 and 2009 with fork-length range from 78-111 mm were age-0 fish.

Because we tagged fish with PIT tags, we were able to recapture, identify, and measure the growth of individual fish. We had few PIT-tagged and recaptured speckled dace (n = 10 recaptures). Two that were captured in March 2009 and again in June had both had lost weight (18 percent and 15 percent). The mean change in fork length of desert suckers above Delmue Falls from October 2008 to October 2009 was +0.080 mm/day (n = 9; SD = 0.035). The mean change in weight for the same period was +0.051 g/day (n = 9; SD = 0.021). Growth of desert sucker through the year appeared to be steadier than that of spinedace, and loss of weight between our recapture events was rare (fig. 36).

Several rainbow trout that were PIT tagged and recaptured exhibited rapid growth. One trout was tagged on October 10, 2008 at 93 mm and recaptured on March 14, 2009 at 162 mm, for a change in length of +0.445 mm/day. It gained 41.3 g over the same period, for a change in weight of +0.266 g/day (2.46 percent weight increase/day). Another was tagged on June 23, 2009 at 85 mm and recaptured on October 3, 2009 at 103 mm, for a change in length of +0.176 mm/day. It gained 6.5 g over that period, for change in weight of +0.064 g/day (0.82 percent weight increase/day). One trout was captured, tagged, and recaptured twice (tagged on October 9, 2008, recaptured on June 23, 2009 and on October 3, 2009). This trout was consistently 450 mm, but no weight measurement was taken. Two trout that we recaptured did not increase in length, and one lost weight. The trout that lost weight was tagged on June 23, 2009 at 114.1 g and recaptured on October 3, 2009 at 105.5 g.

Spawning

During the fall of 2008 and 2009, age-0 speckled dace were distributed throughout the area occupied by age-1 and older speckled dace, but were much less common below Delmue Falls. Age-0 speckled dace were found in Kill Wash. Age-0 desert sucker were most common at RB_ND1 and RA_US1. No age-0 desert sucker were found downstream of Reach 8, and they were rare or absent at sites below Delmue Falls. Desert sucker were observed spawning just inside Kill Wash. This spawning took place below our population sample site (TR_US1), and we did not find any age-0 desert sucker at TR_US1. Speckled dace and desert sucker were seen spawning in mainstem MVW at RB_ND1 and near the confluence with Kill Wash. Age-0 speckled dace and desert sucker were both present in Reach A, which is upstream of the small falls, indicating spawning in Reach A. Both species were more abundant at RA_US1 (which was immediately above the falls) than at RA_US2 (which was near the road crossing).

During spring 2009, three large trout were observed together just below Delmue Falls in Reach 5, presumably in a spawning aggregation. Age-0 rainbow trout were found in Reach 5 in fall 2008. During fall 2009, age-0 trout were found in Reaches 5 and 6.

Movement

Desert suckers showed considerable movement (tables 16 and 17). Of 14 tagged in Reach 1, three were detected in Kill Wash and six were detected in Reach B. Of 15 tagged in Reach 2, one was detected on all three upstream readers. Of 33 tagged in Reach 3, 10 were detected in Reach 1, and four each on the readers in Kill Wash and Reach B. Of 12 tagged in Reach 4, four were detected in Reach 1, two in Kill Wash, and one in Reach B.

Tagged desert sucker and speckled dace were detected moving into Kill Wash (PTIS site AT; tables 16 and 18) during spring 2009, presumably for spawning (fig. 36). Desert sucker moved in as early as mid-February and were detected into early April. Detections peaked in mid-March. Though only three PIT-tagged speckled dace were detected in Kill Wash, these data suggest that they have a spawning-related movement around late March and remain present into May. None of the PIT-tagged speckled dace below Delmue Falls were ever detected outside of the Reach. None of the PIT-tagged desert sucker below Delmue Falls were detected on either of the two PITSs there (tables 17 and 19).

Discussion

Our estimates for Big Spring spinedace populations and other fish species had high precision at individual sites, but the high variability between sites resulted in total-population estimates with low precision. The Big Spring spinedace population below Delmue Falls appears to be extremely limited, but we found a concentration of fish in Reach 6. Stream sites below the falls supported low populations of speckled dace. Desert sucker were less prevalent below the falls, and some sample sites often yielded no suckers. Though the confidence intervals for the estimate of total population were wide, the differences in population abundance were great enough to indicate that Big Spring spinedace, desert sucker, and speckled dace populations and densities were much higher upstream of than downstream of Delmue Falls. This is particularly significant because the stream length above Delmue Falls accounted for only about 25 percent of the stream length in the study area.

Site-population estimates and movement patterns suggest that the areas around Kill Wash are important for Big Spring spinedace spawning. Spawning by desert suckers and speckled dace was observed in Kill Wash, in MVW immediately below Kill Wash, and in RB_ND1. Reaches B, 1, and Kill Wash appear to be highly favorable and likely critical for the persistence of native fish populations in Meadow Valley Wash. These reaches had inflow from springs, which provided clear water and moderate water temperatures throughout the year. All three native fish species spawned above the small falls in Reach A. These fish may contribute to downstream populations, but are likely inaccessible to fish downstream of the falls.

All three native species were detected making substantial movements. Spinedace and desert sucker were recorded moving over 1 km from Reach 4 to Kill Wash. Speckled dace moved up to 0.5 km from Reach 2 to Kill Wash. Big Spring spinedace below Delmue Falls also made significant movements from Reaches 6 and 7 to just below Delmue Falls. Movements of all three species occurred during late winter and spring and are most likely associated with fish seeking suitable habitat for spawning. Fish may be seeking favorable temperatures, substrates, or other fish actively spawning. Scoppettone and others (2004) found two size classes of ova in White River spinedace, which suggests prolonged spawning, and found adult fish from 60 to 165 mm. Blinn and others (1998) estimated that Little Colorado spinedace had up to three spawns per year. If Big Spring spinedace share similar life-history traits, it would not be surprising to find fish maturing at differing times and potentially traveling to find mates or more suitable conditions. Movement data demonstrate that all three native species are capable of lengthy movements in a small-stream environment.

Growth of Big Spring spinedace was most rapid between fall and spring. Spring temperatures are likely in the preferred range for spinedace and the food resources they consume. From spring to early summer, many spinedace lost weight, presumably as a result of spawning. Growth through summer into fall was at a slower rate. The increased water temperatures that occurred in summer may not be optimal for spinedace or the food resources they rely on. Desert sucker showed a similar growth pattern, with the highest rates of change over the winter and spring. We did not document as many instances of weight loss in desert suckers, though this could be because they spawn earlier than spinedace and had time to recover weight before our June 2009 sampling.

The upstream extent of our study area was the Delmue Road crossing of MVW (fig. 1) Distribution of Big Spring spinedace and other fish species above this bridge is unknown, but the area could reasonably support interacting factions of these populations. Any future assessment of the vulnerability of the native fish species of MVW to disturbance or habitat change, or response to restoration efforts, should include sampling of the stream above the Delmue Bridge.

Non-native rainbow trout and crayfish were present in the study area. Rainbow trout were found only in Reaches 5 and 6 and never above Delmue Falls. Length data and the observation of a probable spawning aggregation in spring 2009 suggest that wild reproduction occurred. It is not know if conditions above Delmue Falls preclude survival of rainbow trout there, or if they simply were never present there. The origin of rainbow trout in Condor Canyon is not known. They could be the result of upstream or downstream introductions, or possibly of a release near where we found them.

Crayfish were abundant throughout the study area. We did not attempt to quantify the population or density of these non-native crayfish, but they were present both at sample sites with high numbers of spinedace and at sites with no spinedace. Although interaction with non-native rainbow trout and crayfish may be influencing both populations, with our existing data we could not identify any specific relationships to explain differences in populations among study sites. Crayfish may affect Big Spring spinedace, and other native fish in MVW, by direct predation on fish or eggs (Dorn and Wojdak, 2004), competition for invertebrate resources, reduction of the richness of invertebrate resources (Stenroth and Nyström, 2003), or by contributing to increased turbidity (Dorn and Wojdak, 2004).

Reach 6 supported the most robust spinedace populations that we observed below Delmue Falls, but it also had the most rainbow trout. Potential negative consequences of their interaction were not apparent. In a study of Little Colorado spinedace, Bryan and others (2004) found no predation on spinedace by rainbow trout. However, they also observed that spinedace, in the presence of trout, reduced movement, and in the presence of rainbow trout and crayfish, reduced overall activity including movements in and out of refuge areas. A separate study of predation by rainbow trout on Little Colorado spinedace (Blinn and others, 1993) found that predation rates by rainbow trout on spinedace were fairly high. At the end of a 10-day experiment with both species in stream enclosures, the average number of spinedace in rainbow trout stomachs was 0.7 spinedace per trout. One trout consumed 4 spinedace in a 16-hr span. They found that the length of spinedace (mean: 53.2 mm) consumed by rainbow trout was less than those spinedace that were not consumed (mean: 63.7 mm).

Rainbow trout below Delmue Falls may be altering the behavior of or consuming Big Spring spinedace, and control measures may be warranted. Conversely, rainbow trout may be consuming crayfish, which could confer some benefit to spinedace if crayfish negatively affect spinedace populations. A detailed food-web study and analysis is needed to understand what positive and negative loops might exist and what the overall consequences are to Big Spring spinedace and other native fish of MVW.

Lower population densities below Delmue Falls for the three native fish species could be related to differences in a number of habitat variables such as vegetation, turbidity, substrate, and temperature. The high prevalence of cattail and bulrush below Delmue Falls may have contributed to both lower populations of fish there. Cattail and bulrush species can exploit altered aquatic ecosystems. They can form dense monotypic stands that reduce biodiversity and density of organisms (Farrer and Goldberg, 2009; Kostecke and others, 2005). These stands can choke channels with live and dead material, potentially form migration blocks, alter substrates by trapping sediment, and provide potential habitat for crayfish. Dense aquatic vegetation was identified as a possible cause of the decline of a population of White River spinedace (*L. albivallis*) in Flag Springs, Nev. (Scoppettone and others, 2004). This fish population was found to be declining, with potentially no reproduction occurring. The researchers speculated that a dam had made conditions unsuitable for spawning—potentially by altering substrates. The resulting increase in deposition of fine substrates may have favored dense aquatic vegetation, with both factors contributing to recruitment failure.

Watercress was more common above than below Delmue Falls. This plant, which is generally thought to be beneficial to some stream-dwelling fish (Boussu, 1954; Labbe and Fausch, 2000), may provide numerous benefits to the MVW ecosystem. We commonly found watercress patches to be occupied by many amphipods (“scuds”). These likely provide a high-quality food resource for spinedace. Runck and Blinn (1993) found that cladocerans were an important food source for Little Colorado spinedace (*L. vittata*) during summer. Watercress also may provide cover to larval and juvenile fish. Larval Little Colorado spinedace were found to move into slow water and remain along the shore near aquatic vegetation (Blinn and others, 1998). Watercress growth may buffer stream banks from erosion and limit sediment input. The Condor Canyon Habitat Management Plan (Bureau of Land Management, 1990) lists increased watercress bank coverage as a desired condition.

Higher turbidity below Delmue Falls could limit the ability of fish to feed. Spinedace species are likely sight feeders. Runck and Blinn (1993) found that diet of Little Colorado spinedace was composed mostly of terrestrial and aquatic insects, which they captured at the surface or midwater, and Scoppettone and others (2004) observed White River spinedace feeding on drift. Increased turbidity can also reduce primary productivity. Lloyd and others (1987) showed that in a clear, shallow stream, an increase of 25 NTU could decrease primary production by 13–50 percent.

In addition to turbidity effects, fine particulates can have a number of other negative effects on stream communities. Clay particles can be somewhat adhesive and destructive to biota (Waters, 1995). Portions of Condor Canyon do contain clay soils (Bureau of Land Management, 1990). Fine substrate is known to have a deleterious effect on stream benthos, particularly on those drift organisms most likely to be consumed by sight feeders (Lemly, 1982; Mackay and Waters, 1986; McClelland and Brusven, 1980). Fine substrate can also smother fish eggs or spawning substrates. Minshall (1988) described a heterogeneous substrate composed of gravel, pebble, and cobbles as most favorable to benthos abundance. Substrate heterogeneity was higher above Delmue Falls than below. Blinn and others (1998) reported that Little Colorado spinedace spawned in moving water with gravel from 2 mm to 16 mm in diameter. The high prevalence of fine substrate material in the reaches below Delmue Falls is likely a factor contributing to the lower densities of fish compared to above the falls.

Pools made up a much lower proportion of stream length below Delmue Falls than above. Both Little Colorado spinedace and Virgin spinedace (*L. m. mollispinis*) have been found to prefer pool habitat during some portions of the year (Angrandi and others, 1991; Runck and Blinn, 1993, Blinn and others, 1998). Pools may be a critical habitat of Big Spring spinedace, at least for some phases of their life history.

Water temperatures in MVW below Delmue Falls reached lower minimums than in the section above the falls, which may have contributed to a lower population of spinedace below the falls. However, the thermal limits of Big Spring spinedace are not known. Blinn and others (1998) noted that spawn timing of Little Colorado spinedace is temperature dependent and those that spawned as little as two weeks later than other spinedace produced young-of-year fish that were as much as 14 mm smaller at the onset of winter than the spawn of adult fish that spawned earlier. The lower minimum temperatures in MVW in lower Condor Canyon alone may not be enough to exclude Big Spring spinedace, but combined with other habitat conditions, they may make lower MVW relatively inhospitable to native fish compared to areas upstream of Delmue Falls.

We found no Big Spring spinedace in Reaches 9 and 10, coincident with where relatively low numbers of desert sucker and speckled dace were found. Reaches 9 and 10 had the most bulrush and cattail, the least watercress, the least gravel and coarse sediment, and the highest incidence of fine substrate within the study area. Many of these habitat conditions may represent disturbances of the natural state of MVW and contribute to conditions favorable to crayfish populations. Though crayfish were ubiquitous throughout the study area, the habitat below Delmue Falls may have been most favorable for them. An abundance of fine substrate types or vegetation litter, both common in the lower reaches of MVW, is favorable to some species of crayfish (Charlebois and Lamerti, 1996; Demers and others, 2003).

Reach 6 has better native fish habitat than of any reach in Condor Canyon below Delmue Falls. A previous assessment (PBS&J, 2007) found that Reach 6 had stable geometry and good in-stream habitat. Our surveys found Reach 6 to have the most gravel substrate (23 percent) and the greatest bank coverage by watercress (21 percent) of any reach below Delmue Falls.

Management Implications

What is Good Big Spring Spinedace Habitat?

Big Spring spinedace are currently limited in (at least) their downstream distribution; they have much lower population abundance and density downstream of Delmue Falls than above. Explicit reasons for this are not known, but we found substantial longitudinal change in habitat conditions. Possible negative factors that change from upstream to downstream include higher density of cattail and bulrush, decreased coverage by watercress, higher turbidity, higher amount of fine sediment, lower ratio of pool to non-pool habitat, increasing stream temperatures in summer, and decreasing stream temperatures in winter. We found the best spinedace populations in upstream areas that had clear water, watercress present or close by, spawning substrate available, cover present (but not dense stands of cattail or bulrush), and moderate stream temperatures (including low diel variation).

Kill Wash and the numerous other springs that contribute water to MVW within the upper portion of Condor Canyon likely serve a critical role in maintaining water quality and quantity. These spring inputs contribute clear water that may moderate mainstem turbidity, allowing effective site feeding by spinedace. The spring inputs also serve to moderate both high and low temperatures. During winter, the sections of MVW at the downstream end of Condor Canyon become very cold, possibly inhibiting spinedace from persisting there.

Addressing Existing and Future Threats

Because MVW is the only know habitat of Big Spring spinedace, the population is greatly at risk. The population of Big Spring spinedace in the Condor Canyon section of MVW is potentially susceptible to a number of direct or indirect threats including dewatering, non-native species (those present and others that could be introduced), catastrophic flooding, drought, contamination, or other disturbances that could impact MVW. Flooding is perhaps more of a threat than ever before, because of: (1) the loss of much of the stream's prior course through meadows above the canyon reaches, and (2) the confinement of the stream, which has become straightened and entrenched in an eroded streambed.

The current designated critical habitat for spinedace extends to the upstream end of Condor Canyon (Federal Register, 1985), but does not include Kill Wash or MVW from the Kill Wash confluence upstream to the Delmue Road Bridge. We found a large proportion of the spinedace population (possibly up to 40 percent of the total population), and other native fish, in MVW from the Kill Wash confluence to the Delmue Road Bridge. All three native species spawned in the area of MVW near the Kill Wash confluence and in Kill Wash itself. Managers may wish to consider expansion of the designated critical habitat upstream to incorporate what appears to be a large and important part of the known population of Big Spring spinedace.

The highest flow we recorded in Condor Canyon was 0.06 m^3/s, though we did not take flow measures during high-flow events, which certainly would have exceeded our observed flows. The Nature Conservancy (TNC) has a water right to 0.08 m^3/s in a portion of Condor Canyon, which exceeds flow during much of the year. Flow decreased from the upper end of Condor Canyon to the lower end, likely lost to groundwater or evaporation. Restoration of stream function and stream shade in lower Condor Canyon may help to enhance surface flows.

The dense stands of cattail and bulrush in MVW are likely detrimental to native fish populations. Sample sites that were choked with cattail and bulrush often had very few fish of any species present. It is not currently known if cattail and bulrush are expanding their coverage in our study area. Managers may wish to track coverage of cattail and bulrush and take control measures if coverage is expanding.

The restoration of hydrologic function and the enhancement of riparian vegetation may be the primary long-term solution to prevent spread and decrease coverage of the extremely dense stands of cattail and bulrush currently found.

Managers should consider enhancing access and flow of spring tributaries to increase availability of refugia areas of native fish from high and turbid flows and extreme temperature events. Kill Wash and its watershed are a primary opportunity for protection, given its obvious importance to native fish (as habitat and as a contributor of clear, thermally stable water) and because much of the stream length and its watershed is in public ownership.

Regarding restoration of mainstem areas, it appears prudent to start below Delmue Falls and below Reach 6. Because Reach 6 appears capable of holding and sustaining a population of spinedace, it could serve as a template for restoration goals of downstream reaches. Physical restoration such as improved floodplain condition and connection with the mainstem channel, improved riparian condition and vegetation, combined with improved watershed function throughout the MVW drainage in reaches downstream of Reach 6 may also improve water quality in downstream areas of MVW.

Translocation of some Big Spring spinedace to establish one or more new populations to diminish risk to this isolated population from catastrophic events has been considered by managers. Though specific limiting factors (including thermal limits, dissolved-oxygen requirements, food needs and preferences, spawning requirements) remain largely unknown, this document provides a good oversight of habitat in areas of MVW where spinedace populations are healthy at the local scale. Any translocation site should meet some minimum criteria derived from sites in MVW above Delmue Falls, where Big Spring spinedace showed successful reproduction and high population densities.

Recommendations for Future Monitoring and Research

Our sampling did not extend upstream of the Delmue Road Bridge, but it is possible that important habitat and interacting native fish populations (including Big Spring spinedace) exist above this bridge. Managers should consider additional assessment of MVW upstream of the Delmue Road crossing to determine the extent and robustness of a potential Big Spring spinedace population and other fish populations above this bridge.

To generate future total-population estimates, an improved approach would be to sample more stream length, which could be done at a less intensive level then our effort. A mark-recapture methodology would allow coverage of more stream area per reach and could result in a more precise estimate of the total population. There is certainly merit in continuing the annual monitoring at NDOW's established 25-m sites. We do recommend that NDOW use the methodology of Connolly (1996) and, as described in this report, that NDOW determine if and when more than three removal passes are needed to obtain a valid estimate with a desired precision. We hope that, by increasing the number and spread of 25-m sites sampled, our intensive study gives the NDOW sites context.

Managers of MVW may wish to consider assessing nonnative crayfish populations and the relationship between crayfish and Big Spring spinedace. Extremely high densities of crayfish were observed throughout the study area. Control measures may be warranted. If control efforts are implemented, monitoring crayfish may also be appropriate to assess the effect of these control efforts on crayfish and native fish populations. Managers should consider gathering data on the diet of rainbow trout and Big Spring spinedace, along with other foodweb data, to assess predation, competition, and other complex interactions. For example, it may be that the relatively small population of nonnative rainbow trout has minimal impact on Big Spring spinedace if rainbow trout consume primarily crayfish—this may benefit native fish by reducing crayfish effects. However, were rainbow trout populations to increase, they could be detrimental to Big Spring spinedace. A foodweb analysis would help managers explore these kinds of interactions and potential responses to habitat changes, such as those that might occur with restoration actions or predicted climate change.

In general, we submit that the information in this report represents an improved understanding of the habitat, basic-population, and life-history information for Big Spring spinedace in MVW. To that end, managers may wish to update existing documents such as the Condor Canyon Habitat Management Plan (Bureau of Land Management, 1990) and the Big Spring Spinedace, *Lepidomeda mollispinis pratensis*, Recovery Plan (U.S. Fish and Wildlife Service, 1993).

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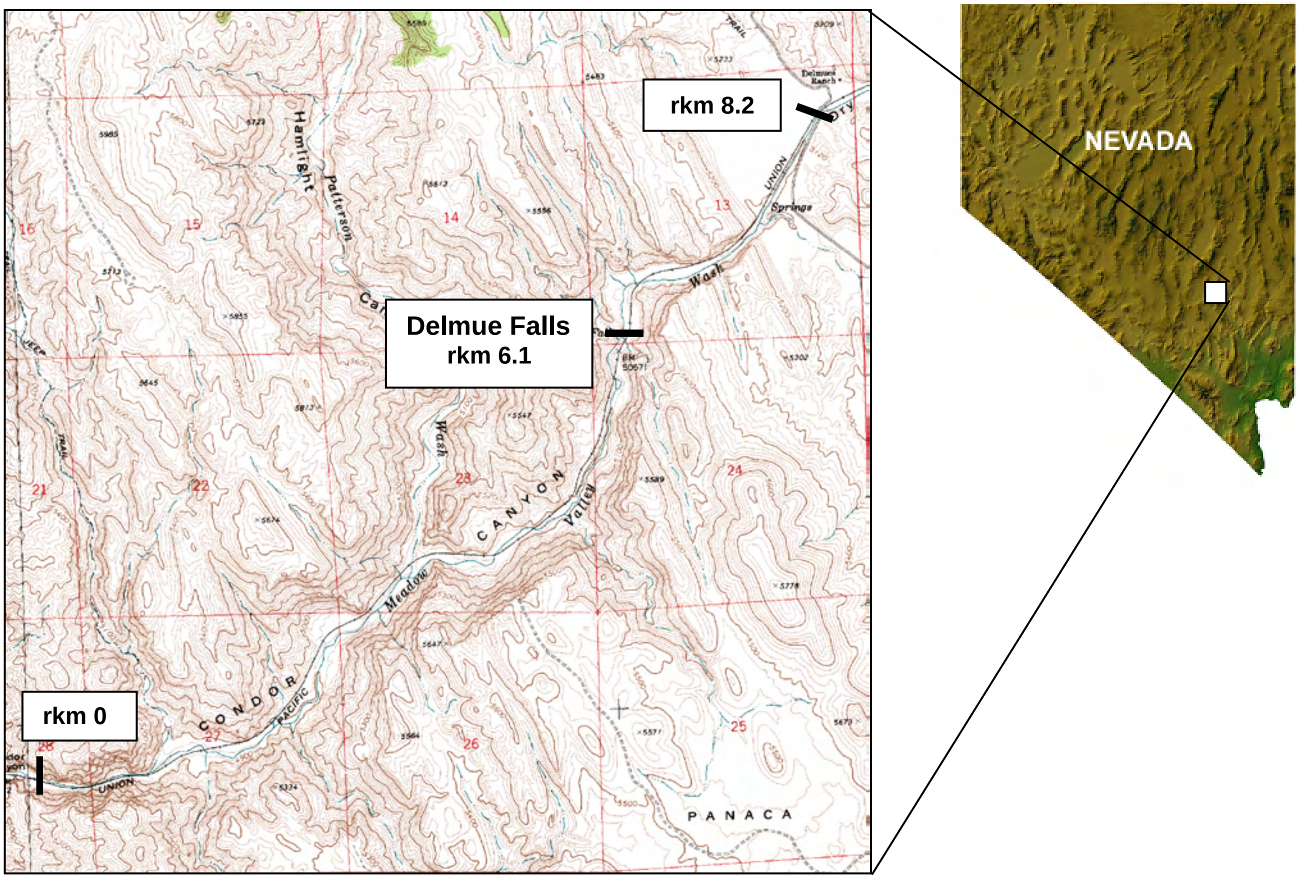


Figure 1. Condor Canyon, Meadow Valley Wash, Nevada.

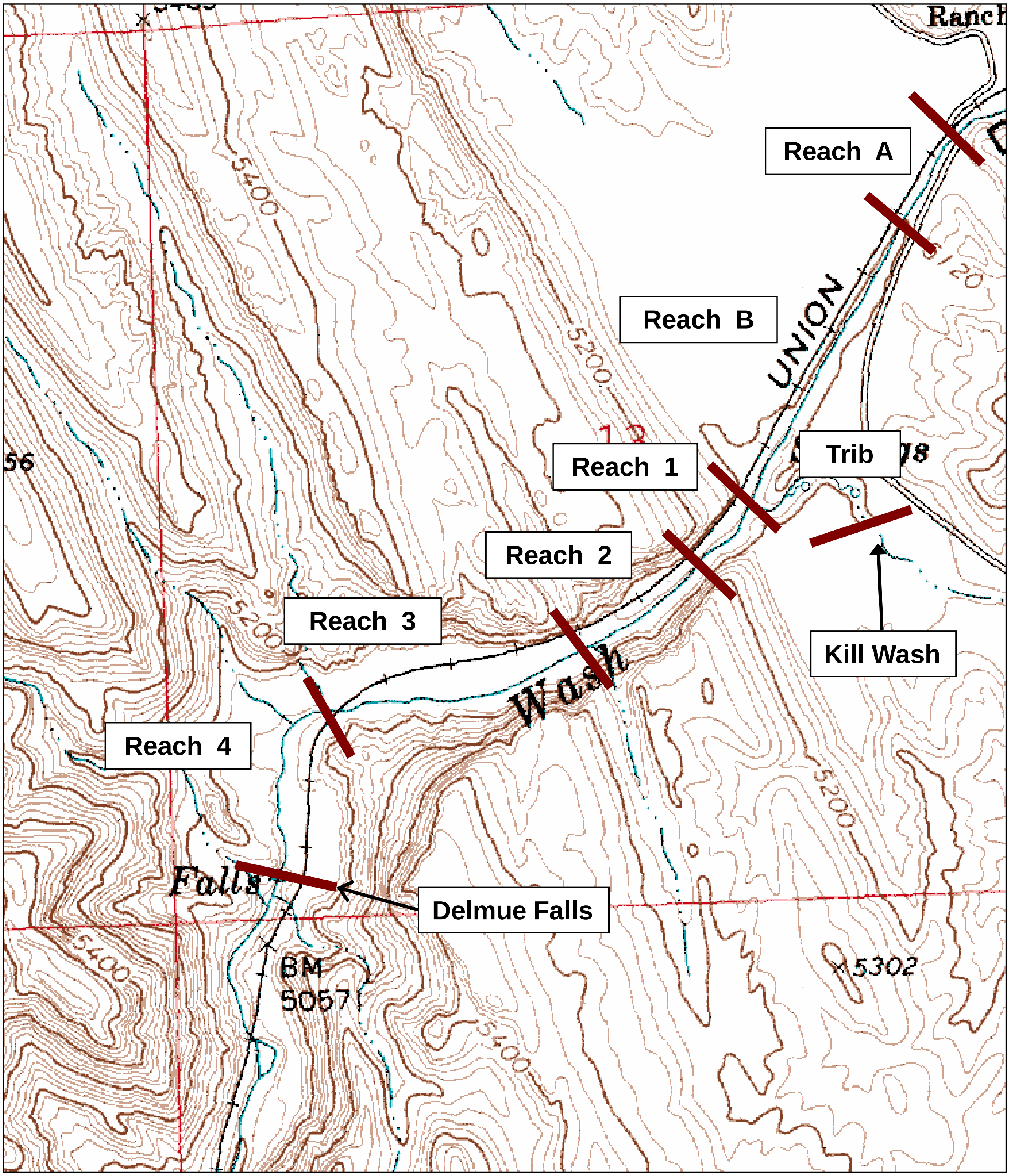


Figure 2. Reach-break locations upstream of Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada. Breaks are geo-referenced in appendix A of this report.

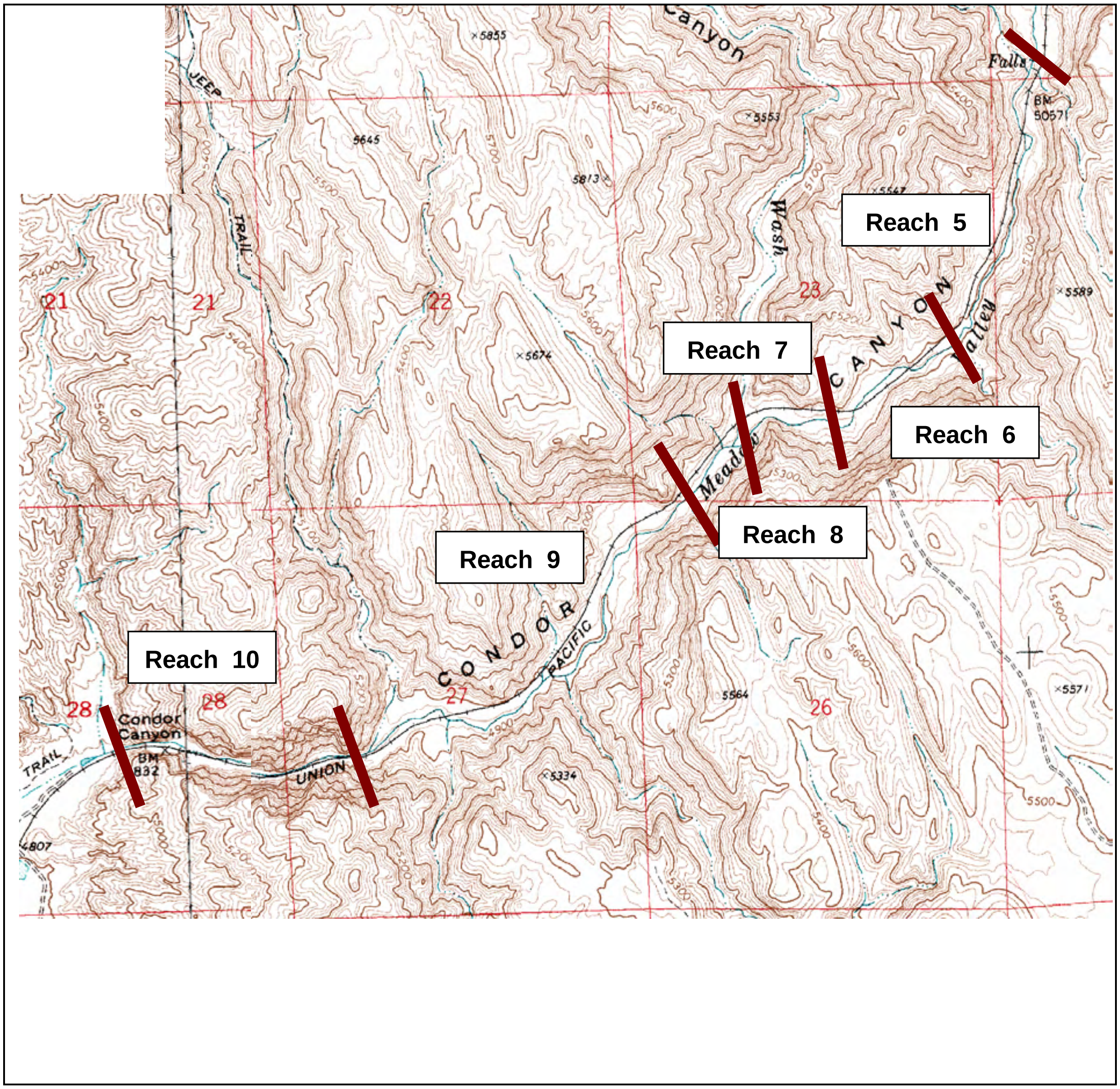


Figure 3. Reach-break locations downstream of Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada. Breaks are geo-referenced in appendix A of this report.

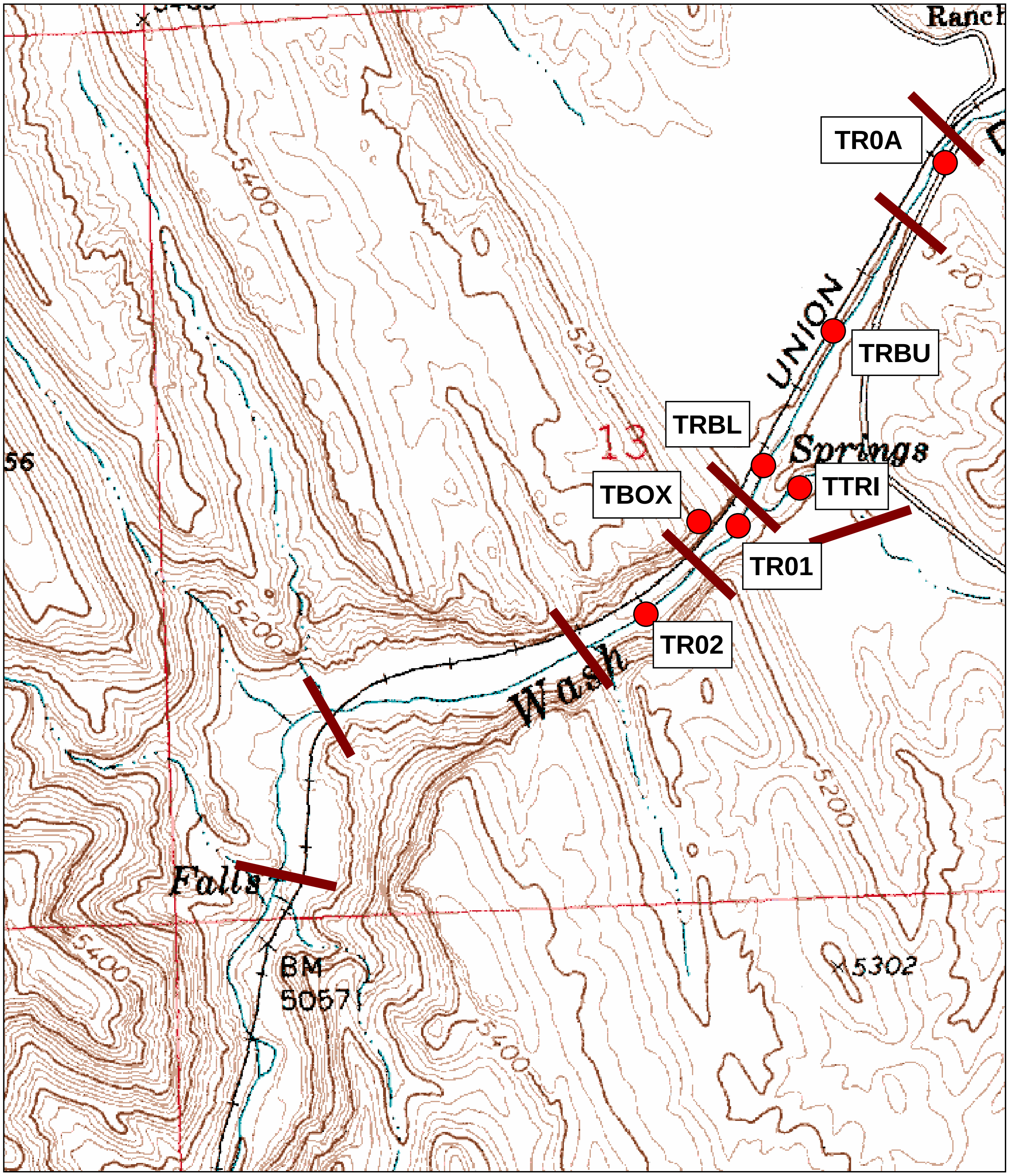


Figure 4. Thermologger locations in reaches upstream of Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada. Sites are geo-referenced in appendix A of this report.

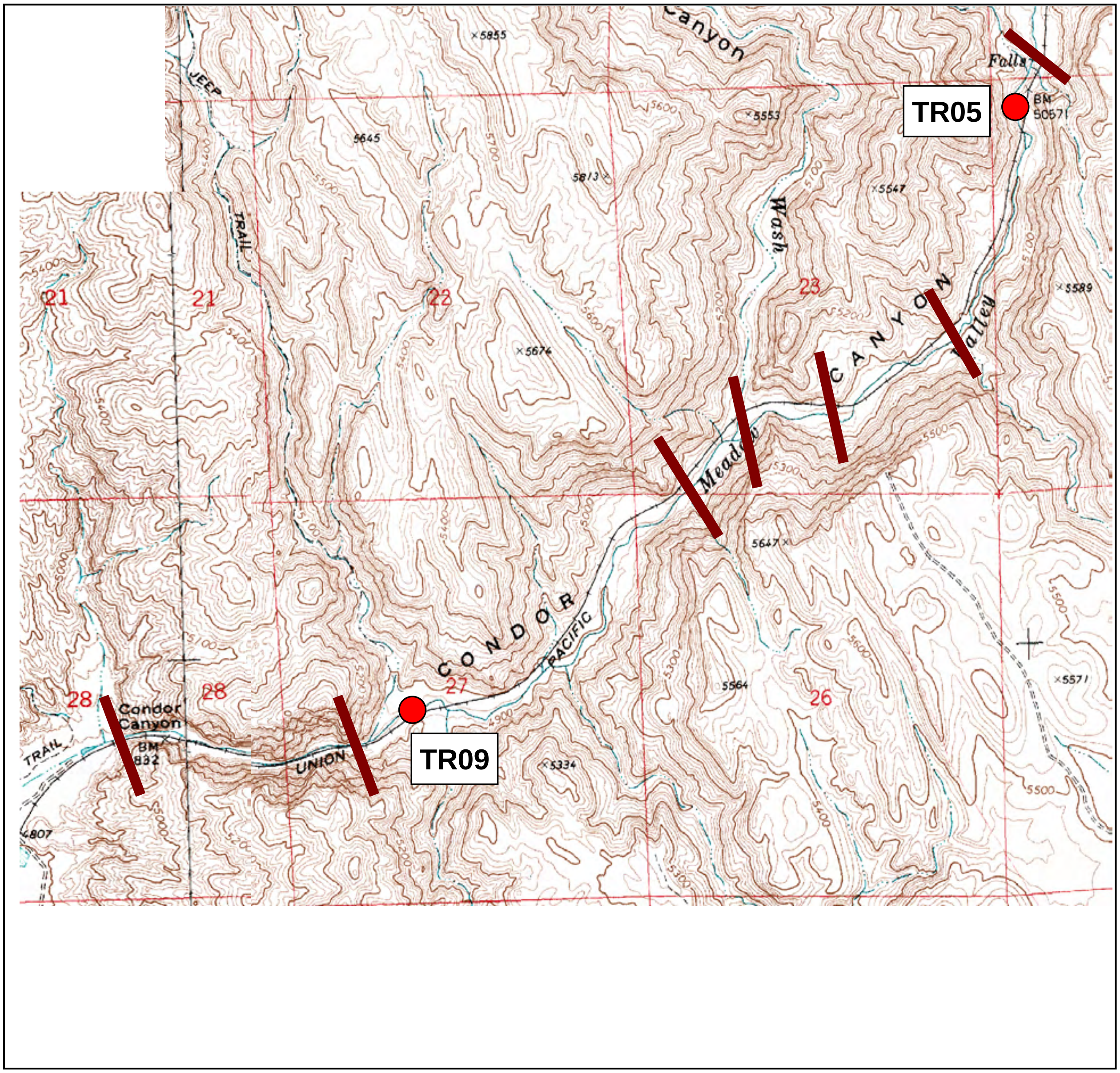


Figure 5. Thermologger locations in reaches downstream of Delmue Falls, Condor Canyon, Meadow Valley Wash, Nevada. Sites are geo-referenced in table 2 of this report.

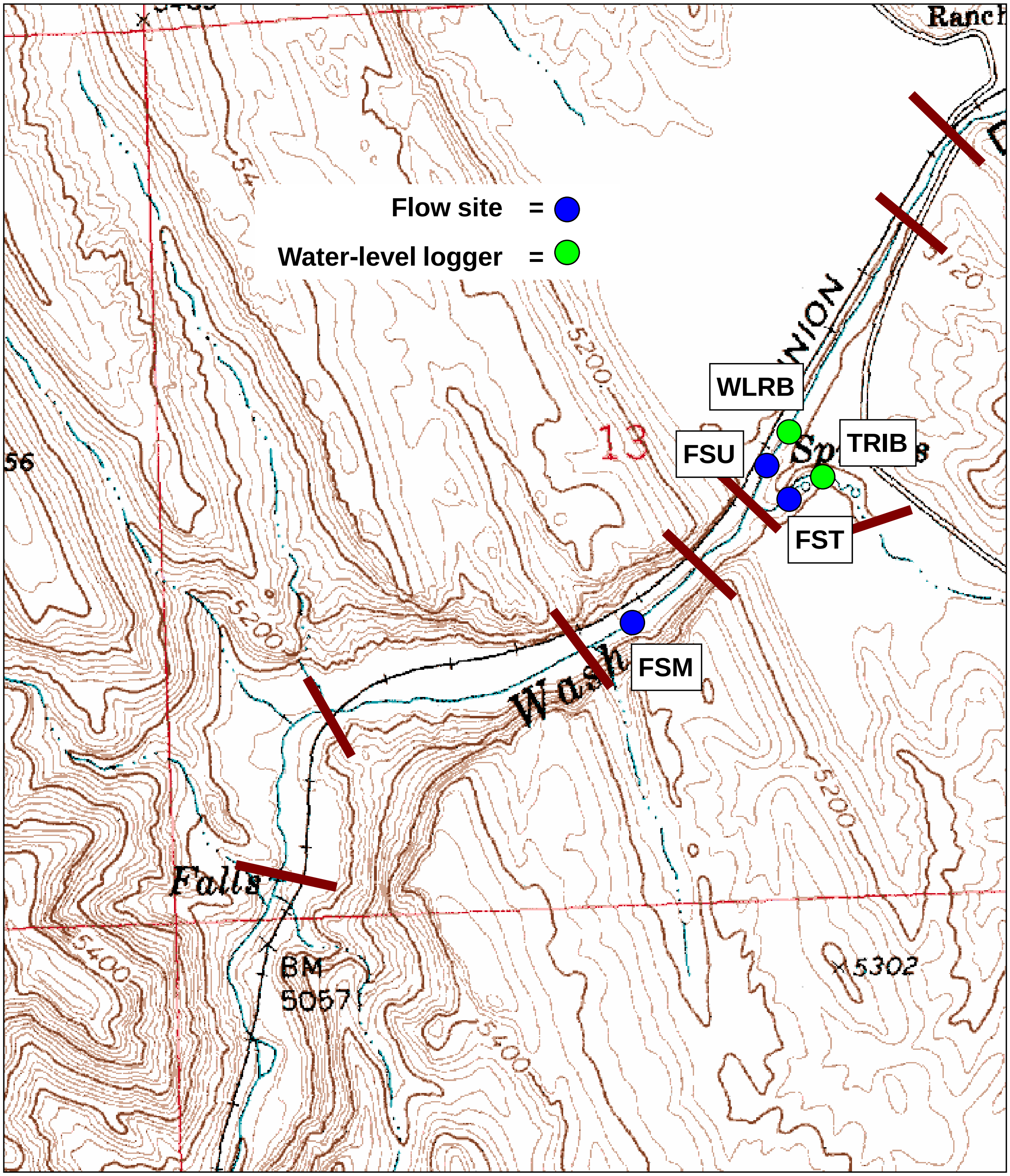


Figure 6. Flow site and water-level logger locations in reaches upstream of Delmue Falls, Condor Canyon, Meadow Valley Wash, Nevada. Sites are geo-referenced in appendix A of this report.

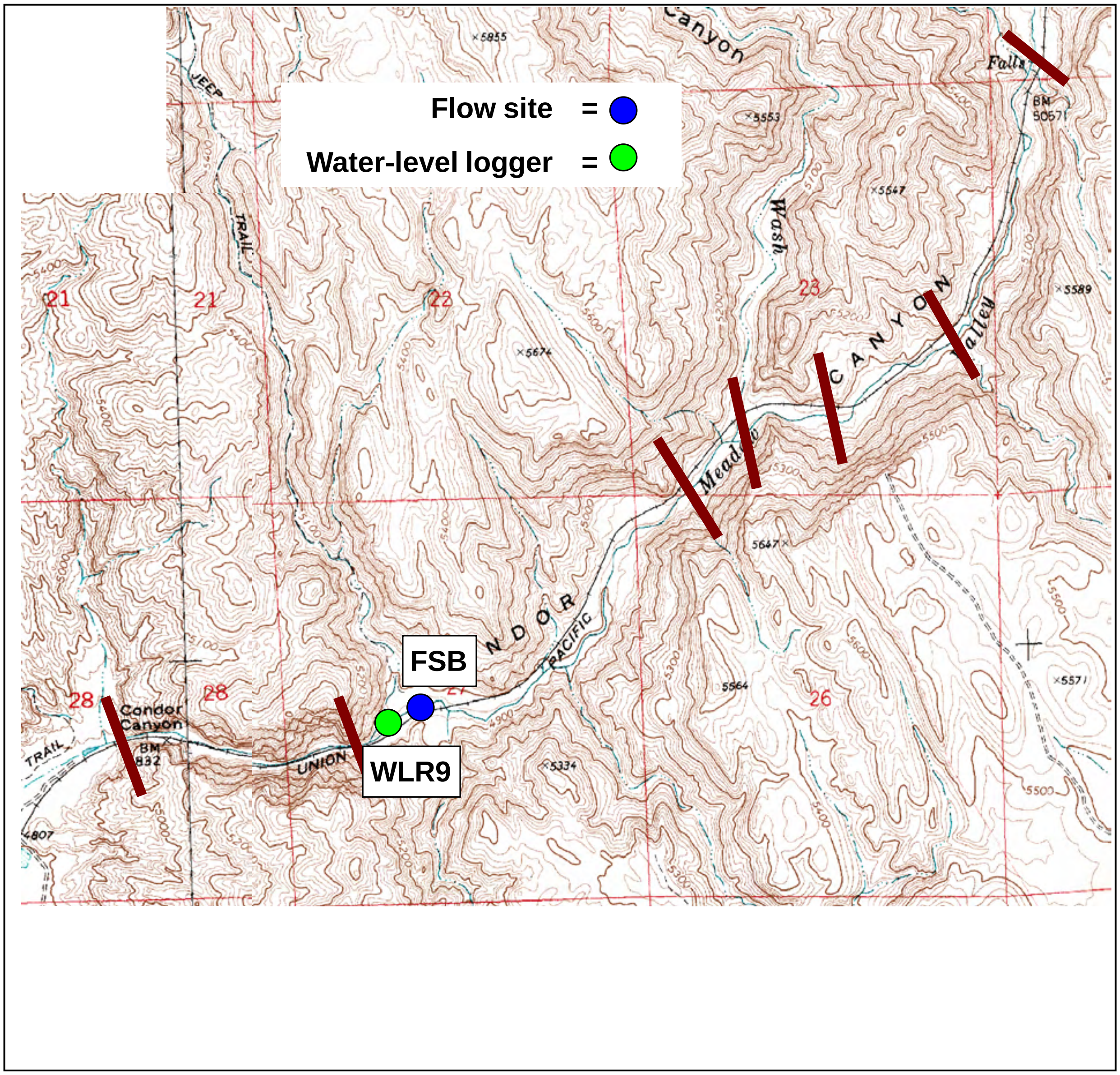


Figure 7. Flow site and water-level logger locations in reaches downstream of Delmue Falls, Condor Canyon, Meadow Valley Wash, Nevada. Sites are geo-referenced in appendix A of this report.

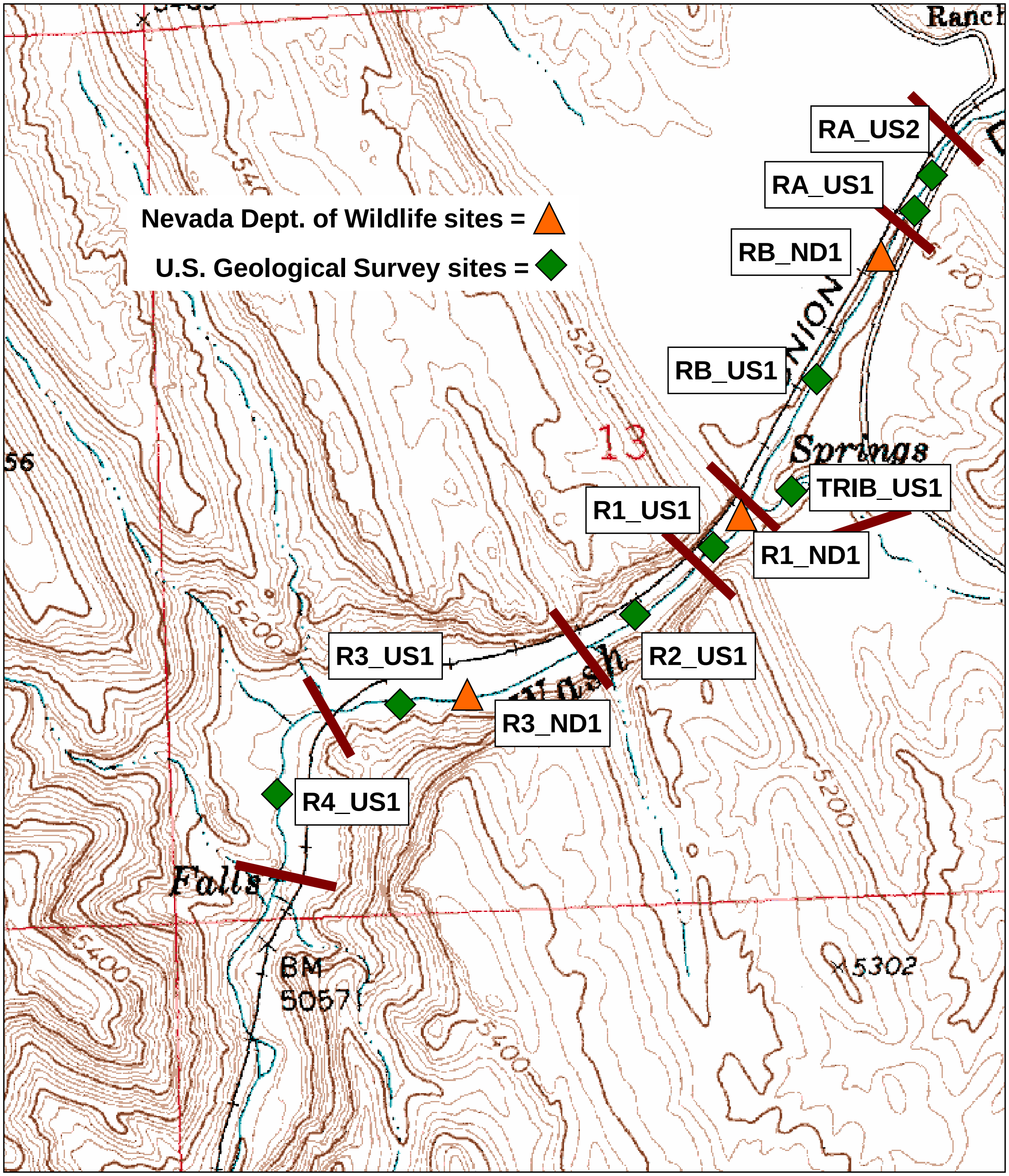


Figure 8. Fish-population-sampling locations in reaches upstream of Delmue Falls, Condor Canyon, Meadow Valley Wash, Nevada. Sites are geo-referenced in appendix A of this report.

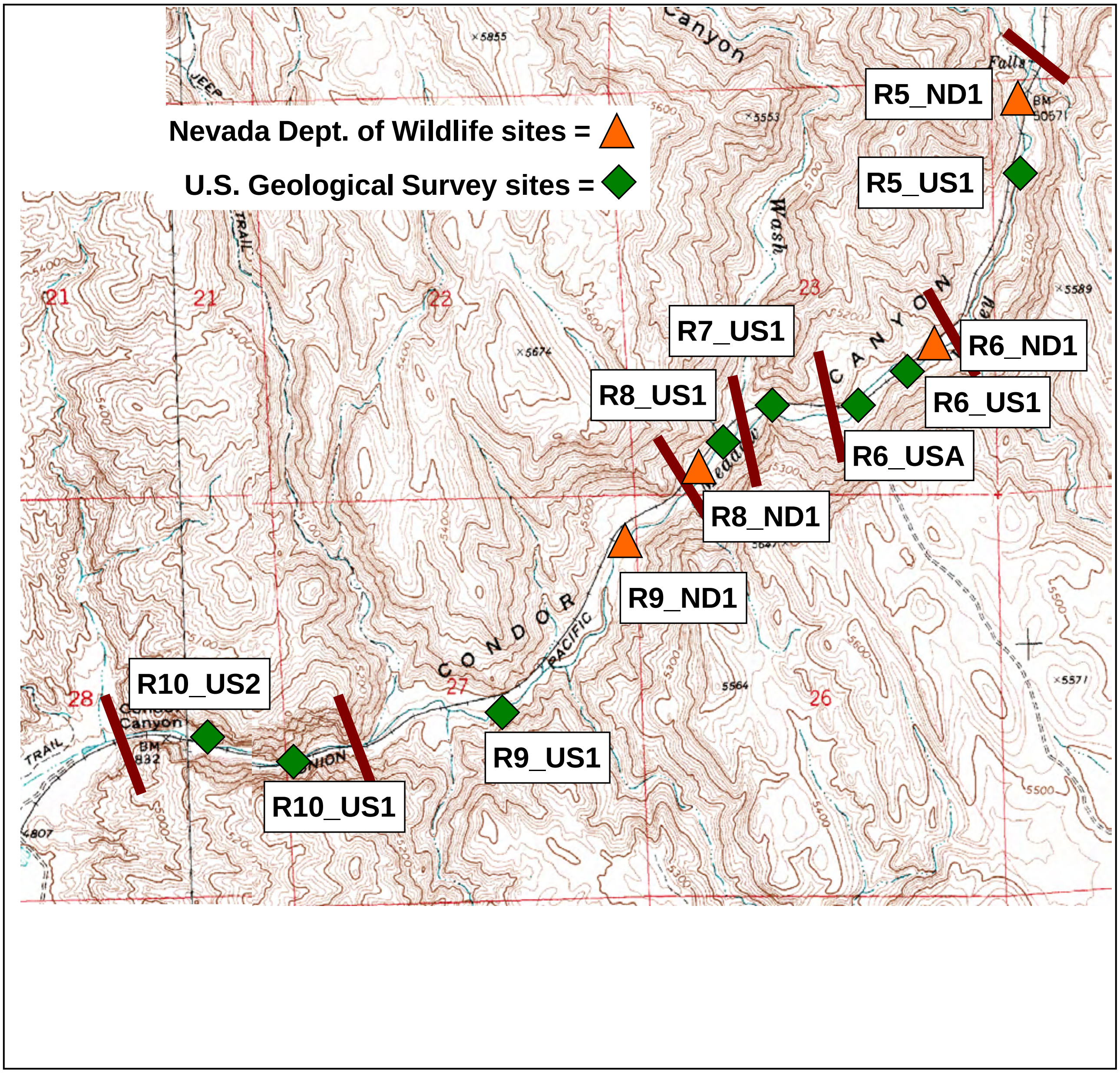


Figure 9. Fish-population-sampling locations in reaches downstream of Delmue Falls, Condor Canyon, Meadow Valley Wash, Nevada. Sites are geo-referenced in appendix A of this report.

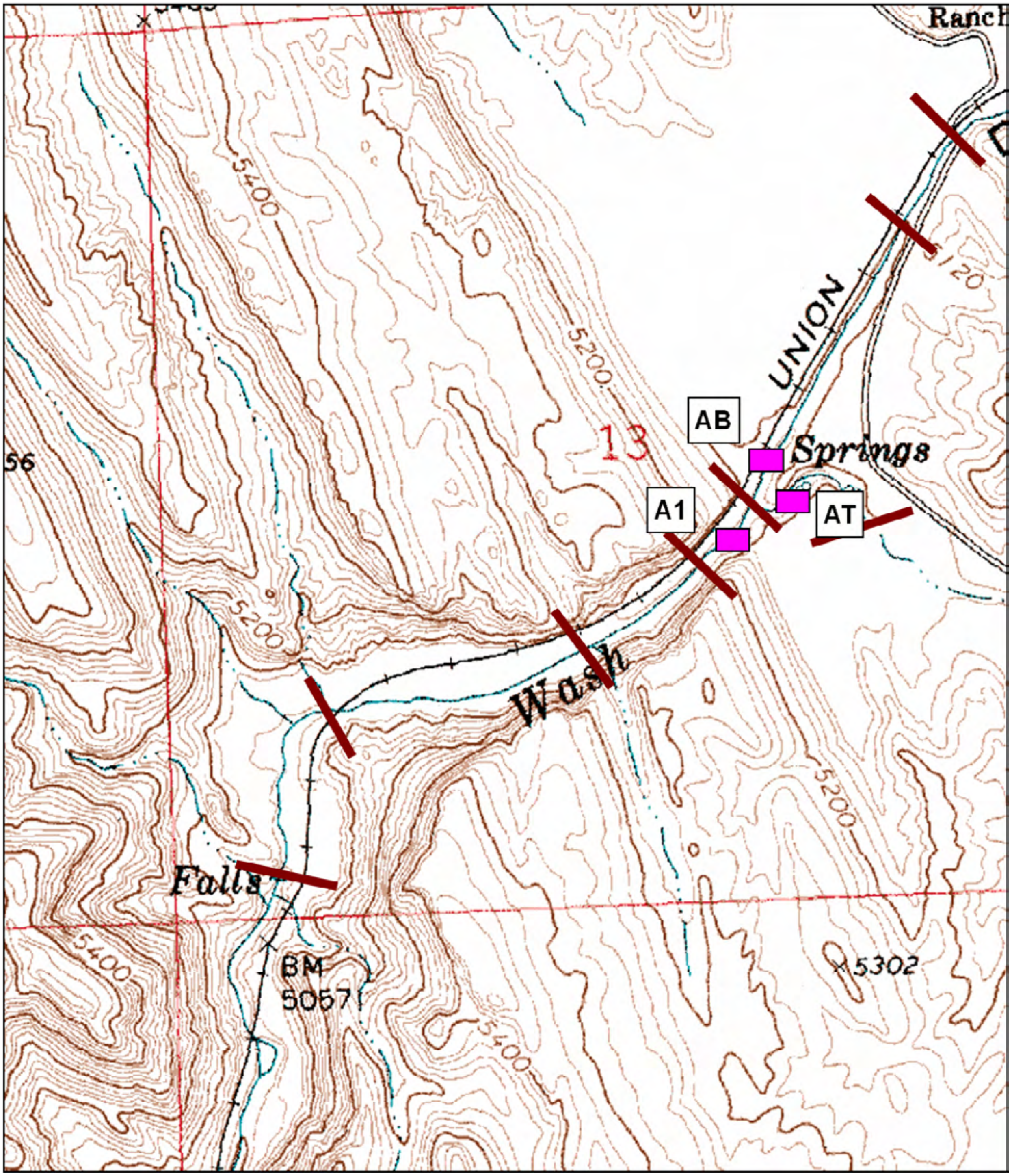


Figure 10. Passive-Integrated-Transponder tag-interrogation system locations in reaches upstream of Delmue Falls, Condor Canyon, Meadow Valley Wash, Nevada. Sites are geo-referenced in appendix A of this report.

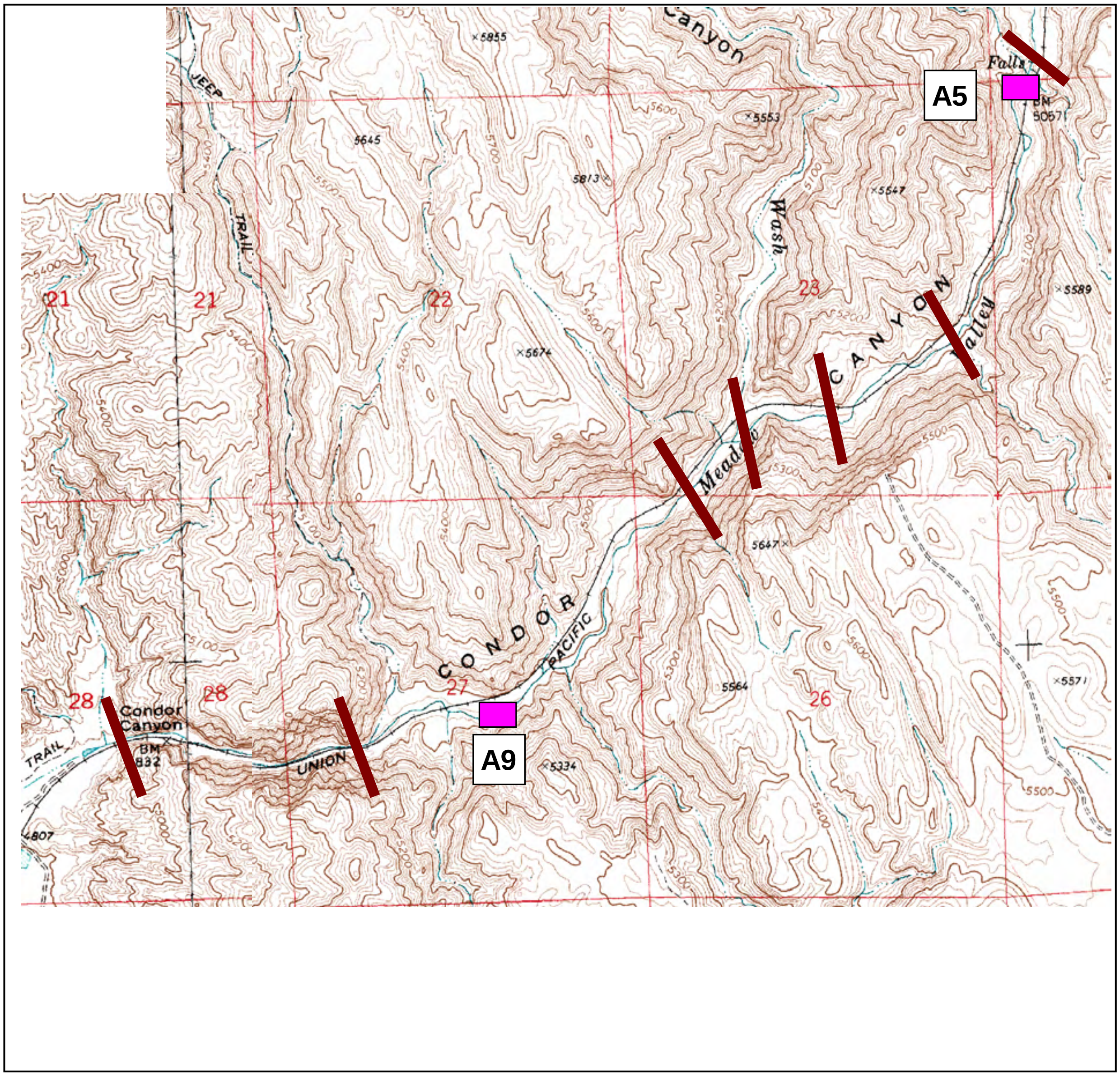


Figure 11. Passive-Integrated-Transponder tag-interrogation system locations in reaches downstream of Delmue Falls, Condor Canyon, Meadow Valley Wash, Nevada. Sites are geo-referenced in appendix A of this report.

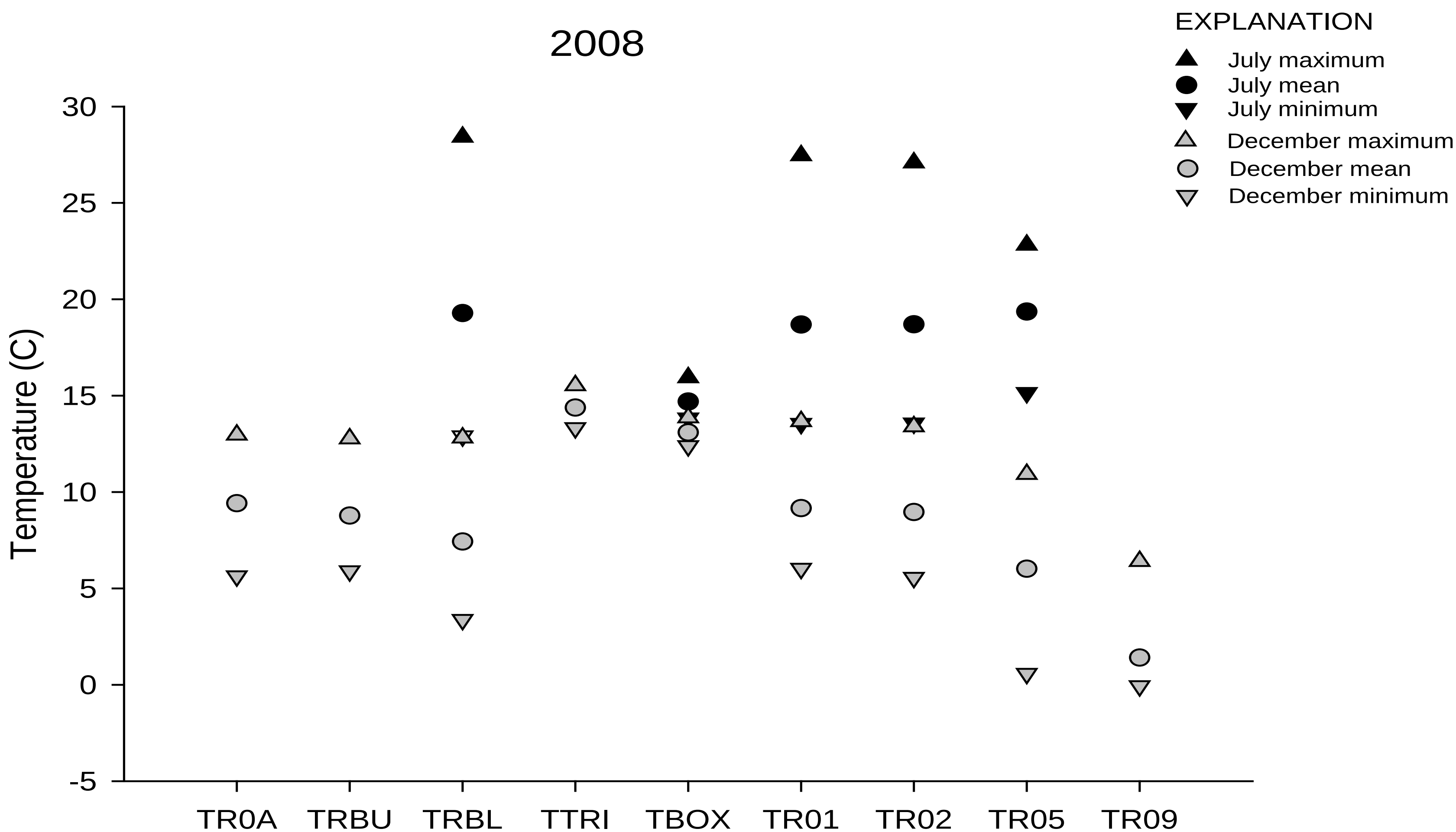


Figure 12. Maximum, mean, and minimum water temperature during the hottest and coldest month for nine sites in Meadow Valley Wash, Condor Canyon, Lincoln County, Nevada. For location of temperature loggers, see appendix A of this report.

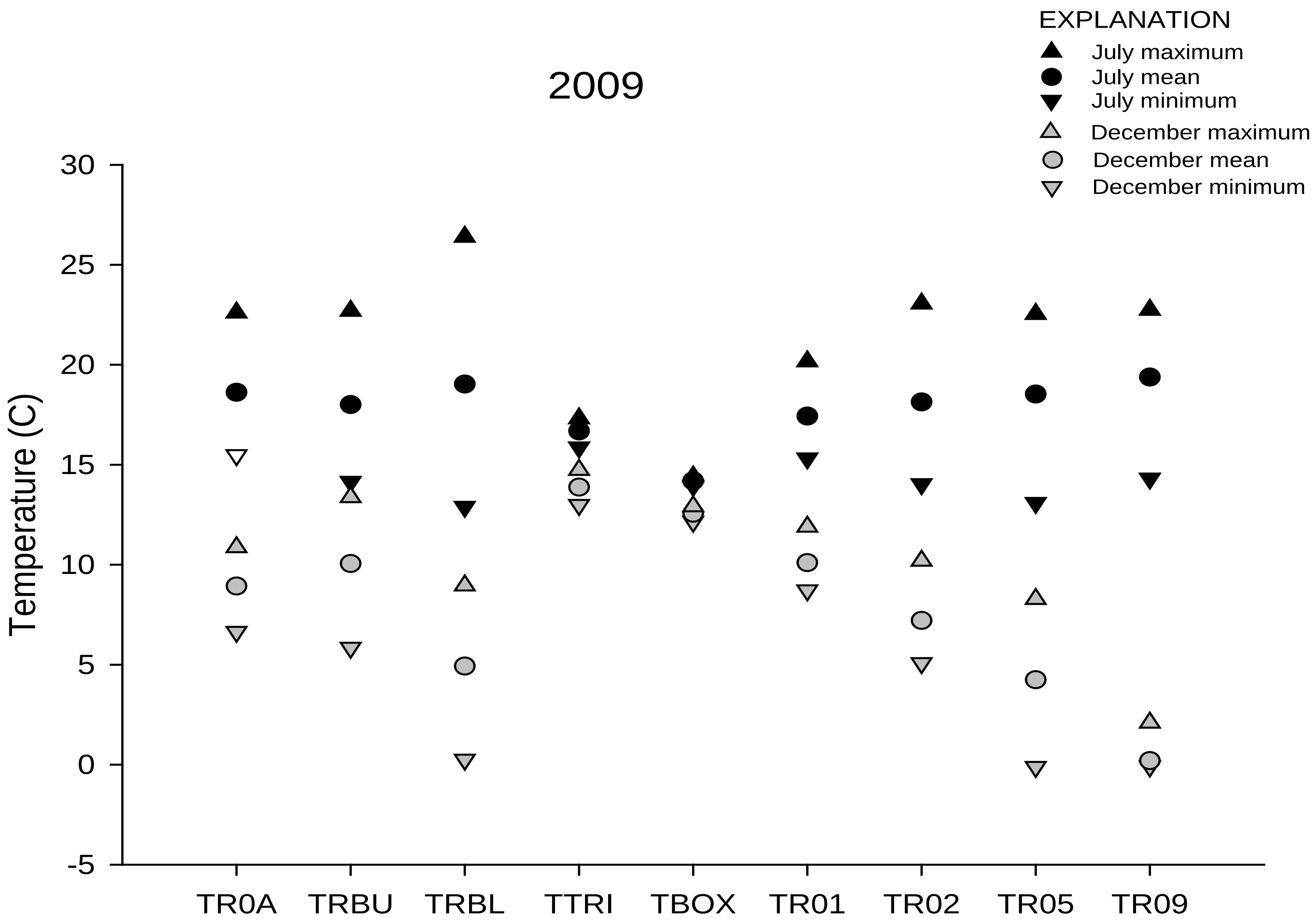


Figure 13. Maximum, mean, and minimum water temperature during the hottest and coldest month for nine sites in Meadow Valley Wash, Condor Canyon, Lincoln County, Nevada. For location of temperature loggers, see appendix A of this report.

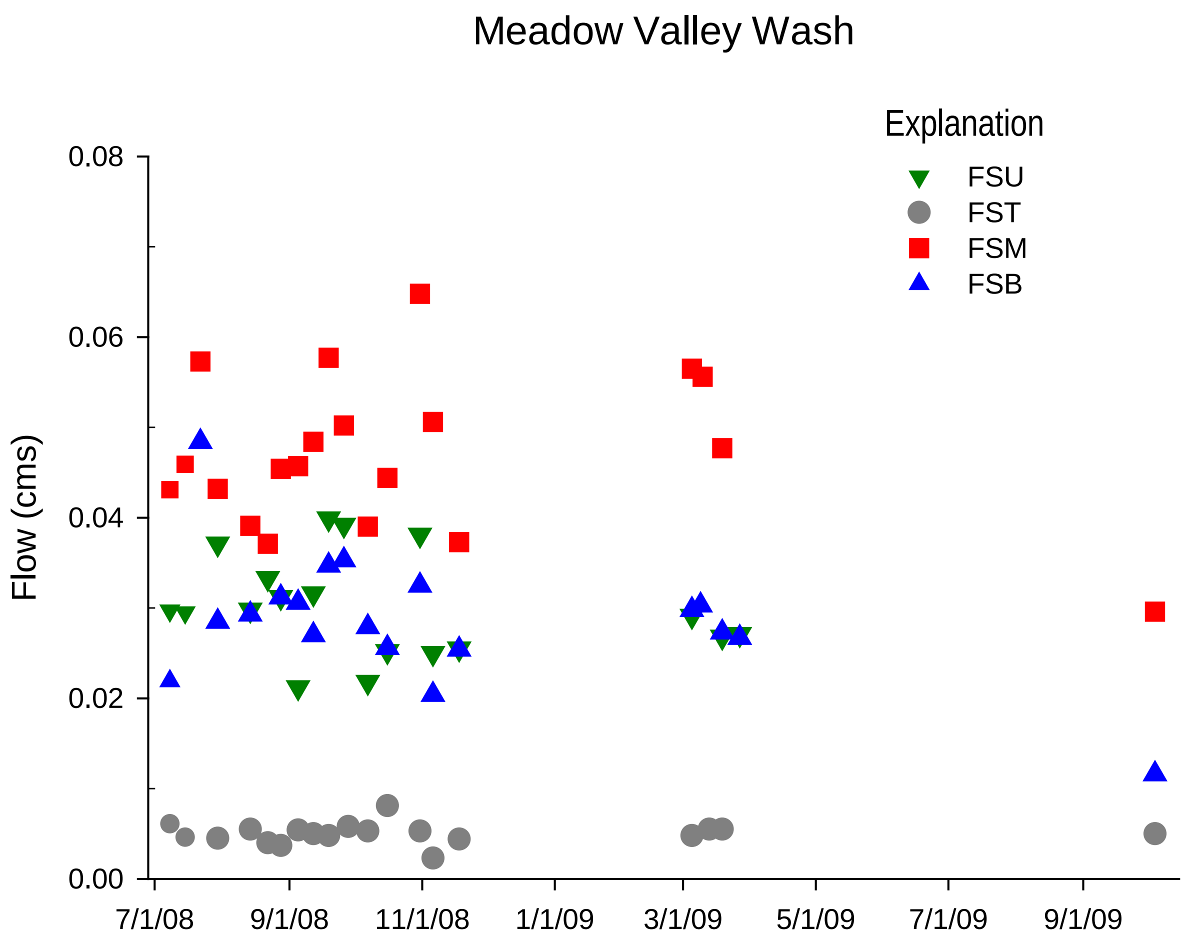


Figure 14. Flow at four sites in Condor Canyon, Meadow Valley Wash, Nevada, from July 2008 through October 2009. [FSU, flow site upper (taken at the upper end of the canyon in Reach B); FST, flow site tributary; FSM, flow site middle (taken in the middle of the canyon in Reach 2); and FSB, flow site bottom (taken at the lower end of the canyon in Reach 9)].

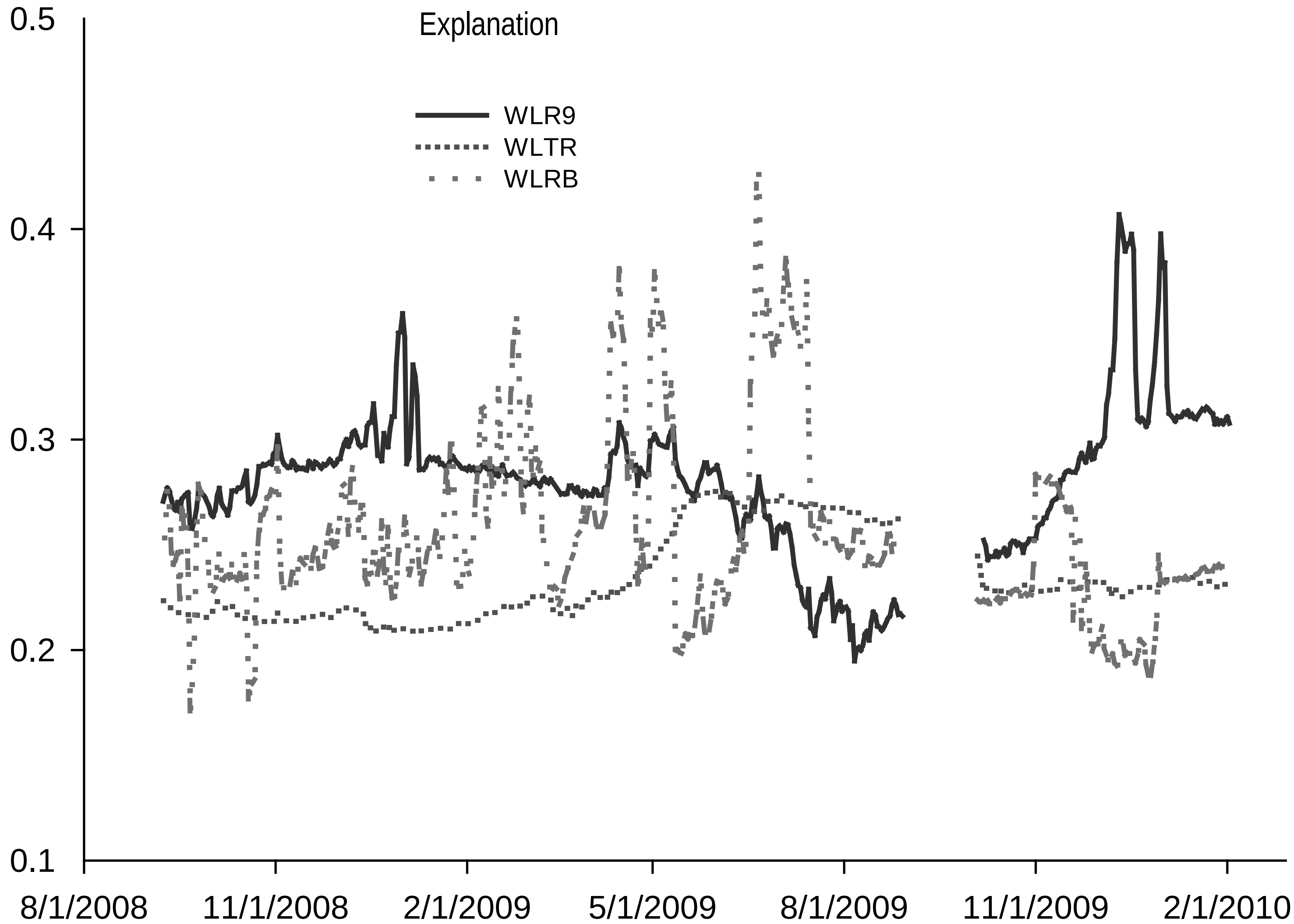


Figure 15. Daily mean water level for three sites in Meadow Valley Wash, Condor Canyon, Nevada, from September 2008 through February 2010. WLR9 is at the upper end of Reach 9, WLRT is in Kill Wash, and WLRB is in Reach B just upstream of the Kill Wash confluence.

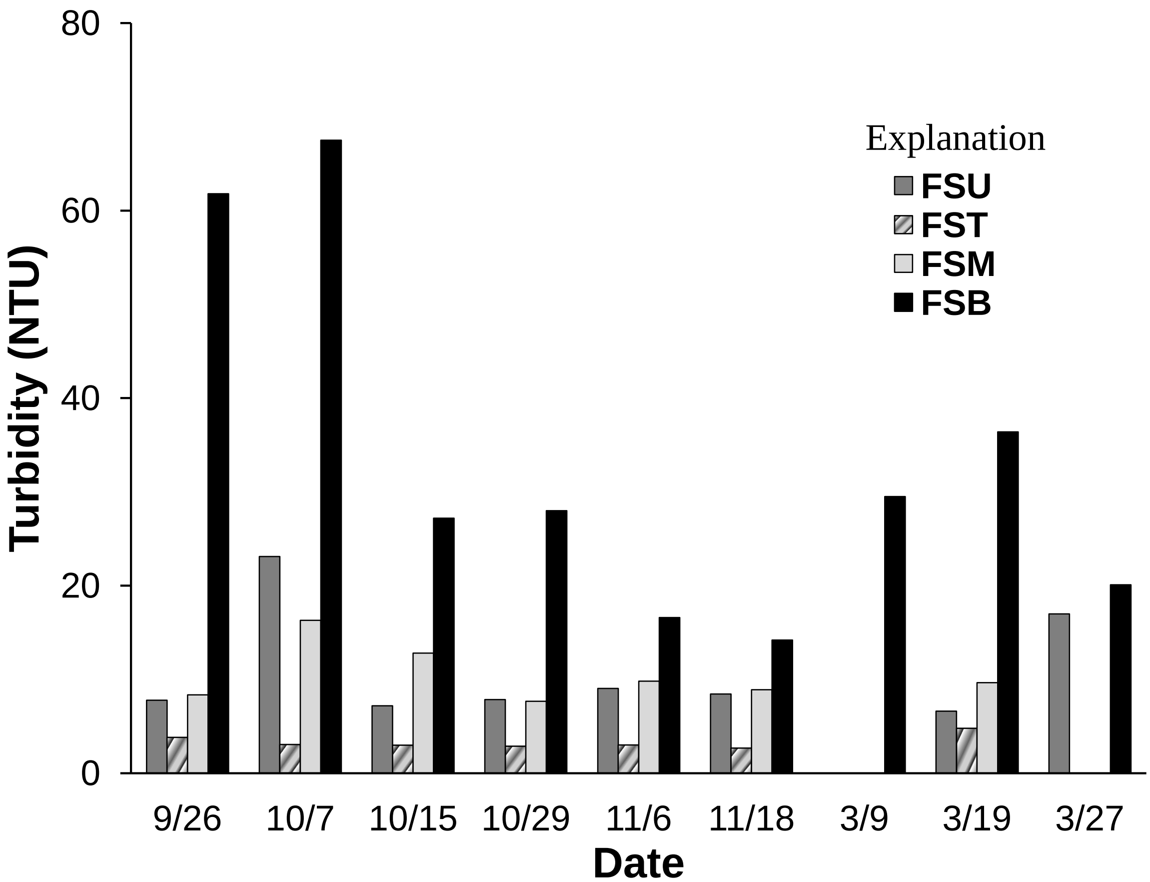


Figure 16. Turbidity at the four flow sites in Condor Canyon, Meadow Valley Wash, Nevada, during fall 2008 and spring 2009. FSU is upstream of the Kill Wash confluence, FST is in Kill Wash, FSM is in Reach 2, and FSB is in Reach 9.

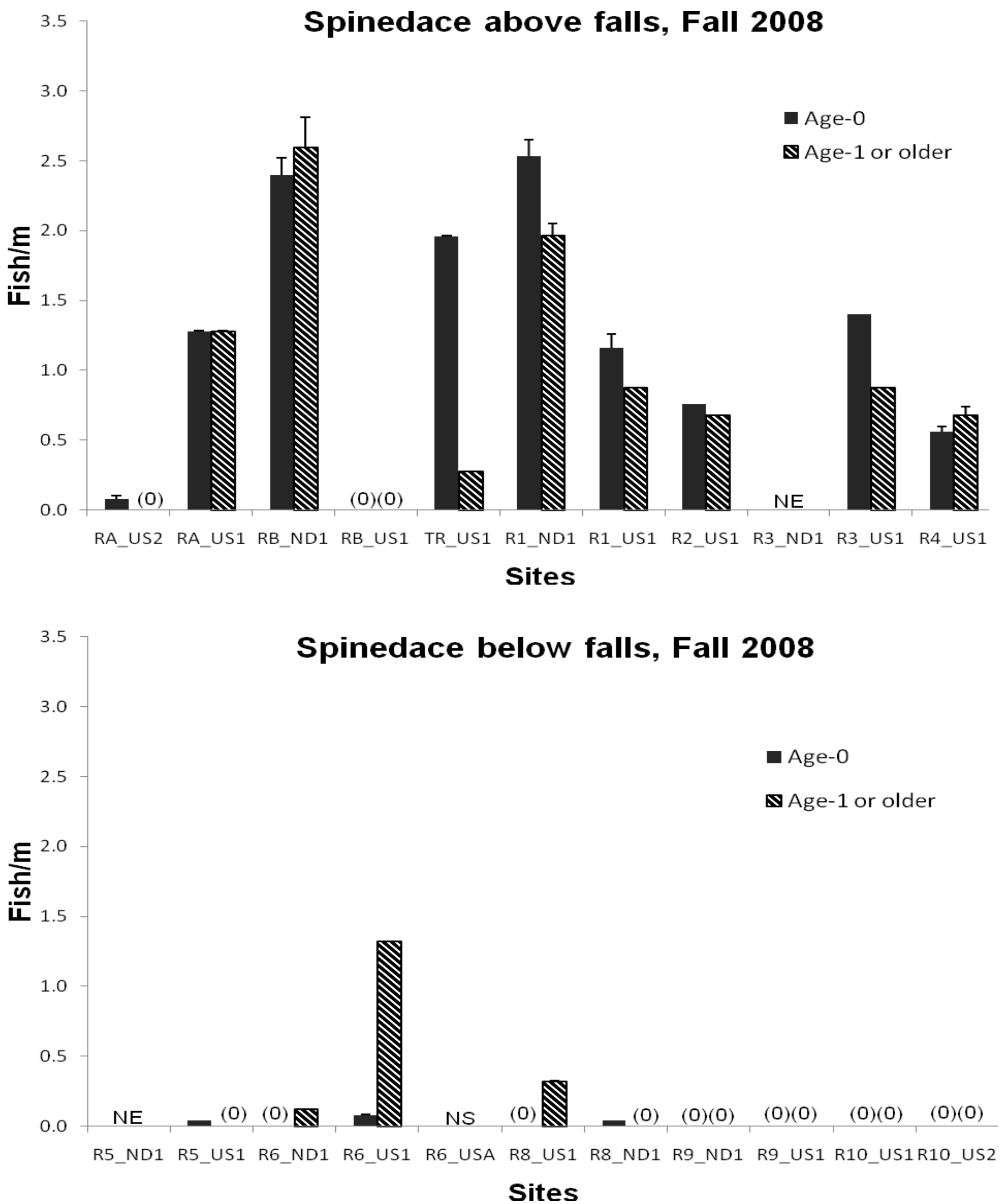


Figure 17. Population estimates of age-0 and age-1 or older Big Spring spinedace above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2008. From left to right, sites are listed from upstream to downstream. [NE, no estimate; NS, not sampled]

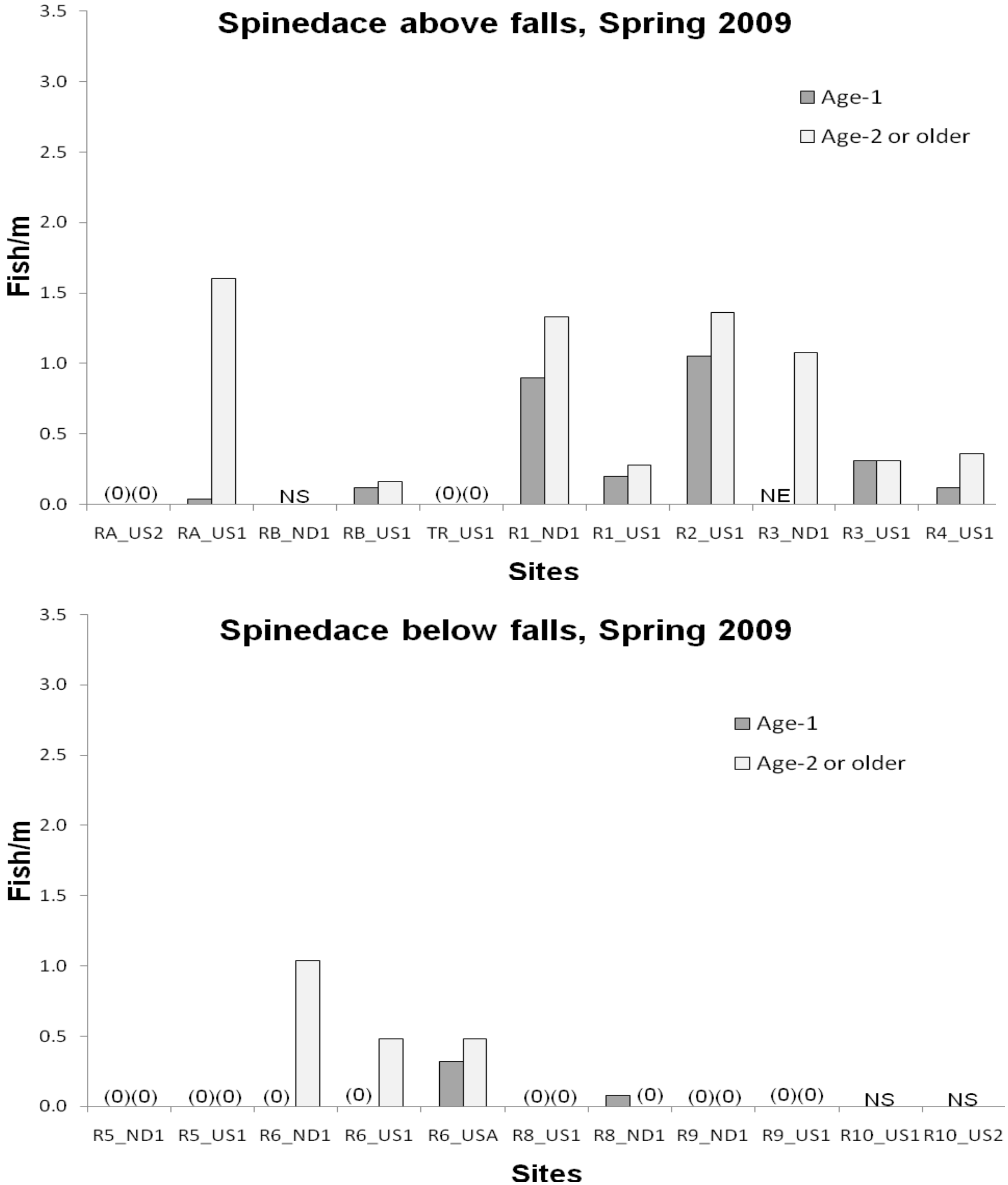
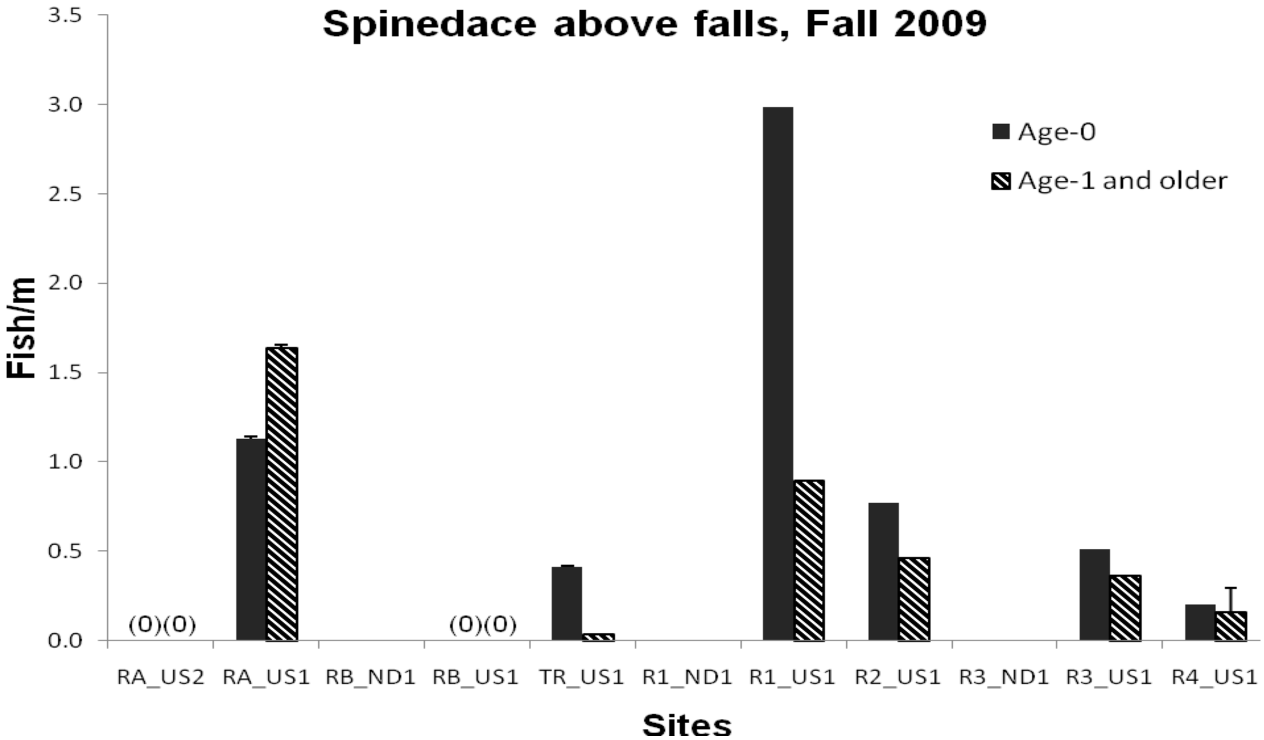


Figure 18. Population estimates of age-1 or age-2 or older Big Spring spinedace above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, spring 2009. From left to right, sites are listed from upstream to downstream. [NE, no estimate; NS, not sampled]



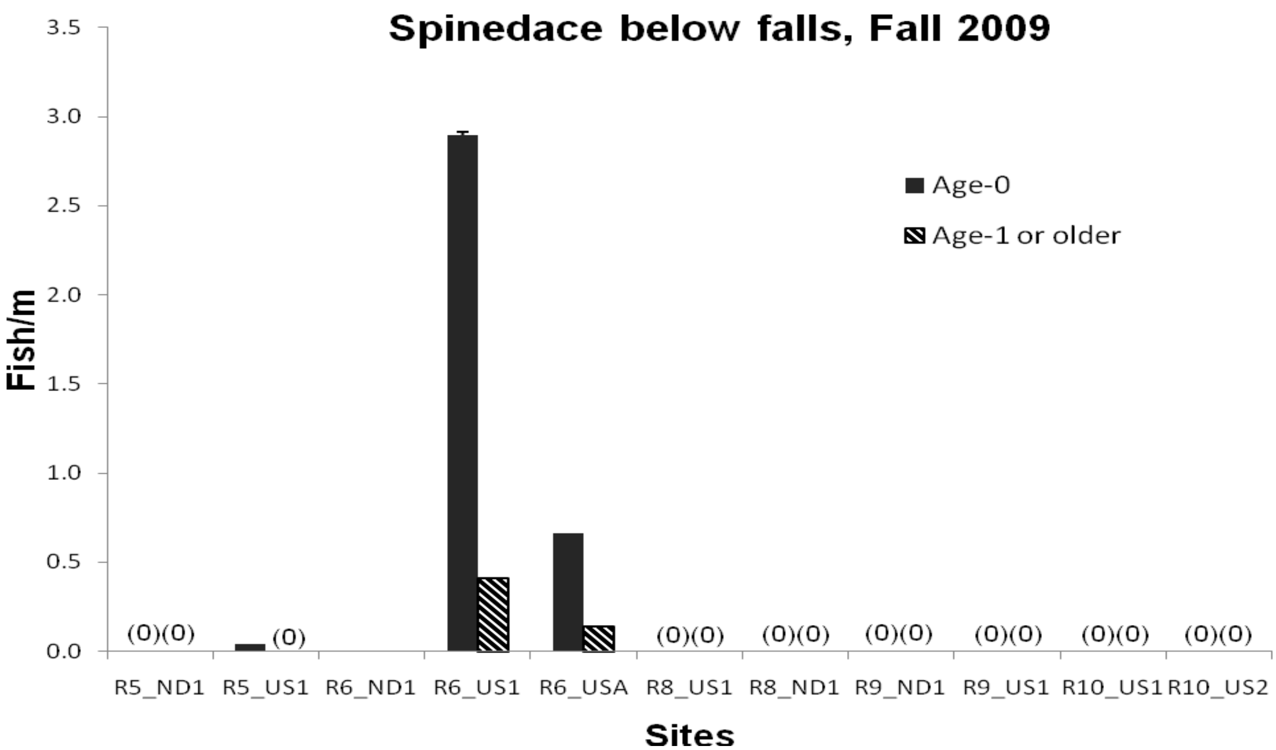


Figure 19. Population estimates of age-0 and age-1 or older Big Spring spinedace above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2009. From left to right, sites are listed from upstream to downstream. Estimates of Big Spring spinedace populations at Nevada Department of Wildlife sites are shown in Figure 20.

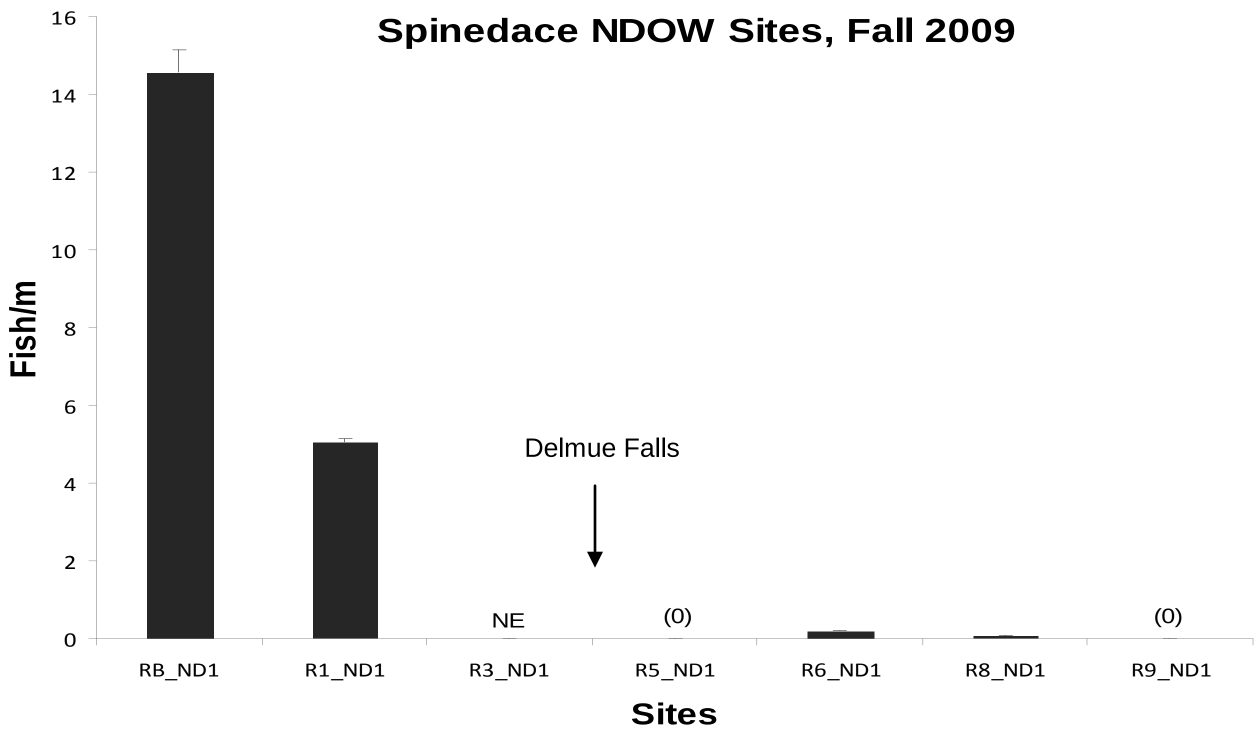


Figure 20. Population estimates of all age classes of Big Spring spinedace at Nevada Department of Wildlife (NDOW) sites above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2009. From left to right, sites are listed from upstream to downstream. [NE, no estimate]

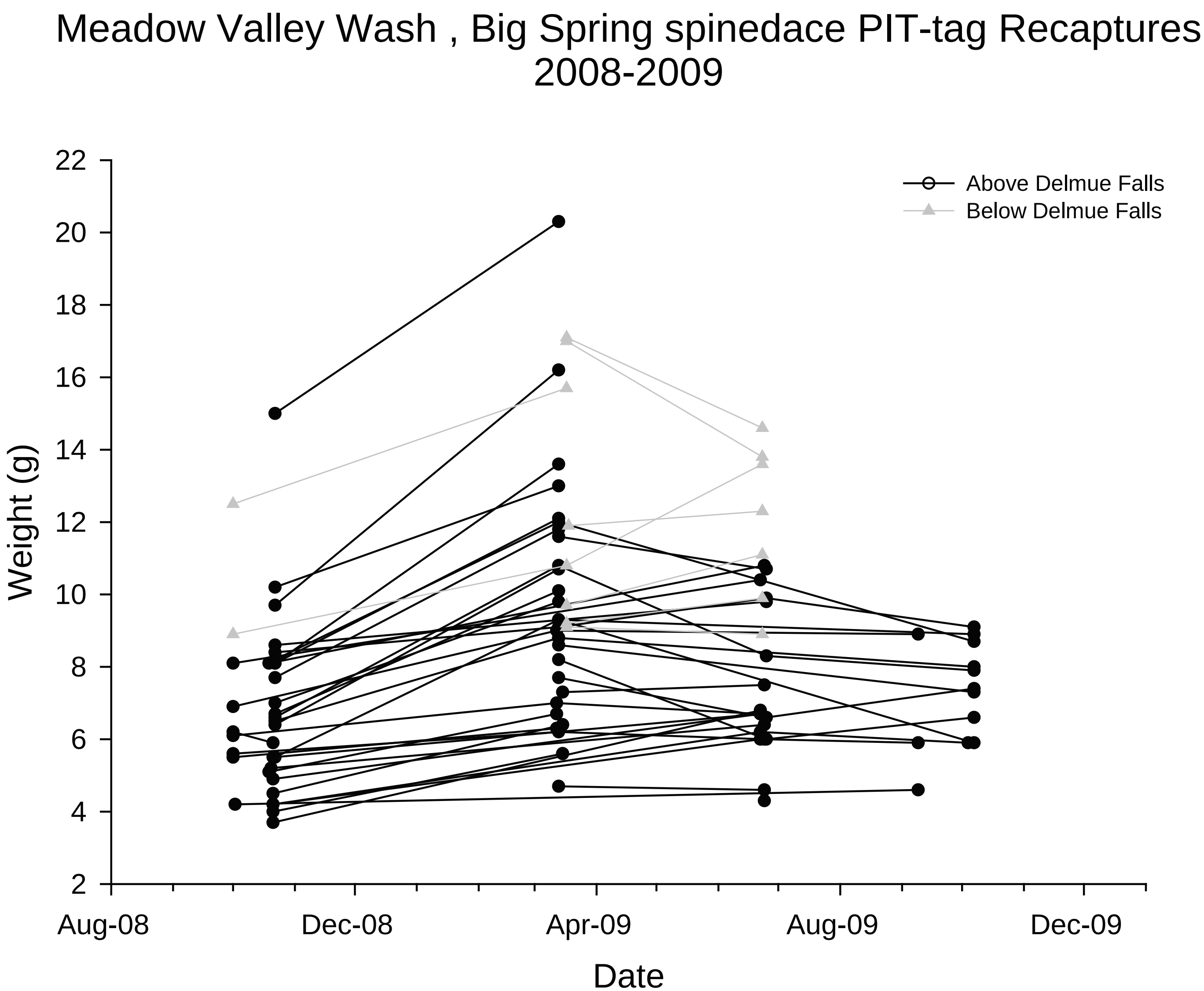


Figure 21. Growth (weight in grams) of recaptured, Passive-Integrated-Transponder-tagged Big Spring spinedace in Condor Canyon, Meadow Valley Wash, Nevada, during 2008 and 2009.

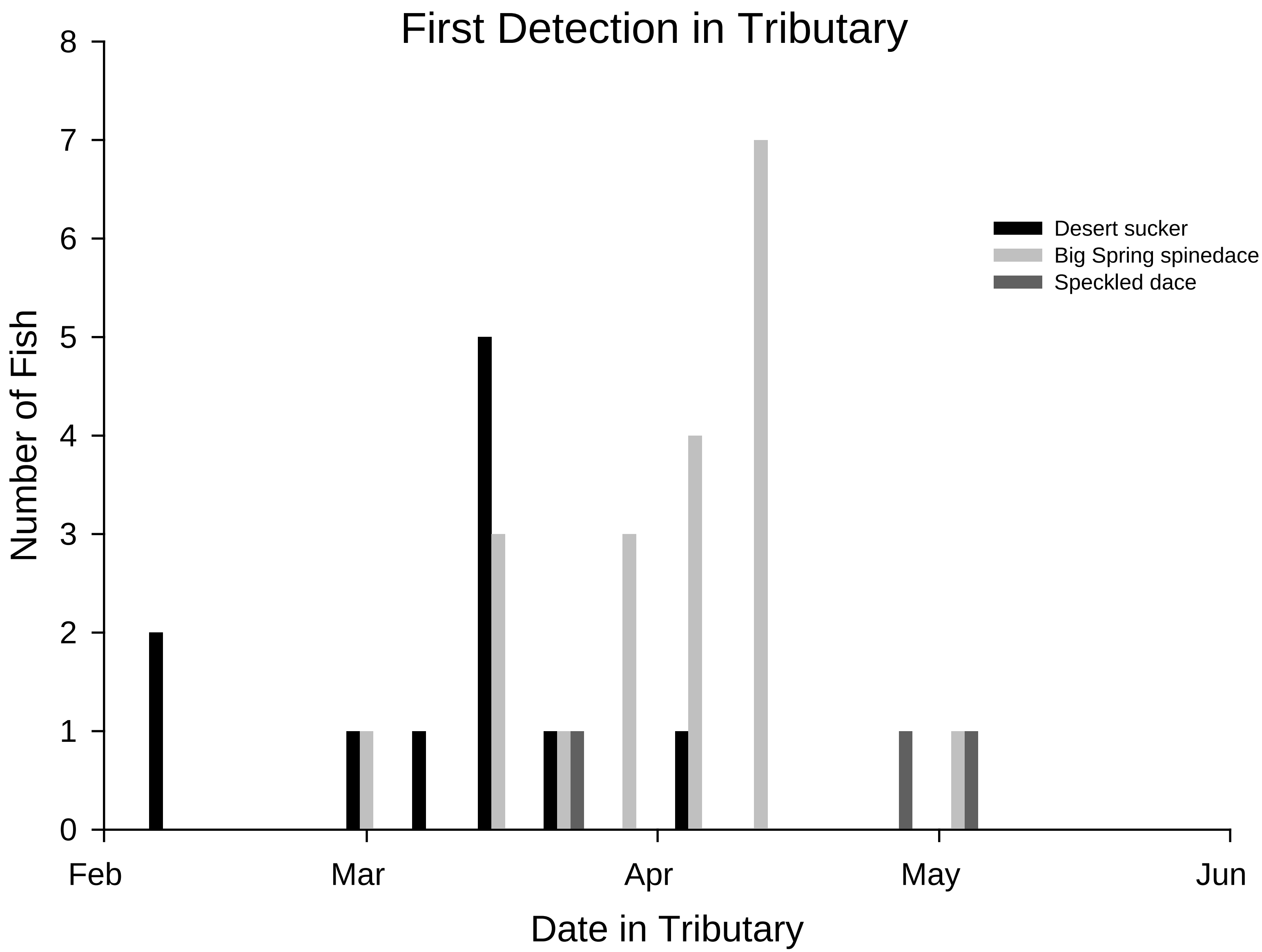


Figure 22. Timing of first detection (by week) of three species during winter and spring 2009 at the Passive-Integrated-Transponder tag interrogator in Kill Wash, a tributary of Meadow Valley Wash, Nevada.

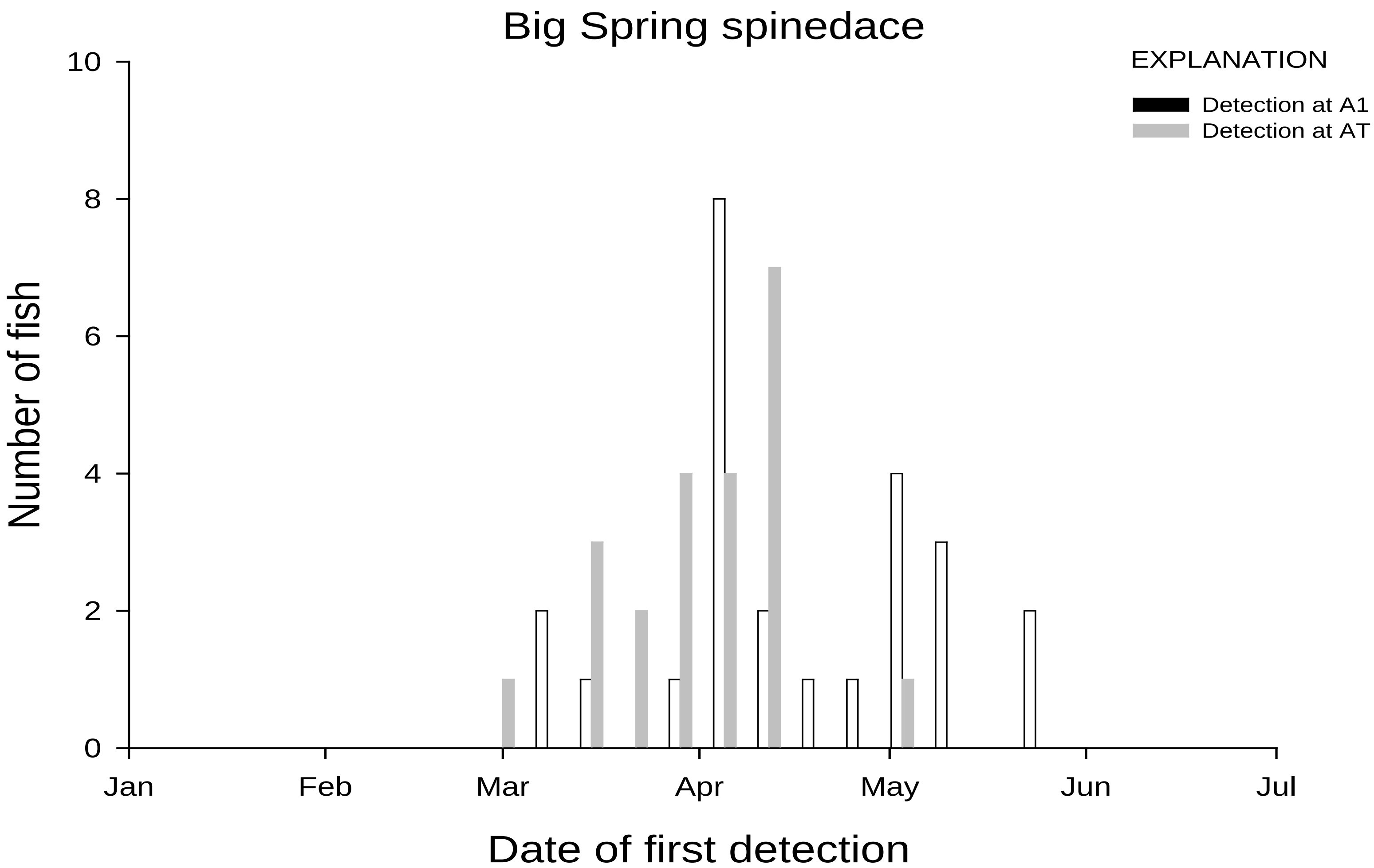


Figure 23. Timing of first detection (by week) of Big Spring spinedace at Passive-Integrated-Transponder tag interrogators A1 (in Reach 1) and AT (in Kill Wash) in Meadow Valley Wash, Nevada, during winter and spring 2009. Fish were tagged in Reach 2 or below.

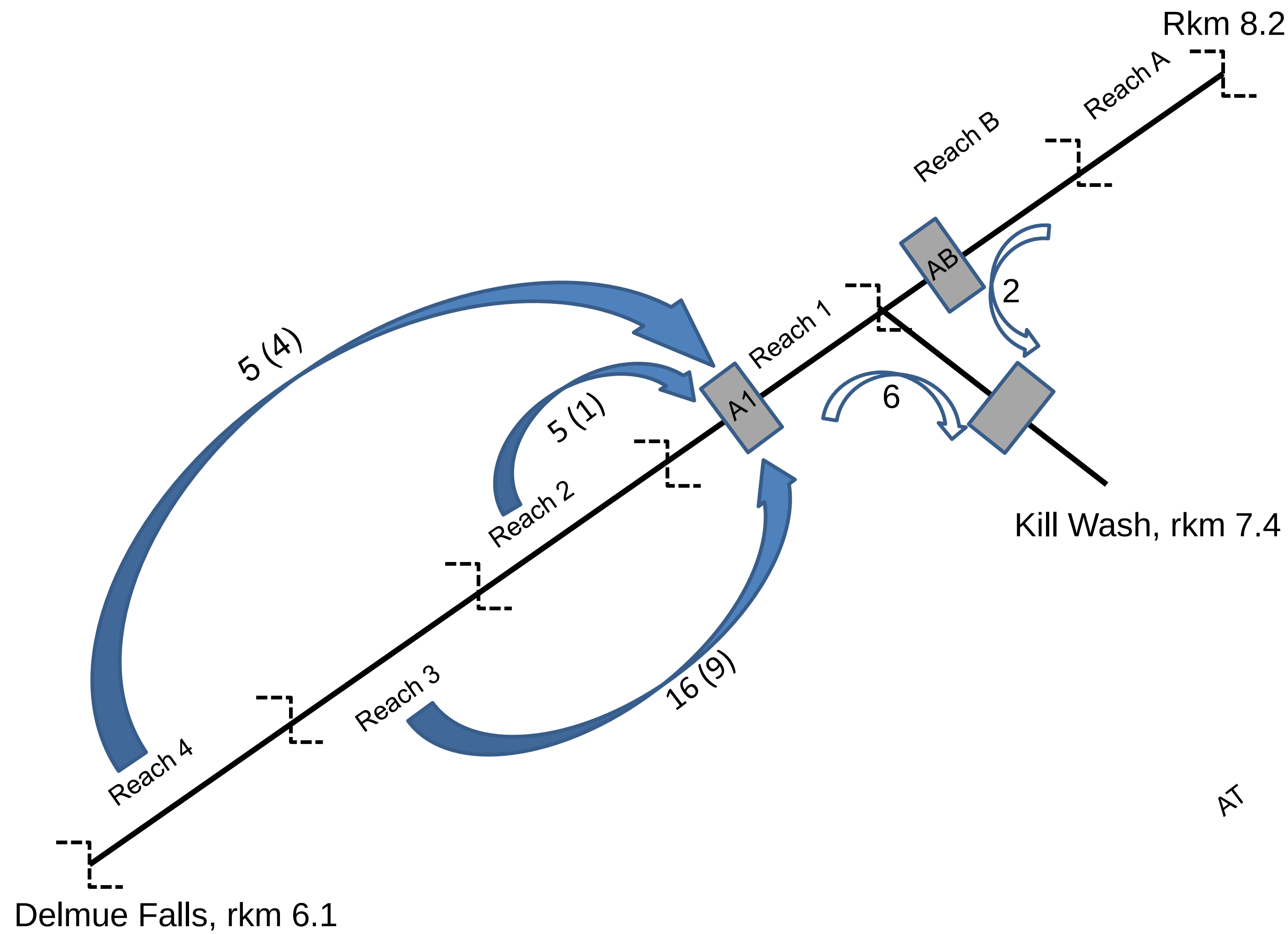
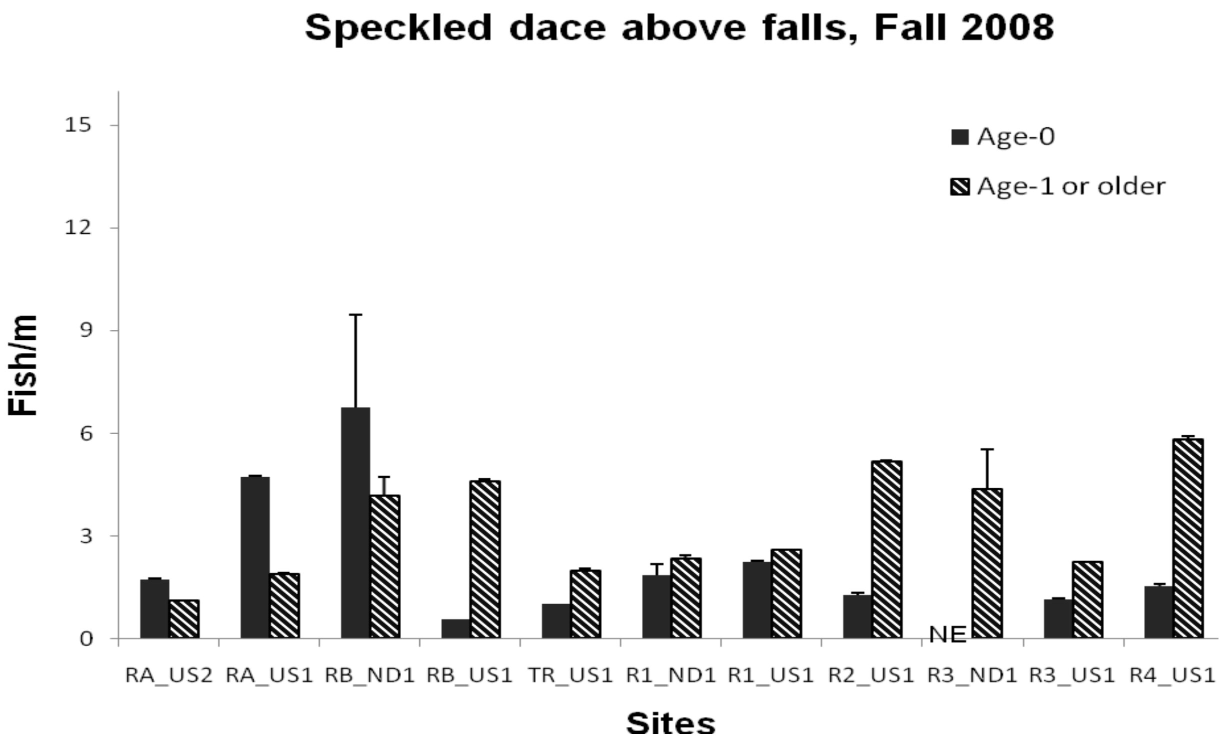


Figure 24. Detections of Passive-Integrated-Transponder (PIT)-tagged Big Spring spinedace at PIT tag interrogators above Delmue Falls. Solid arrows depict fish movement from reaches 2, 3, and 4 to Reach 1 (interrogator A1). The numbers adjacent to the arrows are the number of fish detected at A1 and, in parenthesis, the numbers of fish subsequently detected in Kill Wash (interrogator AT). The open arrows and adjacent numbers depict movement from reaches 1 and B into Kill Wash. One fish each from reaches 2 and 3 were detected in Reach B (interrogator AB). No Big Spring spinedace from Reach A were detected downstream of that reach.



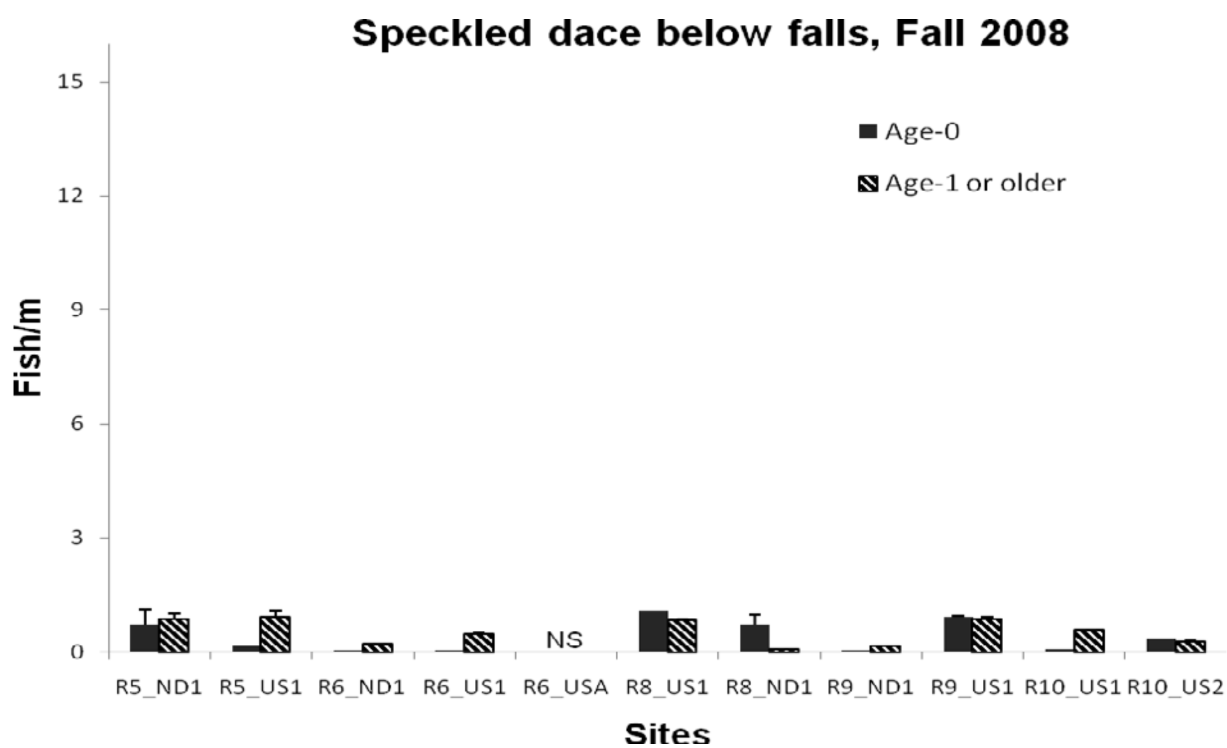


Figure 25. Population estimates of age-0 and age-1 or older speckled dace above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2008. For site locations see figures 8 and 9. [NE, no estimate; NS, not sampled]

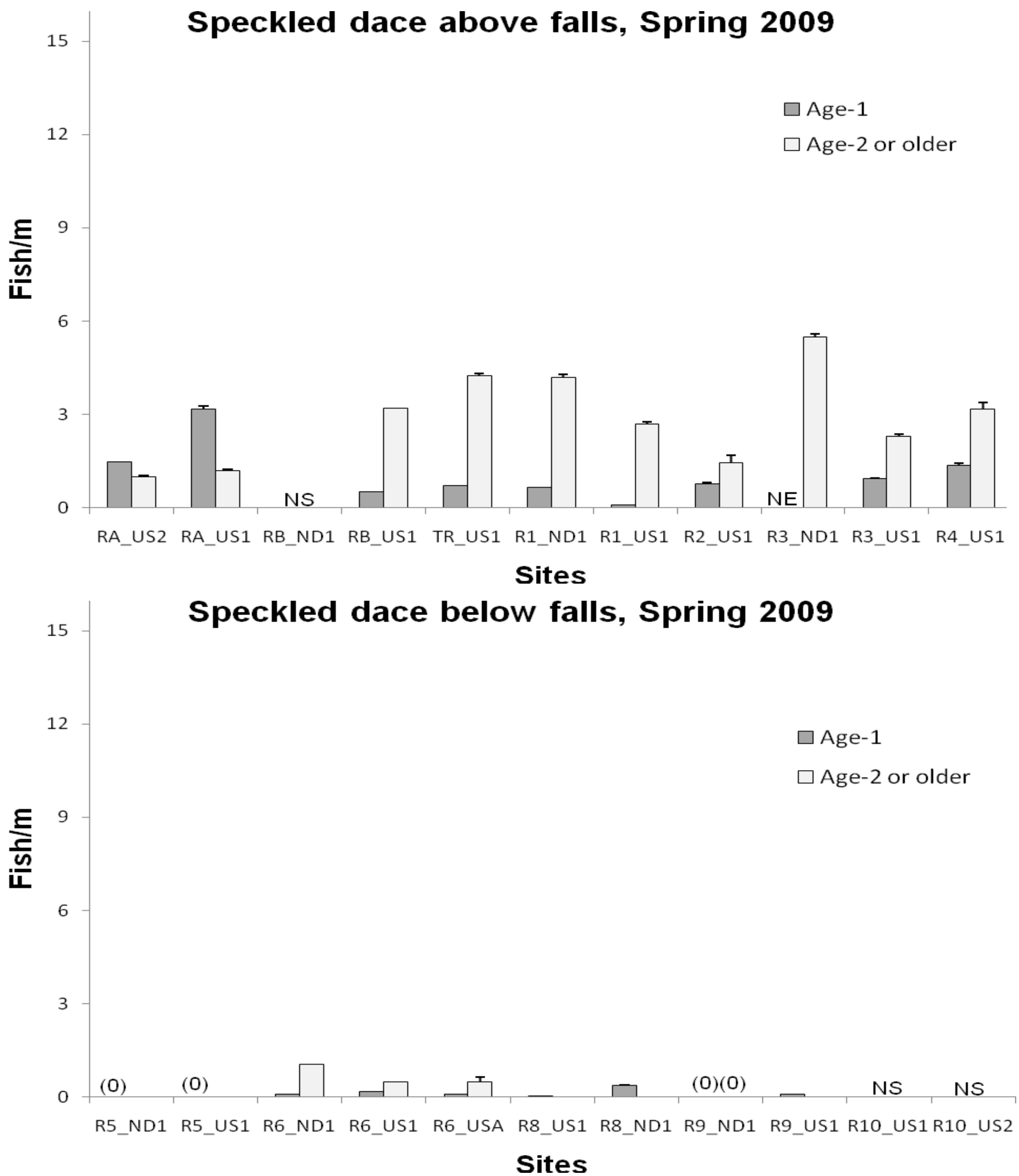


Figure 26. Population estimates of age-1 or age-2 or older speckled dace above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, spring 2009. From left to right, sites are listed from upstream to downstream. [NE, no estimate; NS, not sampled]

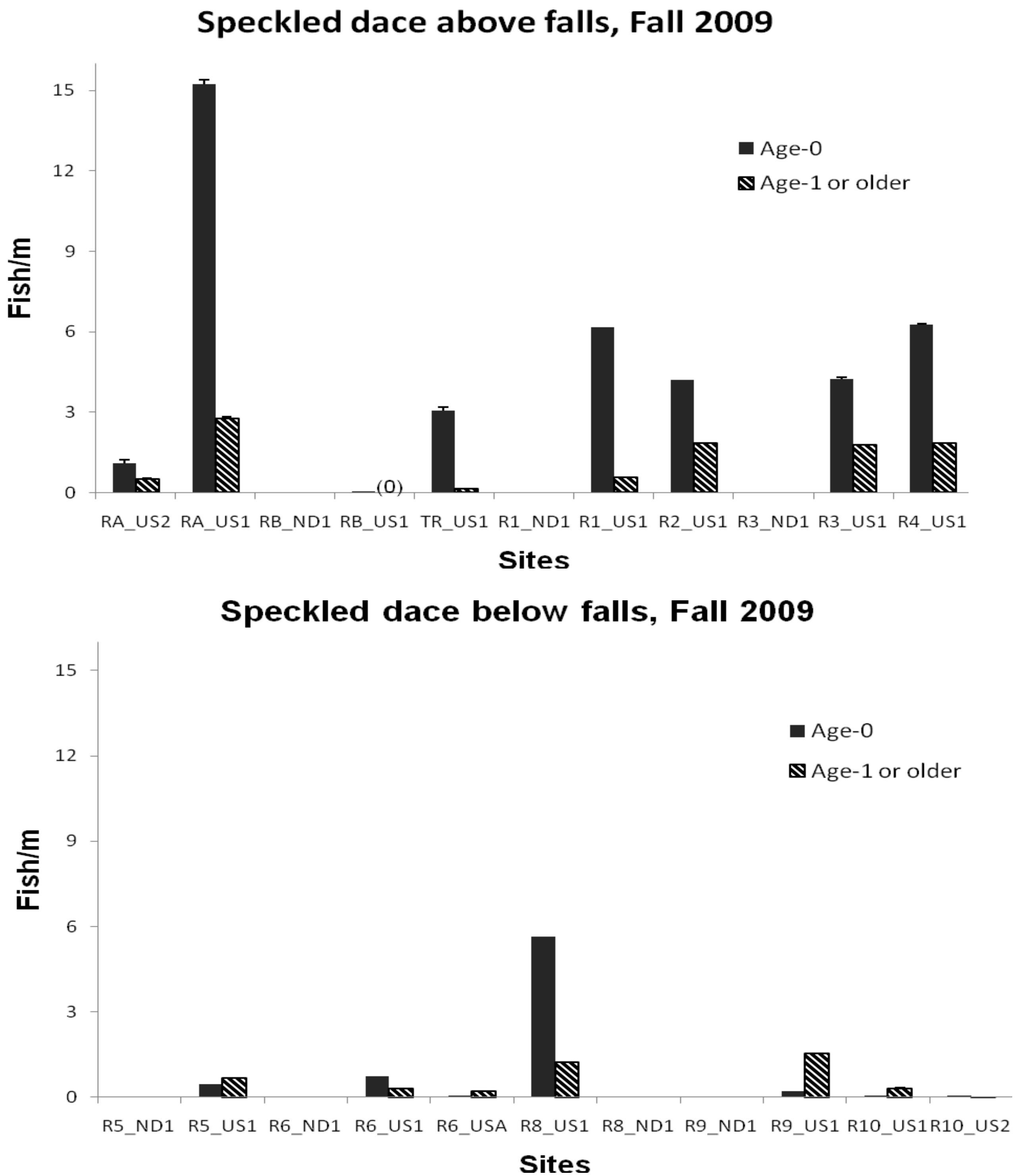


Figure 27. Population estimates of age-0 and age-1 or older speckled dace above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2009. From left to right, sites are listed from upstream to downstream. Estimates of speckled dace populations at Nevada Department of Wildlife sites are shown in figure 24.

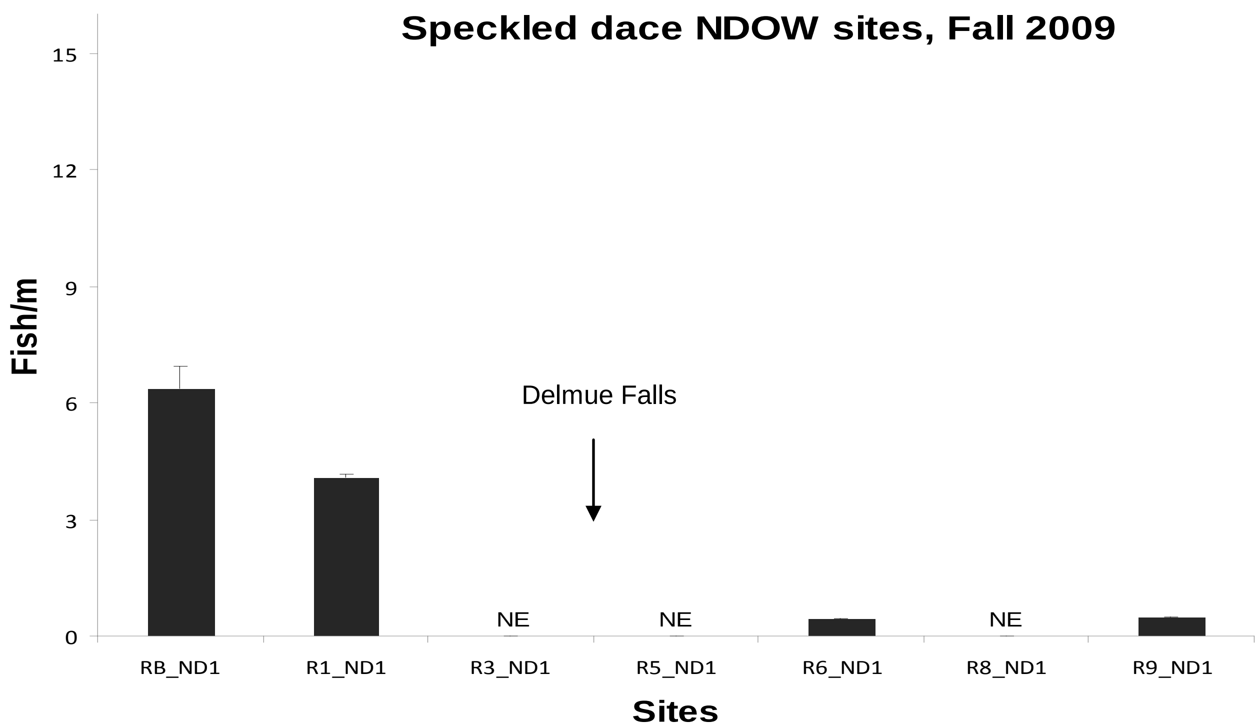


Figure 28. Population estimates of all age classes of speckled dace at Nevada Department of Wildlife (NDOW) sites above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2009. From left to right, sites are listed from upstream to downstream. [NE, no estimate]

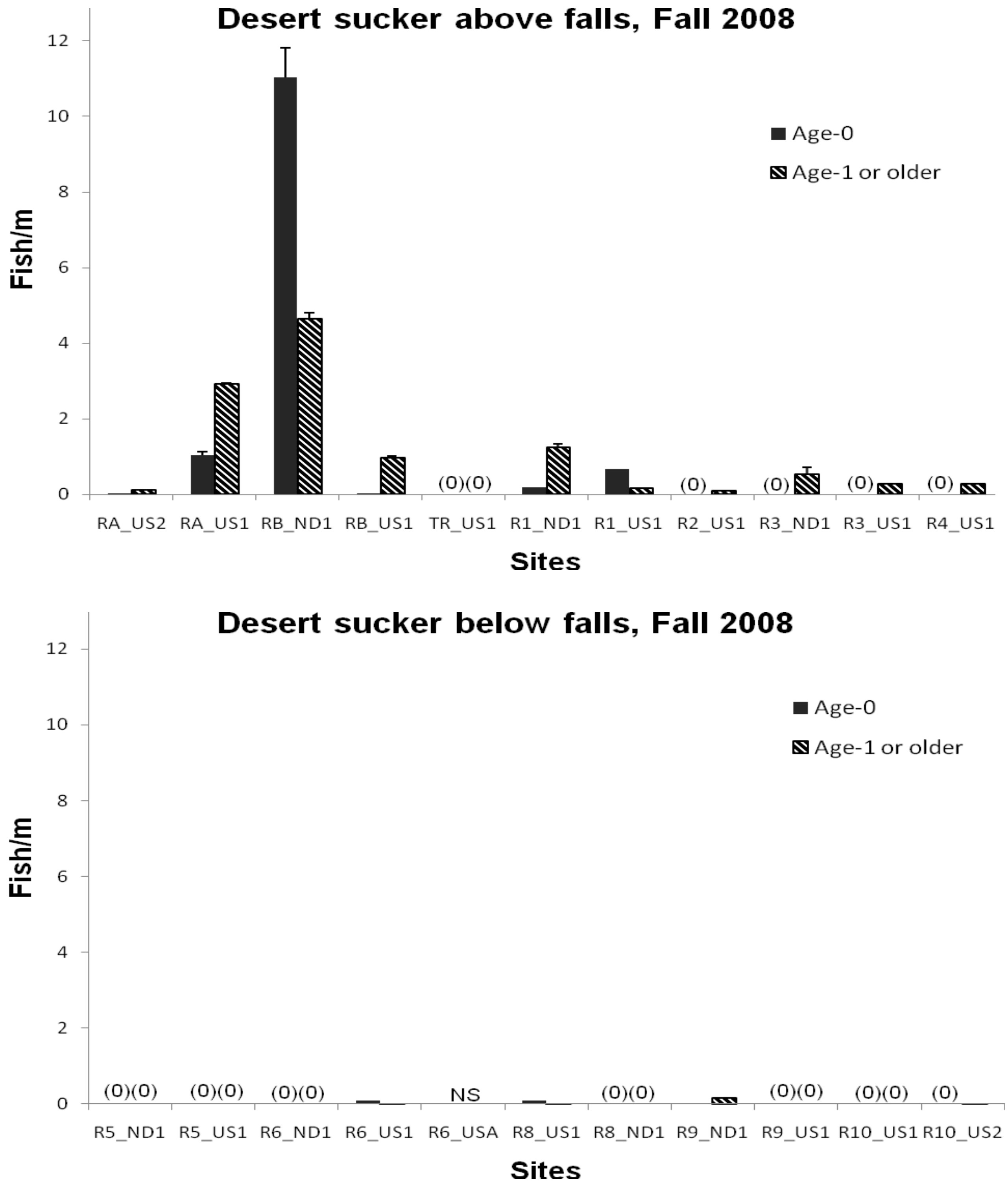
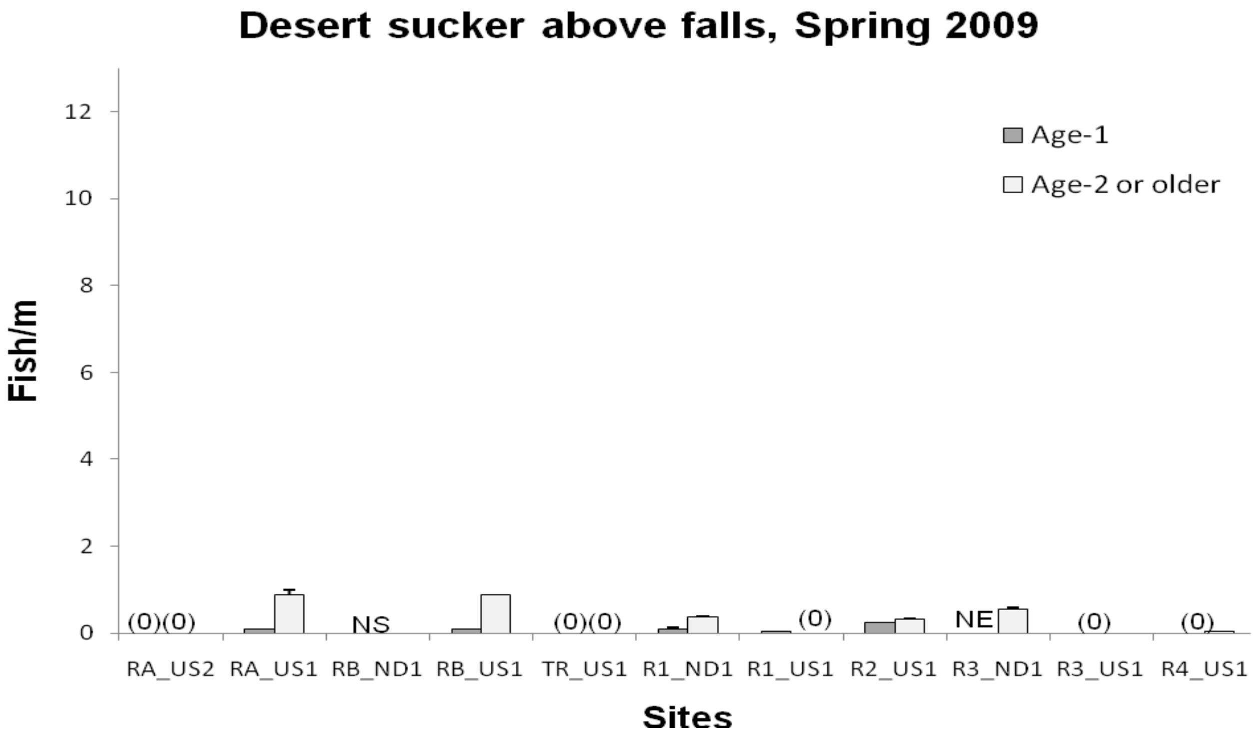


Figure 29. Population estimates of age-0 and age-1 or older desert sucker above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2008. From left to right, sites are listed from upstream to downstream. [NS, not sampled.]



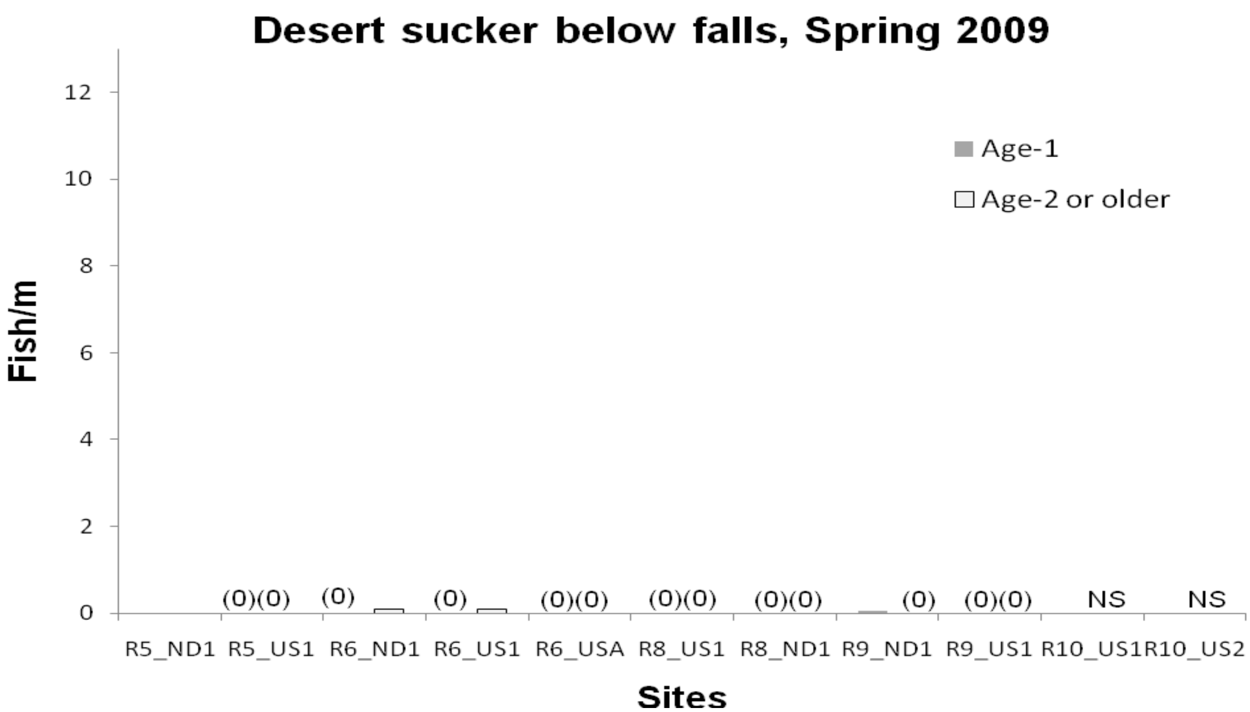
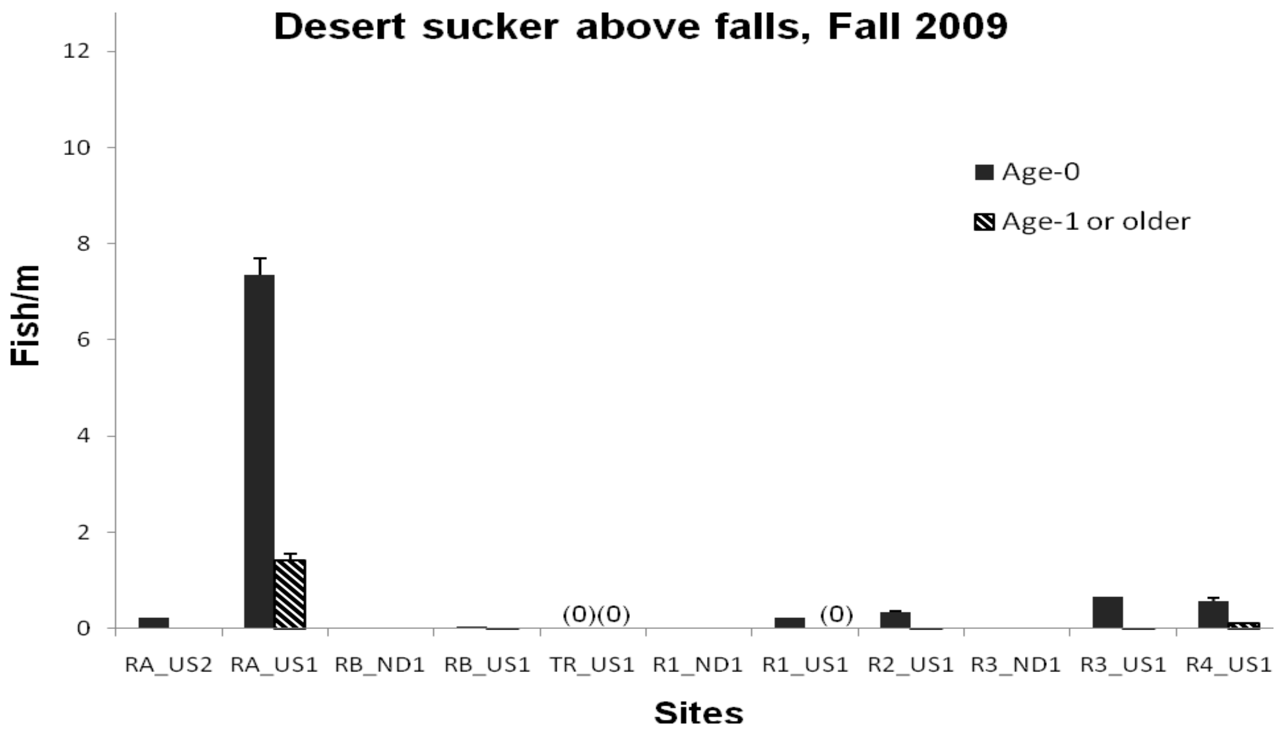


Figure 30. Population estimates of age-1 or age-2 or older desert sucker above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, spring 2009. From left to right, sites are listed from upstream to downstream. [NE, no estimate; NS, not sampled.]



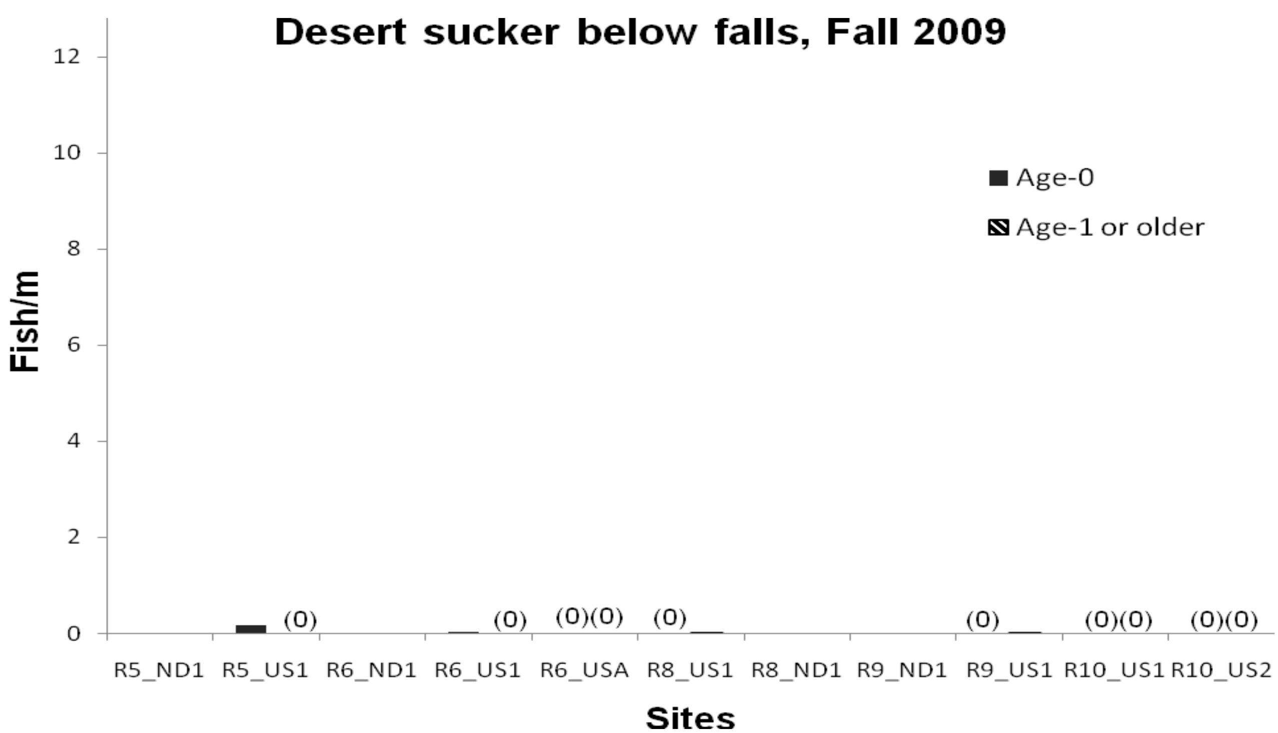


Figure 31. Population estimates of age-0 and age-1 or older desert sucker above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2009. From left to right, sites are listed from upstream to downstream. Estimates of desert-sucker populations at Nevada Department of Wildlife sites are shown in figure 32.

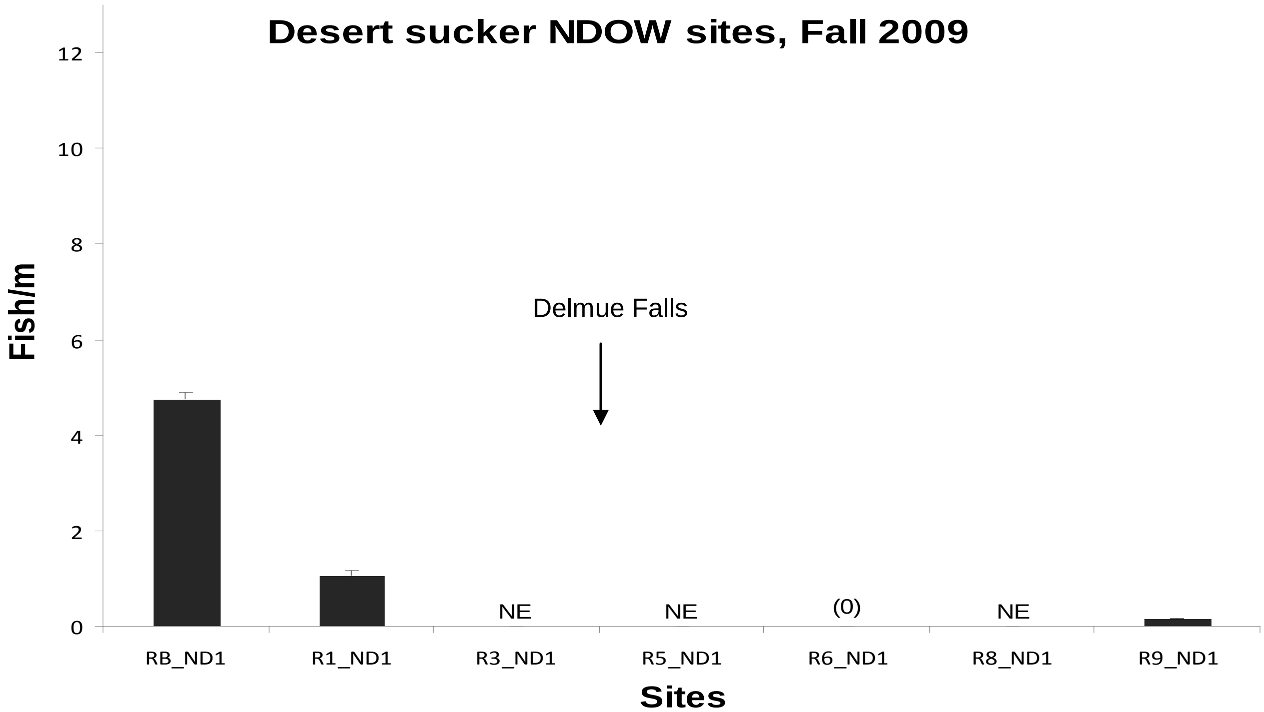


Figure 32. Population estimates of all age classes of desert sucker at Nevada Department of Wildlife (NDOW) sites above and below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2009. From left to right, sites are listed from upstream to downstream. [NE, no estimate.]

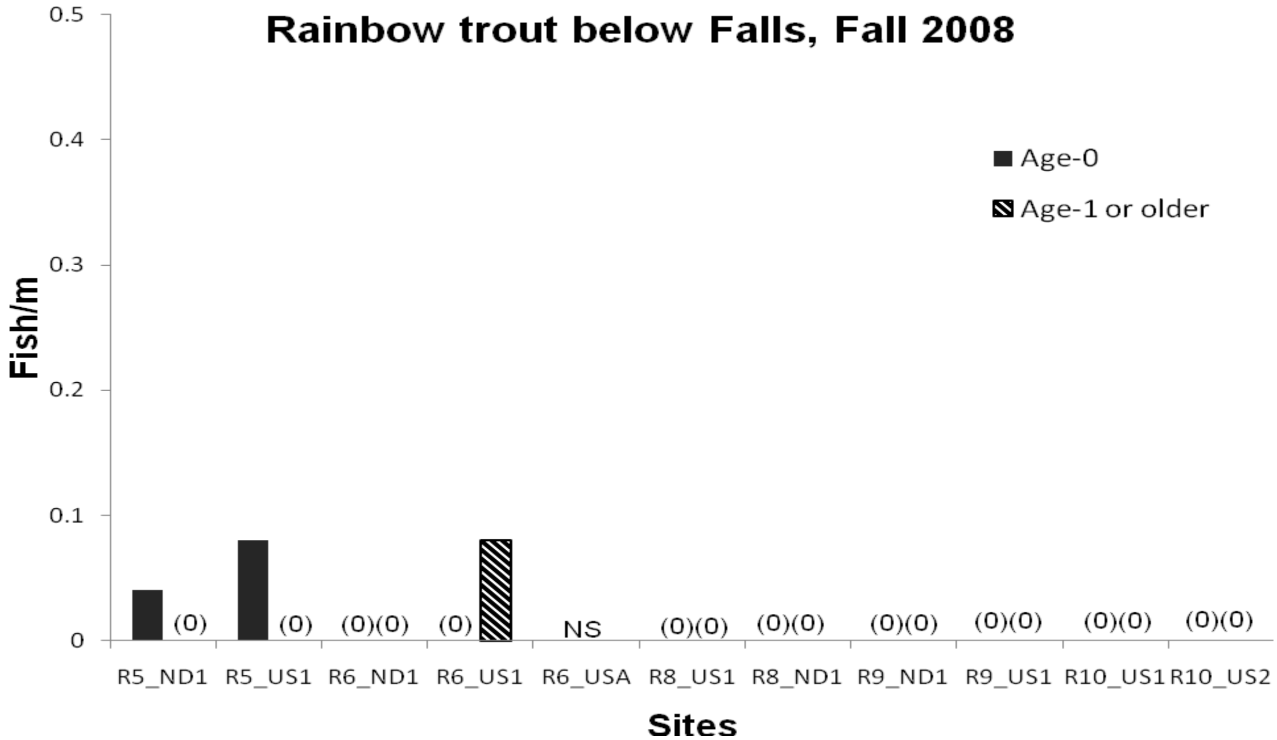


Figure 33. Population estimates of age-0 and age-1 or older rainbow trout below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2008. From left to right, sites are listed from upstream to downstream. [NS, not sampled.]

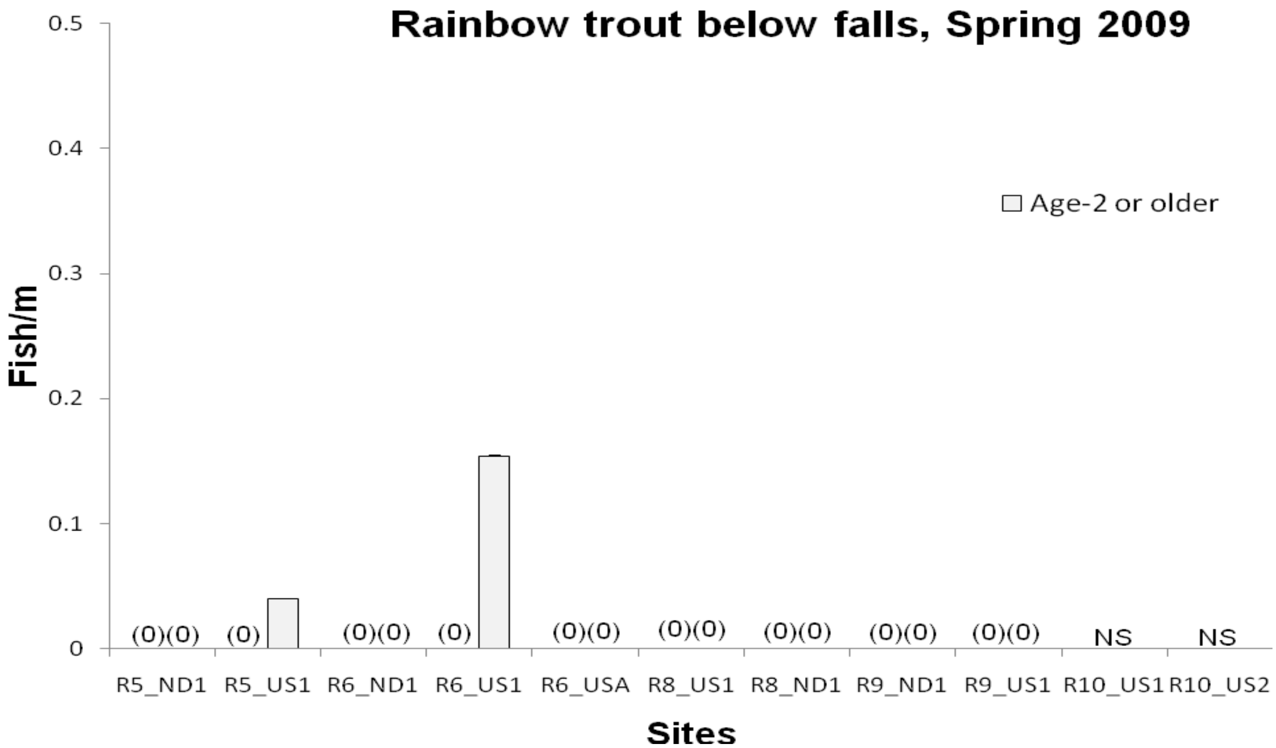


Figure 34. Population estimates of age-2 or older rainbow trout below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, spring 2009. From left to right, sites are listed from upstream to downstream. [NS, not sampled]

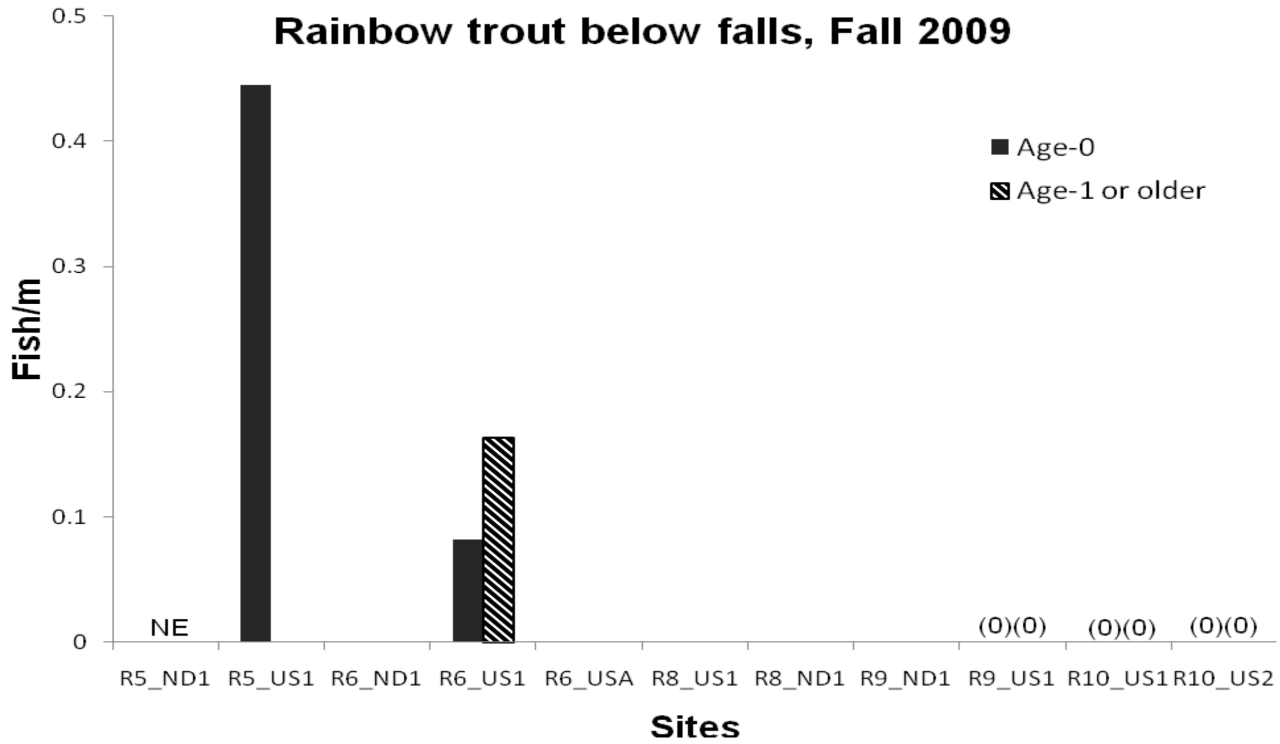


Figure 35. Population estimates of age-0 and age-1 or older rainbow trout below Delmue Falls in Condor Canyon, Meadow Valley Wash, Nevada, fall 2009. From left to right, sites are listed from upstream to downstream. [NE, no estimate]

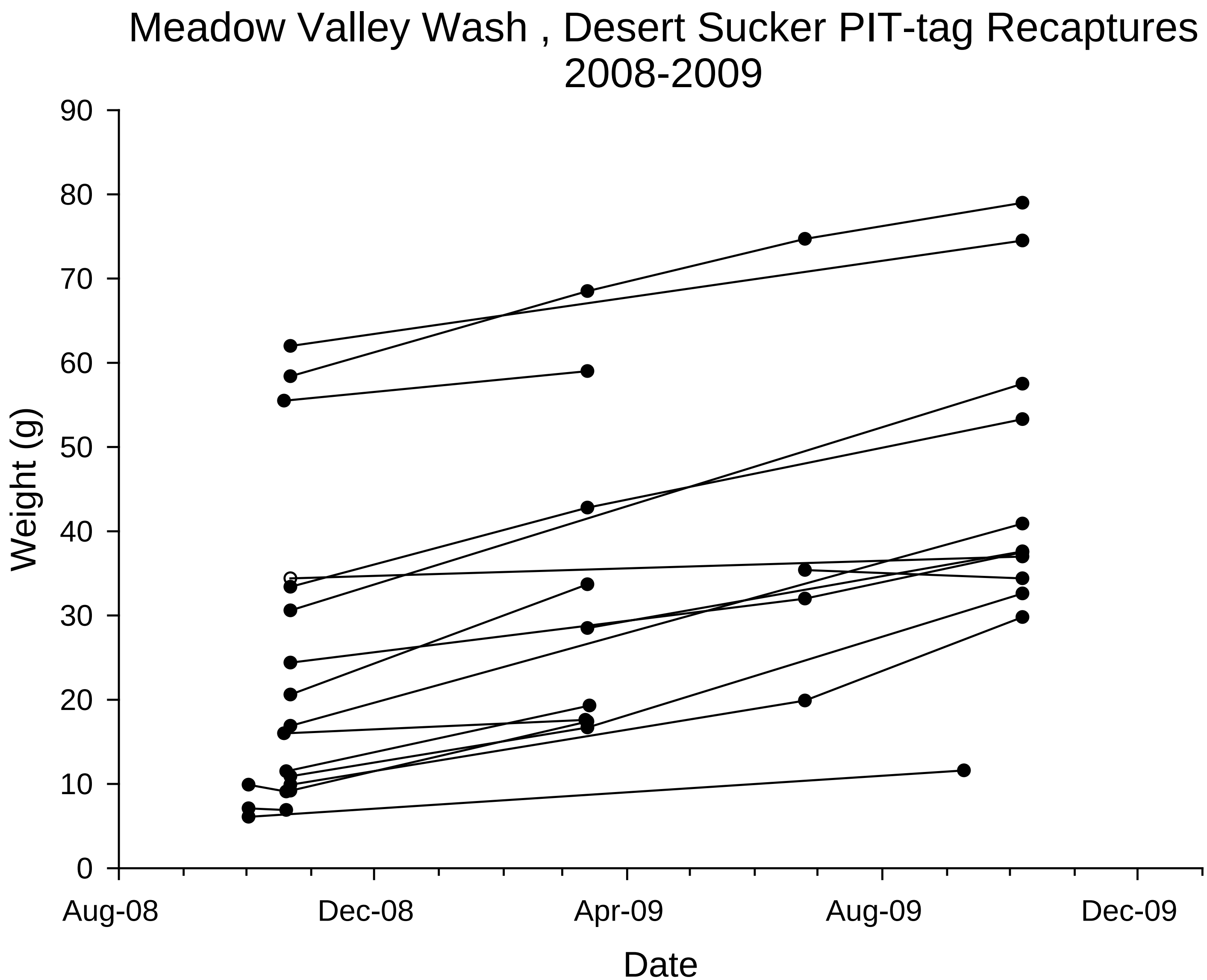


Figure 36. Growth of desert sucker in Condor Canyon, Meadow Valley Wash, Nevada, during 2008 and 2009. [PIT, Passive Integrated Transponder.]

Table 1. Mean water temperature recorded at sites in Condor Canyon, Meadow Valley Wash, Nevada, during July, August, and September 2008, December 2008, and January and February 2009.

[Water temperature ranges are shown in parenthesis. Data are from Onset Corporation's HOBO thermologgers, which recorded water temperature every hour. Sites are listed from upstream to downstream. See appendix A for coordinates of thermologgers. - = no monitoring]

Site	Reach	Month					
		July	Aug.	Sept.	Dec.	Jan.	Feb.
TR0A	A	-	-	16.8 (13.6 – 21.5)	9.4 (5.6–13.0)	9.7 (5.6–13.0)	11.5 (8.5–14.1)
TRBU	B	-	-	16.3 (12.4–21.7)	8.8 (5.9–12.8)	9.3 (5.0–13.2)	10.9 (7.7–14.1)
TRBL	B	19.3 (12.9–28.4)	18.5 (13.0–25.3)	16.1 (9.9–23.1)	7.4 (3.4–12.8)	8.0 (3.1–13.2)	9.7 (5.8–15.4)
TTRI	TR	-	16.8 (15.7–18.5)	16.4 (15.4–17.9)	14.4 (13.3–15.5)	14.3 (13.4–15.2)	14.5 (13.7–15.7)
TBOX	1	14.7 (13.8–15.9)	14.9 (13.9–15.9)	14.3 (13.5–15.6)	13.1 (12.4–13.9)	13.1 (12.6–13.7)	13.2 (12.7–13.8)
TR01	1	18.7 (13.6–27.5)	18.1 (13.6–24.0)	16.2 (12.2–21.7)	9.2 (6.0–13.7)	9.6 (5.6–13.9)	10.9 (7.7–15.8)
TR02	2	18.7 (13.6–27.1)	18.2 (13.4–24.2)	16.2 (11.9–22.2)	9.0 (5.6–13.4)	9.4 (5.4–13.8)	10.7 (7.4–16.2)
TR05	5	-	18.3 (12.0–23.8)	15.5 (9.7–20.7)	6.0 (0.6–10.9)	6.8 (0.9–12.5)	8.4 (3.4–14.3)
TR09	9	19.4 (15.2–22.8)	18.6 (14.3–21.5)	14.6 (10.2–18.9)	1.4 (-0.6–6.4)	2.3 (-0.9–8.6)	4.3 (-0.9–9.9)

Table 2. Mean water temperature recorded at sites in Condor Canyon, Meadow Valley Wash, Nevada, during July, August, and September 2009, December 2009, and January 2010.

[Water temperature ranges are shown in parenthesis. Data are from Onset Corporation's HOBO thermologgers, which recorded water temperature every hour. Sites are listed from upstream to downstream. See appendix A for coordinates of thermologgers]

Site	Reach	Month				
		July	Aug.	Sept.	Dec.	Jan.
TR0A	A	18.6 (15.5–22.6)	16.9 (14.9–19.9)	15.9 (13.4–18.5)	8.9 (6.6–10.8)	10.8 (8.3–13.1)
TRBU	B	18.0 (14.2–22.7)	16.0 (13.5–19.3)	15.4 (12.8–18.1)	10.1 (5.9–13.4)	9.8 (6.8–12.9)
TRBL	B	19.0 (12.9–26.4)	16.9 (10.6–25.5)	15.2 (9.9–21.4)	4.9 (0.3–8.4)	8.4 (4.7–11.8)
TTRI	TR	16.7 (15.9–17.3)	16.7 (16.0–17.3)	16.5 (15.7–17.3)	13.9 (13.0–14.7)	14.0 (13.1–14.7)
TBOX	1	14.2 (14.0–14.4)	14.2 (14.0–14.4)	14.2 (13.9–14.4)	12.6 (12.2–12.9)	12.5 (12.2–12.9)
TR01	1	17.4 (15.3–20.2)	16.7 (15.4–18.6)	16.4 (13.4–18.6)	10.1 (8.7–11.9)	10.8 (9.9–13.1)
TR02	2	18.1 (14.0–23.1)	17.1 (13.2–22.2)	16.3 (13.2–19.7)	7.2 (5.1–10.2)	9.0 (5.9–12.2)
TR05	5	18.5 (13.1–22.5)	17.0 (12.1–21.3)	15.6 (9.7–20.1)	4.3 (-0.1–8.3)	6.6 (1.9–9.5)
TR09	9	19.7 (14.3–22.8)	17.2 (13.2–21.0)	15.4 (10.1–19.4)	0.2 (-0.1–2.1)	2.1 (0.0–4.6)

Table 3. Number of days when recorded water temperature equaled or exceeded 18°C, 20°C, and 22°C and days when recorded water temperature equaled or was less than 6°C, 4°C, and 2°C at sites in the Condor Canyon, Meadow Valley Wash, Nevada.

[Data are from September 2008 through January 2010. Data are from Onset Corporation's StowAway thermographs, which recorded temperature every 2 hours. Sites are listed from upstream to downstream]

	Warm days			Cold days		
Site	> 18°C	> 20°C	> 22°C	< 6°C	< 4°C	< 2°C
TR0A	145	46	6	3	0	0
TRBU	138	53	4	6	0	0
TRBL	259	220	157	97	25	8
TTRI	24	0	0	0	0	0
TBOX	0	0	0	0	0	0
TR01	205	95	58	2	0	0
TR02	246	188	96	17	0	0
TR05	194	114	28	157	60	17
TR09	151	78	9	251	190	134

Table 4. Habitat features of 13 reaches in Meadow Valley Wash, Condor Canyon, Nevada, summer 2008.

[m, meters; C, confinement width/bankfull width less than 2 m; M, confinement width/bankfull width 2 to 4 m; U, confinement width/bankfull width greater than 4 m; LWD, large woody debris; PL:NPL, ratio of length of pool-habitat to non-pool habitat (riffles and glides); HUs, habitat units; –, no data available]

Reach	Length (m)	Stream gradient (%)	Average wetted width (m)	Average bankfull width (m)	% Confinement C/M/U	LWD (#/100 m)	Pools (#/100 m)	PL:NPL	Reach complexity (#HUs/100 m)
A	178	0.38	2.3	4.9	60/40/0	0.0	1.1	1:24	6.2
B	567	0.25	2.8	5.7	40/33/27	1.6	1.1	3:1	3.2
TRIB	94	0.17	1.3	-	-	0.0	2.1	1:21	4.3
1	335	0.12	2.6	5.2	22/61/17	3.3	1.8	1:2	9.0
2	231	0.00	2.3	5.9	83/17/0	13.0	2.6	1:1	7.8
3	480	0.13	2.5	6.8	56/40/4	9.4	0.6	1:1	2.7
4	280	0.46	3.7	6.7	64/29/7	0.7	1.1	3:1	2.5
5	1,369	0.55	3.1	16.4	71/29/0	3.9	1.2	1:3	5.0
6	800	0.28	2.5	11.4	59/34/7	9.3	0.9	1:9	5.9
7	400	0.54	3.6	8.3	52/29/19	5.3	0.8	1:27	5.3
8	260	1.00	3.4	10.0	8/23/69	3.1	1.2	1:8	9.2
9	2,020	0.75	3.0	11.0	22/56/22	43.2	3.1	1:2	10.1
10	1240	0.91	2.8	8.2	50/50/0	4.0	0.3	1:6	7.0

Table 5. Percent substrate type, wetted width, and width-to-depth ratios in 13 reaches in Condor Canyon, Meadow Valley Wash, Nevada, which were surveyed in summer 2008.

[Measurements were taken at cross channel transects every 20 meters. Substrate types are: M, mud/clay; S, sand/silt; G, gravel; C, cobble; B, boulder; O, other; BR, bedrock; W, wood. SD, standard deviation; CV, coefficient of variation (SD/Mean×100); m, meters; w/d, width/depth]

	Substrate type									
Reach	M	S	G	C	B	O	Mean width (m)	Mean w/d	SD	CV
A	20	33	27	10	10	0	2.3	15.8	5	32
B	54	19	18	0	4	4	2.8	35.1	45	128
TRIB	6	11	83	0	0	0	1.3	100.3	120	120
1	22	17	35	20	6	0	2.6	34.3	51	149
2	8	44	46	3	0	0	2.3	19.1	13	69
3	1	75	24	0	0	0	2.5	23.0	15	67
4	11	73	4	0	2	9	3.7	39.1	29	73
5	27	48	16	5	1	4	3.1	25.4	17	68
6	15	46	23	9	1	6	2.5	29.9	34	113
7	14	48	17	5	2	15	3.6	34.1	28	82
8	21	67	10	2	0	0	3.4	37.1	25	68
9	32	42	8	2	1	15	3.0	28.2	25	90
10	1	86	5	0	6	2	2.8	44.1	47	107

Table 6. Dominant and subdominant aquatic vegetation and mean percent bank coverage by watercress in 13 reaches in Condor Canyon, Meadow Valley Wash, Nevada, summer 2008.

[Vegetation was categorized by dominant and subdominant every 20 meters throughout a reach. The percent of reach intervals where species were dominant or subdominant is shown. If only one vegetation type was found in an interval, it was categorized as both dominant and subdominant. Vegetation types are: CT, cattail; BR, bulrush; WC, watercress; NR, needlerush; WP, water parsnip; SG, sedges and grasses; OT, other. SD, standard deviation; CV, coefficient of variation (SD/Mean×100)]

	Aquatic vegetation																
	Dominant							Subdominant							Percent WC		
Reach	CT	BR	WC	NR	WP	SG	OT	CT	BR	WC	NR	WP	SG	OT	Mean	SD	CV
A	11	22	44	0	11	11	0	0	11	22	0	11	56	0	14	18	126
B	17	59	10	0	0	14	0	10	31	38	0	7	14	0	15	20	132
TRIB	0	0	100	0	0	0	0	0	0	100	0	0	0	0	5	3	48
1	35	18	47	0	0	0	0	18	0	76	0	0	6	0	12	13	111
2	50	0	50	0	0	0	0	17	0	83	0	0	0	0	7	9	139
3	54	29	0	0	0	13	4	29	8	58	4	0	0	0	13	13	99
4	57	36	7	0	0	0	0	07	7	64	0	7	7	7	33	25	77
5	44	49	4	0	0	1	1	37	21	40	0	0	3	0	10	16	151
6	45	50	3	3	0	0	0	23	8	65	3	0	3	0	21	20	98
7	50	39	0	0	0	6	6	61	28	11	0	0	0	0	4	7	197
8	54	46	0	0	0	0	0	38	23	15	0	0	8	15	13	20	158
9	72	4	1	1	2	19	1	47	8	2	2	16	24	1	< 1	3	595
10	79	13	0	0	0	3	5	42	26	0	19	0	2	11	0	-	-

Table 7. Dominant and subdominant riparian vegetation and mean overstory cover in 13 reaches in Condor Canyon, Meadow Valley Wash, Nevada, summer 2008.

[Vegetation was categorized by dominant and subdominant every 20 m throughout a reach. Shown is the percent of reach length where species were dominant or subdominant. If only one vegetation type was found in an interval, it was categorized as both dominant and subdominant. All overstory cover was hardwood. Vegetation types are: BW, black willow; GR, grass; CW, coyote willow; TG, tarragon; NT, stinging nettle; TX, tamarisk; BE, box elder; OT, other. SD, standard deviation; CV, coefficient of variation (SD/Mean×100)]

	Riparian vegetation																		
	Dominant								Subdominant								Overstory cover		
Reach	BW	GR	CW	TG	NT	TX	BE	OT	BW	GR	CW	TG	NT	TX	BE	OT	Mean	SD	CV
A	0	44	0	0	0	0	0	56	0	22	0	0	0	0	0	78	0	0	0
B	0	38	17	0	10	0	0	34	0	34	0	3	14	0	0	48	3	15	548
TRIB	0	0	100	0	0	0	0	0	0	40	0	20	20	0	0	20	29	46	157
1	0	0	71	29	0	0	0	0	0	24	0	35	0	18	0	24	11	26	233
2	0	8	0	8	0	75	8	0	0	8	0	8	25	33	0	25	1	3	361
3	0	0	8	13	17	17	0	46	0	13	8	21	21	21	0	17	1	4	490
4	0	7	21	0	64	0	0	7	7	36	0	29	14	0	0	14	16	31	201
5	7	0	58	28	0	0	4	3	3	3	17	51	10	7	3	6	7	21	284
6	15	0	38	40	0	3	0	5	13	10	20	35	13	3	0	8	15	29	188
7	5	15	15	15	40	0	5	5	30	20	15	10	10	0	5	10	10	22	226
8	38	8	0	0	0	0	0	54	23	8	0	0	15	0	0	54	31	41	133
9	98	0	2	0	0	0	0	0	1	62	9	0	20	1	0	7	63	33	53
10	21	5	10	0	0	5	44	16	6	29	11	0	0	10	11	32	30	40	133

Table 8. Assemblages of fish species observed in Condor Canyon, Meadow Valley Wash, Nevada, by electrofishing in fall 2008, spring 2009, and fall 2009.

[Sites are listed upstream to downstream. P, present; A, absent]

Reach	Site	Big Spring spinedace	Speckled dace	Desert sucker	Rainbow trout[1]
Reach A	RA_US2	P	P	P	A
	RA_US1	P	P	P	A
Reach B	RB_ND1	P	P	P	A
	RB_US1	P	P	P	A
Reach TRIB	TR_US1	P	P	P	A
Reach 1	R1_ND1	P	P	P	A
	R1_US1	P	P	P	A
Reach 2	R2_US1	P	P	P	A
Reach 3	R3_ND1	P	P	P	A
	R3_US1	P	P	P	A
Reach 4	R4_US1	P	P	P	A
Reach 5	R5_ND1	P	P	A	P
	R5_US1	P	P	P	P
Reach 6	R6_ND1	P	P	P	A
	R6_US1	P	P	P	P
	R6_USA	P	P	A	A
Reach 7	R7_US1	P	P	A	A
Reach 8	R8_ND1	P	P	A	A
	R8_US1	P	P	P	A
Reach 9	R9_ND1	A	P	P	A
	R9_US1	A	P	P	A
Reach 10	R10_US1	A	P	A	A
	R10_US2	A	P	P	A

[1] Rainbow trout are not native to Meadow Valley Wash.

Table 9. Population estimates, with (±95 percent confidence limit in parenthesis), of Big Spring spinedace (*Lepidomeda mollispinis pratensis*), speckled dace (*Rhinichthys osculus*), desert sucker (*Catostomus clarki*), and rainbow trout (*Oncorhynchus mykiss*) in Condor Canyon, Meadow Valley Wash, Nevada, fall 2008 and fall 2009.

[Because fish lengths were not measured at NDOW sites in fall 2009, the proportion of age-0 and age-1 or older fish of each species collected at each NDOW site in fall 2008 were applied to the fish collected at those sites in fall 2009. This assumption applies for estimates for spinedace, speckled dace, and desert sucker]

	Big Spring spinedace		Speckled dace		Desert sucker		Rainbow trout	
	Age-0	Age-1 or older	Age-0	Age-1 or older	Age-0	Age-1 or older	Age-0	Age-1 or older
Fall 2008								
Above	2,568 (1,166)	2,078 (1,054)	4,800 (2,179)	7,274 (1,892)	3,221 (5,528)	2,683 (2,275)	0	0
Below	90 (85)	964 (1,380)	2,729 (2,776)	3,783 (4,347)	75 (207)	200 (248)	57 (77)	38 (90)
Total	2,658 (1,170)	3,042 (1,736)	7,529 (3,539)	11,057 (4,740)	3,296 (5,537)	2,883 (2,290)	57 (77)	38 (90)
Fall 2009								
Above	4,035 (3,734)	3,433 (3,792)	10,322 (5,241)	3,465 (1,381)	2,840 (2,520)	715 (716)	0	0
Below	1,484 (866)	312 (212)	4,251 (6,372)	3,458 (2,664)	98 (129)	145 (111)	826 (514)	66 (125)
Total	5,539 (3,842)	3,745 (3,807)	14,573 (6135)	6,923 (3,000)	2,938 (2,530)	860 (725)	826 (514)	66 (125)

Table 10. Population estimates, with (±95 percent confidence limit in parenthesis), of Big Spring spinedace (*Lepidomeda mollispinis pratensis*), speckled dace (*Rhinichthys osculus*), desert sucker (*Catostomus clarki*), and rainbow trout (*Oncorhynchus mykiss*) in Condor Canyon, Meadow Valley Wash, Nevada, spring 2009.

	Big Spring spinedace		Speckled dace		Desert sucker		Rainbow trout	
	Age-1	Age-2 or older	Age-1	Age-2 or older	Age-1	Age-2 or older	Age-1	Age-2 or older
Spring 2009								
Above	950 (558)	1,460 (867)	2,727 (1,315)	5,892 (1,754)	121 (99)	717 (469)	0	0
Below	161 (239)	807 (481)	339 (283)	491 (501)	81 (40)	65 (64)	0	81 (121)
Total	1,111 (608)	2,267 (992)	3,067 (1,347)	6,383 (1,826)	202 (249)	782 (474)	0	81 (121)

Table 11. Fork-length (mm) ranges, by age class, of four fish species at 22 sites in Condor Canyon, Meadow Valley Wash, Nevada, fall 2008.

[Sites are ordered from upstream to downstream. For site location, see appendix A and figs. 8 and 9. NS, not sampled; -, no data available]

		Big Spring spinedace		Speckled dace		Desert sucker		Rainbow trout	
Site	Date	Age-0	Age-1 or older	Age-0	Age-1 or older	Age-0	Age-1 or older	Age-0	Age-1 or older
RA_US2	10/22/08	53–64	-	42–55	57–80	62	64–106	-	-
RA_US1	10/22/08	47–72	77–112	36–52	53–80	47–76	80–185	-	-
RB_ND1	10/02/08	26–48	53–88	25–39	40–76	33–61	63–123	-	-
RB_US1	10/20/08	-	-	38–47	48–75	48	73–135	-	-
TR_US1	10/20/08	39–56	60–70	35–46	48–66	-	-	-	-
R1_ND1	10/01/08	38–50	51–95	32–44	46–75	45–60	74–146	-	-
R1_US1	10/20/08	35–49	52–81	35–47	48–71	43–52	56–100	-	-
R2_US1	10/21/08	41–54	64–85	36–46	47–65	65	150	-	-
R3_ND1	10/01/08	44–55	65–95	36–43	46–69	-	95–171	-	-
R3_US1	10/21/08	41–55	59–103	37–46	48–73	-	80–144	-	-
R4_US1	10/19/08	48–60	68–95	37–47	48–80		73–175	-	-
R5_ND1	10/01/08	53–56	74	40–45	58–82	-	-	105	-
R5_US1	10/10/08	50	-	42–46	51–76	-	-	93–98	-
R6_ND1	10/01/08	-	95–105	48	70–85	-	-	-	-
R6_US1	10/09/08	48–61	77–115	45	55–90	58–67	89	-	179–450
R6_USA	NS	NS	NS	NS	NS	NS	NS	NS	NS
R7_US1	10/09/08	44–55	75–85	43–51	72	-	-	-	-
R8_US1	10/08/08	-	58–64	38–47	48–76	56–61	65–167	-	-
R8_ND1	10/01/08	55	-	38–49	72–77	-	-	-	-
R9_ND1	09/30/08	-	-	38–47	48–76	-	86–190	-	-
R9_US1	10/08/08	-	-	36–45	49–90	-	-	-	-
R10_US1	10/07/08	-	-	40–44	55–79	-	-	-	-
R10_US2	10/07/08	-	-	32–47	64–91	-	136	-	-

Table 12. Fork length (mm) ranges, by age class, of four fish species at 22 sites in Condor Canyon, Meadow Valley Wash, Nevada, spring 2009.

[Sites are ordered from upstream to downstream. For site location, see appendix A and figs. 8 and 9. NS, not sampled; -, no data available]

		Big Spring spinedace		Speckled dace		Desert sucker		Rainbow trout	
Site	Date	Age-1	Age-2 or older	Age-1	Age-2 or older	Age-1	Age-2 or older	Age-1	Age-2 or older
RA_US2	3/16/09	-	-	42–59	61–84	-	-	-	-
RA_US1	3/13/09	53	64–115	35–58	61–80	58–60	88–172	-	-
RB_ND1	NS	NS	NS	NS	NS	NS	NS	NS	NS
RB_US1	3/14/09	48–50	62–70	38–46	48–68	49–67	72–150	-	-
TR_US1	3/14/09	-	-	40–50	51–70	-	-	-	-
R1_ND1	3/13/09	38–61	64–85	39–46	48–69	53–66	95–173	-	-
R1_US1	3/14/09	41–57	64–80	43–44	48–63	68	-	-	-
R2_US1	3/15/09	48–59	63–90	34–50	52–74	59–72	92–121	-	-
R3_ND1	3/12/09	45–60	69–93	36–49	50–75	50–70	96–182	-	-
R3_US1	3/15/09	48–64	70–88	39–48	50–74	-	-	-	-
R4_US1	3/12/09	54–61	70–86	35–47	49–68	-	162	-	-
R5_ND1	3/15/09	-	-	-	71	-	-	-	-
R5_US1	3/14/09	-	-	-	61–84	-	-	-	162
R6_ND1	3/17/09	-	79–114	48–49	68	-	128–160	-	-
R6_US1	3/17/09	-	78–112	48–50	53–88	-	190–203	-	163–365
R6_USA	3/18/09	49–67	75–100	44–47	53–81				
R7_US1	3/18/09	-	77–101	44–47	52–82	-	-	-	-
R8_US1	3/16/09	57–60	-	38–50	80–83	-	-	-	-
R8_ND1	3/17/09	-	-	45	53–72	-	-	-	-
R9_ND1	3/18/09	-	-	-	-	41	-	-	-
R9_US1	3/18/09	-	-	39–40	67	-	-	-	-
R10_US1	NS	NS	NS	NS	NS	NS	NS	NS	NS
R10_US2	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 13. Fork length (mm) ranges, by age class, of four fish species at 22 sites in Condor Canyon, Meadow Valley Wash, Nevada, fall 2009.

[Sites are ordered from upstream to downstream. For site location, see appendix A and figs. 8 and 9. NS, not sampled; -, no data available]

		Big Spring spinedace		Speckled dace		Desert sucker		Rainbow trout	
Site	Date	Age-0	Age-1 or older	Age-0	Age-1 or older	Age-0	Age-1 or older	Age-0	Age-1 or older
RA_US2	10/6/09	-	-	33–47	53–78	37–59	-	-	-
RA_US1	10/7/09	35–60	65–105	28–49	50–78	35–65	71–178	-	-
RB_ND1	-	-	-	-	-	-	-	-	-
RB_US1	10/6/09	-	-	40	-	75	184	-	-
TR_US1	10/6/09	32–42	72	27–50	54–57	-	-	-	-
R1_ND1	-	-	-	-	-	-	-	-	-
R1_US1	10/5/09	25–46	55–73	25–45	50–60	43–60	-	-	-
R2_US1	10/5/09	35–52	61–84	28–49	52–75	43–56	125	-	-
R3_ND1	-	-	-	-	-	-	-	-	-
R3_US1	10/4/09	40–57	67–83	30–44	50–79	48–64	138	-	-
R4_US1	10/4/09	43–59	69–76	28–52	53–76	46–68	80–108	-	-
R5_ND1	-	-	-	-	-	-	-	-	-
R5_US1	10/4/09	55	-	39–48	52–80	49–59	-	78–111	-
R6_ND1	-	-	-	-	-	-	-	-	-
R6_US1	10/3/09	40–59	80–115	41–55	75–91	58	115–150	103–108	190–450
R6_USA	10/3/09	48–58	68–80	48	64–82	-	-	-	-
R7_US1	-	-	-	-	-	-	-	-	-
R8_US1	-	-	-	-	-	-	-	-	-
R8_ND1	10/3/09	-	-	33–50	55–81	-	118	-	-
R9_ND1	-	-	-	-	-	-	-	-	-
R9_US1	10/3/09	-	-	35–45	50–90	-	140	-	-
R10_US1	10/7/09	-	-	46–61	72–74	-	-	-	-
R10_US2	10/7/09	-	-	44	64	-	-	-	-

Table 14. Total number of Passive-Integrated-Transponder-tagged Big Spring spinedace at sites above Delmue Falls and the number of tag detections at each interrogation site in Condor Canyon, Meadow Valley Wash, Nevada, from 2008 to 2009.

[Sites are listed from upstream to downstream: AB, Reach B just upstream of Kill Wash; AT, Kill Wash; A1, Reach 1 just downstream of Kill Wash; A5, Reach 5 just downstream of Delmue Falls; A9, Reach 9. PIT, Passive Integrated Transponder; NS, not sampled; -, no data available]

Tag site	Tagging date	PIT tags deployed	Number detected	Interrogation site				
				AB	AT	A1	A5	A9
RA_US2	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
RA_US1	Oct. 08	22	0	0	0	0	0	0
	Mar. 09	9	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
RB_ND1	Oct. 08	9	1	0	1	0	0	0
	Mar. 09	NS	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
RB_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	2	1	0	1	0	0	0
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
TR_US1	Oct. 08	1	1	0	0	1	0	0
	Mar. 09	0	-	-	-	-	-	-
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R1_ND1	Oct. 08	5	3	0	2	3	0	0
	Mar. 09	9	6	0	2	6	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R1_US1	Oct. 08	6	2	0	1	2	0	0
	Mar. 09	3	3	0	1	3	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R2_US1	Oct. 08	6	3	1	1	2	0	0
	Mar. 09	15	3	0	0	3	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R3_ND1	Oct. 08	10	3	0	0	3	0	0
	Mar. 09	12	6	0	2	5	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R3_US1	Oct. 08	19	7	1	7	7	0	0
	Mar. 09	6	2	0	0	1	1	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R4_US1	Oct. 08	8	3	0	2	3	0	0
	Mar. 09	7	3	0	2	2	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
Total		**149**	**47**	**2**	**22**	**41**	**1**	**0**

Table 15. Total number of Passive-Integrated-Transponder-tagged Big Spring spinedace below Delmue Falls and the number of tag detections at each interrogation site in Condor Canyon, Meadow Valley Wash, Nevada, from 2008 to 2009.

[Sites are listed from upstream to downstream: AB, Reach B just upstream of Kill Wash; AT, Kill Wash; A1, Reach 1 just downstream of Kill Wash; A5, Reach 5 just downstream of Delmue Falls; A9, Reach 9. PIT, Passive Integrated Transponder; NS, not sampled; -, no data available]

Tag site	Tagging date	PIT tags deployed	Number detected	Interrogation site				
				AB	AT	A1	A5	A9
R5_ND1	Oct. 08	1	1	0	0	0	1	0
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R5_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R6_ND1	Oct. 08	3	0	0	0	0	0	0
	Mar. 09	20	2	0	0	0	2	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R6_US1	Oct. 08	6	0	0	0	0	0	0
	Mar. 09	12	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R6_USA	Oct. 08	NS	-	-	-	-	-	-
	Mar. 09	4	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R7_US1	Oct. 08	4	1	0	0	0	1	0
	Mar. 09	4	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	NS	-	-	-	-	-	-
R8_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R8_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R9_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R9_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R10_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	NS	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R10_US2	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	NS	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
Total		**50**	**4**	**0**	**0**	**0**	**4**	**0**

Table 16. Total number of Passive-Integrated-Transponder-tagged desert sucker above Delmue Falls and the number of tag detections at each interrogation site in Condor Canyon, Meadow Valley Wash, Nevada, from 2008 to 2009.

[Sites are listed from upstream to downstream: AB, Reach B just upstream of Kill Wash; AT, Kill Wash; A1, Reach 1 just downstream of Kill Wash; A5, Reach 5 just downstream of Delmue Falls; A9, Reach 9. PIT, Passive Integrated Transponder; NS, not sampled; -, no data available]

Tag site	Tagging date	PIT tags deployed	Number detected	Interrogation site				
				AB	AT	A1	A5	A9
RA_US2	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
RA_US1	Oct. 08	42	0	0	0	0	0	0
	Mar. 09	14	0	0	0	0	0	0
	June 09	3	0	0	0	0	0	0
	Oct. 09	20	0	0	0	0	0	0
RB_ND1	Oct. 08	15	2	2	0	1	0	0
	Mar. 09	NS	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
RB_US1	Oct. 08	20	3	2	1	2	0	0
	Mar. 09	12	4	1	0	3	0	0
	June 09	NS	-	-	-	-	-	-
	Oct. 09	2	1	0	0	1	0	0
TR_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R1_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	9	9	3	3	9	0	0
	June 09	2	2	0	0	2	0	0
	Oct. 09	0	-	-	-	-	-	-
R1_US1	Oct. 08	4	3	3	0	2	0	0
	Mar. 09	0	-	-	-	-	-	-
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R2_US1	Oct. 08	1	1	1	1	1	0	0
	Mar. 09	8	0	0	0	0	0	0
	June 09	6	0	0	0	0	0	0
	Oct. 09	0	-	-	-	-	-	-
R3_ND1	Oct. 08	8	5	3	1	5	0	0
	Mar. 09	10	4	1	3	4	0	0
	June 09	6	0	0	0	0	0	0
	Oct. 09	0	-	-	-	-	-	-
R3_US1	Oct. 08	7	1	0	0	1	0	0
	Mar. 09	0	-	-	-	-	-	-
	June 09	1	0	0	0	0	0	0
	Oct. 09	1	0	0	0	0	0	0
R4_US1	Oct. 08	7	3	1	2	3	0	0
	Mar. 09	1	0	0	0	0	0	0
	June 09	1	0	0	0	0	0	0
	Oct. 09	3	1	0	0	1	0	0
Total		**203**	**39**	**17**	**11**	**35**	**0**	**0**

Table 17. Total number of Passive-Integrated-Transponder-tagged desert sucker below Delmue Falls and the number of tag detections at each interrogation site in Condor Canyon, Meadow Valley Wash, Nevada, from 2008 to 2009.

[Sites are listed from upstream to downstream: AB, Reach B just upstream of Kill Wash; AT, Kill Wash; A1, Reach 1 just downstream of Kill Wash; A5, Reach 5 just downstream of Delmue Falls; A9, Reach 9. PIT, Passive Integrated Transponder; NS, not sampled; -, no data available]

Tag site	Tagging date	PIT tags deployed	Number detected	Interrogation site				
				AB	AT	A1	A5	A9
R5_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	NS	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R5_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R6_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	2	0	0	0	0	0	0
	June 09	1	0	0	0	0	0	0
	Oct. 09	0	-	-	-	-	-	-
R6_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	2	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	1	0	0	0	0	0	0
R6_USA	Oct. 08	NS	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R7_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R8_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R8_US1	Oct. 08	3	0	0	0	0	0	0
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	1	0	0	0	0	0	0
R9_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R9_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R10_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	NS	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R10_US2	Oct. 08	6	0	0	0	0	0	0
	Mar. 09	NS	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
Total		**16**	**0**	**0**	**0**	**0**	**0**	**0**

Table 18. Total number of Passive-Integrated-Transponder-tagged speckled dace above Delmue Falls and the number of tag detections at each interrogation site in Condor Canyon, Meadow Valley Wash, Nevada, from 2008 to 2009.

[Sites are listed from upstream to downstream: AB, Reach B just upstream of Kill Wash; AT, Kill Wash; A1, Reach 1 just downstream of Kill Wash; A5, Reach 5 just downstream of Delmue Falls; A9, Reach 9. PIT, Passive Integrated Transponder; NS, not sampled; -, no data available]

Tag site	Tagging date	PIT tags deployed	Number detected	Interrogation site				
				AB	AT	A1	A5	A9
RA_US2	Oct. 08	8	0	0	0	0	0	0
	Mar. 09	6	0	0	0	0	0	0
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
RA_US1	Oct. 08	8	0	0	0	0	0	0
	Mar. 09	1	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	2	0	0	0	0	0	0
RB_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	NS	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Sep. 09	0	-	-	-	-	-	-
RB_US1	Oct. 08	3	2	1	2	1	0	0
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	NS					
	Oct. 09	0	-	-	-	-	-	-
TR_US1	Oct. 08	5	5	3	5	3	0	0
	Mar. 09	10	8	2	8	4	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R1_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	0	-	-	-	-	-	-
	Sep. 09	0	-	-	-	-	-	-
R1_US1	Oct. 08	3	3	2	1	3	0	0
	Mar. 09	0	-	-	-	-	-	-
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R2_US1	Oct. 08	3	0	0	0	0	0	0
	Mar. 09	6	2	0	2	2	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R3_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	0	-	-	-	-	-	-
	Sep. 09	0	-	-	-	-	-	-
R3_US1	Oct. 08	7	0	0	0	0	0	0
	Mar. 09	1	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	1	0	0	0	0	0	0
R4_US1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	1	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	5	0	0	0	0	0	0
Total		**70**	**20**	**8**	**18**	**13**	**0**	**0**

Table 19. Total number of Passive-Integrated-Transponder-tagged speckled dace below Delmue Falls and the number of tag detections at each interrogation site in Condor Canyon, Meadow Valley Wash, Nevada, from 2008 to 2009.

[Sites are listed from upstream to downstream: AB, Reach B just upstream of Kill Wash; AT, Kill Wash; A1, Reach 1 just downstream of Kill Wash; A5, Reach 5 just downstream of Delmue Falls; A9, Reach 9. PIT, Passive Integrated Transponder; NS, not sampled; -, no data available]

Tag site	Tagging date	PIT tags deployed	Number detected	Interrogation site				
				AB	AT	A1	A5	A9
R5_ND1	Oct. 08	6	4	0	0	0	4	0
	Mar. 09	1	0	0	0	0	0	0
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R5_US1	Oct. 08	3	0	0	0	0	0	0
	Mar. 09	1	1	0	0	0	1	0
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R6_ND1	Oct. 08	5	0	0	0	0	0	0
	Mar. 09	1	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R6_US1	Oct. 08	4	0	0	0	0	0	0
	Mar. 09	4	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R6_USA	Oct. 08	NS	-	-	-	-	-	-
	Mar. 09	5	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R7_US1	Oct. 08	1	0	0	0	0	0	0
	Mar. 09	2	0	0	0	0	0	0
	June 09	0	-	-	-	-	-	-
	Oct. 09	NS	-	-	-	-	-	-
R8_ND1	Oct. 08	0	-	-	-	-	-	-
	Mar. 09	2	0	0	0	0	0	0
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R8_US1	Oct. 08	1	0	0	0	0	0	0
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	NS	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R9_ND1	Sep. 08	0	-	-	-	-	-	-
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	NS	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R9_US1	Oct. 08	14	7	-	-	-	0	7
	Mar. 09	0	-	-	-	-	-	-
	June 09	NS	NS	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R10_US1	Oct. 08	10	0	0	0	0	0	0
	Mar. 09	NS	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
R10_US2	Oct. 08	6	0	0	0	0	0	0
	Mar. 09	NS	-	-	-	-	-	-
	June 09	NS	-	-	-	-	-	-
	Oct. 09	0	-	-	-	-	-	-
Total		**61**	**12**	**0**	**0**	**0**	**5**	**7**

Appendix A. Additional habitat and fish-sample-site data

Table A1. Universal Transverse Mercator coordinates of 13 geomorphic reaches in Condor Canyon, Meadow Valley Wash, Nevada, where habitat and fish sampling was conducted in summer 2008 through fall 2009.

[Reaches 1 through 10 correspond to those described in PBS&J (2007) and are within Condor Canyon. Reaches A and B are immediately upstream of Condor Canyon. Reach TR is a tributary that enters Meadow Valley Wash from the east at the upstream end of Condor Canyon. Coordinates were obtained from a hand-held Global Positioning System using North American Datum 1983]

	UTM coordinates			
	Downstream end		Upstream end	
Reach	Northing	Easting	Northing	Easting
A	4194183	735755	4194352	735840
B	4193673	735480	4194183	735755
TR	4193673	735480	4193656	735692
1	4193466	735264	4193673	735480
2	4193367	735068	4193466	735264
3	4193276	734651	4193367	735068
4	4193032	734631	4193276	734651
5	4191902	734278	4193032	734631
6	4191603	733654	4191902	734278
7	4191489	733314	4191603	733654
8	4191321	733141	4191489	733314
9	4190380	731873	4191321	733141
10	4190273	730725	4190380	731873

Table A2. Locations of temperature loggers, water-level loggers, barometer, and flow sites in Condor Canyon, Meadow Valley Wash, Nevada, which were maintained from summer 2008 through winter 2010.

[Sites are listed from upstream to downstream within Condor Canyon, Meadow Valley Wash, Nev. Universal Transverse Mercator coordinates were obtained from a hand-held Global Positioning System using North American Datum 1983]

		UTM Coordinates			
Recording unit	Reach	Northing	Easting	Date start (mm/yy)	Date end (mm/yy)
Thermologgers					
TR0A	A	4194352	735840	8/08	01/10
TRBU	B	4194141	735733	6/08	01/10
TRBL	B	4193756	735508	6/08	01/10
TTR1	TRIB	4193661	735510	6/08	01/10
TBOX[1]	1	4193577	735356	6/08	01/10
TR01	1	4193622	735458	6/08	01/10
TR02	2	4193424	735198	6/08	01/10
TR05	5	4192819	734539	8/08	01/10
TR09	9	4190434	731968	6/08	01/10
Water level loggers					
WLRB	B	4193756	735508	9/08	01/10
WLTR	TRIB	4193687	735553	9/08	01/10
WLR9	9	4190431	731945	9/08	01/10
Barometer					
WLTRB	TRIB	4193687	735551	9/08	01/10
Flow sites					
FSU	B	4193752	735504	7/08	10/09
FST	TRIB	4193658	735513	7/08	10/09
FSM	2	4193474	735281	7/08	10/09
FSB	9	4190446	732005	7/08	10/09

[1] TBOX is in a spring, which is providing groundwater to MVW, but from which the railroad grade has blocked surface flow.

Table A3. Universal Transverse Mercator coordinates of sites electrofished for fish-population estimates in Condor Canyon, Meadow Valley Wash, Nevada, during fall 2008, spring 2009, and fall 2009.

[Coordinates were obtained from a hand-held Global Positioning System using North American Datum 1983]

		UTM coordinates	
Reach	Site name	Northing	Easting
A	RA_US2	4194245	735788
	RA_US1	4194184	735754
B	RB_ND1	4194136	735727
	RB_US1	4193952	735613
TRIB	TR_US1	4193679	735563
1	R1_ND1	4193625	735459
	R1_US1	4193592	735407
2	R2_US1	4193409	735166
3	R3_ND1	4193317	734838
	R3_US1	4193305	734731
4	R4_US1	4193165	734629
5	R5_ND1	4192865	734539
	R5_US1	4192746	734548
6	R6_ND1	4191813	734144
	R6_US1	4191766	733987
	R6_USA		
7	R7_US1	4191582	733539
8	R8_US1	4191440	733255
	R8_ND1	4191270	733105
9	R9_ND1	4190528	732442
	R9_US1	4190392	732235
10	R10_US2	4190239	731055
	R10_US1	4190235	731006

Table A4. Locations and dates of operation of Passive Integrated Transponder tag interrogation systems deployed in Condor Canyon, Meadow Valley Wash, Nevada.

[Sites are listed from upstream to downstream. Universal Transverse Mercator coordinates were obtained from a hand-held Global Positioning System using North American Datum 1983]

PTIS	Reach	UTM Coordinates: Northing	UTM Coordinates: Easting	Start date (mm/yy)	End date (mm/yy)
AB	B	4193705	735492	10/08	present
A1	1	4193679	735498	10/08	present
AT	TRIB	4193667	735496	10/08	present
A5	5	4192917	734588	10/08	present
A9	9	4190350	732191	10/08	present

Table A5. Fish population sample sites above Delmue Falls, in Condor Canyon, Meadow Valley Wash, Nevada, with dates sampled and site characteristics.

[m, meters; m^2, square meters; m^3, cubic meters; NS, not sampled]

Site	Date sampled	Length (m)	Average Width (m)	Area (m^2)	Volume (m^3)
RA_US2	Fall 2008	25	1.2	29.0	2.7
	Spring 2009	25	1.5	37.9	3.6
	Fall 2009	26	1.0	25.1	1.0
RA_US1	Fall 2008	25	2.2	55.5	16.8
	Spring 2009	25	2.2	56.1	14.7
	Fall 2009	28	2.2	61.3	13.2
RB_ND1	Fall 2008	25	2.2	54.5	10.3
	Spring 2009	NS	NS	NS	NS
	Fall 2009	34	2.4	81.6	11.3
RB_US1	Fall 2008	25	2.3	58.0	4.2
	Spring 2009	25	2.3	57.9	5.0
	Fall 2009	24	1.7	40.6	2.0
TR_US1	Fall 2008	25	0.9	22.0	0.7
	Spring 2009	25	1.3	32.9	0.8
	Fall 2009	27	1.4	38.2	1.3
R1_ND1	Fall 2008	30	2.4	71.4	5.0
	Spring 2009	30	2.2	66.0	6.6
	Fall 2009	30	2.2	65.1	4.3
R1_US1	Fall 2008	25	1.8	45.0	3.2
	Spring 2009	25	2.2	54.3	2.6
	Fall 2009	27	2.0	54.7	4.3
R2_US1	Fall 2008	25	2.5	62.5	6.6
	Spring 2009	26	2.6	67.4	0.0
	Fall 2009	26	2.3	60.9	4.8
R3_ND1	Fall 2008	25	1.9	47.0	7.4
	Spring 2009	25	3.0	73.9	11.0
	Fall 2009	24	2.5	60.3	6.5
R3_US1	Fall 2008	25	1.2	31.0	4.8
	Spring 2009	28	1.8	48.5	8.0
	Fall 2009	27	1.6	44.9	5.1
R4_US1	Fall 2008	25	2.3	57.5	6.6
	Spring 2009	25	2.4	61.1	8.4
	Fall 2009	25	2.3	58.4	6.7

Table A6. Fish population sample sites below Delmue Falls, in Condor Canyon, Meadow Valley Wash, Nevada, with dates sampled and site characteristics.

[-, no habitat data taken; NS, not sampled]

Site		Length (m)	Average Width (m)	Area (m^2)	Volume (m^3)
R5_ND1	Fall 2008	25	2.1	53.5	4.2
	Spring 2009	24	2.3	55.9	5.7
	Fall 2009	-	-	-	-
R5_US1	Fall 2008	25	1.3	33.5	4.4
	Spring 2009	25	1.4	35.6	4.5
	Fall 2009	25	1.3	33.2	3.4
R6_ND1	Fall 2008	25	2.4	59.0	14.0
	Spring 2009	25	2.0	49.3	9.8
	Fall 2009	27	2.0	54.4	7.2
R6_US1	Fall 2008	25	1.5	37.0	9.1
	Spring 2009	25	1.9	47.1	13.2
	Fall 2009	25	1.8	44.3	6.2
R6_USA	Fall 2008	NS	NS	NS	NS
	Spring 2009	25	2.3	57.1	7.2
	Fall 2009	21	2.0	43.3	4.0
R8_US1	Fall 2008	25	2.1	52.5	5.2
	Spring 2009	25	2.2	55.7	5.9
	Fall 2009	25	1.8	44.5	3.2
R8_ND1	Fall 2008	25	2.3	57.0	7.2
	Spring 2009	25	2.7	66.4	11.2
	Fall 2009	25	-	-	-
R9_ND1	Fall 2008	25	2.2	54.5	13.3
	Spring 2009	20	3.1	61.3	17.2
	Fall 2009	25	2.0	50.0	5.6
R9_US1	Fall 2008	25	3.0	75.5	12.6
	Spring 2009	25	2.7	67.1	9.2
	Fall 2009	27	2.0	53.2	5.8
R10_US2	Fall 2008	25	2.0	49.0	4.5
	Spring 2009	NS	NS	NS	NS
	Fall 2009	23	1.6	37.8	1.8
R10_US1	Fall 2008	25	1.7	43.0	4.1
	Spring 2009	NS	NS	NS	NS
	Fall 2009	24	1.7	39.8	2.6

Table A7. Percent substrate type (rounded to whole numbers) and width-to-depth ratios taken from cross-channel transects at each of the 22 population-electrofishing sites in Condor Canyon, Meadow Valley Wash, Nevada.

[Substrate types are: M, mud/clay/silt; S, sand; G, gravel; C, cobble; B, boulder; O, other. SD, standard deviation; CV, coefficient of variation (SD/Mean×100); NS, not sampled; w/d, width/depth

Site		Substrate type (%)						Mean	Mean		
		M	S	G	C	B	O	width (m)	w/d	SD	CV
RA_US2	Fall 2008	0	0	0	80	20	0	1.2	12.7	2	18
	Spring 2009	10	10	19	33	19	10	1.5	19.0	11	59
	Fall 2009	5	52	10	10	24	0	1.0	41.1	38	93
RA_US1	Fall 2008	27	27	40	7	0	0	2.2	7.5	2	25
	Spring 2009	14	14	0	14	43	14	2.2	10.9	7	68
	Fall 2009	48	33	0	0	19	0	2.2	16.8	12	74
RB_ND1	Fall 2008	53	40	7	0	0	0	2.2	11.8	2	14
	Spring 2009	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Fall 2009	24	57	19	0	0	0	2.4	18.3	6	32
RB_US1	Fall 2008	93	7	0	0	0	0	2.3	33.7	10	29
	Spring 2009	62	5	14	0	0	19	2.3	29.0	8	29
	Fall 2009	52	5	5	0	0	38	1.7	38.3	16	42
TR_US1	Fall 2008	0	60	40	0	0	0	0.9	33.7	16	48
	Spring 2009	62	5	14	0	0	19	1.3	61.3	26	43
	Fall 2009	0	67	33	0	0	0	1.4	52.0	31	59
R1_ND1	Fall 2008	0	7	53	40	0	0	2.4	35.8	13	37
	Spring 2009	0	48	43	0	5	5	2.2	22.1	4	18
	Fall 2009	19	43	29	10	0	0	2.2	37.2	15	42
R1_US1	Fall 2008	0	13	87	0	0	0	1.8	25.8	6	24
	Spring 2009	10	19	71	0	0	0	2.2	48.0	16	33
	Fall 2009	0	48	52	0	0	0	2.0	26.4	5	21

Table A7. Percent substrate type (rounded to whole numbers) and width-to-depth ratios taken from cross-channel transects at each of the 22 population-electrofishing sites in Condor Canyon, Meadow Valley Wash, Nevada.—Continued

[Substrate types are: M, mud/clay/silt; S, sand; G, gravel; C, cobble; B, boulder; O, other. SD, standard deviation; CV, coefficient of variation (SD/Mean×100); -, no habitat data taken; w/d, width/depth]

		Substrate type (%)						Mean	Mean		
Reach		M	S	G	C	B	O	width (m)	w/d	SD	CV
R2_US1	Fall 2008	13	13	73	0	0	0	2.5	29.9	17	56
	Spring 2009	14	24	48	5	0	10	2.6	28.9	21	72
	Fall 2009	0	67	29	5	0	0	2.3	33.7	20	59
R3_ND1	Fall 2008	27	60	13	0	0	0	1.9	13.1	6	46
	Spring 2009	67	14	0	0	0	19	3.0	20.6	7	35
	Fall 2009	38	57	5	0	0	0	2.5	24.2	5	21
R3_US1	Fall 2008	33	60	7	0	0	0	1.2	8.5	3	31
	Spring 2009	62	19	10	0	0	10	1.8	11.1	3	24
	Fall 2009	10	90	0	0	0	0	1.6	14.5	3	19
R4_US1	Fall 2008	27	67	7	0	0	0	2.3	22.0	12	54
	Spring 2009	81	10	5	0	0	5	2.4	19.5	9	47
	Fall 2009	86	14	0	0	0	0	2.3	21.2	7	35
R5_ND1	Fall 2008	0	0	73	20	7	0	2.1	27.8	6	22
	Spring 2009	19	0	57	10	5	10	1.4	12.3	5	39
	Fall 2009	-	-	-	-	-	-	-	-	-	-
R5_US1	Fall 2008	0	27	47	27	0	0	1.3	10.4	2	18
	Spring 2009	17	17	50	11	6	0	2.3	27.5	16	57
	Fall 2009	5	43	43	10	0	0	1.3	13.9	4	29
R6_ND1	Fall 2008	60	7	7	0	20	7	2.4	10.1	1	12
	Spring 2009	76	10	0	0	14	0	2.0	10.2	2	21
	Fall 2009	67	14	0	10	10	0	2.0	16.9	7	40
R6_US1	Fall 2008	0	40	40	20	0	0	1.5	6.6	4	65
	Spring 2009	33	38	19	10	0	0	1.9	7.1	3	44
	Fall 2009	48	10	10	33	0	0	1.8	12.9	4	34

Table A7. Percent substrate type (rounded to whole numbers) and width-to-depth ratios taken from cross-channel transects at each of the 22 population-electrofishing sites in Condor Canyon, Meadow Valley Wash, Nevada.—Continued

[Substrate types are: M, mud/clay/silt; S, sand; G, gravel; C, cobble; B, boulder; O, other. SD, standard deviation; CV, coefficient of variation (SD/Mean×100); -, no habitat data taken; w/d, width/depth; NS, not sampled]

		Substrate type (%)									
Reach		M	S	G	C	B	O	Mean width (m)	Mean w/d	SD	CV
R6_USA	Fall 2008	NS[a]	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Spring 2009	19	38	19	14	0	10	2.3	19.4	7	39
	Fall 2009	43	10	33	14	0	0	2.0	24.4	11	44
R8_US1	Fall 2008	20	0	13	40	20	7	2.1	29.1	19	66
	Spring 2009	10	14	10	24	5	38	2.2	21.7	7	31
	Fall 2009	24	24	24	29	0	0	1.8	25.1	7	26
R8_ND1	Fall 2008	13	60	0	0	0	27	2.3	20.5	11	53
	Spring 2009	5	38	19	0	0	38	2.7	18.0	12	68
	Fall 2009	-	-	-	-	-	-	-	-	-	-
R9_ND1	Fall 2008	13	60	0	0	0	27	2.2	9.4	2	21
	Spring 2009	6	39	17	0	0	39	3.1	15.9	18	113
	Fall 2009	33	48	5	10	0	5	2.0	19.4	6	32
R9_US1	Fall 2008	40	0	7	0	0	53	3.0	22.6	15	65
	Spring 2009	52	10	0	5	0	33	2.7	23.3	17	70
	Fall 2009	76	19	5	0	0	0	2.0	21.7	13	58
R10_US2	Fall 2008	100	0	0	0	0	0	2.0	23.7	9	40
	Spring 2009	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Fall 2009	0	67	29	0	5	0	1.6	38.7	13	33
R10_US1	Fall 2008	40	40	7	13	0	0	1.7	19.0	7	35
	Spring 2009	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Fall 2009	0	76	19	5	0	0	1.7	28.3	13	45

Table 8A. Flow and depth measurements in Condor Canyon, Meadow Valley Wash, Nevada, 2008 and 2009.

[Sites, from left to right, are listed from upstream to downstream within Condor Canyon, Meadow Valley Wash. Measured flow was taken with a Marsh McBirney flow meter. Depth was recorded by Onset Hobo Water Level Loggers. cms, cubic meters per second; -, no data available.]

Date	Measured flow (cms)				Level logger depth (m)		
	FSU	FST	FSM	FSB	WLRB	WLTR	WLR9
7/8/2008	0.0298	0.0061	0.0432	0.0219	-	-	-
7/15/2008	0.0295	0.0046	0.0460	-	-	-	-
7/22/2008	-	-	0.0573	0.0485	-	-	-
7/30/2008	0.0371	0.0049	0.0433	0.0286	-	-	-
8/14/2008	0.0298	0.0055	0.0392	0.0293	-	-	-
8/22/2008	0.0333	0.0040	0.0371	0.0298	-	-	-
8/28/2008	0.0312	0.0037	0.0454	0.0309	-	-	-
9/5/2008	0.0213	0.0054	0.0457	0.0306	-	-	-
9/12/2008	0.0316	0.0050	0.0484	0.0270	0.245	0.214	0.269
9/19/2008	0.0400	0.0048	0.0577	0.0347	0.271	0.210	0.271
9/26/2008	0.0392	0.0058	0.0503	0.0353	0.271	0.211	0.272
10/7/2008	0.0219	0.0053	0.0390	0.0279	0.230	0.216	0.267
10/16/2008	0.0252	0.0081	0.0445	0.0257	0.234	0.211	0.274
10/31/2008	0.0382	0.0053	0.0648	0.0325	0.273	0.208	0.290
11/6/2008	0.0250	0.0023	0.0506	0.0204	0.228	0.210	0.286
11/18/2008	0.0255	0.0044	0.0373	0.0254	0.234	0.211	0.286
3/5/2009	0.0298	0.0048	0.0565	0.0298	0.257	0.222	0.282
3/9/2009	-	-	-	0.0303	-	-	0.279
3/10/2009	-	-	0.0557	-	-	-	-
3/13/2009	-	0.0055	-	-	-	0.222	-
3/19/2009	0.0268	0.0055	0.0478	0.0273	0.223	0.215	0.272
3/27/2009	0.0271	-	-	0.0267	0.248	-	0.272
10/4/2009	-	0.0050	0.0296	0.0118	0.224	0.255	-

Appendix B. Genetic samples and additional fish-population data

Table B1. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, and Lincoln County, Nevada, 2008 and 2009.

[Reach A is above the small falls, which is the break between Reach A and B. Reach B and 1–4 are above Delmue Falls and Reaches 5–8 are below Delmue Falls]

	Year	
Sites	2008	2009
Reach A	48	0
Reaches B and 1–4	186	0
Reaches 5–8	28	35

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder]

Date	Site	FL (mm)	WT (g)	Genetics #	PIT tag code
10/22/2008	RA_US1	61	2.8	1025-066	
10/22/2008	RA_US1	65	3.1	1025-095	
10/22/2008	RA_US1	83	6.5	1032-093	
10/22/2008	RA_US1	77	5.3	MVW08-B1a	3D9.1C2CFA96CD
10/22/2008	RA_US1	62	2.9	MVW08-B2a	
10/22/2008	RA_US1	86	7.7	MVW08-B3a	3D9.1C2CFAC1D1
10/22/2008	RA_US1	80	5.2	MVW08-B4a	3D9.1C2CFA94CC
10/22/2008	RA_US1	86	7.0	MVW08-B5a	3D9.1C2CFA9262
10/22/2008	RA_US1	93	8.4	MVW08-B6a	3D9.1C2CFAA8E2
10/22/2008	RA_US1	94	9.7	MVW08-B7a	3D9.1C2CFA8DD4
10/22/2008	RA_US1	60	2.2	MVW08-B8a	
10/22/2008	RA_US1	57	2.0	MVW08-C10A	
10/22/2008	RA_US1	62	3.0	MVW08-C1a	
10/22/2008	RA_US1	83	6.3	MVW08-C3a	
10/22/2008	RA_US1	70	3.7	MVW08-C4a	
10/22/2008	RA_US1	65	3.3	MVW08-C5a	
10/22/2008	RA_US1	90	8.2	MVW08-D10a	3D9.1C2CFAA36B
10/22/2008	RA_US1	95	9.6	MVW08-D1a	3D9.1C2CCFA917E
10/22/2008	RA_US1	82	6.6	MVW08-D2a	3D9.1C2CFA9717
10/22/2008	RA_US1	69	3.8	MVW08-D3a	
10/22/2008	RA_US1	96	10.2	MVW08-D4a	3D9.1C2CFABCA8
10/22/2008	RA_US1	82	6.4	MVW08-D6a	3D9.1C2CFAC2A2
10/22/2008	RA_US1	71	4.2	MVW08-D7a	3D9.1C2CFA9B37
10/22/2008	RA_US1	66	3.4	MVW08-D8a	
10/22/2008	RA_US1	112	15.0	MVW08-D9a	3D9.1C2CFA83E7

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder.]

Date	Site	FL (mm)	WT (g)	Genetics #	PIT tag code
10/22/2008	RA_US1	90	8.1	MVW08-E1a	3D9.1C2CFAB44C
10/22/2008	RA_US1	90	8.6	MVW08-E2a	3D9.1C2CFABBA8
10/22/2008	RA_US1	65	3.2	MVW08-E3a	
10/22/2008	RA_US1	84	6.5	MVW08-E4a	3D9.1C2CFA9B68
10/22/2008	RA_US1	85	6.7	MVW08-E5a	3D9.1C2CFAA975
10/22/2008	RA_US1	92	8.1	MVW08-F10a	3D9.1C2CFAC5D4
10/22/2008	RA_US1	55	1.8	MVW08-F1a	
10/22/2008	RA_US1	87	7.9	MVW08-F2a	3D9.1C2CFAB32
10/22/2008	RA_US1	69	3.7	MVW08-F3a	
10/22/2008	RA_US1	80	6.0	MVW08-F4a	3D9.1C2CFA8DF1
10/22/2008	RA_US1	47	1.2	MVW08-F5a	
10/22/2008	RA_US1	65	3.1	MVW08-F6a	
10/22/2008	RA_US1	60	2.6	MVW08-F7a	
10/22/2008	RA_US1	79	5.5	MVW08-F8a	3D9.1C2CFA85FB
10/22/2008	RA_US1	81	6.1	MVW08-F9a	3D9.1C2CFA986D
10/22/2008	RA_US1	94	10.1	MVW08-G1a	
10/22/2008	RA_US1	72	4.3	MVW08-G2a	
10/22/2008	RA_US1	69	3.8	MVW08-G3a	
10/22/2008	RA_US1	82	6.4	MVW08-G4a	
10/22/2008	RA_US1	85	7.3	MVW08-G5a	
10/22/2008	RA_US1	93	9.8	MVW08-G6a	
10/22/2008	RA_US1	65	3.3	MVW08-G7a	
10/22/2008	RA_US2	64	2.5	MVW08-C2A	
10/2/2008	RB_ND1	61	1.8	MVW 56	
10/2/2008	RB_ND1	61	2.2	MVW 57	
10/2/2008	RB_ND1	46	1.1	MVW 58	
10/2/2008	RB_ND1	68	3.2	MVW 59	
10/2/2008	RB_ND1	68	3.1	MVW 60	

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder]

Date	Site	FL (mm)	WT (g)	Genetics code	PIT tag code
10/2/2008	RB_ND1	70	4.3	MVW 61	3D9.1C2CFAAB57
10/2/2008	RB_ND1	80	4.7	MVW 62	3D9.1C2CFAA5A6
10/2/2008	RB_ND1	63	2.6	MVW 64	
10/2/2008	RB_ND1	68	3.3	MVW 65	
10/2/2008	RB_ND1	63	2.9	MVW08-66	
10/2/2008	RB_ND1	60	2.1	MVW08-67	
10/2/2008	RB_ND1	61	2.8	MVW08-68	
10/2/2008	RB_ND1	27	0.2	MVW08-69	
10/2/2008	RB_ND1	80	5.8	MVW08-70	3D9.1C2CFA8D6C
10/2/2008	RB_ND1	62	2.9	MVW08-71	
10/2/2008	RB_ND1	60	2.1	MVW08-72	
10/2/2008	RB_ND1	37	0.5	MVW08-73	
10/2/2008	RB_ND1	70	4.0	MVW08-74	3D9.1C2CFA9D99
10/2/2008	RB_ND1	78	5.2	MVW08-75	3D9.1C2CFAC1A3
10/2/2008	RB_ND1	66	3.2	MVW08-76	
10/2/2008	RB_ND1	64	2.7	MVW08-77	
10/2/2008	RB_ND1	76	5.5	MVW08-78	3D9.1C2CFA936F
10/2/2008	RB_ND1	88	6.8	MVW08-79	3D9.1C2CFAA76D
10/20/2008	RTR1B_US1	43	0.9	MVW08-E10	
10/20/2008	RTR1B_US1	39	1.0	MVW08-E9	
10/20/2008	RTR1B_US1	45	0.9	MVW08-F1	
10/20/2008	RTR1B_US1	60	2.5	MVW08-F10	
10/20/2008	RTR1B_US1	44	0.9	MVW08-F2	
10/20/2008	RTR1B_US1	53	1.6	MVW08-F3	
10/20/2008	RTR1B_US1	40	0.8	MVW08-F4	
10/20/2008	RTR1B_US1	46	0.9	MVW08-F5	
10/20/2008	RTR1B_US1	56	2.1	MVW08-F6	
10/20/2008	RTR1B_US1	49	1.2	MVW08-F7	
10/20/2008	RTR1B_US1	43	0.7	MVW08-F8	

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued.

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder]

Date	Site	FL (mm)	WT (g)	Genetics code	PIT tag code
10/20/2008	RTR1B_US1	40	0.8	MVW08-F9	
10/20/2008	RTR1B_US1	52	1.8	MVW08-G1	
10/20/2008	RTR1B_US1	42	0.8	MVW08-G10	
10/20/2008	RTR1B_US1	48	1.3	MVW08-G2	
10/20/2008	RTR1B_US1	70	3.9	MVW08-G3	3D9.1C2CFA99AC
10/20/2008	RTR1B_US1	45	1.1	MVW08-G4	
10/20/2008	RTR1B_US1	45	1.1	MVW08-G5	
10/20/2008	RTR1B_US1	48	1.2	MVW08-G6	
10/20/2008	RTR1B_US1	45	1.0	MVW08-G7	
10/20/2008	RTR1B_US1	42	0.8	MVW08-G8	
10/20/2008	RTR1B_US1	44	0.8	MVW08-G9	
10/20/2008	RTR1B_US1	40	0.7	MVW08-H1	
10/20/2008	RTR1B_US1	42	0.6	MVW08-H10	
10/20/2008	RTR1B_US1	50	1.5	MVW08-H2	
10/20/2008	RTR1B_US1	60	2.2	MVW08-H3	
10/20/2008	RTR1B_US1	46	1.0	MVW08-H4	
10/20/2008	RTR1B_US1	67	3.2	MVW08-H5	
10/20/2008	RTR1B_US1	45	1.2	MVW08-H6	
10/20/2008	RTR1B_US1	49	1.1	MVW08-H7	
10/20/2008	RTR1B_US1	53	2.0	MVW08-H8	
10/20/2008	RTR1B_US1	46	1.1	MVW08-H9	
10/20/2008	RTR1B_US1	44	1.1	MVW08-I1	
10/20/2008	RTR1B_US1	46	1.0	MVW08-I10	
10/20/2008	RTR1B_US1	45	0.9	MVW08-I2	
10/20/2008	RTR1B_US1	47	1.0	MVW08-I3	
10/20/2008	RTR1B_US1	40	1.0	MVW08-I4	
10/20/2008	RTR1B_US1	45	1.0	MVW08-I5	
10/20/2008	RTR1B_US1	51	1.3	MVW08-I6	
10/20/2008	RTR1B_US1	51	1.4	MVW08-I7	

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder]

Date	Site	FL (mm)	WT (g)	Genetics code	PIT tag code
10/20/2008	RTR1B_US1	55	1.7	MVW08-I8	
10/20/2008	RTR1B_US1	39	0.7	MVW08-I9	
10/20/2008	RTR1B_US1	69	3.5	MVW08-J1	
10/20/2008	RTR1B_US1	50	1.3	MVW08-J2	
10/20/2008	RTR1B_US1	45	0.9	MVW08-J3	
10/20/2008	RTR1B_US1	47	1.2	MVW08-J4	
10/20/2008	RTR1B_US1	41	0.9	MVW08-J5	
10/20/2008	RTR1B_US1	44	0.9	MVW08-J6	
10/20/2008	RTR1B_US1	34	0.5	MVW08-J7	
10/20/2008	RTR1B_US1	50	1.2	MVW08-J8	
10/1/2008	R1_ND1	48	1.16	MVW08-43	
10/1/2008	R1_ND1	48	1.23	MVW08-44	
10/1/2008	R1_ND1	43	0.80	MVW08-45	
10/1/2008	R1_ND1	56	2.06	MVW08-46	
10/1/2008	R1_ND1	64	2.68	MVW08-47	
10/1/2008	R1_ND1	95	9.15	MVW08-48	3D9.1C2CFA90BD
10/1/2008	R1_ND1	65	3.31	MVW08-49	
10/1/2008	R1_ND1	69	3.07	MVW08-50	
10/1/2008	R1_ND1	61	2.32	MVW08-51	
10/1/2008	R1_ND1	77	5.10	MVW08-52	3D9.1C2CFAC014
10/1/2008	R1_ND1	71	3.80	MVW08-53	3D9.1C2CFABF3B
10/1/2008	R1_ND1	80	5.58	MVW08-54	3D9.1C2CFAC266
10/1/2008	R1_ND1	76	4.49	MVW08-55	3D9.1C2CFA935D
10/20/2008	R1_US1	55	1.8	MVW08-C10	
10/20/2008	R1_US1	40	0.7	MVW08-C9	
10/20/2008	R1_US1	55	1.8	MVW08-D1	
10/20/2008	R1_US1	65	2.7	MVW08-D10	
10/20/2008	R1_US1	46	1.0	MVW08-D2	
10/20/2008	R1_US1	45	0.9	MVW08-D3	

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder]

Date	Site	FL (mm)	WT (g)	Genetics code	PIT tag code
10/20/2008	R1_US1	35	0.5	MVW08-D4	
10/20/2008	R1_US1	45	1.2	MVW08-D5	
10/20/2008	R1_US1	60	2.2	MVW08-D6	
10/20/2008	R1_US1	56	2.2	MVW08-D7	
10/20/2008	R1_US1	66	3.1	MVW08-D8	
10/20/2008	R1_US1	72	4.0	MVW08-D9	3D9.1C2CFA9B26
10/20/2008	R1_US1	69	3.5	MVW08-E1	
10/20/2008	R1_US1	81	5.2	MVW08-E2	3D9.1C2CFAC19F
10/20/2008	R1_US1	41	0.6	MVW08-E3	
10/20/2008	R1_US1	36	0.7	MVW08-E4	
10/20/2008	R1_US1	38	0.6	MVW08-E5	
10/20/2008	R1_US1	75	3.6	MVW08-E6	3D9.1C2CFABA9A
10/20/2008	R1_US1	70	3.6	MVW08-E7	3D9.1C2CFA915C
10/20/2008	R1_US1	45	0.9	MVW08-E8	
10/21/2008	R2_US1	85	6.6	MVW08-A2a	3D9.1C2CFA8856
10/21/2008	R2_US1	45	1.3	MVW08-B10a	
10/21/2008	R2_US1	44	1.0	MVW08-B9a	
10/21/2008	R2_US1	75	4.3	MVW08-C6a	3D9.1C2CFA9024
10/21/2008	R2_US1	54	1.7	MVW08-C7a	
10/21/2008	R2_US1	70	4.3	MVW08-C8a	
10/21/2008	R2_US1	80	6.8	MVW08-C9a	3D9.239F83A74C
10/21/2008	R2_US1	76	5.0	MVW08-E6a	
10/21/2008	R2_US1	73	4.0	MVW08-E7a	3D9.1C2CFA83EA
10/21/2008	R2_US1	81	4.5	MVW08-E8a	3D9.1C2CFAAD1C
10/1/2008	R3_ND1	68	3.5	MVW08-10	
10/1/2008	R3_ND1	46	1.0	MVW08-11	
10/1/2008	R3_ND1	51	1.4	MVW08-12	
10/1/2008	R3_ND1	95	9.4	MVW08-13	3D9.1C2CFA84E8
10/1/2008	R3_ND1	53	1.5	MVW08-14	

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder]

Date	Site	FL (mm)	WT (g)	Genetics code	PIT tag code
10/1/2008	R3_ND1	49	1.3	MVW08-15	
10/1/2008	R3_ND1	48	1.3	MVW08-16	
10/1/2008	R3_ND1	65	3.0	MVW08-17	
10/1/2008	R3_ND1	55	1.7	MVW08-18	
10/1/2008	R3_ND1	54	1.7	MVW08-19	
10/1/2008	R3_ND1	89	6.9	MVW08-20	3D9.1C2CFAB8FE
10/1/2008	R3_ND1	90	8.1	MVW08-21	3D9.1C2CFAAF4D
10/1/2008	R3_ND1	54	1.4	MVW08-22	
10/1/2008	R3_ND1	80	5.4	MVW08-23	3D9.1C2CFABF8E
10/1/2008	R3_ND1	85	6.7	MVW08-24	3D9.1C2CFA9153
10/1/2008	R3_ND1	51	1.4	MVW08-25	
10/1/2008	R3_ND1	82	5.3	MVW08-26	3D9.1C2CFABE40
10/1/2008	R3_ND1	86	6.2	MVW08-27	3D9.1C2CFA8236
10/1/2008	R3_ND1	49	1.2	MVW08-28	
10/1/2008	R3_ND1	48	1.0	MVW08-29	
10/1/2008	R3_ND1	46	1.0	MVW08-30	
10/1/2008	R3_ND1	46	1.1	MVW08-32	
10/1/2008	R3_ND1	46	1.0	MVW08-33	
10/1/2008	R3_ND1	45	1.0	MVW08-34	
10/1/2008	R3_ND1	44	1.0	MVW08-35	
10/1/2008	R3_ND1	83	6.1	MVW08-36	3D9.1C2CFABF99
10/1/2008	R3_ND1	86	7.3	MVW08-37	3D9.1C2CFA81CD
10/1/2008	R3_ND1	55	1.7	MVW08-38	
10/1/2008	R3_ND1	75	5.5	MVW08-39	3D9.1C2CFAB495
10/1/2008	R3_ND1	51	1.6	MVW08-40	
10/1/2008	R3_ND1	54	1.7	MVW08-41	
10/1/2008	R3_ND1	50	1.4	MVW08-42	
10/21/2008	R3_US1	50	1.4	MVW08-A10a	
10/21/2008	R3_US1	52	1.4	MVW08-A1a	

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder]

Date	Site	FL (mm)	WT (g)	Genetics code	PIT tag code
10/21/2008	R3_US1	103	13.1	MVW08-A3a	3D9.1C2CFA84E2
10/21/2008	R3_US1	76	4.8	MVW08-A4a	3D9.1C2CFA8A13
10/21/2008	R3_US1	45	1.1	MVW08-A5a	
10/21/2008	R3_US1	42	0.6	MVW08-A6a	
10/21/2008	R3_US1	47	1.5	MVW08-A7a	
10/21/2008	R3_US1	47	1.1	MVW08-A8a	
10/21/2008	R3_US1	71	4.2	MVW08-A9a	3D9.1C2CFA96DD
10/21/2008	R3_US1	65	3.4	MVW08-E10a	
10/21/2008	R3_US1	49	1.3	MVW08-E9a	
10/19/2008	R4_US1	88	8.1	MVW08-A10	3D9.1C2CFABDFB
10/19/2008	R4_US1	75	3.9	MVW08-A2	3D9.239F83A768
10/19/2008	R4_US1	55	1.8	MVW08-A3	
10/19/2008	R4_US1	69	3.6	MVW08-A4	
10/19/2008	R4_US1	70	3.6	MVW08-A5	3D9.239F83A74D
10/19/2008	R4_US1	54	2.0	MVW08-A6	
10/19/2008	R4_US1	55	1.8	MVW08-A7	
10/19/2008	R4_US1	59	2.3	MVW08-A8	
10/19/2008	R4_US1	59	2.4	MVW08-A9	
10/19/2008	R4_US1	80	5.1	MVW08-B1	3D9.1C2CFA82AF
10/19/2008	R4_US1	50	1.4	MVW08-B10	
10/19/2008	R4_US1	68	3.5	MVW08-B2	
10/19/2008	R4_US1	55	1.7	MVW08-B3	
10/19/2008	R4_US1	52	1.5	MVW08-B4	
10/19/2008	R4_US1	91	8.9	MVW08-B5	3D9.239F83A735
10/19/2008	R4_US1	58	2.1	MVW08-B6	
10/19/2008	R4_US1	83	6.5	MVW08-B7	3D9.239F83A756
10/19/2008	R4_US1	81	6.2	MVW08-B8	3D9.239F83A71D
10/19/2008	R4_US1	85	7.1	MVW08-B9	3D9.239F83A766
10/19/2008	R4_US1	95	10.4	MVW08-C1	

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder]

Date	Site	FL (mm)	WT (g)	Genetics code	PIT tag code
10/19/2008	R4_US1	90	7.7	MVW08-C2	
10/19/2008	R4_US1	52	1.8	MVW08-C3	
10/19/2008	R4_US1	87	7.8	MVW08-C4	
10/19/2008	R4_US1	58	2.2	MVW08-C5	
10/19/2008	R4_US1	53	1.7	MVW08-C6	
10/19/2008	R4_US1	75	4.5	MVW08-C7	
10/19/2008	R4_US1	79	5.6	MVW08-C8	
10/1/2008	R5_ND1	53	1.85	MVW08-07	
10/1/2008	R5_ND1	56	2.48	MVW08-08	
10/1/2008	R5_ND1	74	4.84	MVW08-09	3D9.1C2CFA871E
10/10/2008	R5_US1	50	1.3	mvw08-02	
10/1/2008	R6_ND1	105	12.54	MVW08-03	3D9.1C2CFAA6EF
10/1/2008	R6_ND1	95	8.86	MVW08-04	3D9.1C2CFA9C89
10/1/2008	R6_ND1	98	11.15	MVW08-05	3D9.1C2CFA86AC
3/17/2009	R6_ND1	104	15.1	MVW09B10	3D9.1C2D235D6F
3/17/2009	R6_ND1	84	9.2	MVW09B5	3D9.1C2D23A711
3/17/2009	R6_ND1	105	7.5	MVW09B6	3D9.1C2D23A759
3/17/2009	R6_ND1	110	17.9	MVW09B7	3D9.1C2D23670A
3/17/2009	R6_ND1	110	16.6	MVW09B8	3D9.1C2D23FB9D
3/17/2009	R6_ND1	90	9.7	MVW09B9	3D9.1C2D23C213
3/17/2009	R6_ND1	95	12.2	MVW09C1	3D9.1C2D235236
3/17/2009	R6_ND1	87	8.7	MVW09C10	3D9.1C2D23BF8C
3/17/2009	R6_ND1	97	12.4	MVW09C2	3D9.1C2D23A762
3/17/2009	R6_ND1	106	15.8	MVW09C3	3D9.1C2D23AEFB
3/17/2009	R6_ND1	103	15.8	MVW09C4	3D9.1C2D23A0E1
3/17/2009	R6_ND1	85	9.5	MVW09C5	3D9.1C2D23B3E9
3/17/2009	R6_ND1	95	12.4	MVW09C6	3D9.1C2D23A188
3/17/2009	R6_ND1	105	16.2	MVW09C7	3D9.1C2D2353DF
3/17/2009	R6_ND1	96	12.5	MVW09C8	3D9.1C2D239CC4

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder]

Date	Site	FL (mm)	WT (g)	Genetics code	PIT tag code
3/17/2009	R6_ND1	111	18.4	MVW09C9	3D9.1C2D23B3FD
3/17/2009	R6_ND1	114	16.0	MVW09D1	
3/17/2009	R6_ND1	105	17.1	MVW09D2	3D9.1C2D23C212
3/17/2009	R6_ND1	109	17.0	MVW09D3	3D9.1C2D23A3FE
3/17/2009	R6_ND1	110	18.8	MVW09D4	3D9.1C2D23A0D0
10/9/2008	R6_US1	113	16.2	MVW08-100	3D9.239F83A755
10/9/2008	R6_US1	100	11.8	MVW08-95	3D9.1C2CFAC532
10/9/2008	R6_US1	115	17.3	MVW08-96	3D9.239F83A732
10/9/2008	R6_US1	105	13.1	MVW08-97	3D9.1C2CFAA378
10/9/2008	R6_US1	102	12.5	MVW08-98	3D9.239F83A75F
10/9/2008	R6_US1	85	7.1	MVW08-99	3D9.239F83A73F
3/17/2009	R6_US1	88	8.7	MVW09A10	3D9.1C2D239A5B
3/17/2009	R6_US1	82	9.1	MVW09A2	3D9.1C2D23B226
3/17/2009	R6_US1	100	13.8	MVW09A3	3D9.1C2D23AF8D
3/17/2009	R6_US1	112	10.0	MVW09A4	3D9.1C2D239ABA
3/17/2009	R6_US1	95	13.0	MVW09A5	3D9.1C2D23B557
3/17/2009	R6_US1	87	8.9	MVW09A6	3D9.1C2D237A8D
3/17/2009	R6_US1	81	6.7	MVW09A7	3D9.1C2D23FA33
3/17/2009	R6_US1	84	7.8	MVW09A8	3D9.1C2D23C263
3/17/2009	R6_US1	78	5.6	MVW09A9	3D9.1C2D23A127
3/17/2009	R6_US1	104	14.9	MVW09B1	3D9.1C2D236C76
3/17/2009	R6_US1	79	6.7	MVW09B2	3D9.1C2D23982B
3/17/2009	R6_US1	100	13.9	MVW09B3	3D9.1C2D23A9B4
10/9/2008	R7_US1	55	2.0	MVW08-88	
10/9/2008	R7_US1	85	7.5	MVW08-89	3D9.239F83A72C
10/9/2008	R7_US1	81	6.0	MVW08-90	3D9.1C2CFAA721
10/9/2008	R7_US1	80	5.8	MVW08-91	3D9.239F83A750
10/9/2008	R7_US1	44	1.5	MVW08-92	

Table B2. Genetic samples collected from Big Spring spinedace captured during electrofishing surveys in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, 2008 and 2009.—Continued

[FL, fork length; mm, millimeters; WT, weight; g, grams; PIT, Passive Integrated Transponder.]

Date	Site	FL (mm)	WT (g)	Genetics code	PIT tag code
10/9/2008	R7_US1	52	1.9	MVW08-93	
10/9/2008	R7_US1	75	5.1	MVW08-94	3D9.239F83A765
3/18/2009	R7_US1	101	14.5	MVW09D5	3D9.1C2D239CD6
3/18/2009	R7_US1	92	11.2	MVW09D6	3D9.1C2D23A9DC
3/18/2009	R7_US1	77	5.6	MVW09D7	3D9.1C2D23A730
10/1/2008	R8_ND1	55	4.78	MVW08-01	
10/8/2008	R8_US1	61	2.7	MVW08-80	
10/8/2008	R8_US1	63	3.0	MVW08-81	
10/8/2008	R8_US1	64	3.0	MVW08-82	
10/8/2008	R8_US1	61	2.8	MVW08-83	
10/8/2008	R8_US1	63	3.3	MVW08-84	
10/8/2008	R8_US1	64	3.0	MVW08-85	
10/8/2008	R8_US1	58	2.4	MVW08-87	

Table B3. Estimates of populations from electrofishing surveys for two age classes of Big Spring spinedace in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2008.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NE, no estimate.]

	Age-0					Age-1 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	2	27.8	0.080	0.069	0.741	0	0.0	0.000	0.000	0.000
RA_US1	32	0.5	1.280	0.577	1.905	32	0.2	1.280	0.577	1.905
RB_ND1	60	5.1	2.400	1.101	5.825	65	8.1	2.600	1.193	6.311
RB_US1	0	0.0	0.000	0.000	0.000	0	0.0	0.000	0.000	0.000
TR_US1	49	0.3	1.960	2.227	70.000	7	0.0	0.280	0.318	10.000
R1_ND1	76	4.6	2.533	1.064	15.200	59	4.4	1.967	0.826	11.800
R1_US1	29	8.4	1.160	0.644	9.063	22	0.0	0.880	0.489	6.875
R2_US1	19	0.2	0.760	0.304	2.879	17	0.0	0.680	0.272	2.576
R3_ND1	NE					NE				
R3_US1	35	0.1	1.400	1.129	7.292	22	0.0	0.880	0.710	4.583
R4_US1	14	6.2	0.560	0.243	2.121	17	9.2	0.680	0.296	2.576
Below Delmue Falls										
R5_ND1	NE					NE				
R5_US1	1	0.0	0.040	0.018	0.060	0	0.0	0.000	0.000	0.000
R6_ND1	0	0.0	0.000	0.000	0.000	3	0.0	0.120	0.055	0.291
R6_US1	2	4.9	0.080	0.034	0.476	33	0.3	1.320	0.569	7.857
R6_USA	NE					NE				
R8_US1	0	0.0	0.000	0.000	0.000	8	1.5	0.267	0.112	1.600
R8_ND1	1	0.0	0.040	0.022	0.313	0	0.0	0.000	0.000	0.000
R9_ND1	0	0.0	0.000	0.000	0.000	0	0.0	0.000	0.000	0.000
R9_US1	0	0.0	0.000	0.000	0.000	0	0.0	0.000	0.000	0.000
R10_US1	0	0.0	0.000	0.000	0.000	0	0.0	0.000	0.000	0.000
R10_US2	0	0.0	0.000	0.000	0.000	0	0.0	0.000	0.000	0.000

Table B4. Estimates of populations from electrofishing surveys for two age classes of speckled dace in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2008.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NS, not sampled; NE, no estimate]

	Age-0					Age-1 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	43	2.8	1.720	1.483	15.926	28	2.8	1.120	0.966	10.370
RA_US1	118	0.7	4.720	2.126	7.024	47	0.7	1.880	0.847	2.798
RB_ND1	169	40.0	6.760	3.101	16.408	104	40.0	4.160	1.908	10.097
RB_US1	17	2.7	0.680	0.290	4.040	115	3.3	4.600	1.983	27.381
TRIB_US1	25	0.0	1.000	1.136	35.714	49	0.0	1.960	2.227	70.000
R1_ND1	56	16.8	1.867	0.784	11.200	70	16.8	2.333	0.980	14.000
R1_US1	56	1.0	2.240	1.244	17.500	65	1.0	2.600	1.444	20.313
R2_US1	32	4.3	1.280	0.512	4.848	129	4.3	5.160	2.064	19.545
R3_ND1	NE					109	27.1	4.360	2.319	14.730
R3_US1	29	1.8	1.160	0.935	6.042	56	1.8	2.240	1.806	11.667
R4_US1	38	4.9	1.520	0.661	5.758	145	4.9	5.800	2.522	21.970
Below Delmue Falls										
R5_ND1	18	56.9	0.720	0.336	4.286	22	13.3	0.880	0.411	5.238
R5_US1	4	0.0	0.160	0.119	0.909	23	17.8	0.920	0.687	5.227
R6_ND1	1	0.0	0.040	0.017	0.071	6	1.3	0.240	0.102	0.429
R6_US1	1	0.0	0.040	0.027	0.110	12	3.8	0.480	0.324	1.319
R6_USA	NS					NS				
R8_US1	27	0.9	1.080	0.514	5.192	21	3.5	0.840	0.400	4.038
R8_ND1	18	34.9	0.720	0.316	2.500	NE				
R9_ND1	1	0.0	0.040	0.018	0.075	NE				
R9_US1	23	1.8	0.920	0.305	1.825	22	3.9	0.880	0.291	1.746
R10_US1	NE					NE				
R10_US2	9	1.6	0.360	0.184	2.000	7	2.4	0.280	0.143	1.556

Table B5. Estimates of populations from electrofishing surveys for two age classes of desert sucker in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2008.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NS, not sampled; NE, no estimate]

	Age-0					Age-1 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	NE	-	-	-	-	NE	-	-	-	-
RA_US1	26	8.8	1.040	0.468	1.548	73	1.2	2.920	1.315	4.345
RB_ND1	276	7.0	11.040	5.064	26.796	116	3.5	4.640	2.128	11.262
RB_US1	1	0.0	0.040	0.017	0.238	24	5.0	0.960	0.414	5.714
TR_US1	0	---	0.000	0.000	0.000	0	0.0	0.000	0.000	0.000
R1_ND1	6	0.0	0.200	0.084	1.200	37	8.6	1.233	0.518	7.400
R1_US1	17	0.0	0.680	0.378	5.313	4	0.0	0.160	0.089	1.250
R2_US1	0	---	0.000	0.000	0.000	2	0.0	0.080	0.032	0.303
R3_ND1	0	---	0.000	0.000	0.000	13	40.4	0.520	0.277	1.757
R3_US1	0	---	0.000	0.000	0.000	7	0.0	0.280	0.226	1.458
R4_US1	0	---	0.000	0.000	0.000	7	0.0	0.280	0.122	1.061
Below Delmue Falls										
R5_ND1	0	---	0.000	0.000	0.000	0	---	0.000	0.000	0.000
R5_US1	0	---	0.000	0.000	0.000	0	---	0.000	0.000	0.000
R6_ND1	0	---	0.000	0.000	0.000	0	---	0.000	0.000	0.000
R6_US1	2	0.0	0.080	0.054	0.220	1	0.0	0.040	0.027	0.110
R6_USA	NS		---	---	---	NS		---	---	---
R8_US1	2	0.0	0.080	0.038	0.385	1	0.0	0.040	0.019	0.192
R8_ND1	0	---	0.000	0.000	0.000	0	---	0.000	0.000	0.000
R9_ND1	0	---	0.000	0.000	0.000	4	0.0	0.160	0.073	0.301
R9_US1	0	---	0.000	0.000	0.000	0	---	0.000	0.000	0.000
R10_US1	0	---	0.000	0.000	0.000	0	---	0.000	0.000	0.000
R10_US2	0	---	0.000	0.000	0.000	1	0.0	0.040	0.020	0.222

Table B6. Estimates of populations from electrofishing surveys for two age classes of rainbow trout in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2008.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NS, not sampled]

	Age-0					Age-1 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	0		0.000	0.000	0.000	0		0.000	0.000	0.000
RA_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
RB_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
RB_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
TR_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R1_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R1_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R2_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R3_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R3_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R4_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
Below Delmue Falls										
R5_ND1	1	0.0	0.040	0.040	0.238	0		0.000	0.000	0.000
R5_US1	2	0.0	0.080	0.080	0.455	0		0.000	0.000	0.000
R6_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R6_US1	0		0.000	0.000	0.000	2	0.0	0.080	0.054	0.220
R6_USA	NS					NS				
R8_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R8_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R9_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R9_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US2	0		0.000	0.000	0.000	0		0.000	0.000	0.000

Table B7. Estimates of populations from electrofishing surveys for two age classes of Big Spring spinedace in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, spring 2009.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NS, not sampled]

	Age-1					Age-2 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	0		0.000	0.018	0.000	0		0.000	0.000	0.000
RA_US1	1	0.0	0.040	0.018	0.068	40	0.0	1.600	0.713	2.721
RB_ND1	NS					NS				
RB_US1	3	0.0	0.120	0.052	0.600	4	0.0	0.160	0.069	0.800
TR_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R1_ND1	27	0.0	0.900	0.409	4.091	40	0.0	1.333	0.606	6.061
R1_US1	5	0.0	0.200	0.092	1.923	7	0.0	0.280	0.129	2.692
R2_US1	27	0.0	1.051	0.401	3.462	35	0.0	1.362	0.519	4.487
R3_ND1	41	0.7	1.640	0.555	3.727	27	0.3	1.080	0.365	2.455
R3_US1	8	0.0	0.291	0.165	1.000	8	0.0	0.291	0.165	1.000
R4_US1	3	0.0	0.120	0.049	0.357	9	0.4	0.360	0.147	1.071
Below Delmue Falls										
R5_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R5_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R6_ND1	0		0.000	0.000	0.000	26		1.040	0.527	2.653
R6_US1	0		0.000	0.000	0.000	12	0.1	0.480	0.255	0.909
R6_USA	8		0.320	0.140	1.111	12	0.0	0.480	0.210	1.667
R8_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R8_ND1	2		0.080	0.030	0.179	0		0.000	0.000	0.000
R9_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R9_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US1	NS					NS				
R10_US2	NS					NS				

Table B8. Estimates of populations from electrofishing surveys for two age classes of speckled dace in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, spring 2009.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NS, not sampled; NE, no estimate]

	Age-1					Age-2 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	37	1.1	1.480	0.976	10.278	25	3.7	1.000	0.660	6.944
RA_US1	79	3.6	3.160	1.408	5.374	30	2.4	1.200	0.535	2.040
RB_ND1	NS					NS				
RB_US1	13	0.0	0.520	0.225	2.600	80	0.7	3.200	1.382	16.000
TR_US1	18	0.0	0.720	0.547	22.500	106	1.6	4.240	3.222	132.500
R1_ND1	20	0.0	0.667	0.303	3.030	126	1.8	4.200	1.909	19.091
R1_US1	2	0.0	0.080	0.037	0.769	67	2.9	2.680	1.234	25.769
R2_US1	20	2.9	0.778	0.297	2.564	37	16.4	1.440	0.549	4.744
R3_ND1	64	14.3	2.560	0.866	5.818	137	1.8	5.480	1.854	12.455
R3_US1	24	1.7	0.873	0.495	3.000	59	3.1	2.145	1.216	7.375
R4_US1	34	6.0	1.360	0.556	4.048	79	6.8	3.160	1.293	9.405
Below Delmue Falls										
R5_ND1	0		0.000	0.000	0.000	1	0.0	0.042	0.018	0.175
R5_US1	0		0.000	0.000	0.000	3	0.0	0.120	0.084	0.667
R6_ND1	2	0.0	0.080	0.041	0.204	3	0.0	0.120	0.061	0.306
R6_US1	4	0.0	0.160	0.085	0.303	NE				
R6_USA	2	0.0	0.080	0.035	0.278	15	28.6	0.600	0.263	2.083
R8_US1	1	0.0	0.040	0.018	0.169	2	0.0	0.080	0.036	0.339
R8_ND1	9	5.9	0.360	0.136	0.804	2	0.0	0.080	0.030	0.179
R9_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R9_US1	2	0.0	0.080	0.030	0.271	0		0.000	0.000	0.000
R10_US1	NS					NS				
R10_US2	NS					NS				

Table B9. Estimates of populations from electrofishing surveys for two age classes of desert sucker in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, spring 2009.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NE, no estimate; NS, not sampled]

	Age-1					Age-2 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	0		0.000	0.000	0.000	0		0.000	0.000	0.000
RA_US1	2	0.0	0.080	0.036	0.136	22	12.8	0.880	0.392	1.497
RB_ND1	NS					NS				
RB_US1	2	0.0	0.080	0.035	0.400	22	0.0	0.880	0.380	4.400
TR_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R1_ND1	3	22.1	0.100	0.045	0.455	11	4.1	0.367	0.167	1.667
R1_US1	1	0.0	0.040	0.018	0.385	0		0.000	0.000	0.000
R2_US1	6	0.0	0.233	0.089		8	2.9	0.311	0.119	
R3_ND1	NE					14	3.5	0.560	0.189	1.273
R3_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R4_US1	0		0.000	0.000	0.000	1	0.0	0.040	0.016	0.119
Below Delmue Falls										
R5_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R5_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R6_ND1	0		0.000	0.000	0.000	2	0.0	0.080	0.041	0.204
R6_US1	0		0.000	0.000	0.000	2	0.0	0.080	0.042	0.152
R6_USA	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R8_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R8_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R9_ND1	1	0.0	0.050	0.016	0.058	0		0.000	0.000	0.000
R9_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US1	NS					NS				
R10_US2	NS					NS				

Table B10. Estimates of populations from electrofishing surveys for two age classes of rainbow trout in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, spring 2009.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NS, not sampled]

	Age-1					Age-2 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	0		0.000	0.000	0.000	0		0.000	0.000	0.000
RA_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
RB_ND1	NS					NS				
RB_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
TR_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R1_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R1_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R2_US1	0		0.000	0.000		0		0.000	0.000	
R3_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R3_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R4_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
Below Delmue Falls										
R5_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R5_US1	0		0.000	0.000	0.000	1	0.0	0.040	0.028	0.222
R6_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R6_US1	0		0.000	0.000	0.000	4	0.4	0.160	0.085	0.303
R6_USA	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R8_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R8_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R9_ND1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R9_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US1	NS					NS				
R10_US2	NS					NS				

Table B11. Estimates of populations from electrofishing surveys for two age classes of Big Spring spinedace in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2009.

[Sites are listed from upstream to downstream. *N*; population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter]

	Age-0					Age-1 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	0		0.000	0.000	0.000	0		0.000	0.000	0.000
RA_US1	31	1.5	1.127	0.506	2.348	45	1.0	1.636	0.734	3.409
RB_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
TR_US1	11	0.2	0.415	0.288	8.462	1	0.0	0.038	0.026	0.769
R1_US1	80	0.0	2.985	1.463	18.605	24	0.0	0.896	0.439	5.581
R2_US1	20	0.0	0.769	0.328	4.167	12	0.0	0.462	0.197	2.500
R3_US1	14	0.0	0.513	0.312	2.745	10	0.0	0.366	0.223	1.961
R4_US1	5	0.0	0.199	0.086	0.746	4	86.6	0.159	0.068	0.597
Below Delmue Falls										
R5_US1	1	0.0	0.040	0.030	0.294	0		0.000	0.000	0.000
R6_US1	71	0.0	2.898	1.603	11.452	10	0.0	0.408	0.226	1.613
R6_USA	14	2.4	0.660	0.323	3.500	3	0.0	0.142	0.069	0.750
R8_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R9_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US2	0		0.000	0.000	0.000	0		0.000	0.000	0.000

Table 12B. Estimates of populations from electrofishing surveys of Big Spring spinedace in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2009.

[Sites are listed from upstream to downstream. Age was not estimated at these sites. N, population estimate; CV = percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NE, no estimate]

	All spinedace				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3
NDOW Sites					
RB_ND1	496	3.7	14.588	6.123	43.894
R1_ND1	152	1.4	5.067	2.335	35.349
R3_ND1	NE				
R5_ND1	0				
R6_ND1	6	0.1	0.222	0.110	0.833
R8_ND1	2	0.0	0.080	0.030	0.180
R9_ND1	0		0.000	0.000	0.000

Table 13B. Estimates of populations from electrofishing surveys for two age classes of speckled dace in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2009.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter; NE, no estimate]

	Age-0					Age-1 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	28	12.0	1.098	1.116	28.000	13	7.5	0.510	0.518	13.000
RA_US1	419	1.1	15.236	6.835	31.742	76	2.3	2.764	1.240	5.758
RB_US1	1	0.0	0.029	0.012	0.088	0		0.000	0.000	0.000
TR_US1	81	4.3	3.057	2.120	62.308	4	0.0	0.151	0.105	3.077
R1_US1	165	0.3	6.157	3.016	38.372	16	2.1	0.597	0.293	3.721
R2_US1	109	0.1	4.192	1.790	22.708	48	0.6	1.846	0.788	10.000
R3_US1	116	1.1	4.249	2.584	22.745	49	0.2	1.795	1.091	9.608
R4_US1	157	0.5	6.255	2.688	23.433	47	1.1	1.873	0.805	7.015
Below Delmue Falls										
R5_US1	11	0.0	0.445	0.331	3.235	16	1.0	0.648	0.482	4.706
R6_US1	18	25.6	0.735	0.406	2.903	NE				
R6_USA	1	0.0	0.047	0.023	0.250	4	0.0	0.189	0.092	1.000
R8_US1	143	0.3	5.652	3.213	44.688	31	3.8	1.225	0.697	9.688
R9_US1	6	0.1	0.224	0.113	1.034	41	2.1	1.530	0.771	7.069
R10_US1	1	0.0	0.042	0.025	0.385	7	8.9	0.292	0.176	2.692
R10_US2	1	0.0	0.043	0.026	0.556	1	0.0	0.043	0.026	0.556

Table B14. Estimates of populations from electrofishing surveys of speckled dace in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2009.

[Sites are listed from upstream to downstream. Age was not estimated at these sites. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter]

	All speckled dace				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3
NDOW Sites					
RB_ND1	217	8.5	6.382	2.659	19.204
R1_ND1	122	2.2	4.067	1.874	28.372
R3_ND1	NE				
R5_ND1	NE				
R6_ND1	12	0.7	0.444	0.221	1.667
R8_ND1	NE				
R9_ND1	12	2.2	0.480	0.240	2.143

Table B15. Estimates of populations from electrofishing surveys for two age classes of desert sucker in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2009.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter]

	Age-0					Age-1 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	6	0.0	0.235	0.239	6.000	0		0.000	0.000	0.000
RA_US1	202	4.7	7.345	3.295	15.303	39	9.5	1.418	0.636	2.955
RB_US1	1	0.0	0.029	0.012	0.088	1	0.0	0.029	0.012	0.088
TR_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R1_US1	6	2.8	0.224	0.110	1.395	0		0.000	0.000	0.000
R2_US1	9	1.9	0.346	0.148	1.875	1	0.0	0.038	0.016	0.208
R3_US1	18	0.0	0.659	0.401	3.529	1	0.0	0.037	0.022	0.196
R4_US1	14	13.1	0.558	0.240	2.090	3	0.0	0.120	0.051	0.448
Below Delmue Falls										
R5_US1	4	11.8	0.162	0.120	1.176	0		0.000	0.000	0.000
R6_US1	1	0.0	0.041	0.023	0.161	5	0.0	0.204	0.113	0.806
R6_USA	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R8_US1	0		0.000	0.000	0.000	1	0.0	0.040	0.022	0.313
R9_US1	0		0.000	0.000	0.000	1	0.0	0.037	0.019	0.172
R10_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US2	0		0.000	0.000	0.000	0		0.000	0.000	0.000

Table B16. Estimates of populations from electrofishing surveys of desert sucker in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2009.

[Sites are listed from upstream to downstream. Age was not estimated at these sites. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter]

	All desert sucker				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3
NDOW Sites					
RB_ND1	162	2.9	4.765	1.985	14.336
R1_ND1	32	10.6	1.067	0.492	7.442
R3_ND1	NE				
R5_ND1	0				
R6_ND1	0		0.000	0.000	0.000
R8_ND1	2	0.0			
R9_ND1	NE				

Table B17. Estimates of populations from electrofishing surveys for two age classes of rainbow trout in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2009.

[Sites are listed from upstream to downstream. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter]

	Age-0					Age-1 or older				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3	*N* (est)	CV	no./m	no./m^2	no./m^3
Above Delmue Falls										
RA_US2	0		0.000	0.000	0.000	0		0.000	0.000	0.000
RA_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
RB_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
TR_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R1_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R2_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R3_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R4_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
Below Delmue Falls										
R5_US1	11	1.1	0.445	0.331	3.235	0		0.000	0.000	0.000
R6_US1	2	0.0	0.082	0.045	0.323	4	0.0	0.163	0.090	0.645
R6_USA	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R8_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R9_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US1	0		0.000	0.000	0.000	0		0.000	0.000	0.000
R10_US2	0		0.000	0.000	0.000	0		0.000	0.000	0.000

Table B18. Estimates of populations from electrofishing surveys of rainbow trout in Condor Canyon, Meadow Valley Wash, Lincoln County, Nevada, fall 2009.

[Sites are listed from upstream to downstream. Age was not estimated at these sites. *N*, population estimate; CV, percent coefficient of variation (SE/N×100); m, meter; m^2, square meter; m^3, cubic meter]

	All rainbow trout				
Site	*N* (est)	CV	no./m	no./m^2	no./m^3
NDOW Sites					
RB_ND1	0		0.000	0.000	0.000
R1_ND1	0		0.000	0.000	0.000
R3_ND1	0		0.000	0.000	0.000
R5_ND1	38	15.6			
R6_ND1	0		0.000	0.000	0.000
R8_ND1	0				
R9_ND1	0		0.000	0.000	0.000

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Jezorek and others— **Big Spring Spinedace and Associated Fish Populations and Habitat Conditions in Condor Canyon, Meadow Valley Wash, Nevada**—Open-File Report 2011–1072