



Mojave Desert Network Inventory and Monitoring Selected Large Springs Pilot Study

Saratoga Spring Springsnail and Benthic Macroinvertebrate Data

Natural Resource Data Series NPS/MOJN/NRDS—2014/656



ON THE COVER

Saratoga Spring in Death Valley National Park

Photograph courtesy of Mojave Desert Network Inventory and Monitoring Program

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Overview

The National Park Service (NPS) Mojave Desert Network Inventory and Monitoring Program (MOJN I&M) is developing a protocol to monitor the hydrology and ecology of large springs in the MOJN parks. The MOJN Selected Large Springs (SLS) protocol will cover springs in Death Valley National Park (DEVA), Great Basin National Park (GRBA), Joshua Tree National Park (JOTR), Lake Mead National Recreation Area (LAKE), Mojave National Preserve (MOJA), and Grand Canyon-Parashant National Monument (PARA). The monitored springs have been selected in cooperation with park staff to address the parks' resource management priorities.

As part of the SLS protocol, MOJN will collect samples of benthic macroinvertebrates (BMI) and monitor springsnail populations in several springs. The purpose of this monitoring is twofold:

- to provide data regarding the overall health of the aquatic ecosystems in the monitored springs, and
- to monitor the endemic species present in the springs.

These data will be useful in determining the effects of any observed changes in hydrology or vegetation, and will provide baseline information that can be used to evaluate management actions at the springs.

In March of 2012, MOJN visited Saratoga Spring in DEVA to test the methods initially proposed for benthic macroinvertebrate (BMI) sampling and springsnail monitoring. This report presents the results of these pilot tests.

Saratoga Spring

Saratoga Spring is located near the southern end of DEVA (Figure 1). Throughout its history, the spring has been used as a watering stop for mule teams, the water supply for nearby mines, the source for a water bottling operation, and a tourist spa (Latschar 1981), so the area has been highly disturbed. The spring's discharge has been estimated at 23,000 liters/minute (Bedinger et al. 1989), and it supports approximately 7 hectares of wetlands vegetation (primarily reeds and bulrushes) and open water. At the southern end of the spring, water flows from a historic spring box to a source pool that is approximately 10 m in diameter (Figure 2). From the source pool, water flows north along a low-banked channel through the reeds to a series of artificial downstream ponds (Figure 3), the largest of which is approximately 60 m by 200 m. The spring supports endemic species or subspecies such as the Saratoga Springs pupfish (*Cyprinodon nevadensis nevadensis*) and the Saratoga Springs belostoman bug (*Belostoma saratogae*).

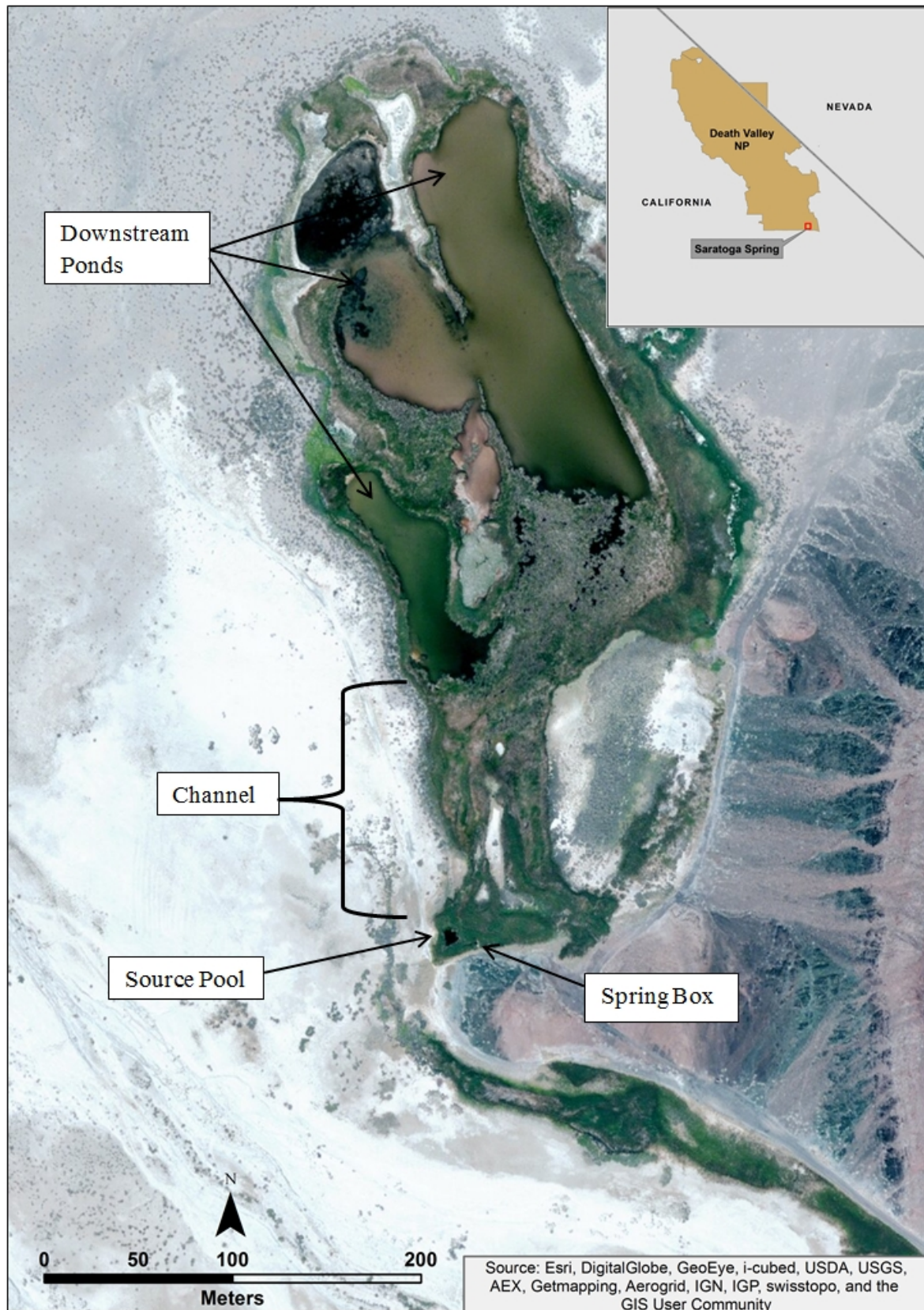


Figure 1. Aerial view of Saratoga Spring. Inset: Location of Saratoga Spring in DEVA.



Figure 2. The source pool at Saratoga Spring.



Figure 3. View of Saratoga Spring looking south over the downstream ponds.

Benthic Macroinvertebrate Sampling

Methods

BMI sampling occurred on March 22, 2012. Samples were collected in three habitats: the source pool, the channel, and the downstream ponds. In order to avoid the creation of new social trails, the crew was limited to the use of existing trails through the thick reeds. This limitation made quantitative sampling impossible, and biased the sample towards open areas that receive more sun. The methods used to collect each sample are described below.

Source Pool

The bottom of the source pool is soft-sediment, and has a high springsnail population density (Figure 4). A standard kicknet sample from a 30 cm x 30 cm area of the pool bottom would collect thousands of springsnails. Therefore, the BMI sample was collected from the reeds at the margins of the source pool (Figure 2). Five sample locations were chosen at equidistant points around the edge of the pool. At each location, the submerged parts of the reeds were jabbed five times with the kicknet. The material collected from the jabs was combined into a single sample for submission to a laboratory.



Figure 4. Underwater view of the source pool. The labeled features are examples of: A) Springsnails (the small black dots). B) Saratoga Springs pupfish. C. Red-rim melania (discussed later in text). D) A spring source, where the discharge of water keeps the sediment in constant motion, preventing the growth of algae.

Channel

The channel sample was collected along a 27 m reach of the channel that was accessible without trampling vegetation. Ten sample locations were chosen approximately 3 m apart. At each location, the substrate and emergent vegetation were jabbed six times with the kick net. The material collected at the 10 sample locations was combined into a single sample.

Downstream Ponds

The substrate of the downstream ponds consisted of anoxic mire. While invertebrates were observed during a snorkel survey of the ponds in 2009 (K. Wilson, NPS, Personal Communication), no visible epibenthic (bottom-dwelling) invertebrates were observed while wading in and near the pond at the time of sampling. Therefore, sampling was focused on the emergent vegetation on the ponds' margins. A total of eleven sample locations were chosen at roughly equidistant points along the pond banks that could be accessed safely. At each location, the submerged parts of the emergent vegetation were jabbed five times with the kicknet. The subsamples were combined into a single sample.

Results

The three samples collected from Saratoga Spring were preserved in alcohol and shipped to the Utah State University National Aquatic Monitoring Center (NAMC) for processing. There, the samples were sorted, identified to the lowest resolute taxon, and enumerated. Identifications were made by taxonomists certified by the Society for Freshwater Science using the taxonomic keys recommended by the Southwest Association of Freshwater Invertebrate Taxonomists (Richards and Rogers 2011). The NAMC's procedures can be reviewed on their website (www.usu.edu/buglab/SampleProcessing, accessed 16 April 2014). The results of the sample analyses are shown in Table 1.

The NAMC sent several of the springsnail specimens from the source pool sample to Dr. Robert Hershler of the Smithsonian Institution for identification to the species level. He identified three separate Hydrobiid species: *Pyrgulopsis amargosae* (Amargosa springsnail), *Tryonia variegata* (Amargosa tryonia), and a previously undescribed species of the genus *Pyrgulopsis*. A manuscript describing the *Pyrgulopsis* species is in preparation (R. Hershler, Smithsonian Institute, personal communication, 7/18/13).

Table 1. Benthic macroinvertebrates found in samples collected in Saratoga Springs, Death Valley National Park, California.

Phylum	Class	Order	Family	SubFamily	Genus	Species	Source Pool	Channel	Down-stream Pond
Annelida	Clitellata						0	1	0
Arthropoda	Arachnida	Trombidiformes					12	27	8
Arthropoda	Arachnida	Trombidiformes	Arrenuridae		Arrenurus		0	0	2
Arthropoda	Arachnida	Trombidiformes	Limnocharidae		Limnochares		8	0	0
Arthropoda	Insecta	Coleoptera	Curculionidae				1	1	0
Arthropoda	Insecta	Coleoptera	Dytiscidae	Dytiscinae	Cybister		0	2	0
Arthropoda	Insecta	Coleoptera	Dytiscidae	Hydroporinae	Liodessus	obscurellus	0	0	12
Arthropoda	Insecta	Coleoptera	Elmidae		Microcylloepus		11	0	0
Arthropoda	Insecta	Coleoptera	Hydraenidae		Ochthebius		0	0	1
Arthropoda	Insecta	Coleoptera	Hydrophilidae				0	1	3
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Hydrophilinae	Berosus		0	0	20
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Hydrophilinae	Tropisternus		1	0	1
Arthropoda	Insecta	Diptera	Ceratopogonidae				0	0	17
Arthropoda	Insecta	Diptera	Ceratopogonidae	Dasyheleinae	Dasyhelea		0	0	21
Arthropoda	Insecta	Diptera	Ceratopogonidae	Forcipomyiinae	Atrichopogon		1	0	0
Arthropoda	Insecta	Diptera	Chironomidae	Chironominae			2	0	0
Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	Apedilum		0	0	24
Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	Endotribelos		2	1	5
Arthropoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsus		0	0	4
Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae			0	1	0
Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae	Labrundinia		0	0	4
Arthropoda	Insecta	Diptera	Dolichopodidae				0	0	1
Arthropoda	Insecta	Diptera	Stratiomyidae				2	1	0
Arthropoda	Insecta	Diptera	Stratiomyidae		Stratiomys		0	0	11
Arthropoda	Insecta	Ephemeroptera	Baetidae		Callibaetis		8	1	17
Arthropoda	Insecta	Hemiptera	Belostomatidae	Belostomatinae	Belostoma		1	1	0
Arthropoda	Insecta	Hemiptera	Corixidae				0	1	0
Arthropoda	Insecta	Hemiptera	Naucoridae				4	0	0
Arthropoda	Insecta	Hemiptera	Naucoridae	Naucorinae	Pelocoris	shoshone	0	2	1
Arthropoda	Insecta	Odonata	Aeshnidae				0	0	1
Arthropoda	Insecta	Odonata	Coenagrionidae				1	4	95
Arthropoda	Insecta	Odonata	Coenagrionidae		Enallagma		0	0	9

Table 1. Benthic macroinvertebrates found in samples collected in Saratoga Springs, Death Valley National Park, California (continued).

Phylum	Class	Order	Family	SubFamily	Genus	Species	Source Pool	Channel	Down- stream Pond
Arthropoda	Insecta	Odonata	Coenagrionidae		Ischnura		1	0	0
Arthropoda	Insecta	Odonata	Libellulidae				0	0	1
Arthropoda	Insecta	Trichoptera	Limnephilidae		Limnephilus		0	0	1
Arthropoda	Malacostraca	Amphipoda	Hyalellidae		Hyalella		178	81	66
Chordata	Actinopterygii						0	3	1
Platyhelminthes	Turbellaria						5	0	0
Mollusca	Gastropoda	Neotaenioglossa	Assimineidae		Assimineia	infima	1	0	0
Mollusca	Gastropoda	Neotaenioglossa	Thiaridae		Melanoides	tuberculatus	0	7	0
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae				220	43	13
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae		Pyrgulopsis	(undescribed)	present	-	-
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae		Pyrgulopsis	amargosae	present	-	-
Mollusca	Gastropoda	Neotaenioglossa	Hydrobiidae		Tryonia	variegata	present	-	-

Benthic Macroinvertebrate Discussion

Different qualitative methods were used to collect each of the three samples, so quantitative comparison of the results inappropriate. The only taxa for which more than one specimen was found in all three samples were *Hyalella* (freshwater amphipods), *Trombidiformes* (water mites) and *Hydrobiidae* (springsnails). *Coenagrionidae* (damselflies) were found in large numbers in the downstream pond sample, but not in the other samples. Single specimens of *Belostomatinae* (likely the endemic Saratoga Springs belostomon bug) were found in the source pool and channel samples, but not the downstream pond sample. Other species found in the samples that are endemic to a small number of desert springs include *Assiminea infima* (Badwater snail), found in the source pool sample, and *Pelocoris shoshone* (likely the subspecies *Pelocoris shoshone amargosus*, the Amargosa naucorid), found in the channel and downstream pond samples. The undescribed springsnail species may also be endemic.

The only invasive species found in the samples was *Melanoides tuberculata* (red-rim melania, also known as the Malaysian trumpet snail). These snails were found in the channel sample (Figure 5), and were observed in large numbers in the central portion of the source pool (Figure 4), which was not sampled for BMI. Red-rim melania were introduced to the United States by aquarists in the early 20th century (Murray 1971) and have the potential to reach population densities of thousands of snails per square meter within a few years of introduction, displacing native species (Rader et al. 2003). Red-rim melania have been present in Saratoga Spring since at least 1985 (K. Wilson, Death Valley National Park, personal communication, 3/20/12), so it is unlikely its population density is increasing rapidly.



Figure 5. Red-rim melania found in Saratoga Spring.

Springsnail Monitoring

Methods

While springsnails were included in the benthic macroinvertebrate samples discussed above, MOJN also monitors the density and spatial extent of the springsnail population in Saratoga Spring. The springsnail monitoring method was tested during a visit to Saratoga Spring on March 16, 2012. The method was modified from the one outlined by Sada (2009), and was designed to monitor the extent and density of the springsnail (hydrobiid) population. To avoid creating new social trails, the crew accessed the spring from existing trails only. Therefore, we were unable to use a measuring tape to achieve the regular spacing of monitoring points proposed by Sada (2009). The monitoring method we used is briefly summarized below:

- The extent of the springsnail population was determined by observing the presence or absence of springsnails at accessible locations. (Figure 6). At each location, a sample of substrate was brushed into a sieve. The retained portion of the substrate was then spread across a white plastic tray and visually inspected for springsnails.
- Monitoring points were selected at accessible locations across the reach where springsnails were present. A measuring tape could not be used, so GPS coordinates were used to find locations approximately 10 m apart (Figure 6).
- At each monitoring point, a 10 cm by 10 cm quadrat was placed on the bottom, and the surface material and loose substrate were brushed into a sieve. The retained material from the sieve was transferred to a sorting tray, and approximately 1 cm of water was added. The number of springsnails in the tray was then counted. All springsnails were returned to the spring.



Figure 6. Springsnail monitoring locations along the channel. Springsnail population densities at each location are given in Table 2.

Results

Extent

Springsnails were observed in the source pool and in the channel from the source pool to the downstream pond, and no springsnails were detected in or around the spring box. However, the

furthest downstream extent of the springsnails in the channel could not be determined without trampling vegetation. Springsnails were found in the BMI samples collected from the downstream pond (Table 1), so it is likely that they are present over the entire length of the channel.

Population Density

Table 2 shows the observed springsnail population densities. The highest population densities were estimated for two reasons: it was difficult to count large numbers of springsnails in the field and the method used for sampling (brushing substrate through a sieve) was not feasible in the deep water of the source pond (Figure 2).

Springsnails were present at extremely high densities (~1,000 in each 10 cm by 10 cm quadrat, so on the order of 100,000 per square meter) in the source pool, and at lower densities in the channel. Station C was located along a social trail which received more sunlight than other portions of the channel, which may explain the high observed springsnail population density.

Table 2. Observed springsnail population densities.

Location	Comment	UTM Coordinates Zone 11N, NAD83		Snail Count in 0.01 m ² quadrat	Substrate
		Easting (m)	Northing (m)		
A	Source pool, estimated count	552249	3948774	~1000	Dense vegetation, Soft sediment
B		552264	3948790	35	Soft sediment
C	Estimated count	552266	3948801	~200	Silt
D		552258	3948839	24	Vegetative mat
E		552264	3948871	4	Vegetative mat
F		552263	3948876	50	Vegetative mat
G		552265	3948878	3	Soft sediment
H		552274	3948887	5	Soft sediment, organic matter
I		552274	3948887	6	Soft sediment
J	Impassable due to vegetation, ~15 m from pond	552274	3948890	3	Soft sediment
K	Spring box	0552267	3948769	0	Gravel, sand

Springsnail Monitoring Discussion

The method for determining the extent of springsnail population was not successful at Saratoga Spring because access to the full spatial extent of the spring was restricted to avoid creating new social trails. Springsnails were found in the BMI samples collected the downstream pond (Table 1), so it is likely that they are present over the entire length of the channel. It is also possible that springsnails are not confined to the source pool, channel, and pond, and that they are present throughout the entire wetlands area at low densities. Any method used to monitor the full spatial extent of springsnails at Saratoga Spring must examine locations across the entire spring.

The springsnail population density data show that the springsnails population is extremely dense in the source pool, with density decreasing along the channel. These data are likely biased by

monitoring only accessible locations, which receive more sunlight than the inaccessible locations. The estimated data make quantitative analyses of changes in population density difficult. Methods need to be developed to quantify high density springsnail populations and to monitor springsnails in water depths greater than 1 m. Notably, the method is only able to enumerate the presence of springsnails and cannot distinguish among the three species present. Thus, the method will not be able to determine whether the distribution or density of individual springsnail species changes through time. Nonetheless, the method and these data do provide information that would indicate a strong shift in distribution within the sampled habitats, if for instance, springsnails were extirpated from one or more of the sampling areas.

Literature Cited

- Bedinger, M. S., W. H. Langer, and I. E. Reed. 1989. Ground-water hydrology. Pages 28-35 in M. S. Bedinger, K. A. Sargent, and W. H. Langer, eds. Studies of geology and hydrology in the Basin and Range Province, Southwestern United States, for isolation of high-level radioactive waste—characterization of the Death Valley region, Nevada and California. U.S. Geological Survey Professional Paper 1370-F.
- Latschar, J. A. 1981. Death Valley National Monument historic resource study: A history of mining. Volume II. Section IV D 4: The Saratoga Springs Region. Available from http://www.nps.gov/history/history/online_books/deva/index.htm (accessed 9 August 2010).
- Murray, H. D. 1971. The introduction and spread of thiarids in the United States. *The Biologist* 53:133-135.
- Rader, R. B., M. C. Belk, and M. J. Keleher. 2003. The introduction of an invasive snail (*Melanoides tuberculata*) to spring ecosystems of the Bonneville Basin, Utah. *Journal of Freshwater Ecology* 18: 647–657.
- Richards, A. B., and D. C. Rogers. 2011. Southwest Association of Freshwater Invertebrate Taxonomists List of Freshwater Macroinvertebrate Taxa from California and Adjacent States including Standard Taxonomic Effort Levels. Unpublished report. Available from http://www.safit.org/Docs/STE_1_March_2011_7MB.pdf (accessed 17 April 2014).
- Sada, D. W. 2009. A guide to springsnail (family Hyrobiidae) identification and monitoring. Unpublished report. Desert Research Institute, Reno, Nevada.