National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Springs Vegetation Monitoring for Yucca House National Monument

2019 Data Report

Natural Resource Data Series NPS/SCPN/NRDS—2020/1280

ON THE COVER
Photograph of view of Historic Cabin from Aztec Spring in Yucca House National Monument.
Photo by NPS

Springs Vegetation Monitoring for Yucca House National Monument

2019 Data Report

Natural Resource Data Series NPS/SCPN/NRDS—2020/1280

Megan C. Swan

National Park Service
Southern Colorado Plateau Network Inventory & Monitoring Program
2255 N Gemini Dr
Flagstaff, AZ 86001

Edited by Jean Palumbo
Southern Colorado Plateau Network Inventory & Monitoring Program
2255 N Gemini Dr
Flagstaff, AZ 86001

June 2020

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of those protocols.

This report is available in digital format from Southern Colorado Plateau I&M Network website, and the Natural Resource Publications Management website. If you have difficulty accessing information in this publication, particularly if using assistive technology, please email irma@nps.gov.

Please cite this publication as:

Swan, M. C. 2020. Springs vegetation monitoring for Yucca House National Monument: 2019 data report. Natural Resource Data Series NPS/SCPN/NRDS—2020/1280. National Park Service, Fort Collins, Colorado.

NPS 318/170574, June 2020

Contents

Figures

Page

Tables

Page

Abstract

In 2019, the Southern Colorado Plateau Inventory and Monitoring Network sampled vegetation at Aztec Spring in Yucca House National Monument in southwestern Colorado. The spring site consists of 3 distinct low-gradient regions where water can spread out and potentially pool. The spring head is the area including and directly below the spring orifice; a second distinct area, the upper runout, is located between the spring orifice and a groundwater well; and the furthest from the spring orifice, the lower runout, is where a groundwater well is located. Due to a lack of saturated soils and sensitive vegetation, and disjoint spring-influenced regions, SCPN staff determined that point intercept methods could be used to sample springs vegetation at this site.

We established eight transects approximately perpendicular to the prevailing slope in the three regions of the spring. Within each region, transects were oriented parallel to one another and approximately centered over the area delineated by the riparian vegetation and topography. We installed 2 or 3 transects in each region depending on the length of the region. Due to the culturally sensitive nature of the site, the endpoints of the transects were not permanently monumented, but their locations were recorded with GPS and described so they could be approximately relocated during future visits. In addition, we conducted a vascular plant inventory during which we identified and recorded all plant species that occurred within the spring area.

Vegetation consisted mostly of upland species, with few wetland specialists. Over half the species identified were nonnative, including several that are considered noxious weeds in Montezuma County. We identified 42 plant species during the inventory. Overall vegetation cover was highest in the upper runout region. *Juncus balticus* was dominant in this region of the spring and is one of only two native, facultative wetland species encountered during point intercept sampling. Future plans include resampling springs vegetation at Yucca House NM at 3 to 5-year intervals.

Acknowledgements

Thanks to Tova Spector for facilitating our work in the park and to Andrew Spear and Isabel Ashton for collecting data in the field. Thanks also to Lee McCoy, Jodi Norris and Andrew Spear for helpful reviews of draft versions of this report.

Introduction

The Southern Colorado Plateau Inventory and Monitoring Network (SCPN) monitors the condition of select natural resources, or 'vital signs', to support science-based management of network parks. Spring ecosystems were identified as a vital sign in the 2006 monitoring plan (Thomas et al. 2006). The *Springs Monitoring Protocol Implementation Plan (PIP) for Park Units in the Southern Colorado Plateau Network* was published in 2018 (Perkins et al. 2018). The PIP identifies three associated vital signs for spring ecosystems: water quality, water quantity, and spring vegetation. This report presents results of the first iteration of spring vegetation monitoring at Aztec Spring in Yucca House National Monument (YUHO) which occurred on August 21, 2019.

Yucca House National Monument was established in 1919 to preserve a large, unexcavated ancestral Puebloan site. It is located on the eastern slope of Sleeping Ute Mountain in the Montezuma Valley south of Cortez, Colorado. Originally four ha, the monument was expanded to 14 ha in 1990. This small monument is surrounded by privately-owned ranchland. Elevation ranges between 1788 and 1807 m (5,798–5,922 ft) (Thornberry-Ehrlich 2013). YUHO is recognized as one of the northernmost Chacoan outlier sites and consists of two major archeological complexes that remain unexcavated. The main pueblo was at least three stories tall (YUHO 1987). Central to the unexcavated main pueblo site is a spring first documented in 1878.

Due to its location, Aztec Spring (also called Yucca House Spring) is important to the cultural interpretation of the site. Yucca House's 1999 Resource Management Plan stressed the importance this spring to the natural resources of the monument, as well (YUHO 1999). In the southwest, springs are vitally important sources of water in the otherwise arid environment. The presence of a spring increases diversity, in both plants and wildlife (Stevens and Meretsky 2008).

The recharge area for Aztec Spring occurs upgradient from the monument in the foothills of Sleeping Ute Mountain (Wright 2006). Recent flows would not be able to support a community of the size that once existed on the site, so it is likely spring flow has changed considerably over time (Wright 2006). However, changes to the spring have not been well documented. The most recent published discharge measurements (in 2006) ranged from 0.001 to 0.002 ft^3.sec (Wright 2006). An SCPN inventory visit in July 2005 recorded the presence of surface water, but no visible flow (Springer et al. 2006). The existence of a spring pipe below the spring was noted in 2019. A pipe is referenced in historical documents but was not known to the park until this recent discovery.

Aztec Spring has been trending towards drier conditions since the 2000's (Thornberry-Ehrlich 2013). Although the spring is located down gradient from irrigation sources, it is unclear whether irrigation, increasingly arid conditions, or both, are affecting spring flow. While historic information is limited, descriptions of the spring often include associated wetland, marshes or low gradient cienegas below the spring orifice (e.g., YUHO 1987, Springer et. al 2006, Thornberry-Ehrlich 2013). During our visit in August 2019, all the areas below the spring were dry with no standing water or saturated soils, except a small area directly surrounding the old spring pipe located several meters downslope from the spring orifice. There was no discernable flow.

Methods

The SCPN Springs Protocol Implementation Plan (PIP) (Perkins et al. 2018) sets out general methods to be used for sampling springs vegetation. However, springs in SCPN parks are extremely variable in spring type, setting, and size, as well as the parameters of the vegetation communities. To address this variability, SCPN is developing site-specific standard operating procedures (SOPs) for springs that do not fit neatly into the methods described in the PIP. For Aztec Spring, a summary of the methods used to monitor springs vegetation is described here. We will also develop a separate standard operating procedure for monitoring vegetation at this spring which will also be published.

Due to a lack of saturated soils or sensitive vegetation and three discontinuous spring-influenced regions, SCPN staff determined that Aztec Spring was a good candidate for point intercept vegetation monitoring. The spring site consists of three distinct regions. The spring head is the area including and directly below the spring orifice. The second distinct region, the upper runout, is located between the spring orifice and the groundwater well. The third region, the lower runout, is the furthest from the spring orifice and is where the groundwater monitoring well is located (Figure 1).

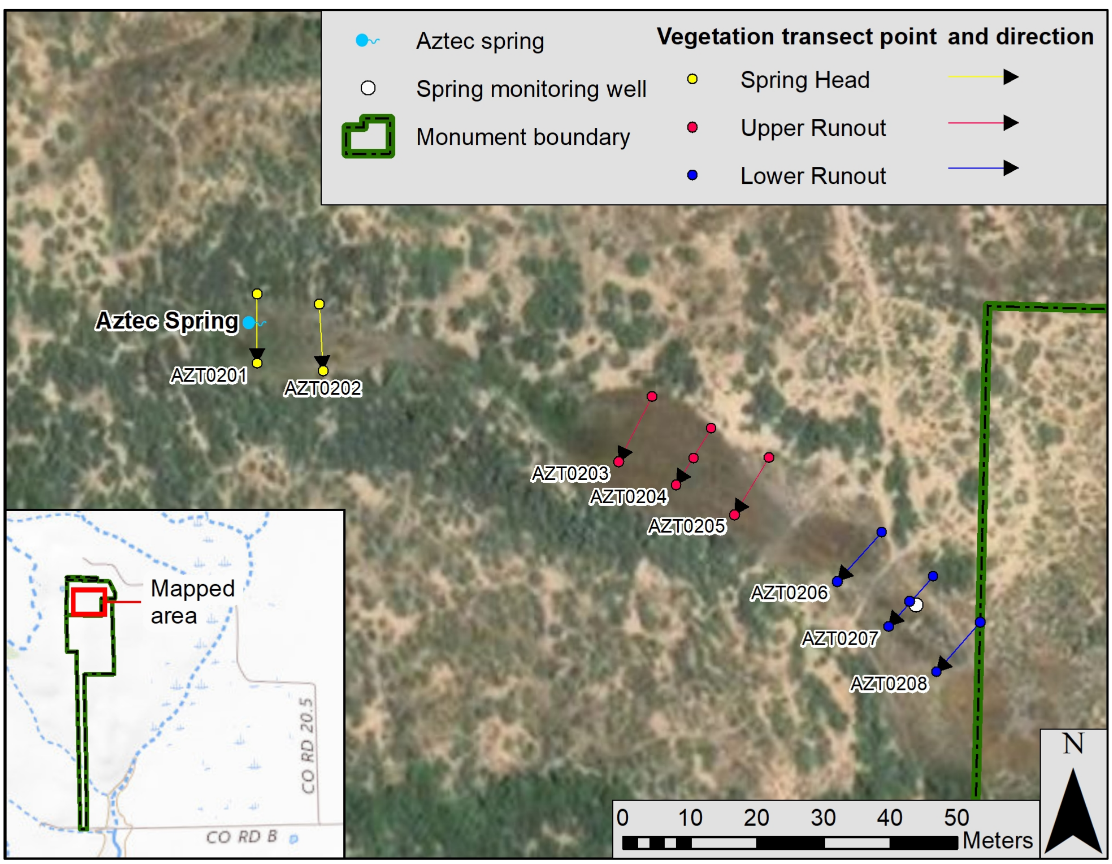

Figure 1. Map of Aztec Spring in Yucca House NM showing the location of the eight 10 m transects used for spring vegetation monitoring. Direction indicates the orientation of the transect, from 0 end to 10 m end.

We established transects in each of the three regions of the spring to sample vegetation. Within each region, a set of 10 m transects were oriented parallel to one another, perpendicular to the prevailing slope, and approximately centered over the area delineated by the riparian vegetation and topography (Figure 1). The zero end of each tape was located on the north side of the site. None of the transects extended beyond the spring area as delineated by topography and vegetation. Due to the culturally sensitive nature of the site, the endpoints of the transects were not permanently monumented, but their locations were recorded with GPS and described so they could be approximately relocated during future visits. The transects were located in the following manner:

> *Spring head. 2 transects. Transect azimuth 235°.* Transect #1 and #2 were in the uppermost area of the spring, the spring head. Transect #1 was located just below the spring orifice and transect #2 was located 10 m downslope of transect #1.
>
> *Upper runout. 3 transects. Transect azimuth 199°.* We placed 3 transects within the upper runout area. Transect 4 was located near the center of the upper runout area. Transect #3 was located 10 m upslope of transect #4 and transect #5 was located 10 m downslope.
>
> *Lower runout. 3 transects. Transect azimuth 200°.* We placed another set of 3 transects within the lower runout region. Transect #7 was centered over the groundwater monitoring well. Transect #8 was located approximately 10 m downslope of the monitoring well. Transect #6 was located 10 m upslope of the well.

We used a pin flag as the point intercept pole for sampling. The recorder stood on the downhill side of the tape and took measurements on the uphill side of the tape starting at 0.3 m on the tape and every 0.5 m after (e.g. 0.3 m, 0.8 m, 1.3 m) for a total of 20 points total along each transect. All plant species that intersected the pole were recorded in the order that they intercepted the pole from highest to lowest. Substrate was recorded in one of three categories where the pin met the soil surface: litter, embedded rock or bare soil. Immediately following the point intercept sampling, we performed a species inventory of the entire springs site, identifying and recording every species we encountered.

We calculated percent cover for substrate, total vegetation, and vegetation by species for each transect, then took the average of the transect values for each spring region. We assigned nativity, duration and wetland status (Table 1) for each species using the USDA Plants database (https://plants.sc.egov.usda.gov/java/ accessed 4/3/2020). Some species did not have a wetland status, and we did not apply one. Data were summarized and figures were created using R and ggplot (R Core Team 2019, Wickham 2016).

Table 1. Wetland indicator codes derived from USDAPlants (https://plants.sc.egov.usda.gov/wetinfo.html accessed 3/31/20).

Indicator Code	Indicator Status	Designation	Comment
OBL	Obligate Wetland	Hydrophyte	Almost always occur in wetlands
FACW	Facultative Wetland	Hydrophyte	Usually occur in wetlands, but may occur in non-wetlands
FAC	Facultative	Hydrophyte	Occur in wetlands and non-wetlands
FACU	Facultative Upland	Nonhydrophyte	Usually occur in non-wetlands, but may occur in wetlands
UPL	Obligate Upland	Nonhydrophyte	Almost never occur in wetlands

Results and Discussion

According to precipitation records from Cortez, CO, 2019 was wetter than the long-term average and wetter than the previous three years. Most of the precipitation fell in the winter and spring, however, and monthly total precipitation for June-Sept were well below average (Figure 2). Maximum and minimum temperatures were close to normal, or above normal in the two months preceding sampling (Figure 2).

Figure 2. A. Monthly precipitation (cm) recorded at the Cortez, CO weather station (COOP ID #51886) for the water year Oct 2018–Sep 2019. Black dots show long-term average monthly precipitation (1911–2016). B. Monthly maximum temperature and minimum temperature deviation from long term average (1911–2016) recorded at the Cortez, CO weather station (COOP ID #51886) (https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?co1886, accessed 04/27/2020).

During point intercept sampling, we recorded 16 species. Only three of these species are classified as facultative wetland (adapted to living in saturated conditions). Total vegetative cover was highest (85%) in the upper runout region (Table 2). The spring head and lower runout had lower amounts of vegetative cover. Litter was the most frequent substrate sampled in all three spring regions and bare ground had the greatest cover in the lower runout (Table 2).

Table 2. Mean substrate and total vegetative percent cover in the three spring regions at Aztec Spring, in Yucca House NM.

Category	Type	Spring Head	Upper Runout	Lower Runout
Vegetation	Total Vegetation	55	85	51.67
Surface	Litter	82.50	98.33	65
	Bare Ground	15	1.67	35
	Rock	2.50	0	0

The spring head region had the highest richness (number of species) identified during point intercept sampling (9), including all three invasive thistle species. All three regions of the spring supported a mix of facultative wetland, facultative, and upland species, however, the upper runout was the only region dominated by the facultative wetland species, *Juncus balticus* (Figure 3). Park staff regularly use herbicide to treat nonnative species near the spring. In 2019, treatments were applied in May (Andrew Spear, personal communication).

Figure 3. Mean percent cover by species based on point intercept sampling for each region of the Aztec Spring site. Species names followed by * indicate nonnative species. Note: Although *Phalaris arundinacea* has a native status based on USDAPlants, it is considered invasive and weedy by many sources.

During the vascular plant inventory, we identified 42 species, including three unknowns (all unknowns were vegetative graminoids). No rare species were identified. Excluding unknowns, just over half of the species identified at Aztec Spring were nonnative (53.8%, 21 species). Half of the nonnative species are perennial, and half biennial or annual species. Eight are on the noxious species list for Montezuma County. Four (*Cirsium vulgare*, *Cirsium arvense*, *Acroptilon repens*, and *Carduus nutans*) are classified as Class B noxious weeds in Montezuma County (https://montezumacounty.org/web/departments/weeds/ accessed 3/21/2020). Another four are Class C (*Erodium cicutarium*, *Cichorium intybus*, *Convolvulus arvense, Bromus tectorum*). See Appendix A for a full list of species recorded during the inventory.

Next Steps

This Data Report provides a summary of vegetation data collected during the 2019 monitoring visit to Yucca House National Monument. Spring vegetation monitoring will be conducted at 3 to 5-year intervals. All data included in this report are available upon request from the Southern Colorado Plateau Network.

Literature Cited

Perkins, D. W., R. Wissinger, M. Moran, S. Monroe, H. Thomas, L. McCoy, and E. Soles. 2018. Springs Monitoring Protocol Implementation Plan for park units in the Southern Colorado Plateau Network. Natural Resource Report NPS/SCPN/NRR—2018/1771. National Park Service, Fort Collins, Colorado.

R Core Team 2019. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Springer A. E., L. Stevens and R. Harms. 2006. Inventory and classification of selected National Park Service springs on the Colorado Plateau. NPS Cooperative Agreement Number CA 1200-99-009; Task # NAU-118. Northern Arizona University. Flagstaff, Arizona.

Stevens L. E. and V. J. Meretsky. 2008. Springs ecosystem ecology and conservation. In Lawrence E. Stevens and Vicky J. Meretsky, editors. Aridland Springs in North America: Ecology and Conservation. University of Arizona Press, Tucson, Arizona.

Thomas L. P., M. N. Hendrie (editor), C. L. Lauver, S. A. Monroe, N. J. Tancreto, S. L. Garman, and M. E. Miller. 2006. Vital signs monitoring plan for the Southern Colorado Plateau Network. Natural Resource Report. NPS/SCPN/NRR—2006/002. National Park Service. Fort Collins, Colorado.

Thornberry-Ehrlich, T. L. 2013. Yucca House National Monument: geologic resources inventory report. Natural Resource Report NPS/NRSS/GRD/NRR—2013/705. National Park Service, Fort Collins, Colorado.

Wickham, H. 2016. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York. ISBN 978-3-319-24277-4. https://ggplot2.tidyverse.org.

Wright, W. G. 2006. Hydrology and geochemistry of Yucca House National Monument and surrounding area, Southwestern Colorado. Southwest Hydro-Logic Hydrological Investigations Report 2006-1.

Yucca House National Monument. 1987. Statement for Management. Mesa Verde National Park, Colorado.

Yucca House National Monument. 1999. Resource Management Plan for Yucca House National Monument. 1999. Mesa Verde National Park, Colorado.

Appendix A.

Table A1. List of all species identified during springs vegetation monitoring at Yucca House National Monument in August 2019.

Family	**Species**	**Common name**	**Lifeform**	**Duration**	**Nativity**	**Wetland Status**
Amaranthaceae	*Chenopodium spp.*	goosefoot	forb	annual	native	Not available
Amaranthaceae	*Kochia scoparia*	burningbush	forb	annual	nonnative	Not available
Amaranthaceae	*Salsola tragus*	prickly Russian thistle	forb	annual	nonnative	FACU
Apocynaceae	*Asclepias subverticillata*	horsetail milkweed	forb	perennial	native	FACU
Asteraceae	*Acroptilon repens*	hardheads	forb	perennial	nonnative	Not available
Asteraceae	*Carduus nutans*	nodding plumeless thistle	forb	biennial	nonnative	FACU
Asteraceae	*Chichorium intybus*	chicory	forb	perennial	nonnative	FACU
Asteraceae	*Cirsium arvense*	Canada thistle	forb	perennial	nonnative	FACU
Asteraceae	*Cirsium vulgare*	bull thistle	forb	biennial	nonnative	FACU
Asteraceae	*Conyza canadensis*	Canadian horseweed	forb	annual	native	Not available
Asteraceae	*Ericameria nauseosa*	rubber rabbitbrush	shrub	perennial	native	Not available
Asteraceae	*Helianthus annuus*	common sunflower	forb	annual	native	FACU
Asteraceae	*Lactuca serriola*	prickly lettuce	forb	annual	nonnative	FACU
Asteraceae	*Sonchus asper*	spiny sowthistle	forb	annual	nonnative	FAC
Asteraceae	*Symphyotrichum falcatum*	white prairie aster	forb	perennial	native	FACU
Brassicaceae	*Alyssum alyssoides*	pale madwort	forb	biennial	nonnative	Not available
Brassicaceae	*Camelina microcarpa*	littlepod false flax	forb	annual	nonnative	FACU
Brassicaceae	*Descurainia pinnata*	western tansymustard	forb	perennial	nonnative	Not available
Brassicaceae	*Sisymbrium altissimum*	tall tumblemustard	forb	annual	nonnative	FACU
Convolvulaceae	*Convolvulus arvensis*	field bindweed	forb	perennial	nonnative	Not available
Cyperaceae	*Carex spp.*	sedge	graminoid	annual	native	Not available
Fabaceae	*Melilotus officinalis*	sweetclover	forb	perennial	nonnative	FACU
Geraniaceae	*Erodium cicutarium*	redstem stork's bill	forb	annual	nonnative	Not available

Juncaceae	*Juncus balticus*	Baltic rush	graminoid	perennial	native	FACW
Juncaceae	*Juncus saximontanus*	Torrey's rush	graminoid	perennial	native	FACW
Liliaceae	*Asparagus officinalis*	asparagus	forb	perennial	nonnative	FACU
Poaceae	*Achnatherum hymenoides*	Indian ricegrass	graminoid	perennial	native	UPL
Poaceae	*Bromus tectorum*	cheatgrass	graminoid	annual	nonnative	Not available
Poaceae	*Elymus elymoides*	squirreltail	graminoid	perennial	native	FACU
Poaceae	*Hordeum jubatum*	foxtail barley	graminoid	perennial	native	FAC
Poaceae	*Leymus triticoides*	beardless wildrye	graminoid	perennial	native	FAC
Poaceae	*Muhlenbergia asperifolia*	scratchgrass	graminoid	perennial	native	FACW
Poaceae	*Pascopyrum smithii*	western wheatgrass	graminoid	perennial	native	FAC
Poaceae	*Phalaris arundinacea*	reed canarygrass	graminoid	perennial	native	FACW
Poaceae	*Poa pratensis*	Kentucky bluegrass	graminoid	perennial	nonnative	FAC
Poaceae	*Schedonorus pratensis*	meadow fescue	graminoid	perennial	nonnative	FACU
Poaceae	*Sporobolus airoides*	alkali sacaton	graminoid	perennial	native	FAC
Polygonaceae	*Rumex crispus*	curly dock	forb	perennial	nonnative	FAC
Sarcobataceae	*Sarcobatus vermiculatus*	greasewood	shrub	perennial	native	FAC

NPS 318/170574, June 2020

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

EXPERIENCE YOUR AMERICA ™