

Spring, Seep and Hanging Garden Monitoring Protocol Implementation Plan for Park Units in the Southern Colorado Plateau Network Standard Operating Procedure (SOP) #7

Associated Measures at Hanging Gardens: Endemic Plant Census

Version SCPN_Springs_SOP7_20180930

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

This SOP is adopted from the Northern Colorado Plateau Network’s SOP #7 Associated Measures at Hanging Gardens: Endemic Plant Census, Version 1.00 (June 2016) in Weissinger, R., M. Moran, S. Monroe, and H. Thomas. 2017. Springs and seeps monitoring protocol for park units in the Northern Colorado Plateau Network, Version 1.00. Natural Resource Report NPS/NCPN/NRR—2017/1439. National Park Service, Fort Collins, Colorado.

This SOP includes instructions for monitoring endemic plant populations at hanging gardens. These measures should be taken during site establishment and during each revisit. When staff turnover results in a new observer, the new observer and another experienced vegetation monitoring observer should conduct independent counts at each site for one sample season to adjust discrepancies between long-time observer counts.

Endemic plant census

Using the site map and reference photographs, identify the backwall, alcove floor and spring-associated colluvial slope of the hanging garden, if present. Not all hanging gardens have all three features.

Search these three surfaces for 1 minute per 5-m² of vegetated area, or a maximum of two hours total at larger sites, for the endemic plant species listed below. In accessible portions of the hanging garden, it is helpful to delineate portions of the search area using one or more folding rulers so that individuals are not counted more than once. Count up to 500 individuals for each species per geomorphic surface. For larger populations, estimate the **count** of each species in the *accessible portions only* of each surface using the following count classes (Table 1).

Estimate the percent of each surface that is inaccessible. Delineate inaccessible portions on the site map and on the site overview photo. Inaccessible areas are primarily determined by steep colluvial slopes where traversing the slope would cause soil movement and root displacement.

Table 1. Count classes for endemic species at hanging gardens.

Count Code	Definition
N	Species not seen and presumed absent.
1-500	Number of individuals counted
A	501-1000 individuals
B	1001-10,000 individuals

C	> 10,000 individuals
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Table 2 lists the following target species list that has been developed for Glen Canyon National Recreation Area (GLCA).

Table 2. Endemic species and their presence in GLCA and species monitored at Southeast Utah Group Parks (SEUG). P = Present in Park, U = Unconfirmed but suspected to occur in park, SJ = present in San Juan County.

Family	Species	Counting Unit	Note	Waterpocket Fold	Wilson Mesa	GLCA elsewhere	Spring Restricted	Monitored at SEUG?
Asteraceae	<i>Cirsium rydbergii</i>	Rosette		P	P		Yes	Yes
Asteraceae	<i>Erigeron kachinensis</i>	Rosette	Rhizomatous			P	Yes	Yes
Asteraceae	<i>Perityle specuicola</i>	Individual				P	No	No
Asteraceae	<i>Symphyotrichum welshii</i>	Rosette	Rhizomatous	P			No	No
Betulaceae	<i>Ostrya knowltonii</i>	Individual		P			No	No
Cyperaceae	<i>Carex curatorum</i>	Individual		P	P		Yes	No
Cyperaceae	<i>Carex specuicola</i>	Individual				P	Yes	No
Liliaceae	<i>Anticlea elegans</i> ssp. <i>vaginatus</i>	Individual	<i>Zigadenus vaginatus</i>	P	P		Yes	Yes
Orchidaceae	<i>Platanthera zothecina</i>	Individual	<i>Habenaria zothecina</i>	P	P		No	Yes
Phrymaceae	<i>Mimulus eastwoodiae</i>	Shoot	Rhizomatous Stoloniferous	P	P		Yes	Yes
Primulaceae	<i>Dodecatheon pulchellum</i> var. <i>zionense</i>	Rosette	Rhizomatous			P	No	No
Primulaceae	<i>Primula specuicola</i>	Rosette	Rhizomatous	P	P		Yes	Yes
Ranunculaceae	<i>Aquilegia micrantha</i>	Individual		P	P		Yes	Yes
Rhamnaceae	<i>Frangula obovata</i>	Individual		P	P		No	No

Species descriptions

Asteraceae – *Cirsium rydbergii* (Rydberg's thistle)

The large basal rosette, up to 100 cm across, and large leaves, up to 10 cm wide, distinguish this thistle at maturity from all other Utah thistles (Fig. 1). The leaves are green on both sides. Flowers are small and pink. Seedlings can be identified relatively early on (at about 3 cm across) by their light green color and shallowly lobed leaves. Do not count smaller seedlings that cannot be positively identified.



Figure 1. *Cirsium rydbergii* in flower.

Asteraceae – *Erigeron kachinensis* (Kachina daisy)

Sub-stoloniferous dwarf daisy with spatulate leaves, usually growing low to the ground or backwall (Fig. 2).



Figure 2. *Erigeron kachinensis* in flower.

Asteraceae – *Perityle specuicola* (alcove rock daisy)

Present in desert shrub and hanging garden communities. Plant is 50-75 cm in size, with hispidulous herbage and a pappus with 3 (4) unequal bristles (Figure 3).



Figure 3. *Perityle specuicola* in flower.

Asteraceae – Symphyotrichum welshii (Welsh's aster)

Perennials, 30-100 cm colonial; rhizomes shallow and long, often relatively thick (those of the season each producing a distal rosette near the parent plant) (Figure 4). Stems 1-2, ascending to erect (sometimes lax, sometimes reddish), glabrous or sparsely strigoso-villosulous distally (arrays). Leaves (adaxially green, abaxially pale green, sometimes glaucous) thin (proximal) to stiff (distal), margins serrulate (proximal) or entire or nearly so, $\pm$ revolute, scabrous, apices mucronulate or sometimes callous-pointed, faces glabrous; basal withering by flowering, petiolate (petioles narrowly winged, sheathing), blades oblanceolate to spatulate, $10-40+ \times 4-9+$ mm, bases attenuate, margins entire, apices obtuse; proximal cauline withering by flowering, sessile or winged-petiolate, blades lanceolate to oblanceolate, $50-150 \times 8-11$ mm, bases slightly clasping, margins sparsely serrulate, apices acute; distal sessile, blades linear to linear-lanceolate, $50-130 \times 4-6$ mm, gradually reduced distally, bases $\pm$ clasping, apices acute. Heads in open, slender, leafy, paniculiform or racemiform arrays, branches ascending. Peduncles 0.5-2 cm, scabro-villosulous, bracts linear, scabro-ciliolate. Involucres cylindro-campanulate, 4-7 mm. Phyllaries in 3-4 series, lanceolate (outer) to linear (inner), $\pm$ unequal, bases indurate, margins hyaline, erose, distally scabro-ciliolate to ciliolate, green zones $\pm$ foliaceous (outer) or lanceolate, apices acute to acuminate, sometimes purplish, faces glabrous. Ray florets 18-25; corollas pink to white, laminae $9-12 \times 0.8-1.5$ mm. Disc florets 23-60; corollas pale yellow, 3.8-6.4 mm, tubes shorter than funnelform throats, lobes narrowly triangular, 0.4-0.8 mm. Cypselae pinkish tan (nerves stramineous), obovoid, $\pm$ compressed, 0.8-1.6 mm, 3-5-nerved, faces sparsely strigillose; pappi white, 2.8-5.3 mm. $2n = 16$. Flowering Aug-Oct. Wet soils in dry areas, hanging gardens, seeps, wet ledges, stream banks.



Figure 4. *Symphyotrichum welshii* in flower.

Betulaceae – *Ostrya knowltonii* (Knowlton's hophornbeam)

Trees , to 9 m; crowns open, narrowly rounded (Figure 5). Bark brownish gray, broken into narrow vertical scales or rather ragged strips. Twigs sparsely to moderately pubescent, often with stipitate glands. Leaves: petiole covered with stipitate glands. Leaf blade ovate or broadly ovate-elliptic to broadly elliptic or nearly orbiculate, 2.5--6.5 × 1.5--5 cm, base narrowly rounded to cordate or cuneate, margins sharply and unevenly doubly serrate, apex acute; surfaces abaxially pubescent, especially on veins. Inflorescences: staminate catkins 2--3 cm; pistillate catkins 0.6--1 cm. Infructescences 2.5--4 × 1.8--2.5 cm; bracts 1--1.8 × 0.5--1 cm.

Flowering late spring. Streamsides and rocky slopes in moist canyons. *Ostrya knowltonii* occurs sporadically throughout the arid Southwest.



Figure 5. *Ostrya knowltonii*

Cyperaceae – *Carex curatorum* (Kaibab sedge)

Plants cespitose; rhizomes rarely conspicuous (Figure 6). Culms erect, (23–) 35–91 cm. Leaves: sheaths and bases from previous year's leaves absent; ligules acute; blades sparsely pilose adaxially, especially along median adaxial groove and veins. Inflorescences unispicate (occasionally with 1–2 short lateral spikes of same sex), erect, ellipsoid; primary inflorescence bracts leaflike, as long as or longer than inflorescences. Scales red-brown, oblong-lanceolate, to 3.5×1.9 mm, shorter than or equaling perigynia, margins hyaline, broad, central midrib extending to scale apex, apex acute. Perigynia tawny to red-brown, obovate to ovate, $2-3(-4) \times 1.5-1.8$ mm, often wider than subtending scale, apex tapering or rounded, distal $3/4$ hirsute; beak to 0.5 mm, orifice adaxially oblique; rachilla often present. Achenes $1.2-2 \times 0.8-1.2$ mm, loosely enveloped by perigynia, occupying $1/3-2/3$ width and $1/3-3/4$ length of perigynia. $2n = 62$.

Fruiting May–Jul. Riparian or hanging garden communities.



Figure 6. *Carex curatorum*

Cyperaceae – *Carex specuicola* (Navajo sedge)

Navajo sedge is a perennial, grass-like sedge (Figure 7). The plants form bunches from 25 to 45 cm (10 to 18 in) tall with long, slender, pale green leaves, 1 to 2 mm (0.04 to 0.08 in) wide and 12 to 20 cm (5 to 8 in) long. The stems are triangular in cross section, and end in 2 to 4 floral spikes. The terminal spike contains both male and female flowers, with the female flowers situated above the male. The fruit is an achene borne within a perigynium (a sack-like appendage). This species is

unusual in that it has two types of female flowers, those with two-branched styles and lenticular (lens shaped) achenes, and those with three-branched styles and triangular achenes (USDI-FWS, 1987).

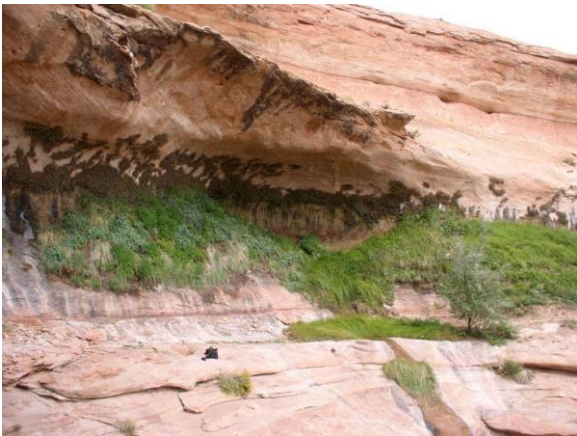


Figure 7. *Carex specuicola* Photo by Daniela Roth, Navajo National Heritage Project

Lilaceae – *Anticlea elegans* ssp. *vaginatus* aka *Zigadenus vaginatus* (Alcove death camas)

Distinctive, narrow monocot leaf from 8-30 cm long. White flowers are borne in panicles on a single flowering stalk (Fig. 8). Individuals can be difficult to distinguish vegetatively from a distance. When in flower, flowering stalks can be counted.



Figure 8. *Zigadenus vaginatus* in flower.

Orchidaceae – *Platanthera zothecina* aka *Habenaria zothecina* (Alcove bog-orchid)

Stem is leafy below, with rounded basal and cauline leaves. Flowers are green with a long spur (Fig. 9). This species can be confused with another orchid, *Epipactis gigantea*, when young and only two leaves are present. *Epipactis* leaves are pointed at the tip and strongly clasp the stem. *Epipactis* stems often have a purple tinge.



Figure 9. *Habenaria zothecina* in flower.

Phrymaceae – *Mimulus eastwoodiae* (Scarlet monkey-flower)
Scrophulariaceae – *Mimulus eastwoodiae*

This species is the only monkey-flower common in hanging gardens of southeastern Utah (Figure 10). Generally a backwall specialist, the bright red flowers bloom in late summer and fall. Leafy stolons are easily recognizable when flowers are not present.



Figure 10. *Mimulus eastwoodiae* in flower.

Primulaceae – *Dodecatheon pulchellum* var. *zionense* (Zion shooting star)

Mostly glabrous (Figure 11). Leaves (8-)10-48 × 1.5-8.5 cm; blade elliptic to spatulate or nearly oval. Pedicels minutely glandular-puberulent. Flowers: calyx minutely glandular-puberulent; corolla tube yellow with maroon, thin, wavy ring, lobes magenta, 8-16(-20) mm; filament tube yellow basally, maroon distally, rarely wholly yellow or maroon, 1-3 mm; anthers 4.5-7 mm; pollen sacs usually dark maroon to black at least distally, connective usually maroon to black, rarely yellow.

Variety *zionense* grows primarily in hanging gardens of north-central Arizona, southwestern Utah, in scattered, disjunct populations on the Colorado Plateau, and on the southern edge of the Uinta Mountains, Utah. The pollen sacs are basically maroon and fade to yellowish apically, unlike those of var. *pulchellum* which, in this area, has only maroon pollen sacs. Without exception, at least the distal one-half to one-third of the pollen sac is purplish to maroon in all populations. As well, nearly all populations have minutely glandular pedicels and, often, calyces. Variation in stamen features may indicate that var. *zionense*, as defined here, comprises merely the ecological extremes of other variants, namely var. *pulchellum* and var. *monanthum*; the combinations of shade and continued moisture may be the only factors that promote the distinctive large leaf blades.



Figure 11. *Dodecatheon* var. *zionense* in flower.

Primulaceae – *Primula specuicola* (Easter-flower)

Bi-colored rosettes are white mealy below and green above (Fig. 12). Flowers in early spring, but old flowering stalks often persist throughout the growing season.



Figure 12. *Primula specuicola* in flower.

Ranunculaceae – *Aquilegia micrantha* (Alcove columbine)

This species is the only columbine that grows in hanging gardens in southeast Utah. Small, typically white or pale flowers with a short sepal to spur length ratio are diagnostic (Fig. 13).



Figure 13. *Aquilegia micrantha* in bloom.

Rhamnaceae – *Frangula obovata* (obovate buckthorn)

Leaf blades obovate to oblong-obovate or oblong, 1.2–1.8(–2.5) times longer than wide, distinctly thickened and nearly coriaceous, evenly colored on both surfaces, lateral veins (5–)6–8(–9) pairs (Figure 14). Flowering Apr–Jun. Canyon bottoms, cliff faces, stream and creek banks, hanging gardens, talus, seepage below cliffs.



Figure 14. *Frangula obovata*

SCPN Springs Monitoring Hanging Garden Datasheet - v. 1.0 Endemic Plant Species

Park Code:	Site Name:	Observer:		Date:
	Backwall	Alcove	Colluvial Slope	Start Time:
% inaccessible				End Time:
Count				
Species	Backwall	Alcove	Colluvial Slope	
Cirryd				
Erikac				
Perspe				
Symwel				
Ostkno				
Carcur				
Carspe				
Antele (Zigvag)				
Plazot (Habzot)				
Mimeas				
Dodzio				
Prispe				
Aqumic				
Fraobo				

Count Code	Definition	Family	Species	Counting Unit
N	Species not seen and presumed absent.	Asteraceae	<i>Cirsium rydbergii</i> , <i>Erigeron kachinensi</i> , <i>Symphyotrichum welshii</i>	Rosette
1-500	Count individuals	Asteraceae	<i>Perityle specuicola</i>	Individual
		Betulaceae	<i>Ostrya knowltonii</i>	Individual
		Cyperaceae	<i>Carex curatorum</i> , <i>Carex specuicola</i>	Individual
A	501-1000 individuals	Liliaceae	<i>Anticlea elegans</i> ssp. <i>vaginatus</i> (<i>Zigadenus vaginatus</i>)	Individual
B	1001-10,000 individuals	Orchidaceae	<i>Platanthera zothecina</i> (<i>Habenaria zothecina</i>)	Individual
C	> 10,000 individuals	Primulaceae	<i>Primula specuicola</i> , <i>Dodecatheon</i> var. <i>zionense</i>	Rosette
		Ranunculaceae	<i>Aquilegia micrantha</i>	Individual
		Phyrmaceae	<i>Mimulus eastwoodiae</i>	Shoot
		Rhamnaceae	<i>Frangula obovata</i>	Individual

Park Code: ARCH

Site Name: BH1

RW

Date: 4 Jun 2015

Start Time: 9:45

End Time: 10:55

	Backwall	Alcove	Colluvial Slope
% inaccessible	_____	_____	_____

Species	Backwall	Alcove	Colluvial Slope
Cirryd	 (69)		
Erikac	N		
Zigvag	 120 + 30 + 120 + 50	(313)	
Habzot	N		
Prispe	 130 + 30 + 130 + 20 + 30 + 20 + 20 + 30	(350)	
Aqumic	 138		
Mimeas	100 + 40 + 50 + 60 + 100 (A)		

Court Code	Definition
N	Species not seen and presumed absent
A	501-100 0 individuals
B	1001-10,000 individuals
C	> 10,000 individuals

Family	Species	Counting Unit
Asteraceae	<i>Cirsium rydbergii</i>	Rosette
Asteraceae	<i>Erigeron kachinensis</i>	Rosette
Liliaceae	<i>Zigadenus vaginatus</i>	Individual
Orchidaceae	<i>Habenaria zothecina</i>	Individual
Primulaceae	<i>Primula specuicola</i>	Rosette
Ranunculaceae	<i>Aquilegia micrantha</i>	Individual
Scrophulariaceae	<i>Mimulus eastwoodiae</i>	Stem