West Desert Water and Wildlife

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Introduction

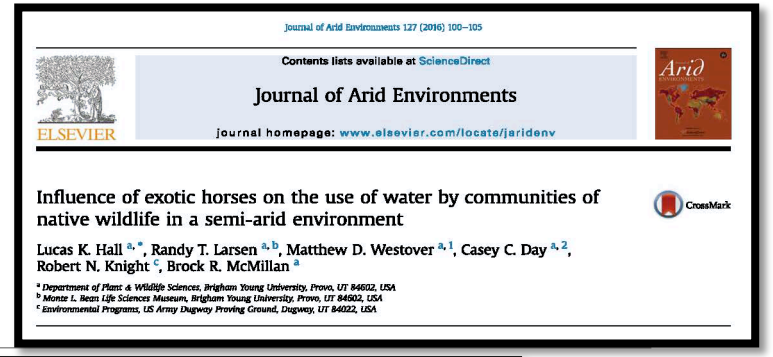
- Water is limiting in arid environments for many species
- Leopold (1933) identified water as one of just a few fundamental needs for wildlife
- Competition for access to limited water sources (Valeix et al. 2007)

Research Themes

- What is the influence of water on populations and communities of native and exotic wildlife?
- How does the addition of water (i.e., wildlife guzzlers) influence arid-land specialists like kit fox?
- How are wildlife species likely to respond to reduced availability of water in the future?
- How do native wildlife respond to a recently introduced, large-bodied species like the horse?

Couple Dozen Publications

- Effects of horses on behavior and use of water by wildlife
- Role of water in shaping dynamic interactions between sympatric carnivores
- Potential effects of changes in surface area of water on bats



Journal of Arid Environments 127 (2016) 100–105

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Influence of exotic horses on the use of water by communities of native wildlife in a semi-arid environment

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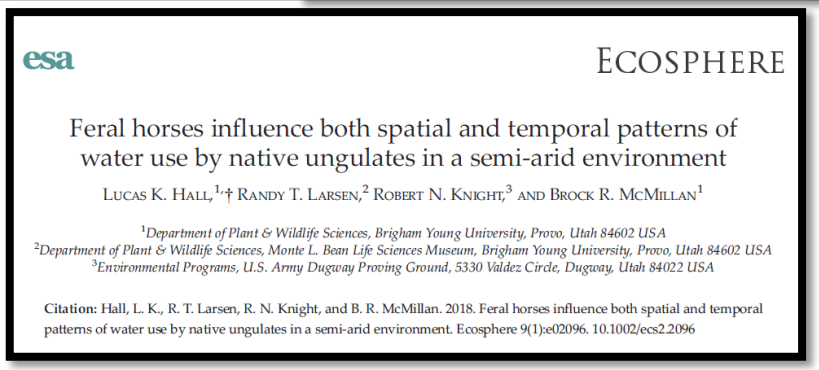

esa

ECOSPHERE

Feral horses influence both spatial and temporal patterns of water use by native ungulates in a semi-arid environment

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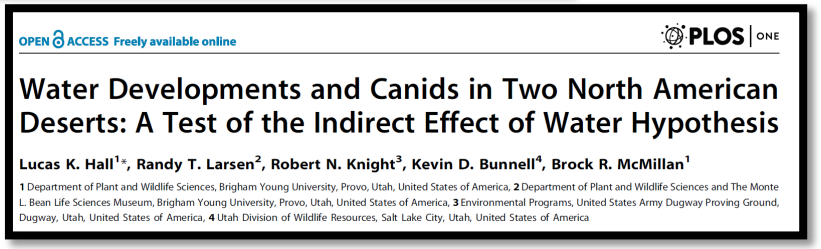

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PLOS ONE

Water Developments and Canids in Two North American Deserts: A Test of the Indirect Effect of Water Hypothesis

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Will climate change leave some desert bat species thirstier than others?

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Results: ~6 million photos across more than 200 water sources

Current Two-part Project

- Springs sampling (2018)
- Golden Eagle water use

Study Area

Military Operations Area (MOA)

- Blue = Springs
- Orange = Guzzlers

Springs Sampling

Data Collected at 91 Springs

- Spring Type
- Sketch Map
- Site description and access directions
- Spring area and microhabitats
- Flow measured in L/sec
- Water quality (pH, salinity, conductivity, temperature, DO)
- Livestock and non-native ungulate presence
- Plant Diversity
- Animal Diversity
- Remote Camera images spanning 2 weeks

Spring Types

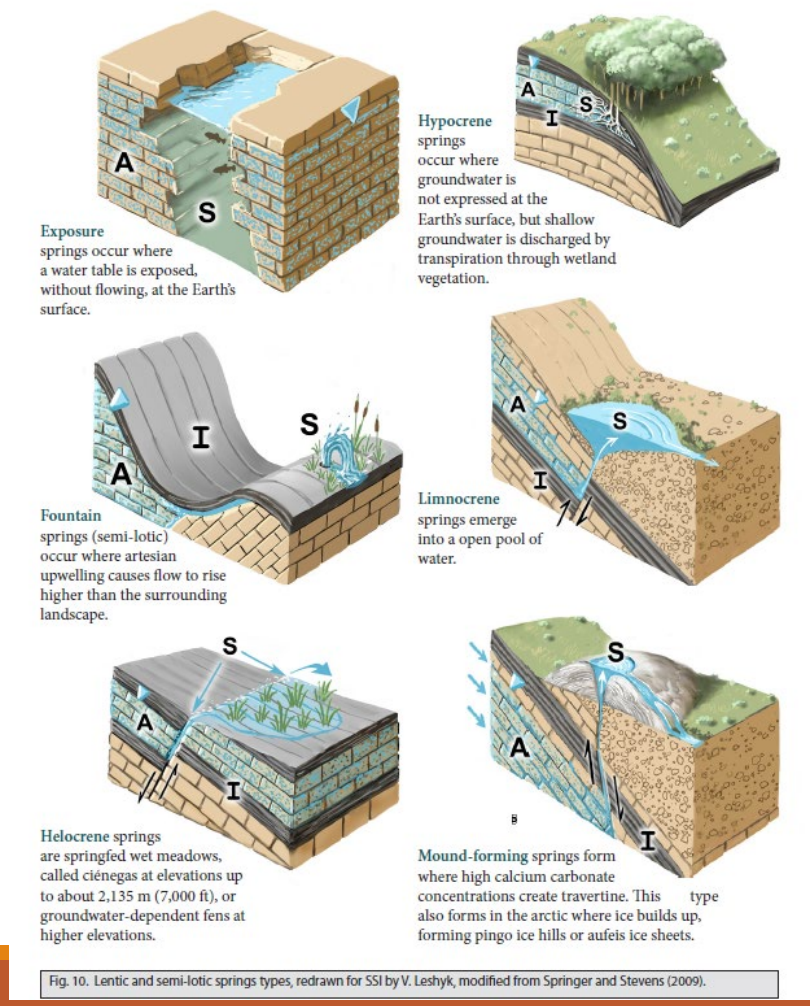


Fig. 10. Lentic and semi-lotic springs types, redrawn for SSI by V. Leshyk, modified from Springer and Stevens (2009).

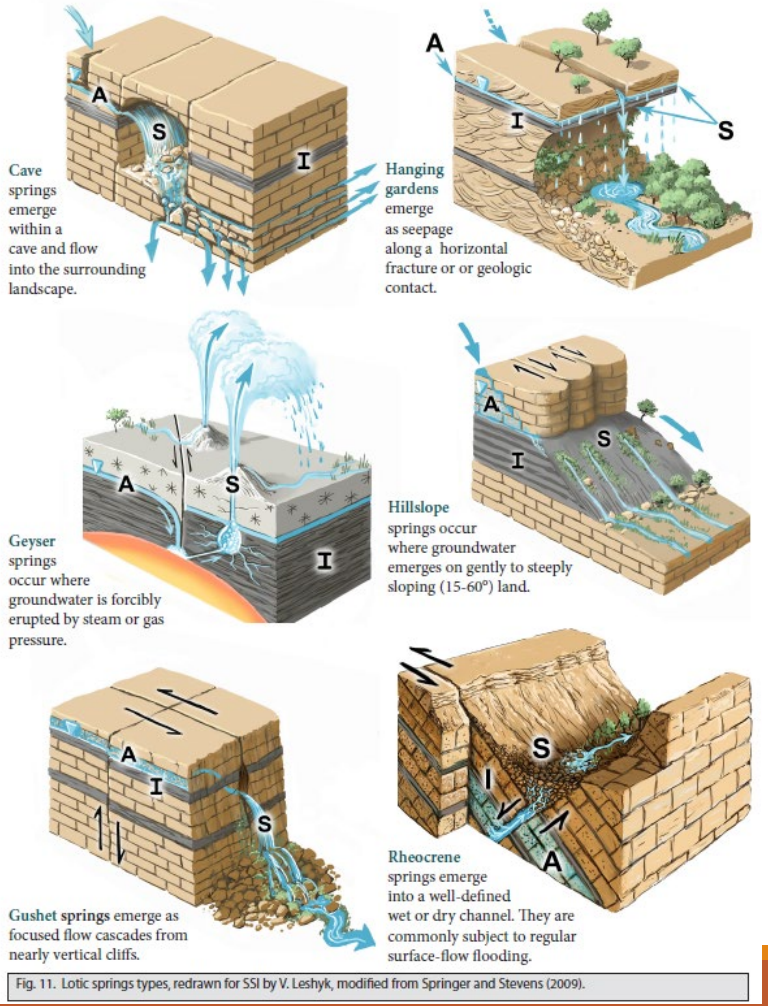
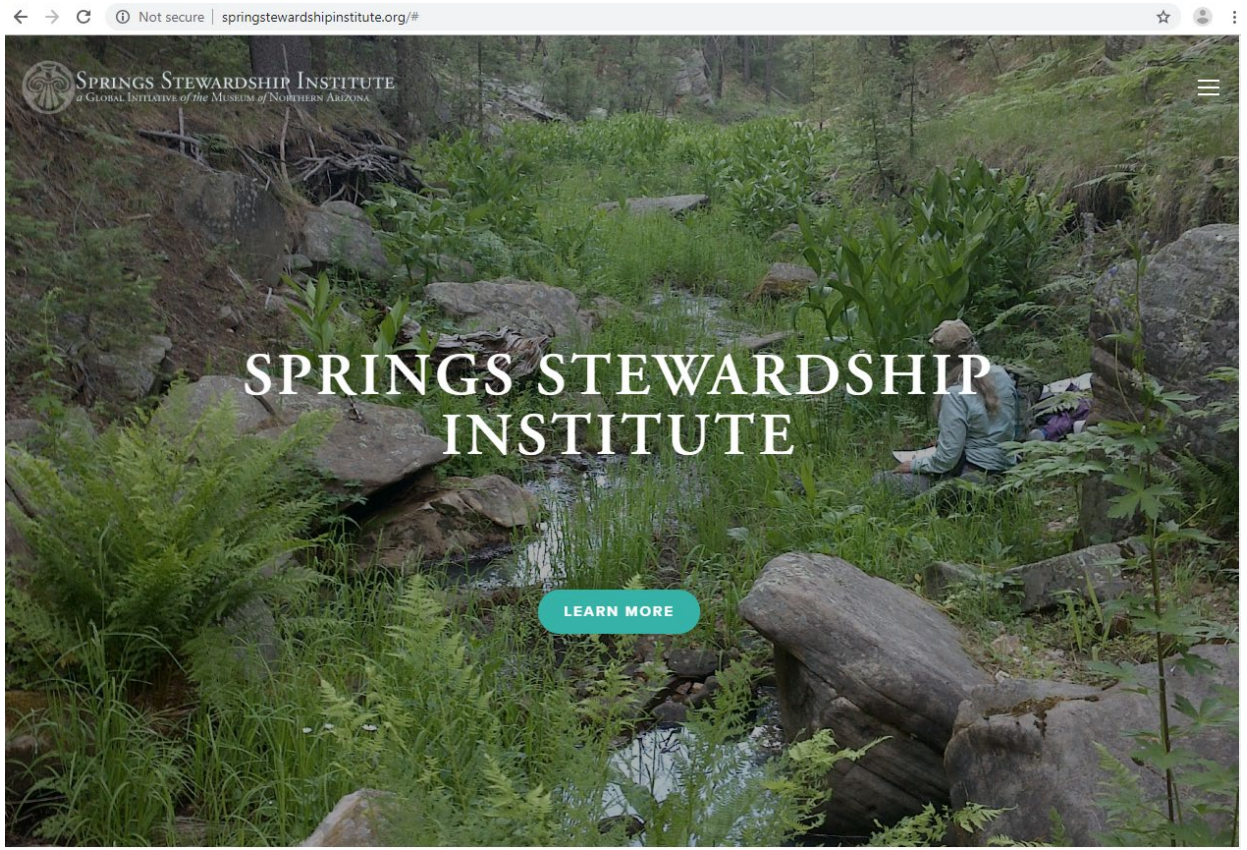


Fig. 11. Lotic springs types, redrawn for SSI by V. Leshyk, modified from Springer and Stevens (2009).

Basic Stats

- 56/91 had water enough to measure quality
- Completely dry: 13
- Had flow: 43
- Horses: 34
- Livestock: 40
- Golden Eagles: 12
- Sage-grouse: 1
- Human alteration of some sort: 90% to some degree

Springs Stewardship Institute



Data Input – can sort by project

Project Surveys

Site Name	State	County	Land Unit	Detail	Date	EOD
Little Drum Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-02	5
Cricket Seeps	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-03	8
North Spring	UT	Tooele	BLM	Bureau Of Land Management UT	2018-07-09	8
Secret Spring	UT	Tooele	BLM	Bureau Of Land Management UT	2018-07-10	8
Chadman Spring	UT	Tooele	BLM	Bureau Of Land Management UT	2018-07-11	7
Cold Spring	UT	Tooele	BLM	Bureau Of Land Management UT	2018-07-11	8
Greasewood Spring	UT	Tooele	BLM	Bureau Of Land Management UT	2018-07-11	7
Cane Spring	UT	Tooele	Private	Private US Landowner UT	2018-07-12	8
Minnehaha Spring	UT	Tooele	Private	Private US Landowner UT	2018-07-12	6
Skinner Spring	UT	Tooele	BLM	Bureau Of Land Management UT	2018-07-12	8
Wild Goose Spring	UT	Tooele	Private	Private US Landowner UT	2018-07-12	6
Willow Spring	UT	Tooele	BLM	Bureau Of Land Management UT	2018-07-12	5
Coyote Spring	UT	Juab	State	State Trust UT	2018-07-16	8
Little Red Cedar Spring	UT	Juab	BLM	Bureau Of Land Management UT	2018-07-16	7
Warm Springs	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-16	8
Cold Spring	UT	Millard	Private	Private US Landowner UT	2018-07-17	7
Conger Spring	UT	Millard	State	State Trust UT	2018-07-17	5
Horse Trap Spring	UT	Millard	State	State Trust UT	2018-07-17	6
Knoll Springs	UT	Millard	State	State Trust UT	2018-07-17	6
Lime Spring	UT	Juab	BLM	Bureau Of Land Management UT	2018-07-17	7
North Knoll Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-17	8
Trough Spring	UT	Juab	BLM	Bureau Of Land Management UT	2018-07-17	8
Twin Springs	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-17	7
Antelope Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-24	8
Mud Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-24	8
Sinbad Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-24	8
Stove Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-24	8
Wildhorse Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-24	4
Chokecherry Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-25	7
Red Cedar Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-25	8
Robbers Roost Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-25	6
Sawmill Basin Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-25	8
Swasey Spring	UT	Millard	BLM	Bureau Of Land Management UT	2018-07-25	8
Laird Spring	UT	Juab	BLM	Bureau Of Land Management UT	2018-07-26	7
Schoenburger Spring	UT	Juab	BLM	Bureau Of Land Management UT	2018-07-26	4
Craner Spring	UT	Tooele	USFS	Fishlake National Forest	2018-07-30	8
Eightmile Spring	UT	Tooele	Private	Private US Landowner UT	2018-07-30	8

Summary Report

Painter Spring

Survey Summary Report, Site ID 109534

Submitted December 12, 2018 by Springs Stewardship Institute

Location: The Painter Spring ecosystem is located in Millard County in the Tule Valley Utah 16020303 HUC, managed by the US Bureau of Land Management. The spring is located in the Bureau Of Land Management UT, in the Notch Peak USGS Quad, at 39.18499, -113.44026 measured using a GPS (WGS84, estimated position error 3 meters). The elevation is approximately 1679 meters. Danielle Finlayson, Rona Rasmussen, Kenya Lund, and Jessie Draper surveyed the site on 8/07/18 for 01:10 hours, beginning at 10:40, and collected data in 8 of 10 categories. This survey was conducted under the Utah MOA project using the Stevens et al. Level 2 protocol.

Fig 1.1 Painter Spring: View of spring head

Physical Description: Painter Spring is a rheocrene spring. This spring is located in a canyon in the House mountain range of Utah. The head emerges from a rock with a vertical indentation, surrounded by other boulders. The channel continues downstream for a considerable distance, eventually encountering a concrete wall and small vertical culvert with a pipe coming out the top. There is evidence of more piping further down. The microhabitats associated with the spring cover 125 sqm.

The site has 2 microhabitats, including A -- a 40 sqm channel, B -- a 85 sqm terrace. The geomorphic diversity is 0.27, based on the Shannon-Weiner diversity index.

Table 1.1 Painter Spring Microhabitat characteristics.

Code	A	B
Name	Channel	Terrace
Area sqm	40	85
Surface type	CH	TE
Surface subtype		
Slope variability	Med	Med
Aspect TN	270	270
Slope degrees		
Moisture (scale 1-10)	7	4
Water depth cm	4	
Area % open water	75	
Substrate		
1 - Clay %	0	0
2 - Silt %	0	0
3 - Sand %	0	0
4 - Fine gravel %	0	0
5 - Coarse gravel %	0	0
6 - Cobble %	0	0
7 - Boulder %	0	0
8 - Bedrock %	0	0
Organic %	0	0
Other % (anthropogenic)	0	0
Precipitate %	0	0
Litter %	0	0
Wood %	0	0
Litter Depth (cm)		

Access Directions: This site is not accessible by vehicle. From Old Highway 6/50, turn south on Ye Old Indian road. Turn east on dirt road by an old rusted out car, and drive until you reach a campground. Then hike the last .5 miles to the spring head.

Survey Notes: At the time of the survey there was a gentle flow of water emerging from the small pool at the head. There was more water above the head. The channel continues downstream for several hundred meters, although it petered out in a few places before starting up again. There was no evidence of livestock use.

Summary Report

Flow: Surveyors measured a flow of 0.21 liters/second, using a volume capture over time method. Flow was adjusted for an estimate of 90% of site flow capture. Flow was measured approximately 100m downstream from the head.
Water Quality: Water quality was measured at the small pool at the spring head. Location 1: at the spring source in standing water at 08:30:00.

Table 1.2 Painter Spring Water Quality with multiple readings averaged.

Characteristic Measured	Average Value	Site Number	Device	Comments
Dissolved oxygen (field) (mg/L)	6	1	CHEMets DO kit	
pH (field)	8.37	1	Hanna Combo	
Salinity (field) (ppt)	0.373	1	Hanna Combo	
Specific conductance (field) (uS/cm)	868	1	Hanna Combo	
Temperature, water C	17.9	1	Hanna Combo	

Flora: Surveyors identified 22 plant species at the site, with 0.176 species/sqm. These included 18 native and 4 nonnative species.

Table 1.3 Painter Spring Cover Type.

Cover Type	Species Count	Wetland Species Count
Ground	12	5
Shrub	6	3
Mid-canopy	2	0
Tall canopy	0	0
Basal	0	0
Aquatic	2	2
Non-vascular	0	0

Table 1.4 Painter Spring Vegetation % Cover in Microhabitats.

Species	Cover Code	Native Status	Wetland Status	Comments	A	B
Achnatherum hymenoides	GC	N	U		0	0.5
Agrostis stolonifera	GC	I	W		0	0.2
Aquilegia formosa	GC	N	W		0	0.2
Artemisia ludoviciana	GC	N	F		0	0.5
Artemisia tridentata	SC	N	F		0	3
Bromus tectorum	GC	I	F		0	0.5
Castilleja	GC	N	U		0	0.1
Clematis ligusticifolia	SC	N	R		0	5
Equisetum	GC	N	WR		0	0.2
Grindelia squarrosa	GC	N	U		0	0.5
Juniperus osteosperma	MC	N	U		0	3
Phragmites australis	AQ	N	WR		2	0
Platanthera dilatata	GC	N	WR		0	0.2
Populus x acuminata	MC	N			0	15
Rhus aromatica	SC	N			0	20
Rosa woodsii	SC	N	F		0	1
Salix exigua	SC	N	WR		0	4
Schoenoplectus acutus	GC	N	W		2	0
Solidago	GC	N	F		0	0.1
Tamarix	SC	I	WR		0	0.2
Typha latifolia	AQ	N	A		0.5	0
Verbascum thapsus	GC	I	F		0	0.1

Fauna: Surveyors collected or observed 7 aquatic and 4 terrestrial invertebrates and 12 vertebrate specimens.

Table 1.5 Painter Spring Invertebrates.

Species	Lifestage	Habitat	Method	Rep#	Count	Species Detail
Araneae	Ad	T	Spot			
Diptera	Ad	T	Spot			
Diptera Ceratopogonidae Atrichopogon	L	A			1	Specimen collected
Diptera Dixidae	L	A			1	Specimen collected
Diptera Simuliidae	L	A			1	Specimen collected
Hemiptera Veliidae Microvelia	I	A			4	Specimens collected
Hymenoptera Apoidea	Ad	T	Spot			
Hymenoptera Pompilidae	Ad	T	Spot			
Mollusca Physidae Physella	Ad	A			1	Specimen collected
Neotaenioglossa Hydrobiidae Pyrgulopsis	Ad	A			14	Specimens collected
Trichoptera Hydroptilidae Orthotrichia	L	A			2	Specimens collected

Table 1.6 Painter Spring Vertebrates.

Vertebrate Species Common Name	Count	Detection	Comments
Western Scrub-jay	1	call	
Spotted Towhee	3	call	
Lesser Goldfinch	2	obs	
Canyon Wren	2	call	
Pinyon Jay	85	obs	Flyover
Rufous Hummingbird	1	obs	
Common Bushtit	7	obs	
Common Poorwill		sign	Feather
Mule Deer		sign	Scat
Rabbit		sign	Scat
Coyote		sign	Scat
Townsend's Big-eared Bat	1	obs	Dead at spring head

Summary Report

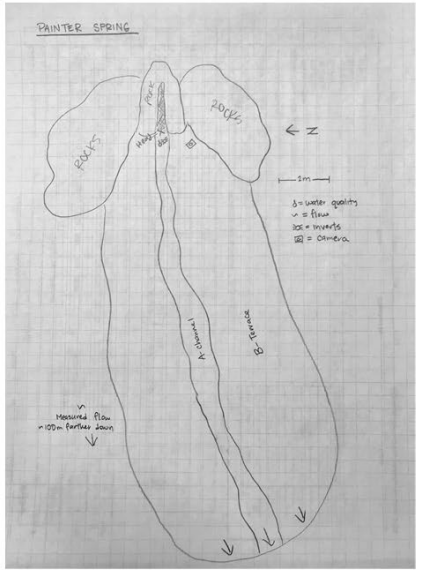


Fig 1.2 Painter Spring Sketchmap.

Fig 1.3 Painter Spring: Concrete wall and piping downstream

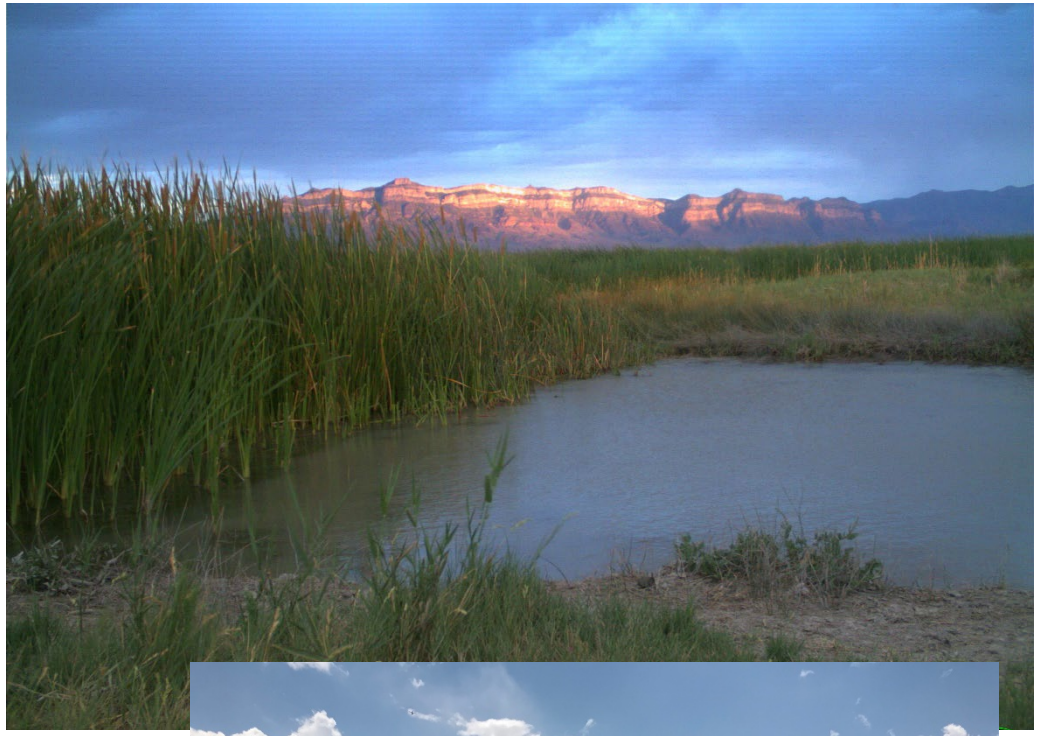
Fig 1.4 Painter Spring: More piping

Fig 1.5 Painter Spring: Channel

Fig 1.6 Painter Spring: Dead Townsend's Big-eared Bat found at spring head

Analysis

- We are still finishing up analyses
- Quantifying how different measurements (water quality, flow, GIS attributes, horse presence, etc.) affect the invert, vertebrate, and plant diversity at the springs.



Remote Camera Pics


2018-08-13 4:21:22 PM M 1/1 47°C
CAM 204
RECONYX


2018-08-22 10:15:00 T 77°F
360
RECONYX


2018-09-04 2:06:48 PM M 1/1 95°F
PC900 PROFESSIONAL
RECONYX


2018-09-05 1:04:48 PM M 1/1 96°F
PC900 COVERT PRO
RECONYX


2018-09-22 16:30:36 M 1/1 71°F
351
RECONYX


2018-08-02 13:30:00 T 81°F
338
RECONYX

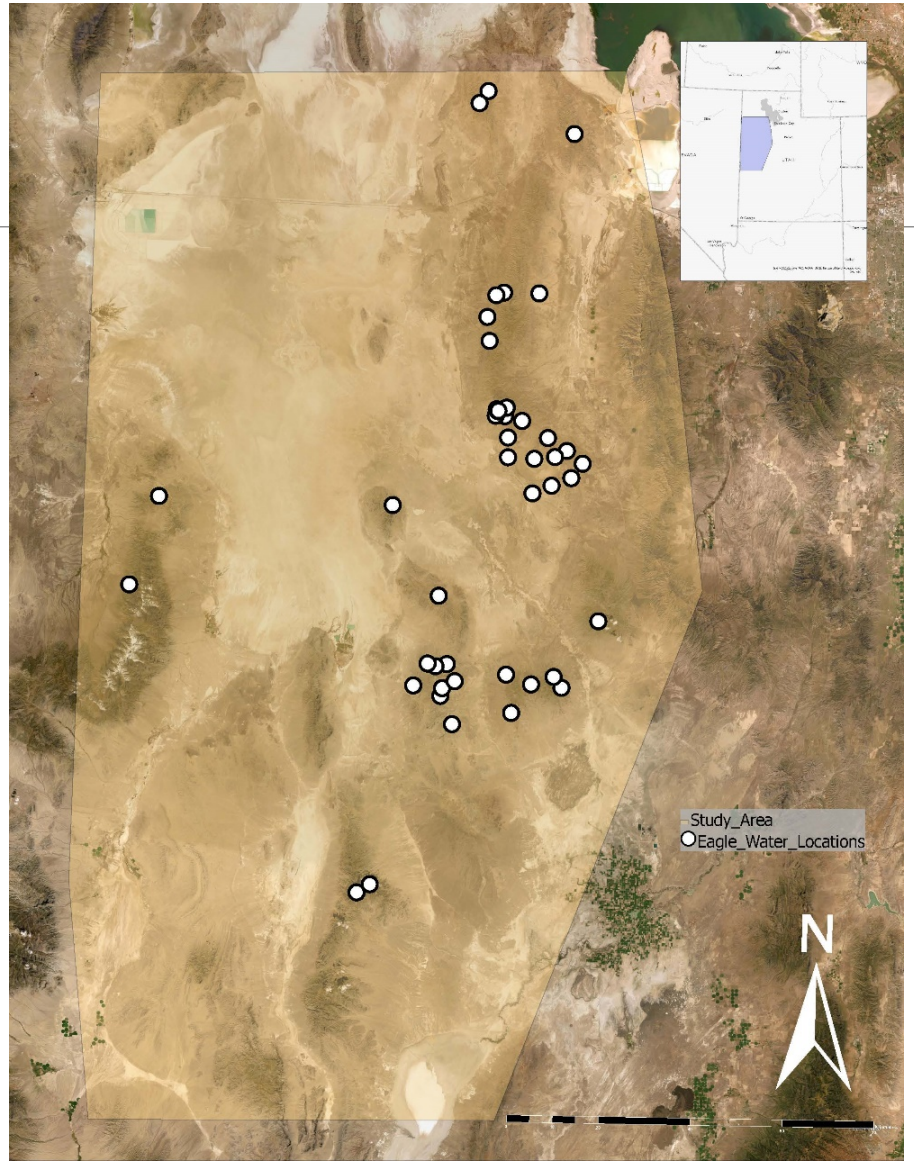

2018-09-19 21:59:49 M 1/1 50°F
351
RECONYX


2018-09-03 7:33:59 AM M 1/1 21°C
CAM 235
RECONYX

Sage-grouse at Mud Spring

Golden Eagle Use of Water

Study Area



Introduction

- The Golden Eagle (*Aquila chrysaetos*) is a species for which there is conservation concern that occurs in arid regions
- It has been assumed that raptors get their water exclusively from their prey, and therefore do not need to drink (Brown and Amadon 1968)
- Research has been done on many aspects of eagle life history (Kochert et al. 2002), but little is known about their dependence on free water
- Other sources, as well as anecdotal evidence, suggest that eagles do utilize water for both bathing and drinking (Charlet and Rust 1991)
- **Our objective was to quantify seasonal use of free water by eagles and document their behavior at these sources**

Current Literature

Drinks occasionally, but most or all liquid requirements, particularly for nestlings, are met by ingesting prey (Brown and Amadon 1968). Adults and immatures in Nevada drank in mountain bogs and springs and ingested snow near or above timberline (Charlet and Rust 1991, Johnson 1994f). Drinking was a frequent daily activity of a captive adult female (Kish 1970). Casts pellets, usually once early in the day (M. Collopy pers. comm.). To cast, eagle arches neck with face down and forward and gapes widely while rapidly shaking head laterally. Behavior repeated several times with brief pauses between head-shakes; soft squeaks or whistles often accompany casting. Often bobs head in a Neck Pump prior to casting, and conspicuous swallowing often follows casting attempt. Adults do not cast at nest; chicks cast 1–3 pellets/d from age 20 d to fledging, but some chicks did not cast every day (Ellis 1979). Two captive male and 2 captive female chicks produced an average of 7.7 g/d (dry mass) and 6.9 g/d (dry mass) of pellets (Collopy 1980). The same captive eaglets defecated an average of 57.0 g/d (dry mass) and 59.6 g/d (dry mass), respectively (Collopy 1980). Number of defecations/d increases linearly to about 20 d in wild nestlings and then levels off to 10–16/d until fledging (n = 4; Ellis 1979).

Methods

- We placed motion-sensing cameras at water features in the west desert of Utah starting in 2010
- Photos with eagles present were sorted by events recording their behavior, age class, number of birds, date, temperature, and visit duration
- We determined seasonal use of water features solely from 38 cameras that were deployed year-round on Dugway Proving Ground (DPG)
- Age was determined by the amount of white in the tail, and was categorized into juvenile, sub-adult, adult, or unknown
- Eagle observations included drinking, bathing, preening, and if a full crop was visible
- Events were determined by a minimum of 30 minutes absence from a site

Aging Golden Eagles

1st year (juvenile) bird: feathers are a dark brown with a white base and are all the same age.

Sub-adult (age 2-4) bird: feathers are a mixture of juvenile and sub-adult, or sub-adult and adult feathers.

Adult (age 5+) bird: all feathers have wavy gray bands with no white at the base.

Stats

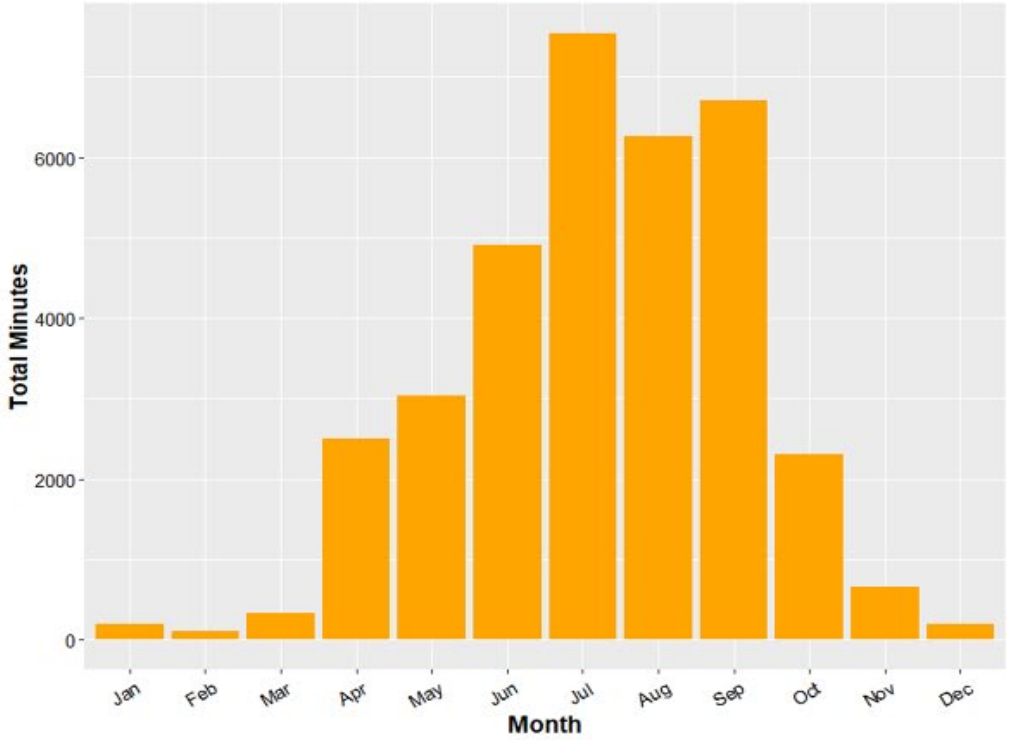
We analyzed eagle visitation during 1512 different events at 53 different sites

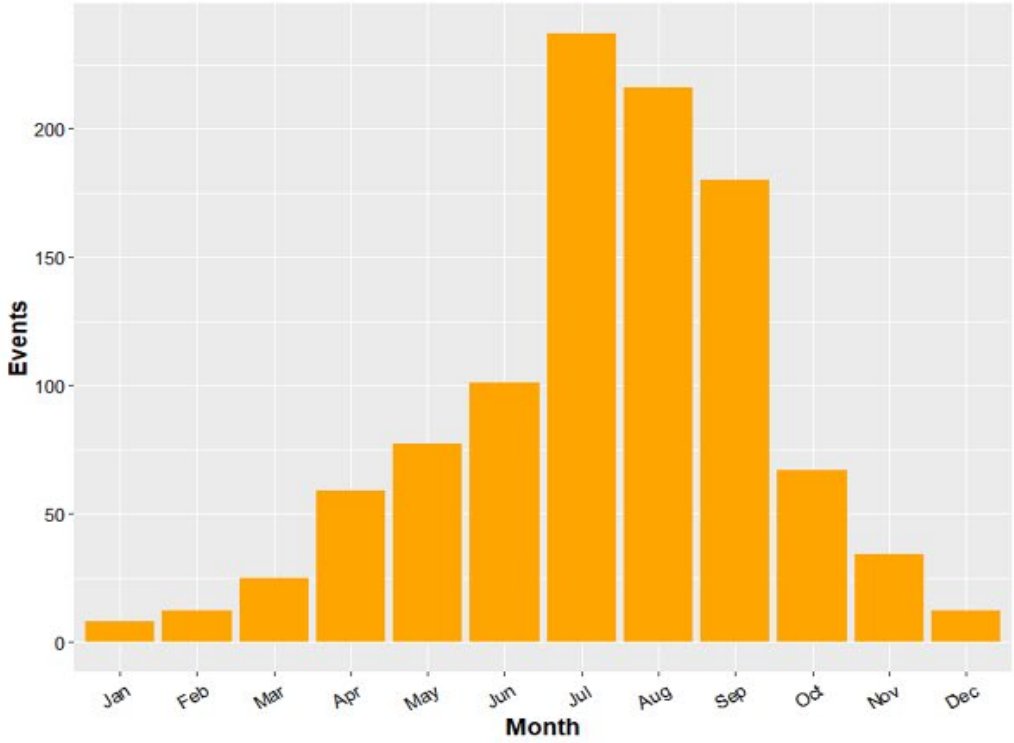
- Adult birds: 1293 (86%)
- Sub-adult birds: 63 (4%)
- Juvenile birds: 73 (5%)
- Unknown age: 110 (7%)
- Number of birds per event: 1.05
- Behavior:
  - Drinking: 44%
  - Bathing: 31%
  - Preening: 15%
  - Full crop: 24%
- Total time at water source:
  - Min: 2 seconds
  - Mean: 37 minutes
  - Max: 8 hours, 11 minutes
- Time of year:
  - Most visited month: July
  - Least visited month: January

Springs vs. Guzzlers

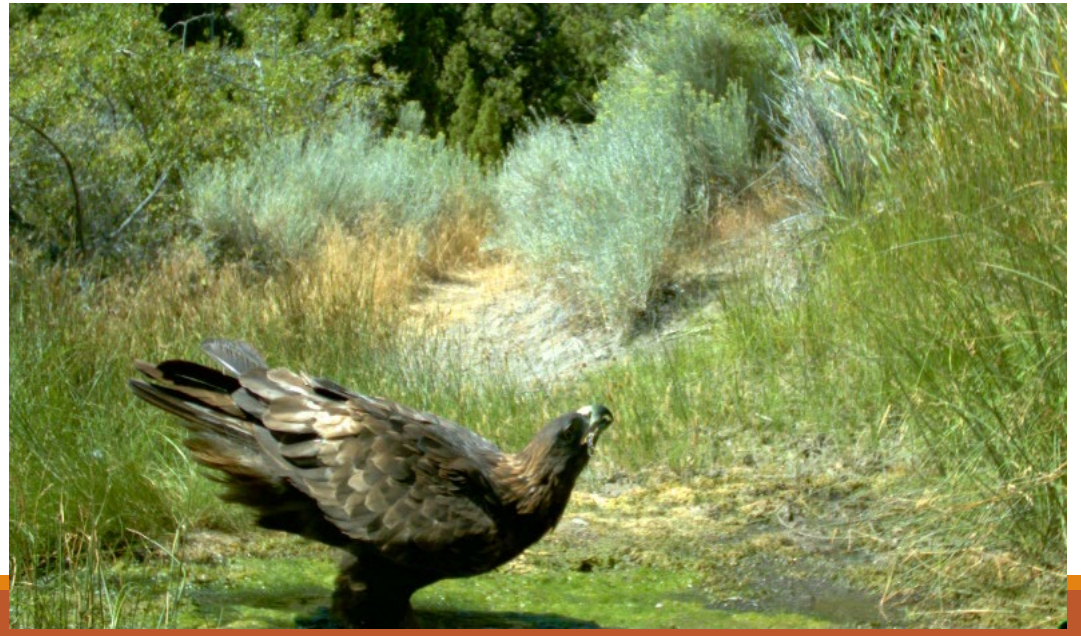
Feature	Drinking	Bathing	Preening	Full Crop	Ave. Time	Max time	Total
Spring	47.41%	12.02%	17.20%	18.36%	31:53	5:08:42	599 events
Guzzler	44.80%	46.33%	14.13%	27.38%	35:38	8:11:13	913 events

Eagle Water Usage by Month





Drinking



Bathing

Preening

Full crop

Number of birds

Discussion

- Not surprisingly, use of water features was heavily dependent on the time of year. Eagles were more likely to use a water feature in the heat of the summer than in the cooler months
- Adult birds (age 5+) were more common than sub-adult and juvenile birds
- Most common behavior was drinking, followed by bathing and preening.
- Observed eagles with prey items in only two events
- Difference between springs and guzzlers. More bathing and more full crops observed at guzzlers.

Discussion

Runway theory (Charlet and Rust 1991)

- Suggested that eagles needed a “runway” to take off from in order to use a water site. A drop of 30 m within 200 m

- Used ArgGIS PRO to calculate the elevation within a 200 m buffer around each site

- Our results showed slope didn’t influence probability of use, but there was a positive relationship between the number of visits and maximum slope out to 200 m

Conclusions

- There is a gap in the literature on how Golden Eagles utilize water
- Use of natural springs and guzzlers by eagles could have important implications for how both eagles and water features are managed in arid environments – particularly with the predicted decrease of water in the coming decades

Questions??