Kaibab National Forest

Forest Plan Monitoring Report

Fiscal Year 2014

All cover photos credit U.S. Forest Service, Southwestern Region, Kaibab National Forest. Clockwise from top left: mist netting bats, Mexican spotted owl, Arizona bugbane, AZ Bugbane monitoring, Aspen Field trip, Pottery sherd.

Introduction

This report documents monitoring activities and accomplishments for fiscal year (FY) 2014. This is the first monitoring report prepared using the Kaibab National Forest's revised Forest Plan, which went into effect in April of 2014. The new Forest Plan includes a new monitoring plan that was designed to inform progress toward desired conditions and achievement of objectives. Monitoring information enables the forest to evaluate the conditions and management actions and to identify any concerns that would trigger a change in management or prompt further investigation in support of adaptive management. Subsequent monitoring and analysis will enable the responsible official to determine if a change is needed in plan components or other plan content, including the monitoring plan, that guide management of resources in the plan area.

The Monitoring Plan can be found in Chapter 5 of the Kaibab Land and Resource Management Plan (2014). It is organized by the five primary methods of data acquisition used. Monitoring reports from previous years can be accessed at http://fs.usda.gov/goto/kaibab/planning or available on request.

Data Acquisition

Specific monitoring questions require that data be gathered at differing scales. As a result, a combination of strategies for obtaining data are used. These include ground based rapid plots, rigorous field assessment protocols, remote sensing, and utilization of existing monitoring efforts. Additionally, data collected for other purposes are used to answer monitoring questions in the plan.

Ground Based Rapid Plots

Rapid plot data were collected using a systematic sampling framework superimposed across the entire Kaibab NF to make inferences at the Forest level. The rapid plot design is a new monitoring effort developed collaboratively with Northern Arizona University's (NAU) Lab of Landscape Ecology and Conservation Biology. Still in its initial phase of implementation, the rapid plot effort was designed specifically to support the adaptive management aspect of the recently revised forest plan with an emphasis on fine to mid-scale level monitoring questions, but designed to be flexible enough to allow data to be aggregated upward to answer questions at broader scales (e.g. across forests, adjacent landscapes).

Rapid plot questions are specifically identified in the monitoring plan, with a focus on maintaining or moving key ecological conditions (e.g. watershed conditions, key terrestrial and aquatic ecosystems, and species at risk) toward the desired conditions identified in the forest plan. This information will be critical to successful implementation of the revised plan and will also help the Kaibab NF meet monitoring requirements under the new 2012 planning rule. Data include relatively simple field based metrics that are easily observed such as snags, down logs, large trees, presence of nonnative invasive species, and soil conditions. Rapid plots have their own sampling protocol and are intended to be permanent plots. This consistency will allow for statistically robust comparisons of data over time.

Fiscal year 2014 marked the pilot implementation year for the "rapid plot" sampling effort on the Kaibab NF, thus results reported here are preliminary and more in depth analyses and hypotheses testing have yet to be completed. From June 2 to August 15, 2014, all three Kaibab National Forest Ranger Districts were visited and a total of 291 rapid plots were sampled (Williams = 118, Tusayan = 71, North Kaibab = 102) (Figures 1 and 2). Although this sample fell short of the initial target sample size (n=380), Kaibab NF collaborators at NAU felt this was still adequate to provide for statistically meaningful results. The Tusayan Ranger District was 90% completed with only 8 plots not visited due to issues with access (e.g., due to closed or impassable roads). The Williams Ranger District was 80% completed and 65% of the North Kaibab Ranger District was completed. The majority of plots not visited in the Williams Ranger District were because of closures due to the Sitgreaves Complex fire and other road closure types, causing the sampling of some plots to be impractical or impossible.

As expected, several rapid plots were located within planned Four Forest Restoration Initiative (4FRI) treatment areas and other designated treatments throughout the Williams and Tusayan Ranger Districts. Within the Williams Ranger District, there were 29 plots sampled within planned 4FRI treatment areas and 3 plots in other designated treatment areas. In the Tusayan Ranger District, 14 rapid plots were located in 4FRI planned treatment areas and 2 plots were located in other planned treatment areas. Visiting the majority of plots located within planned treatment areas will provide pre-treatment data that can be later compared with post-treatment data in a statistically meaningful and rigorous fashion. The number of rapid plots could easily be increased as new treatment areas come 'on line,' or where there is a need to sample in areas recently disturbed by, for example, insects or wildfire. The number of additional rapid plots located in these areas should be determined by the specific questions and hypotheses needing to be addressed and a suitable power analysis or simulation exercise.

Table 1. Rapid plots sampled by vegetation strata and ranger district across the Kaibab NF, 2014.

Vegetation type	North Kaibab	Tusayan	Williams	Grand Total
Aspen	5	0	2	**7**
Aspen, Mixed Conifer	6	0	0	**6**
Grassland	10	7	22	**39**
Grassland, PJ	0	2	1	**3**
Mixed Conifer	28	0	2	**30**
Oak	8	0	1	**9**
Pinyon-Juniper (PJ)	14	34	37	**85**
PJ, Sagebrush	3	3	0	**6**
Ponderosa	21	22	46	**89**
Ponderosa, Grassland	0	1	1	**2**
Ponderosa, Oak	0	0	5	**5**
Sagebrush	4	2	0	**6**
Scrub	3	0	1	**4**
Grand Total	**102**	**71**	**118**	**291**

The following summarizes some of the key findings and exploratory statistics from the 2014 effort. More in depth inferential statistics and hypotheses testing will occur in the future in support of specific monitoring plan question hypotheses and associated desired conditions.

Monitoring Plan Questions 1, 7, 9

Are snags, coarse woody debris, downed logs and large old trees at desired levels at the midscale (100-1,000 acre average)? How many acres of the Kaibab NF are in an uneven aged open state, at the midscale (above 100 acres)? Is the stand density within a range that will allow for a robust understory?

Eight different tree species were identified in the North Kaibab Ranger District, with aspen and ponderosa pine being the two most common species. The majority of trees were in the class 1 (10-20 cm) and class 2 (20-30 cm) DBH categories. There were only a total of 36 snags (DBH > 45) across all plots in the district and the average number of snags in each plot was 0.90 (SD = 0.34). The average DBH for trees in class 4 (>40 cm DBH) was 51.7.

Five different tree species were identified in the Tusayan Ranger District, with pinyon pine and ponderosa

pine being the two most common species. The majority of trees were in class 1 and class 2 DBH categories. There were only a total of 8 snags (> 45 dbh) across all plots in the district and the average number of snags in each plot was 1.2 (SD = 1.09). The average DBH for trees in the class 4 was 47.5.

Ten different tree species were identified in the Williams Ranger District with ponderosa pine, Utah juniper, and Gambel oak being the most common species. The majority of trees were in class 1 and class 2 DBH categories. There were only a total of 15 snags (> 45 cm dbh) across all plots in the district and the average number of snags in each plot was 0.9 (SD = 0.06). The average DBH for trees in the class 4 was 55.7.

Mean trees per acre (TPA), basal area (BA) and stand density index (SDI) were highest in the North Kaibab RD, followed by the Williams RD and then the Tusayan RD. Mean Quadratic mean diameter (QMD) however, was highest in the Williams RD and lowest in the North Kaibab RD. The mixed conifer, mixed conifer/aspen, and ponderosa/oak vegetation types tended to have the largest mean values for TPA, BA, SDI, and QMD. Basal area for these forest components was at or above the desired condition.

Table 2. Mean (and SD) values for rapid plot data collected during 2014 within each of the dominant vegetation types on the Kaibab National Forest. QMD and BA were calculated using the average value of the DBH classification range, and TPA and SDI were calculated using trees > 3.94" DBH. TPA = trees per acre.

Vegetation type	TPA	QMD (in)	BA (ft_2/acre)	SDI
Aspen	99.8 (62.6)	11.8 (4.6)	53.6 (18.8)	95.3 (34.6)
Grassland	3.7 (9.3)	2.8 (5.0)	2 (4.3)	3.5 (7.5)
Grassland/Pinyon-Juniper	55.3 (51.3)	9.2 (1.4)	24.4 (20.1)	46.5 (39.4)
Mixed Conifer	172.5 (57.1)	11.1 (1. 8)	114.1 (46.1)	199.7 (72.5)
Mixed Conifer/Aspen	250 (84.5)	8.3 (1.0)	90.6 (20.3)	179.4 (41.0)
Oak	29.9 (62.4)	7.8 (12.6)	16.8 (27.7)	28.1 (50.3)
Pinyon-Juniper	93.2 (59.0)	11.9 (3.9)	72.5 (45.3)	121.1 (71.4)
Pinyon-Juniper/ Sagebrush	18.1 (15.1)	9.7 (4.0)	12.9 (15.2)	21.8 (24.6)
Ponderosa	105.4 (67.3)	12.6 (3.5)	77.6 (40.9)	131.8 (67.4)
Ponderosa/Grassland	106.3 (67.5)	12.7 (5.6)	57.2 (20.2)	101.4 (52.2)
Ponderosa/Oak	176.3 (153.8)	11.3 (2.1)	108 (61.6)	191.6 (117.3)
Sagebrush	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Scrub	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)

Across the Kaibab National Forest, woody debris occurred in 55% of the plots sampled. The maximum amount of woody debris in a plot was 39 logs. The average was 5.7 logs per plot (SD = 6.6, mode = 1.0). North Kaibab plots exhibited the largest amount of woody debris (70.6% of all plots), while the Williams (47.5%) and Tusayan (46.5%) Ranger Districts were similar in the proportion of plots with down logs. Plots with the highest amounts of woody debris typically occurred in the aspen or mixed conifer dominated vegetation type categories.

Monitoring Plan Question 3
What is the percent of effective ground cover?

Effective ground cover includes live and dead vegetation, litter, wood, or rock that covers bare ground and prevents erosion. Effective ground cover was highest on the North Kaibab Ranger District (92.3%) with relatively similar ratings for the Williams (83.6%) and Tusayan (81.2%) Districts.

Monitoring Plan Question 4
Are the effects of forest management resulting in changes to the productivity of soils?

Soil disturbance areas greater than 0.5 m^2 in size were recorded as either burned, compacted, displaced, or other. Forest wide, there were a total of 30 plots (10%) with signs of soil compaction, and the majority of these were on old logging roads or other closed roads that ran through the plot. Compaction was also due to game trails and camp sites.

Monitoring Plan Question 6
What is the percent cover of noxious weeds?

Overall, 32% of the plots had non-native invasive species present. The most common invasive species included several different thistle species (over half) followed by cheat grass, and Russian thistle. Invasive species were most common in the North Kaibab Ranger District (42% of all plots), followed by the Williams Ranger District (34%) and the Tusayan Ranger District (14%).

Next Steps

The Kaibab NF continues to work with its partners on further refinement and implementation of the rapid plot effort. This is an iterative process and while the Kaibab NF made great strides in 2014, additional modifications are expected to occur over time, particularly as the Kaibab NF Forest tries to support broader initiatives such as the 4FRI multiparty monitoring effort and other regional monitoring efforts. Data collection is currently ongoing (summer 2015) on the Coconino National Forest in support of 4FRI. A complementary Access database is also in development which will facilitate more efficient data extraction and subsequent analyses in the future. This database will also complement and support the corporate FSVeg database, allowing for additional utility over time. It is expected to be operational in FY 2016.

Additional information about the rapid plot design as well as pilot year results can be found on the Kaibab National Forest website at

http://www.fs.usda.gov/detail/kaibab/landmanagement/planning/?cid=stelprdb5359623

Existing Sources

This report draws upon existing data the Kaibab NF or its partners already collect and report. Much of these data are managed under the Natural Resource Manager system, a system of database tools for managing Agency data across the Forest Service. Natural Resource Manager includes Forest Service Activity Tracking System, Infrastructure, and the Natural Resource Information System databases, among others. Data routinely collected by the Arizona Department of Environmental Quality, Arizona Game and Fish Department, and USDA Animal and Plant Health Inspection Service are other sources of existing data that can be leveraged to answer Forest-wide questions.

Forest Plan Monitoring Questions 9
Is the stand density within a range that will allow for a robust understory?

The mean and median SDI calculations were obtained from the mid-scale data. These calculations are intended to provide a baseline for future comparison.

Table 3. Stand Density calculations from Mid-scale data

District	Vegetation Type	Mean SDI	Median SDI
Williams	Ponderosa pine	233	236
	Frequent Fire Mixed Conifer	262	287
Tusayan	Ponderosa pine	185	186
North Kaibab	Ponderosa pine	228	242
	Frequent Fire Mixed Conifer	281	305

Monitoring Plan Question 15
How many acres were burned with desired and undesired fire behavior and effects?

Almost 35,000 acres of desired fire effects were achieved through a combination of prescribed fire (management ignited) and managed wildfire. Prescribed fires accounted for 6,352 acres and 28,630 acres were from managed wildfires. Managed wildfires are those where natural/lightning ignitions are managed to play their natural role in the ecosystem to achieve resource objectives. The managed wildfires were as follows:

McRae - 5,505 acres
Duck - 322 acres
Quaking - 500 acres
Sitgreaves - 10, 748 acres
Hammer- 8,871 acres
Belknap -2,684 acres

Acreage having undesired fire effects on the Kaibab National Forest (requiring a BAER assessment) totaled 102.7 acres. The breakdown by incident and vegetation type is as follows:

Belknap – 1.1 ac., all in ponderosa pine/Gambel oak
Hammer – 38 ac., all in ponderosa pine/Gambel oak
Sitgreaves - 10.1 ac. in white fir/Douglas fir; 21.4 ac. in Douglas fir; 21.1 ac. in ponderosa pine/Gambel oak

Monitoring Plan Question 17
How many acres of conifer species were planted? Were they successful?

<u>Williams Ranger District</u>

- 101 acres of planting on Eagle Rock fire which includes:
  - 101 acres of tree protection cone installation for browse protection
  - 14 acres of fenced exclosures around seedlings for browse protection
- 28 acres of certification of natural regeneration w/out site prep
- 210 acres certification of natural regeneration w/ site prep
- Purchased aspen seedlings to plant 15 acres of fenced dead aspen sites in FY15
- Completed 171 acres of 1st year survival surveys on FY14 Eagle Rock Fire planting
- Yearly fence maintenance on Williams RD pine and aspen plantation fence exclosures

Monitoring Plan Question 18
What was the total area of aspen fenced?

21 acres of fenced exclosures were constructed around aspen for browse protection and to stimulate sprouting, includes: 20 acres of contract fence construction and 1 acre constructed with YCC crew

Monitoring Plan Question 19
How many acres treated for conifer encroachment?

Conifers were removed on 150 acres to reduce competition and reduce stress to aspen clones on the Williams District.

Monitoring Plan Question 21
How many miles of fence were modified for pronghorn?

In FY 2014, approximately 8 miles of fence unneeded fence was removed and 1 mile of fence was modified in pronghorn habitat to improve pronghorn movement.

Monitoring Plan Question 22
What was the acreage of outbreaks of insects and disease?

According to the 2014 Forest Insect and Disease conditions in the Southwestern Region report (USDA Forest Service 2014), there was 864 acres of aspen defoliation. Mortality from bark beetles included 1.5 acres of juniper from cedar and cypress bark beetles, 7 acres of Douglas-fir beetle, 44 acres of ponderosa ips, 0.75 acres of spruce beetle, and 129 acres ponderosa pine mortality from western bark beetle.

Monitoring Plan Question 23
What is the estimated population trend of pronghorn?

Trend in population for pronghorn in Game Management Units 7, 8, 9, 10 and 12A were all stable to increasing. The 3-year trends are for 2012-2014; and 10-year for 2005-2014. The data below were generated by the Arizona Game and Fish Department.

Population trends for pronghorn were determined using modeling of the populations. The inputs for the models were harvest, male: female ratios, young: female ratios, estimated mean mortality rates, and estimated starting populations. The best model is estimated by changing mortality rates or the starting population so that the predicted male: female ratios from the models for each year match those that are based on the surveys.

Table 4. Trends in Pronghorn Populations

Unit	3-Year	10-Year
7	Stable	Stable
8	Increasing	Stable
9	Increasing	Stable
10	Stable	Stable

Monitoring Plan Question 25
How many acres of invasive plants were treated?

Table 5. Acres of invasive plants treated on the Kaibab NF in 2014

Species	Acres
Bull Thistle (CIVU)	340
Dalmatian Toadflax (LIDA)	351
Russian Thistle (SAKA)	24
Cheatgrass (BRTE)	615
Russian olive (ELAN)	20
Scotch Thistle (ONAC)	24
Misc.	20
Total	1394

Monitoring Plan Question 26
How many springs were protected and restored?

Big Spring and Castle Spring on the NKRD were restored in FY 2014. Castle spring still needs some additional work, but it's now fenced and improved as part of the Hopi Workforce Investment spring restoration project last August. Castle Spring was restored using Traditional Ecological Knowledge of members of the Hopi Tribe. Restoration actions at Castle Spring included construction of a pool to improve water storage, removal of invasive and noxious weeds, and protection of the spring source through construction of an exclosure fence. Restoration/stewardship actions at Big Springs included stabilization of the trail leading to the spring source and removal of invasive and noxious weeds in the surrounding area. A survey of Big Springs and Castle Spring in July, 2015 indicated that there were reduced populations of invasive weeds at both sites and trail stabilization practices (BMPs) at Big Springs remain effective at preventing erosion of the trail. Water storage in the pool at the source of Castle Spring has increased and water quality has improved slightly due to installation of the livestock exclosure fence.

Monitoring Plan Question 27
How many acres of wetlands were restored?

The Duck Lake Restoration Project on Williams Ranger District restored 55 acres of wetlands in 2014.

Monitoring Plan Question 28
Are there any water bodies not meeting Arizona water quality standards?

Lake monitoring of four lakes that serve as freshwater fisheries was completed in May of 2014. The four lakes monitored were Kaibab Lake, Whitehorse Lake, Dogtown Reservoir, and Cataract Lake. No water quality concerns were found. All lakes were achieving ADEQ standards for designated uses. Water quality monitoring results are reported to ADEQ annually. All water bodies on the Kaibab are meeting ADEQ standards for designated uses.

Monitoring Plan Question 32
How many acres of cultural resource surveys were conducted?

7,529 acres of cultural resource surveys were conducted in 2014.

Monitoring Plan Question 33
How many acres of suitable timberlands were managed (TSI, harvest, etc.) for timber production?

Williams Ranger District

- 8,141 acres of total TSI which includes:
  - 108 acres of force account TSI
  - 1,603 acres of contract TSI
  - 6,430 acres of 4FRI stewardship TSI
- 88 acres of aspen release (snipping small conifers in Fenced Aspen sites)

Tusayan Ranger District

- 1,631 acres of total TSI which includes:
  - 22 acres of force account TSI
  - 84 acres of TSI w/State Thinning Crew
  - 281 acres of TSI w/ Alamo Navajo Thinning Crew
  - 1,244 acres of contract TSI

North Kaibab Ranger District

- 1,002 acres of contract TSI

Monitoring Plan Question 34
Have much wood was offered?

A total of 64,128 CCF from the Kaibab NF in FY 2014.

Interviews

Interviews are largely qualitative in nature and may be subjective. These may include questions posed to resource specialists or partners or during tribal discussions. Follow-up interpretation of the results is required to obtain information.

Monitoring Plan Question 46
Are livestock numbers balanced with forage capacity on each allotment?

In 2014 livestock numbers were balanced with forage capacity on each allotment. This was the case because the Forest received an average spring cool season growth followed by a great 2014 monsoon which produced above average forage. With this above average growth no pasture utilization levels exceeded allowable utilization standards of 30-40%.

Monitoring Plan Question 47
Are plant species of known medicinal and cultural value being depleted?

Tribal Liaison Mike Lyndon asked this question during consultation meetings with the Tribal TPAs and cultural resource advisory teams. There were no concerns expressed about depletion of any culturally important plants. There were a couple comments that they have seen an increase in certain important plants (native tobacco and osha) following thinning and fire treatments.

Monitoring Plan Question 48
Were the monitoring requirements met as identified in the AZ Bugbane conservation agreement?

The conservation agreement is currently expired. However, in preparation for the new agreement, a new and

more robust monitoring protocol was implemented better determine condition and trend of our primary and concentrated population within our botanical area. A "total station" was used to map the population on Bill Williams Mountain. This mapping device with allow us to better determine population trend over time than the former tape transect protocol. We will premeasure the population within a five year period. During the data collection, anecdotal observations indicated that the Kaibab population is robust and thriving.

Monitoring Plan Question 49
Were the monitoring requirements met as identified in the Pediocactus conservation agreement?

Starting in 2014, NKRD personnel have used survey grade GPS and a total station to better inform current status on eight of the current monitoring plots and to monitor individual plants in the plots. Weekly monitoring that begins immediately after spring snow melt has improved detectability. Although these data have not been thoroughly analyzed, they indicate that the plant is more numerous and widespread than indicated in previous monitoring. These data were used for the new (recently signed) conservation agreement.

Monitoring Plan Question 50
Were there any events or changed circumstances that would indicate a potential change to timber suitability?

Changes to timber suitability can occur through a project-level decision or policy change. Because the recently revised plan had reviewed and recalculated timber suitability, no additional adjustments were needed at this time.

Intensive

Intensive monitoring informs the status of key ecological attributes for focal ecological resources at fine spatial scales or spatial resolution, although measurements in multiple locations can provide wide spatial coverage. Data sources might include simple to complex field-based metrics that are usually quantitative and collected within a statistical sampling design. Examples include surveys of birds to assess density levels, analyses involving specific soil and water chemistry parameters, and quantitative vegetation structure measurements.

Monitoring Plan Question 53
In treated/protected areas are water flow patterns and vegetation intact?

The Museum of Northern Arizona's Springs Stewardship Institute completed inventories and assessments of 8 spring ecosystems on the Kaibab National Forest during fiscal year 2014 using the Springs Ecosystem Assessment Protocol (SEAP). These springs inventories and assessments are part of a larger project that was implemented under a cost-share agreement. Data captured during the inventories and assessments are valuable for assessing restoration opportunities and providing a baseline from which to evaluate restoration responses and successes and for long term forest plan monitoring. Data captured during each spring survey include the following: geomorphology, soils, geology, solar radiation, flora, fauna, water quality, flow, georeferencing, and cultural resources, as well as assessment of the site's ecological integrity and risks. Details of the eight spring inventories for FY 2014 can be found in Appendix A. The complete springs inventory database is available on the Springs Stewardship Institute website available at http://springstewardshipinstitute.org/about-the-database

Monitoring Plan Question 54
What is the estimated population trend for Graces warbler, western bluebird and ruby-crowned kinglet?

The Kaibab NF continued its multiyear project with Rocky Mountain Bird Observatory (RMBO) to gather long-term trend data for populations of most diurnal, regularly breeding bird species in the forest. In the short term, this program provides information needed to effectively manage and conserve bird

populations on the forest. It also supports the forest's efforts to comply with requirements set forth in the National Forest Management Act and other law, regulation, and policy. Stratification by elevation allows for adjusting sampling intensity to target management indicator species (MIS) on the Forest.

In 2014, field technicians completed all 40 planned surveys (100%). They conducted 571 point counts within the 40 surveyed grid cells between 6 May and 20 June. They detected 105 species, including 3 MIS. RMBO estimated densities and population sizes for 83 species, 3 of which are MIS. The data yielded robust density estimates (Coefficient of Variation (CV) < 50%) for 42 of these species.

RMBO estimated the proportion of 1 km^2 grid cells occupied (Psi) throughout Kaibab National Forest for 87 species, 3 of which are MIS. The data yielded robust occupancy estimates (CV < 50%) for 53 of these species.

The data collected by the RMBO is located in the Rocky Mountain Avian Data Center, http://rmbo.org/v3/avian/Home.aspx. This data is used to help determine population trends. As noted above a CV less than 50% show that the enough data was collected to have a robust estimate for the species for either density or occupancy. The lower the CV percentage the more robust is the data. Starting with the 2010 survey data the RMBO was able to do estimated proportion of transects (Psi) occupied by species. A Psi estimate equal to 1 indicates the species was detected on all transects surveyed (White et al. 2011).

Grace's Warbler

It should be noted that the density estimates for 2010-2014 are lower than in previous years (Table 6). There may be is likely some unexplained year-to-year variation, but more likely it was the change in stratification methods and the amount of survey efforts. It is important to view the table by changes within each grouping and not by changes between 2005 and 2014.

In 2012, the forest began stratifying survey effort based on elevation with a high stratum (6500 ft. and above) and a lower stratum (below 6500 ft.) to capture all other species. The new stratification by elevation allows for adjusting sampling intensity for MIS within the respective strata. In Table 6 below, species density for just the high elevation surveys does increase in 2012 through 2014. Although it is lower than previous years, it still falls within the overall range found on the forest since 2005. However, Table 7 shows that the occupancy estimates for 2012 and 2013 are similar to 2010 and 2011 for all transects. Occupancy estimates are higher for 2012 and 2013 for the high strata only.

Table 6. Grace's Warbler Density Estimates (RMBO Website; 7/14/2015)

Stratum	Habitat	Year	Density[1]	Population Estimate	%CV	n[2]
AZ-MC	MC	2005	36.78		49	10
AZ-MC	MC	2006	4.93		39	18
AZ-MC	MC	2007	14.76		61	13
AZ-MC	MC	2008	24.14		41	50
AZ-MC	MC	2009	21.42		41	27
AZ-PP	PP	2005	34.21		23	97
AZ-PP	PP	2006	25.24		23	76
AZ-PP	PP	2007	24.84		23	117
AZ-PP	PP	2008	24.76		24	147
AZ-PP	PP	2009	36.79		27	189
KAIOLD-KF		2010	19.43	116,387	22	158
KAIOLD-KF		2011	18.16	108,766	25	139
Kaibab KH		2012	7.66	33,072	30	21
Kaibab KH		2013	11.06	47,785	40	54
Kaibab KH		2014	13.08	56,503	19	117
Kaibab KL		2012	2.29	4,998	98	8

Stratum	Habitat	Year	Density[1]	Population Estimate	%CV	n[2]
Kaibab KL		2013	1.25	2,733	101	4
Kaibab Forest		2012	5.86	38,070	30	29
Kaibab Forest		2013	7.77	50,517	38	58
Kaibab Forest		2014	8.69	56,503	19	117

[1] Density = birds per kilometer squared
[2]n = number of detections used for analysis
KH = Stratum 6500 feet and above
KL = Stratum below 6500 feet

Occupancy estimates for the Grace's warbler was done for surveys efforts from 2010 and 2014 based when the RMBO changed the survey methods to be able to determine Psi. As noted above when you only look at the high strata for 2012-2014, this represents the majority of the habitat for the species.

Table 7. Grace's Warbler Occupancy Estimates (RMBO Website; 07/14/2015)

Stratum	Year	Transects	Psi	SE	%CV
KAIOLD-KF	2010	19	0.425	0.052	12
KAIOLD-KF	2011	20	0.446	0.074	17
Kaibab Forest	2012	7	0.437	0.109	25
Kaibab Forest	2013	11	0.406	0.085	21
Kaibab Forest	2014	22	0.490	0.054	11
Kaibab KH	2012	6	0.607	0.157	26
Kaibab KH	2013	10	0.560	0.118	21
Kaibab KH	2014	22	0.737	0.081	11
Kaibab KL	2012	1	0.100	0.095	95
Kaibab KL	2013	1	0.100	0.095	95

Occupancy model results for the Grace's warbler show that 245,417 acres are of high quality habitat and 132,161 acres are of moderate quality, for a total of 377,578 acres within ponderosa pine based on occupancy potential (Dickson et al 2011). It should be noted that the occupancy modeling for potential distribution of Grace's warblers is for the whole KNF not just for ponderosa pine PNTV. While most areas outside of ponderosa pine PNVT are shown as no occurrence or very low potential, some areas especially in frequent fire mixed conifer PNVT that have a high occurrence of ponderosa pine within that PNVT are also shown as providing habitat for Grace's warbler. In Figure 1, the occupancy probability colors range from high occurrence (shown in blue with a value of 1) to no occurrence (shown in orange with a value of 0).

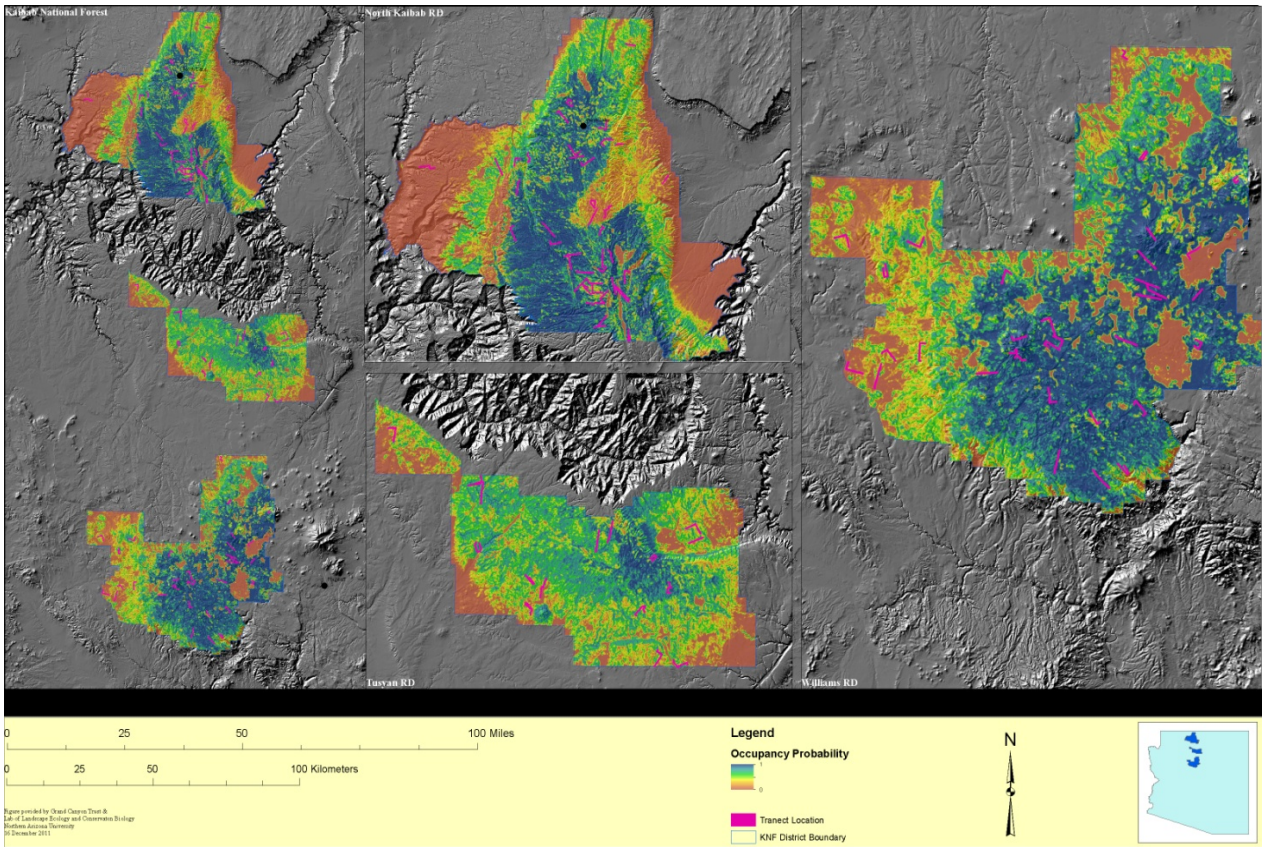

Figure 1. Spatially explicit model of Grace's Warbler occupancy on the Kaibab National Forest (Arizona, USA), 2010 (Dickson et al. 2011).

Western Bluebird

As with the Grace's warbler, the density estimates should be view as within different type of strata groups instead of looking all the years together. Majority of the habitat used by the western bluebird is within the ponderosa pine about 6500 feet elevation. While there does appear to be a drop in density for 2012 and 2013, this could had been dependent on the amount of survey effort or other unknown reasons.

Table 8. Western Bluebird Density Estimates (RMBO Website; 7/14/2015)

Stratum	Habitat	Year	Density[1]	Population Estimate	%CV	n[2]
AZ-PP	PP	2005	28.08		27	38
AZ-PP	PP	2006	32.56		20	47
AZ-PP	PP	2007	31.14		19	64
AZ-PP	PP	2008	34.96		19	96
AZ-PP	PP	2009	33.59		16	101
AZ-WG	WG	2009	14.85		37	55
KAIOLD-KF		2010	19.08	114,281	20	90
KAIOLD-KF		2011	17.27	103,478	18	88
Kaibab KH		2012	6.54	28,252	37	12
Kaibab KH		2013	14.19	61,275	28	38
Kaibab KH		2014	31.52	136,154	17	103
Kaibab KL		2012	3.85	8,405	43	6
Kaibab KL		2014	6.97	15,215	80	4
Kaibab Forest		2012	5.64	36,658	31	18

Stratum	Habitat	Year	Density[1]	Population Estimate	%CV	n[2]
Kaibab Forest		2013	9.43	61,275	28	38
Kaibab Forest		2014	23.28	151,368	17	107

[1] Density = birds per kilometer squared
[2]n = number of detections used for analysis
KH = Stratum 6500 feet and above
KL = Stratum below 6500 feet

Occupancy estimates for the western bluebird was done for surveys efforts from 2010 and 2014 based when the RMBO changed the survey methods to be able to determine Psi. As noted above when you only look at the high strata for 2012-2014, this represents the majority of the habitat for the species.

Table 9. Western Bluebird Occupancy Estimates (RMBO Website; 07/14/2015)

Stratum	Year	Transects	Psi	SE	%CV
KAIOLD-KF	2010	19	0.425	0.052	12
KAIOLD-KF	2011	20	0.446	0.074	17
Kaibab Forest	2012	6	0.607	0.157	26
Kaibab Forest	2013	1	0.1	0.095	95
Kaibab Forest	2014	7	0.437	0.109	25
Kaibab KH	2012	10	0.56	0.118	21
Kaibab KH	2013	1	0.095	0.095	95
Kaibab KH	2014	11	0.406	0.085	21
Kaibab KL	2012	22	0.737	0.081	11
Kaibab KL	2013	22	0.49	0.054	11

Occupancy model results for the western bluebird show that 417,111 acres within the ponderosa pine are high quality habitat while 64,315 acres are of moderate habitat quality, for a total of 481,426 acres with potential occupancy (Dickson et al 2011). It should be noted that the occupancy modeling for potential distribution of western bluebirds is for the whole KNF not just for ponderosa pine PNTV. While most areas outside of ponderosa pine PNVT are shown as no occurrence or very low potential, some areas especially in frequent fire mixed conifer PNVT that have a high occurrence of ponderosa pine within that PNVT are also shown as providing habitat for the western bluebird.

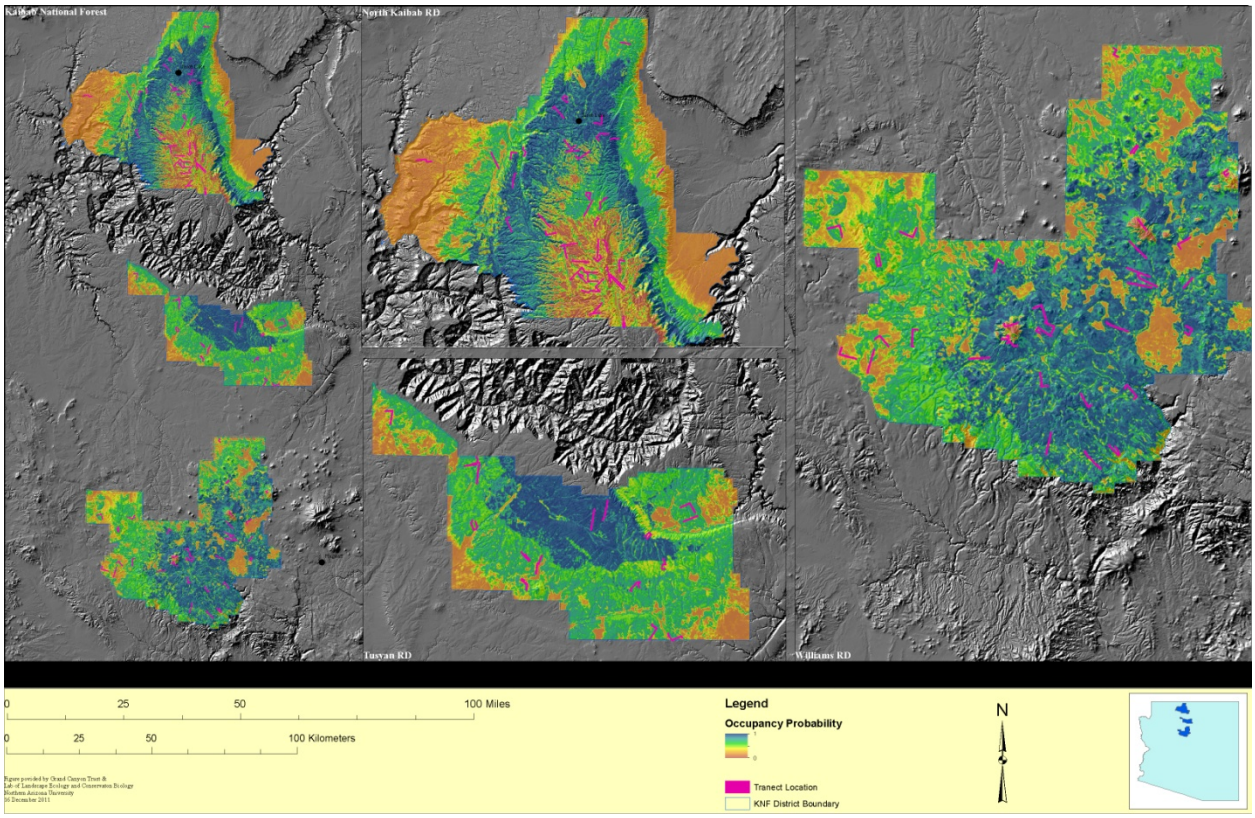

Figure 2. Spatially explicit model of Western Bluebird occupancy on the Kaibab National Forest (Arizona, USA), 2010 (Dickson et al. 2011).

Ruby-crowned Kinglet

The Forest has collected data on the ruby-crowned kinglet since 2005 (Table 10). In 2010 surveys were based on a new sample design and the amount of surveys within mixed conifer stands was greatly reduced. As a result there were not enough ruby-crowned kinglets found to conduct a density estimate. In 2012, only 20 transects were done for the whole forest. Due to the limited amount of randomly selected transects within mixed-confer stands, no ruby-crowned kinglets were found that year.

Table 10. Ruby-crowned Kinglet Density Estimates (RMBO Website; 7/14/2015)

Stratum	Habitat	Year	Density[1]	Population Estimate	%CV	n[2]
AZ-MC	MC	2005	45.47		34	17
AZ-MC	MC	2006	19.13		22	96
AZ-MC	MC	2007	46.22		21	56
AZ-MC	MC	2008	66.69		18	189
AZ-MC	MC	2009	102.23		22	176
KAIOLD-KF		2010	5.7	34,156	34	17
KAIOLD-KF		2011	5.34	31,971	22	96
Kaibab KH		2013	1.72	7,428	99	8
Kaibab KH		2014	4.89	21,119	57	36
Kaibab Forest		2013	1.14	7,428	99	8
Kaibab Forest		2014	3.25	21,119	57	36

[1] Density = birds per kilometer squared
[2]n = number of detections used for analysis
KH = Stratum 6500 feet and above
KL = Stratum below 6500 feet

Occupancy estimates for the ruby-crowned kinglet was done for surveys efforts from 2010 and 2014 based when the RMBO changed the survey methods to be able to determine Psi. As noted above there is no data for 2012 due to no detections.

Table 11. Ruby-crowned Kinglet Occupancy Estimates (RMBO Website; 07/14/2015)

Stratum	Year	Transects	Psi	SE	%CV
KAIOLD-KF	2010	5	0.113	0.046	41
KAIOLD-KF	2011	4	0.089	0.042	48
Kaibab Forest	2013	1	0.039	0.038	97
Kaibab Forest	2014	4	0.086	0.042	47
Kaibab KH	2013	1	0.058	0.057	97
Kaibab KH	2014	4	0.134	0.063	47

The occupancy modeling results for the ruby-crowned kinglet show that 17,112 acres within the mixed-conifer are of high quality habitat while 2,997 acres are moderate quality. It should be noted that the occupancy modeling for potential distribution of western bluebirds is for the whole KNF not just for mixed conifer PNTV. While most areas outside of mixed conifer PNVT are shown as no occurrence or very low potential, some areas especially in ponderosa pine PNVT that is shown as providing habitat for the western bluebird.

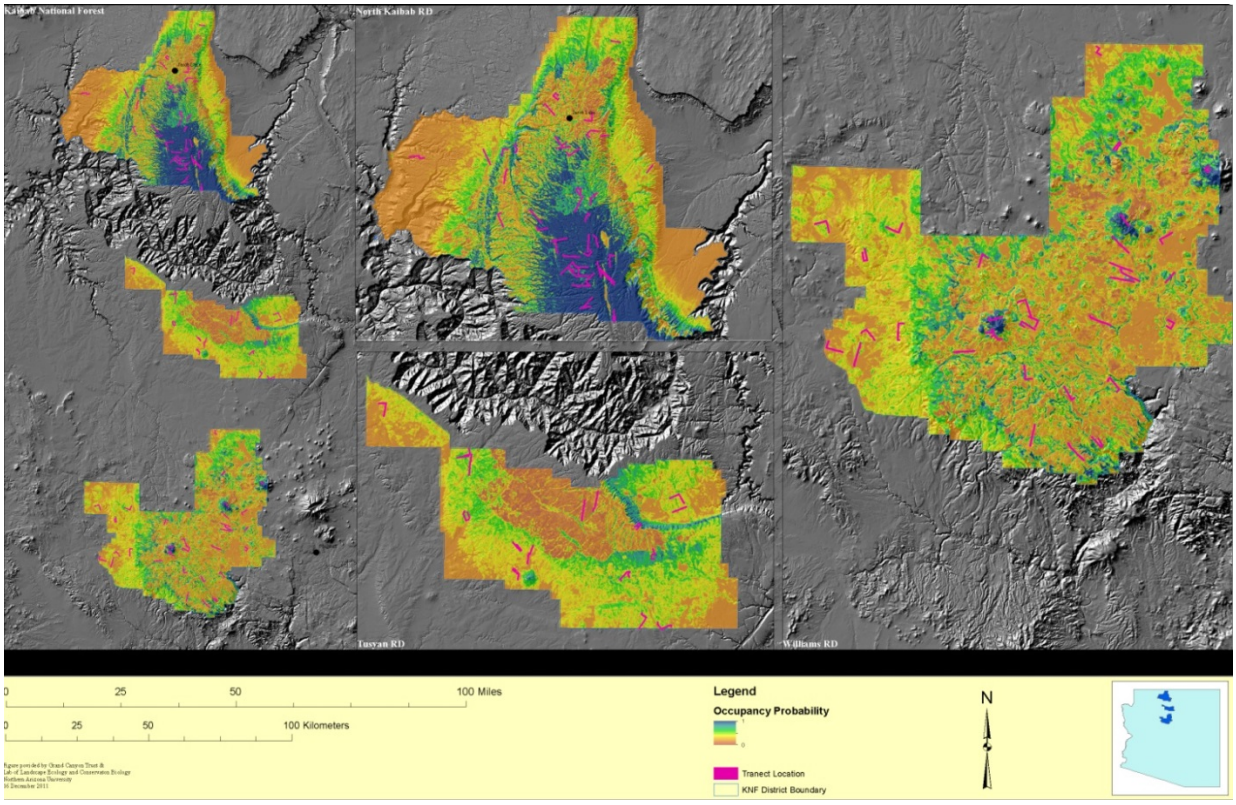

Figure 3. Spatially explicit model of Ruby-crowned Kinglet occupancy on the Kaibab National Forest (Arizona, USA), 2010 (Dickson et al. 2011).

Monitoring Plan Question 55
Are Mexican spotted owls present in PACs?

There are seven designated Mexican spotted owl Protected Activity Centers (PAC) on the Kaibab NF, all on the Williams Ranger District. Five of the seven PAC's were monitored during the 2014 field season. Mexican spotted owls were detected in three of those five PACs using protocols described in the 2012 U.S. Fish and Wildlife Service Mexican spotted owl Recovery Plan. The Revised Recovery Plan for the Mexican spotted owl includes a new occupancy based approach for monitoring population trends, which is expected to be more efficient and yield more statistically robust data on trends over time. Mexican spotted owls were detected in Bill Williams, Kendrick, and Pumpkin PACs. There were no detections in the McCracken or Sitgreaves PACs, and the Big Springs and Tule PACs were not monitored.

Bill Williams PAC
The Bill Williams PAC was surveyed on 5-21 at call stations W3, W6, and W7. A male Mexican spotted owl responded near call station W3 after that call station was completed while the surveyors were walking toward the next call station. A daytime follow-up survey was conducted. No Mexican spotted owls were detected on the follow-up. The PAC was surveyed again on 6-3 and 7-22 at call stations W2 and W3. No Mexican spotted owls were detected on either date. Flammulated owls were detected at call stationW3 and a great horned owl was detected at call station W2. See figure 1.

Kendrick PAC
The Kendrick PAC was surveyed on 5-15 at one call stations. A female responded14 minutes after calling was initiated. No other owls were detected. A daytime follow-up survey was not conducted. The PAC was surveyed again on 6-9. One male and one female Mexican spotted owl responded and were visually observed. Upon first sighting, the male was perched in a 10 inch DBH Douglas fir and the female was perched in a 24 inch ponderosa pine snag.

A daytime follow-up survey was conducted on 6-11. After initiating calling the male and female both flew in to caller. Mousing was immediately initiated. Both owls took a mouse and flew to a nearby perch. The male consumed the mouse but did not return for another while the female did not consume the mouse and just stayed on the perch grasping the mouse in her talons. Thirty minutes after initiating mousing the survey was concluded. See figure 2.

McCracken
The McCracken PAC was surveyed on 3-26, 5-28, and 7-2. No Mexican spotted owls were detected. The PAC was not surveyed to protocol. See figure 3.

Pumpkin PAC
The Pumpkin PAC was surveyed on 5-14 and 7-1 on a continuous call route. A male Mexican spotted owl responded on 7-1 near the historic nest site. A daytime follow-up survey was conducted early morning on 7-3. No Mexican spotted owls were detected on the follow-up. A northern saw-whet owl was detected on 5-14. See figure 4.

Sitgreaves PAC
The Sitgreaves PAC was surveyed on 5-13 and 6-18. We called continuously throughout the entire nest core and down the canyon (approximately ½ mile). No Mexican spotted owls were detected. The PAC was not surveyed to protocol. See figure 5.

Monitoring Plan Question 57
What is the population trend of Pediocactus peeblesianus var. fickeisenii?

Pediocactus peeblesianus var. fickeisenii is a Candidate species. In FY 2014, the Kaibab continued a systematic inventory using a total station to establish a baseline understanding of population sizes and distributions. Many new plants were found in areas known to be occupied. Searches of similar habitat in other locations did not yield new populations. Repeat visits will be conducted inform population trends over time.

Other Plan Related Monitoring

Northern Goshawk – Ten goshawk PFAs were surveyed on the Williams and Tusayan Districts with approximately 40% of the PFAs having goshawks detected.

Golden Eagles – Ten nest areas were surveyed with nesting eagles found at 1 site.

Bald Eagles – One nest at Whitehorse lake was detected and monitored over the season with one chick successfully fledged.

Peregrine Falcons - Three historic nest sites surveyed with one site being occupied by nesting birds at Eagle Rock (D1) successfully fledging 2 chicks two chicks.

Prairie Dogs - Surveys in both D1 and D4 found that most colonies were stable or increasing. Two colonies in Garland Prairie was vacant, with no animals detected

Burrowing Owl Surveys were conducted at all Prairie Dog surveys. None were recorded on the forest.

Shorebird Survey at Coleman Lake – a Least Bittern was observed. This is the only known observation of least bittern at Coleman Lake.

Disturbed Rabbitbrush – A field survey was completed on the forest for Forest Service Sensitive Species, Disturbed Rabbitbrush (*Chrysothamnus molestus* (Blake). A full report is on file at the Kaibab Supervisor's Office. Based on the results, botanist recommended that before any restoration treatments are done in *Chrysothamnus molestus* habitat, the populations should be monitored during the flowering period in the late summer to determine their success. The preliminary data regarding the effects of fire and disturbance should be evaluated before treatments begin to help determine the appropriate timing. It is recommended that large old junipers be retained and resultant litter maintained to provide shelter for *C. molestus* plants.

Chrysothamnus molestus is found in the fringe habitat of open, contiguous Great Basin grasslands. This habitat type has a unique composition of plant and animal species such as antelope. It would be beneficial to learn more about what is necessary for the proper management of this habitat type in order to positively benefit the plant and animal species dependent on it and avoid having inadvertent detrimental impacts through management actions. It is important to increase good habitat for wildlife including increasing shrubs like four---wing saltbush and winterfat; however, increasing those species might be detrimental to *C. molestus*. Further study is needed to determine the effects of increasing shrub density on *C. molestus*. A habitat management plan for the fragile *Chrysothamnus molestus* habitat would be beneficial.

References

USDA Forest Service. 2014. Forest insect and disease conditions in the Southwestern Region, 2014. Region 3: Albuquerque, NM.

USDI Fish and Wildlife Service (USFWS). 2012. Recovery Plan for the Mexican Spotted owl (*Strix occidentalis lucida*), First Revision. USFWS, Albuquerque, New Mexico USA. 414 pp. Available at http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/MSO/2012MSO_Recovery_Plan_Firs

Appendix A. 2014 Springs Inventory Data

1. Campbell Spring SKNF

Location: The Campbell Spring SKNF ecosystem is located in Coconino County in the Upper Verde. Arizona. 15060202 HUC, managed by the US Forest Service. in the Williams South USGS Quad. The elevation is approximately 2005 meters. Larry Stevens, Glenn Rink and Jeri Ledbetter surveyed the site on 6/21/14 for 02:00 hours, beginning at 15:30, and collected data in 9 of 12 categories.

Fig 1.1 Campbell Spring SKNF.

Physical Description: Campbell Spring SKNF is a rheocrene spring. In 2014, Campbell Spring was depicted on the DRG, and was said to be PFC by a surveying hydrologist. It is located in a channel, with several sources emerging from fractured rock. The microhabitats associated with the spring cover 341 sqm. The site has 4 microhabitats, including A -- a 57 sqm pool, B -- a 88 sqm channel, C -- a 160 sqm terrace, D -- a 36 sqm terrace. Geomorphic diversity is 0.54, based on the Shannon-Weiner diversity index.

Campbell Spring SKNF emerges as a seepage or filtration spring from the basalt flow, a igneous, basalt rock layer. The emergence environment is subaerial, with a gravity flow force mechanism. The distance to the nearest spring is 1447 meters. The site receives approximately 0% of available solar radiation, with 0 Mj annually.

Survey Notes: The spring emerges from a bench of exposed bedrock at the side of a wide canyon. The site is forested and moderately influenced by surface flow. There was some evidence of past cattle grazing, and moderate trampling by elk.

Table 1.1 Campbell Spring SKNF Water Quality with multiple readings averaged.

Characteristic Measured	Average Value
pH (field)	9.945
Salinity (field) (ppt)	0.079
Specific conductance (field) (uS/cm)	143.285
Temperature, water C	31.4

Flora: Surveyors identified 30 plant species at the site, with 0.088 species/sqm. These included 18 native and 12 nonnative species.

Table 1.2 Campbell Spring SKNF Cover Type, Percent Cover, and Wetland Species.

Cover Type	Species Count	Percent Cover	Wetland Species Count	Wetland % Cover
Ground	24	0.05	9	0
Shrub	2	0.06	0	0
Mid-canopy	0	0	0	0
Tall canopy	0	0	0	0
Basal	0	0	0	0
Aquatic	3	0.04	3	0
Non-vascular	1	28.5	0	0

Table 1.3 Campbell Spring SKNF Vegetation % Cover in Microhabitats.

Species	Cover Code	Native Status	Wetland Status	A	B	C	D	E	F	G	H	I	J	K	L
Achillea millefolium	GC	N	U	0	0	0.01	0	0	0	0	0	0	0	0	0
algae sp	AQ	N	A	10	1	0	0	0	0	0	0	0	0	0	0
Alisma triviale	AQ	N	W	0.2	0.5	0	0	0	0	0	0	0	0	0	0
Alopecurus aequalis	GC	N	U	0	0.02	0	0	0	0	0	0	0	0	0	0
Ambrosia	GC		F	0	0	0.1	0	0	0	0	0	0	0	0	0
Amorpha fruticosa	SC	N	F	0	0	0	8	0	0	0	0	0	0	0	0
Bromus commutatus	GC	I	U	0	0	1	0	0	0	0	0	0	0	0	0
Bromus tectorum	GC	I	F	0	0	1	0	0	0	0	0	0	0	0	0
Carex occidentalis	GC	N	W	0	0	0.5	0	0	0	0	0	0	0	0	0
Carex subfusca	GC	N	W	0	0	2	0	0	0	0	0	0	0	0	0
Eleocharis palustris	GC	N	W	0	1	5	20	0	0	0	0	0	0	0	0
Epilobium ciliatum	GC	N	W	0	0	0	0.5	0	0	0	0	0	0	0	0
Hordeum jubatum	GC	N	WR	0	0	0.01	0	0	0	0	0	0	0	0	0
Iris missouriensis	GC	N	F	0	0.1	0.5	0	0	0	0	0	0	0	0	0
Juncus interior	GC	N	U	0	0.01	1	1	0	0	0	0	0	0	0	0
Lichen	NV	N	U	0	0	0.01	0.01	0	0	0	0	0	0	0	0
Melilotus officinalis	GC	I	WR	0	0	1	0	0	0	0	0	0	0	0	0
Muhlenbergia rigens	GC	N	U	0	0.01	5	20	0	0	0	0	0	0	0	0
Poa pratensis	GC	I	F	0	0	2	0	0	0	0	0	0	0	0	0
Potamogeton nodosus	AQ	N	A	2	2	0	0	0	0	0	0	0	0	0	0
Rosa woodsii	SC	N	F	0	0	0	1	0	0	0	0	0	0	0	0
Rumex californicus	GC		F	0	0	0.01	0	0	0	0	0	0	0	0	0
Rumex crispus	GC	I	WR	0	0.1	0	0.1	0	0	0	0	0	0	0	0
Thalictrum fendleri	GC	N	F	0	0	0	3	0	0	0	0	0	0	0	0
Thermopsis pinetorum	GC		F	0	0	2	0	0	0	0	0	0	0	0	0
Trifolium repens	GC	I	WR	0	0	0	8	0	0	0	0	0	0	0	0

unknown dicot	GC			0	0	0.01	0	0	0	0	0	0	0	0	0
unknown Moss	GC			0	0	0	0.1	0	0	0	0	0	0	0	0
Verbascum thapsus	GC	I	F	0	0	0.01	0	0	0	0	0	0	0	0	0
Veronica	GC	N	A	0	0.02	0	0.01	0	0	0	0	0	0	0	0

Fauna: Surveyors collected or observed 2 aquatic and 21 terrestrial invertebrates and 5 vertebrate specimens.

Table 1.4 Campbell Spring SKNF Invertebrates.

Species	Lifestage	Habitat	Method	Count	Species detail
Odonata Libellulidae Libellula saturata	Ad	T	Spot	6	
Lepidoptera Nymphalidae Junonia coenia	Ad	T	Spot		
Decapoda	Ad	A	Spot	2	1 dead, 1 huge live
Coleoptera Coccinellidae	Ad	T		1	
Coleoptera	Ad			1	
Coleoptera Buprestidae	Ad	T		1	
Coleoptera Carabidae	Ad	T		1	
Coleoptera Lycidae	Ad	T		1	
Diptera	Ad	T		1	
Diptera Asilidae Promachus albifacies	Ad	T		1	
Diptera Tachinidae	Ad	T		1	
Diptera Therevidae	Ad	T		1	
Hemiptera Gerridae	Ad	A		1	
Homoptera Cicadellidae	Ad	T		1	
Hymenoptera	Ad	T		1	
Hymenoptera Braconidae	Ad	T		1	

Hymenoptera Megachilidae Megachile subexilis	Ad	T		1	
Hymenoptera Pompilidae	Ad	T		1	
Hymenoptera Sphecidae	Ad	T		1	
Hymenoptera Sphecidae Chalybion californicum	Ad	T		1	
Hymenoptera Vespidae	Ad	T		1	
Orthoptera Acrididae	Ad	T		1	
Orthoptera Gryllidae	Ad	T		1	
Coleoptera Carabidae Galerita	Ad	T		1	
Hemiptera Scutelleridae	Ad			1	

Table 1.5 Campbell Spring SKNF Vertebrates.

Species Common Name	Qty	DetectionType
dark-eyed junco	1	obs
house wren	1	call
elk		sign
domestic cow		sign
tree lizard	1	obs

Assessment: Assessment scores were compiled in 6 categories and 36 subcategories, with 6 null condition scores, and 1 null risk score. Aquifer functionality and water quality are good with significant restoration potential and there is negligible risk. Geomorphology condition is good with significant restoration potential and there is negligible risk. Habitat condition is good with significant restoration potential and there is low risk. Biotic integrity is good with significant restoration potential and there is low risk. Human influence of site is good with significant restoration potential and there is negligible risk. Administrative context status is poor with limited restoration potential and there is low risk. Overall, the site condition is good with significant restoration potential and there is low risk.

Table 1.6 Campbell Spring SKNF Assessment Scores.

Category	Condition	Risk
Aquifer Functionality & Water Quality	4	1.7

Geomorphology	4	1.4
Habitat	4.2	2.6
Biota	4.4	2.4
Human Influence	4.8	1.6
Administrative Context	2.7	1.9
Overall Ecological Score	4.1	1.9

Management Recommendations: Remove crayfish and monitor periodically.

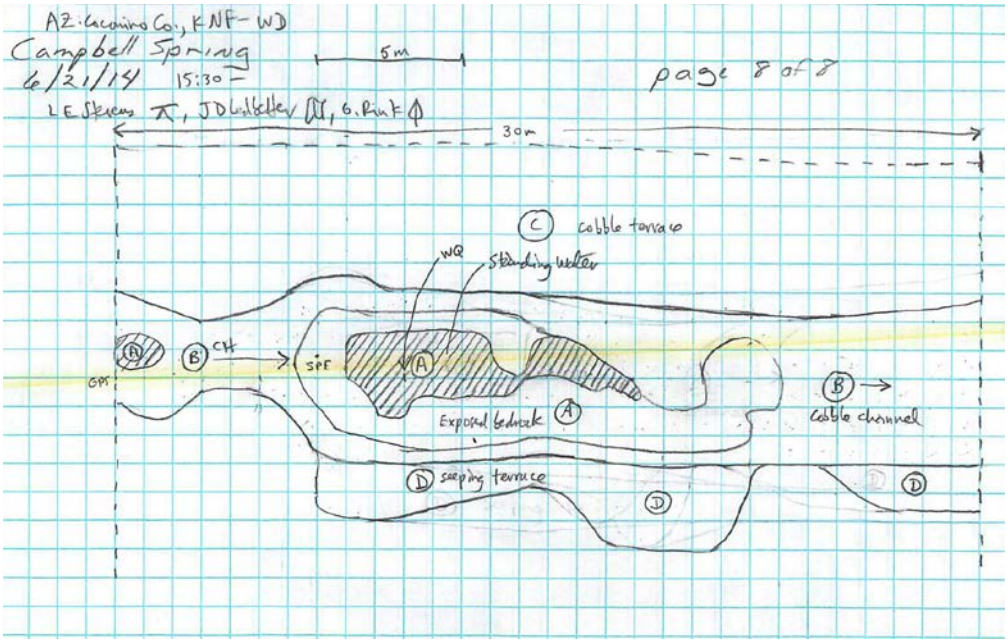

Fig 1.2 Campbell Spring SKNF Sketchmap.

2. Fues Spring

Location: The Fues Spring ecosystem is located in Coconino County in the Havasu Canyon. Arizona. 15010004 HUC, managed by the US Forest Service. The spring is located in the Williams North USGS Quad. The elevation is approximately 2075 meters. A Prescott College Class, Jeri Ledbetter, Larry Stevens, Glenn Rink, and Mason Stansfield surveyed the site on 5/26/14 for 00:50 hours, beginning at 9:50, and collected data in 8 of 12 categories.

Fig 2.1 Fues Spring.

Physical Description: This named site is depicted on the DRG. This site consists of a large pipe in the ground with a circular man-hole type cover over a cylindrical vertical culvert that is 80 cm wide in diameter with water in it. The site is eight meters from Hwy 64. There are four pipes on the inside of the cylindrical tank. The microhabitats associated with the spring cover 9.62 sqm. The site has 2 microhabitats, including A -- a 0.64 sqm pool, B -- a 8.98 sqm colluvial slope. Geomorphic diversity is 0.11, based on the Shannon-Weiner diversity index.

Fues Spring emerges as a seepage or filtration spring from a igneous, basalt rock layer in an unknown unit. The emergence environment is subaerial, with a gravity flow force mechanism. The distance to the nearest spring is 10317 meters.

Survey Notes: There is a cylindrical vertical culvert with approximately three feet of water in it. There are four pipes 3 1/2 feet down and another four pipes further down, near the bottom of the tank. There is a small tube next to the main culvert that is closed with a bent lid. There was a dead lizard at the bottom.

Table 2.1 Fues Spring Water Quality with multiple readings averaged.

Characteristic Measured	Average Value
pH (field)	8.13
Salinity (field) (ppt)	2.81
Specific conductance (field) (uS/cm)	5366
Temperature, water C	14.7

Flora: Surveyors identified 15 plant species at the site, with 1.5593 species/sqm. These included 1 native and 14 nonnative species.

Table 2.2 Fues Spring Cover Type, Percent Cover, and Wetland Species.

Cover Type	Species Count	Percent Cover	Wetland Species Count	Wetland % Cover
Ground	15	0.01	4	0
Shrub	0	0	0	0
Mid-canopy	0	0	0	0
Tall canopy	0	0	0	0
Basal	0	0	0	0
Aquatic	0	0	0	0
Non-vascular	0	0	0	0

Table 2.3 Fues Spring Vegetation % Cover in Microhabitats.

Species	Cover Code	Native Status	Wetland Status	A	B	C	D	E	F	G	H	I	J	K	L
Ambrosia	GC		F	0	1	0	0	0	0	0	0	0	0	0	0
Amsonia	GC			0	0.01	0	0	0	0	0	0	0	0	0	0
Bromus tectorum	GC	I	F	0	1	0	0	0	0	0	0	0	0	0	0
Elymus elymoides	GC	N	F	0	10	0	0	0	0	0	0	0	0	0	0
Gaura hexandra	GC		U	0	2	0	0	0	0	0	0	0	0	0	0
Grindelia	GC		F	0	5	0	0	0	0	0	0	0	0	0	0
Hordeum	GC		WR	0	20	0	0	0	0	0	0	0	0	0	0
Kochia scoparia	GC		F	0	1	0	0	0	0	0	0	0	0	0	0
Lactuca serriola	GC	I	WR	0	1	0	0	0	0	0	0	0	0	0	0
Lamiaceae	GC			0	0.5	0	0	0	0	0	0	0	0	0	0
Melilotus	GC	I	WR	0	1	0	0	0	0	0	0	0	0	0	0
Polygonum aviculare	GC	I	W	0	0.5	0	0	0	0	0	0	0	0	0	0
Rumex spinosus	GC		U	0	6	0	0	0	0	0	0	0	0	0	0
unknown Forb (herbaceous, not grass nor grasslike)	GC			0	10	0	0	0	0	0	0	0	0	0	0

Fauna: Surveyors collected or observed 1 terrestrial invertebrates and 2 vertebrate specimens.

Table 2.4 Fues Spring Invertebrates.

Species	Lifestage	Habitat	Method	TotalReps	Count	Species detail
Coleoptera Carabidae Nebria			Spot		1	
Coleoptera Coccinellidae Hippodamia convergens	Ad	T	Spot		1	
Coleoptera	Ad				1	

Table 2.5 Fues Spring Vertebrates.

Species Common Name	Qty	DetectionType
lizard		obs
elk		sign

Assessment: Assessment scores were compiled in 6 categories and 39 subcategories, with 3 null condition scores, and 1 null risk score. Aquifer functionality and water quality are very poor with very limited restoration potential and there is very high risk. Geomorphology condition is very poor with very limited restoration potential and there is very high risk. Habitat condition is poor with limited restoration potential and there is high risk. Biotic integrity is very poor with very limited restoration potential and there is high risk. Human influence of site is poor with limited restoration potential and there is moderate risk. Administrative context status is poor with limited restoration potential and there is low risk. Overall, the site condition is poor with limited restoration potential and there is high risk.

Table 2.6 Fues Spring Assessment Scores.

Category	Condition	Risk
Aquifer Functionality & Water Quality	1.8	5
Geomorphology	1	5
Habitat	2.2	4.4
Biota	1.1	4.5
Human Influence	2.6	3.3
Administrative Context	2.3	2.8
Overall Ecological Score	1.9	4

Management Recommendations: This site can be used to monitor roadway salt contribution to shallow groundwater, which is alarmingly high here. The site has been sacrificed to ADOT and road construction/maintenance.

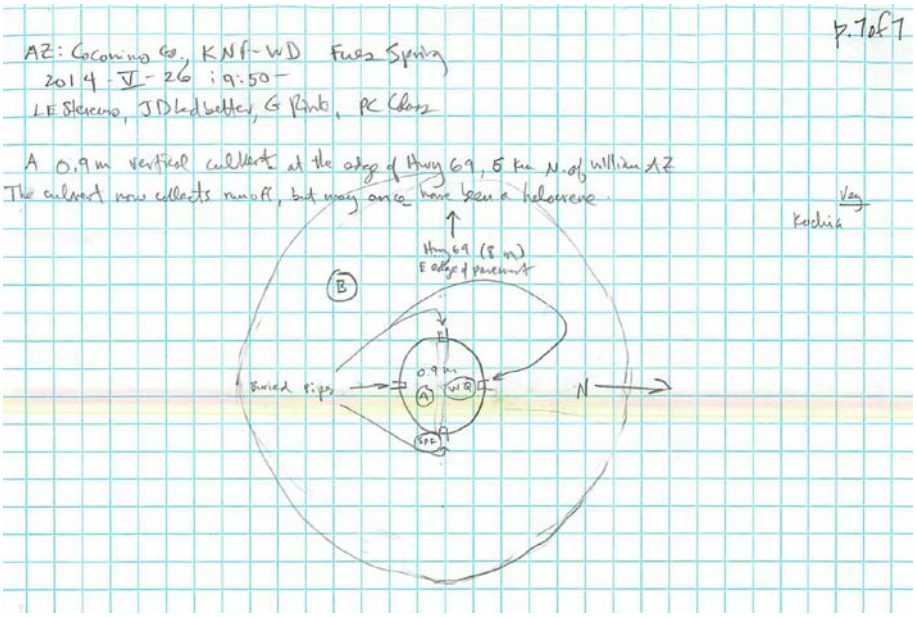

Fig 2.2 Fues Spring Sketchmap.

3. L O Spring

Location: The L O Spring ecosystem is located in Coconino County in the Upper Verde. Arizona. 15060202 HUC, managed by the US Forest Service. The spring is located in the Garland Prairie USGS Quad. The elevation is approximately 2041 meters. Larry Stevens, Jeri Ledbetter, and Glenn Rink surveyed the site on 6/22/14 for 03:15 hours, beginning at 13:15, and collected data in 7 of 12 categories.

Fig 3.1 L O Spring.

Physical Description: L O Spring is a hillslope/rheocrene spring. This named site is located in the headwaters of Sycamore Canyon, and is depicted on the DRG. Surveyed by Flora in 2004, it was reported to be a limnocrene spring emerging from a basalt layer. In 2014, SSI surveyors found a large springs complex with four discreet hillslope sources, and probably diffuse emergence, in a wide, shallow channel, heavily influenced by runoff. The site is in a forested area, within 500 meters of a parking lot. The flow was reported in 1949 as 0.0631 in the Arizona GWSI database. The microhabitats associated with the spring cover 6563 sqm. The site has 7 microhabitats. Geomorphic diversity is 0.25, based on the Shannon-Weiner diversity index.

L O Spring emerges as a seepage or filtration spring from the Igneous colluvium, a igneous, basalt rock layer. The emergence environment is subaerial, with a gravity flow force mechanism. The distance to the nearest spring is 120 meters.

Survey Notes: The site was in good condition with limited trampling. There were large areas of dead typha. Polygons were designated but no areas given so polygon areas are from the 2015 survey. Polygons were surveyed for plants but not percent cover so there is a flora list for each polygon but no diversity index.

Table 3.1 L O Spring Water Quality with multiple readings averaged.

Characteristic Measured	Average Value
pH (field)	7.8
Salinity (field) (ppt)	0.097
Specific conductance (field) (uS/cm)	279.5
Temperature, air C	28.9
Temperature, water C	10.95

Flora: Surveyors identified microhabitats and listed vegetation that were present, but did not complete a vegetation survey. In other words, no percent cover values were indicated for flora so no diversity indices were calculated. Surveyors identified 54 plant species at the site, with 0.0082 species/sqm. These included 33 native and 21 nonnative species.

Table 3.2 L O Spring Cover Type, Percent Cover, and Wetland Species.

Cover Type	Species Count	Percent Cover	Wetland Species Count	Wetland % Cover
Ground	45	0	26	0
Shrub	3	0	1	0
Mid-canopy	2	0	0	0
Tall canopy	0	0	0	0
Basal	0	0	0	0
Aquatic	1	0	0	0
Non-vascular	1	0	0	0

Table 3.3 L O Spring Vegetation % Cover in Microhabitats.

Species	Cover	Native	Wetland	A	B	C	D	E	F	G	H	I	J	K	L

	Code	Status	Status												
Alopecurus	GC		U	0	0	0	0	0	0	0	0	0	0	0	0
Apiaceae	GC			0	0	0	0	0	0	0	0	0	0	0	0
Bromus commutatus	GC	I	U	0	0	0	0	0	0	0	0	0	0	0	0
Bromus inermis	GC	I	F	0	0	0	0	0	0	0	0	0	0	0	0
Bromus tectorum	GC	I	F	0	0	0	0	0	0	0	0	0	0	0	0
Carex athrostachya	GC	N	W	0	0	0	0	0	0	0	0	0	0	0	0
Carex scoparia	GC	N	W	0	0	0	0	0	0	0	0	0	0	0	0
Carex subfusca	GC	N	W	0	0	0	0	0	0	0	0	0	0	0	0
Eleocharis acicularis	GC	N	W	0	0	0	0	0	0	0	0	0	0	0	0
Elymus glaucus	GC	N	WR	0	0	0	0	0	0	0	0	0	0	0	0
Glyceria	GC		W	0	0	0	0	0	0	0	0	0	0	0	0
Glyceria borealis	GC	N	W	0	0	0	0	0	0	0	0	0	0	0	0
Glyceria elata			W	0	0	0	0	0	0	0	0	0	0	0	0
Lathyrus	GC	N	R	0	0	0	0	0	0	0	0	0	0	0	0
Medicago lupulina	GC	I	WR	0	0	0	0	0	0	0	0	0	0	0	0
Mimulus guttatus	GC	N	W	0	0	0	0	0	0	0	0	0	0	0	0
Muhlenbergia rigens	GC	N	U	0	0	0	0	0	0	0	0	0	0	0	0
Nymphaea	AQ			0	0	0	0	0	0	0	0	0	0	0	0
Pericome caudata	GC			0	0	0	0	0	0	0	0	0	0	0	0
Pinus ponderosa	MC	N	F	0	0	0	0	0	0	0	0	0	0	0	0
Poa	GC		F	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla	GC	N	F	0	0	0	0	0	0	0	0	0	0	0	0
Quercus gambelii	SC	N	F	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus cymbalaria	GC	N	W	0	0	0	0	0	0	0	0	0	0	0	0
Ranunculus macounii	GC	N	W	0	0	0	0	0	0	0	0	0	0	0	0
Rorippa nasturtium-aquaticum	GC		W	0	0	0	0	0	0	0	0	0	0	0	0
Schedonorus arundinaceus			F	0	0	0	0	0	0	0	0	0	0	0	0

Sidalcea neomexicana	GC	N	WR	0	0	0	0	0	0	0	0	0	0	0	0
Sisyrinchium	GC		WR	0	0	0	0	0	0	0	0	0	0	0	0
Sonchus	GC		F	0	0	0	0	0	0	0	0	0	0	0	0
Trifolium pinetorum	GC	N	WR	0	0	0	0	0	0	0	0	0	0	0	0
Verbascum thapsus	GC	I	F	0	0	0	0	0	0	0	0	0	0	0	0
Viola	GC	N	F	0	0	0	0	0	0	0	0	0	0	0	0

Fauna: Surveyors collected or observed 5 terrestrial invertebrates and 7 vertebrate specimens.

Table 3.4 L O Spring Invertebrates.

Species	Lifestage	Habitat	Method	TotalReps	Count	Species detail
Lepidoptera Pieridae Colias eurytheme	Ad	T	Spot			
Odonata Aeshnidae Rhionaeschna multicolor	Ad	T	Spot			
Odonata Libellulidae Libellula saturata	Ad	T	Spot			
Odonata Coenagrionidae Enallagma	Ad	T	Spot			
Diptera Asilidae Promachus albifacies	Ad	T			1	Forest edge

Table 3.5 L O Spring Vertebrates.

Species Common Name	Qty	DetectionType
bullfrog	3	obs
Red-winged Blackbird	8	obs
garter snake	1	obs
elk		sign
fathead minnow		obs
pocket gopher		sign
American robin	5	obs

Fig 3.2 L O Spring Sketchmap.

4. Laws Tank North Spring

Location: The Laws Tank North Spring ecosystem is located in Coconino County in the Havasu Canyon. Arizona. 15010004 HUC, managed by the US Forest Service. The spring is located in the Squaw Mountain USGS Quad. The elevation is approximately 2092 meters.

Larry Stevens, Jeri Ledbetter, Glenn Rink, Jeff Glessing, Lance Murray, Lucky Thomas, Mason Stansfield, Julie Polovitch, and Andy Gosnell surveyed the site on 5/26/14 for 00:00 hours, beginning at 0:00, and collected data in 0 of 12 categories.

Physical Description: This site is in the NHD database, but is not depicted on the DRG, although there are several other springs in the area. On 5/26/2014 surveyors found no evidence of a spring or tank at this location, although Laws Tank is nearby. There was also no evidence of a spring in August 2014.

Laws Tank North Spring emerges from a igneous, basalt rock layer in an unknown unit. The distance to the nearest spring is 334 meters.

Survey Notes: Surveyors found no evidence of a spring or tank in the area.

5. Laws Tank South Spring

Location: The Laws Tank South Spring ecosystem is located in Coconino County in the Havasu Canyon. Arizona. 15010004 HUC, managed by the US Forest Service. The spring is located in the Squaw Mountain USGS Quad. The elevation is approximately 2080 meters. Larry Stevens, Jeri Ledbetter, Glenn Rink, Jeff Glessing, Lance Murray, Lucky Thomas, Mason Stansfield, Julie Polovitch, and Andy Gosnell surveyed the site on 5/26/14 for 00:00 hours, beginning at 0:00, and collected data in 0 of 12 categories.

Physical Description: This site is in the NHD database, but is not depicted on the DRG, although there are several other springs in the area. On 5/26/2014 surveyors found no evidence of a spring or tank.

Laws Tank South Spring emerges from a igneous, basalt rock layer in an unknown unit. The distance to the nearest spring is 300 meters.

Survey Notes: Surveyors found no evidence of a spring or tank at the reported location, although Laws Tank was nearby.

6. Laws Upper Spring

Location: The Laws Upper Spring ecosystem is located in Coconino County in the Havasu Canyon. Arizona. 15010004 HUC, managed by the US Forest Service. The spring is located in the Squaw Mountain USGS Quad. The elevation is approximately 2073 meters. Jeri Ledbetter, Larry Stevens, Glenn Rink, and Prescott College Students surveyed the site on 5/26/14 for 00:15 hours, beginning at 15:15, and collected data in 1 of 12 categories.

Physical Description: This unnamed site is labeled on the DRG, and is one of two springs that appear to provide water to Laws Natural Tank.

Laws Upper Spring emerges from a igneous, basalt rock layer in an unknown unit. The distance to the nearest spring is 41 meters.

Survey Notes: Surveyors found no evidence of a spring at this location, although it is marked on a topo map. It is upslope of Laws Tank.

Fauna: Surveyors collected or observed 1 terrestrial invertebrates specimens.

Table 6.1 Laws Upper Spring Invertebrates.

Species	Lifestage	Habitat	Method	TotalReps	Count	Species detail
Hymenoptera	Ad	T			1	

7. Metate Tank

Location: The Metate Tank ecosystem is located in Coconino County in the Upper Verde. Arizona. 15060202 HUC, managed by the US Forest Service. The spring is located in the Williams South USGS Quad, measured using a GPS (WGS84, 5). The elevation is approximately 2105 meters. Larry Stevens, Glenn Rink, and Jeri Ledbetter surveyed the site on 6/21/14 for 02:20 hours, beginning at 11:00, and collected data in 9 of 12 categories.

Fig 7.1 Metate Tank.

Physical Description: Metate Tank is a limnocrene spring. This site is marked as a tank on the topographic map. Surveyors suspect it is groundwater supported, as it had water during a very dry period in late June 2014. The site has 4 microhabitats.

Metate Tank emerges as a seepage or filtration spring from the basalt flow, a igneous, rhyolite rock layer. The emergence environment is subaqueous-lentic freshwater, with a gravity flow force mechanism. The distance to the nearest spring is 2472 meters. The site receives approximately 18% of available solar radiation, with 1201 Mj annually.

Survey Notes: The site was heavily trampled by elk all around the perimeter. The pond appears to be shrinking seasonally. High water reaches the edge of the lacustrine upper terrace (polygon C).

Table 7.1 Metate Tank Water Quality with multiple readings averaged.

Characteristic Measured	Average Value
pH (field)	9.23
Salinity (field) (ppt)	0.061
Specific conductance (field) (uS/cm)	126
Temperature, air C	30.6
Temperature, water C	23.8

Flora: Surveyors identified 46 plant species at the site, with 0.0102 species/sqm. These included 33 native and 13 nonnative species.

Table 7.2 Metate Tank Cover Type, Percent Cover, and Wetland Species.

Cover Type	Species Count	Percent Cover	Wetland Species Count	Wetland % Cover
Ground	38	0.8	12	0
Shrub	3	7.59	0	0
Mid-canopy	1	16	0	0
Tall canopy	1	5.87	0	0
Basal	0	0	0	0
Aquatic	6	0.21	6	0
Non-vascular	0	0	0	0

Table 7.3 Metate Tank Vegetation % Cover in Microhabitats.

Species	Cover Code	Native Status	Wetland Status	A	B	C	D	E	F	G	H	I	J	K	L

Achillea millefolium	GC	N	U	0	0	0.01	0.03	0	0	0	0	0	0	0	0
algae sp	AQ	N	A	1	0	0	0	0	0	0	0	0	0	0	0
Alisma triviale	AQ	N	W	0.01	0.01	0	0	0	0	0	0	0	0	0	0
Ambrosia	GC	I	F	0	0	0	0.1	0	0	0	0	0	0	0	0
Antennaria parvifolia	GC	N	U	0	0	0	0.01	0	0	0	0	0	0	0	0
Aristida	GC	N	U	0	0	0	10	0	0	0	0	0	0	0	0
Artemisia carruthii	GC	N	U	0	0	0	0.01	0	0	0	0	0	0	0	0
Astragalus	GC	N	U	0	0	0	0.01	0	0	0	0	0	0	0	0
Boechera fendleri	GC	N	U	0	0	0	0.01	0	0	0	0	0	0	0	0
Bouteloua gracilis	GC	N	U	0	0	0	1	0	0	0	0	0	0	0	0
Bromus japonicus	GC	I	U	0	0	0.01	0	0	0	0	0	0	0	0	0
Bromus tectorum	GC	I	F	0	0	0.5	5	0	0	0	0	0	0	0	0
Carex occidentalis	GC	N	W	0	0	0.01	5	0	0	0	0	0	0	0	0
Carex rossii	GC	N	W	0	0	0	0.01	0	0	0	0	0	0	0	0
Convolvulus arvensis	GC	I	F	0	0	0	0.1	0	0	0	0	0	0	0	0
Eleocharis acicularis	GC	N	W	0	0	10	0	0	0	0	0	0	0	0	0
Eleocharis palustris	GC	N	W	0	0.001	0	0	0	0	0	0	0	0	0	0
Elymus elymoides	GC	N	F	0	0	0.01	0.01	0	0	0	0	0	0	0	0
Erigeron divergens	GC	N	F	0	0	0.01	0	0	0	0	0	0	0	0	0
Geranium	GC	N	F	0	0	0	0.02	0	0	0	0	0	0	0	0
Glyceria borealis	GC	N	W	0	90	0	0	0	0	0	0	0	0	0	0
Hordeum jubatum	GC	N	WR	0	0	0.1	0.01	0	0	0	0	0	0	0	0
Hymenoxys richardsonii	GC	N	F	0	0	0	0.01	0	0	0	0	0	0	0	0
Iris missouriensis	GC	N	F	0	0	0	20	0	0	0	0	0	0	0	0
Juniperus deppeana	SC	N	U	0	0	0.01	2	0	0	0	0	0	0	0	0
Lappula occidentalis	GC	N	F	0	0	0.01	0	0	0	0	0	0	0	0	0
Lupinus argenteus	GC	N	U	0	0	0	0	0	0	0	0	0	0	0	0
Lupinus kingii	GC	N	U	0	0	0	0.01	0	0	0	0	0	0	0	0

Melilotus officinalis	GC	I	WR	0	0	0.01	0.01	0	0	0	0	0	0	0	0
Muhlenbergia wrightii	GC	N	U	0	0	0	12	0	0	0	0	0	0	0	0
Pinus ponderosa	TC	N	F	0	0	1	2	0	0	0	0	0	0	0	0
Poa	GC		F	0	0	0	10	0	0	0	0	0	0	0	0
Polygonum amphibium	GC	N	W	0	0	0.01	0	0	0	0	0	0	0	0	0
Portulaca oleracea	GC	I	WR	0	0	10	0.01	0	0	0	0	0	0	0	0
Potamogeton nodosus	AQ	N	A	5	0	0	0	0	0	0	0	0	0	0	0
Quercus gambelii	SC	N	F	0	0	0.3	0	0	0	0	0	0	0	0	0
Ranunculus aquatilis	AQ	N	A	50	0.01	0	0	0	0	0	0	0	0	0	0
Rumex	GC		WR	0	0	0.01	0	0	0	0	0	0	0	0	0
Scirpus	AQ	N	W	1	3	0	0	0	0	0	0	0	0	0	0
Taraxacum officinale	GC	I	F	0	0	0	0.01	0	0	0	0	0	0	0	0
Tragopogon dubius	GC	I	F	0	0	0	0.01	0	0	0	0	0	0	0	0
Trifolium repens	GC	I	WR	0	0	0.01	0	0	0	0	0	0	0	0	0
Verbascum thapsus	GC	I	F	0	0	0	0.01	0	0	0	0	0	0	0	0
Veronica	GC	N	A	0	0	0.01	0	0	0	0	0	0	0	0	0
Vicia americana	GC	N	F	0	0	0	0.02	0	0	0	0	0	0	0	0

Fauna: Surveyors collected or observed 3 aquatic and 27 terrestrial invertebrates and 11 vertebrate specimens.

Table 7.4 Metate Tank Invertebrates.

Species	Lifestage	Habitat	Method	TotalReps	Count	Species detail
Odonata Libellulidae Plathemis lydia	Ad	T			1	
Odonata Libellulidae Libellula quadrimaculata	Ad	T	Spot		25	abundant
Odonata Libellulidae Libellula luctuosa	Ad	T	Spot		4	

Odonata Libellulidae Tramea lacerata	Ad	T				
Odonata Libellulidae Erythemis collocata	Ad	T			1	
Odonata Aeshnidae Anax junius	Ad	T	Spot		1	
Odonata Coenagrionidae Argia	Ad	T	Spot		1	vivida?
Odonata Coenagrionidae Enallagma	Ad	T	Spot		20	
Odonata Coenagrionidae Ischnura	Ad	T			1	
Lepidoptera Nymphalidae Adelpha bredowii	Ad	T	Spot		2	
Coleoptera Buprestidae	Ad	T			1	dead ponderosa bark elytra only
Coleoptera Tenebrionidae	Ad	T			1	dead ponderosa bark
Diptera	Ad	T			1	
Diptera Asilidae Promachus albifacies	Ad	T			1	
Hemiptera	Ad	T			1	
Hemiptera Gerridae	Ad	A			1	
Hemiptera Notonectidae	Ad	A			1	
Homoptera Cicadellidae	Ad	T			1	
Lepidoptera Lycaenidae	Ad	T			1	
Odonata Coenagrionidae Enallagma boreale	Ad	T			1	
Odonata Coenagrionidae Enallagma praevarum	Ad	T			1	
Odonata Coenagrionidae Ischnura damula	Ad	T			1	
Odonata Coenagrionidae	Ad	T			1	

Ischnura demorsa						
Odonata Libellulidae Pachydiplax longipennis	Ad	T			1	
Coleoptera Dytiscidae	Ad	A			1	
Coleoptera Elateridae Alaus	Ad	T			1	dead ponderosa bark missing head and abdomen

Table 7.5 Metate Tank Vertebrates.

Species Common Name	Qty	DetectionType
dark-eyed junco	1	obs
western bluebird	3	obs
elk		sign
violet-green swallow	3	obs
white-breasted nuthatch	1	obs
American robin	2	obs
house wren	1	obs
turkey		sign
turkey vulture		sign
coyote		sign
acorn woodpecker	1	call

Assessment: Assessment scores were compiled in 5 categories and 33 subcategories, with 9 null condition scores, and 9 null risk scores. Aquifer functionality and water quality are good with significant restoration potential and there is low risk. Geomorphology condition is poor with limited restoration potential and there is high risk. Habitat condition is good with significant restoration potential and there is moderate risk. Biotic integrity is good with significant restoration potential and there is moderate risk. Human influence of site is moderate with some restoration potential and there is moderate risk. Administrative context status is undetermined due to null scores and there is undetermined risk due to null scores. Overall, the site condition is moderate with some restoration potential and there is moderate risk.

Table 7.6 Metate Tank Assessment Scores.

Category	Condition	Risk
Aquifer Functionality & Water Quality	4.5	2.3
Geomorphology	2.4	4.6
Habitat	4.2	3.2
Biota	3.9	3
Human Influence	3.3	3.2
Administrative Context	0	0
Overall Ecological Score	3.7	3.2

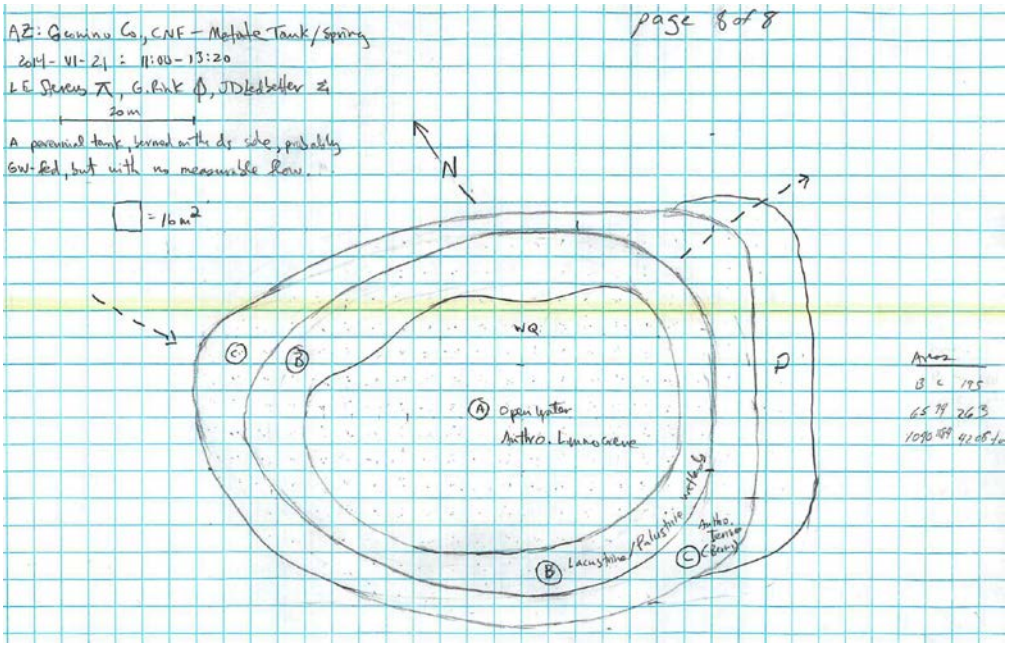

Fig 7.2 Metate Tank Sketchmap.

8. Pitman Valley unnamed spring

Location: The Pitman Valley unnamed spring ecosystem is located in Coconino County in the Upper Verde. Arizona. 15060202 HUC, managed by the US Forest Service. The spring is located in the Davenport Hill USGS Quad. The elevation is approximately 2090 meters. Jeri Ledbetter, Lucky Thomas, Jeff Glessing, Andrew Gosnell, Lance Murray, Julie Polovitch, Mason Stansfield, Glenn Rink, and Jenn Chavez surveyed the site on 5/27/14 for 01:20 hours, beginning at 9:15, and collected data in 9 of 12 categories.

Physical Description: Pitman Valley unnamed spring is a anthropogenic/limnocrene spring. This site is not depicted on the DRG, although there are several tanks marked in the area. It is

included in the NHD Database. This site was likely a wet meadow that has been excavated and perhaps lined. The site area is large and open with no trees. The microhabitats associated with the spring cover 1100 sqm. The site has 2 microhabitats, including A -- a 110 sqm pool, B -- a 990 sqm wet hillslope. Geomorphic diversity is 0.14, based on the Shannon-Weiner diversity index.

Pitman Valley unnamed spring emerges as a seepage or filtration spring from a igneous, basalt rock layer in an unknown unit. The emergence environment is subaqueous-lentic freshwater, with a gravity flow force mechanism. The distance to the nearest spring is 4447 meters.

Survey Notes: The spring was excavated to form a tank. The site is heavily trampled, grazed, and browsed. There is little vegetation.

Table 8.1 Pitman Valley unnamed spring Water Quality with multiple readings averaged.

Characteristic Measured	Average Value
Alkalinity, Total (mg/L)	0.69
pH (field)	8.52
Specific conductance (field) (uS/cm)	390
Temperature, air C	27.7
Temperature, water C	26.2

Flora: Glenn Rink was the botanist. He collected the unknown Brassica and labeled it as 12563. Surveyors identified 23 plant species at the site, with 0.0209 species/sqm. These included 8 native and 15 nonnative species.

Table 8.2 Pitman Valley unnamed spring Cover Type, Percent Cover, and Wetland Species.

Cover Type	Species Count	Percent Cover	Wetland Species Count	Wetland % Cover
Ground	21	0.8	8	0
Shrub	0	0	0	0
Mid-canopy	0	0	0	0
Tall canopy	0	0	0	0
Basal	0	0	0	0
Aquatic	2	0.13	2	0

Non-vascular	0	0	0	0

Table 8.3 Pitman Valley unnamed spring Vegetation % Cover in Microhabitats.

Species	Cover Code	Native Status	Wetland Status	A	B	C	D	E	F	G	H	I	J	K	L
algae sp	AQ	N	A	10	0	0	0	0	0	0	0	0	0	0	0
Alopecurus	GC		U	0	0.1	0	0	0	0	0	0	0	0	0	0
Ambrosia	GC		F	0	0.01	0	0	0	0	0	0	0	0	0	0
Bromus tectorum	GC	I	F	0	1	0	0	0	0	0	0	0	0	0	0
Camelina microcarpa	GC	I	U	0	0.01	0	0	0	0	0	0	0	0	0	0
Carex subfusca	GC	N	W	0	0.02	0	0	0	0	0	0	0	0	0	0
Chara sp	AQ		A	50	0	0	0	0	0	0	0	0	0	0	0
Chenopodium	GC		F	0	0.02	0	0	0	0	0	0	0	0	0	0
Convolvulus arvensis	GC	I	F	0	0.01	0	0	0	0	0	0	0	0	0	0
Erigeron divergens	GC	N	F	0	0.01	0	0	0	0	0	0	0	0	0	0
Erodium cicutarium	GC	I	F	0	0.01	0	0	0	0	0	0	0	0	0	0
Gnaphalium exilifolium	GC	N	W	0	0.01	0	0	0	0	0	0	0	0	0	0
Lactuca serriola	GC	I	WR	0	0.01	0	0	0	0	0	0	0	0	0	0
Lupinus	GC	N	F	0	0.01	0	0	0	0	0	0	0	0	0	0
Medicago lupulina	GC	I	WR	0	0.02	0	0	0	0	0	0	0	0	0	0
Melilotus officinalis	GC	I	WR	0	0.01	0	0	0	0	0	0	0	0	0	0
Poa pratensis	GC	I	F	0	0.1	0	0	0	0	0	0	0	0	0	0
Potentilla	GC	N	F	0	0.01	0	0	0	0	0	0	0	0	0	0
Potentilla pensylvanica	GC	N	U	0	0.01	0	0	0	0	0	0	0	0	0	0
Rorippa	GC		A	0	0.01	0	0	0	0	0	0	0	0	0	0
Rumex	GC		WR	0	0.1	0	0	0	0	0	0	0	0	0	0
Scirpus	GC	N	W	0	40.3	0	0	0	0	0	0	0	0	0	0
Verbascum thapsus	GC	I	F	0	0.01	0	0	0	0	0	0	0	0	0	0

Fauna: Surveyors collected or observed 3 aquatic and 2 terrestrial invertebrates and 4 vertebrate specimens.

Table 8.4 Pitman Valley unnamed spring Invertebrates.

Species	Lifestage	Habitat	Method	TotalReps	Count	Species detail
Odonata Coenagrionidae Argia		A	Spot			
Amphipoda	Ad	A			3	
Coleoptera	Ad				1	
Coleoptera Staphylinidae	Ad	T			1	
Hemiptera	I				1	
Hemiptera Notonectidae	Ad	A			1	
Mollusca	Ad				2	

Table 8.5 Pitman Valley unnamed spring Vertebrates.

Species Common Name	Qty	DetectionType
domestic cow		sign
sparrow		obs
elk		sign
pronghorn	4	obs

Assessment: Assessment scores were compiled in 6 categories and 40 subcategories, with 2 null condition scores, and 4 null risk scores. Aquifer functionality and water quality are excellent with no need for restoration and there is very high risk. Geomorphology condition is moderate with some restoration potential and there is moderate risk. Habitat condition is poor with limited restoration potential and there is low risk. Biotic integrity is poor with limited restoration potential and there is negligible risk. Human influence of site is moderate with some restoration potential and there is negligible risk. Administrative context status is moderate with some restoration potential and there is high risk. Overall, the site condition is moderate with some restoration potential and there is moderate risk.

Table 8.6 Pitman Valley unnamed spring Assessment Scores.

Category	Condition	Risk
Aquifer Functionality & Water Quality	6.67	5.67

Geomorphology	3.2	3
Habitat	2.2	2
Biota	2.38	1.5
Human Influence	2.88	1.63
Administrative Context	3.43	4
Overall Ecological Score	3.41	2.84

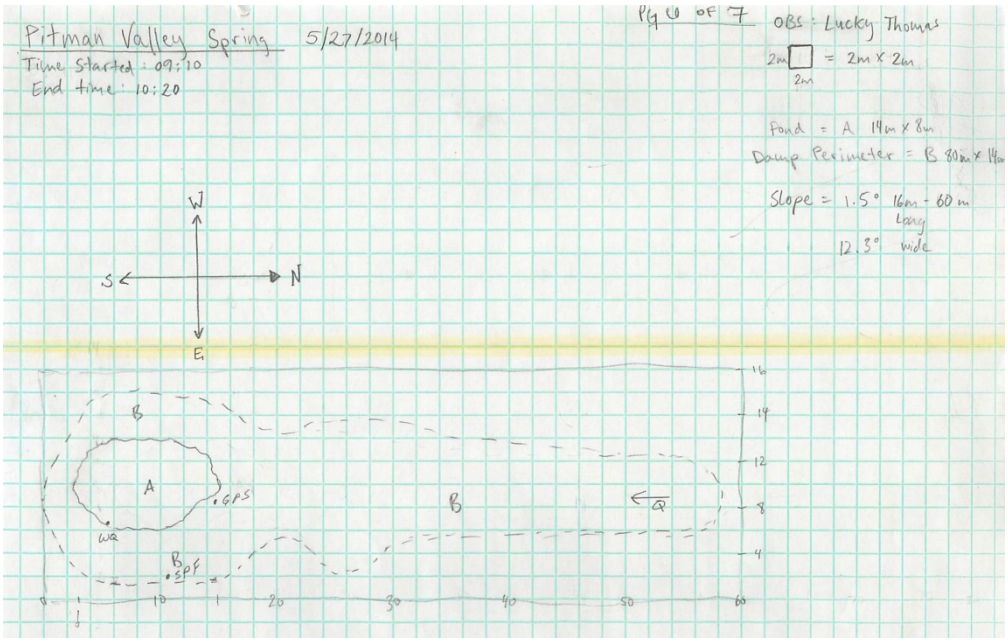

Fig 8.1 Pitman Valley unnamed spring Sketchmap.