State of the Cienega Watershed

March 8, 2017
Overview

• Introduction
• Objective
• Methodology
• Results
  • Climate
  • Water
  • Ecological
  • Socio-cultural
• Conclusion
• Next Steps
Introduction

The Cienega Watershed Partnership (CWP) is a non-profit organization that supports stewardship initiatives in the Cienega Watershed.

CWP works with many partners to sustain the ecological systems, heritage values, wildlife corridors, and open spaces for future generations.

The State of the Watershed is part of a larger effort to provide a regular assessment of our watershed’s health, capitalizing on our partners’ existing data, and providing a additional mechanism for long-term monitoring, regular evaluation, and adaptation of CWP program priorities and actions to meet changing conditions.
The State of the Watershed augments other important events and conversations taking place in the watershed, but hopefully will provide an annual, comprehensive “snap-shot” of watershed health.

We hope this effort deepens our understanding of conditions and trends in the watershed, a chance for us to take stock, discuss strategies, make appropriate adaptations, and continue to engage with partners and the public.
Objective:

Monitor the state of the Cienega Watershed through a common set of overarching indicators, to provide a regular mechanism for evaluating watershed health, communicating this assessment to program partners and the community at large, and guide the implementation and adaptation of CWP program priorities and actions to meet changing conditions.

Source: Pima Association of Governments
Methods and approach

• Initial tasks
  • Develop criteria for evaluating indicators
  • Identify and prioritize indicators
  • Identify sources of data
  • Determine appropriate ways of presenting the results

• Three plenary workshops with CWP partners

• Periodic meetings of four working groups
  • Landscape
  • Riparian/water
  • Uplands
  • Social/cultural
Methods and approach (cont.)

• Electronic survey distributed to CWP partners (R = 40/84)

• Extensive contact with key partners to gather available data, determine how best to communicate the data, and ask where to find missing data, or identify suitable proxy data

• Periodic meetings to further refine data analysis and presentation

Results – Upland Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perennial herbaceous basal cover and…</td>
<td>3.93</td>
</tr>
<tr>
<td>Shrub and woody plant cover, density and…</td>
<td>4.34</td>
</tr>
<tr>
<td>Erosional features</td>
<td>4.72</td>
</tr>
<tr>
<td>Vegetation community change over time</td>
<td>5.14</td>
</tr>
<tr>
<td>Rainfall amount and timing</td>
<td>5.14</td>
</tr>
<tr>
<td>Dominance of non-native vegetation</td>
<td>5.59</td>
</tr>
<tr>
<td>Wildlife and roads</td>
<td>5.66</td>
</tr>
<tr>
<td>Fire return interval</td>
<td>7.45</td>
</tr>
<tr>
<td>Mass mortality events</td>
<td>7.66</td>
</tr>
<tr>
<td>Phenological changes</td>
<td>7.86</td>
</tr>
<tr>
<td>Phenological changes</td>
<td>8.52</td>
</tr>
</tbody>
</table>
Cienega Watershed

Boundary

• Shapefile provided by Brian Powell from Pima County.

• Partially corresponds with USGS – NHD_HUC 10.
Mike List from Pima County provided shapefile for the Sonoita Valley Acquisition Planning District (Sonoita VAPD)

Source: AZGEO. Link: https://azgeo.az.gov/azgeo/
# List of Indicators

<table>
<thead>
<tr>
<th>Category</th>
<th>Indicator</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Climate</strong></td>
<td>Precipitation</td>
<td>1</td>
<td>Historic data on mean precipitation summer vs. winter</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>2</td>
<td>Historic data on mean temperature</td>
</tr>
<tr>
<td></td>
<td>Drought</td>
<td>3</td>
<td>Standardized Index for Drought over time</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>Groundwater levels</td>
<td>4</td>
<td>Change from previous year in Jan. and June (highest/lowest)</td>
</tr>
<tr>
<td></td>
<td>Surface water quantity</td>
<td>5</td>
<td>Wet-dry mapping (June –worst case - or all four)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>Gauges (Narrows and Pantano Dam)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>Monthly Flows/ base flows (ave ft3/sec)/total flow</td>
</tr>
<tr>
<td></td>
<td>Water quality</td>
<td>8</td>
<td>TDS, electrical conductance, heavy metals, dissolved oxygen (fish), PH</td>
</tr>
<tr>
<td><strong>Ecological</strong></td>
<td>Veg. volume/composition/cover</td>
<td>9</td>
<td>Land cover</td>
</tr>
<tr>
<td></td>
<td>Wildlife</td>
<td>10</td>
<td>Prairie dog</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>Pronghorn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>Fish</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13</td>
<td>Frogs</td>
</tr>
<tr>
<td></td>
<td>Fire</td>
<td>14</td>
<td>Coverage, severity</td>
</tr>
<tr>
<td><strong>Socio-cultural</strong></td>
<td>Economic vitality</td>
<td>15</td>
<td>Types of homes, median home values, poverty, wage rate, number of jobs by type of industry, number of businesses, property values</td>
</tr>
<tr>
<td></td>
<td>Land use land cover change</td>
<td>16</td>
<td>Land use</td>
</tr>
<tr>
<td></td>
<td>Archaeological sites conditions</td>
<td>17</td>
<td>Trend in site condition damage by establishing a baseline and measuring up or down; assess both human-caused and natural-caused damage.</td>
</tr>
<tr>
<td></td>
<td>Number of recreational permits</td>
<td>18</td>
<td>Number of permits to the Cienega Watershed recreation areas per year.</td>
</tr>
<tr>
<td></td>
<td>Stewardship engagement programs</td>
<td>19</td>
<td>Number of opportunities for active engagement in the watershed</td>
</tr>
</tbody>
</table>

N=19
Acknowledgments

- **Mead Mier** - Pima Association of Governments
- **Amanda Smith** – University of Arizona & PAG
- **Mike List** - Pima County
- **Gita Bodner** - The Nature Conservancy
- **Brian Powell** - Pima County
- **Frank Postillion** - PC Regional Flood Control District
- **David Scalero** - PC Regional Flood Control District
- **Dave Murray** - Bureau of Land Management
- **Jeff Simms** - Bureau of Land Management
- **Karen Klima** - the AZ Fish and Wildlife Department
- **Holly Hicks** - AZ Fish and Wildlife Department
- **MaryAnn Adams** - Pima County Parks and Recreation
- **Bobbie Young** - Empire Ranch Foundation
- **Wendy Burroughs** - Pima County Natural Resources
- **Laura Norman** - US Geological Survey
- **Mike Crimmins** - University of Arizona
- **George Frisvold** - University of Arizona
- **Courtney Rose** - Pima County
- **Francisco Mendoza** - Bureau of Land Management
- **Rositsa Yaneva** – UMI-iGlobes/Biosphere 2
- **Matthew Behrend** – Arizona State Land Department
- **Kim Ryan** – Bureau of Land Management
- **Chris Schrager** – Bureau of Land Management
- **Dave Mehlic** – Forest Service
- **David Hall** – CWP – Frog Project
- **Kyle Hartfield** – Arizona Remote Sensing Center
- **Wim van Leeuwen** – Arizona Remote Sensing Center

**Supervisors:**
- **Larry Fisher** – UA/CWP
- **Tom Meixner** – UA/CWP
- **Shela McFarlin** - CWP
- **Kelly Mott LaCroix** – WRRC/CWP
- **Tahnee Robertson** - SW Decision Resources/CWP
<table>
<thead>
<tr>
<th>Category</th>
<th>Indicator</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td>Precipitation</td>
<td>1</td>
<td>Historic data on mean precipitation summer vs. winter</td>
</tr>
<tr>
<td></td>
<td>Temperature</td>
<td>2</td>
<td>Historic data on mean temperature</td>
</tr>
<tr>
<td>Drought</td>
<td></td>
<td>3</td>
<td>Standardized Index for Drought over time</td>
</tr>
</tbody>
</table>
• **West Wide Drought Tracker** offers a pixel representation of climate data and drought indices at all time scales.

• Includes point data from rain gauges, which drives the creation of gridded climate data (interpolation/statistical estimate).

• Accounts for elevation.

• It is a defensible way to track climate.

Source: [http://www.wrcc.dri.edu/wwdt/](http://www.wrcc.dri.edu/wwdt/) (click Time Series tab)
Assistance from: Mike Crimmins
Precipitation

Source: http://www.wrcc.dri.edu/wwdt/
Assistance from: Mike Crimmins
Precipitation – summer vs. winter

Source: http://www.wrcc.dri.edu/wwdt/
Assistance from: Mike Crimmins
Temperature

Source: [http://www.wrcc.dri.edu/wwdt/](http://www.wrcc.dri.edu/wwdt/)
Assistance from: Mike Crimmins
Temperature

Source: [http://www.wrcc.dri.edu/wwdt/](http://www.wrcc.dri.edu/wwdt/)
Help from: Mike Crimmins

Climate change
Drought

• SPI – Standardized Index for drought - the simplest index for drought.
• Standard deviation of observed precipitation for a given point.

Source: [http://www.wrcc.dri.edu/wwdt/](http://www.wrcc.dri.edu/wwdt/)
Help from: Mike Crimmins
Drought

48 month SPI – 4 yr. average

Source: http://www.wrcc.dri.edu/wwdt/
Assistance from: Mike Crimmins

12 month SPI – 4 yr. average
Drought

We are in a drought

Shorter term swings recently to less drought

48 month SPI – 4 yr. average

Source: [http://www.wrcc.dri.edu/wwdt/](http://www.wrcc.dri.edu/wwdt/)
Help from: Dr. Mike Crimmins
Climate - General trends

- **Precipitation:** No clear trend, but more precipitation in summer than in winter
- **Temperature:** Dramatic increase in temperature, particularly since 1980
- **Drought:** Periodic droughts; we are currently experiencing shorter term swings toward less drought.
<table>
<thead>
<tr>
<th>Indicator</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater levels</td>
<td>4</td>
<td>Change from previous year in Jan. and June (highest/lowest)</td>
</tr>
<tr>
<td>Surface water quantity</td>
<td>5</td>
<td>Wet-dry mapping (June – worst case – or all four)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Gauges (Narrows and Pantano Dam)</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Monthly flows / base flows (average ft3/sec)/total flow</td>
</tr>
<tr>
<td>Water quality</td>
<td>8</td>
<td>TDS, electrical conductance, heavy metals, dissolved oxygen PH, (fish)</td>
</tr>
</tbody>
</table>
Groundwater levels

Source: Frank Postillion, Pima County Regional Flood Control District
Groundwater levels – Preserve (wells)

• Lower groundwater levels fluctuate more because the wells are recharged by seasonal inputs.

Source: Mead Mier - PAG and Frank Postillion - Pima County Regional Flood Control District

Groundwater levels – BLM (wells)

Source: Dave Murray, BLM
Wet-Dry

Source: Mike List, Pima County – based on data from PAG and BLM
Wet-Dry

Source: Mead Mier, PAG
Wet-Dry

Source: Mead Mier, PAG
Wet-Dry

Source: Mead Mier, PAG and Dave Murray, BLM
Gauges

Pantano Wash
Gauge # 09484600

Source: waterdata.usgs.gov
Winter Stream Flows – Cienega Creek Natural Preserve

Source: Mead Mier, PAG; Pima County Regional Flood Control District (from 6/2015)
Winter Stream Flows - BLM

• Stream flow is measured once a month, and varies depending on which day and hour the data is collected.
• This data provides a ‘snapshot in time.’

Empire Gulch – Spring Source

New measuring site (200ft downstream)
Data starts 2/2016

Source: Dave Murray, BLM
Water quality – Pima County

Source: Mead Mier, PAG and David Scalero, PC Flood Control District
Water quality – Pima County

Source: Mead Mier, PAG and David Scalero, PC Flood Control District
Empire Gulch – Spring Source
Upper Cienega Creek site

Source: Dave Murray, BLM
Empire Gulch – Spring Source

Upper Cienega Creek site

Calculated Total Dissolved Solids (ppm)

10/10/06 7/6/09 4/1/12 12/27/14 9/22/17

Empire Gulch

Upper Cienega

Calculated Total Dissolved Solids (ppm)

0.00 100.00 200.00 300.00 400.00 500.00 600.00

1/14/04 7/6/09 4/1/12 12/27/14 9/22/17

Source: Dave Murray, BLM
Water - general trends

- **Groundwater levels:**
  - Pima County (Preserve): decrease in groundwater levels in shallow wells
  - BLM: Slight decrease in groundwater levels

- **Wet-dry:**
  - Pima County: Decrease in minimum flow (June) with significant recovery in 2015
  - BLM: Decrease in minimum flow (June) with slight recovery in 2016

- **Gauges:**
  - Pantano wash: decrease in annual average stream flow
  - Cienega Creek: slight increase in annual average stream flow
• **Winter stream flows:**
  • Preserve: Significant decrease in Marsh Station, slight increase in Titled Beds
  • BLM: Slight increase in Empire Gulch, slight decrease in Upper Cienega Creek

• **Water quality:**
  • Pima County:
    • PH: Decrease in most sites, except for Davidson 1/3
    • TDS: Decrease in all sites
  • BLM:
    • PH: No clear trend
    • DO: No clear trend in Empire Gulch, decrease in Upper Cienega
    • TDS: No clear trend
<table>
<thead>
<tr>
<th>Indicator</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veg. vol./comp./cover</td>
<td>9</td>
<td>Land cover</td>
</tr>
<tr>
<td>Wildlife</td>
<td>10</td>
<td>Prairie dogs</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Pronghorn</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Fish</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Frogs</td>
</tr>
<tr>
<td>Fire</td>
<td>14</td>
<td>Coverage, severity</td>
</tr>
</tbody>
</table>
Vegetation composition – basal cover (BLM)

Source: Gita Bodner, The Nature Conservancy
Vegetation composition – basal cover and shrubs (BLM)

**Basal cover (Average of % cover)**

- **Bare ground**
- **Litter**
- **Total Perennial Grass**

**Shrub canopy cover (Average of % cover)**

- **Mesquite**
- **Burroweed**

Source: Gita Bodner, The Nature Conservancy
Vegetation composition – Bar V Ranch, Pima County

Source: Brian Powell, Pima County
Pronghorn

- The Cienega Watershed is mostly contained in section 34B
- Habitat fragmentation and mesquite encroachment are major threats to pronghorn.

Source: Karen Klima, Arizona Game and Fish Department
Declines in population of pronghorn in 2002.

Management responses:
1. restricted hunting permits
2. control measures on predator population (coyotes)
3. install and maintain water tanks
4. modify fences

After management, pronghorn population in unit 34B appears to be slowly increasing.

Source: Karen Klima, Arizona Game and Fish Department
Black-Tailed Prairie Dog

- Black-Tailed Prairie Dogs (BTPD) were eradicated from this area in the early 1930s.

- In the 2000s, AZGFD started research and successfully reintroduced the species in 2008 in three sites. A fourth site (Sands Ranch) is in preparation.

- AZGFD monitors the population of BTPD twice a year.

Source: Holly Hicks, Arizona Game and Fish Department
Black-Tailed Prairie Dog

- BTPD is vulnerable to mesquite encroachment. They like to have a clear view of their surroundings in order to avoid predators (e.g., foxes, coyotes, bobcats, badgers, hawks)

- Winter rains favor the development of this species because rain produces better forage in the spring.

- **Management actions:**
  1. Mesquite removal
  2. If there is a dry spring, AGFD provides supplemental feeding
  3. Keeping predation levels down
  4. Prescribed fires to rehabilitate grasslands

Source: Holly Hicks, Arizona Game and Fish Department
Fish

Source: Jeff Simms from BLM
Frogs

- AZFWS introduced bullfrogs into Arizona from 1930’s into early 1980’s to increase sport fishing opportunities. By the late 1980’s bullfrogs began to invade into native frog ranges and exclude native frog species by predation.

- Bullfrogs were first reported on Empire Ranch in the 1980’s and this correlated with native frog declines in the area.

- By 2004 the Chiricahua leopard frog had declined throughout its range and was federally listed as a threatened species. Chiricahua leopard frog reduced to occupying only one site on the LCNCA.

- In 2010, intensive frog conservation efforts began in the area.

Source: David Hall, CWP-Frog Project
Frogs

1980's Geographic distribution of Chiricahua Leopard frog (green line). Black Xs show bullfrog records

2010 Geographic distribution of Chiricahua Leopard frog (green point). Black lines show bullfrog records

2016 Geographic distribution of Chiricahua Leopard frog (green line and points). Black point show current bullfrog distribution

Source: David Hall, CWP-Frog Project
Frogs

Observations in the Headwaters reach of Cienega Creek

Management actions include:

- Removal of invasive species
- Creation of buffer zones that consist of stock water tanks that are wetted during the monsoon season. Then they monitor the tanks during spring and summer months and remove any bullfrogs found.
- Efforts involve the collaboration between federal agencies:
  - AZGFD
  - BLM
  - USFW
  - USFS
- Engagement with private land-owners to work in their land, or creating a buffer zone around it.

Source: David Hall, CWP-Frog Project
Wildfires

Source:
Wildfires

Source:
Wildfires

Source:
Wildfires

Source:
Wildfires

Wildfires

Source:
Wildfires

Source:
Wildfires

Total acreage burned

Ecological indicators - General trends

Vegetation composition

- **Shrub cover** (including mesquite) has been decreasing. This decline may be due to mesquite removal and prescribed-fire projects. More data is needed (e.g., Santa Rita).

- **Perennial grass** basal cover has declined, but 2015 and 2016 have shown some recovery.

- **Invasive perennial grasses** (e.g., Lehman lovegrass) have shown increase. There is an unusual relationship between cover data: basal area is generally down, while canopy is generally up. This may be in large part due to Lehman lovegrass.

- **Bare ground** has decreased, while the amount of **litter** has increased.

This means that

- Mesquite removal has been successful in decreasing shrub species cover and density
- The trend re perennial grass is unclear, but invasive species remain a threat
- Soil erosion may be decreasing because there is less bare ground and more litter
Ecological - General trends

**Pronghorn:**
- Earlier decline in pronghorn population has triggered management actions that have resulted in population recovery

**Prairie Dog:**
- Reintroduction of species in 2008 has been successful

**Fish:**
- Gila Topminnow has recovered significantly in 2015
- Gila chub also shows slow recovery
- Longfin dace has steadily increased

**Frogs:**
- Successful recovery of listed species and reduction of invasive species

**Wildfires:** Significant acreage burned in 1960s. Dramatic increase in acreage burned in 2000s
## Socio-cultural

<table>
<thead>
<tr>
<th>Indicator</th>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic vitality</td>
<td>15</td>
<td>Types of homes, median home values, poverty, wage rate, number of jobs by type of industry, number of businesses, property values</td>
</tr>
<tr>
<td>Land-use land-cover change</td>
<td>16</td>
<td>Land-use land-cover change</td>
</tr>
<tr>
<td>Archaeological sites conditions</td>
<td>17</td>
<td>Trend in site condition damage by establishing a baseline and measuring up or down; assess both human-caused and natural-caused damage.</td>
</tr>
<tr>
<td>Number of recreational permits</td>
<td>18</td>
<td>Number of recreational permits to the Cienega Watershed recreation areas per year.</td>
</tr>
<tr>
<td>Stewardship engagement programs</td>
<td>19</td>
<td>Number of opportunities for active engagement in watershed “do-programs”</td>
</tr>
</tbody>
</table>
Economic vitality

Ecosystem services:

1. Freshwater provision
2. Mineral resources
3. Alternative energy (hydropower, wind mills)
4. Local climate regulation
5. Water flow regulation
6. Water purification
7. Erosion regulation
8. Regulation of waste
9. Recreation and tourism
10. Landscape aesthetics
11. Religious and spiritual experience
12. Natural heritage and natural diversity

Source: Rositsa Yaneva, UMI-¡Globes/Biosphere 2
Economic vitality

Results from survey with **experts** (scientists from University of Arizona)

Results from survey with **local people** (residents of Census Designated Places in Rincon Valley and Sonoita)

Source: Rositsa Yaneva
Economic vitality

Source: Rositsa Yaneva
Website: http://www.city-data.com/county/Pima_County-AZ.html
Economic vitality

Data collected in January 2017

Pimaco Two, AZ
Zip codes = 85611, 85637, 85641

Median household income: $47,679
Median house or condo value: $227,155
Median contract rent: $468
Unemployment: 4.88%
Residents below the poverty level: 6.22%
Median resident age: 58.9

Source: Rositsa Yaneva
Website: http://www.city-data.com/county/Pima_County-AZ.html
Land use – land cover

Land use – land cover

Source: Laura Norman, USGS.
Land use – land cover

Source: Laura Norman, USGS
Land use – land cover

Source: Laura Norman, USGS.
Land use – land cover

Human impact

Landscape

Wetlands

Source: Laura Norman, USGS.
Archaeological Sites Conditions

• Thousands of sites spanning 10,000 years occur in the watershed, generally referred to as cultural resources.

• Agencies monitor selected archaeological sites, historic properties, and areas of special interest depending on their significance, public accessibility, location, and staff capacity.

• Site monitoring varies between agencies as to number of sites monitored, time intervals and personnel (archaeologists, site stewards, law enforcement officers, para-archaeologists).

Source:
• Matthew Behrend – Arizona State Land Department
• Kim Ryan – Bureau of Land Management
• Chris Schrager – Bureau of Land Management
• Dave Mehalic – Forest Service
• Courtney Rose – Pima County
• Shela McFarlin - CWP
Archaeological Sites Condition

To establish trends in the conditions of selected sites, in 2017 watershed archaeologists began exploring shared standards for monitoring which identify both natural and human caused impacts.

Common characteristics to be collected and shared:

• Define classification system to report on the resource condition: "good-fair-poor" or similar classification with shared definition

• Define how change will be reported: "better-same-worse" or similar shared standard

• Identify a checklist of causes for the impacts or condition changes noted: natural, human or management (protection, fencing, stabilization)
• A limiting factor for schools/orgs has been the lack of restroom facilities in some areas.
Engagement programs are those in which people and especially youth have hands-on opportunities in the watershed and its resources and its management.

These are “do” programs: activities like building, weed pulling or planting, stabilizing, recording, mapping; monitoring the resource like site stewardship, student data collection; training, development and programs like Empire Ranch Docents and Hands on the Land.

They do not include general awareness, recreation or school visits, tours, trail rides, exhibits, or general outreach programs, participation in symposia or talks.

Measures are the numbers of programs, not participants. Some are more in-depth than others and participation numbers vary.

Sources: Shela McFarlin, CWP; Bobbie Young, ERF; Dave Mehalic – U.S. Forest Service
# Stewardship engagement programs

<table>
<thead>
<tr>
<th>Org</th>
<th>Name of program</th>
<th>Started</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLM</td>
<td>Pascua Yaqui Youth in Wilderness (PYYW)</td>
<td>2004</td>
</tr>
<tr>
<td>CWP/BLM/ITE/EHS</td>
<td>Youth Engaged Stewardship (YES!)</td>
<td>2011</td>
</tr>
<tr>
<td>BLM/ERF</td>
<td>Wild about the Grasslands (WATG)</td>
<td>2007</td>
</tr>
<tr>
<td>Forest Service</td>
<td>Friends of Kentucky Camp Caretakers (FKCC)</td>
<td>1989</td>
</tr>
<tr>
<td>Empire Ranch Foundation</td>
<td>Docent and restoration projects (DRP)</td>
<td>1999</td>
</tr>
<tr>
<td>State of Arizona</td>
<td>Arizona Site Stewards (ASiSt)</td>
<td>1986</td>
</tr>
<tr>
<td>Antelope Foundation</td>
<td>Youth Habitat Improvement (YHI)</td>
<td>2009</td>
</tr>
<tr>
<td>Various scouting orgs</td>
<td>Scout and Youth Group Work Projects (SYGWP)</td>
<td></td>
</tr>
<tr>
<td>Sky Island Alliance</td>
<td>Sky Island Alliance Volunteers (SIAV)</td>
<td></td>
</tr>
<tr>
<td>Vail School District</td>
<td>Empire High School Ecology Class (EHS)</td>
<td>2009</td>
</tr>
<tr>
<td>Arizona Trail Organization</td>
<td>Trail Volunteers (TV)</td>
<td></td>
</tr>
<tr>
<td>Vail Preservation Society</td>
<td>Preservation Projects (PP)</td>
<td>2006</td>
</tr>
<tr>
<td>BLM/Forest Service</td>
<td>Camp Hosts (CH)</td>
<td>1988</td>
</tr>
</tbody>
</table>

BLM acquired Las Cienegas in 1988, so there is no data before this year.

Sources: Shela McFarlin, CWP; Bobbie Young, ERF; Dave Mehalic – U.S. Forest Service
Socio-cultural - General trends

**Economic vitality:** Baseline created for 2016

**Land use:**
- Human impact: sustained increase
- Landscape: No clear trend
- Wetness: No clear trend; slight increase in open water

**Archaeological sites:**

**Recreational permits**
- Increase in recreational permits
- Increase in number of visitors
- No clear trend in annual passes and schools/organizations

**Number of programs:**
- Created a baseline for the Preserve and the Empire Ranch
- Preserve: Number of program participants show a peak in 2014
# Conclusion of general trends

<table>
<thead>
<tr>
<th>CLIMATE</th>
<th>WATER</th>
<th>ECOLOGICAL</th>
<th>SOCIO-CULTURAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Temperature:</strong> Dramatic increase</td>
<td><strong>Groundwater levels:</strong> Slight decrease in most wells</td>
<td><strong>Vegetation composition:</strong></td>
<td>Economic vitality: Baseline created for 2016</td>
</tr>
<tr>
<td>• <strong>Precipitation:</strong> No clear trend</td>
<td><strong>Wet-dry:</strong> Decrease in minimum June flow, with slight recovery in BLM land in 2016 and significant recovery in the Preserve in 2015</td>
<td>• Shrub cover decrease</td>
<td><strong>Land use:</strong></td>
</tr>
<tr>
<td>• <strong>Drought:</strong> Currently experiencing a period of drought, with shorter term swings to less drought</td>
<td><strong>Gauges:</strong> Decrease in Pantano Wash, slight increase in Cienega Creek</td>
<td>• Perennial grass declined; 2016 showed recovery</td>
<td>• Human impact: sustained increase</td>
</tr>
<tr>
<td></td>
<td><strong>Winter stream flows:</strong></td>
<td>• Invasive species increase</td>
<td>• Landscape: No clear trend</td>
</tr>
<tr>
<td></td>
<td>• Preserve: Significant decrease in Marsh Station, slight increase in Titled Beds</td>
<td>• Bare ground decrease; amount of litter has decreased</td>
<td>• Wetness: Slight increase in open water</td>
</tr>
<tr>
<td></td>
<td>• BLM: Slight increase in Empire Gulch, decrease in Upper Ciénega</td>
<td><strong>Pronghorn:</strong> Recovering</td>
<td>Archaeological sites: Common assessment form</td>
</tr>
<tr>
<td></td>
<td><strong>Water quality:</strong></td>
<td><strong>Prairie dog:</strong> Successful reintroduction</td>
<td>Recreational permits</td>
</tr>
<tr>
<td></td>
<td>• Preserve: Decrease in PH and TDS</td>
<td><strong>Fish:</strong> Recovering</td>
<td>• Increase in recreational permits and number of visitors</td>
</tr>
<tr>
<td></td>
<td>• BLM: No clear trend</td>
<td><strong>Frogs:</strong> Recovery of endangered species and reduction of invasive species</td>
<td><strong>Stewardship engagement programs:</strong> Baseline for 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Wildfires:</strong> Dramatic increase in the 2000s</td>
<td>• Preserve: Number of program participants show peak in 2014</td>
</tr>
</tbody>
</table>
Next steps

• Critical feedback and suggestions
  • On the indicators and presentation
    • How effective are these indicators?
    • What’s missing? What can be eliminated?
    • How can we improve the quality of the presentation?
    • How best to share this with partners and with the public?
  • On responses:
    • What does this information tell us about the State of the Cienega Watershed – trends, concerns, recommendations?

• Following today’s session, we will refine, post, and publish

• CWP will continue to work with partners in using these insights to develop appropriate activities and programs
Thank you!

• Questions? Comments?