



Land Cover Change on Coyote Creek, Anza-Borrego Desert State Park

Timothy Layton

Suzanné Walther PhD, Environmental & Ocean Sciences Department



Introduction

- A multi-year drought that occurred in California from 2011-2016 that impacted vegetation throughout the region¹.
- Vegetation, the cornerstone of a riparian habitat, is even more vital in arid and semi-arid deserts².
- Decreased stream flow from drought results in fragmented pools and dry streambeds, further diminishing habitat for freshwater aquatic invertebrate species³.
- Coyote Creek, a perennial stream located in the northwest corner of Anza Borrego Desert State Park (ABDSP) (Image 1). Three segments, Upper, Middle, and Lower Willows, with important vegetation diversity⁴.
- To determine the impact of the drought on vegetation, this study quantifies land cover change on Lower Willows by asking:
 - What was the area of vegetative cover 2014, 2016, and 2018?
 - What is the total vegetative cover change (loss/gain) between the years?



Image 1. Location of ABDSP (red) with study area (pink). Not to scale.

Methods

- Using ArcMap 10.7, clipped 4-Band aerial imagery (Red, Blue, Green, and Near-IR) provided by USDA to the study area.
- Measured vegetation cover from raw 4-Band imagery for each year using the Normalized Difference Vegetation Index (NDVI), a measure of the vegetation based on the difference between the near-infrared (which vegetation strongly reflects) and red light (which vegetation absorbs) bands.
- Quantified changes in land cover over time using Raster Calculator, by subtracting the older from the newer NDVI data to calculate the difference.
- Re-classified resultant raster images into 3 categories: gain, loss, and no change.

Results

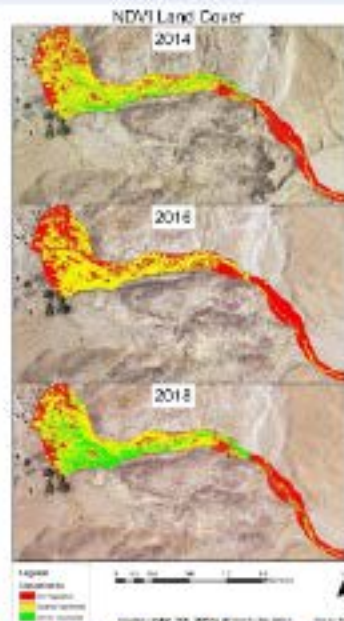


Figure 1. NDVI for 2014, 2016, 2018. Vegetation Classification according to USDA ranges. Study area is 1,027,007 m².

Table 1. Percentage of Vegetation Land Cover of Lower Willows using USDA NDVI classification.

Percentage of Land Cover			
Year	2014	2016	2018
No Vegetation	35	48	30
Sparse Vegetation	55	52	52
Dense Vegetation	10	0	18

- Complete loss of dense vegetation cover from 2014 to 2016 (10% to 0%) then an increase from 2016 to 2018 (0% to 18%) (Figure 1, Table 1).
- Loss of 269,325 m² of vegetation from 2014 to 2016 with a subsequent gain of 377,550 m² from 2016 to 2018 (Figure 2, Table 2).

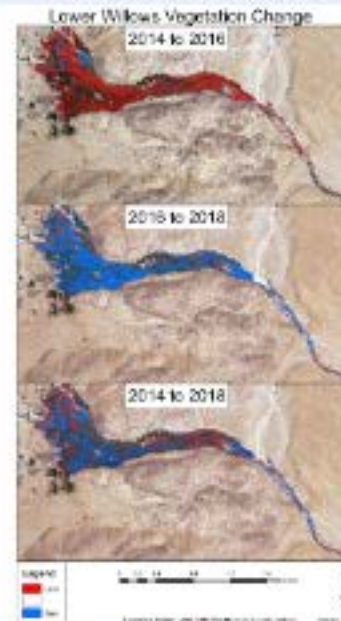


Figure 2. Differencing between NDVI rasters showing gain, loss, and no change.

Table 2. Vegetation Land Cover changes (total area) between study years, shown in square meters.

Vegetation Land Cover (m ²)			
Years	2014 - 2016	2016 - 2018	2014 - 2018
Loss	269,325	15,572	112,477
No Change	720,638	831,601	872,764
Gain	35,892	377,550	242,172

Conclusion

- A complete loss of dense vegetation occurred between 2014-2016, following the least amount of rainfall of the drought in 2014 and 2015¹.
- From 2016-2018, coinciding with the end of the drought¹, dense vegetation increased to 9% more cover in 2018 than in 2014.
- From 2014-2016, over 26% of the vegetation land cover area was lost, while 36% vegetation land cover area was regained from 2016-2018.
- Post-drought vegetation land cover levels were higher than pre-drought levels as shown visually by the NDVI percentages and the calculated area differencing.



Image 2. On site photographs of Lower Willows ABDSP.

Future Work

- Relate vegetation loss and gain to precipitation data from the drought.
- Elevation differencing to assess erosion between the years and to identify channel changes.
- Relationship between the physical aspects of Lower Willows with ecological values. Dr. Soerama's research (Biology Department) (Image 2).

Acknowledgements

Thank you to the Summer Undergraduate Research Experience (SURE) as well as the Office of Undergraduate Research (OUR) to allow me to present this research at the American Association of Geographers annual conference. Thank you to ABDSP for allowing us to conduct preliminary field data gathering.

References

1. Hobbie, J. E., et al. (2014). A multi-year drought that occurred in California from 2011-2016 that impacted vegetation throughout the region. *Journal of Arid Environments*, 108, 1-10.
2. Layton, T. (2018). The impact of the drought on vegetation in the Anza-Borrego Desert State Park. *Journal of Arid Environments*, 108, 1-10.
3. Soerama, S. (2018). The impact of the drought on vegetation in the Anza-Borrego Desert State Park. *Journal of Arid Environments*, 108, 1-10.
4. Soerama, S. (2018). The impact of the drought on vegetation in the Anza-Borrego Desert State Park. *Journal of Arid Environments*, 108, 1-10.