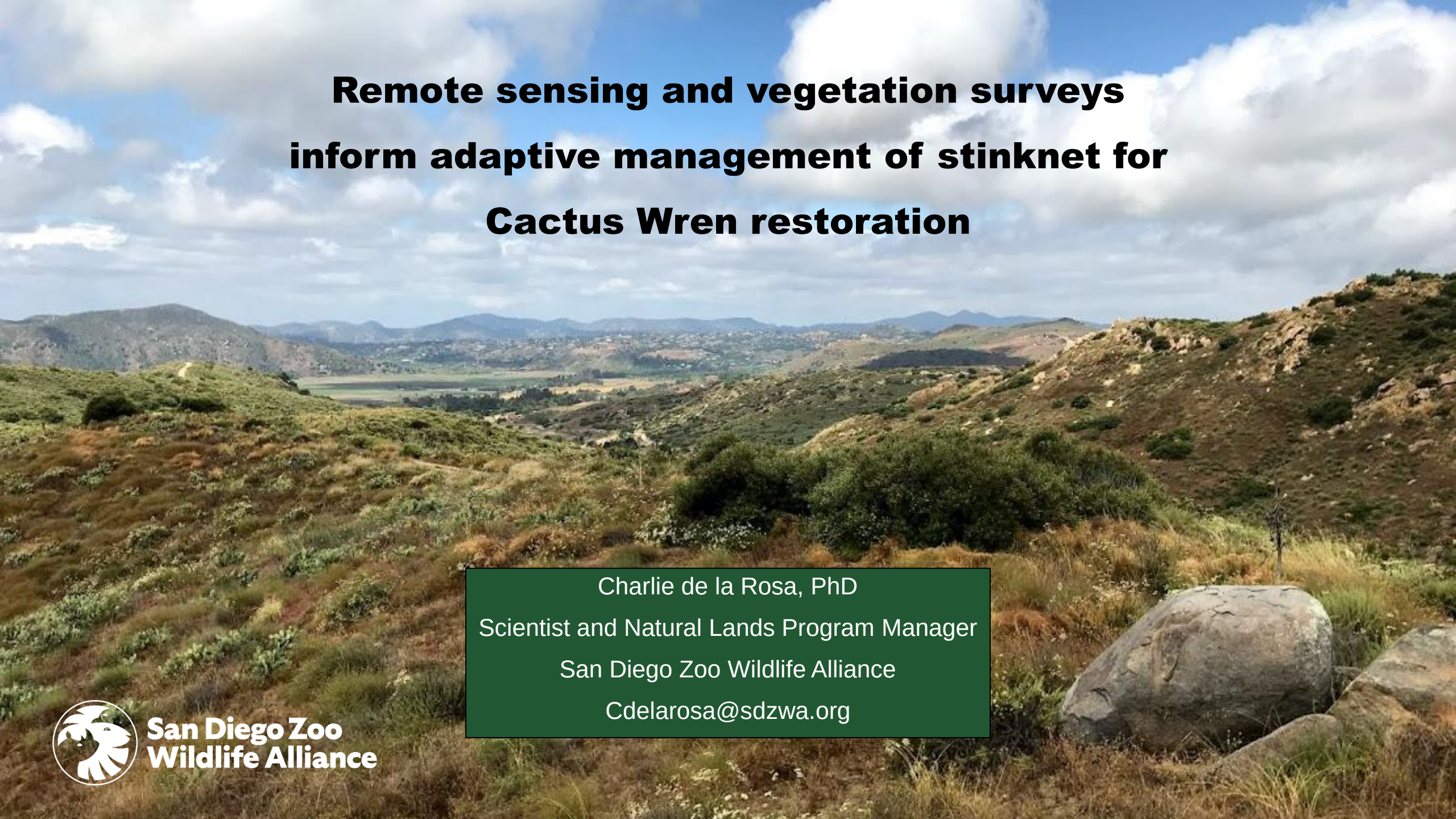
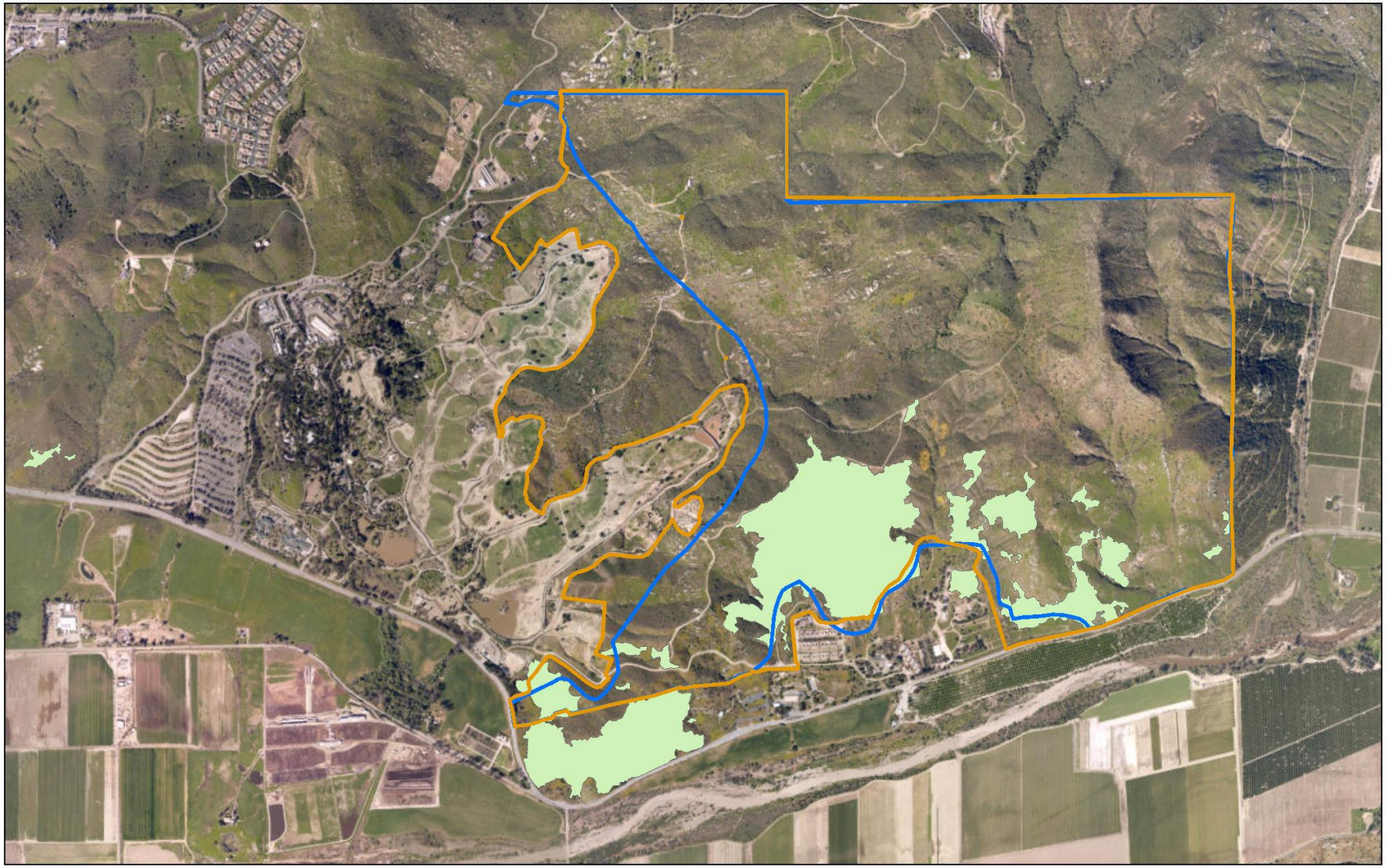
Remote sensing and vegetation surveys inform adaptive management of stinknet for Cactus Wren restoration



Charlie de la Rosa, PhD
Scientist and Natural Lands Program Manager
San Diego Zoo Wildlife Alliance
Cdelarosa@sdzwa.org

San Diego Zoo Wildlife Alliance

Safari Park Biodiversity Reserve



4/22/2025

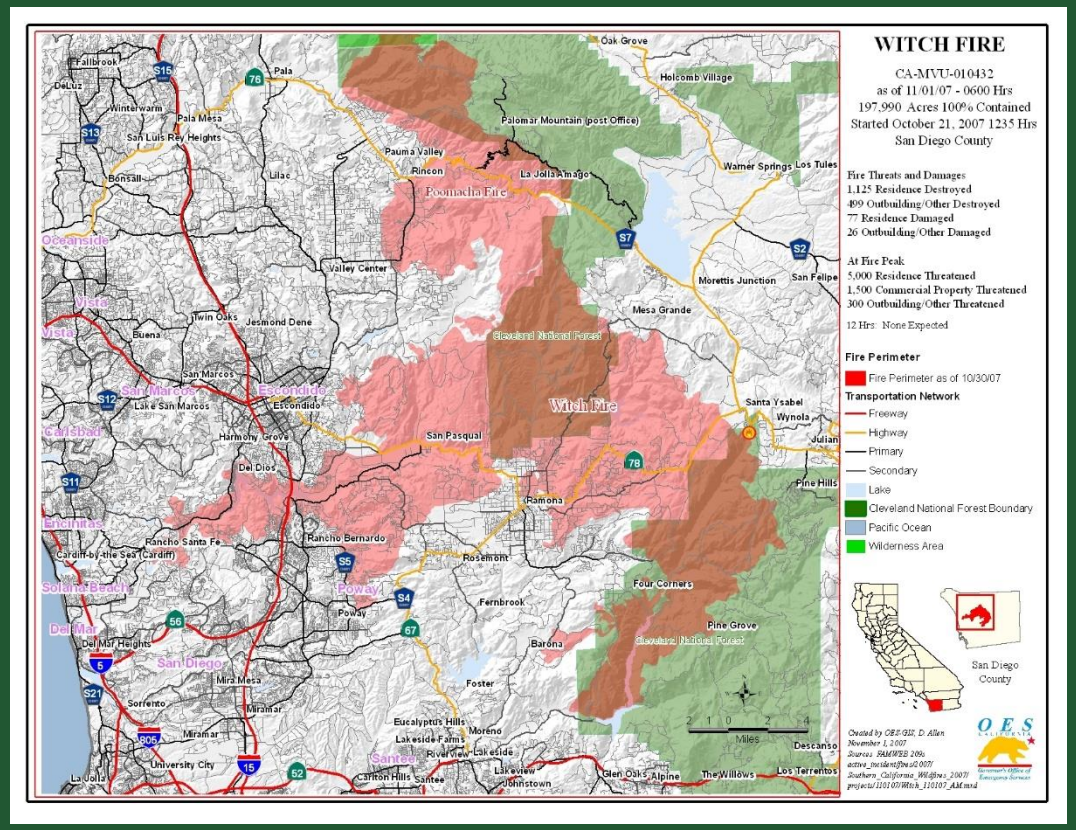
1:23,373

0 0.15 0.3 0.6 mi

0 0.28 0.55 1.1 km

- Biodiversity Reserve boundary
- Safari Park MSCP boundary
- Cactus scrub

2007 Witch Fire



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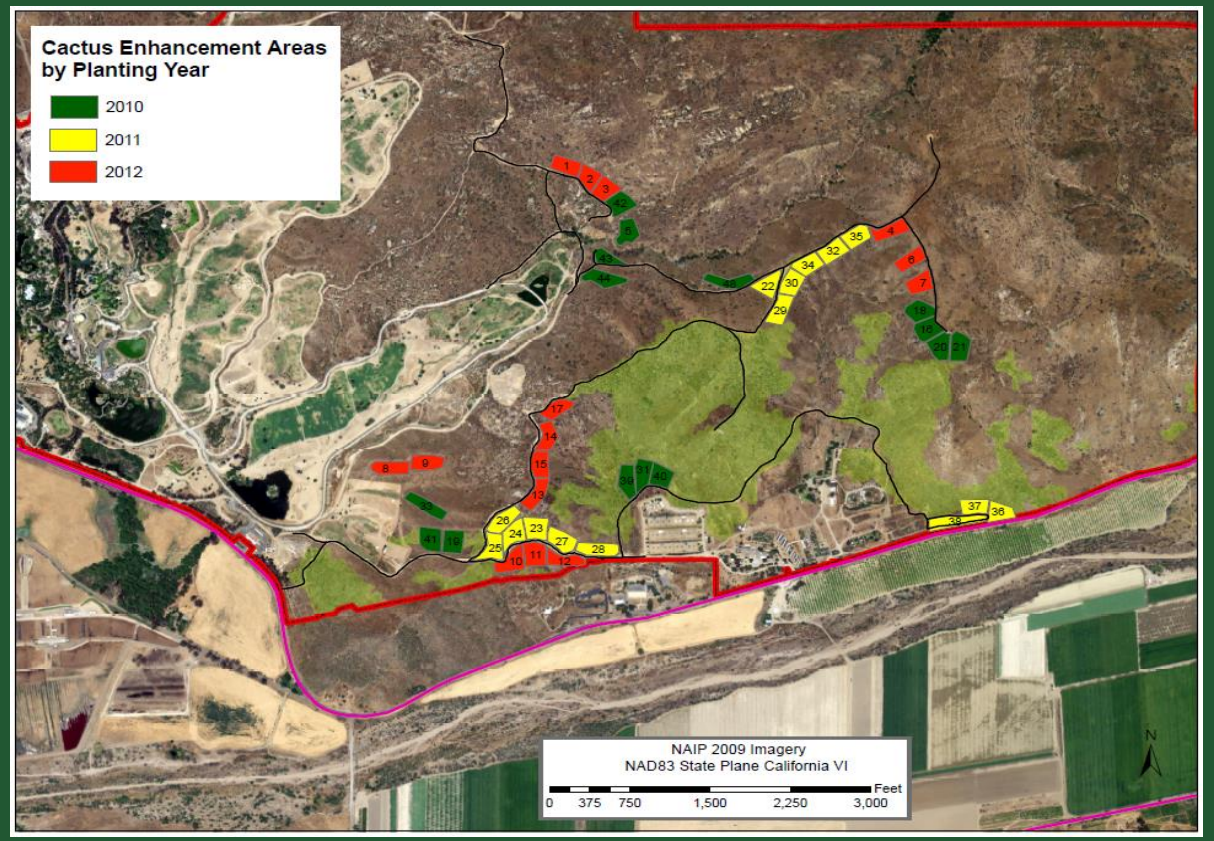
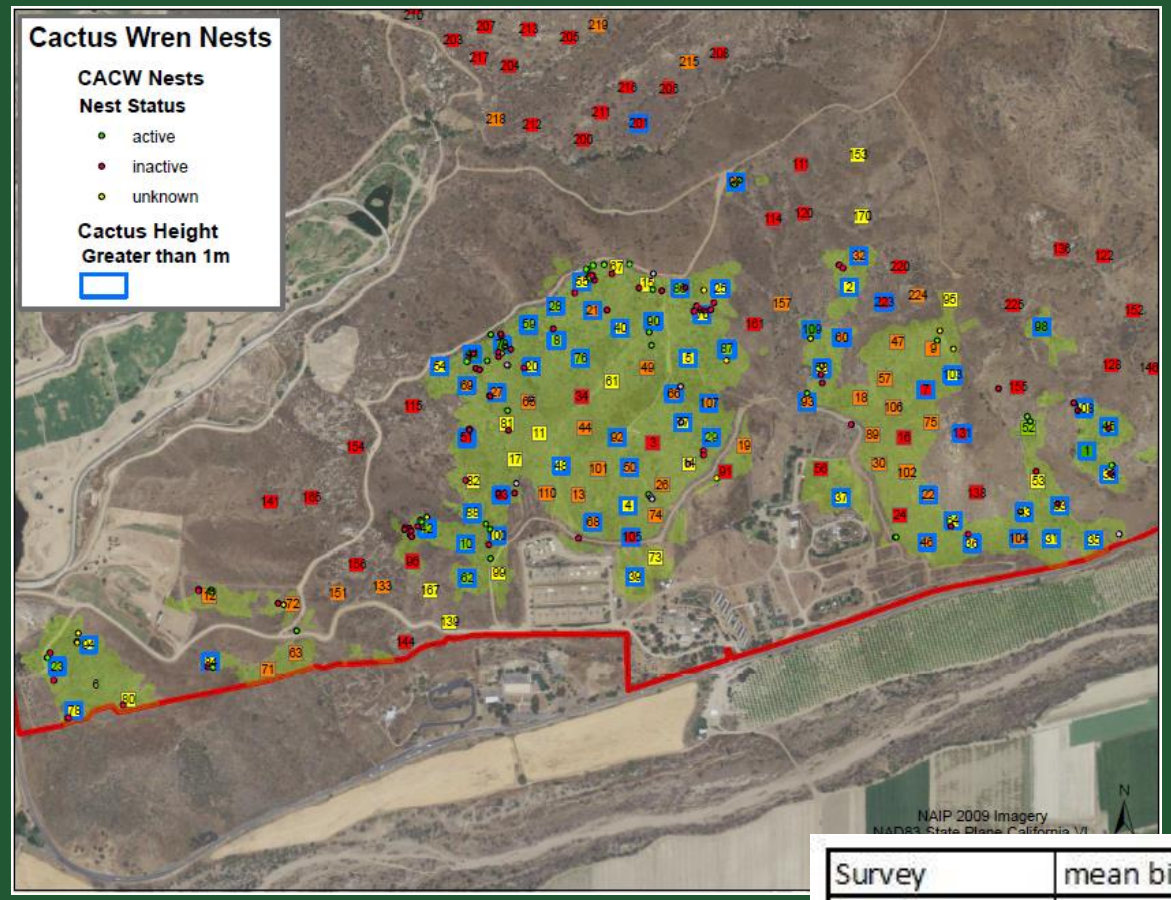
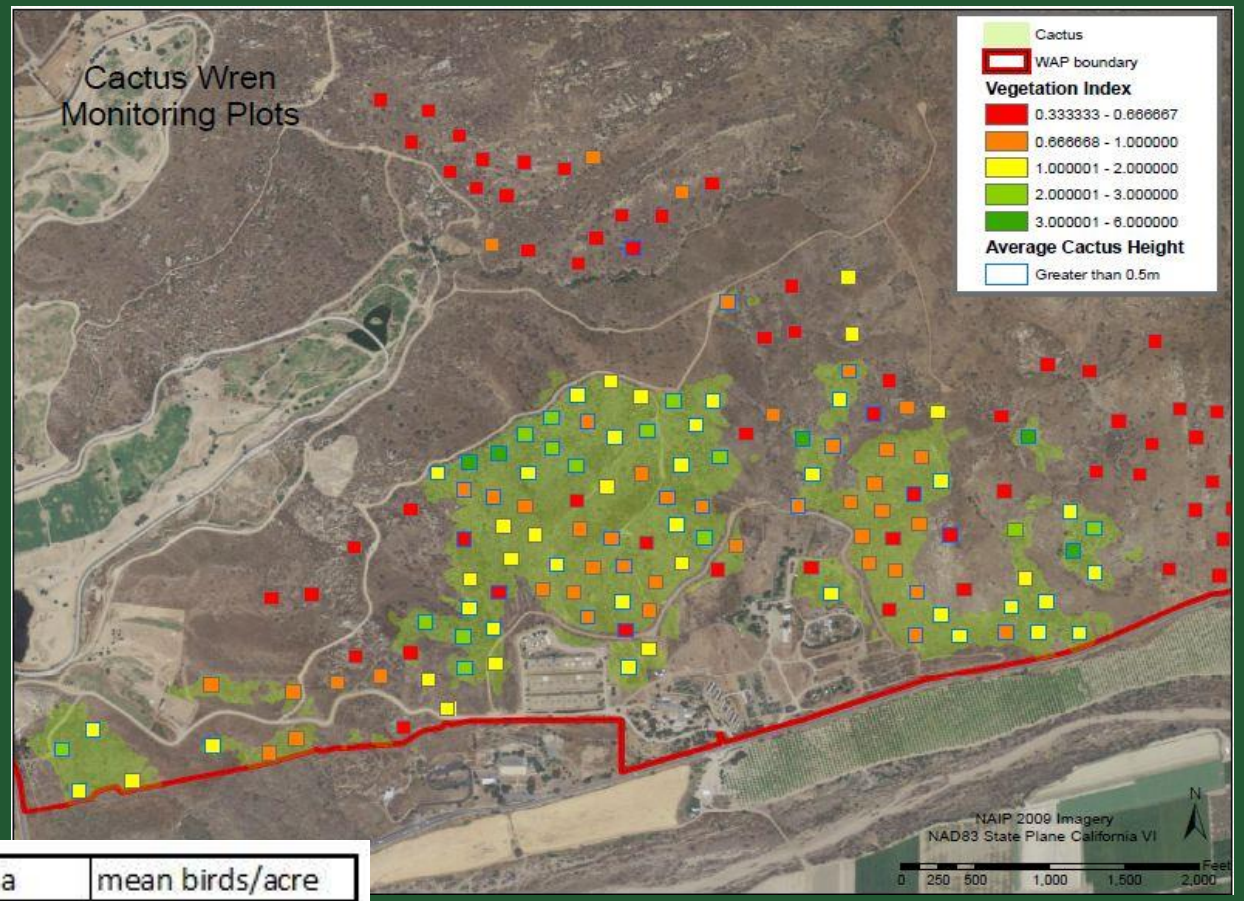
2010 – 2012: Cactus restoration and CACW monitoring



SANDAG funded

2010 – 2012: Cactus restoration and CACW monitoring





Survey	mean birds/ha	mean birds/acre
2010 Fall	0.29	0.12
2011 Spring	0.30	0.12
2011 Fall	0.41	0.17
2012 Spring	0.32	0.13
2012 Fall	0.29	0.12
2013 Spring	Survey ongoing	

SANDAG funded

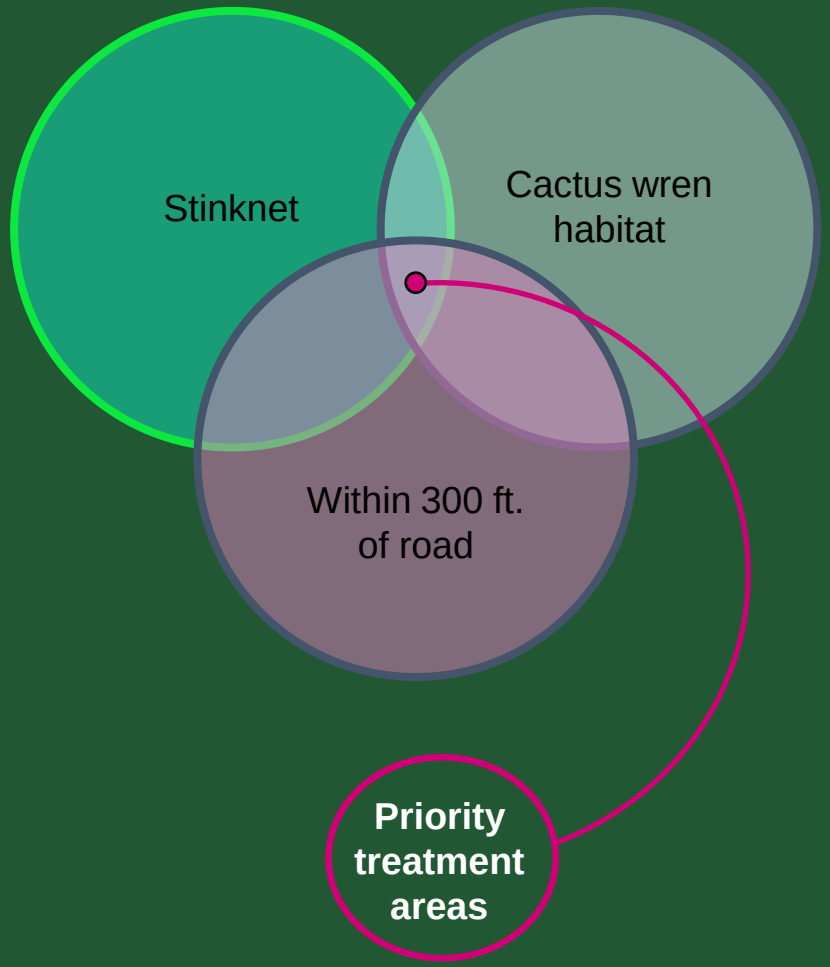
San Diego Zoo Wildlife Alliance

Fast forward to 2019

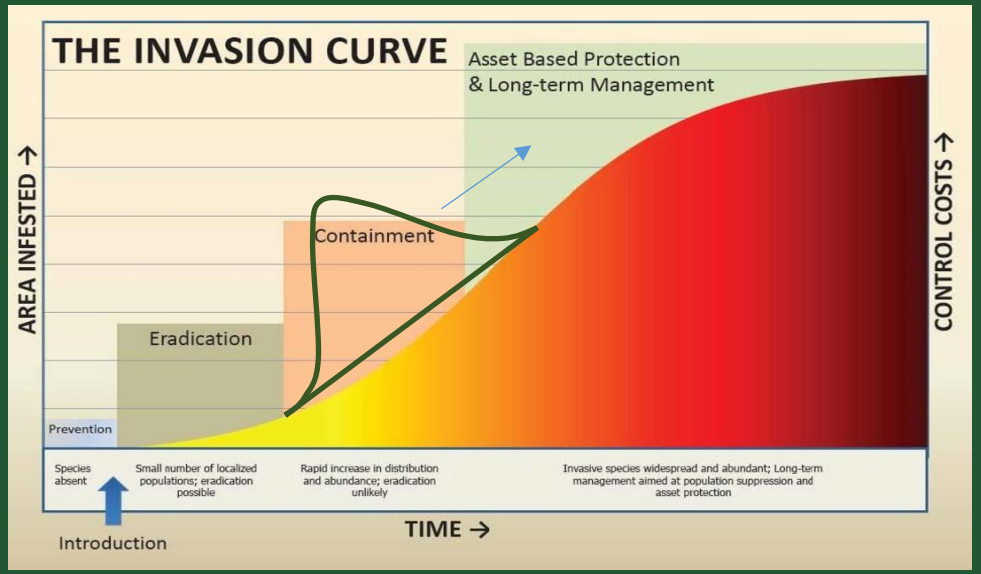
First collection: 1997


2011-06-20 9:54:16 AM M 3/5
81°F
CAM-2
RECONYX

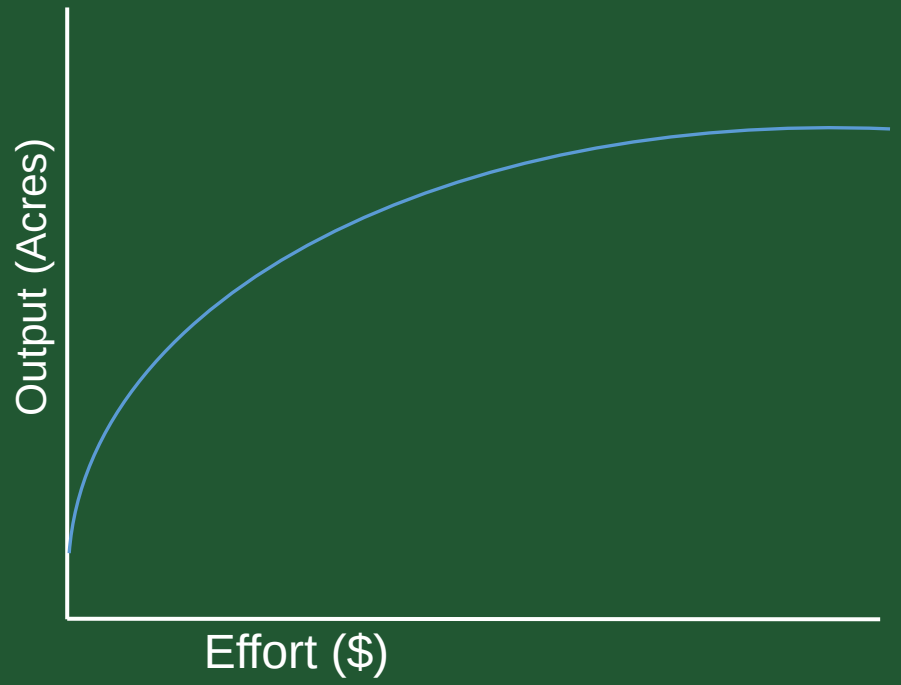
Prioritization



Harvey, R. G., & Mazzotti, F. J. (2014). The invasion curve: A tool for understanding invasive species management in south Florida. *IFAS Publication Number WEC347. Gainesville, FL: University of Florida.*



~488 acres of stinknet (Biodiversity Reserve and ASE)



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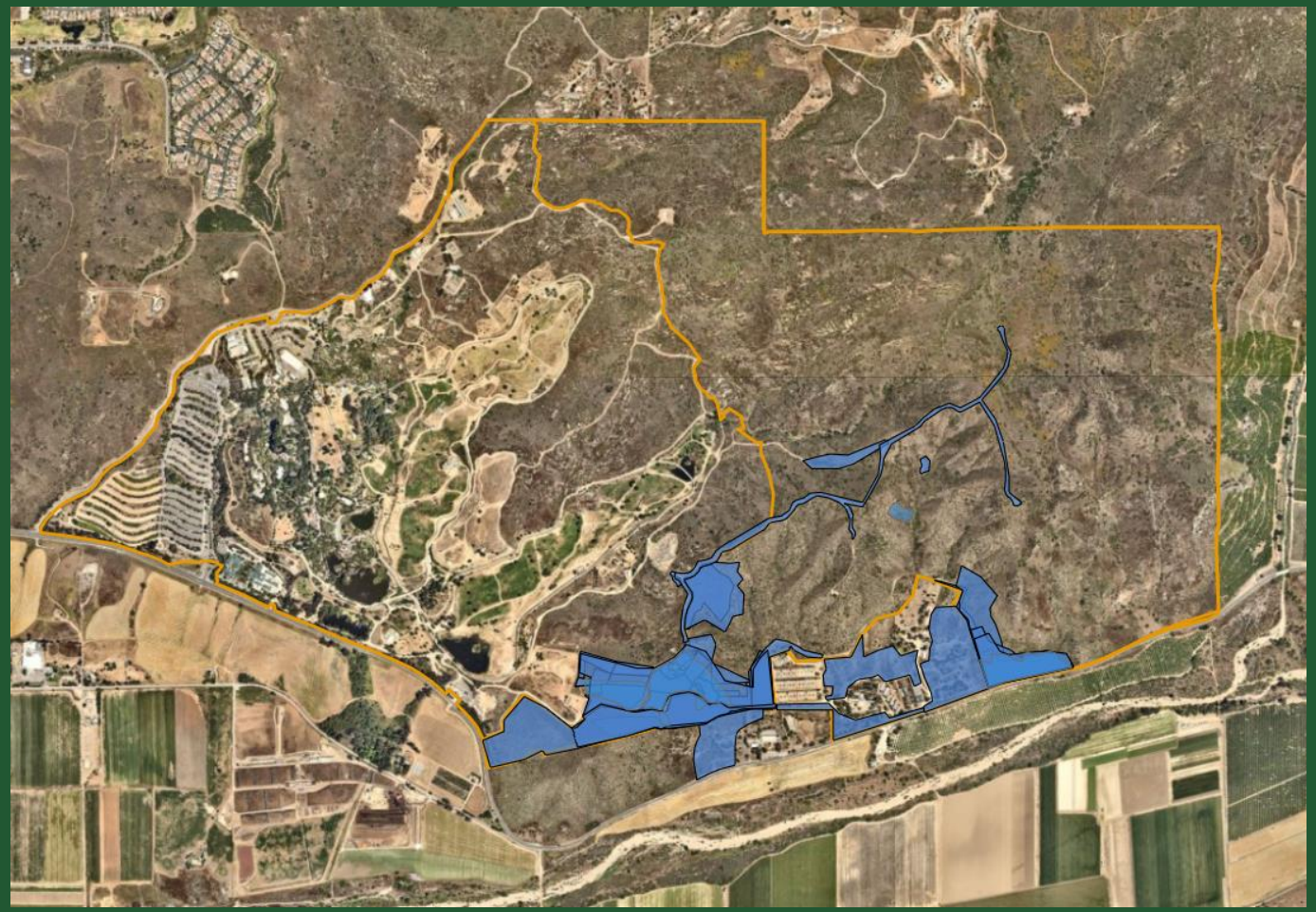
2019 - 2024

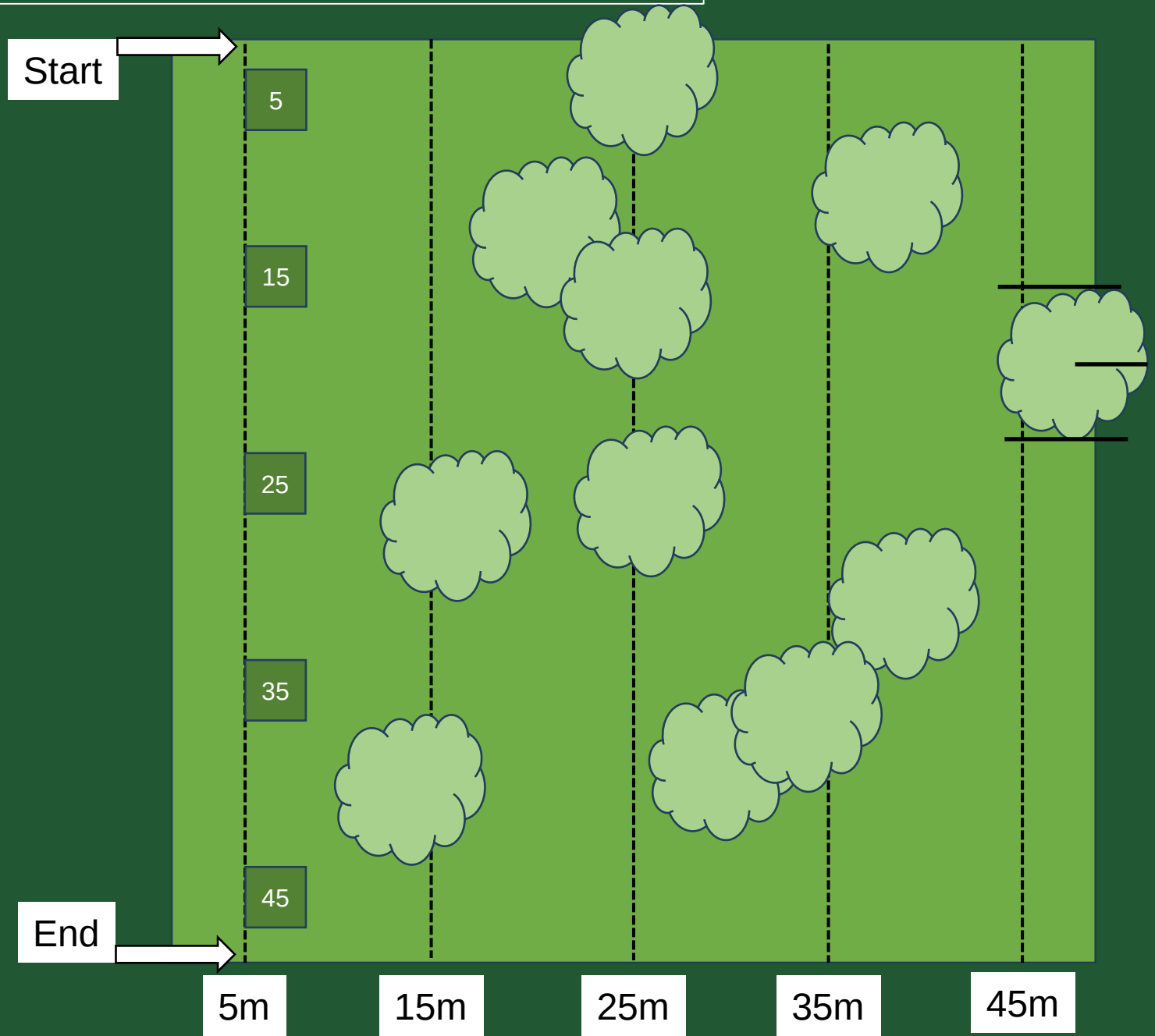


- 124 management acres: stinknet removed or reduced

Season	Treatment method	Herbicide	Treatment acres	New acres per season (management acres)
Spring 2019	Spot, pre and post-emergent	Transline and Gallery SC	19.5	19.5
Spring 2020	Spot, pre and post-emergent	Milestone	30	10
Spring 2021	Spot, pre and post-emergent	Milestone	32	32
Fall 2021	Broadcast, pre-emergent	Gallery SC	82.5	62.5
Spring 2022	Spot, pre and post-emergent	Milestone	44	0
Spring 2023	Spot, pre and post-emergent	Milestone	60	0
Total				**124**

Table 1. Treatment methods, acres treated, and new acres added to the project by season. The sum of the new acres per season *column equals the total project area, or management acres.*

2018 vegetation surveys



Species
Start
Stop
Max height

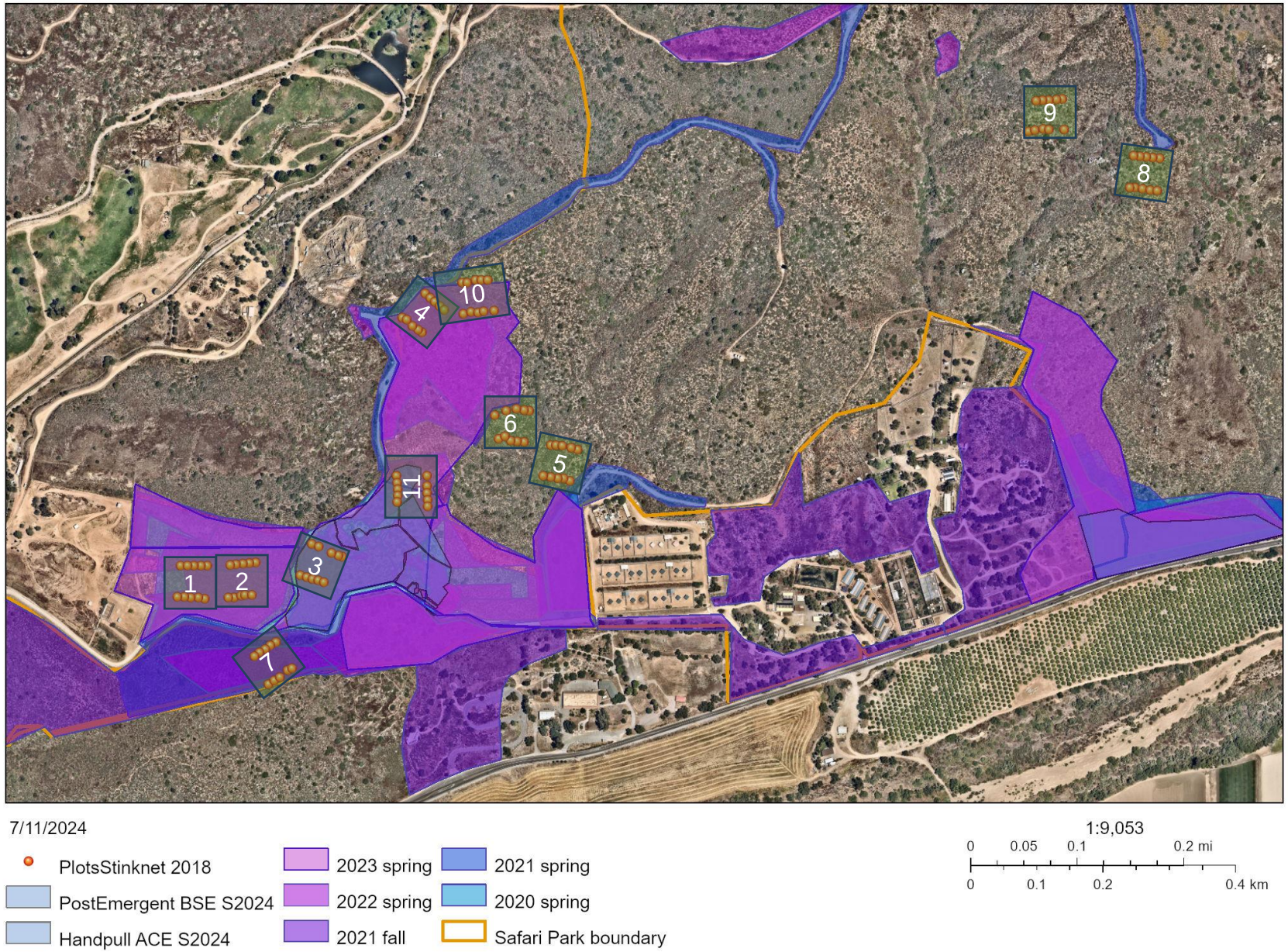
2024 vegetation surveys: volunteers!

2018 vegetation surveys

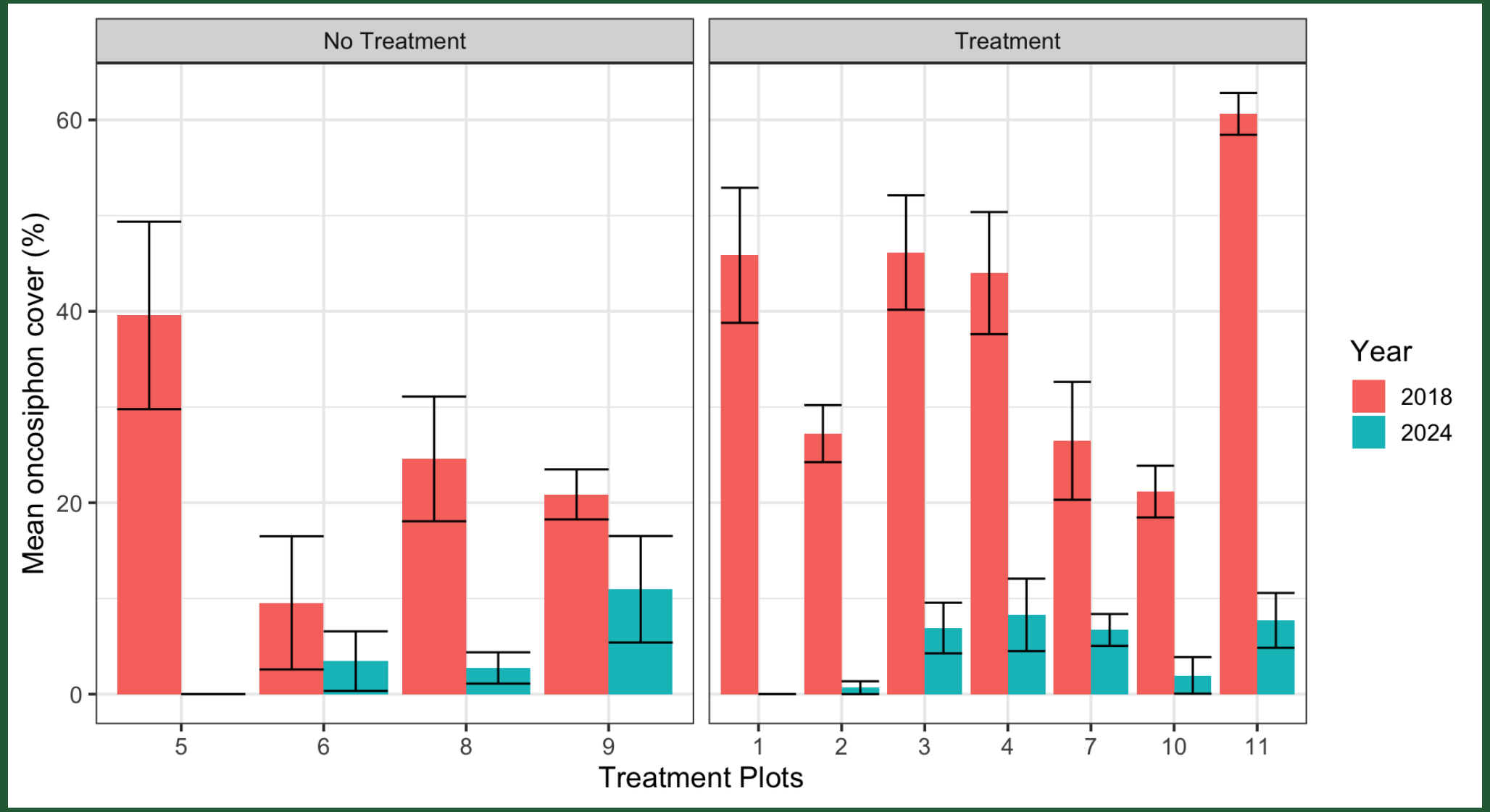
Plots within treatment areas:
- 1, 2, 3, 4, 7, 10, 11

Plots outside of treatment areas:
- 5, 6, 8, 9

Stinknet treatment areas and vegetation quadrats



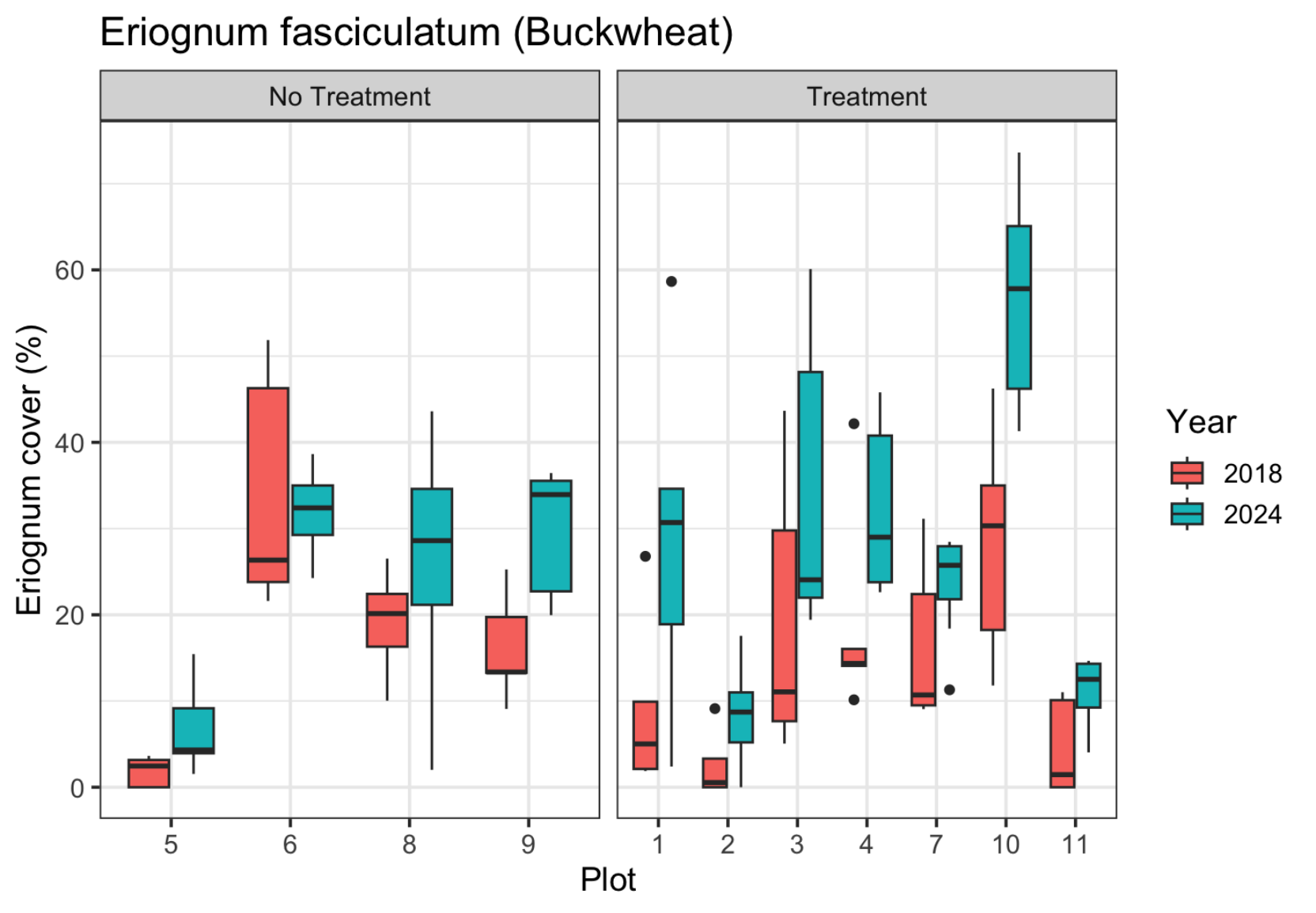
2024 vegetation surveys: preliminary results



Katie Heineman
Center for Species Survival
Program Officer - SDZWA

Treatment by Census Year Interaction **P = 0.005**
The magnitude of the *Oncosiphon* decline is greater in treatment plots (but they had farther to decline)

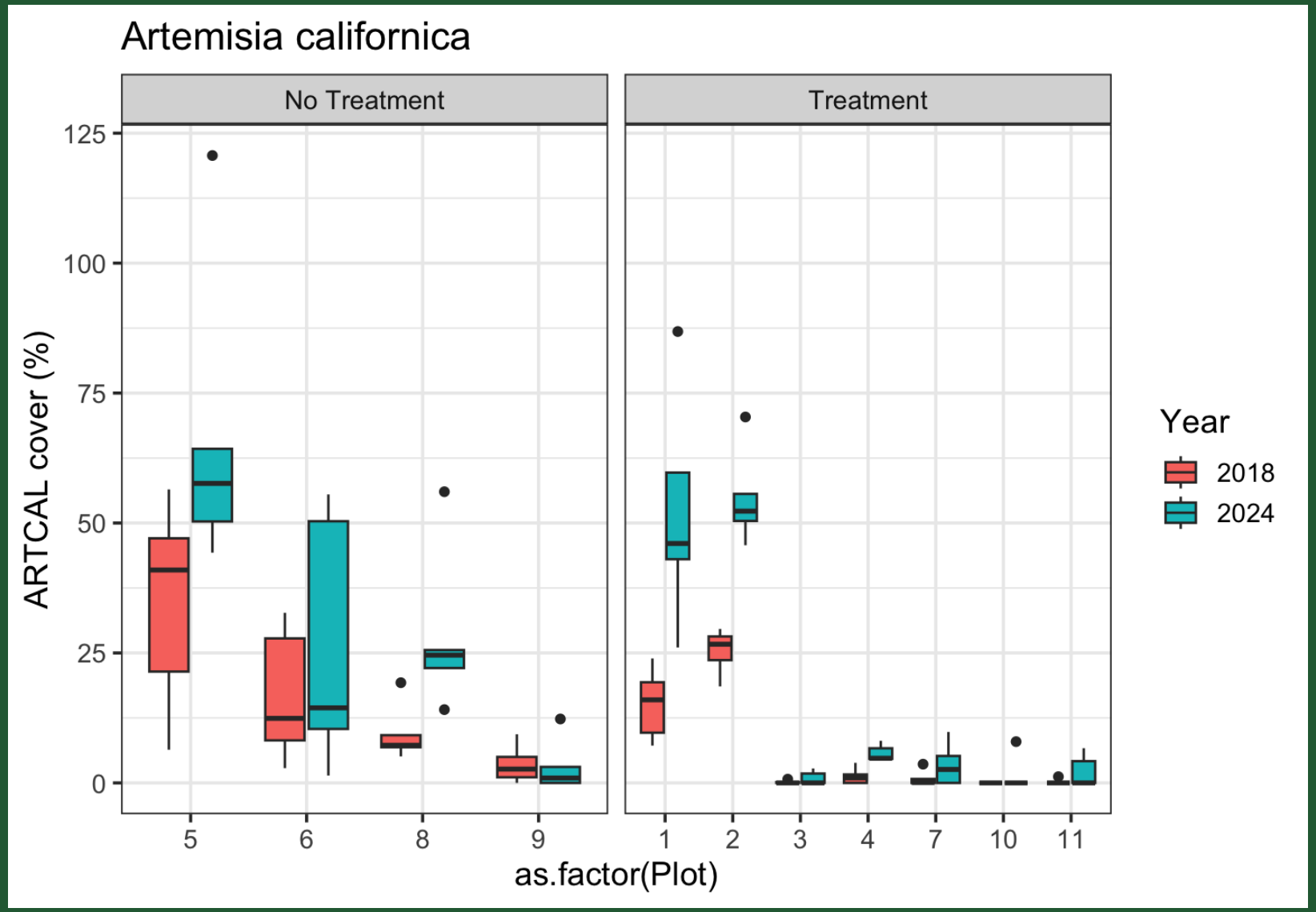
2024 vegetation surveys: preliminary results



Buckwheat cover increasing almost everywhere

Katie Heineman
Center for Species Survival
Program Officer - SDZWA

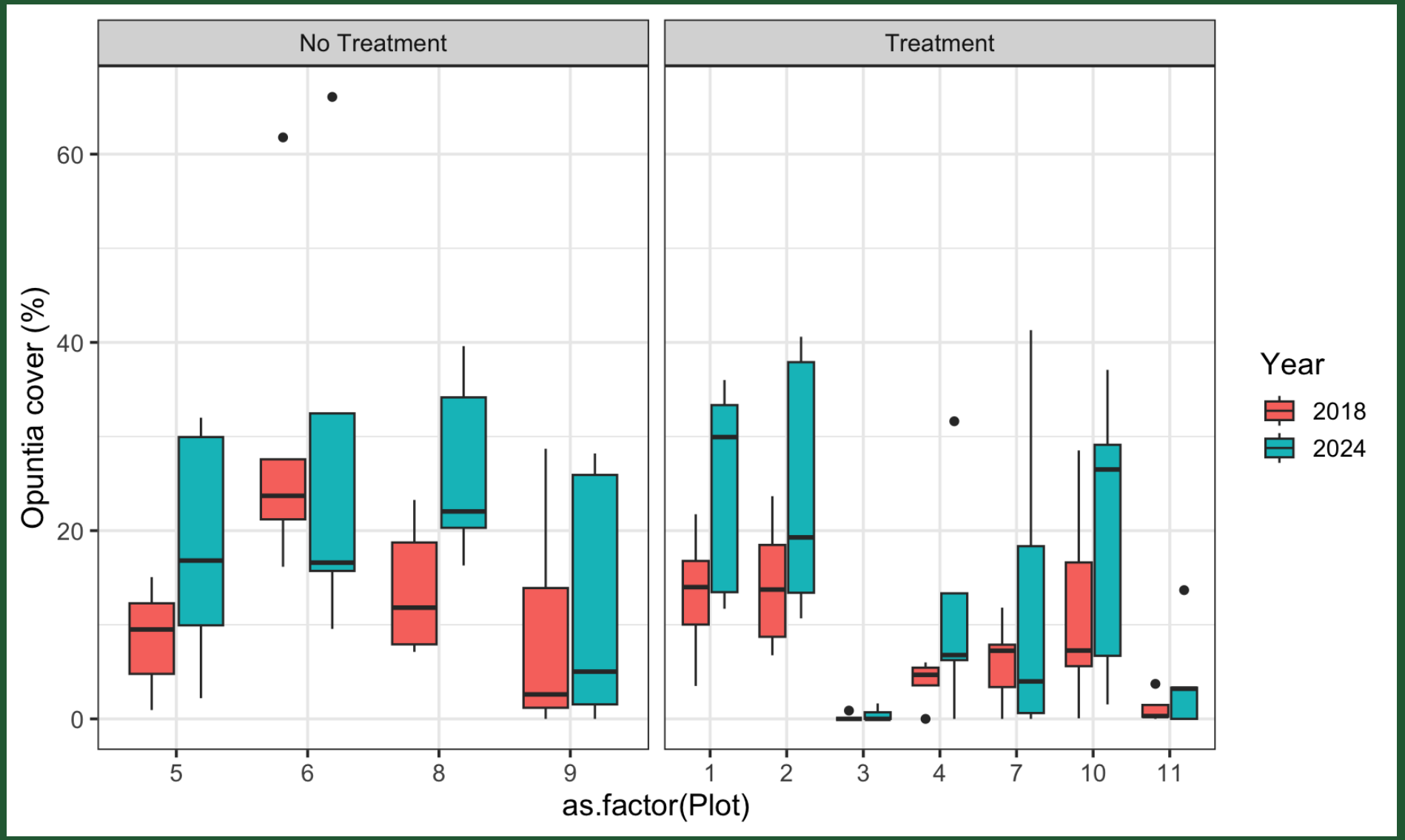
2024 vegetation surveys: preliminary results



California sagebrush increasing where present

Katie Heineman
Center for Species Survival
Program Officer - SDZWA

2024 vegetation surveys: preliminary results



Katie Heineman
Center for Species Survival
Program Officer - SDZWA

Prickly pear cover increasing overall, although fewer significant differences within plots

2018 / 2024

10-25 end

2018

2024

2018 / 2024

3-15 end

2024

2018

Drone flights: April / May 2021 - 2024

- How to measure natural ups and downs of populations due to variation in precipitation and other factors?
- ~2cm resolution
- Trinity F9 fixed wing vertical takeoff/landing from Quantum Systems

April 2022

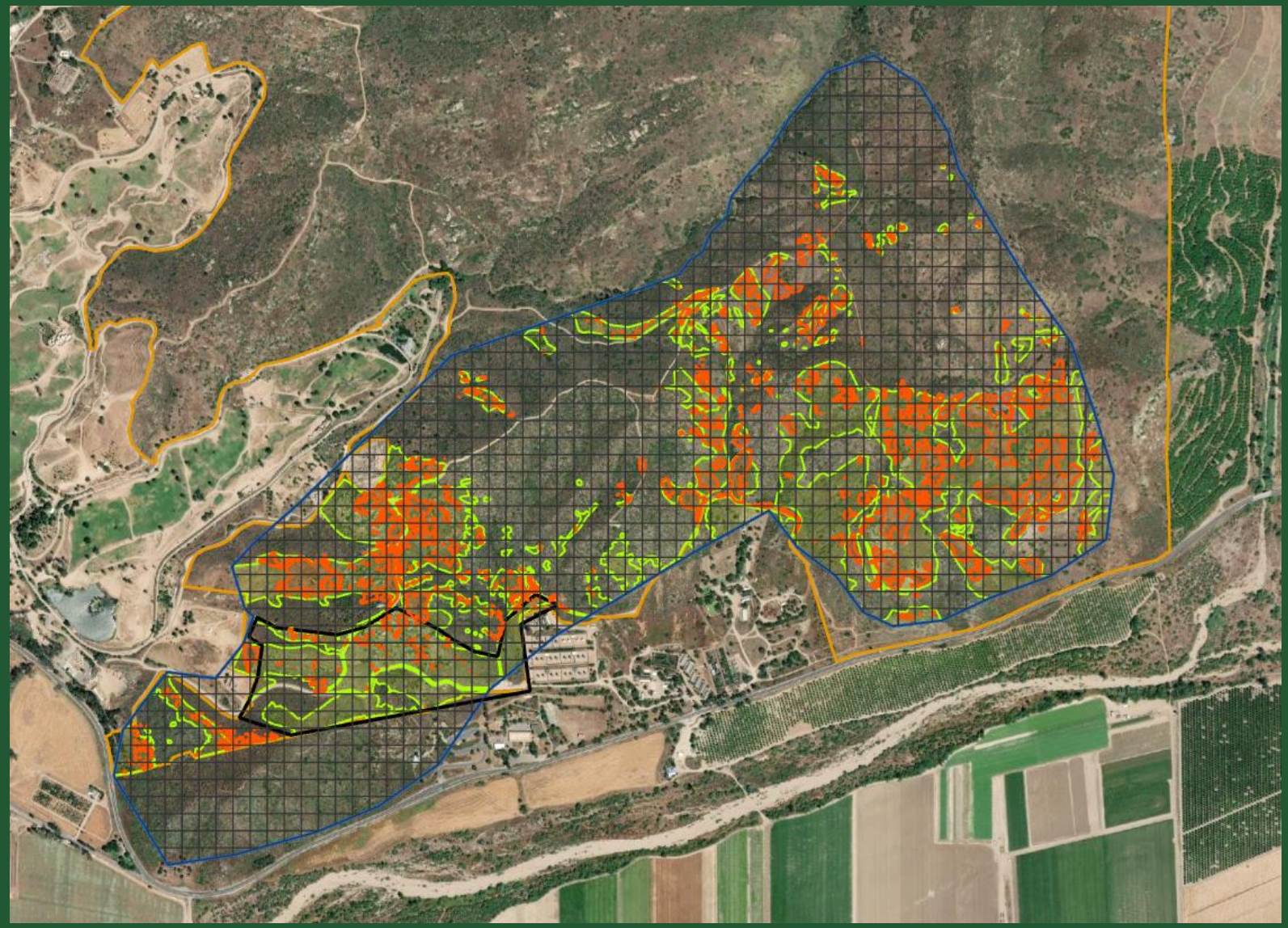
Drone flights: 2023


82%
MISSION
275
XPDR
Synced
300
250
200
MSL [m]
GS 23.50 m/s
AGL e 93 m
Wind 4.90 m/s
Getac
TABLET

Digitized stinknet polygons – 2021

Emily Burson (SDZWA Research Associate 2019-2022)

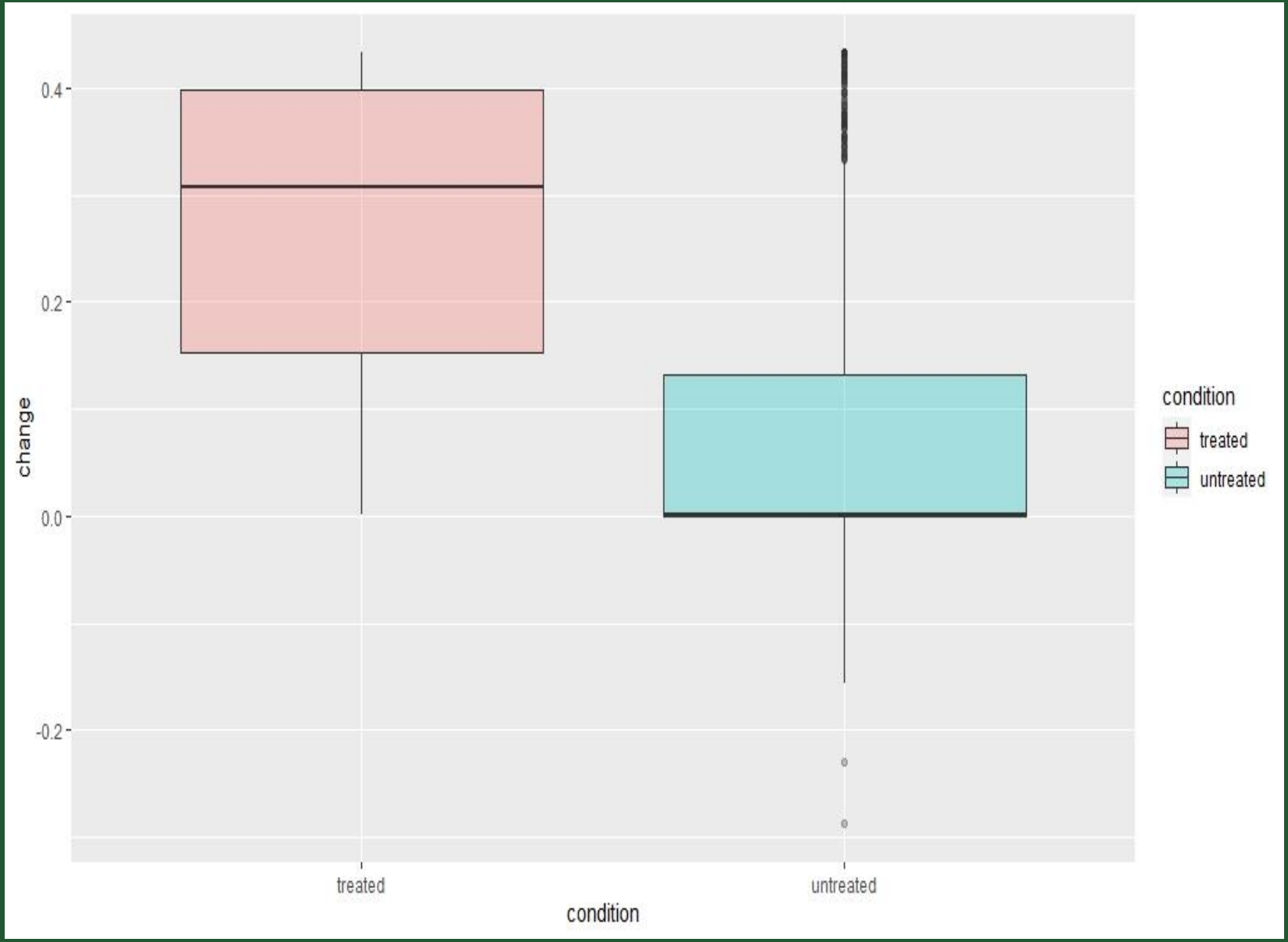
Comparing cover class 2017 – 2021



Data summary

- Overall stinknet (flyover area):
  - 2017: 154 acres
  - 2021: 33 acres

Results



Data analysis

- 2017 - 2021 acres = amount of change in each grid square
- T-test to compare mean change in treated (experimental) grid squares vs mean change in untreated squares
- **Mean untreated decrease: 0.08 acres**
- **Mean treated decrease: 0.27 acres**
- P value < 2.2e-16

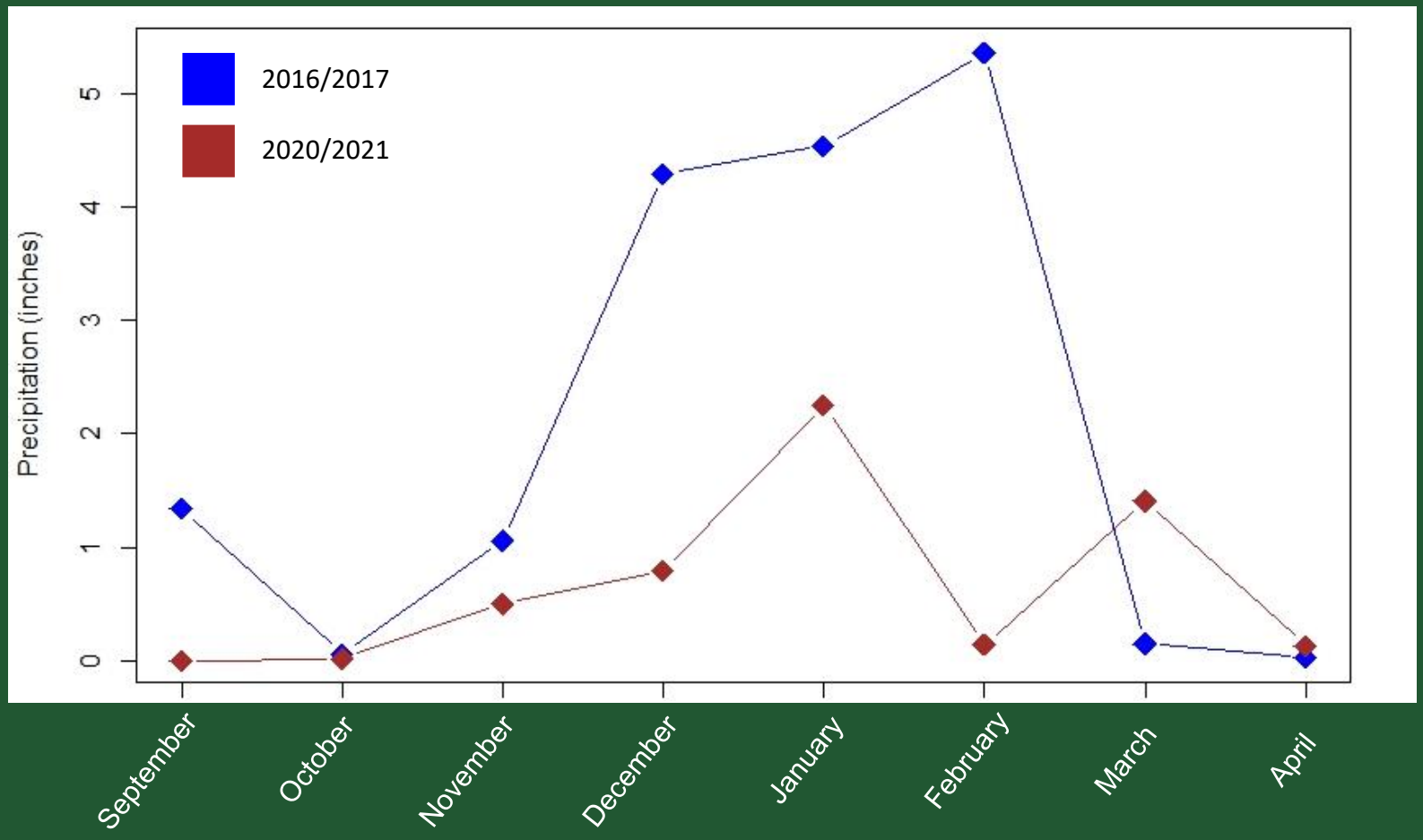
Data summary

- Overall: **121.08 acre decrease**
  - Control: **75% decrease**
  - Treatment: **95% decrease**
- Stinknet only increased ~5% of grid squares, all Control (untreated)

Seed bank expression, size, and phenology changes year to year

March 11, 2020

Feb. 28, 2021



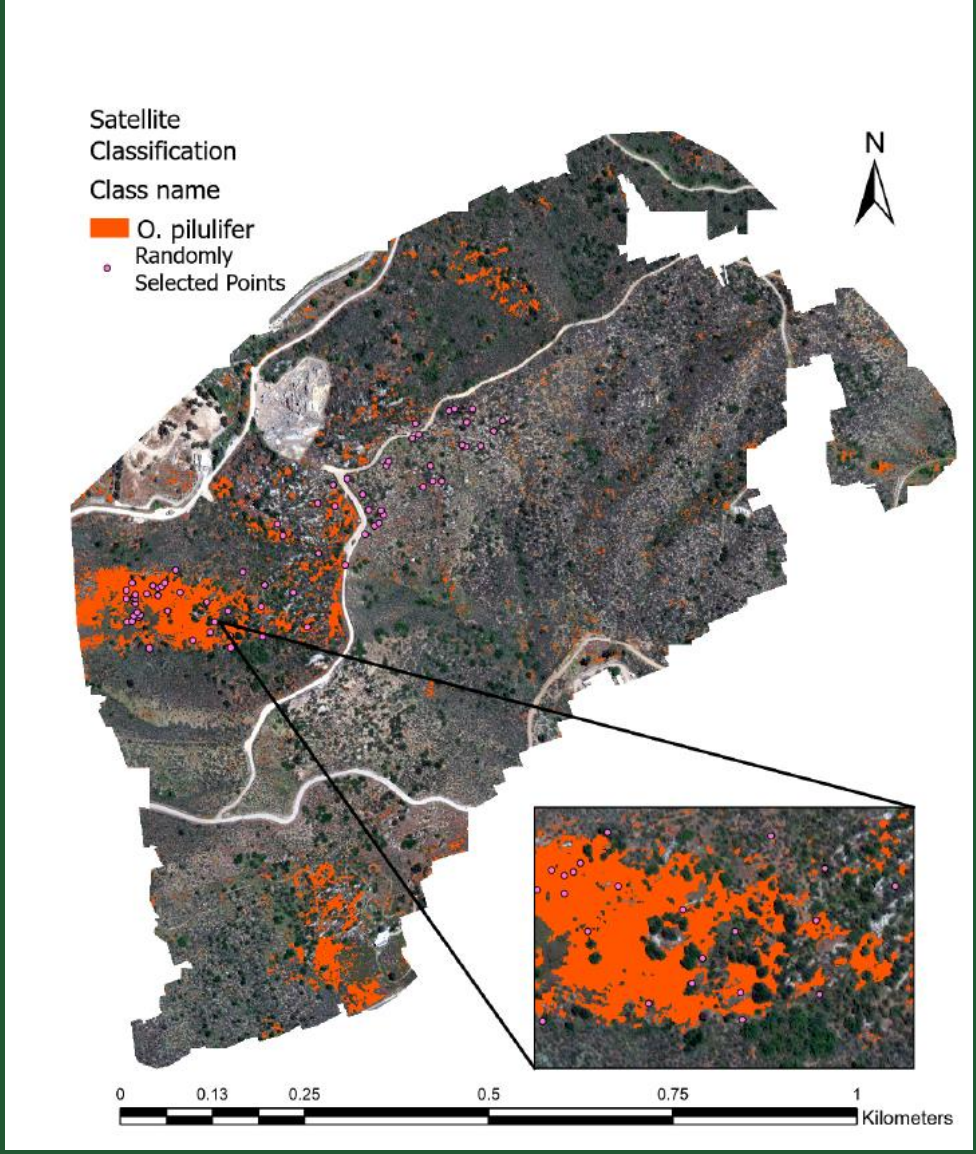
Total precipitation

2016/2017 rainy season: **16.83 inches**

2020/2021 rainy season: **5.24 inches**

Data: McClellan – Palomar Airport Station, Carlsbad, CA

Supervised classification of satellite and drone imagery



Imagery datasets

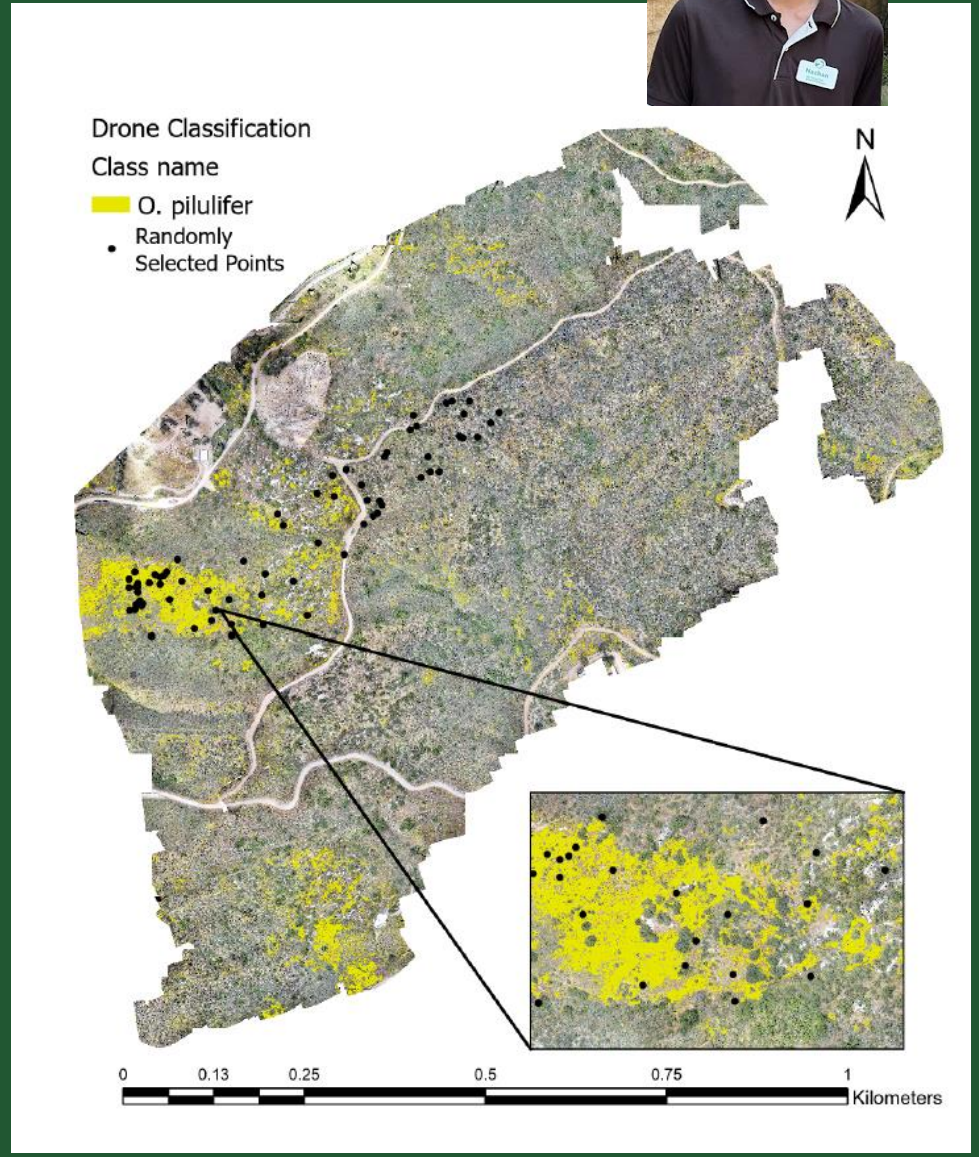
- **30 cm resolution satellite**
- **~1 cm drone**

Stinknet classification

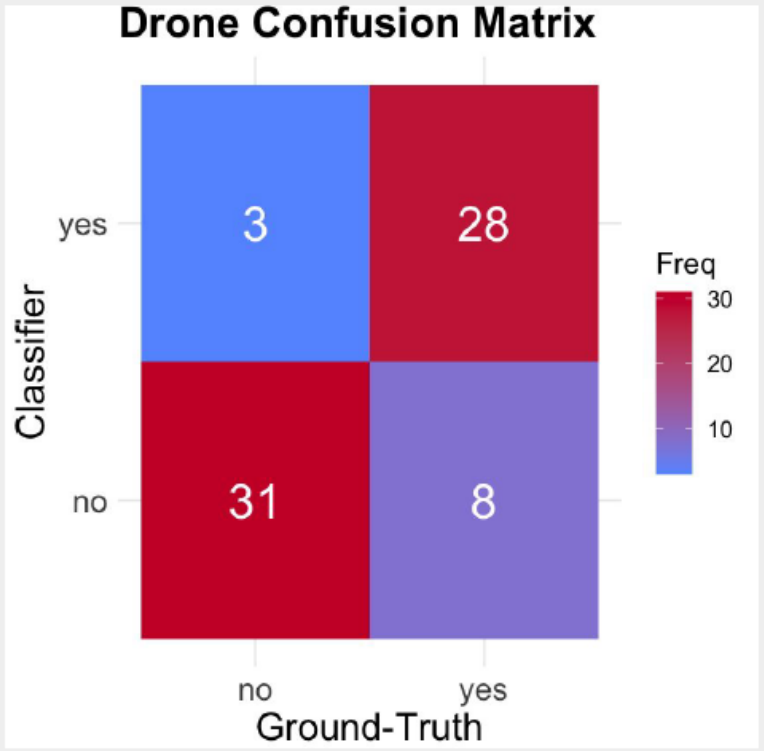
- **Supervised object-based classification w/ Support Vector Machines**

Grid

- **1m x 1m buffer around classification outputs**
- **Coverage = area of class per grid cell**



Satellite vs drone imagery



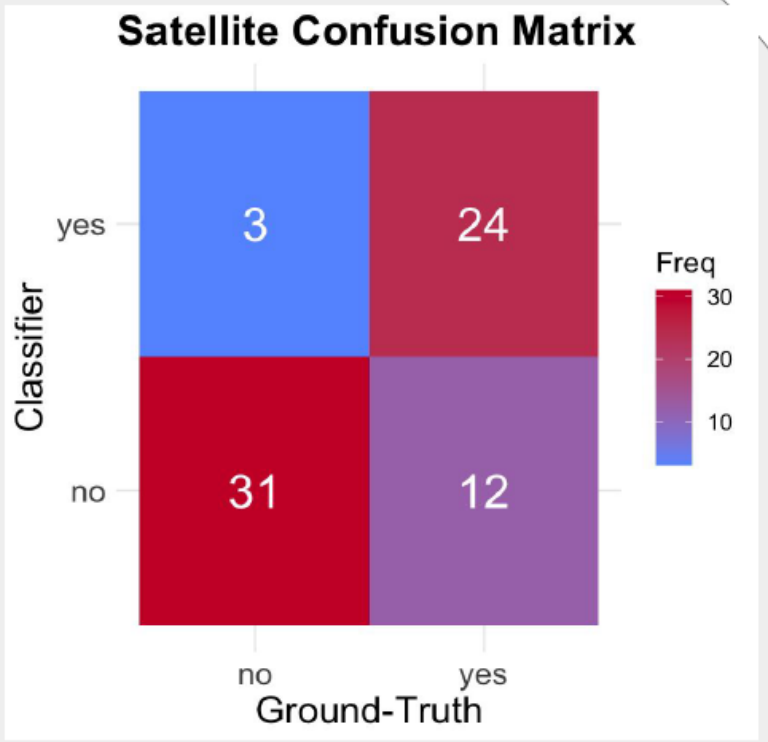


Figure 4 and 5. 2 x 2 Confusion Matrices demonstrating classifier performance against observed stinknet presence across 70 randomly selected sites. Drone classification demonstrated substantial agreement (Kappa = 0.687, SE = 0.086) with ground-truthed sites while satellite classification showed moderate agreement (Kappa = 0.574, SE = 0.094).

Ground truthing dataset

- **70 random sites, estimated stinknet coverage in 1m x 1m quadrat**

Analysis

- **No significant difference btw classifiers**
- **Satellite imagery – slightly more Type II errors (overclassifying)**
- **Kappa: agreement between predicted and actual categories**

Conclusions

- **Drone is better, but satellite viable alternative**

2025 CACW surveys – San Diego Audubon

SBP35

SBP36

SBP34

Single individual at 33.09910N 116.97441W

SBP33

SBP30

SBP32


Thank you!