



# Population genetic structure and diversity in the Harbison's dun skipper (*Euphyes vestris harbisoni*)

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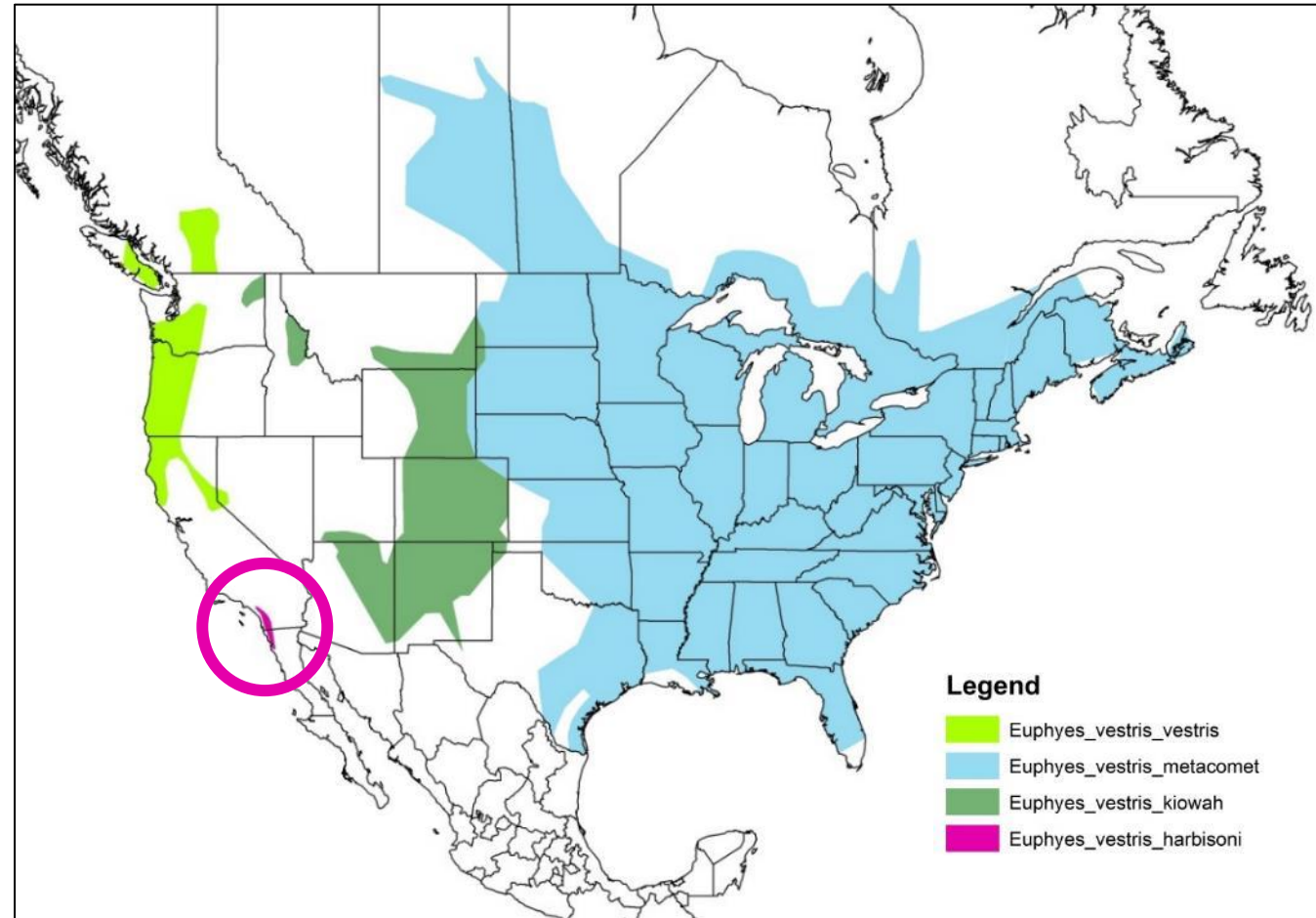
Photo by D Marschalek

*Preliminary Results. Do not cite or distribute*

# *Euphyes vestris harbisoni* (Harbison's dun skipper)

Found in Southern California

Listed as a Category 2 species  
(USFWS, 1989)



(Modified from Peterson Field Guides: Western Butterflies)



# Habitat

## Riparian oak woodlands

- San Diego sedge (*Carex spissa*)



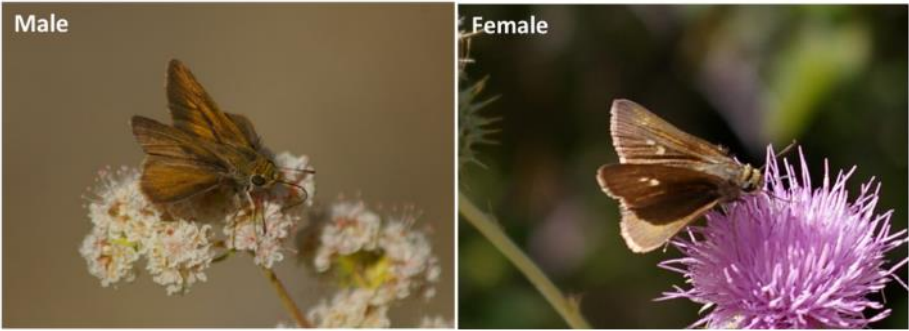
(Photo from Abby Lyons)





# Harbison's Dun Skipper

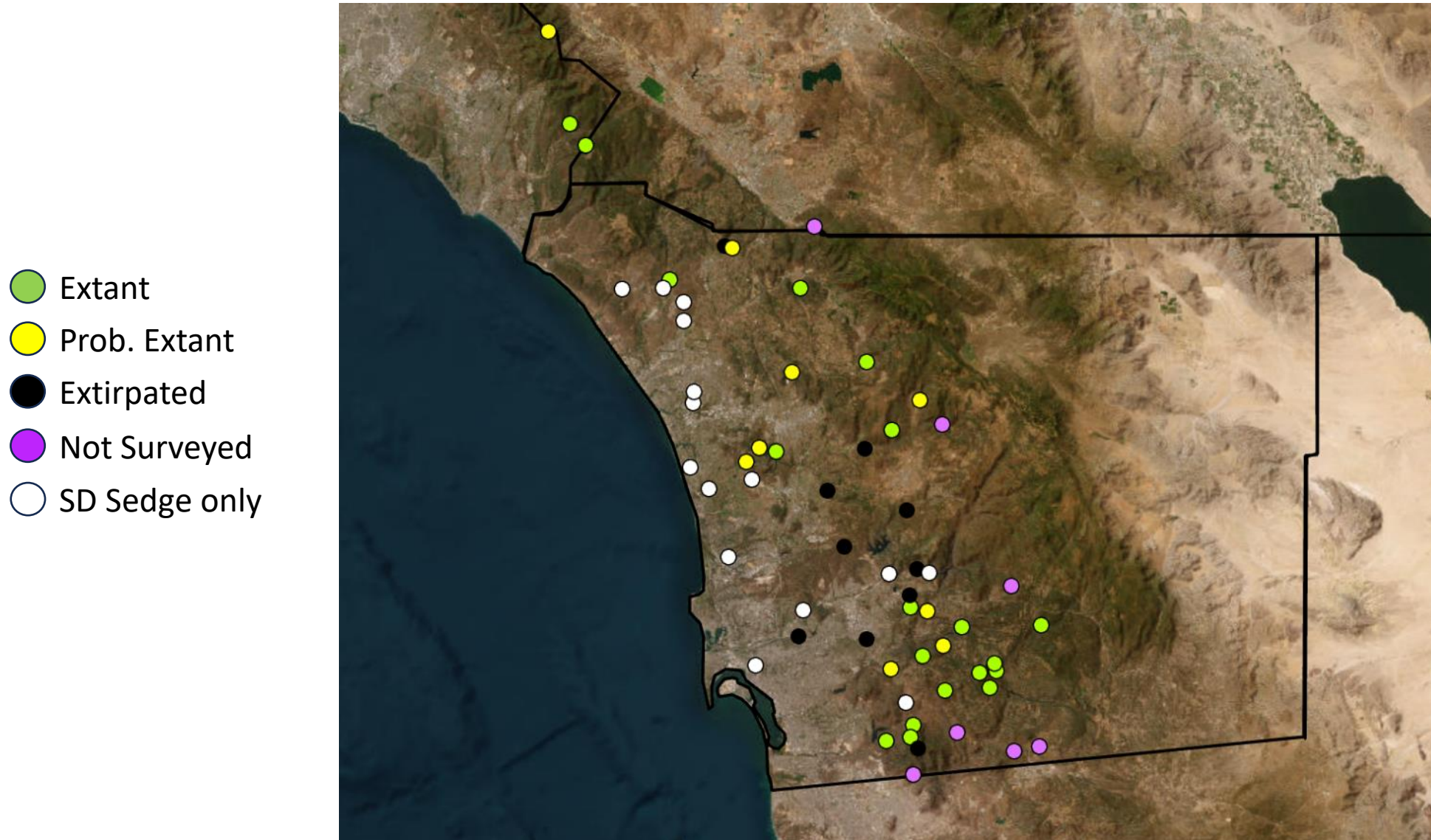
## Surveys



Location	2013	2014	2016	2017	2021	2022
Barrett Lake	6	4	5	1	3	5
Boden Canyon Ecological Reserve	5	1	1	1	0	
Crestridge Ecological Reserve	1	0	0	0	2	3
Daley Ranch	1	2	4		0	
Hellhole Canyon County Park	4	1	1	0	2	2
Hollenbeck Canyon Wildlife Area	6	5	2	3	2	2
Lake Hodges	5	4	6		4	2
Loveland Reservoir	8	4	3	2		
Pamo Valley (CNF)	1	2	0	2	2	0
SDNWR- Las Montanas (South)	2	1	0		0	
Skye Valley Road	2	2	4	1	0	1
Sycuan Peak Ecological Reserve	5	2	4		0	0

Years	p-value
2013-2014	0.065
2013-2017	0.006
2014-2017	0.008
(sign test)	

# Harbison's Dun Skipper known distribution as of 2024



# Detections are low and variable across years

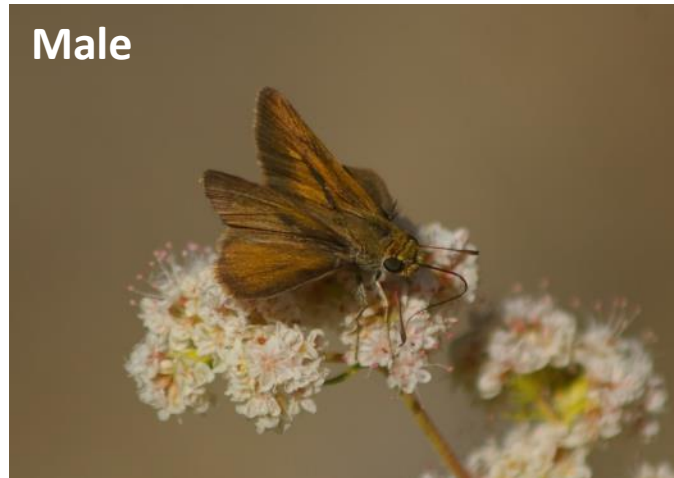
To what extent are local populations connected?

What is the population genetic structure and differentiation among sites?

How much genetic diversity is within sites?

What is the effective population size?

Male



Female





# Data Collection

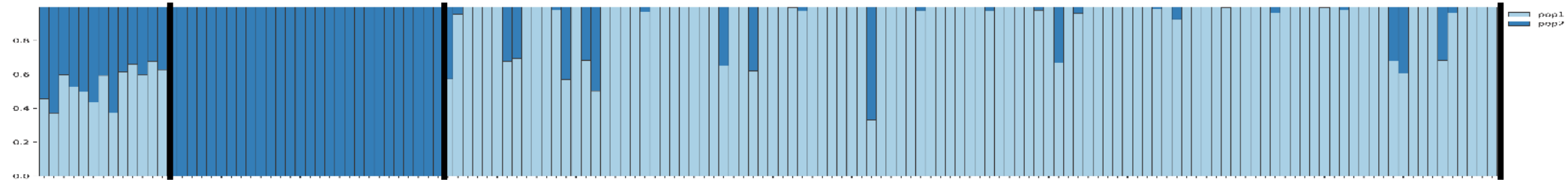
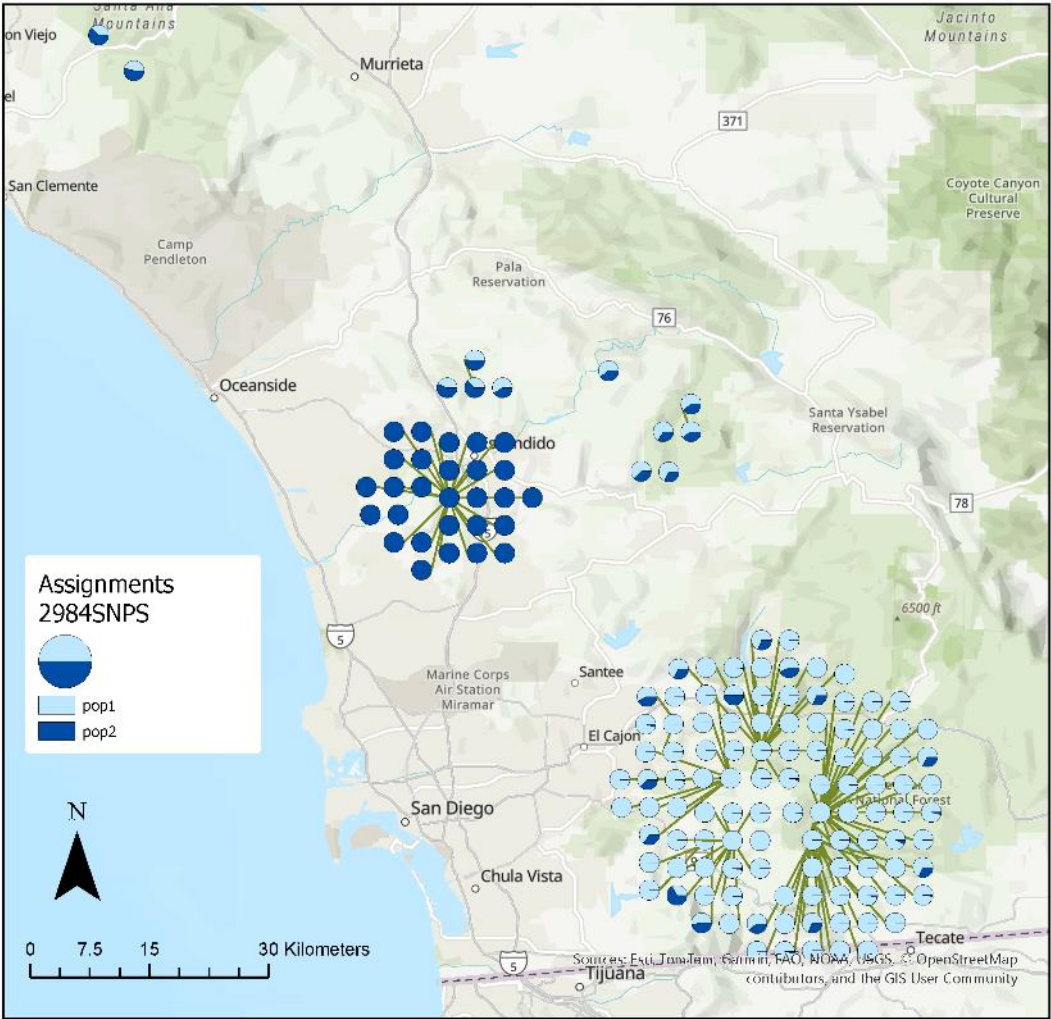
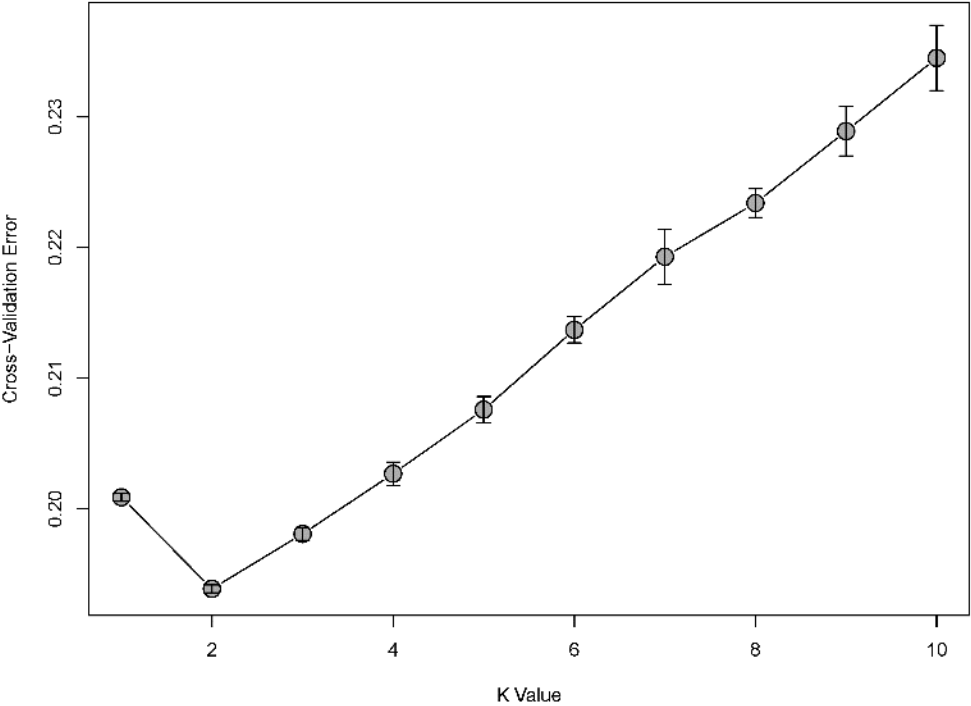
**Samples collected 2013 – 2023**  
**(Led by Dan Marschalek)**

**148 successfully genotyped at 2984 SNPs**  
**10% missing data**



# Population Genetic Structure

## Admixture analysis



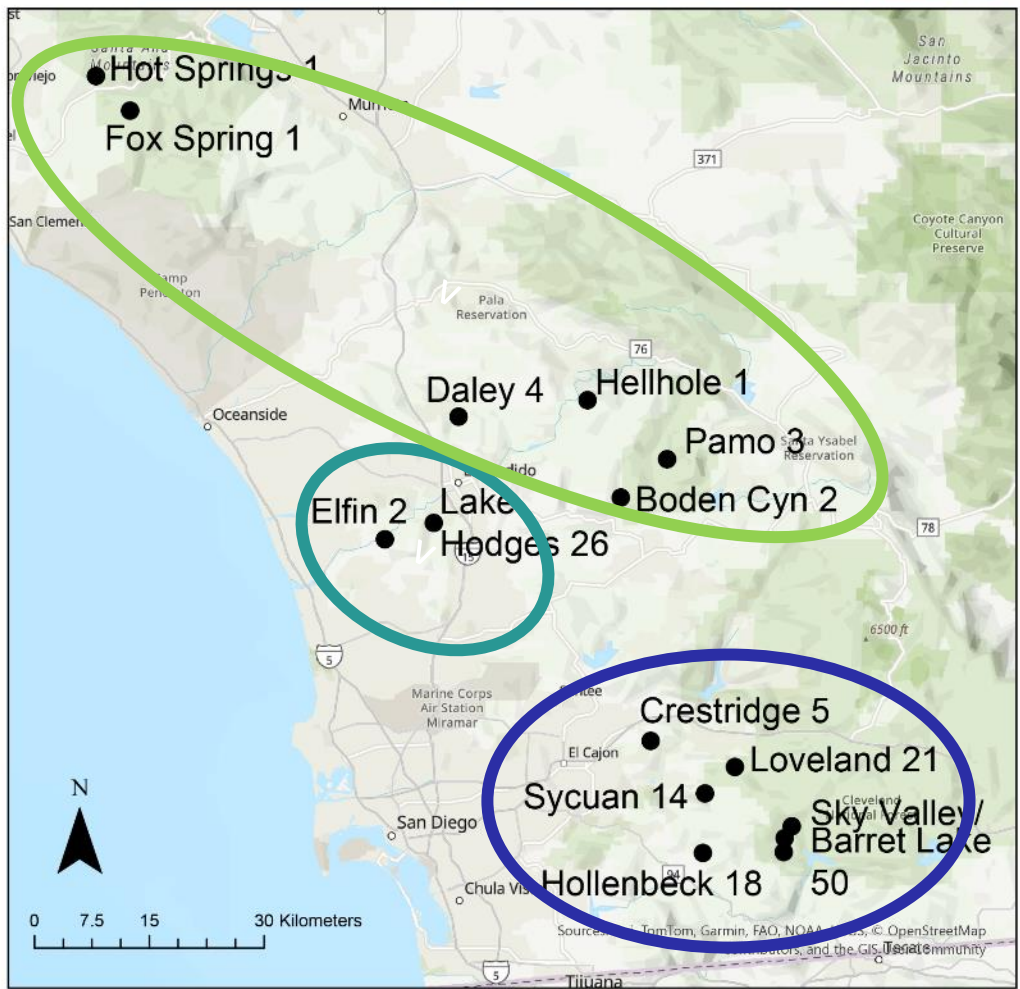
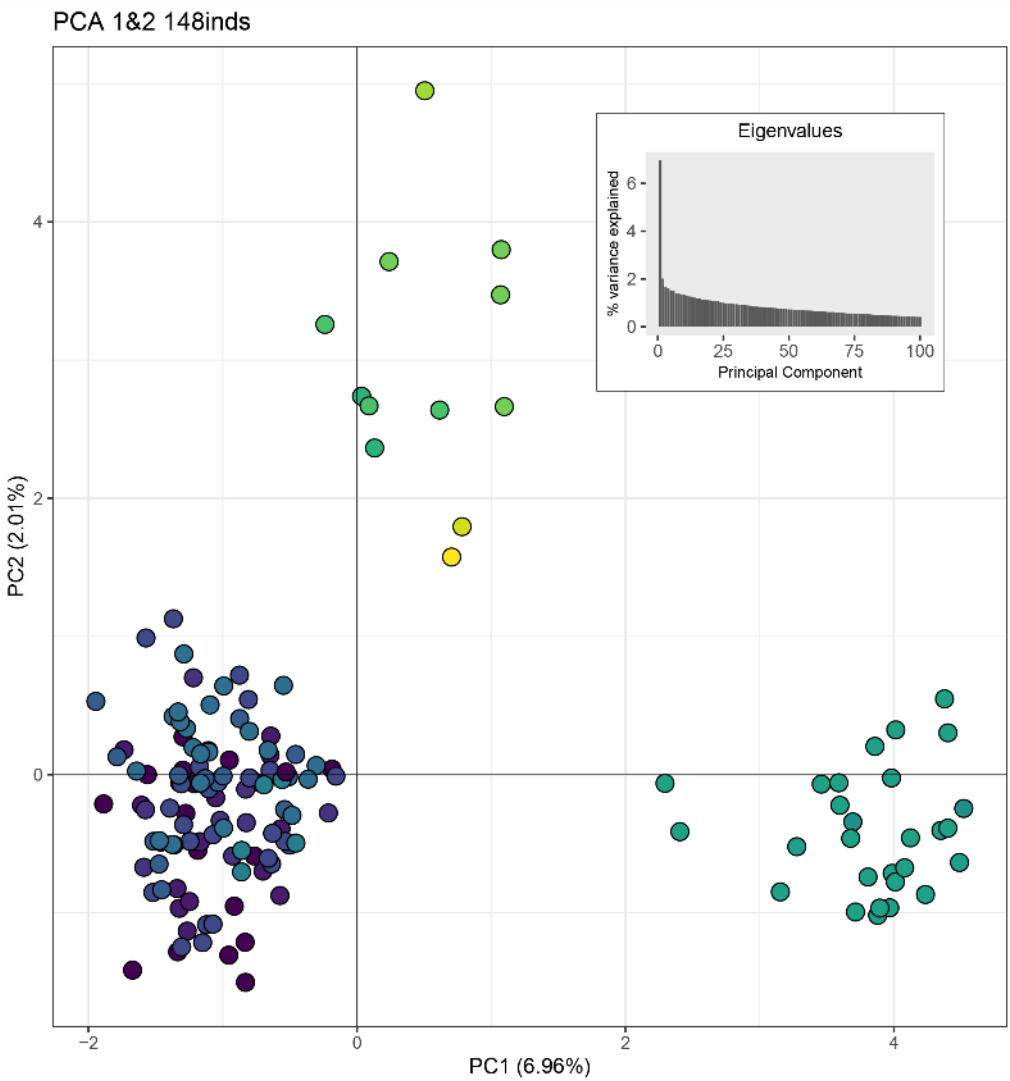
Northeast      Lake Hodges & Elfin Forest      Southeast San Diego County (all other sites)

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# Population Genetic Structure

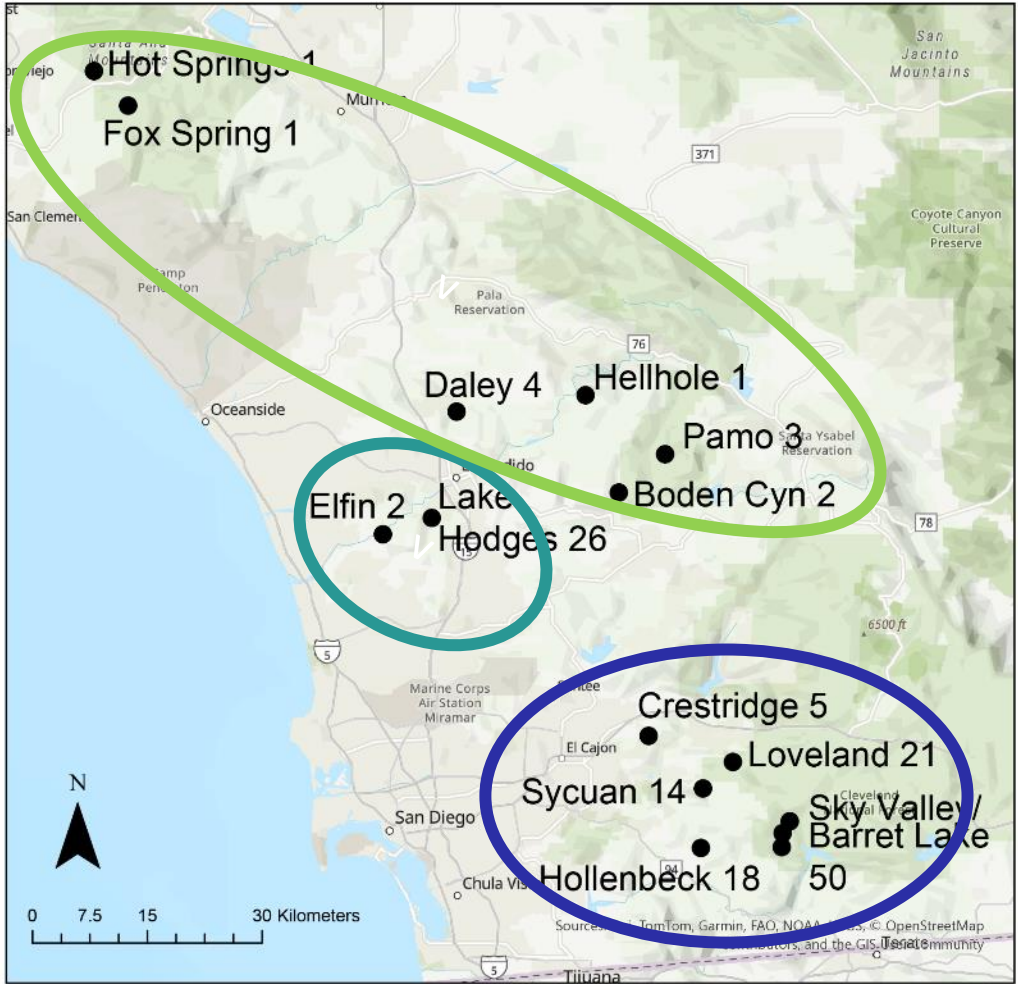
## PCA



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# Population Differentiation ( $F_{ST}$ )

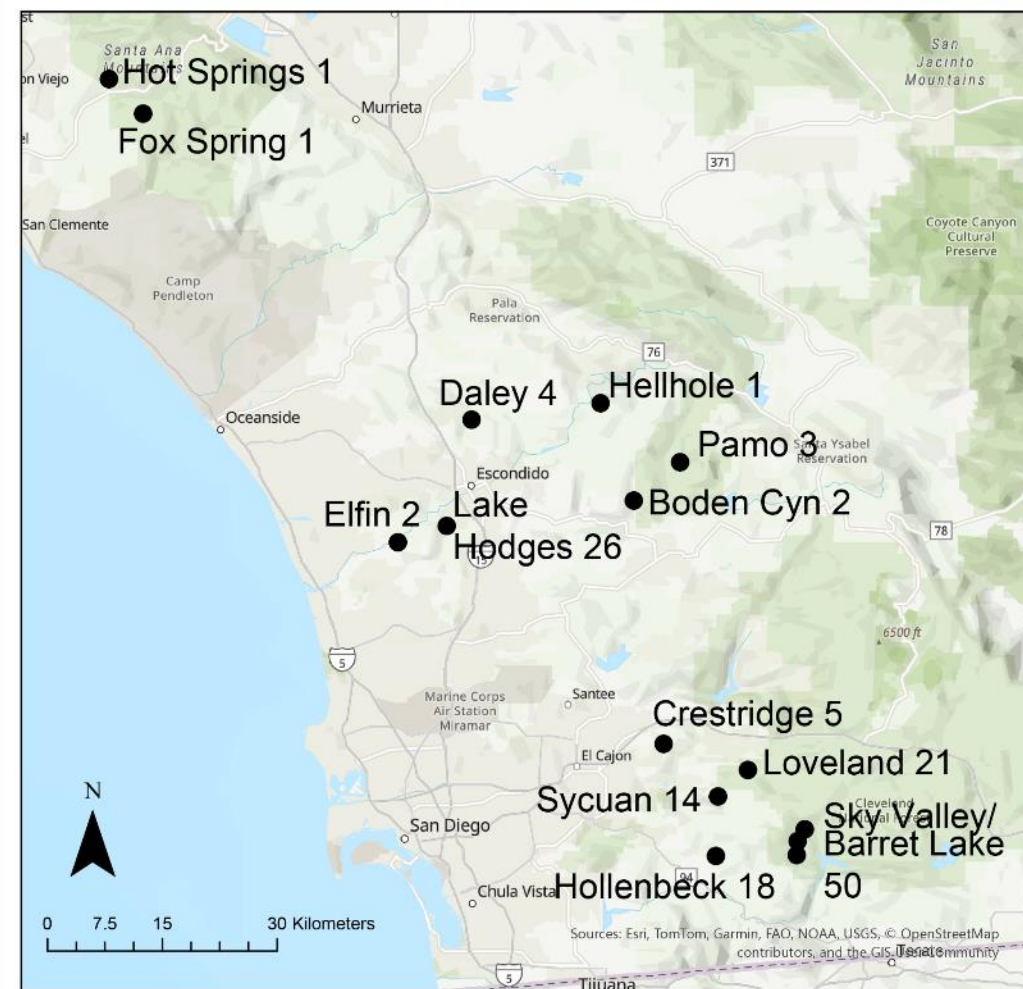
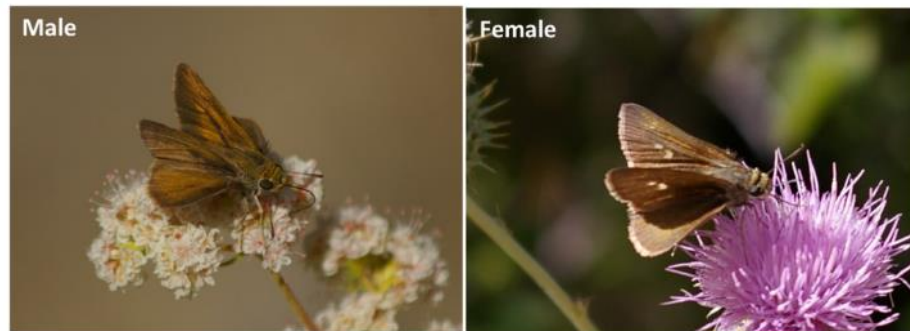
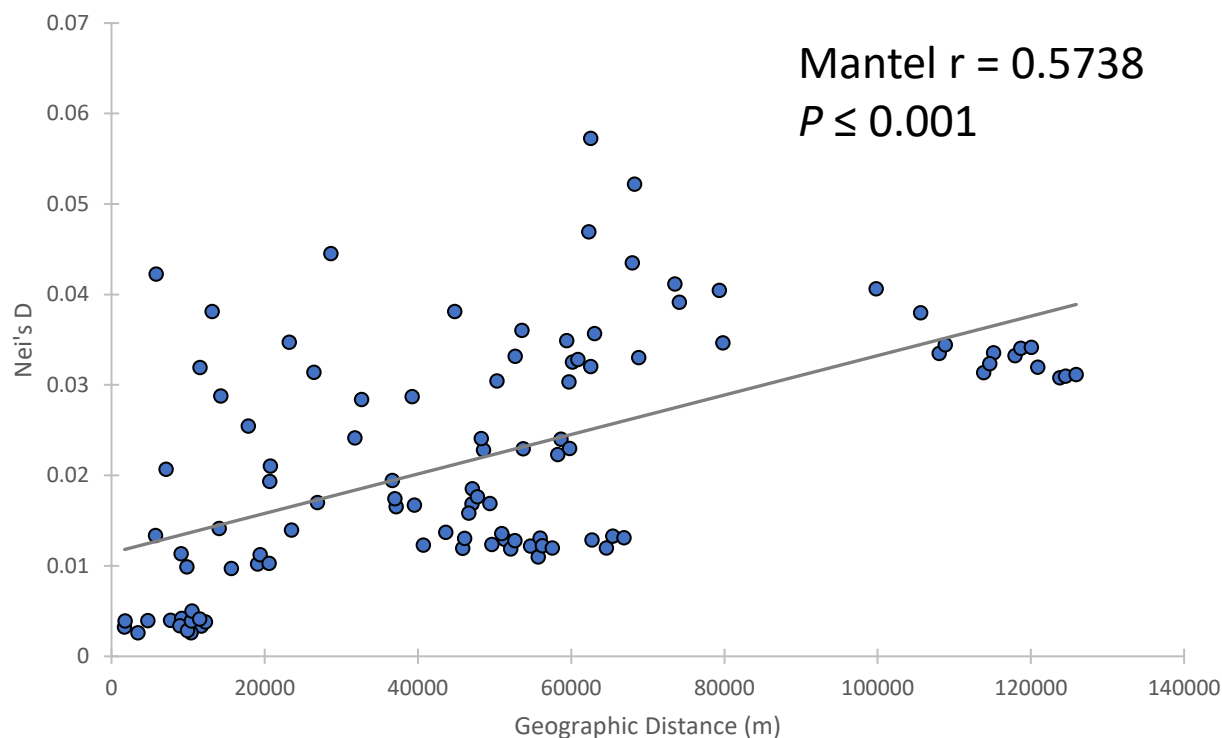
	$F_{ST}$	Lower 95% CI	Upper 95% CI
SE - NE	0.0430	0.0376	0.0480
NE - Hodges	0.0943	0.0817	0.1069
SE - Hodges	0.0999	0.0854	0.1132



Preliminary Results. Do not cite or distribute



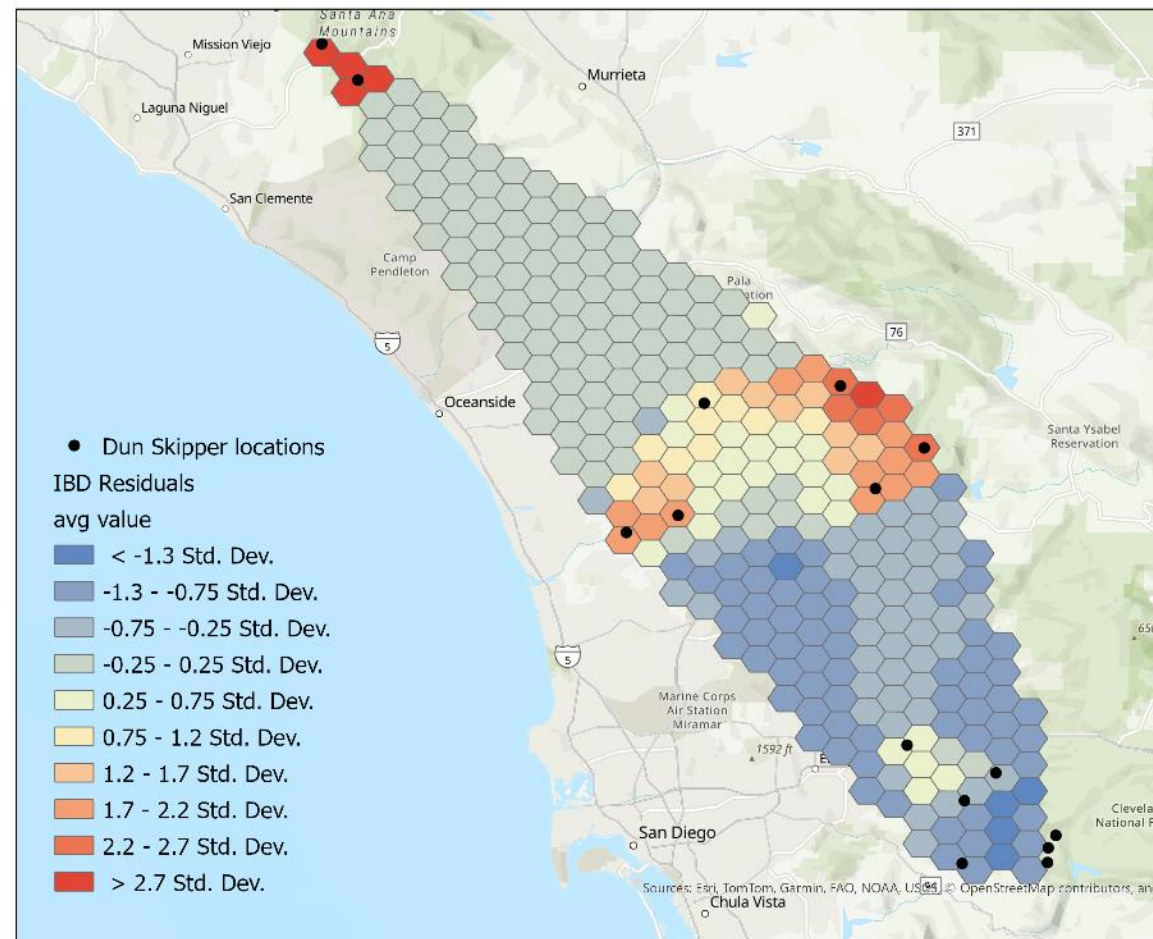
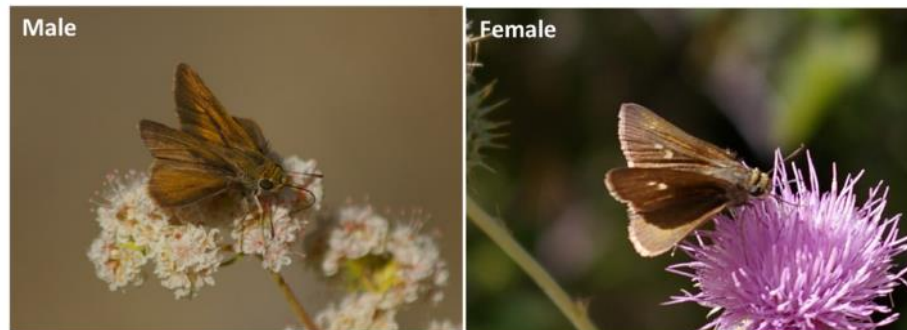
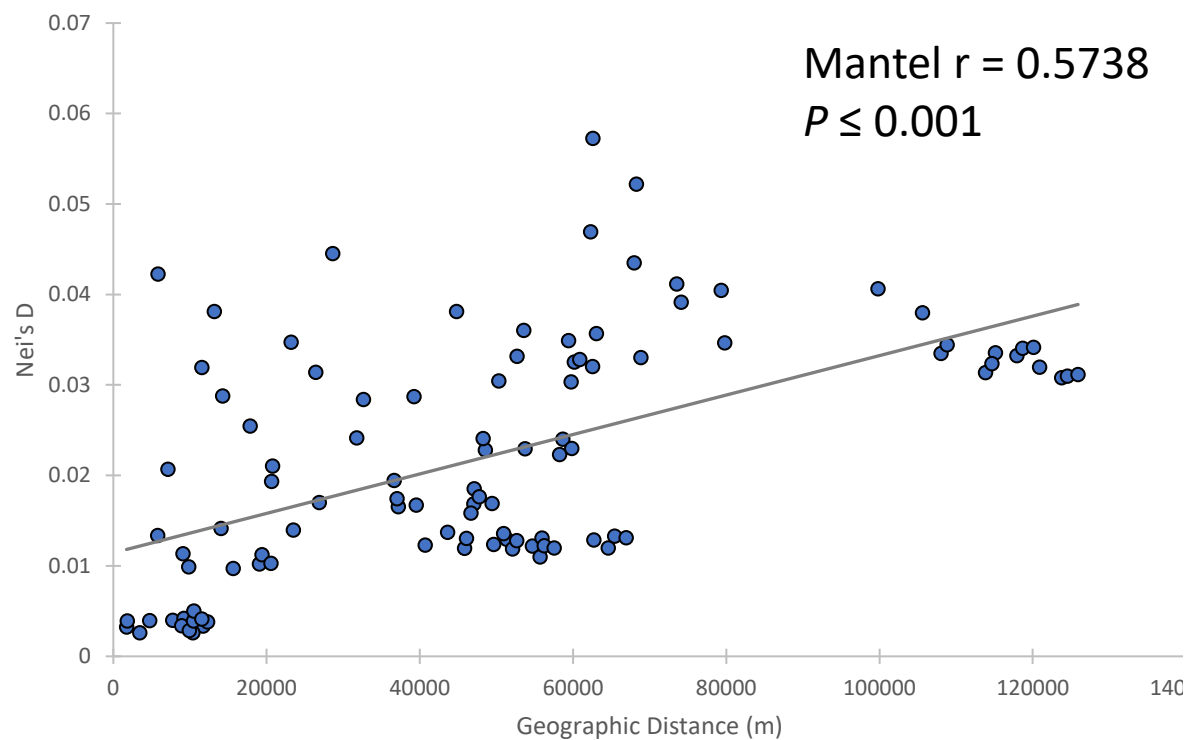
# Population Differentiation Isolation by Distance (Nei's D)



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# Population Differentiation

## Isolation by Distance

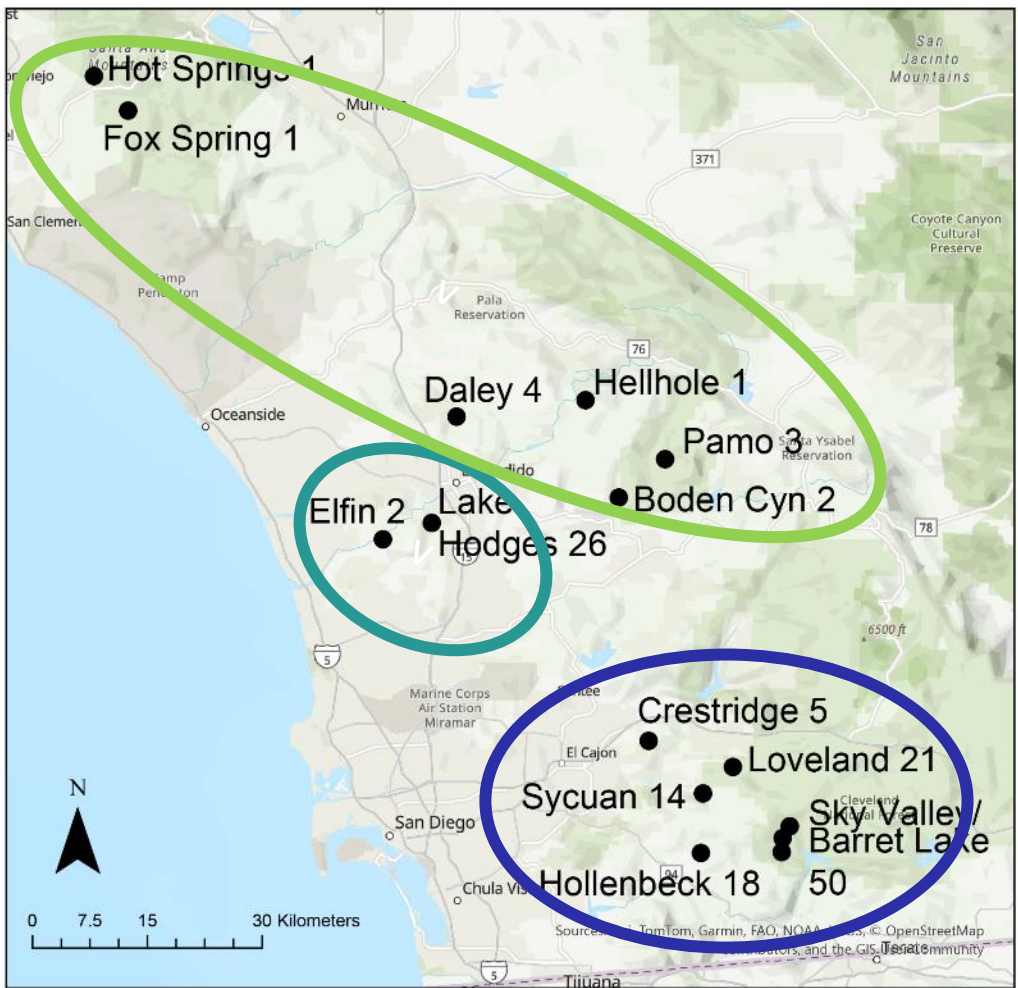
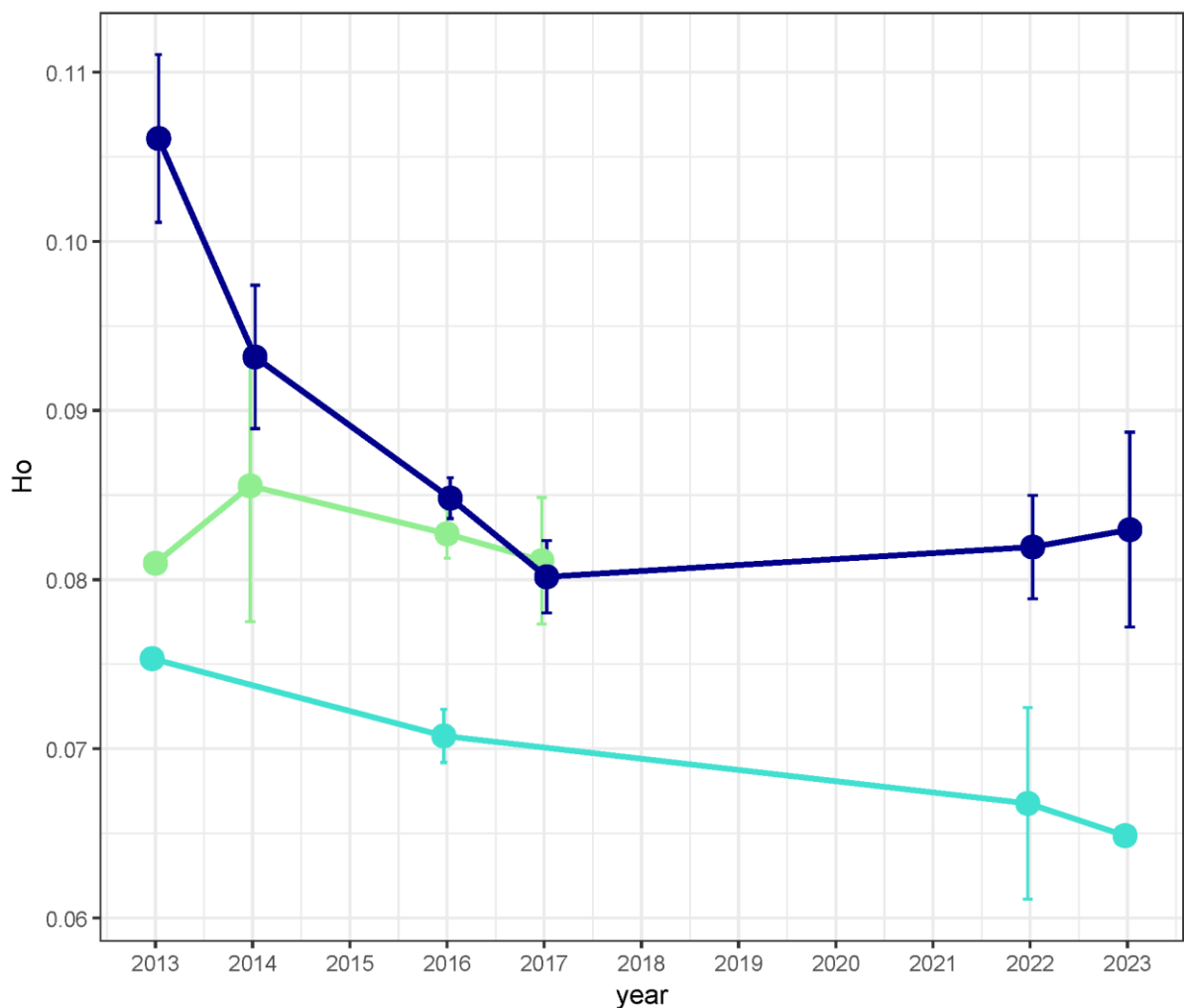


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# Population Genetic Diversity

## Individual heterozygosity over time (Mean $\pm$ SE)



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# Population Genetic Diversity

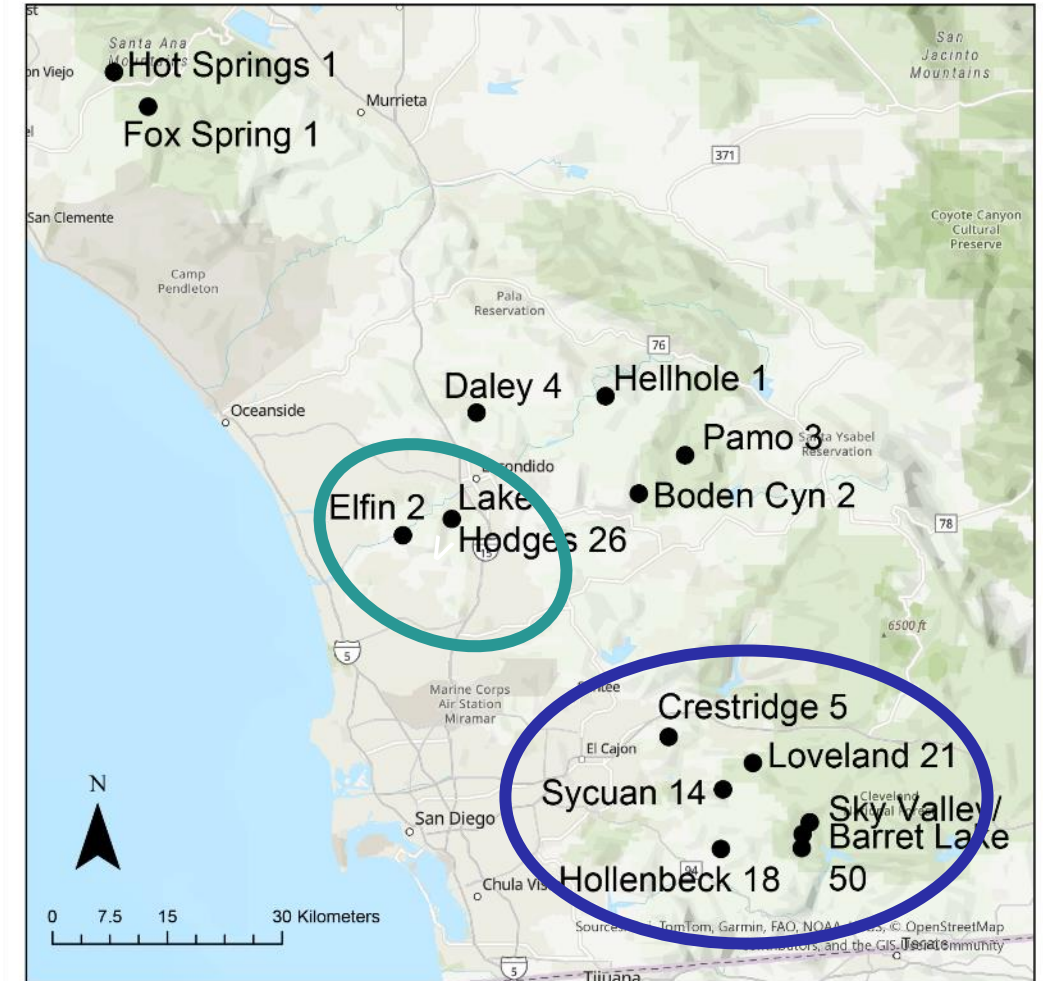
## Effective Population Size- linkage disequilibrium

	Ne	Lower 95% CI	Upper 95% CI	N
SE 2016	968	733	1418	63
Hodges 2016	639	338	4999	24

### Mark Recapture (Lyons et al 2024)

Barrett Lake = 36 (95% CIs = 7–794)

Beaver Hollow (SDNWR) = 10 (95% CIs = 3–203)



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# Major Findings and Next Steps

- 2 or more clusters in San Diego County, strong isolation by distance
- Heterozygosity decline mirrors the decline in occupancy and abundance between 2013-2017 reported in Lyons et al 2024

## Habitat and Conservation Management Plan (2018)

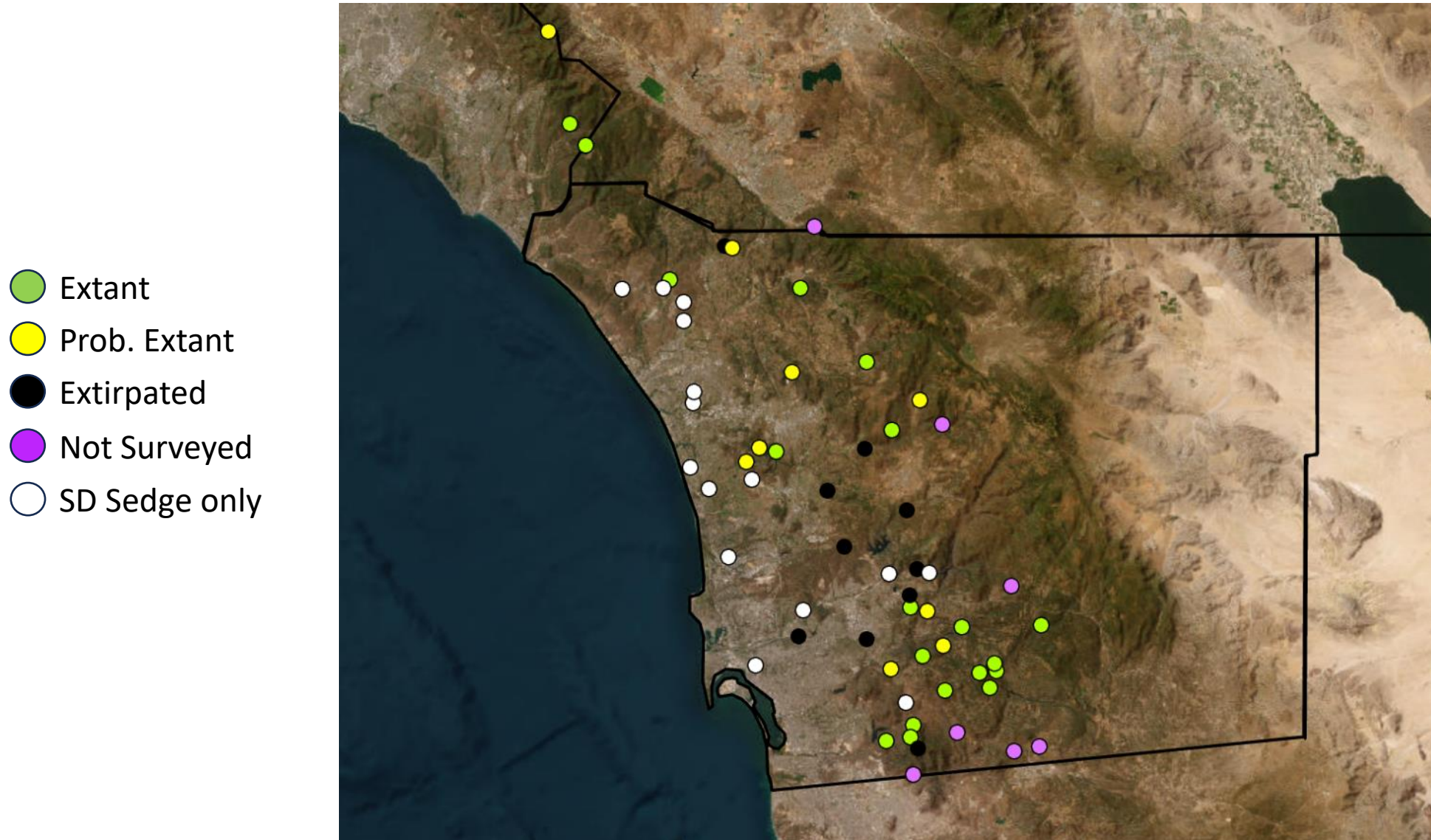
- Enhance habitat in small, extant populations
- Restore distribution- restoration of *C. spissa* and nectar plants in historically occupied areas, translocations
  - Southeast cluster appears more genetically diverse and could be used as sources.

Future genetic collections– DNA yield was generally very low from single leg samples.

- Switch to collecting directly in a cell lysis buffer?
- 2 legs or another tissue type may be needed?



# Harbison's Dun Skipper known distribution as of 2024





# San Diego Sedge Observations 2011-2025

