# Tracking Gray Vireo migration using light-level geolocators

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Science

REPORTS

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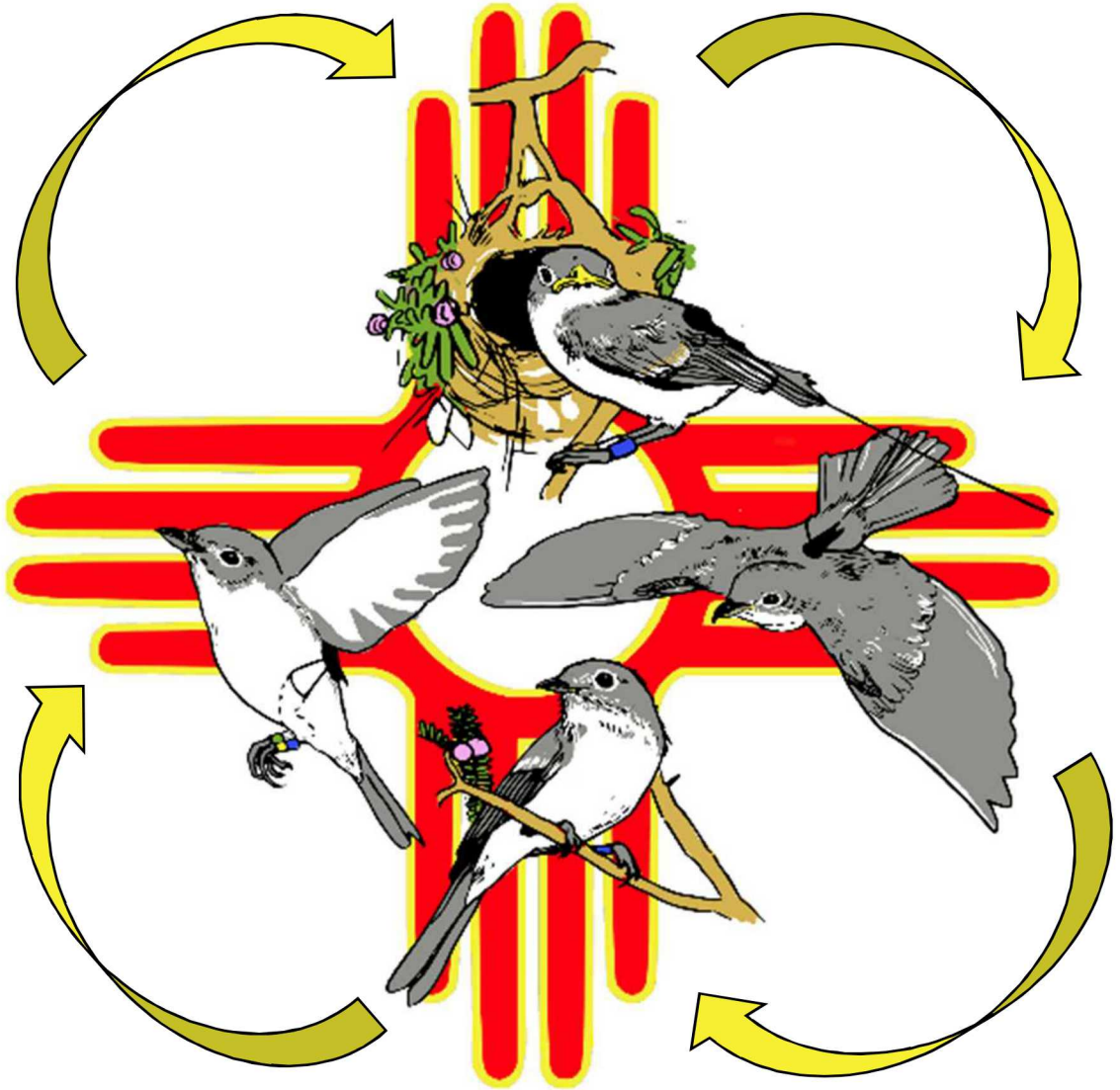
# Decline of the North American avifauna

**Kenneth V. Rosenberg[1,2]*, Adriaan M. Dokter[1], Peter J. Blancher[3], John R. Sauer[4], Adam C. Smith[5], Paul A. Smith[3], Jessica C. Stanton[6], Arvind Panjabi[7], Laura Helft[1], Michael Parr[2], Peter P. Marra[8]†**

figure: American Bird Conservancy

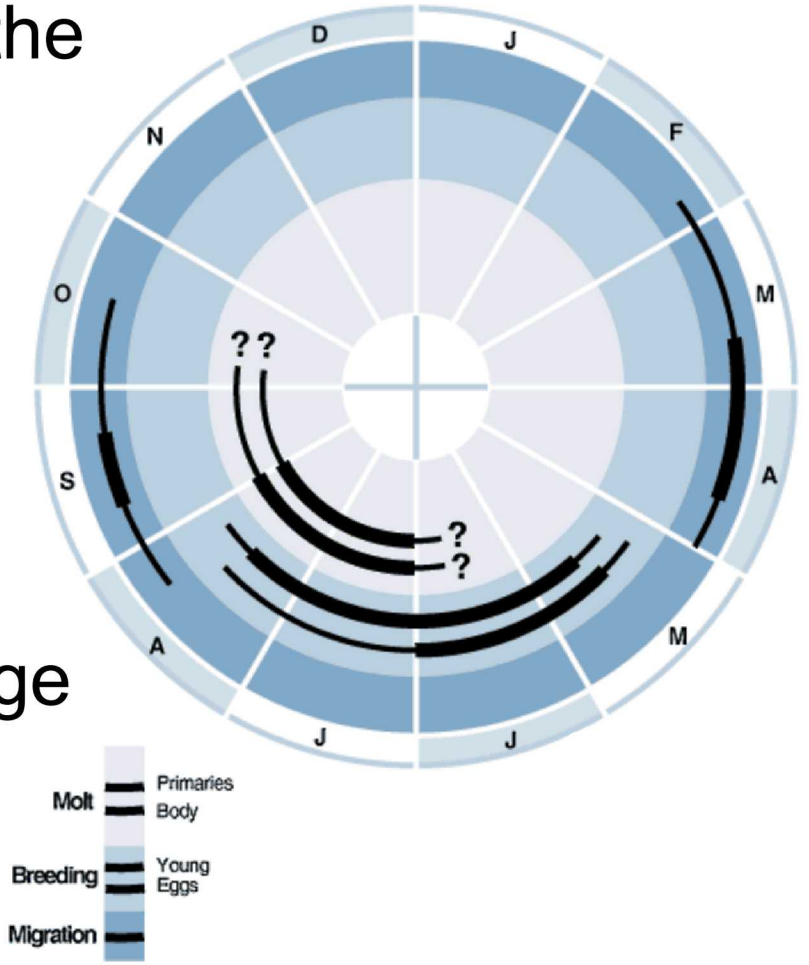
# Conservation in the Anthropocene

- Limiting factors, vital rates
- Annual cycle
- Population trends
- Complex!



# Migration in songbirds

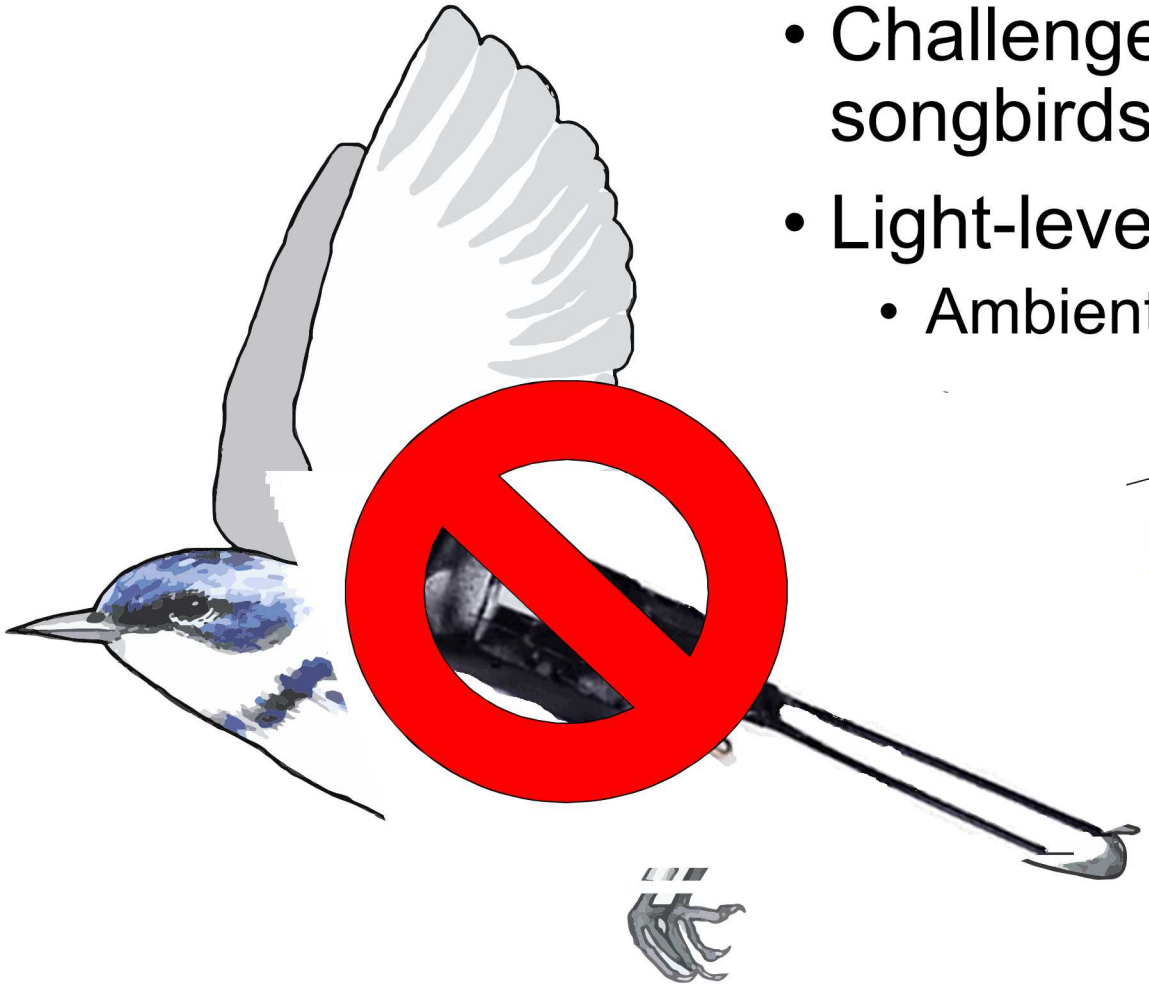
- Problem: migration is one of the most under-studied stages in the annual cycle
  - Focus on eastern birds
- % time on breeding vs. migration and non-breeding
- Songbird decline
- Susceptibility to climate change



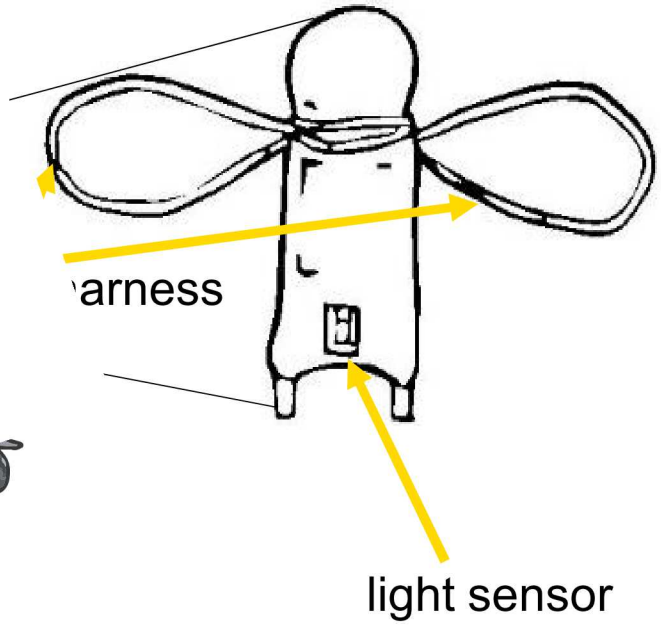
# Populations and individuals

- Gunnar PNAS figure

# How do we study migration?



- Challenges with small songbirds
- Light-level geolocation
  - Ambient light levels



# How do we study migration?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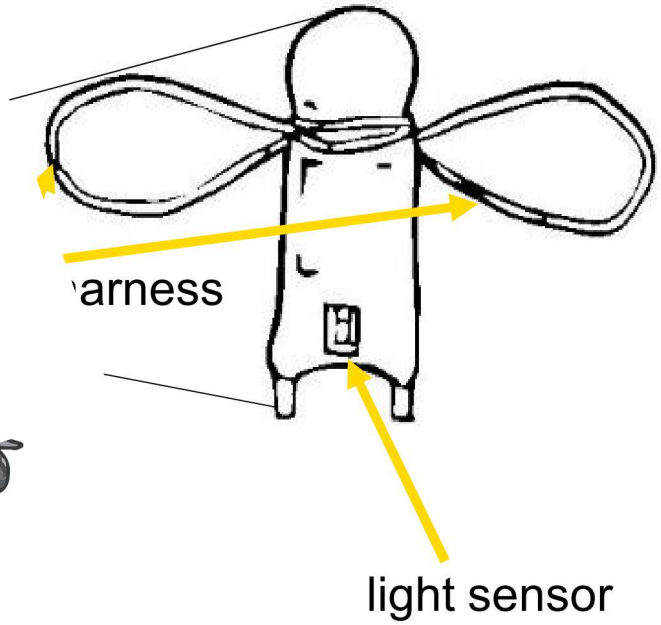
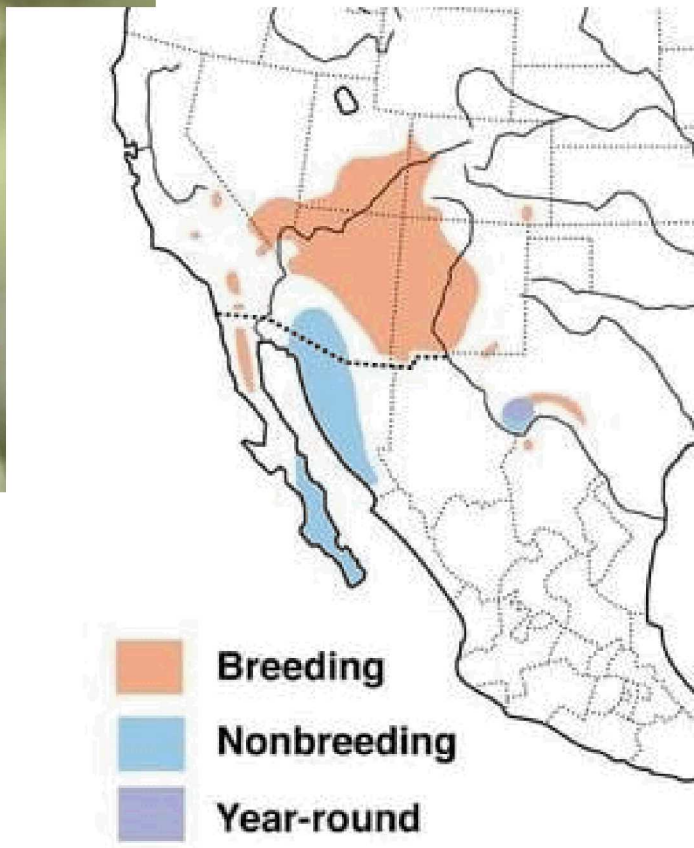


# Research objectives

Identify and compare population-specific non-breeding sites and migration timing

Model species: Gray Vireo (*Vireo vicinior*), desert songbird

# Gray Vireos: life history



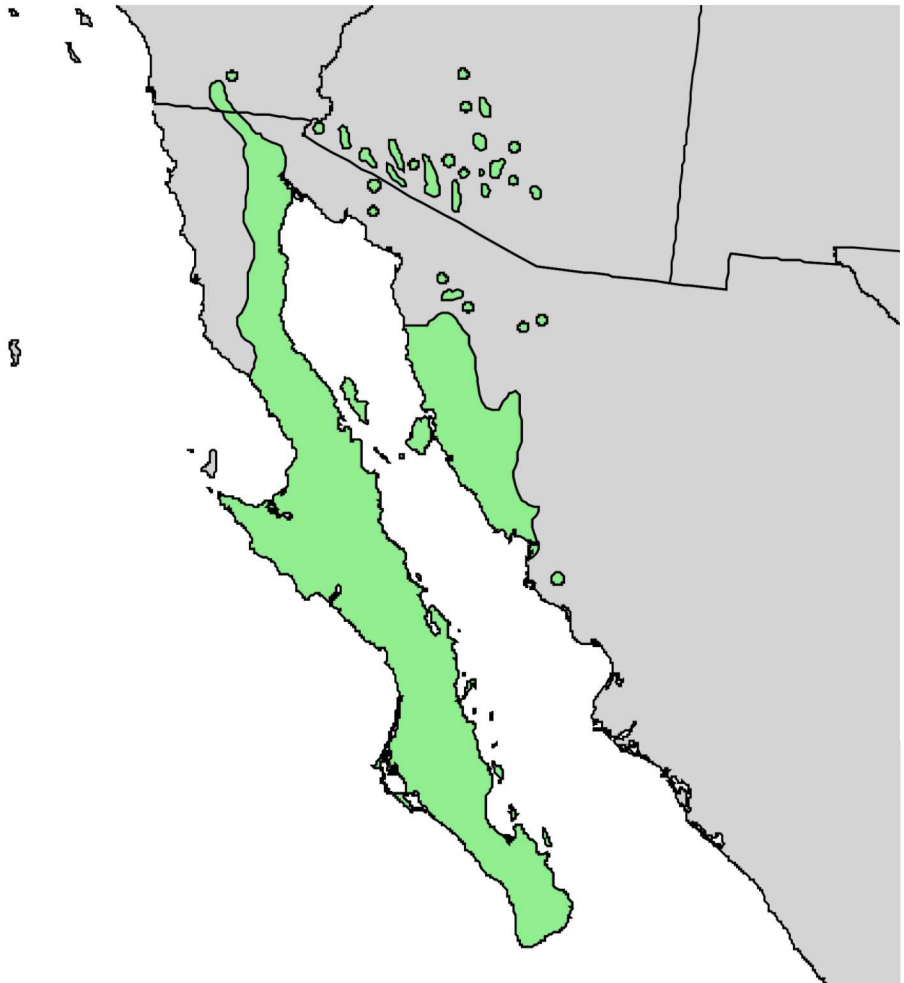

- Under-studied; population trends ???
- Short-distance migrants; ~13g
- Habitat specialists
  - Breeding: arid land juniper savannas
  - Non-breeding: coastal arid lands with elephant trees

# Gray Vireos: non-breeding

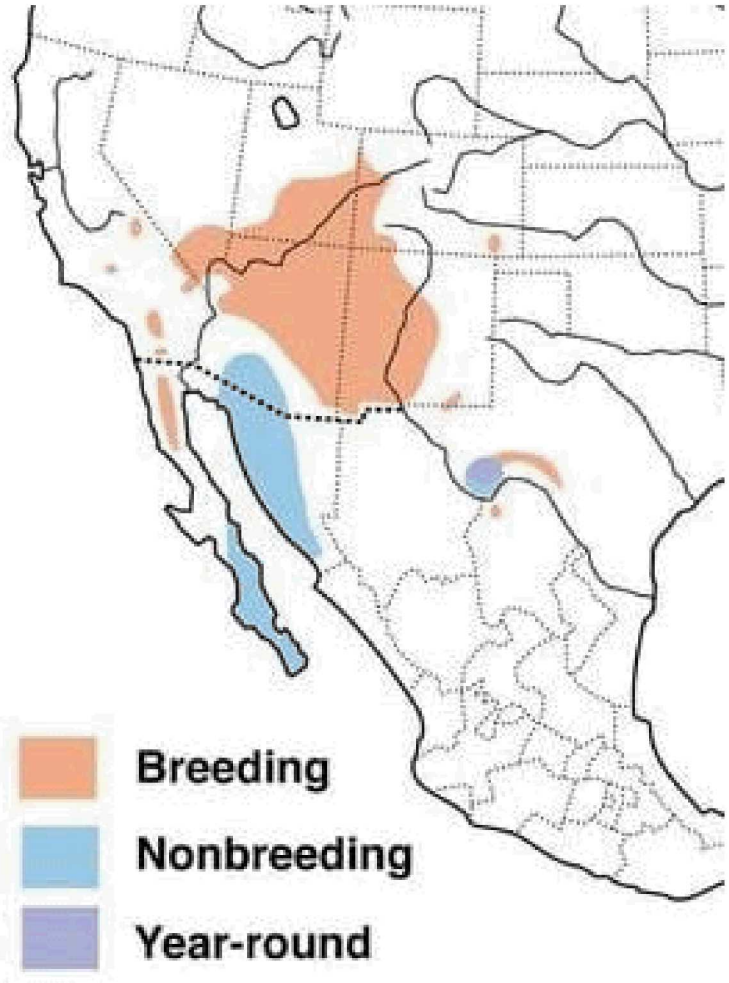
- Elephant tree (*Bursera microphylla*)

# Gray Vireos: non-breeding

Elephant tree (*Bursera microphylla*)

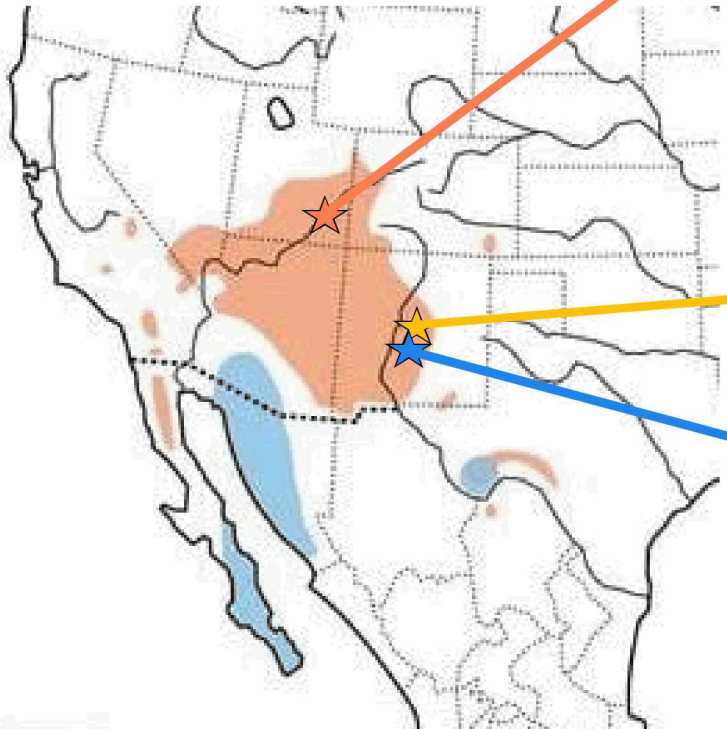


Gray Vireo (*Vireo vicinior*)



# Study sites

- New Mexico
  - Sevilleta National Wildlife Refuge (SNWR)
  - Kirtland Air Force Base (KAFB)
- Utah
  - Abajo Mountains




Juniper savanna

# Field methods: deployment

- Mist-nets and vocalization playback
- Banded and sampled tissue
- Sex, age, measurements

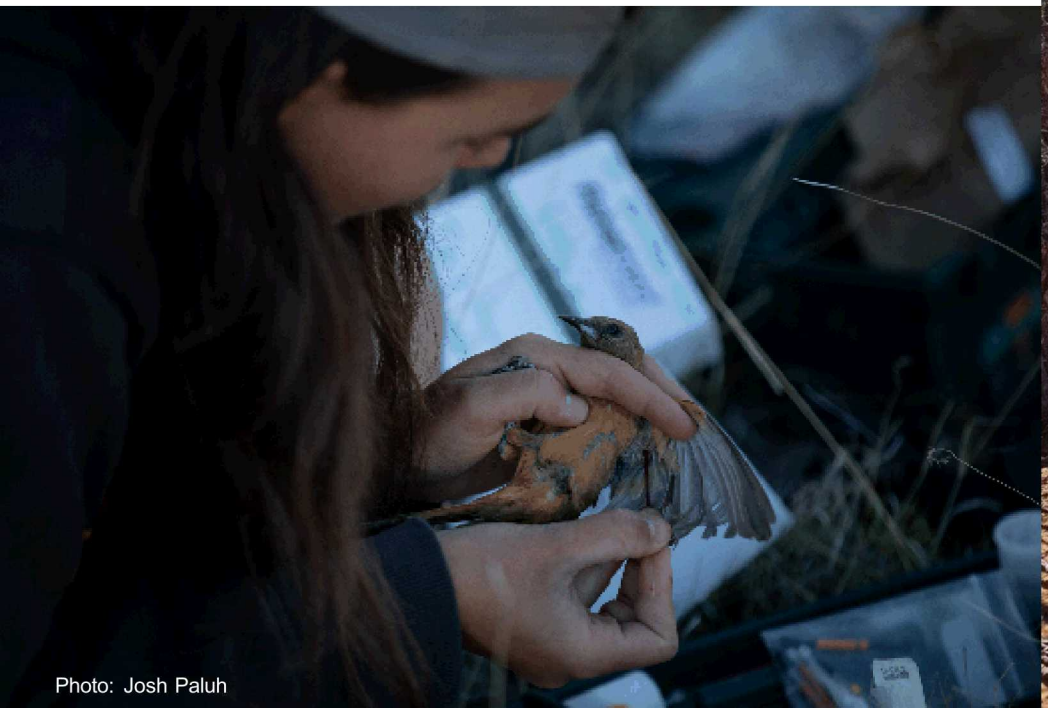
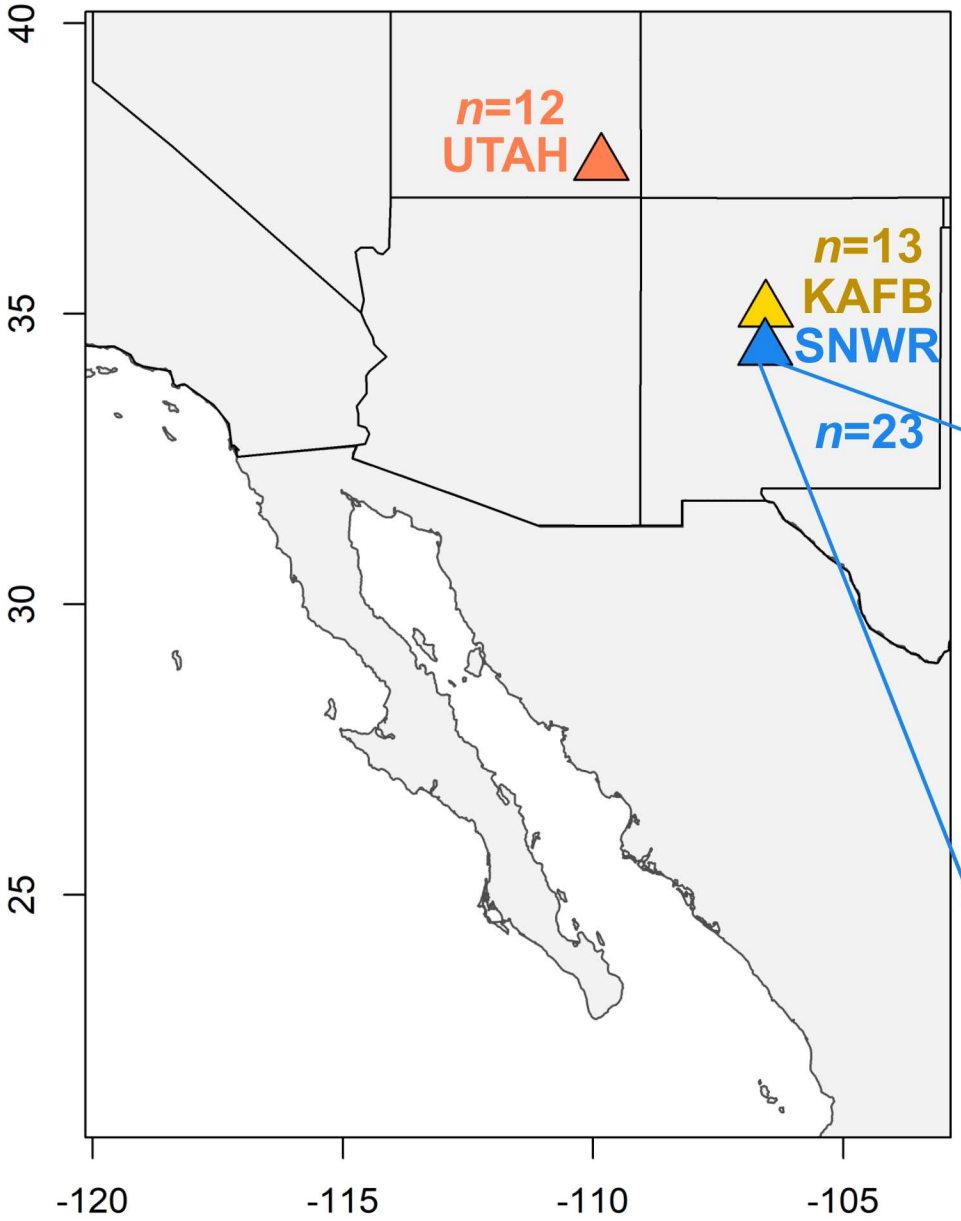


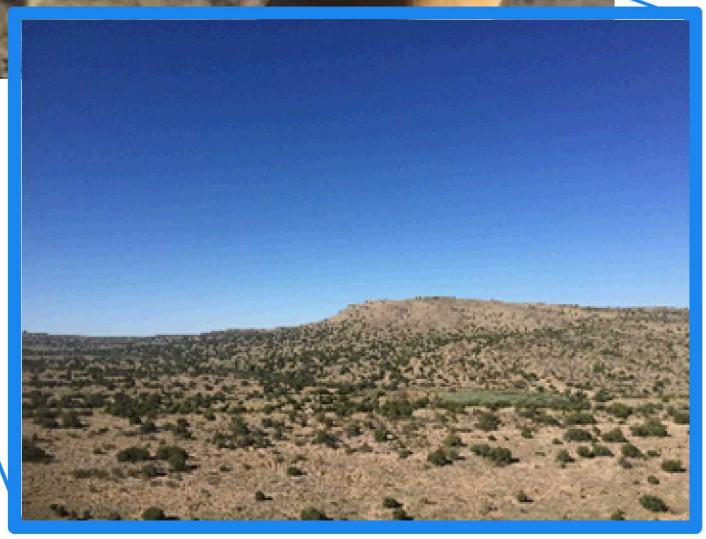
Photo: Josh Paluh

# Field methods: deployment

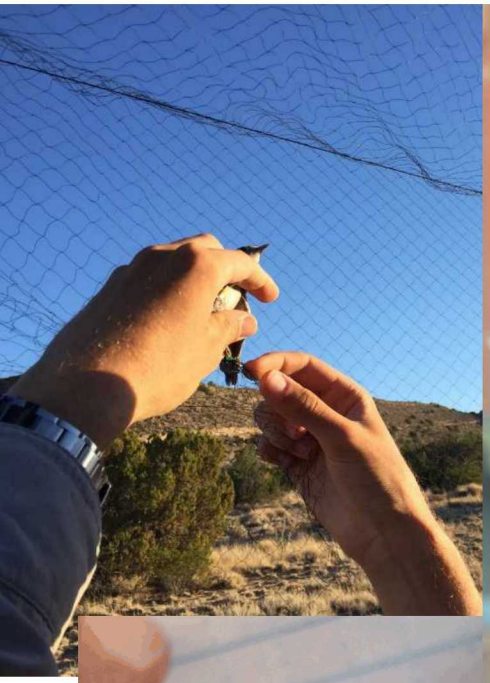
- Deployed 48 geolocators (0.4g) with modified figure-eight harness
  - SNWR (n=23), KAFB (n=13), UT (n=12)

# DEPLOYMENT SITES



# Field methods: recovery

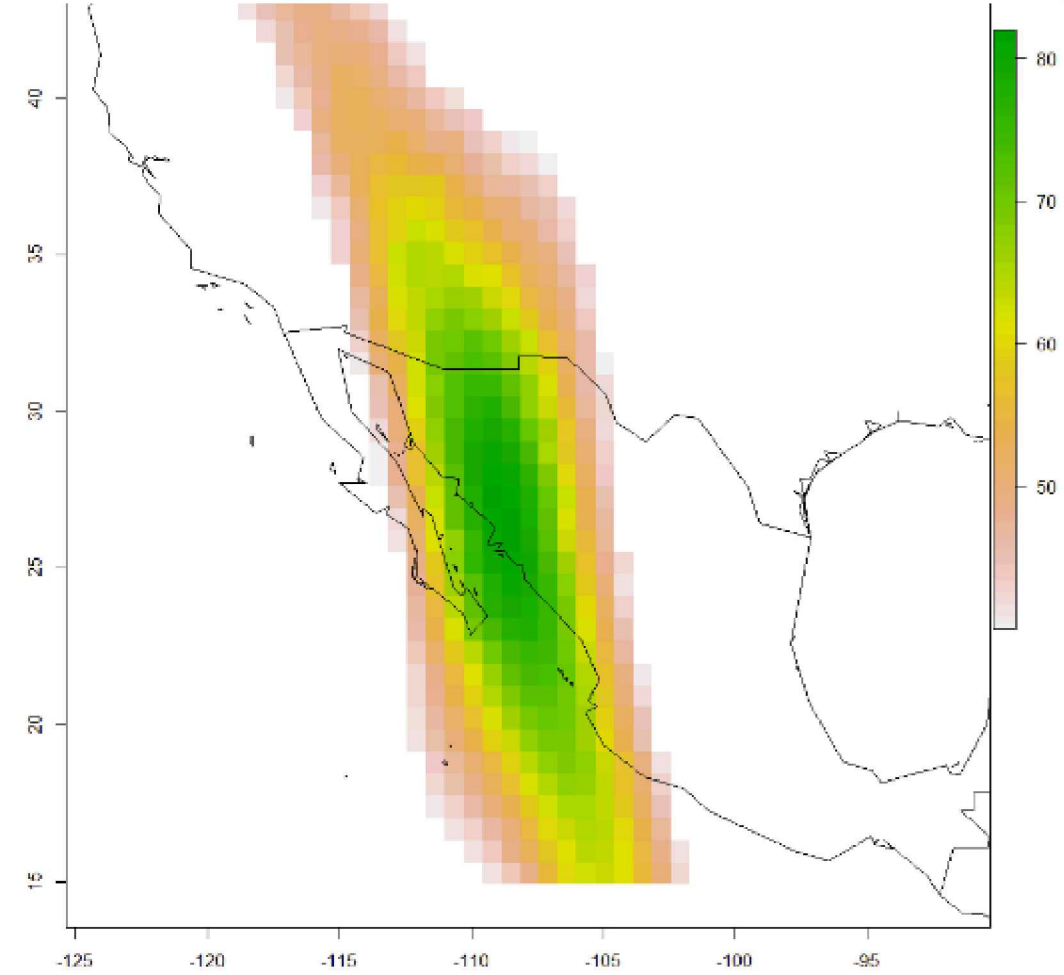


oloyment location

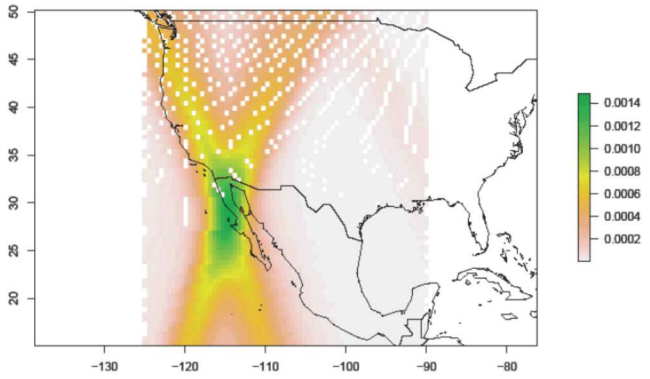
playback

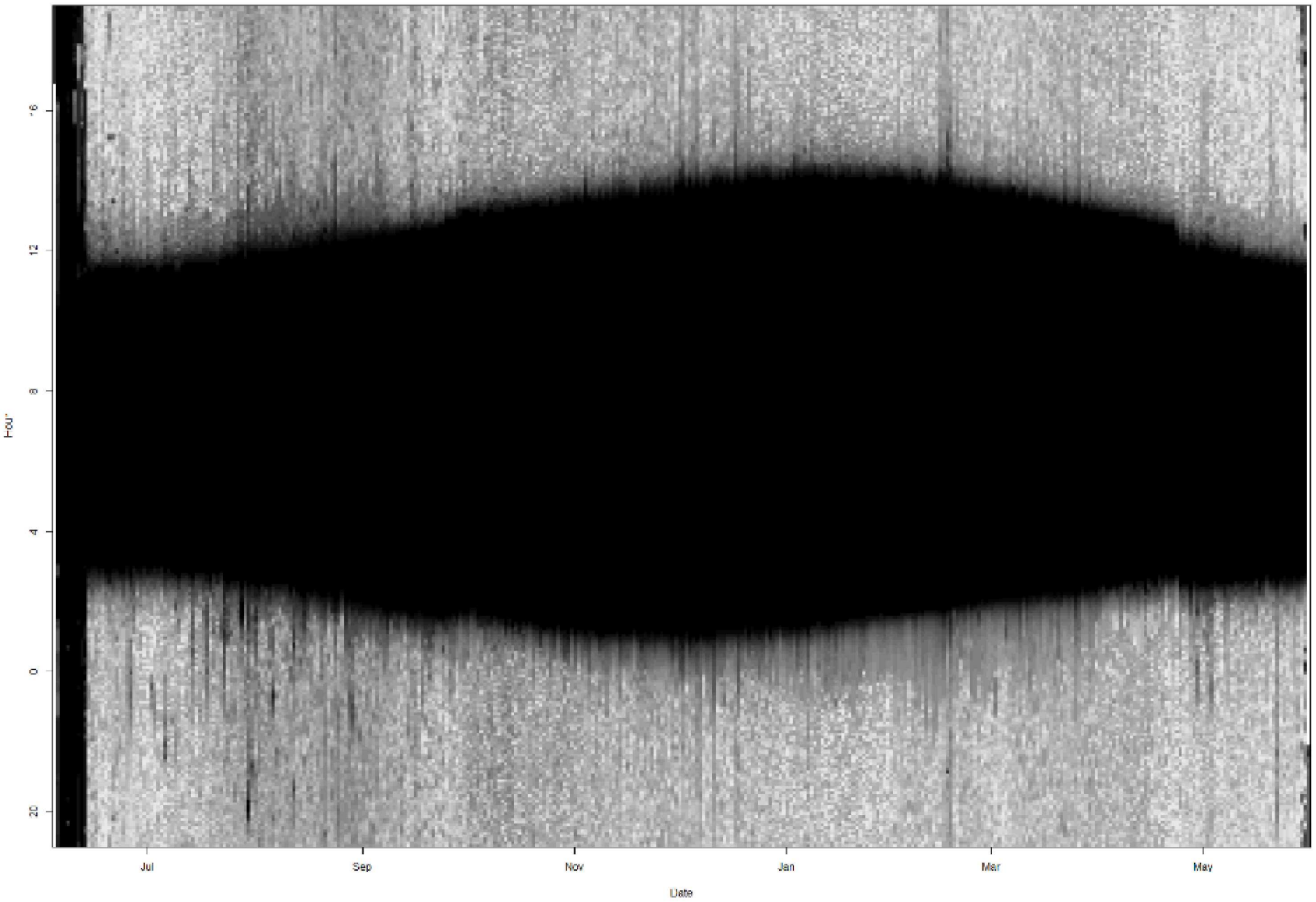
d

# Methods: analysis

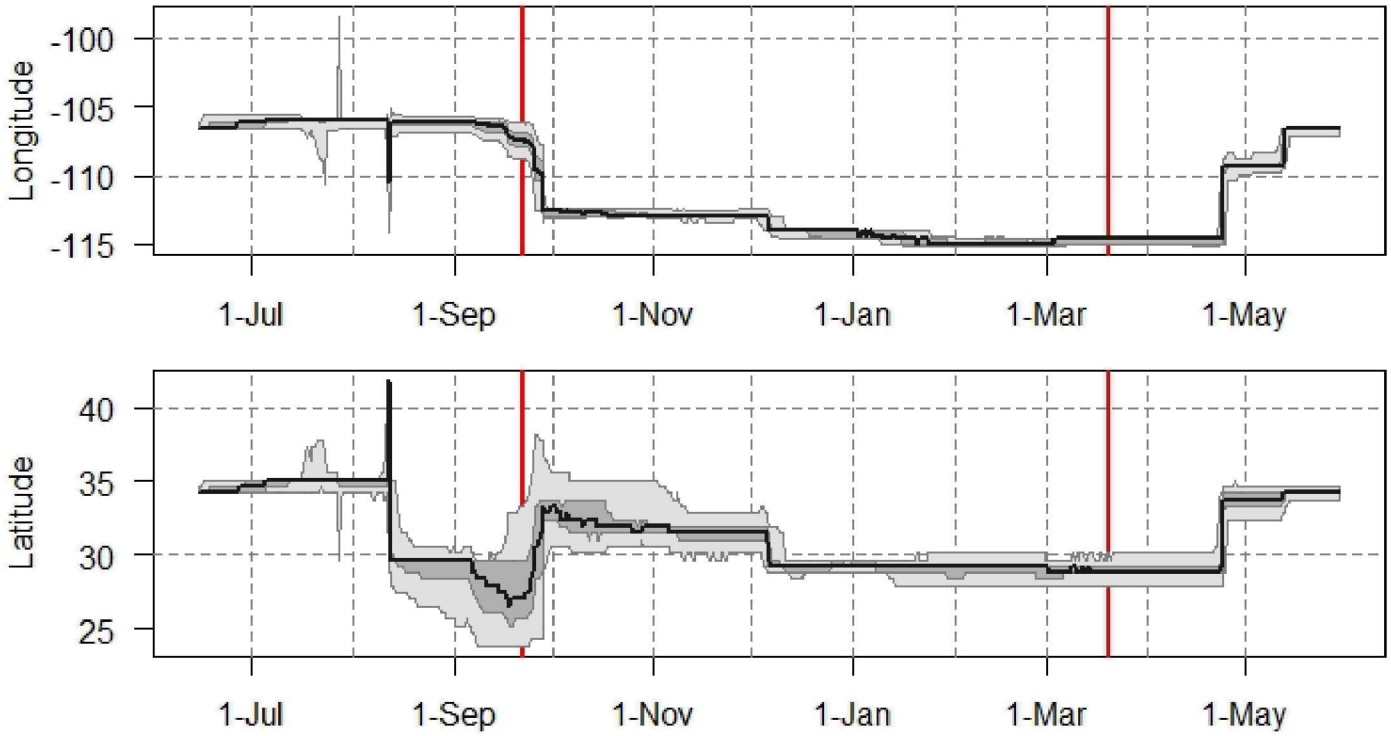



- Pre-process and format data
  Template-fit method in R
  FlightR package
  Spatially explicit likelihood surfaces
  - 1 Nov- 28 Feb = winter
  Probability density functions



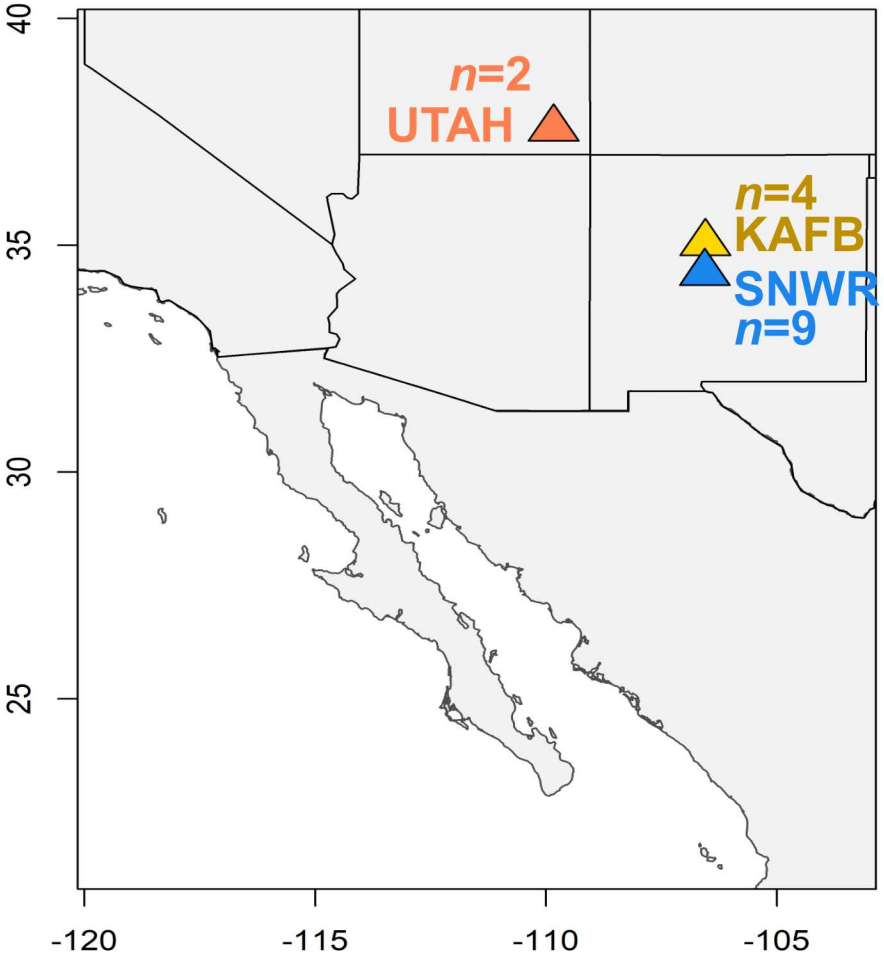

Hour
20
0
4
8
12
16
Jul
Sep
Nov
Jan
Mar
May
Date

# Latitude and longitude plots: timing




# Results

- Retrieved 15 geos, recovered data from 14



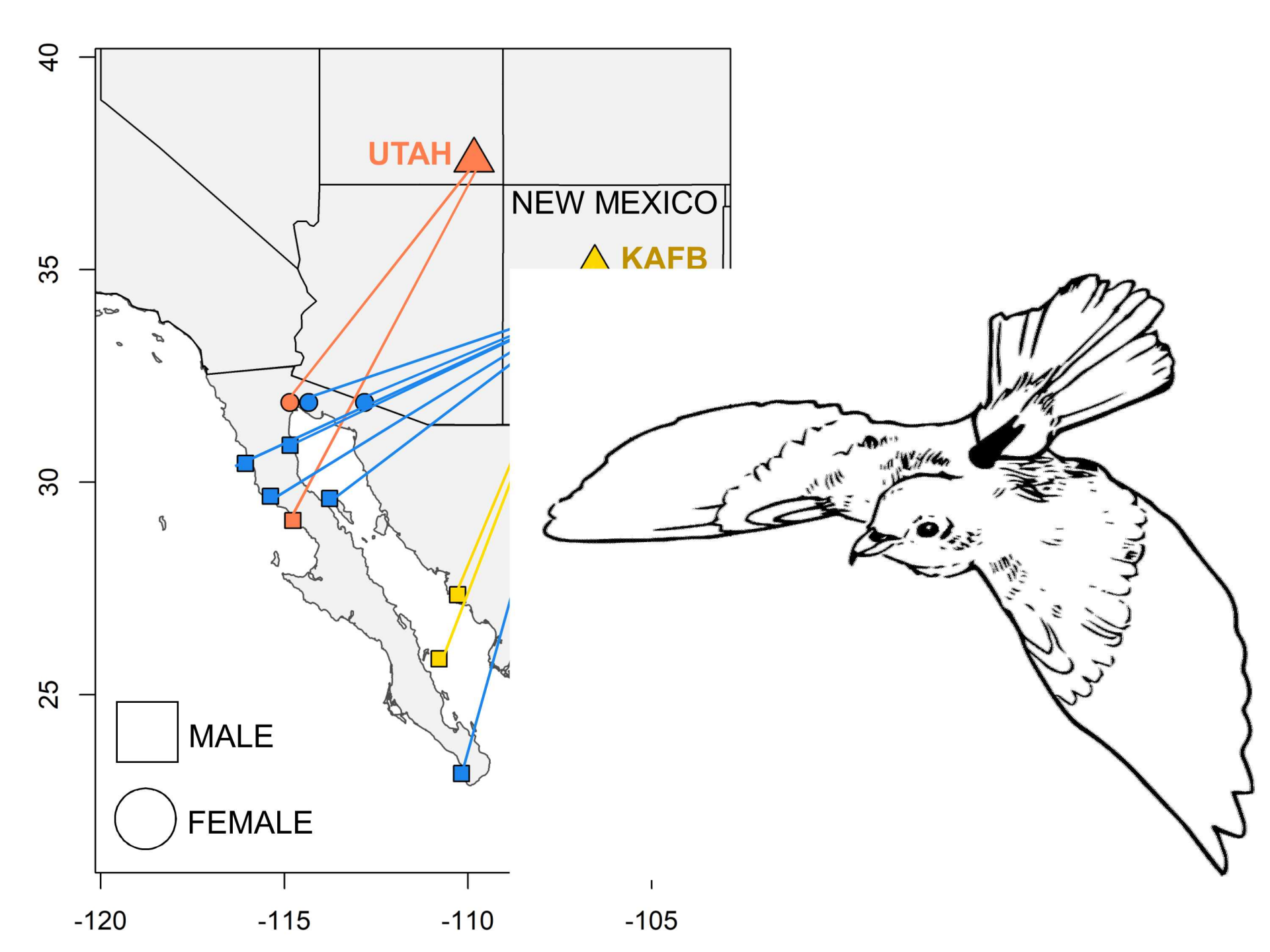
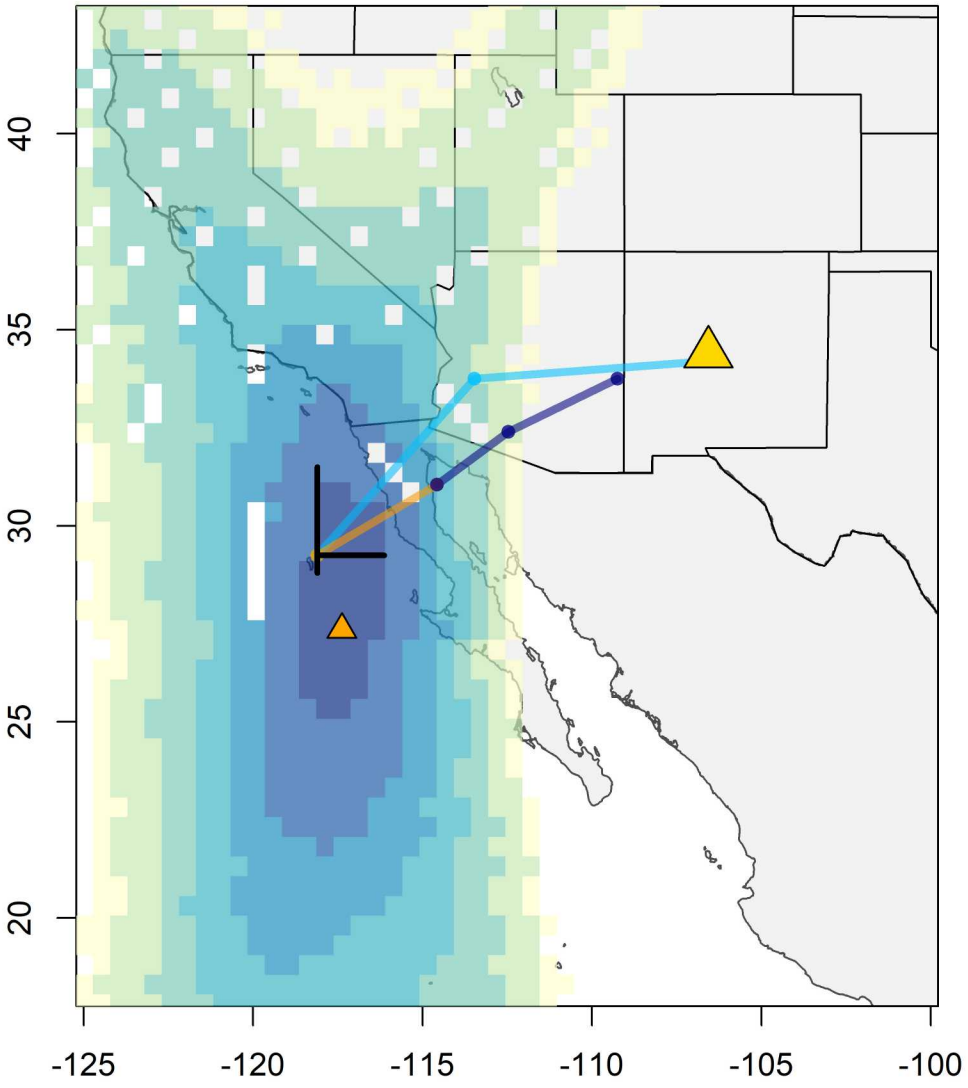

UTAH
NEW MEXICO
KAFB
MALE
FEMALE
40
35
30
25
-120
-115
-110
-105

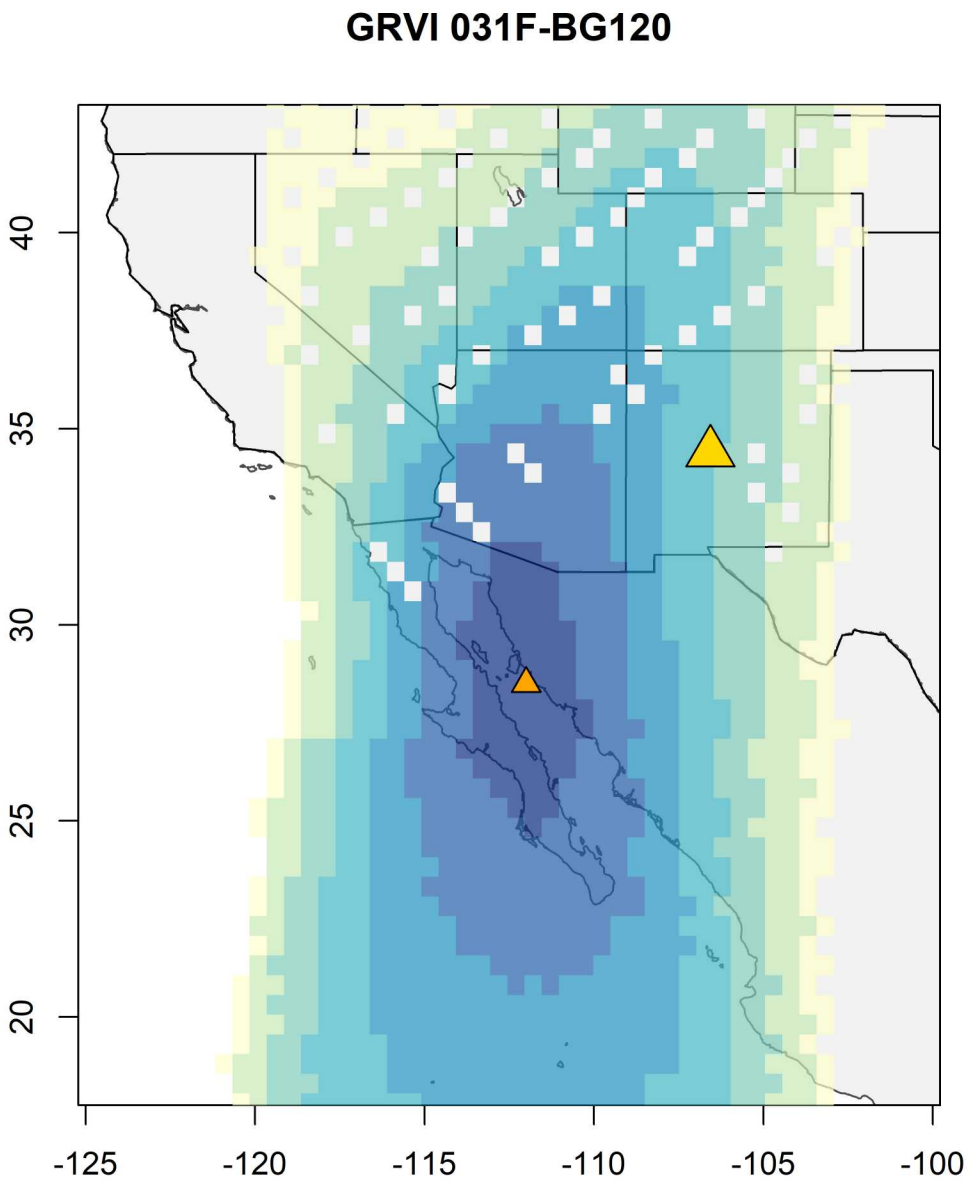

Photo: M. Baumann

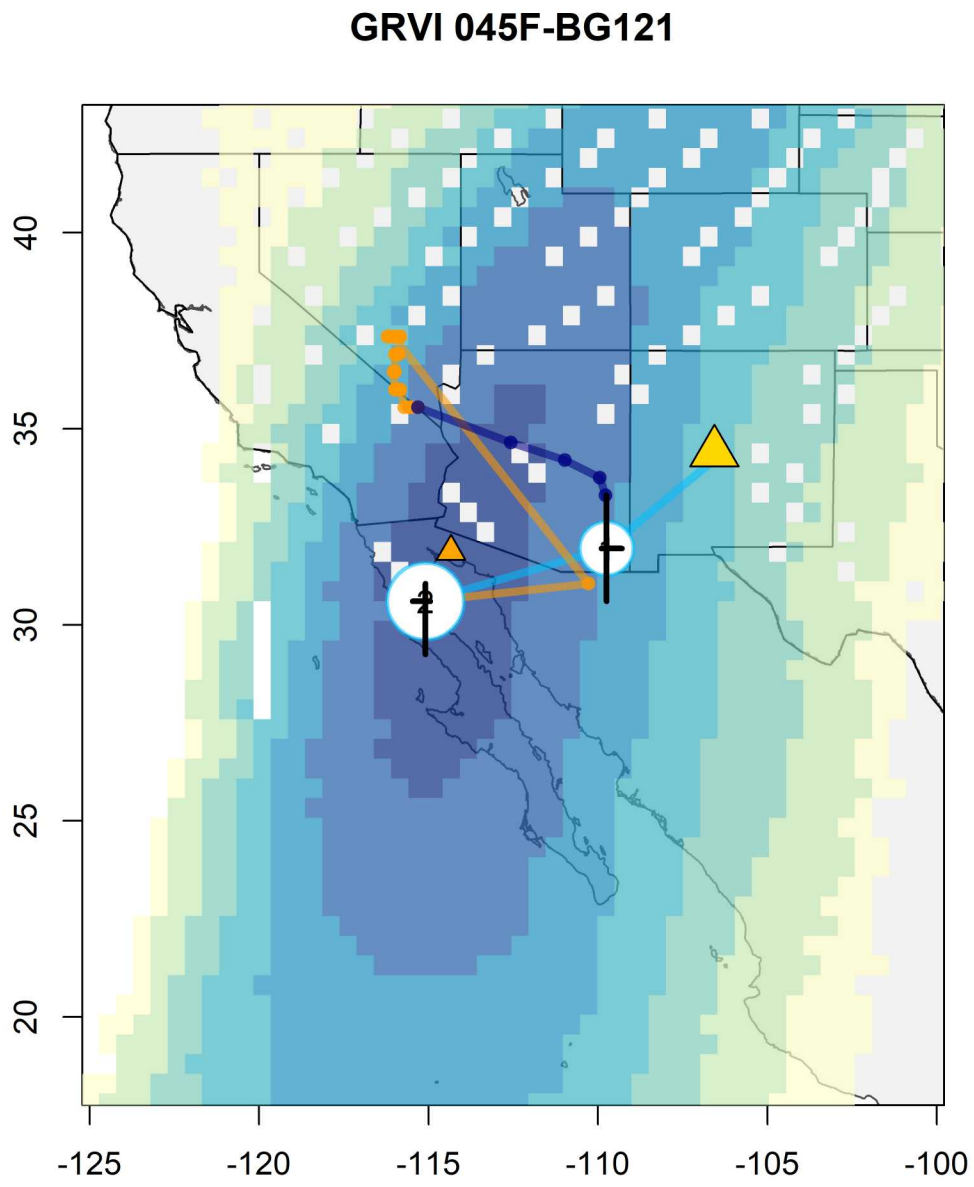
# Results

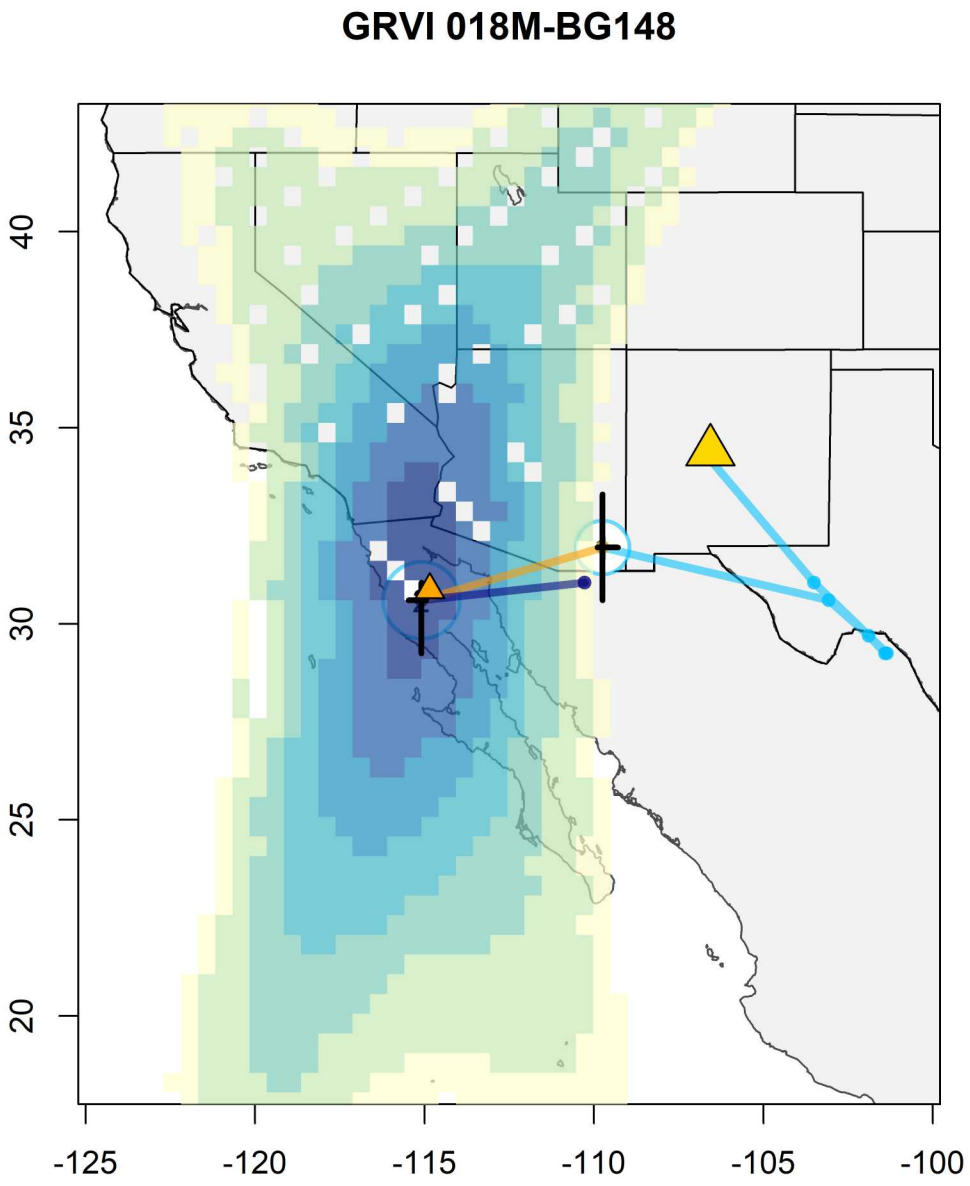
- Males migrated farther than females ($p = 0.004$)
  - Male mean 1003km ± 134
  - Female mean 728km ± 81

# GRVI 052M-BG117




GRVI 031F-BG120
40
35
30
25
20
-125
-120
-115
-110
-105
-100


GRVI 045F-BG121
40
35
30
25
20
-125
-120
-115
-110
-105
-100


GRVI 018M-BG148
40
35
30
25
20
-125
-120
-115
-110
-105
-100

# Results: migration timing

| Population | *n* | Breeding departure | Winter arrival | Winter departure | Breeding arrival |
|---|---|---|---|---|---|
| Overall | 14 | 11 Sep ± 22.4 | 30 Sep ± 9.3 | 23 April ± 14.3 | 14 May ± 19.1 |
| SNWR, NM | 8 | 13 Sep ± 21.2 | 28 Sep ± 2.6 | 19 April ± 15.2 | 16 May ± 19.9 |
| KAFB, NM | 4 | 27 Sep ± 9.8 | 10 Oct ± 8.1 | 24 April ± 5.2 | 29 April ± 1.5 |
| Utah | 2 | 13 Aug ± 1.4 | 19 Sep ± 8.5 | 5 May ± 0.7 | 29 May ± 1.4 |

# Results: migration timing

| Population | n | Fall migration duration (days) | Spring migration duration (days) |
|---|---|---|---|
| Overall | 14 | 18 ± 16.4 | 20.1 ± 19.7 |
| SNWR, NM | 8 | 15 ± 19.5 | 26 ± 23.5 |
| KAFB, NM | 4 | 13.75 ± 3 | 5.7 ± 3.8 |
| Utah | 2 | 37 ± 7.1 | 19.5 ± 0.7 |

# Future research

- Avian blood parasites
- Post-fledging ecology
- Art + ecology
- Female-based stochastic population model
- Female home ranges, roosts, and song

# Acknowledgments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- Stephanie Baker, Jon Erz