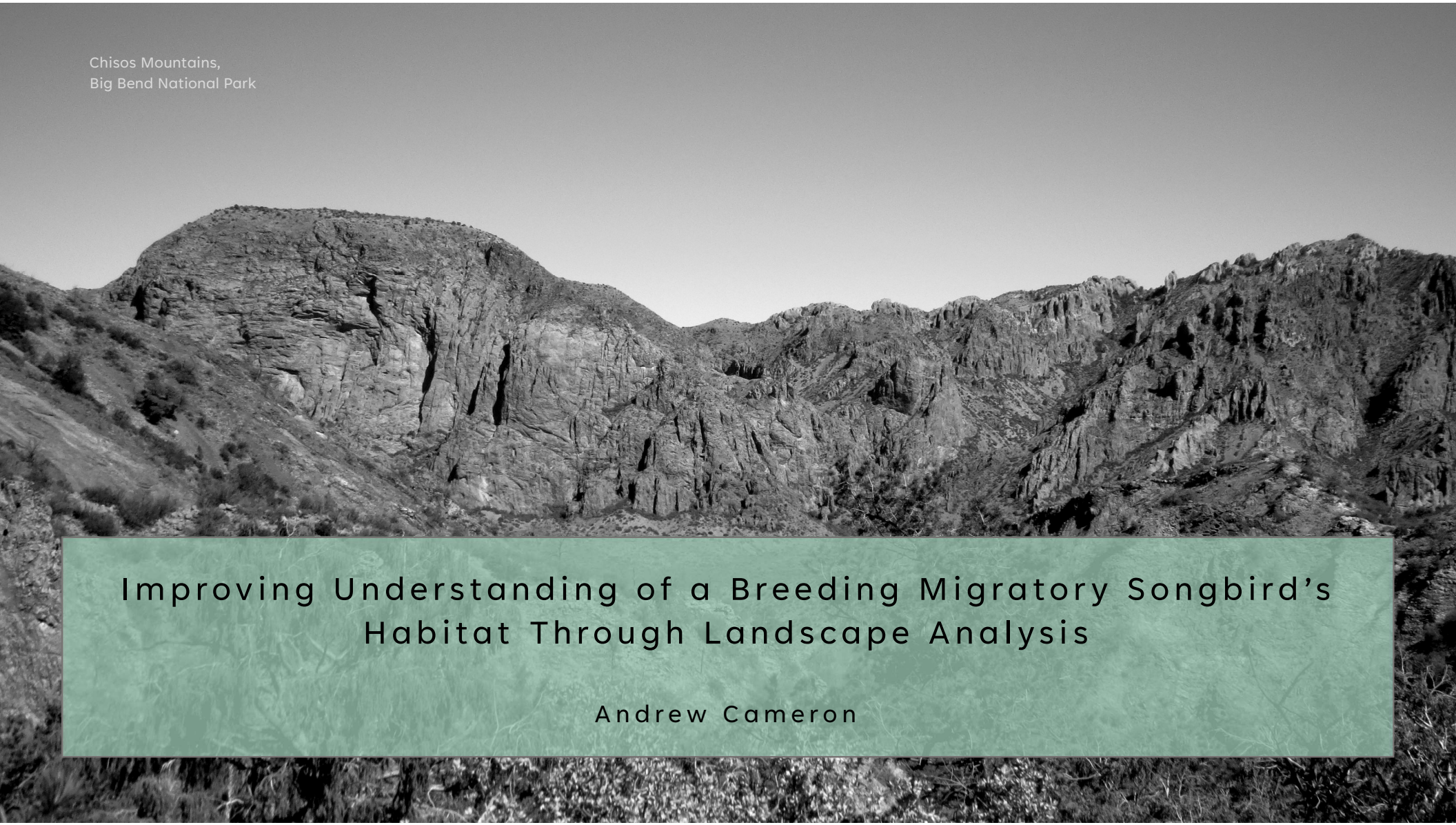


Chisos Mountains,
Big Bend National Park

Improving Understanding of a Breeding Migratory Songbird's Habitat Through Landscape Analysis

Andrew Cameron

Colima Warbler
Leiothylpis crissalis

Red crown = male

Photo credit: Jesse Huth. eBird.

Vast majority of species' range in Mexico, just barely reaching into the United States in Big Bend National Park.

First nest in US only discovered in 1932, more than four decades after the first specimen was collected.

One of the least studied and understood North American warblers.

Photos taken by author

Not Colima Warblers

Photos taken by author

Colima Warbler Range Map

Photo credit: Jason Vasallo. eBird.

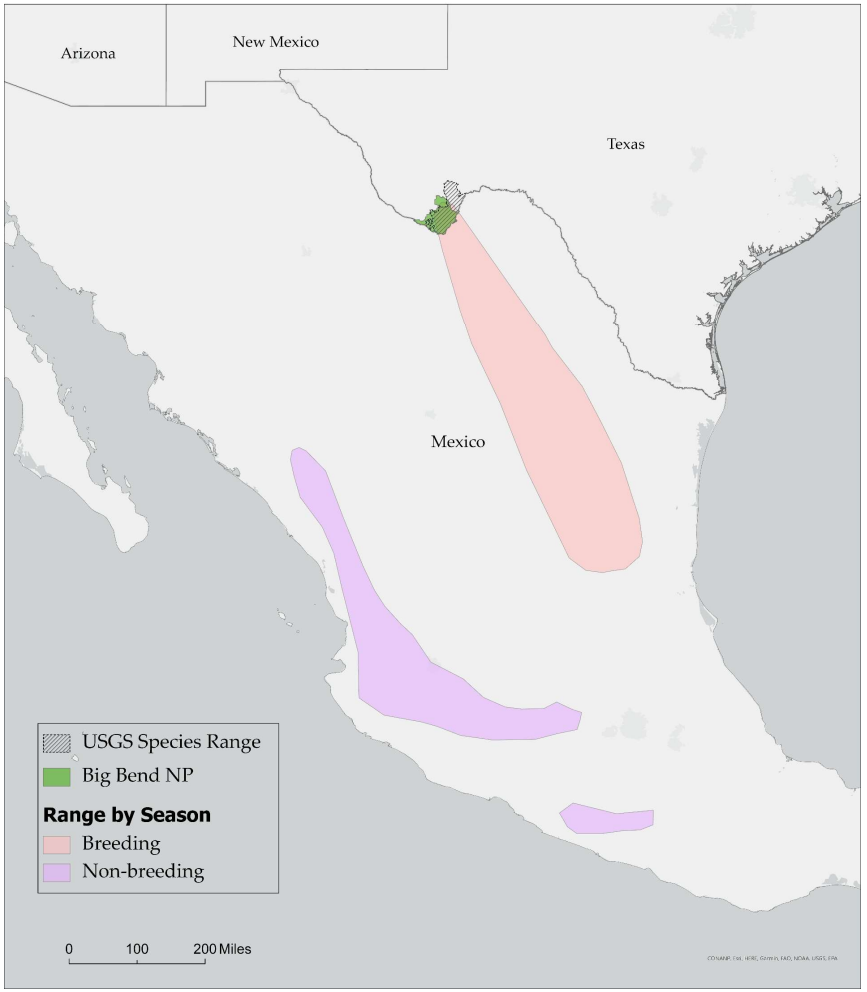
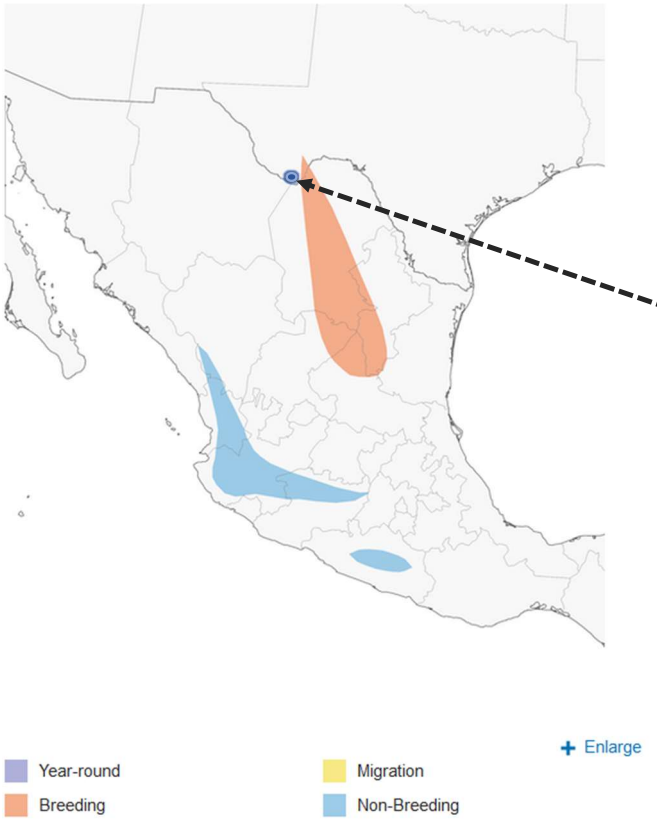
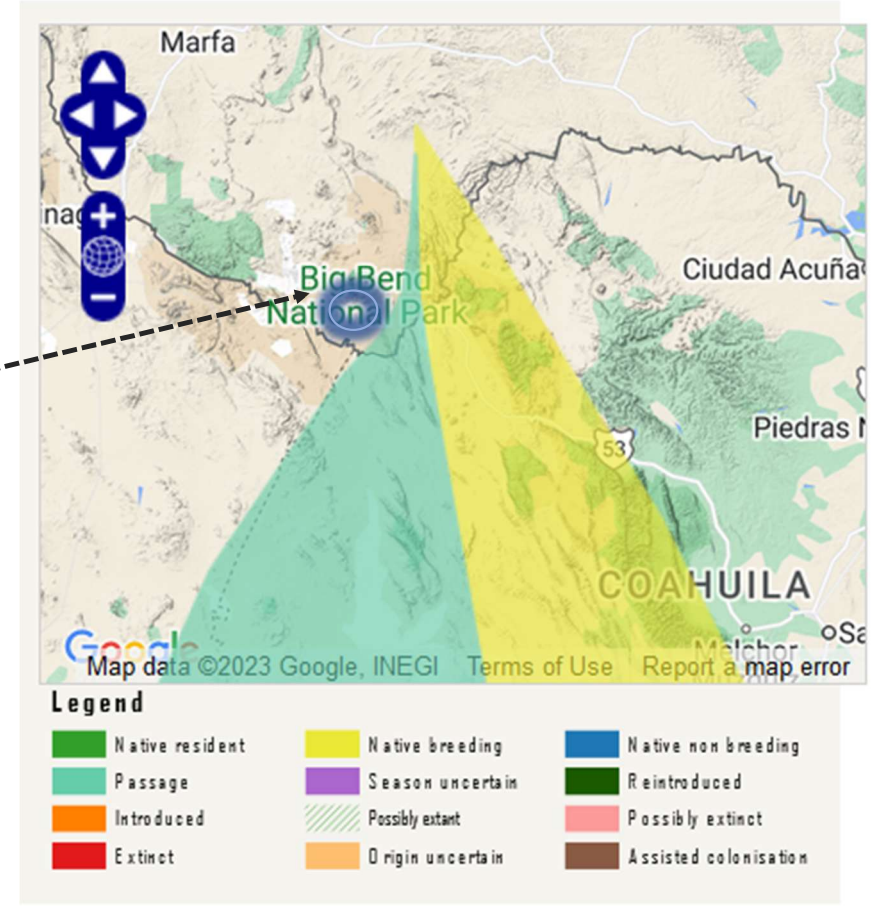


Photo credit: Bradley Hacker. eBird.



Actual breeding range within US



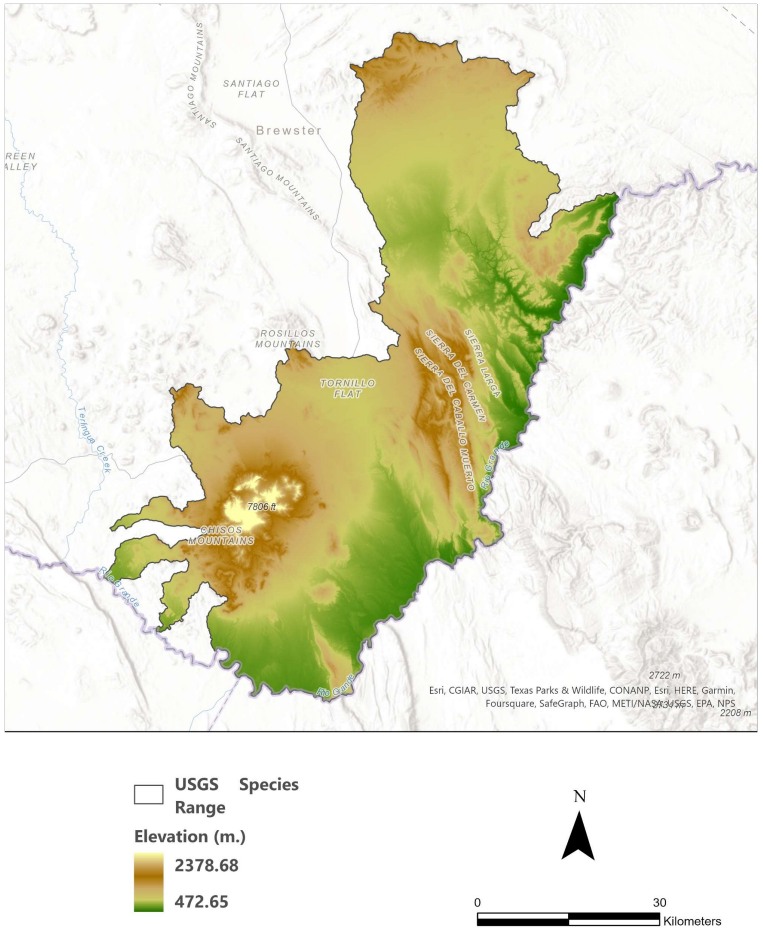
Range map from Cornell Lab of Ornithology

Range map from Bird Life International

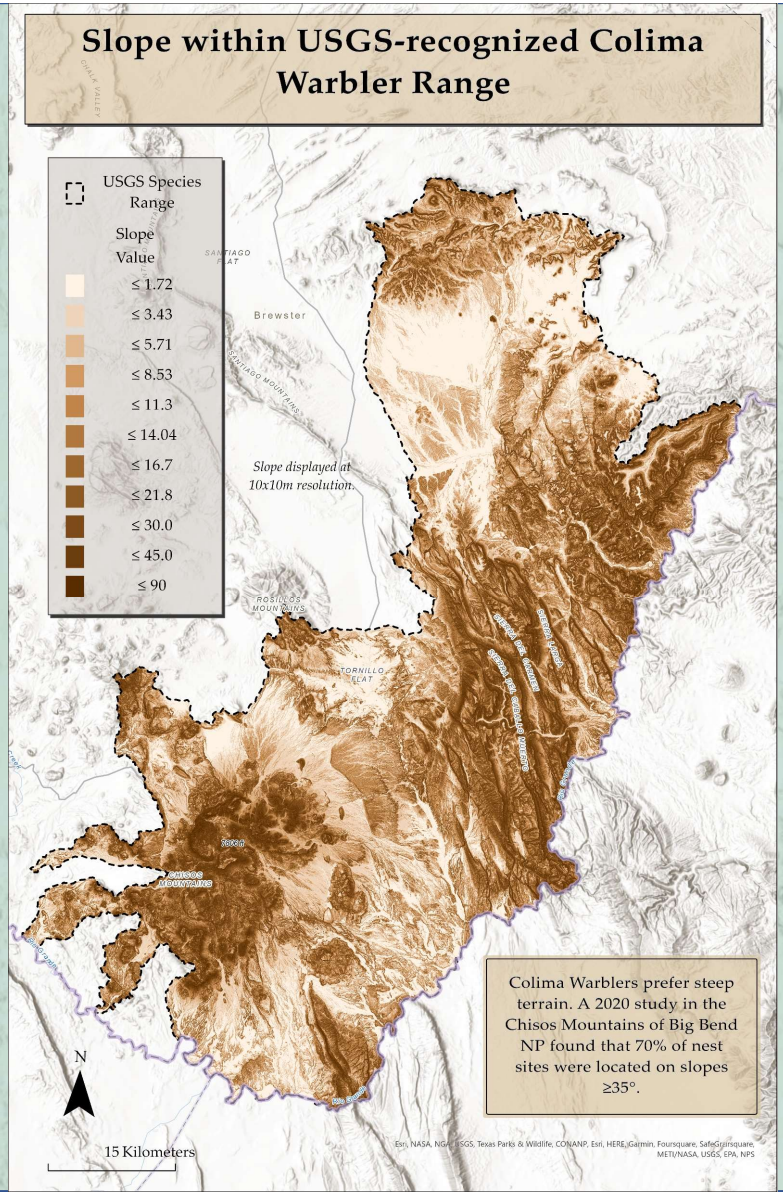
ENVIRONMENTAL VARIABLES

- Colima Warbler (COWA) occurrence and nesting location in the Chisos Mountains are strongly correlated with four variables: elevation, vegetation, slope of terrain, and aspect (Beason & Wauer, 2020).
- Breeding birds inhabit areas dominated by oak, pinyon, juniper, Arizona cypress.
- Prefer elevations above 1,500 m, with individuals most frequently observed at elevations ≥ 1,800 m (Lanning et al., 1990; Van Tyne, 1955)
- COWA employs a ground-nesting strategy and prefers steep (≥35°), north-facing slopes, and sites that are shaded from direct sunlight for 70% of daylight hours (Beason & Wauer, 2020).

Elevation within USGS Species Range Polygon

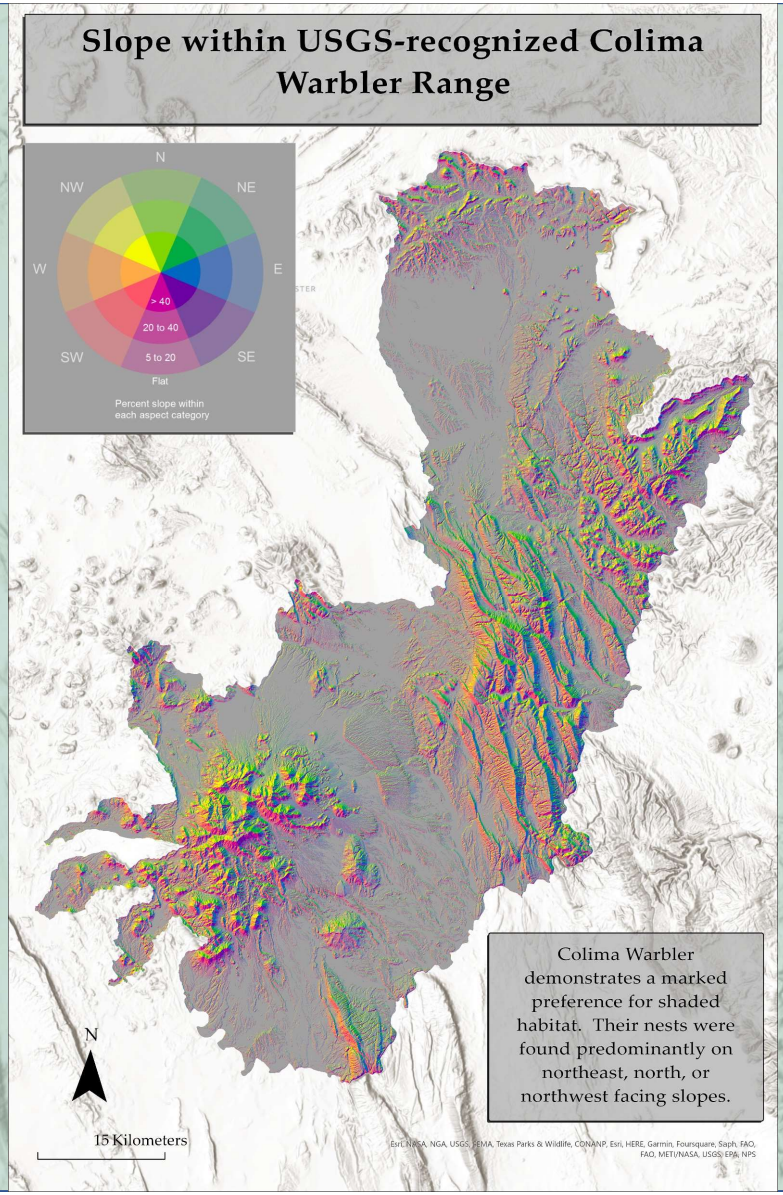


Slope within USGS-recognized Colima Warbler Range



Colima Warblers prefer steep terrain. A 2020 study in the Chisos Mountains of Big Bend NP found that 70% of nest sites were located on slopes ≥35°.

Slope within USGS-recognized Colima Warbler Range



Colima Warbler demonstrates a marked preference for shaded habitat. Their nests were found predominantly on northeast, north, or northwest facing slopes.

D A T A

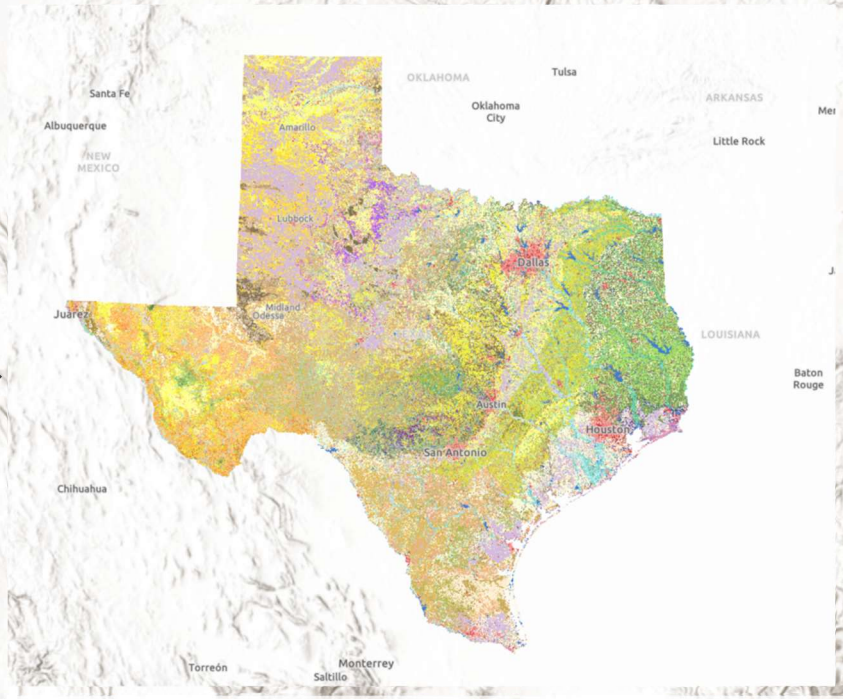
1) **Three digital elevation models** (DEMs) with a spatial resolution of 1/3 arc seconds mosaicked together, projected into Albers, and resampled to a resolution of 10x10 m. Input DEMs were obtained from the USGS National Map data delivery service

2) **Landcover raster data** obtained from the Texas Parks and Wildlife Ecological Systems Classification and Mapping Project (Elliot, 2014). The data use a more fine-grained system of vegetation classification and offer a higher resolution (10x10 m) than the USGS National Land Cover Dataset (30x30 m).

3) A vector data layer consisting of a single contiguous polygon representing the **USGS species extent of occurrence** for *Leiothlypis crissalis*.

Projection: Albers Conical Equal Area

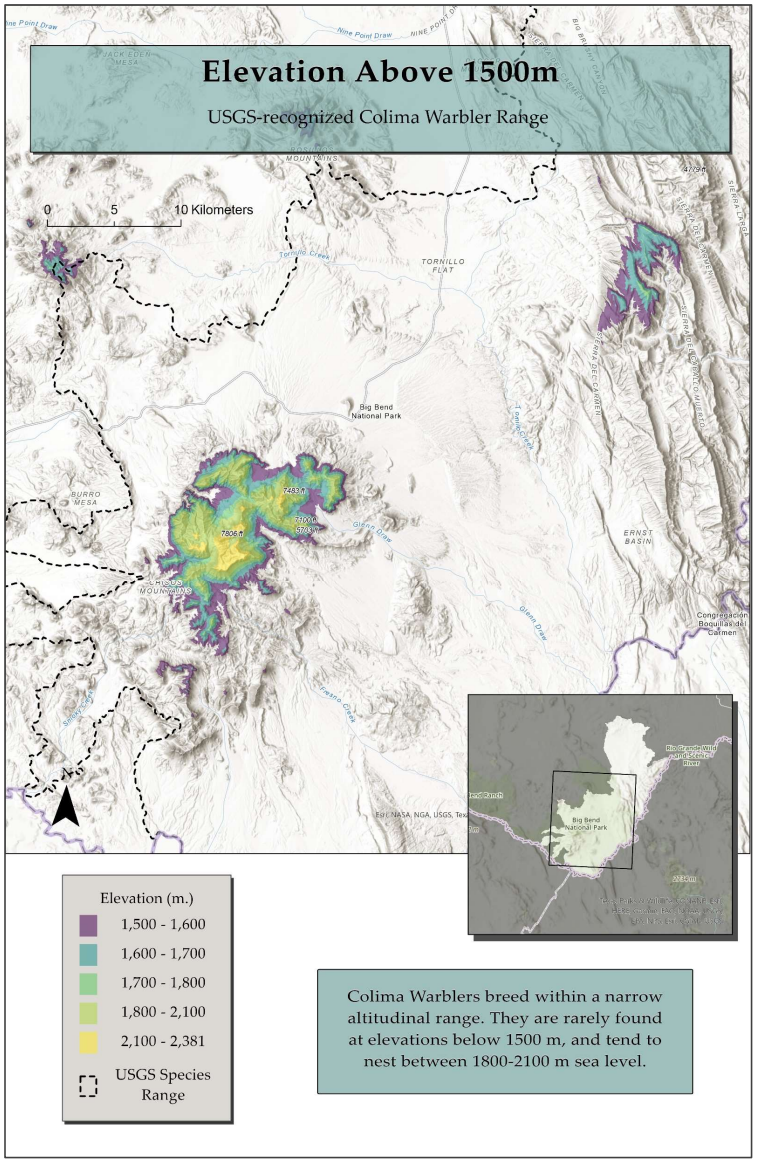
Datum: NAD83



*TX Parks and Wildlife 10x10 raster categorizes land cells into **398** classes of ecological system*

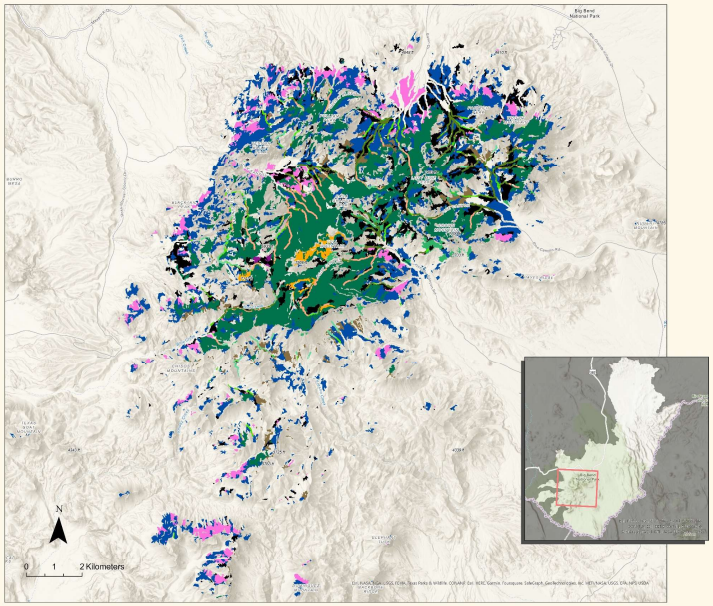
WORKFLOW

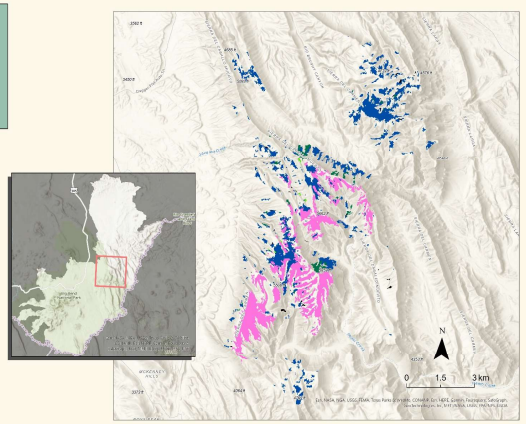

Aspect
Aspect_USGS
Extract by Mask (5)
Slope
Slope_USGS
Extract by Mask (6)
Colima_DEM1.tif
Project Raster
DEM_BigBend...
USGS_above...
USGS Species Range
Extract by Mask
DEM_USGS
Extract by Attributes
Extract by Mask (3)
TX_Ecological...
Extract by Mask (2)
veg_USGS
Extract by Attributes (2)
Extract by Mask (4)
suitableVeg_U...
final_aspect
Reclassify
reclass_aspect
final_slope
Reclassify (2)
reclass_slope
final_Elevation
Reclassify (3)
reclass_elev
Cell Statistics
ColimaHabitat
final_Vegetation
Reclassify (4)
reclass_veg



Suitable Vegetation Cover for Breeding Colima Warbler

within USGS-recognized Species Range





Vegetation Types

- Gray Oak Savanna and Woodland
- Mixed Oak Savanna and Woodland
- Juniper Savanna and Woodland
- Pinyon - Juniper Woodland
- Pinyon - Juniper Shrubland
- Montane Mesic and Canyon Pine - Juniper Forest
- Montane Mesic and Canyon Hardwood - Pine - Juniper Forest
- Montane Mesic and Canyon Hardwood Forest
- Montane Mesic and Canyon Evergreen Shrubland
- Montane Mesic and Canyon Shrubland
- High Mountain Conifer Forest and Woodland
- Rocky Mountain Gambel Oak - Mixed Shrubland

RESULTS

The final model resulted in a reduction of the area of likely occurrence by **98.24**% (68.94 km^2 vs 3,908.76 km^2)

Suitable habitat was restricted to two narrowly circumscribed zones situated entirely within the boundaries of Big Bend National Park,

(1) the Chisos Mountains zone (CM) to the southwest

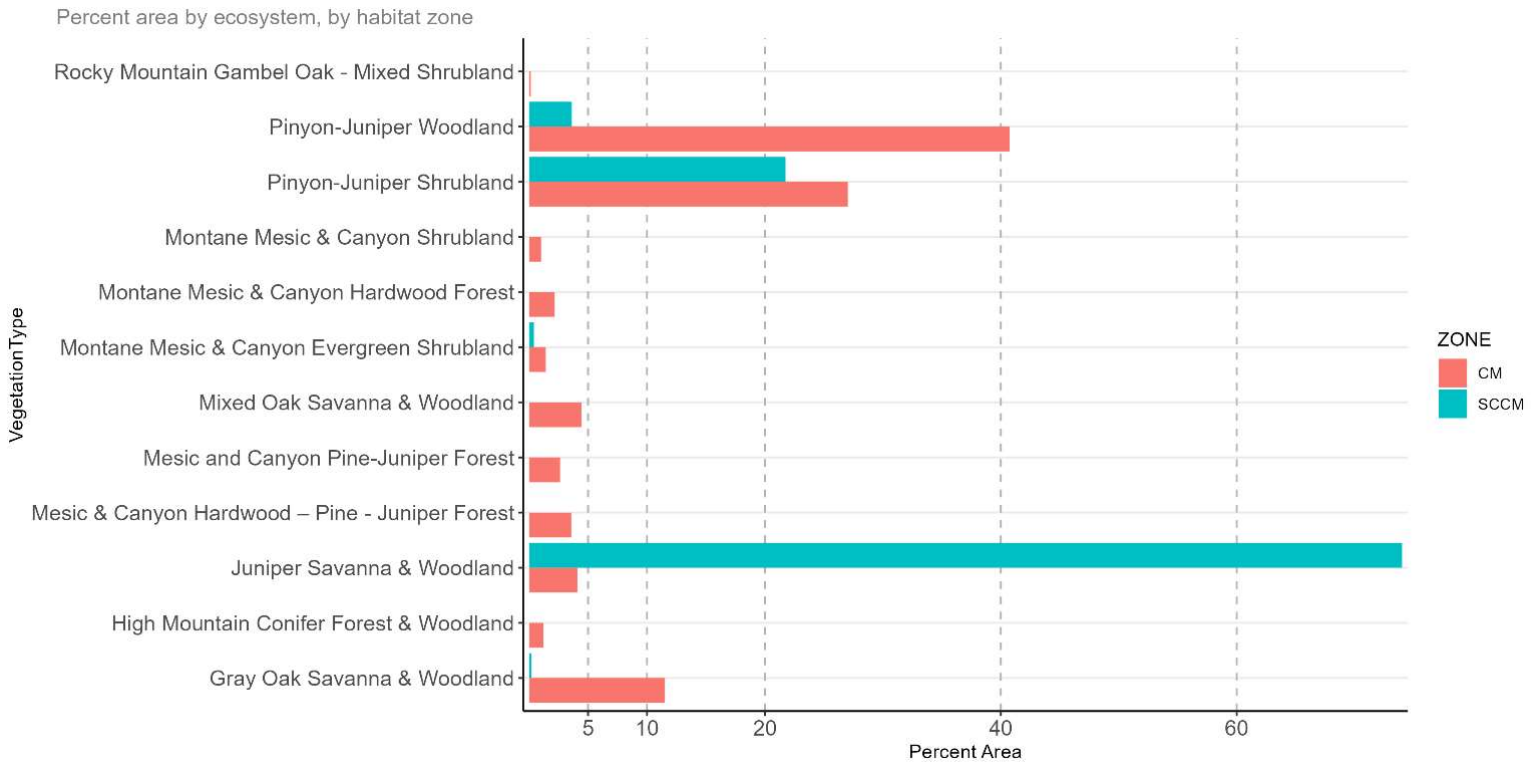
(2) a much smaller zone spanning the Sierra del Carmen and Sierra del Caballo Muerto ranges (SCCM), roughly in the center of the range polygon

FEATURE	AREA (km2)	PERCENT RANGE POLY
USGS species range	3908.76	100%
Elevation above 1500m	135.27	3.46%
Suitable vegetation	88.65	2.27%
Elevation + Vegetation	69.02	1.77%
Final habitat model	68.94	1.76%

ZONE	AREA (km2)	MAX CELL VAL	MEAN CELL VAL	PCT90
Chisos Mountains	59.28	5	3.63	5
Sierra del Carmen/de Caballo Muerto	9.66	4	2.67	4

The types and relative amounts of vegetation classes present in each zone differ substantially.

- Juniper-savanna and woodland ecosystem accounts for 74.02 % of the vegetation in zone SCCM, with pinyon-juniper shrubland accounting for another 21.74%.
- Oak and mesic ecosystems are nearly absent from SCCM, whereas in CM oak and mesic account for 16.12% and 10.82% respectively.
- Pinyon-juniper ecosystems comprise 67.76% of suitable habitat in CM zone.



Area of cells (sq. km) by elevation (in meters), by habitat zone.

ZONE	1500-1650m	1651-1800m	1801-2000m	2001-2381m
CM	20.35	15.57	12.06	11.31
SCCM	7.67	1.99	0.00	0.00

Table 4. Total area (km^2) of cells by elevation (m.) band among habitat zones.

Percent of of suitable habitat by slope (in degrees) among habtiat zones.

ZONE	0-3°	4-9°	10-15°	16-30°	31-60°	61-90°
CM	0.34	7.74	13.02	40.34	38.29	0.27
SCCM	1.87	22.49	24.46	43.94	7.25	0.00

Table 5. Percentage of cells within defined slope ranges, grouped by habitat zone.

Pecentage of cells by aspect among habitat zones.

ZONE	N	NE	E	SE	S	SW	W	NW
CM	17.03	14.32	8.96	6.25	5.60	8.89	13.50	16.91
SCCM	6.05	9.99	16.15	10.09	11.91	19.07	16.45	7.67

Table 6. Percentage of cells corresponding to one of eight cardinal or ordinal directions.

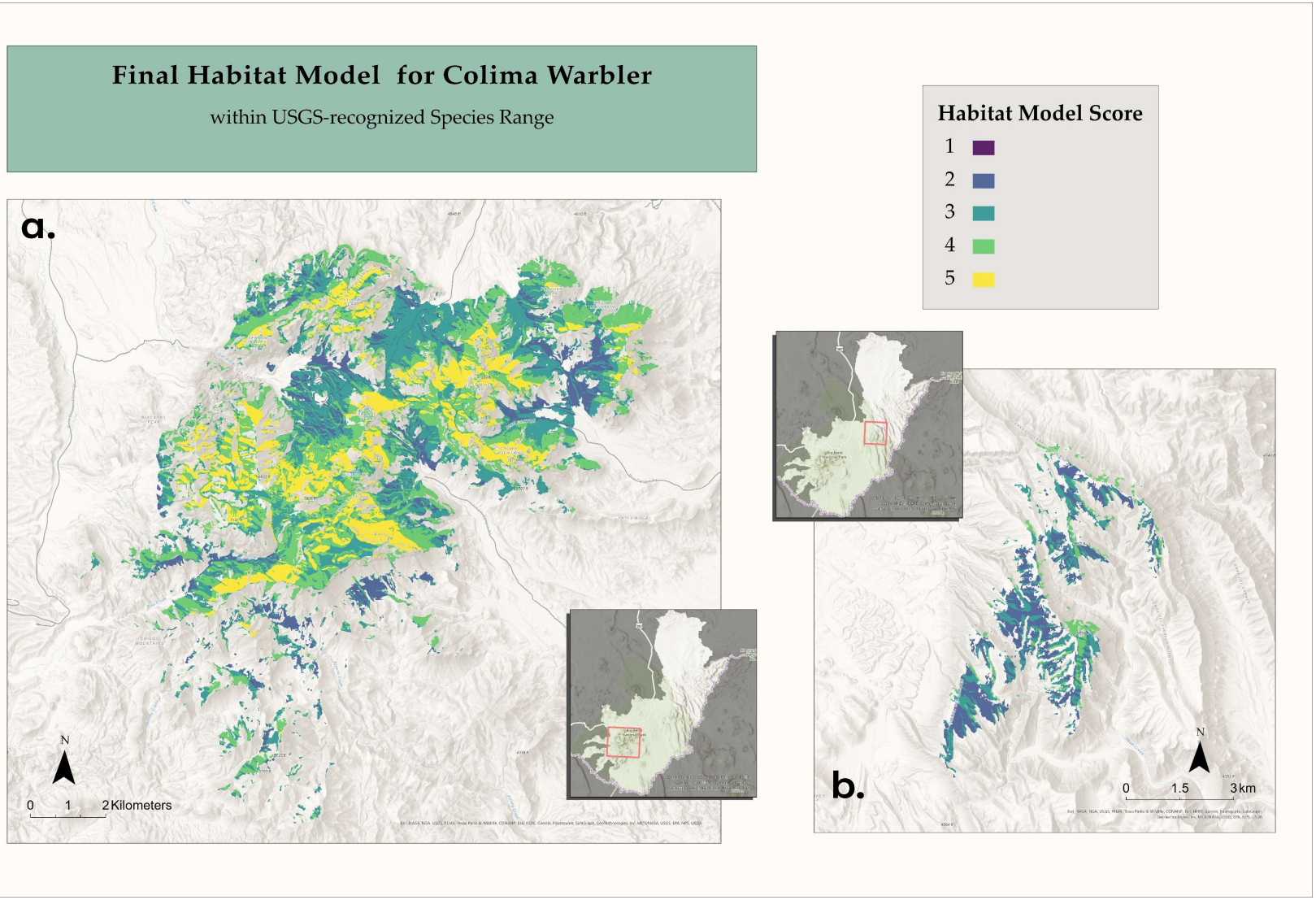


Figure 6. Final habitat model results. All colored cells represent suitable habitat, with higher scores indicating closer alignment with demonstrated species preferences and occurrence data. (a) Chisos Mountains (b) Sierra del Carmen/Sierra del Caballo Muerto.