The distribution of Rusty Blackbirds on their wintering grounds: Potential hotpots and habitat associations

Brian S. Evans, Powell, L.L., and Greenberg, R.
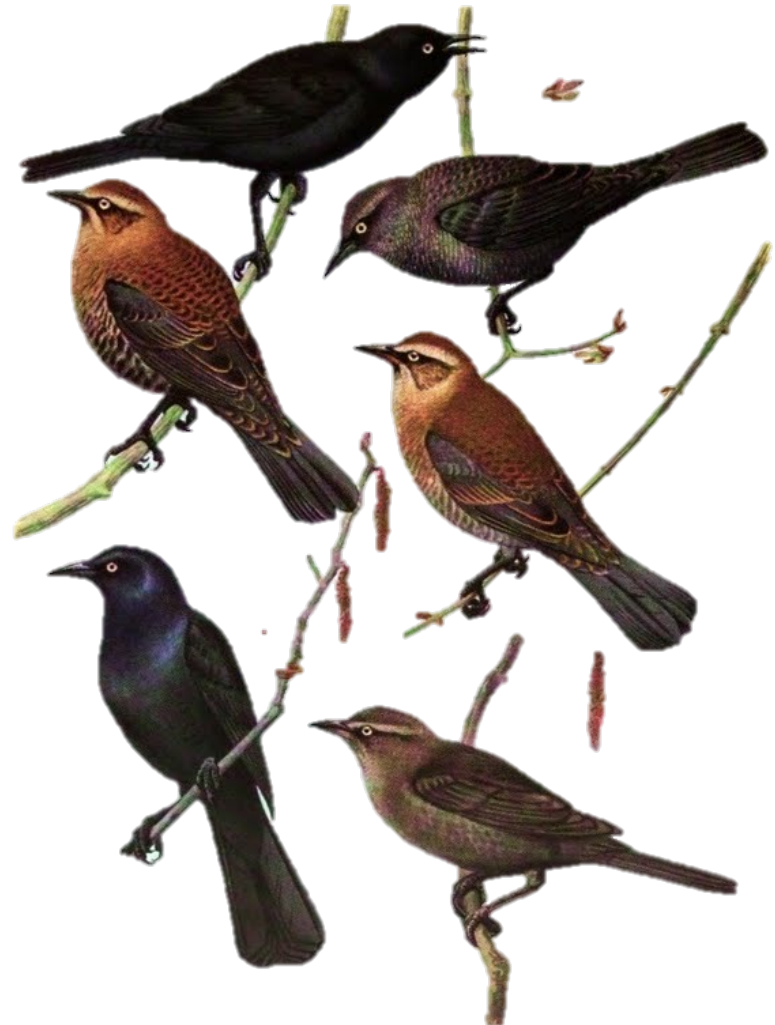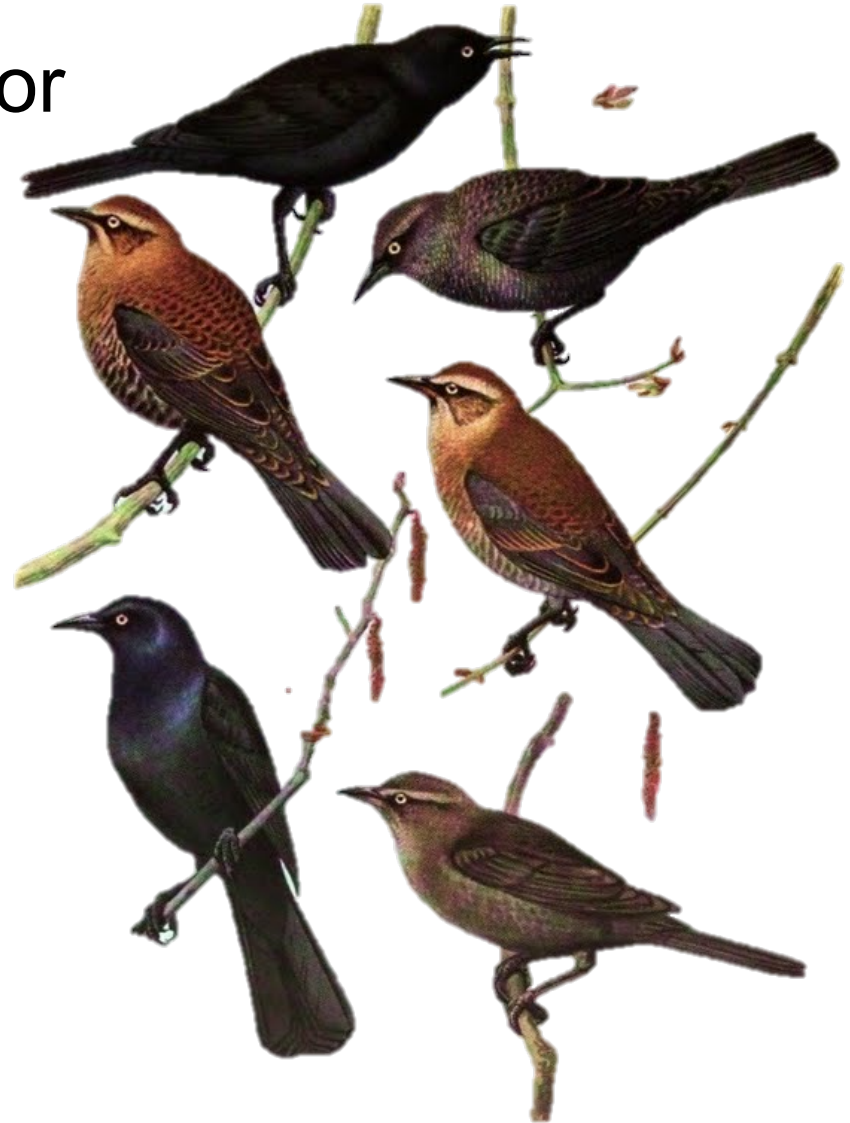
AOU 2014

Smithsonian Migratory Bird Center

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Overview

1) Goal: Predict hot spots for large flocks of Rusty Blackbirds

2) Habitat distribution modeling: The pros and cons of the MaxEnt approach

3) Methods (Model development)

4) Methods (output) and results

Research questions

1) How does prevalence vary by flock size?

2) Do different flock sizes represent different ecological niches?

3) Which environmental variables best predict the distribution of Rusty Blackbird flocks?

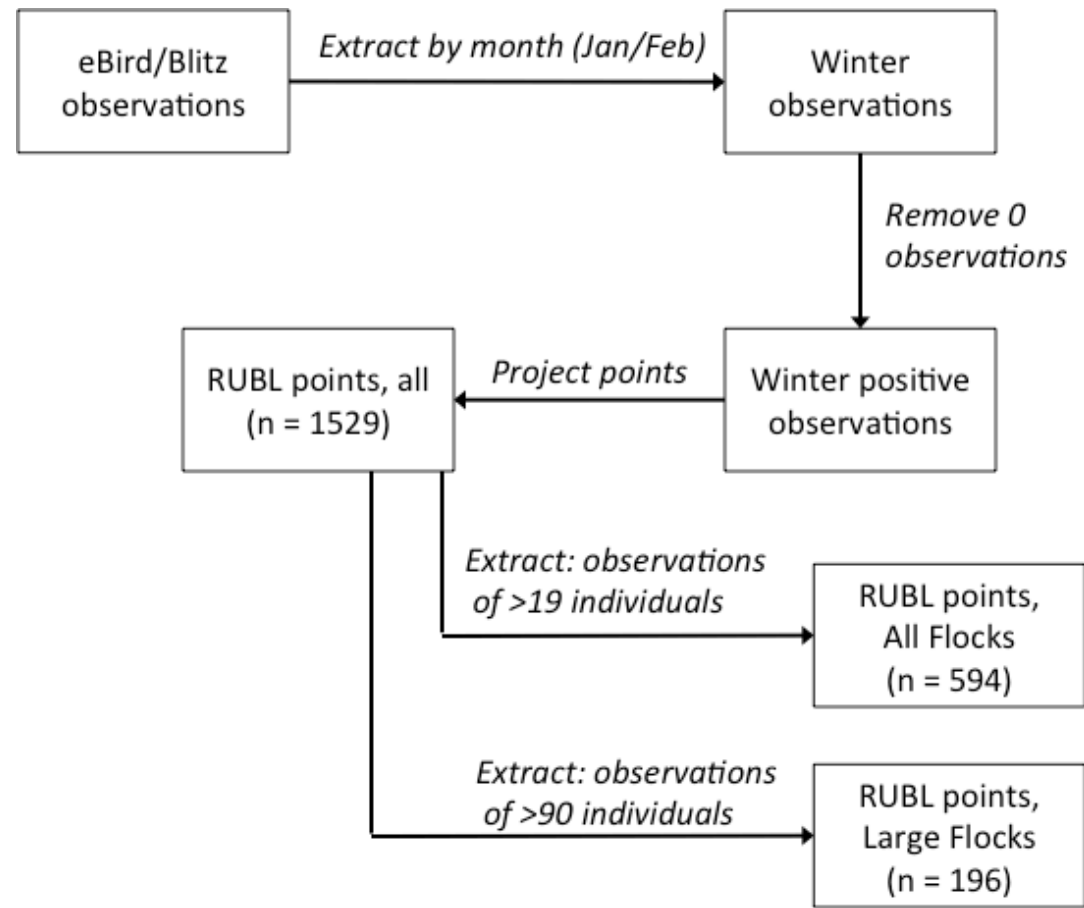4) Did the Rusty Blackbird Blitz provide improved predictions of habitat suitability?

Methods: Distribution modeling overview

- **MaxEnt** or **occupancy** models? The trouble with 0's

- **MaxEnt limitations**:
  - Models distribution in realized niche space (hot spots?)
  - Models tend to be overfit
    - Interaction and quadratic terms
  - Models may be heavily influenced by sampling bias
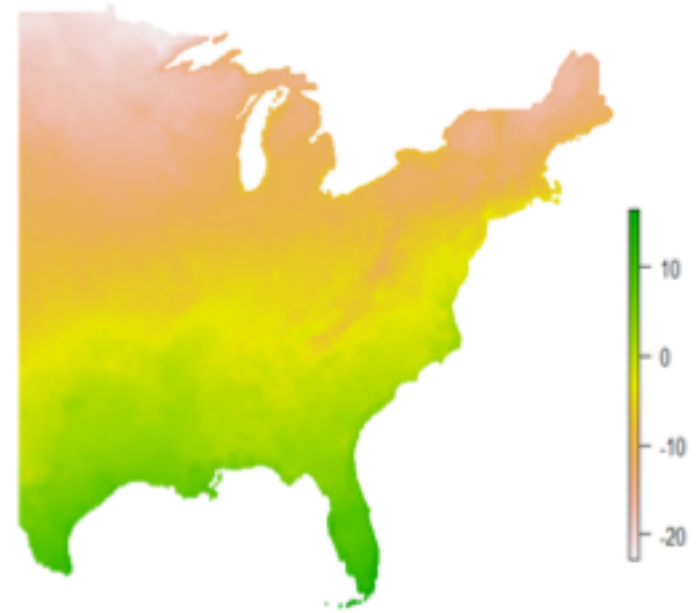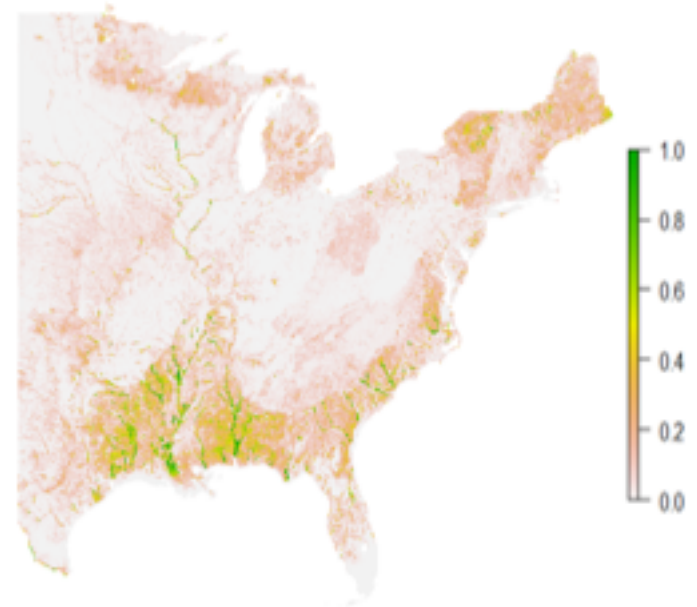 - Observations are spatially autocorrelated

Model building: observational data

- Data collected from RUBL Blitz and eBird

- Subset to Blitz months (Jan-Feb) and flock size classes.

- Extracted to 4 km resolution grid

eBird/Blitz observations — Extract by month (Jan/Feb) → Winter observations

Winter observations — Remove 0 observations ↓ Winter positive observations

Winter positive observations — Project points → RUBL points, all (n = 1529)

RUBL points, all (n = 1529) — Extract: observations of >19 individuals → RUBL points, All Flocks (n = 594)

RUBL points, all (n = 1529) — Extract: observations of >90 individuals → RUBL points, Large Flocks (n = 196)
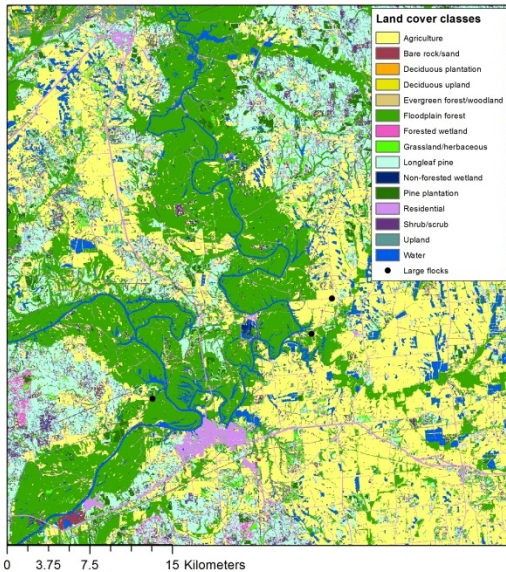
Model building: Environmental data

- Land cover: US GAP Analysis Project, 30 m resolution
  - Reclassified into classes considered predictive of RUBL distribution
  - Aggregated to a grain size of 4 km
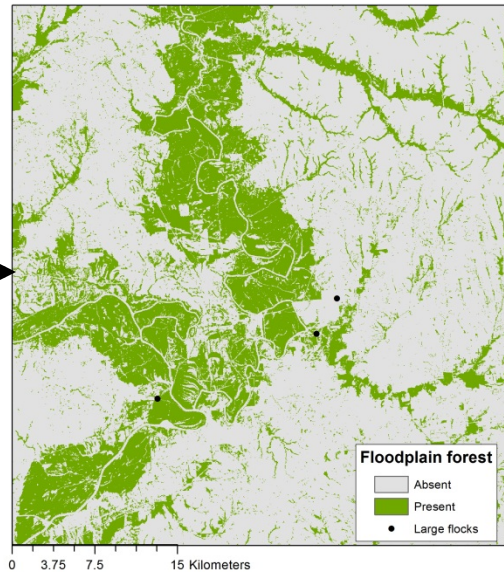- Climate: precipitation (ppt) and minimum temperature (tmin): US PRISM, 4 km resolution
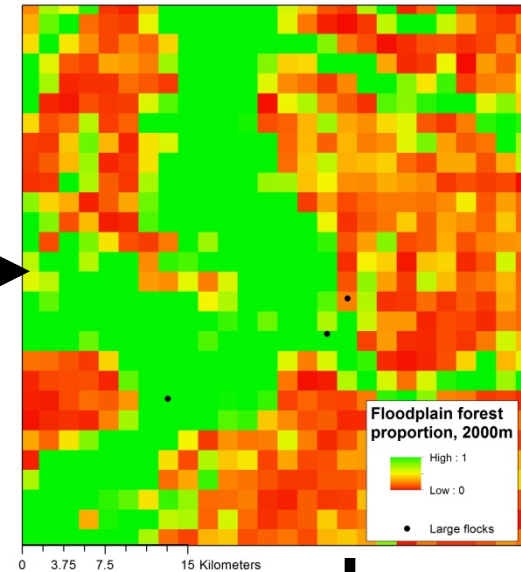
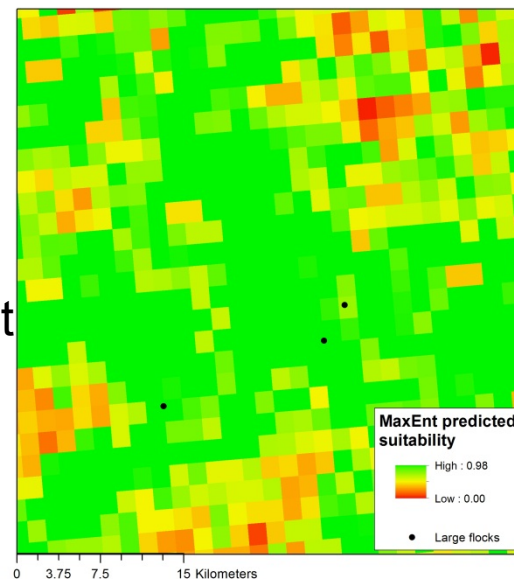# Model building/processing example: Black Belt Alabama

Reclassified land cover

Land cover classes
- Agriculture
- Bare rock/sand
- Deciduous plantation
- Deciduous upland
- Evergreen forest/woodland
- Floodplain forest
- Forested wetland
- Grassland/herbaceous
- Longleaf pine
- Non-forested wetland
- Pine plantation
- Residential
- Shrub/scrub
- Upland
- Water
- Large flocks

0 3.75 7.5   15 Kilometers

Binary land cover, floodplain

Floodplain forest
- Absent
- Present
- Large flocks

0 3.75 7.5   15 Kilometers

Proportional land cover

Floodplain forest proportion, 2000m
- High : 1
- Low : 0
- Large flocks

0 3.75 7.5   15 Kilometers

Maximum entropy model output: Probability of habitat suitability

MaxEnt predicted suitability
- High : 0.98
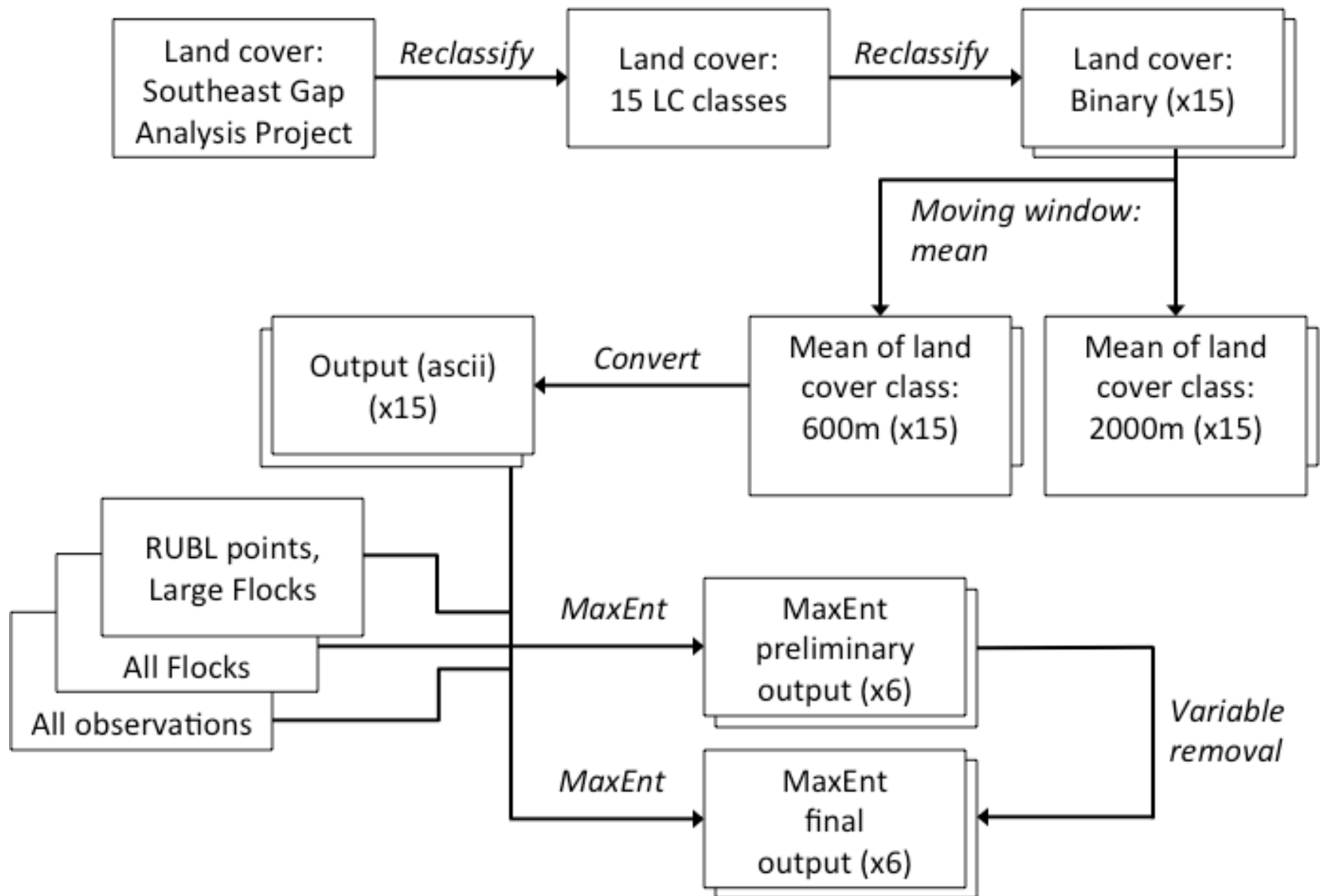- Low : 0.00
- Large flocks

0 3.75 7.5   15 Kilometers

# Model building: "Overcoming" bias and model overfitting
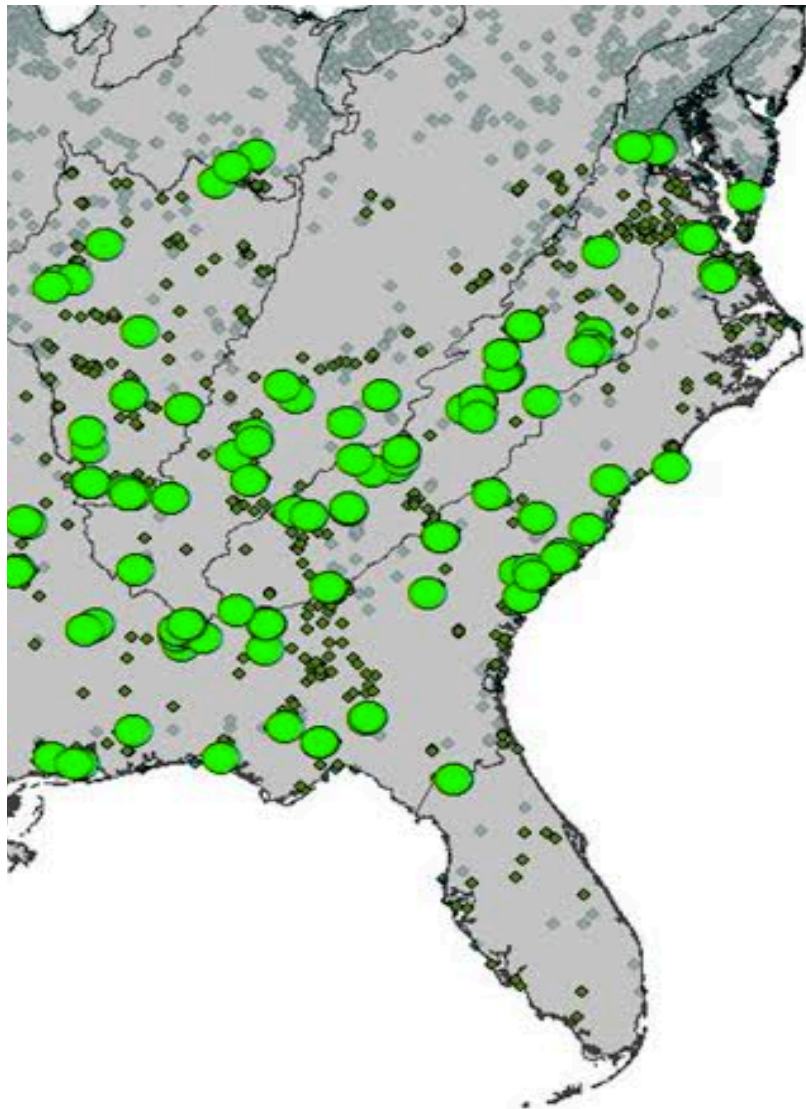
- ## Sampling bias:
  - **Background points** generated from non-RUBL observations with eBird from Jan-Feb of sampled years.

- ## Model overfitting
  - Interactions and quadratic terms added individually prior to modeling
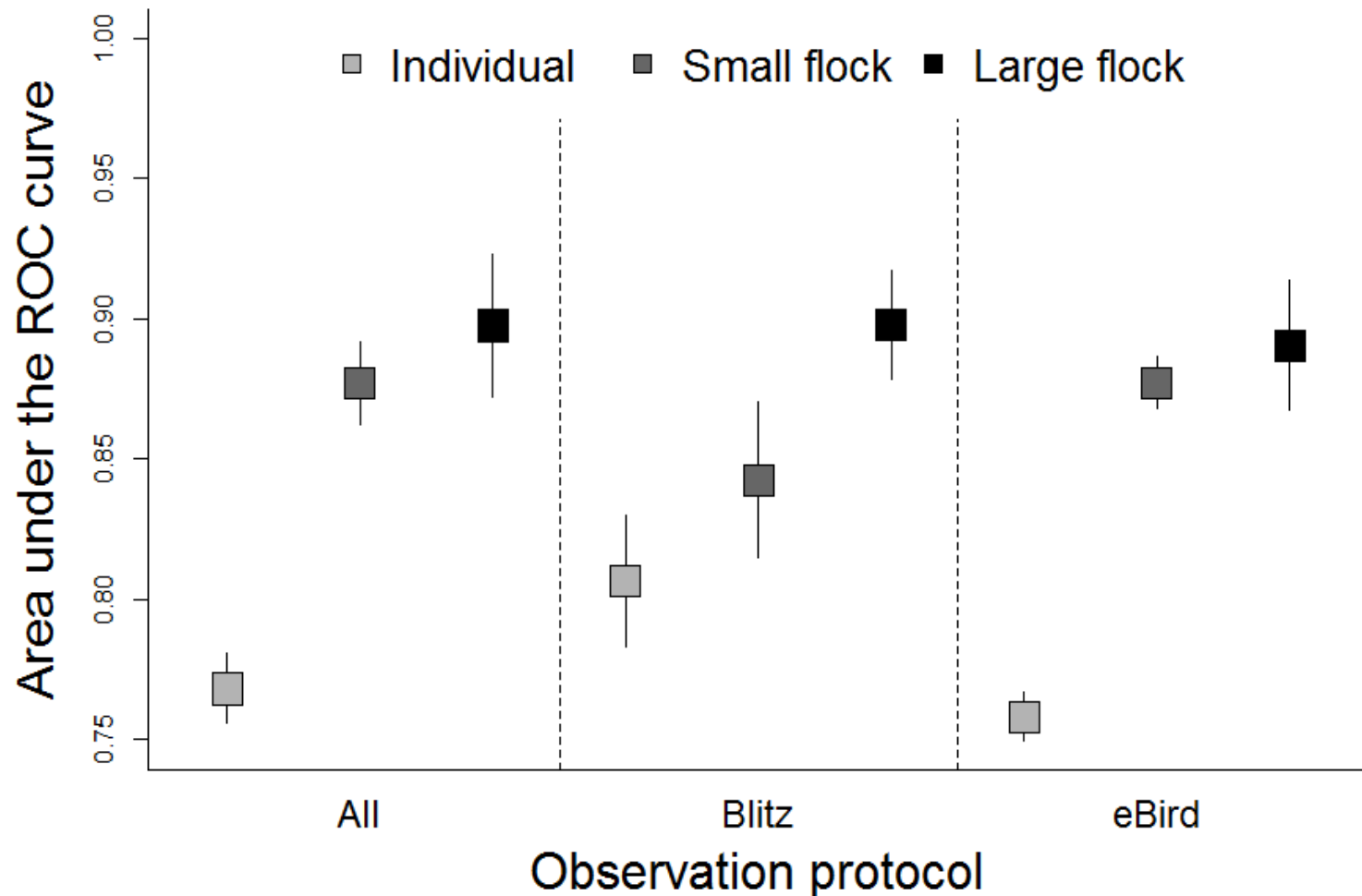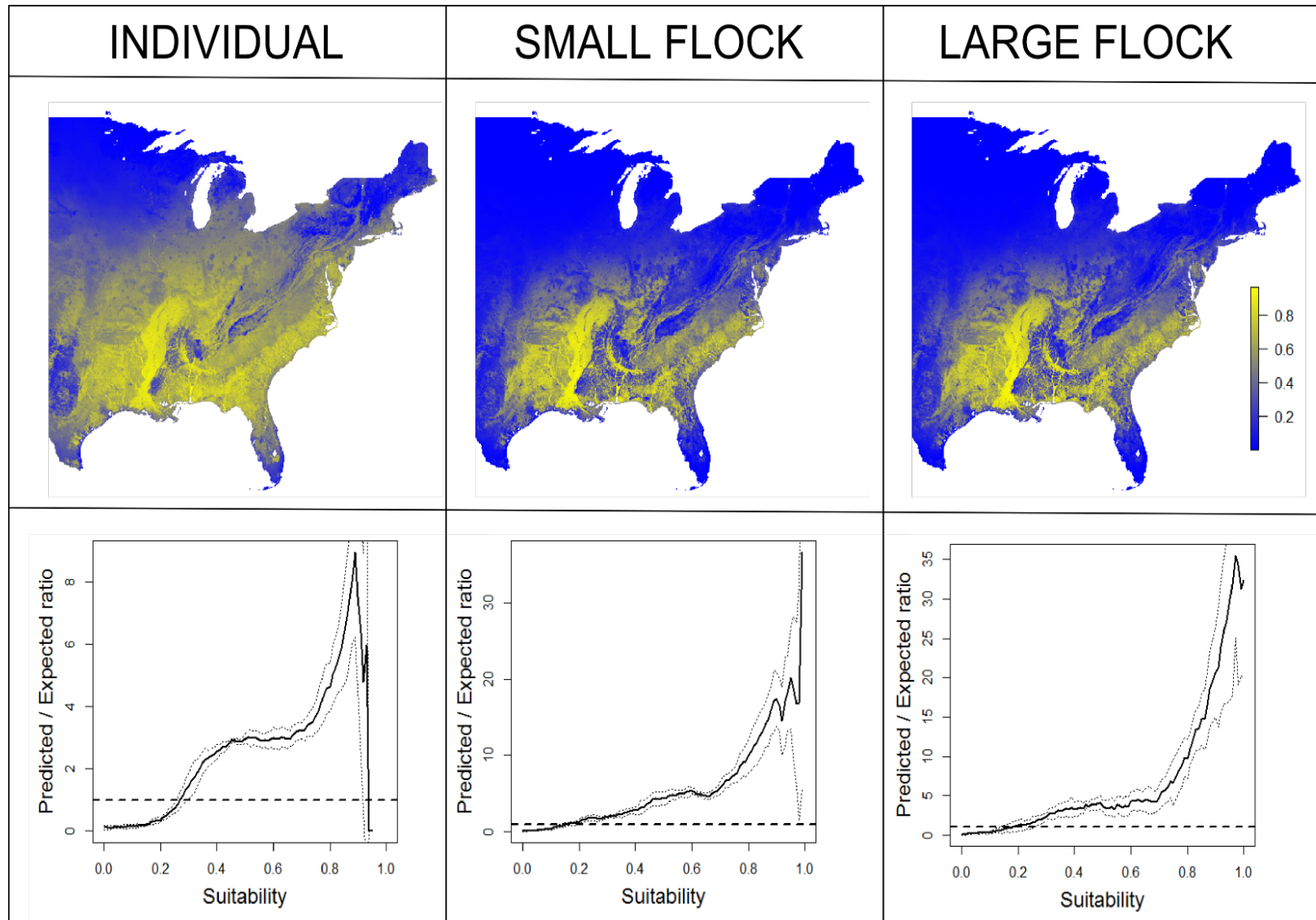 - AIC used for selection of beta parameter

Model building

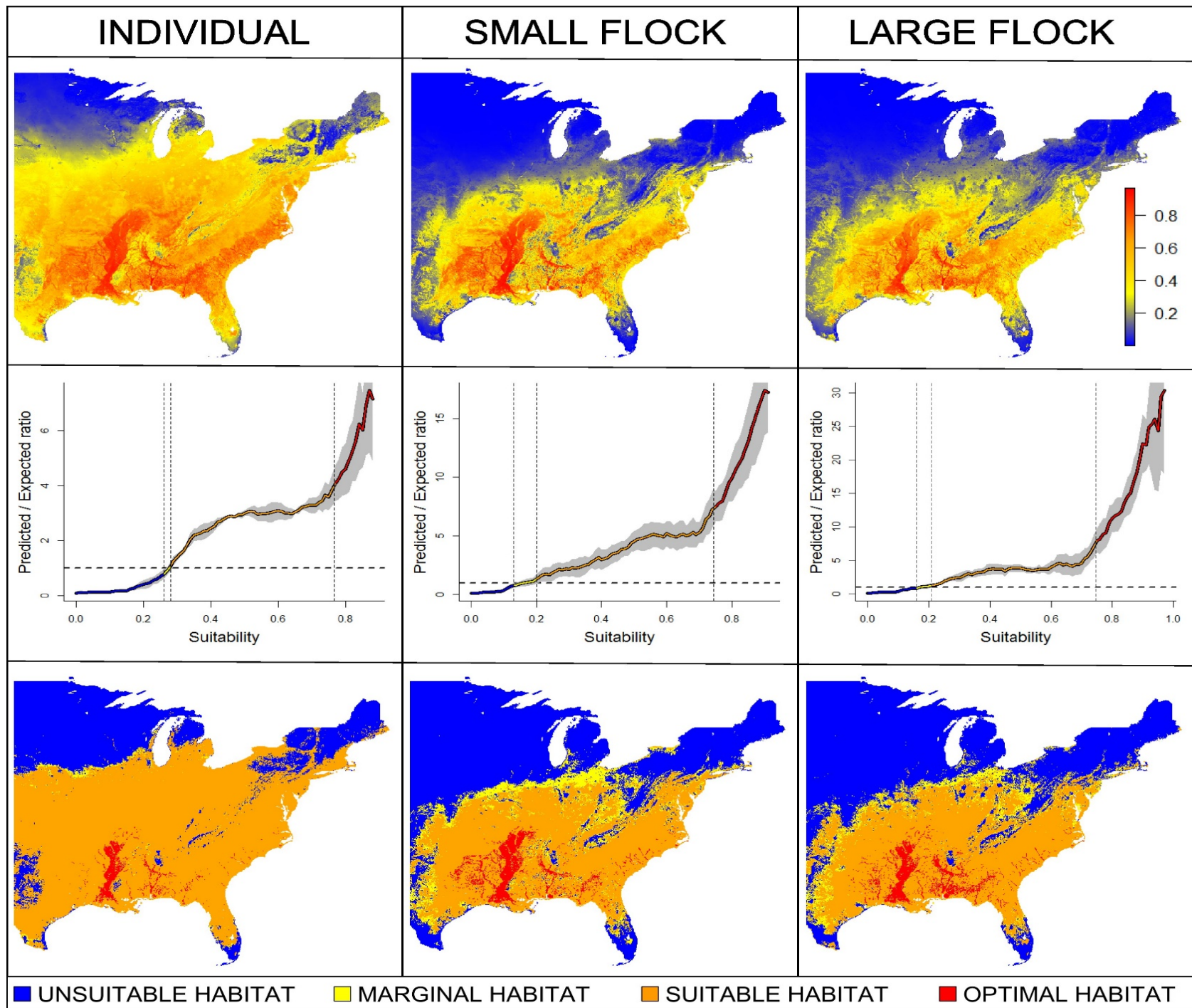# Does prevalence of suitable habitats vary by flock size?
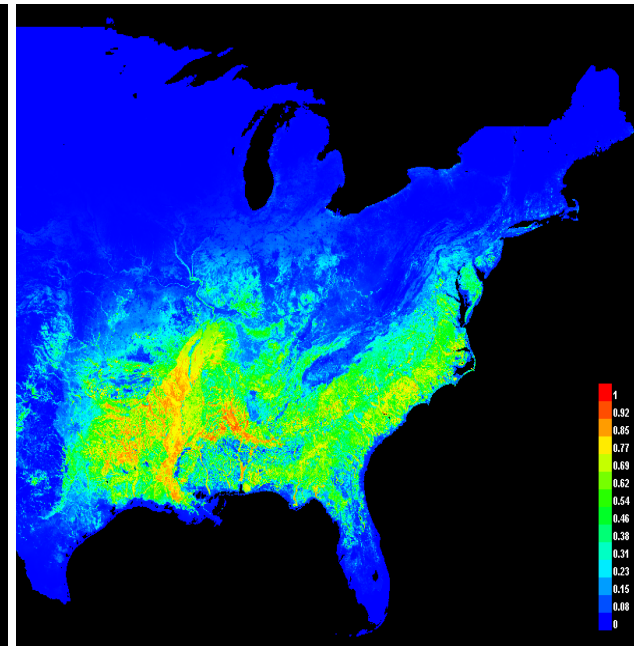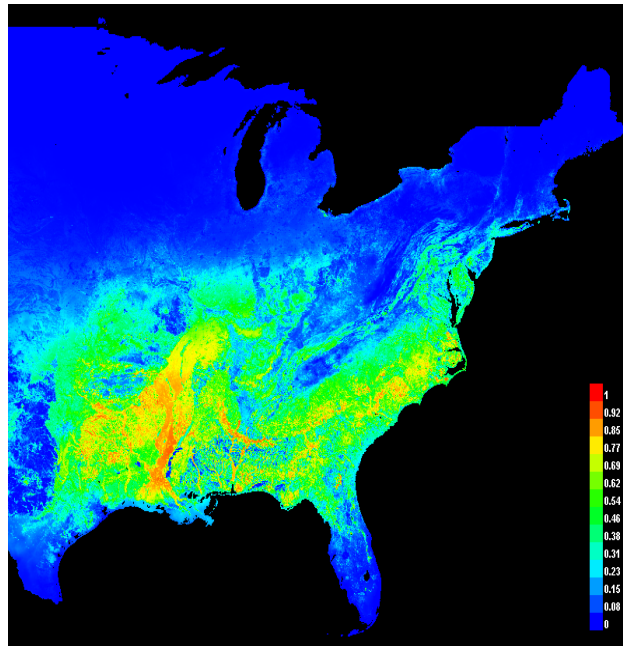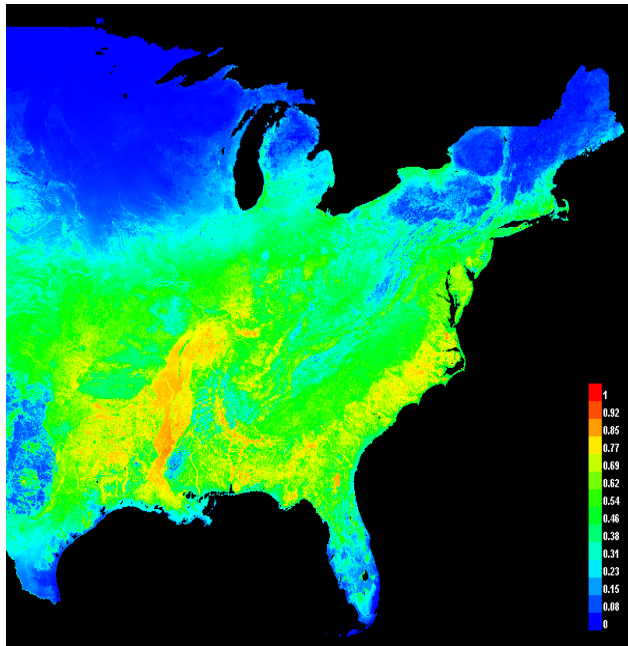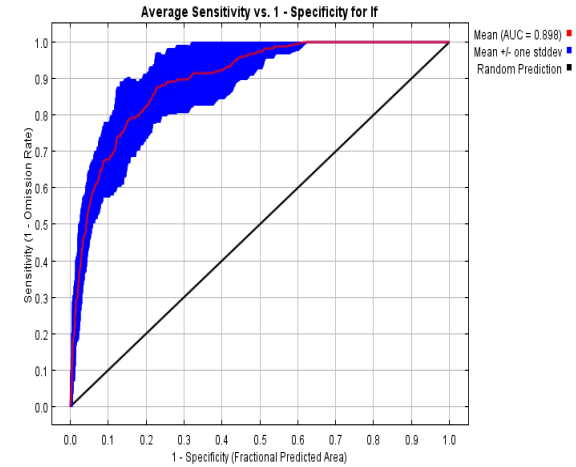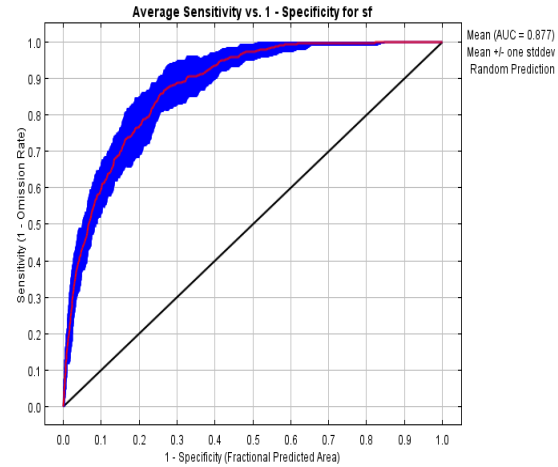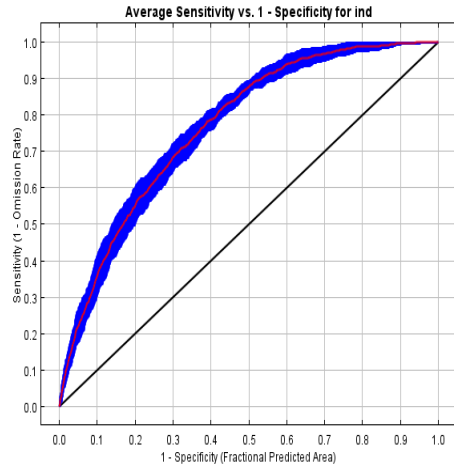
Does prevalence of suitable habitats vary by flock size?

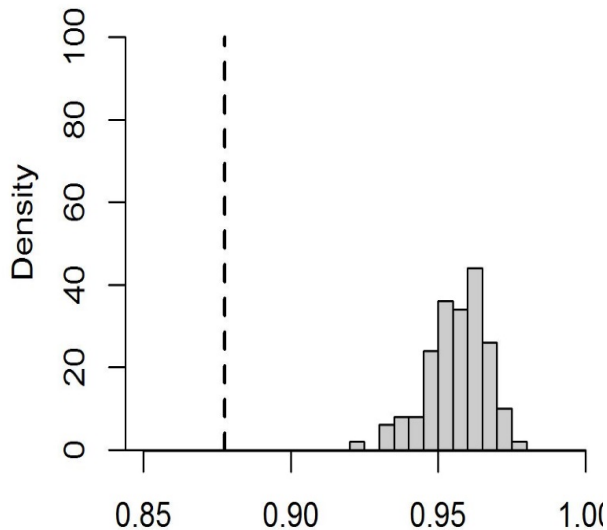# Does prevalence of suitable habitats vary by flock size?

| | INDIVIDUAL | SMALL FLOCK | LARGE FLOCK |

UNSUITABLE HABITAT   MARGINAL HABITAT   SUITABLE HABITAT   OPTIMAL HABITAT

Do different flock sizes occupy different realized niche space?

$$I(p_X, p_Y) = 1 - \frac{1}{2}\sqrt{\sum_i \left(\sqrt{p_{X,i}} - \sqrt{p_{Y,i}}\right)^2}.$$

(Warren 2008)
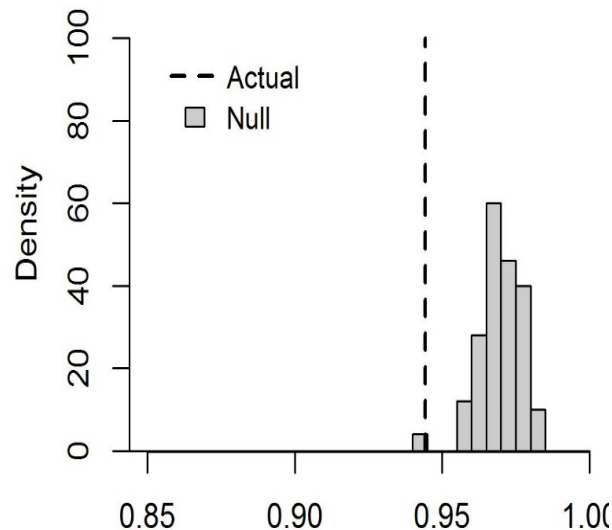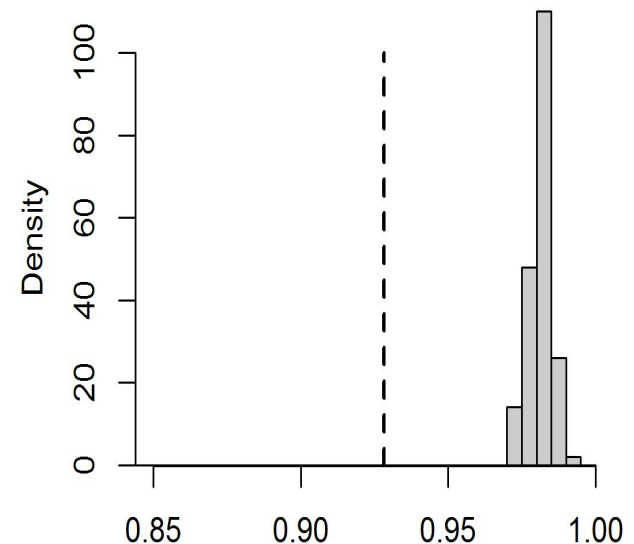
Which environmental variables contribute the most to habitat suitability for individual, small flock, and large flock observations?

Individual observations

Variable	Percent contribution
Tmin	69.3
Floodplain	7.9
Row crop	5.2
PPT	5.0
Pasture	2.4

Small flock observations

Variable	Percent contribution
Tmin	62.6
Floodplain	12
PPT	5.9
Row crop	5.4
Pasture	3.6

Large flock observations

Variable	Percent contribution
Tmin	53.4
Floodplain	22.6
Row crop	5.1
PPT	4.8
Pasture	2.8

Which environmental variables contribute the most to habitat suitability for individual, small flock, and large flock observations?
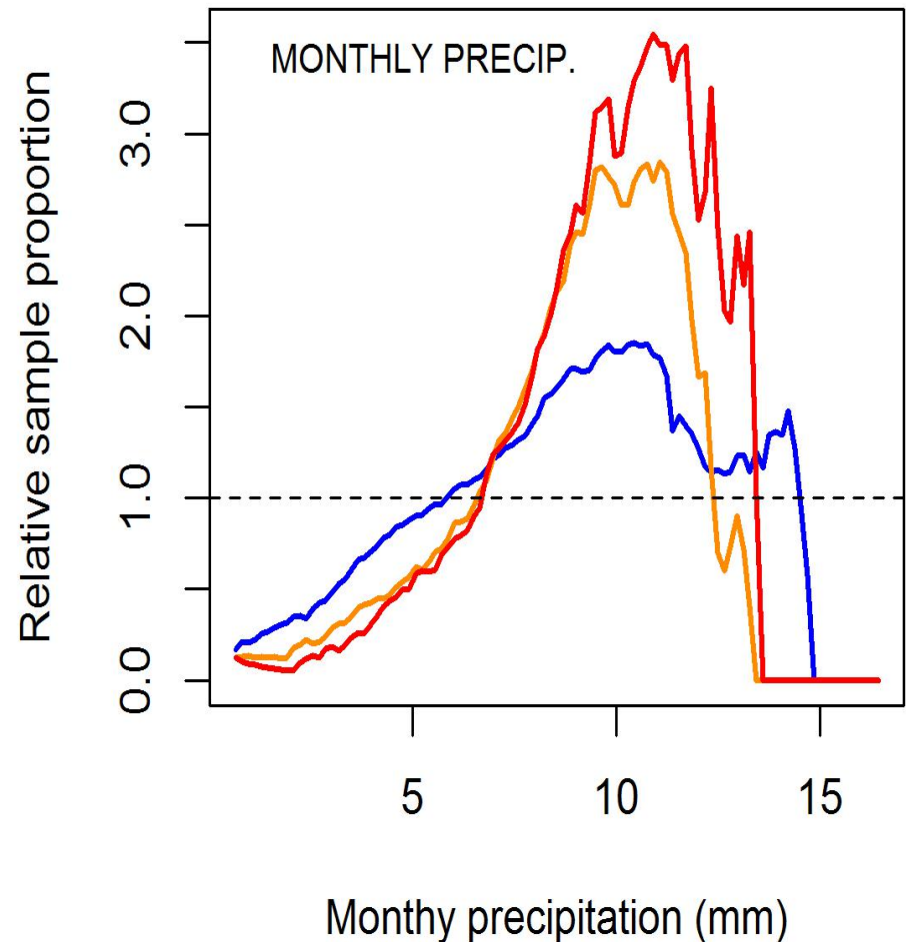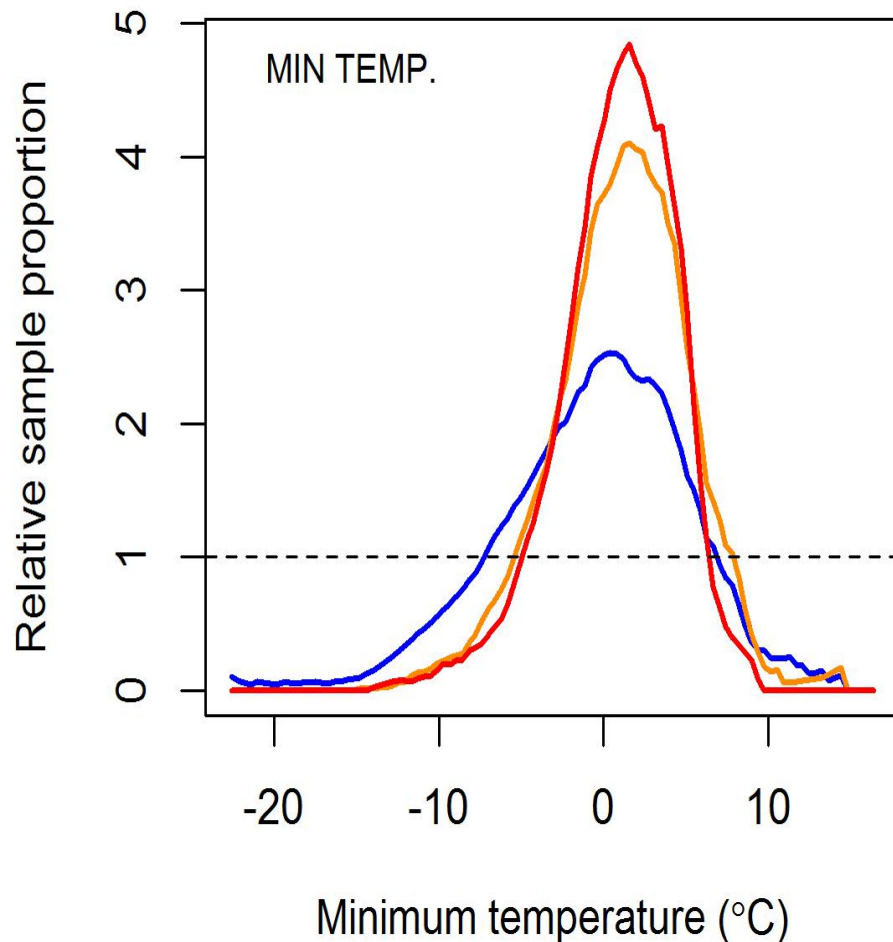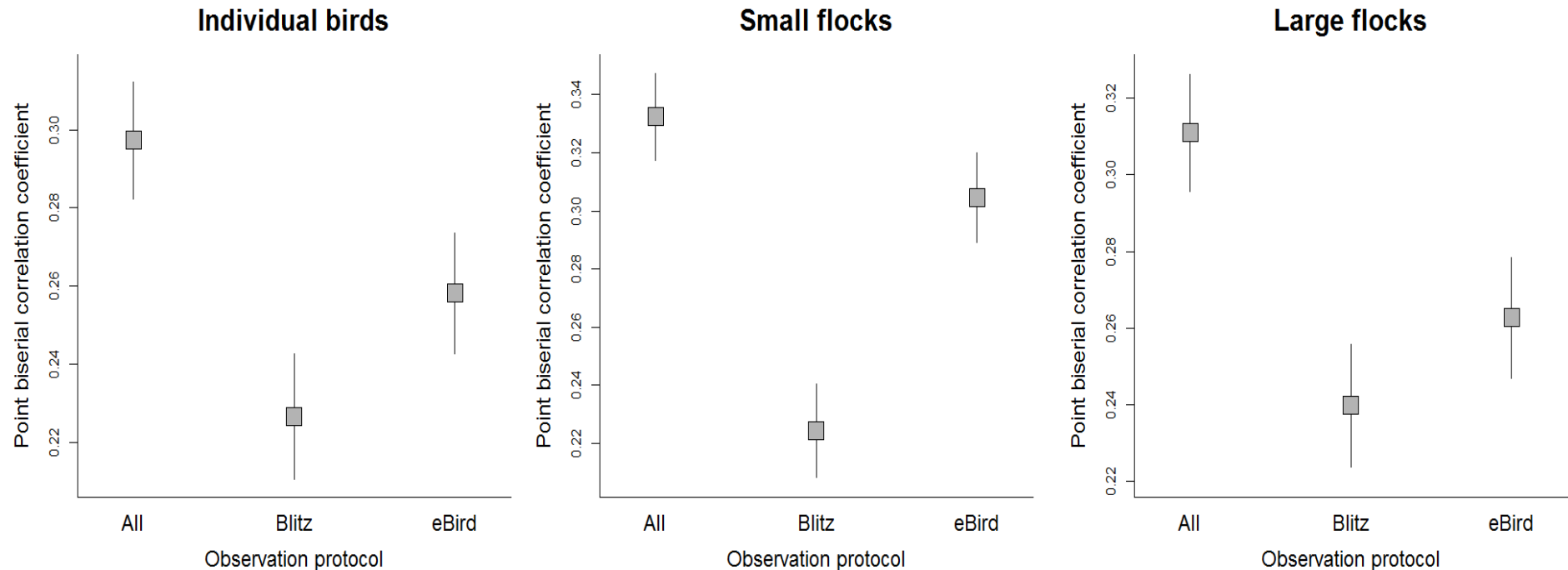
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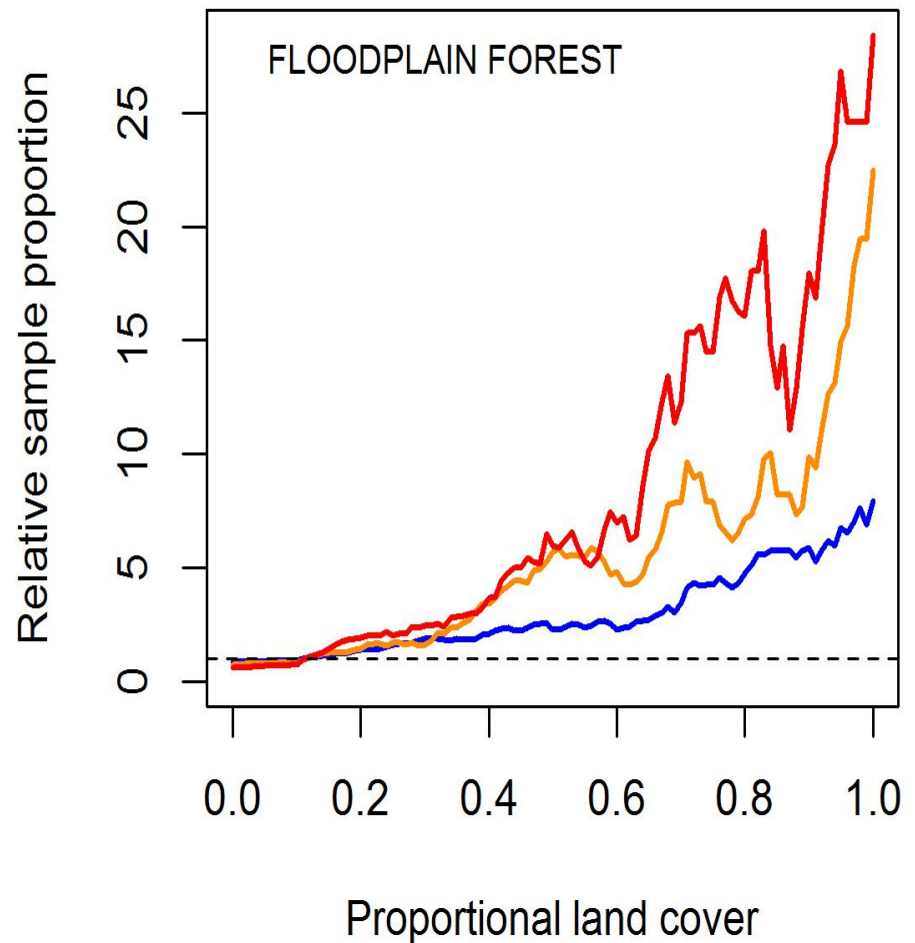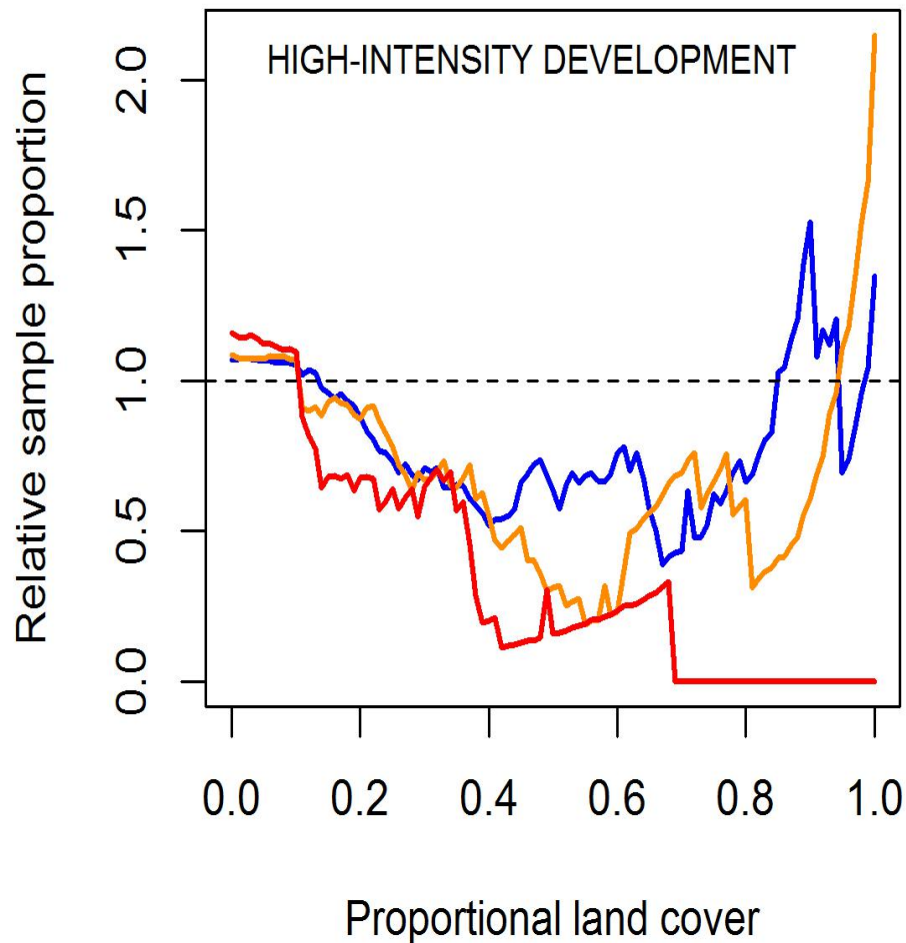
Do Blitz data improve suitability estimates? Point biserial correlation

Pearson correlation between model predictions and presence (1) and background data (0)

Conclusions

1) Prevalence decreases with increasing flock size but was similar for small and large flocks.

2) Realized ecological niches differed across flock size classes.

3) Minimum temperature and floodplain forest were most predictive of the RUBL distributions across flock size classes.

4) For large flock and individual sightings, Blitz data improved suitability estimates.