

ENVIRONMENTAL AND ANTHROPOGENIC INFLUENCES ON THE DIVERSITY AND DISTRIBUTION OF NATIVE POLLINATORS (ORDER HYMENOPTERA)

BEEPLYR

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Image: Dr. KL. James Hung

HYMENOPTERA



NATIVE POLLINATORS



Native Pollinators: Fish and Wildlife Habitat Management Leaflet . Native Pollinators: Fish and Wildlife Habitat Management Leaflet . 2005.

boredpanda.com/cute-bumblebee-butt/?utm_source=google&utm_medium=organic&utm_campaign=organic

A bright metallic, blue sweat bee (*Augochloropsis metallica*), found in Bastrop, Texas. Credit: Public Domain via Flickr/University of Texas at Austin's Insects Unlocked



U.S Geological
Survey Pollinator
Library 2012-2014



2,327 observations
across Texas, North
Dakota and
Colorado of pollinator
data

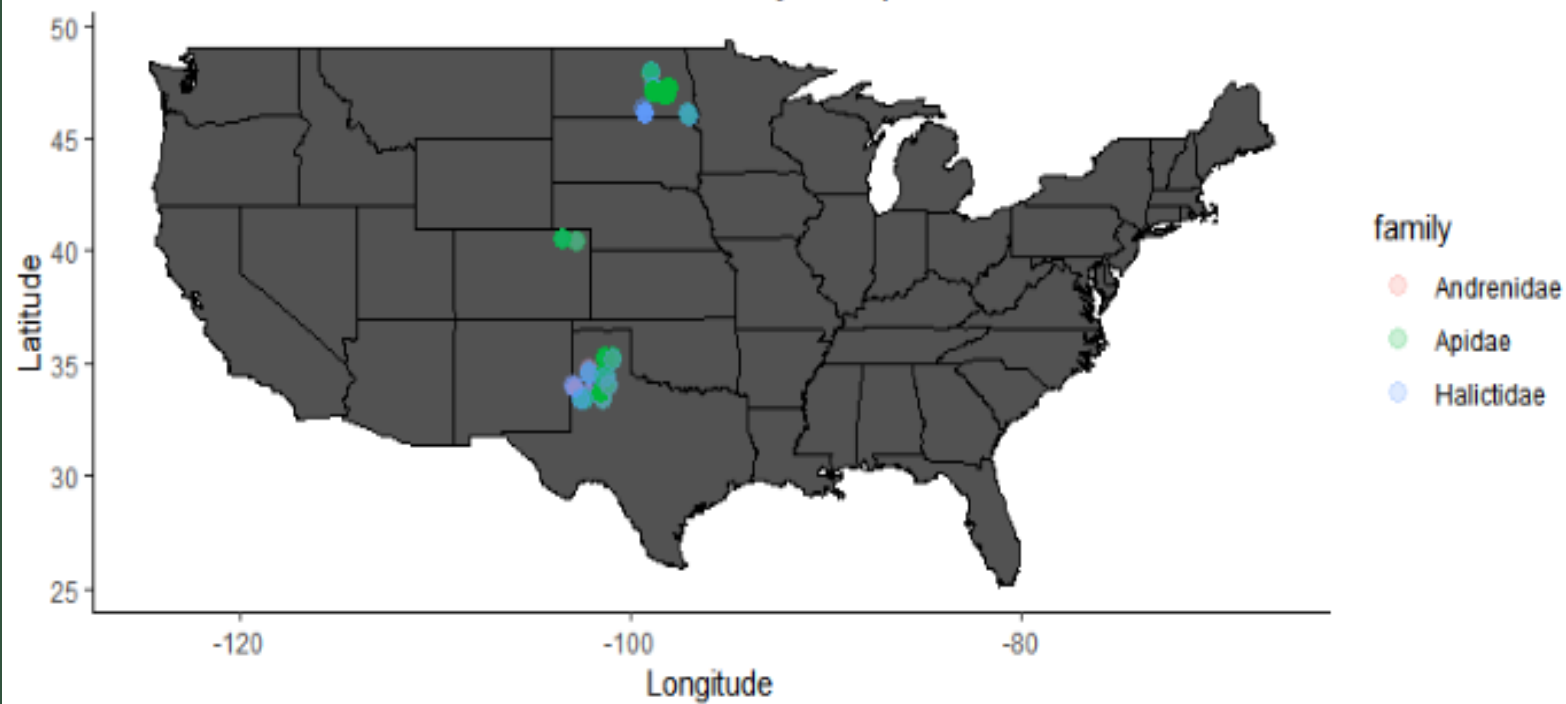


Our data was
filtered to only
include only the order
Hymenoptera and the
largest sampled
families within that
order

Taxonomy, date/time, land use, state/county, elevation, GPS coordinates, avg. wind speed, air temperature, relative humidity
Calculated diversity of genera at each GPS point using Simpson's Diversity Index (thanks challenge assignment)

DATA OVERVIEW

Distribution of Observations in the Order Hymenoptera



WHAT ARE WE INTERESTED IN?

Climatic effects

- Latitude
- Elevation
- Air temperature
- Wind speed
- Relative humidity

Anthropogenic effects

- Land use and management
 - Protected vs agricultural land
- Proximity to human population centers

ENVIRONMENTAL FACTORS

Does species diversity vary with geographic and climatic factors such as latitude, elevation, relative humidity, air temperature, and wind speed?



Are all these factors equally important in predicting diversity?



We predict:

The lower the latitude, the higher the species diversity

The lower the elevation, the higher the species diversity

More humid = more diversity

Higher temperatures = more diversity

Lower wind speed = higher diversity



Question: How does land use affect pollinator diversity?



Hypothesis: Land usage is a significant predictor of pollinator diversity in Hymenoptera.



Predictions: Human disturbance areas lead to loss of pollinator diversity.

LAND USAGE AND DIVERSITY



<https://sites.google.com/a/byu.edu/the-bee-s-knees/human-impact-on-bees>

HOW DOES HUMAN POPULATION DENSITY AFFECTS POLLINATOR DIVERSITY?

Hypothesis:

Lower Hymenoptera diversity in areas with greater human population density compared to areas with lower human population density.

Predictions:

Areas with greater human population density would exert greater anthropogenic influences on local environments, such as through increased pollution habitat degradation/destruction, pesticide use, etc.



DATA ANALYSIS AND RESULTS

ENVIRONMENTAL EFFECTS

Analysis

- Simple linear regression and mixed effects models using AICc model selection
- Checked for assumptions (multicollinearity, normality, and homoscedasticity)
- Predictors were standardised

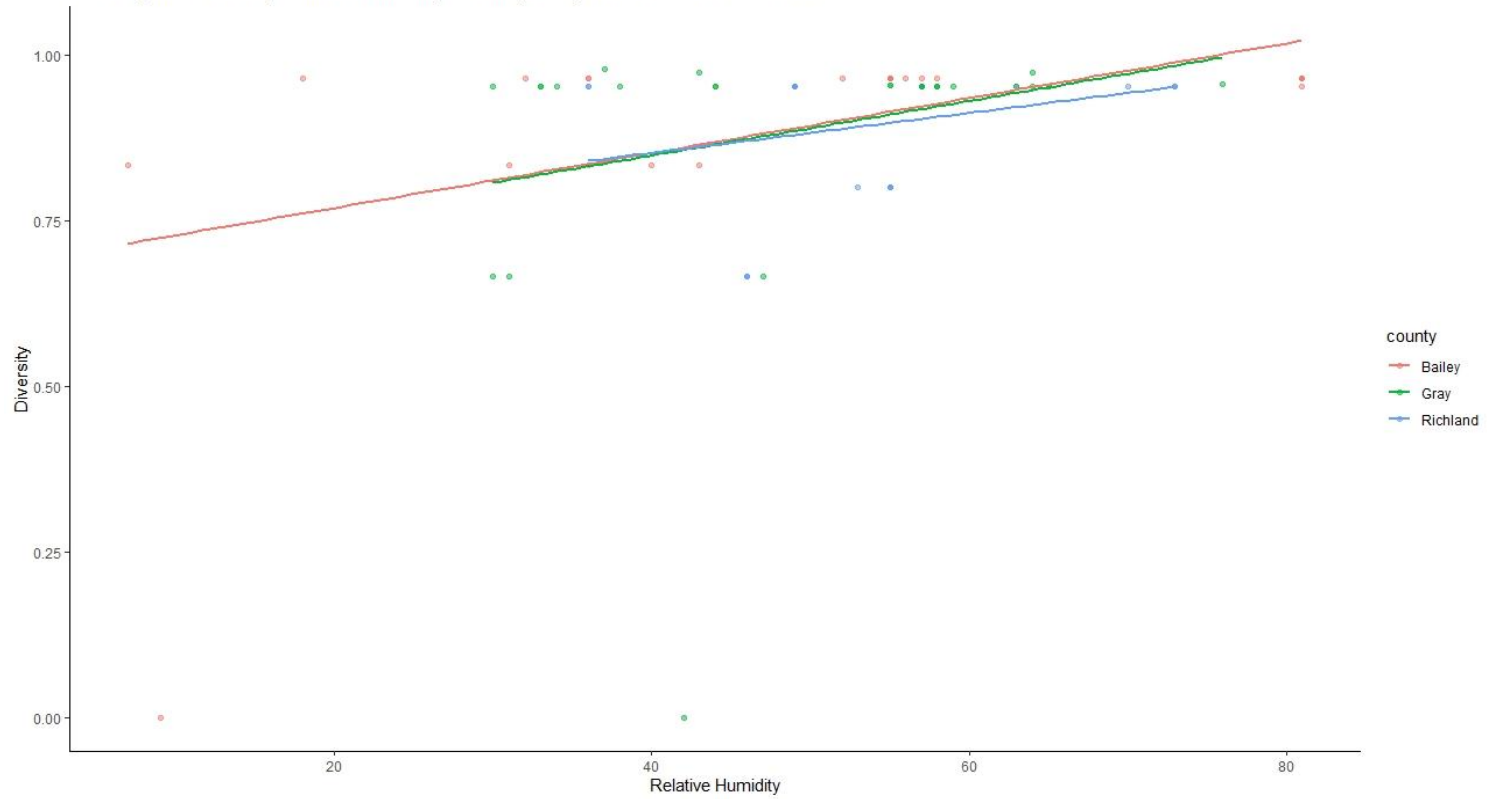
Results:

- Simple linear regression: only relative humidity and latitude were significant
- Mixed effects: Only relative humidity and the interaction between latitude and air temperature were significant predictors of diversity

BIAS:

- Latitude and elevation data were not taken on a transect – availability-based
- This data is janky overall – limitations in simply compiling study data from scientists who happened to study places

Diversity of Genera by Relative Humidity in Bailey, Gray, and Richland Counties



LAND USE EFFECTS



ANALYSIS: ASSESSMENT
OF CLASSICAL TEST
ASSUMPTIONS, ANALYSIS
OF VARIANCE,
MODELLING



RESULTS: RESEARCH PLOT
AND WILDLIFE REFUGE
ARE PREDICTORS OF
POLLINATOR DIVERSITY



BIAS: MEASURE OF
DIVERSITY, NON-
RANDOM SAMPLING,
LAND USE
CATEGORIZATION

ANALYSIS OF VARIANCE TABLE

We reject our null hypothesis and conclude that there is a significant difference in diversity between different land use types.

	Df	Sum of Squares	Mean Square	F Value	Pr
Land Use	4	0.2879	0.071967	6.4525	4.046e-05 ***
Residuals	887	9.8930	0.011153		

Model	Call	df	Residual SE	P-value	R^2	Adjusted R^2	F statistic	AIC
Land use models	Land use	887	0.1178	3.1 e -16	0.08493	0.08081	20.58	-1277.77

	Estimate	Std. Error	T.Value	Pr(> t)
intercept	0.909214	0.012277	74.05	< 2e-16
Conservation Reserve program	-0.001095	0.013793	-0.079	0.9368
National Wildlife Refuge	0.032815	0.015850	2.070	0.0387
Rangeland	-0.025322	0.016204	-1.563	0.1185
Research Plot	0.080091	0.014997	5.341	1.18e-07

Only "Research Plot" and "Wildlife Refuge" were significant predictors of diversity. Both land use types were associated with increased pollinator diversity.

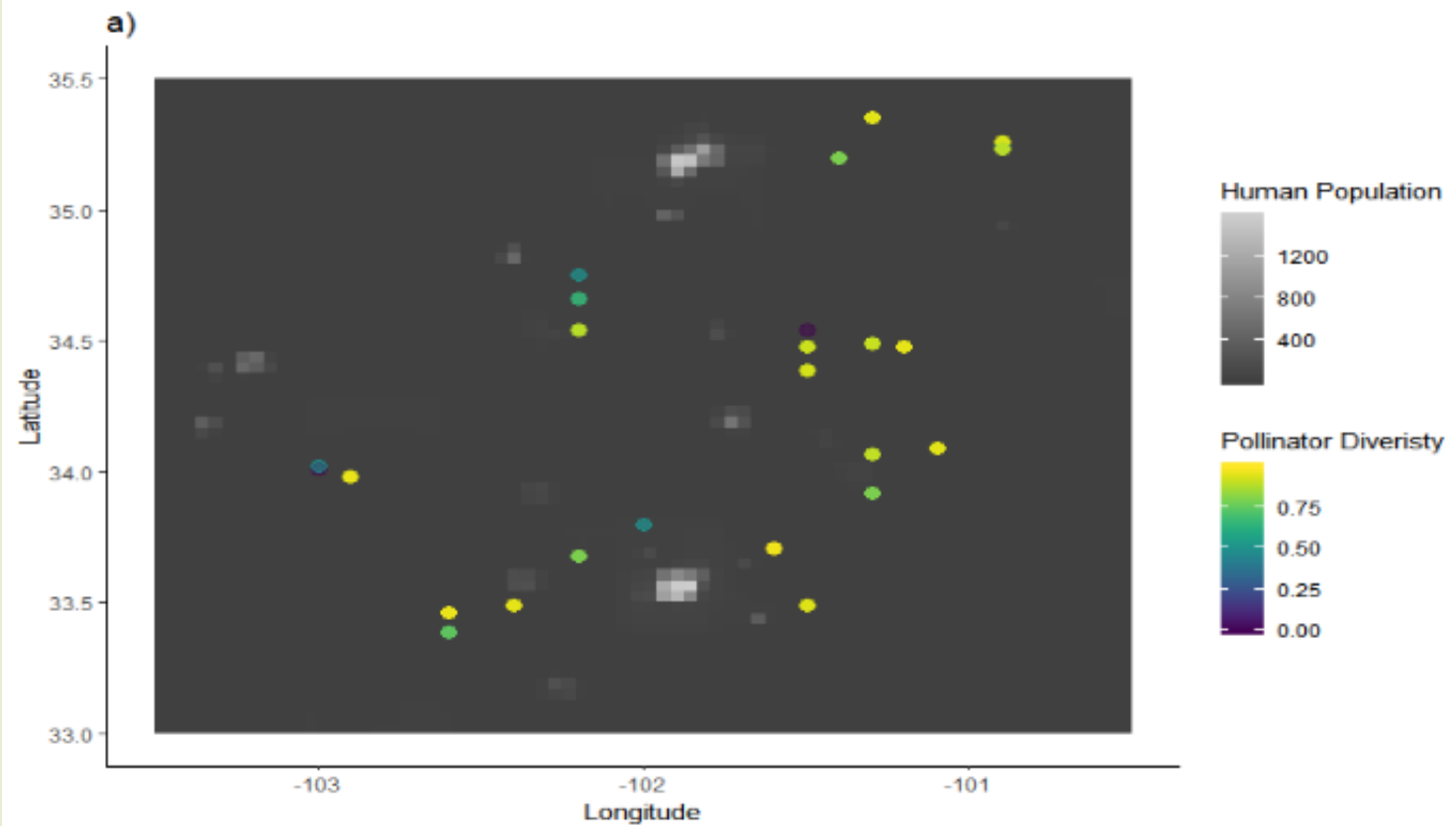
HUMAN POPULATION EFFECTS

Analysis: Mapping and Spatial Stats

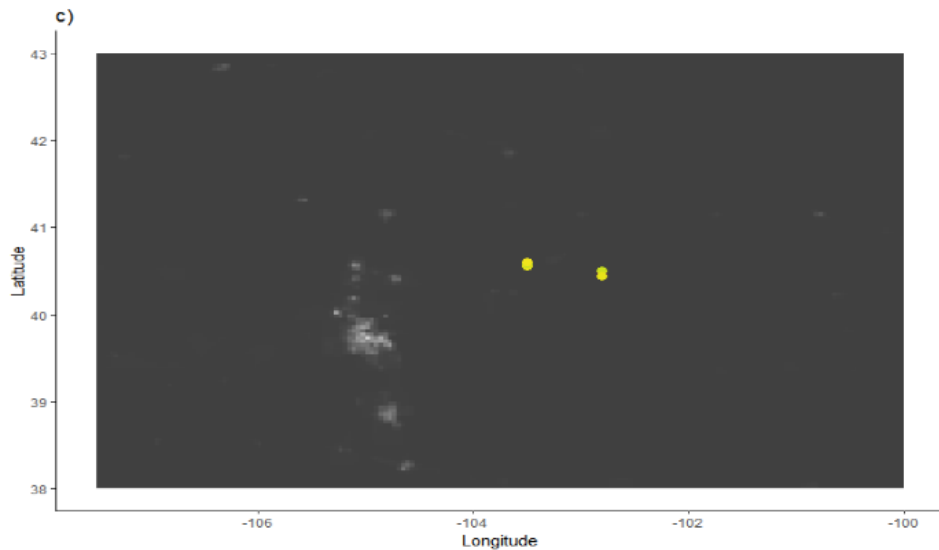
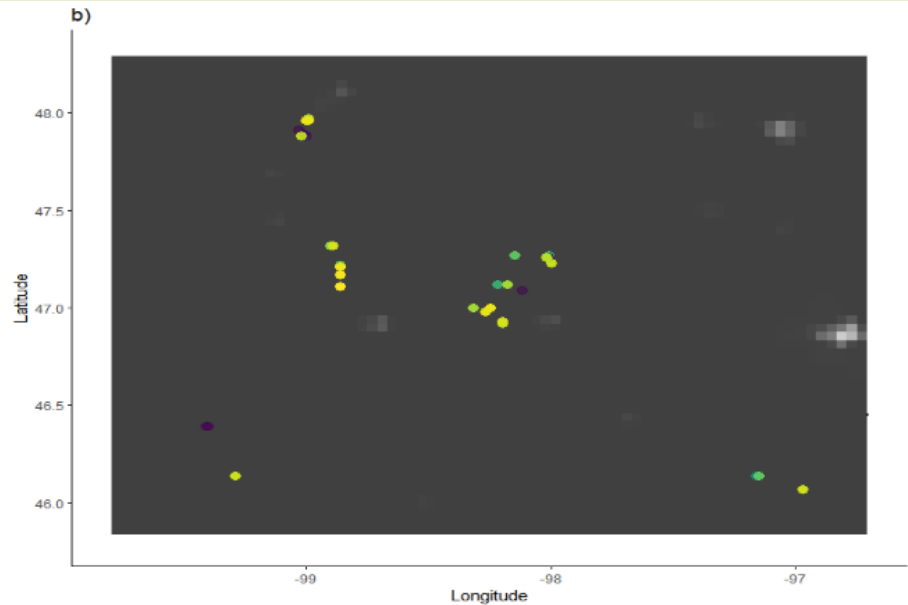
- Map pollinator data on US map
- Download Human Population Raster (year, size)
- Plot human population and diversity by family and state
- Run models and tests to see relationship between diversity, human population, and spatial variation

BIAS: Spatial and Ecological assumptions

- All data were sampled across a gradient of human populations and GPS locations.
- Assumed that pollinators sampled at the same GPS location were in the same community



TEXAS



NORTH DAKOTA

COLORADO

Model	Call	df	Residual SE	P-value	R ²	Adjusted R ²	F statistic	AIC
Human Population	Human population	63	0.3385	0.907	0.0002183	-0.01565	0.01375 on 1	-1206.189

COMBINING ANTHROPOGENIC & ENVIRONMENTAL EFFECTS

Model selection

- Combined all environmental and anthropogenic factors and compared significance/AIC

Biases of large models

- Statistics such as R^2 tend to favour large models simply because there are more predictors
- Must use AIC to account for an inflated df

COMPARING MODELS

Model	Call	df	Residual SE	P-value	R ²	Adjusted R ²	F statistic	AIC
Environmental Effects only	Fixed: Latitude * Relative Humidity * Air Temp Random: (1 + Latitude County)	/	/	/	/	/	/	-1206.189
Anthropogenic Effects only	Human pop * land use	882	0.1168	<2.2e-16	0.1043	0.09519	11.42 on 9	-1286.879
Anthropogenic and Environmental	Latitude * Relative Humidity * Air Temp + Human Population * County * Land Use	711	0.06196	<2.2e-16	0.7804	0.7586	25.6 on 71	-2062.828

FACTORS AFFECTING DIVERSITY:

Environmental Effects:

- Relative humidity
- But...

Anthropogenic Effects:

- Land use: Land conversion
- Human Population



DISCUSSION

CONCLUSION

- Open source data sets have the potential to inform conservation efforts and expand research in these areas. They also bridge the gap between researchers and conservationists.
- Knowing and understanding how we are impacting local pollinator communities through human activities will allow for more specific and targeted legislation, conservation, and personal decision making which could lead to greater protection of native pollinators.



ANALYZING THE DIVERSITY AND DISTRIBUTION OF PLANTS IN RELATION TO THE POLLINATORS



MORE INCLUSIVE DATASET THAT HAS A GREATER SPREAD, ESPECIALLY CLOSER TO LARGE URBAN CENTERS



SAMPLING ACROSS MORE TYPES OF LAND USE TO HAVE A MORE INCLUSIVE DATASET.



POLLINATOR DATA OVER A SERIES OF YEARS TO SEE CHANGE OVER TIME



MOST STUDIES IN THESE AREAS ARE BASED ON ABUNDANCE OR SPECIES RICHNESS, FURTHER STUDIES OF SPECIES COMPOSITION AND RELATIVE ABUNDANCE ARE NEEDED



MORE RESEARCH INTO THE SPECIFIC LEGISLATION IN EACH SAMPLED COUNTY WHICH MIGHT AFFECT POLLINATOR DIVERSITY.

FURTHER STUDIES



THANK YOU FOR LISTENING!