



# Integrating Genomic and Geospatial Data to Improve Everglades Predator-Prey Management

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## Background



### White-Tailed Deer

The species, *Odocoileus virginianus*, is the only large native herbivore in the Greater Everglades. Deer are important keystone species: what they eat greatly affects biodiversity and community composition. Although ecological research has been conducted for several populations in the northern USA and Canada, few studies have been conducted for deer in Florida.

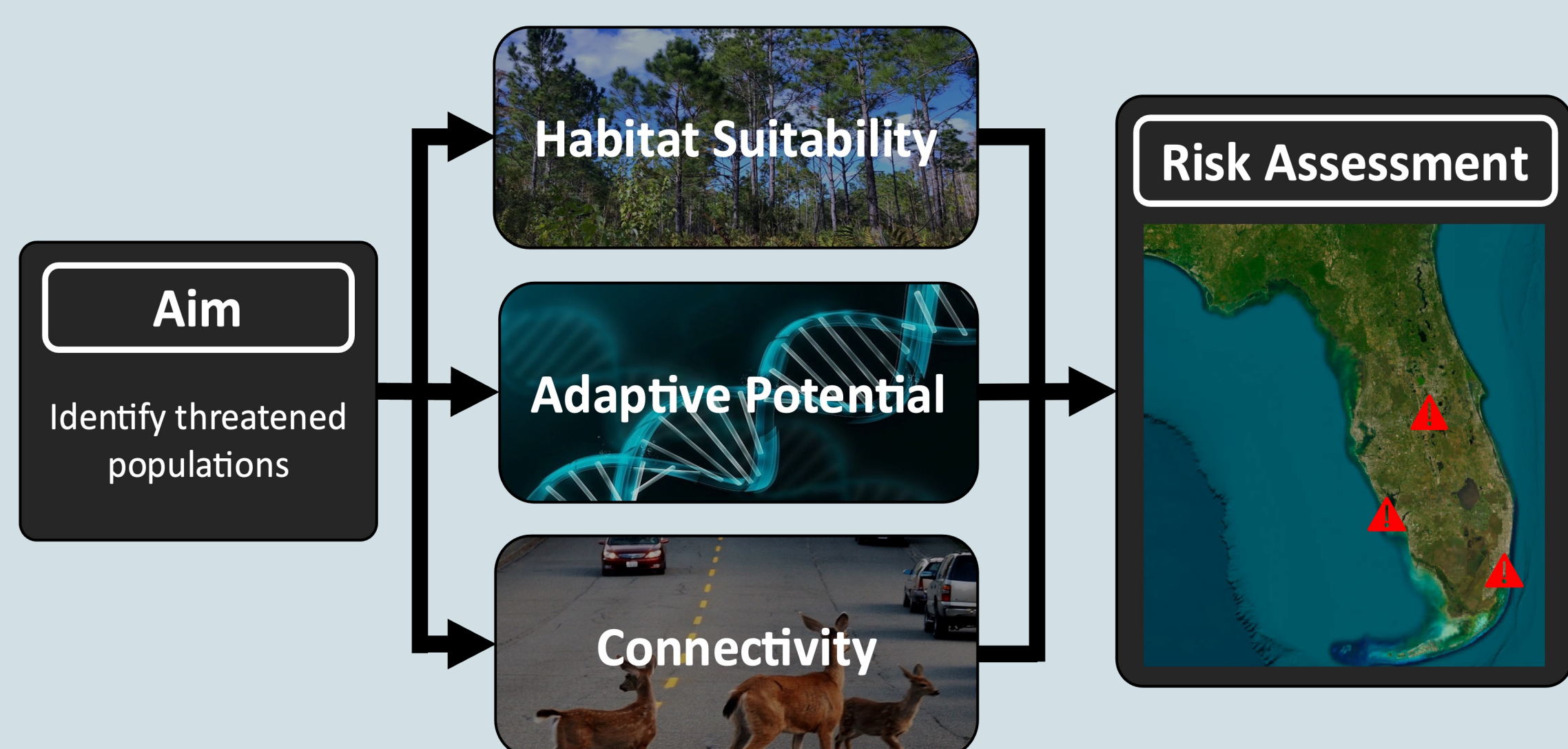
### Florida Panther

The species, *Puma concolor coryi*, is an endangered subspecies of the North American cougar. Florida panthers rely heavily on deer as a food source, and deer account for nearly 90% of predations. Changes to the distribution of deer across Florida likely have a major influence on the location of panther suitable habitat.



## Objective

Climate change and habitat loss threaten not just individual species, but the species and communities that rely on them as well. To address this, I aim to employ a framework to develop a risk assessment for deer and panther populations in Florida by 1) assessing current and future habitat suitability using Species Distribution Models (SDMs) and 2) assessing adaptive potential by identifying genetic variants associated with current environmental conditions that may facilitate adaptation to future conditions. In the near future, I also plan to mentor undergraduate researchers while 3) evaluating current and future connectivity between suitable habitats.

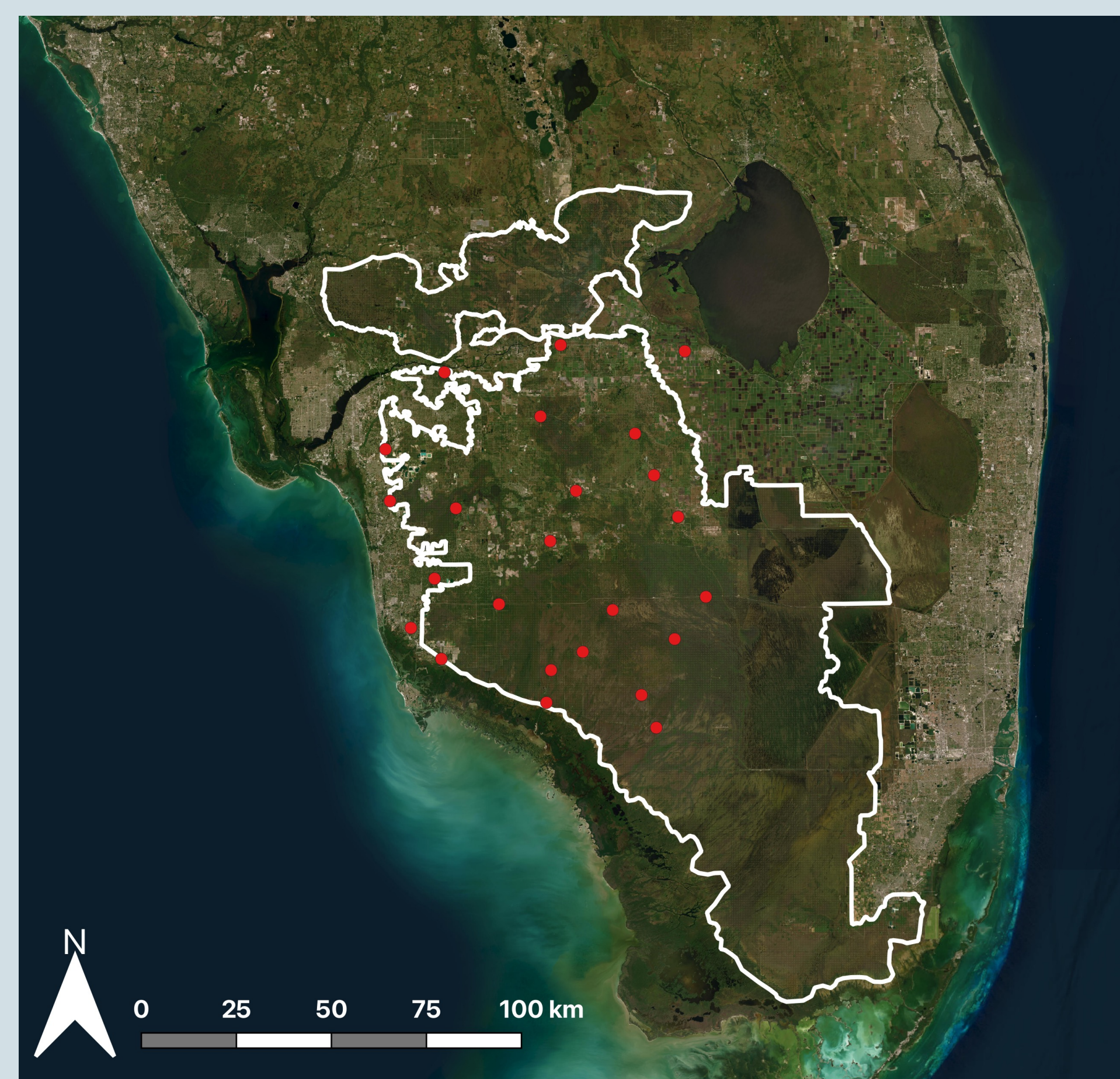


Adapted from Razgour et al. 2018

## Methods

### Adaptive Potential

#### Study Area



### Genome-Environmental Associations (GEA)

GEAs identify associations between genetic variants and environmental conditions. Such associations may be indicative of potential genetic adaptations to those conditions. This can also be used to assess variants that may facilitate adaptation to future conditions, such as variants that may be associated with heat tolerance.

### DNA Extraction and Sequencing

The Florida Wildlife Conservation Commission (FWC) provided tissue samples for panthers. Following DNA extraction, whole genome sequencing was then performed using Illumina NovaSeq sequencing technology.



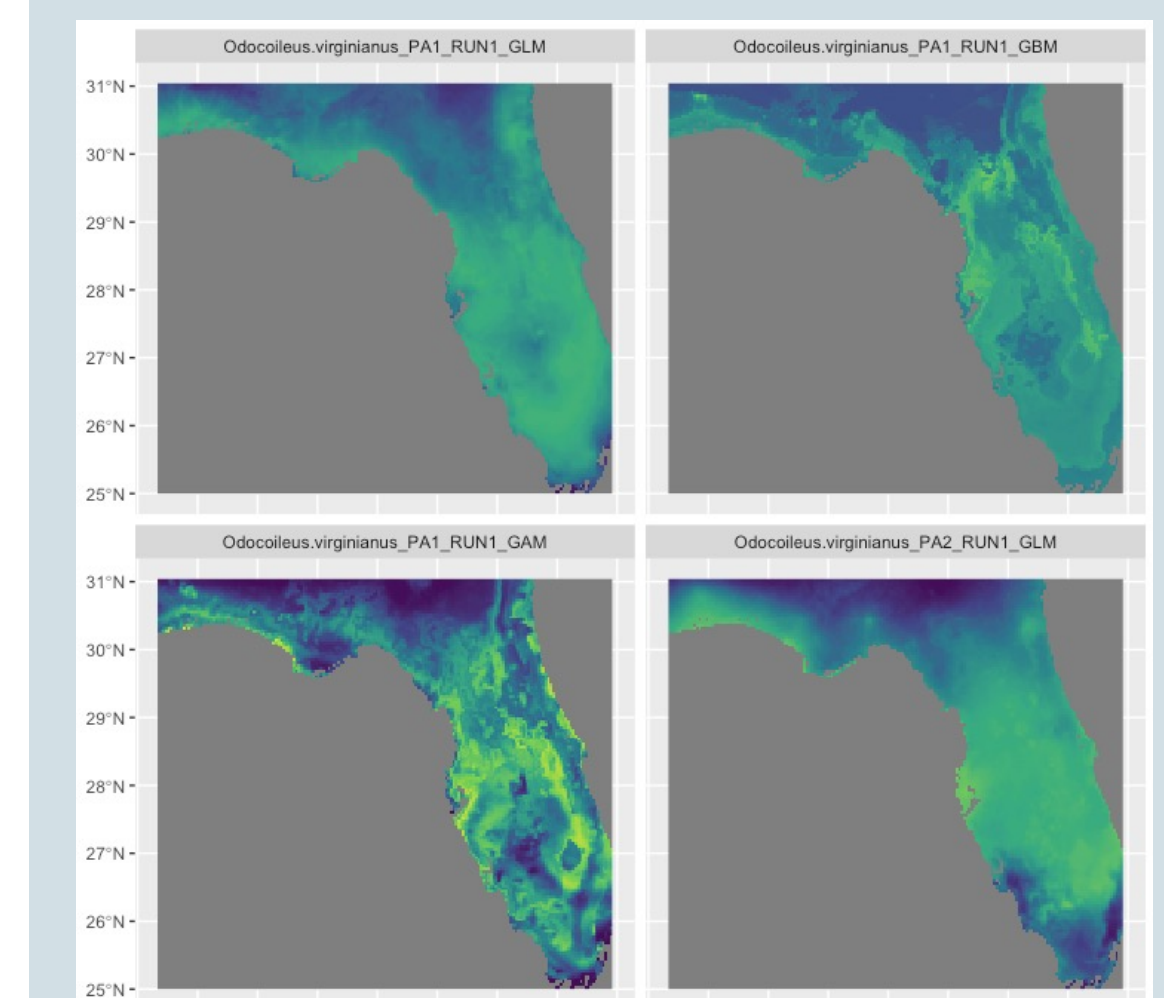
## Preliminary Results

### GEAs

Whole genome sequencing has been performed for 22 panthers. This is the largest collection of Florida panther genomic data to date. I also plan to sequence additional individuals from the southern extent of panther habitat.

Acquisition of deer samples has been prolonged due to a case of Chronic Wasting Disease in Florida. However, the sequencing-to-data pipeline developed for panther DNA will be ready for immediate processing of deer tissue and subsequent sequencing.

### SDMs



Preliminary SDMs show similar patterns when identifying suitable deer habitat across Florida. These models will continue to be optimized and projected to future environmental conditions.

## Applications

These data constitute a genomic-geospatial framework that can be applied to the management of deer and panthers into the future and used to assess the location of suitable habitat and genetic variation important for adaptation to future conditions. This research also assesses interactions between the two species, and the degree to which they may avoid or engage areas where the other is present.

Whole genome sequencing data from deer and panthers will be publicly available for download on the National Institute of Health's GenBank sequence database, contributing to future research.

To assess connectivity, I plan to mentor undergraduates in bioinformatics, guiding them in research that evaluates the ability of both species to move between current and future suitable habitat patches.

## Acknowledgements

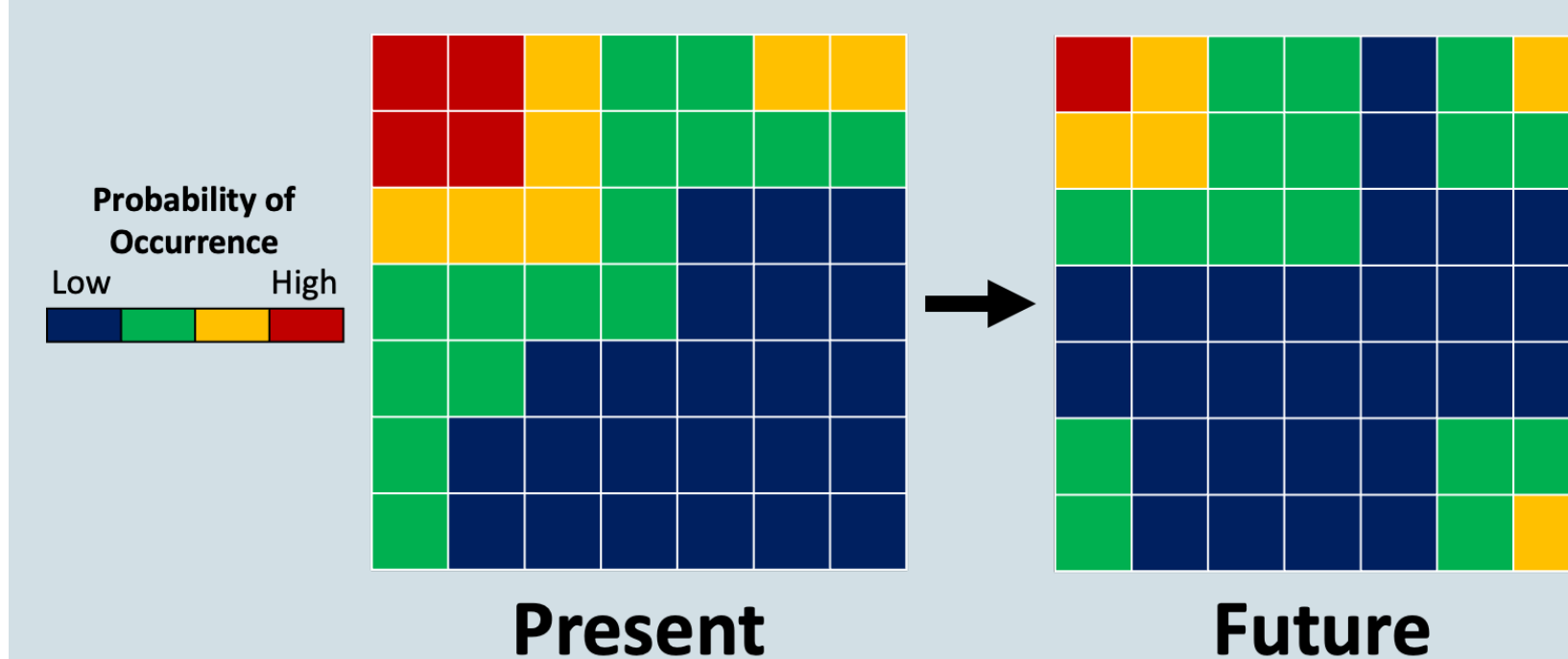
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## Habitat Suitability

### Species Distribution Models (SDM)

SDMs predict what environmental variables correspond to the high probabilities of species occurrences. This can be used to assess what current environmental conditions may constitute suitable habitat and used to predict the location of future suitable habitat.



### Occurrence Data

Occurrence data for both deer and panthers was obtained from FWC. Deer data is also supplemented by the Global Biodiversity Information Facility (GBIF) database.

### Environmental Data



### Predator-Prey Interactions

To assess the frequency and magnitude of predator-prey interactions, the degree of spatial overlap between SDMs for panthers and deer will be quantified using two ecological metrics. These can be used to assess the extent of overlap in the study area and well as the strength of attraction and avoidance between the two species.

#### Predator-Prey Interactions

Degree of Overlap  
Bhattacharyya's Coefficient

Attraction vs Avoidance  
Schoener's D