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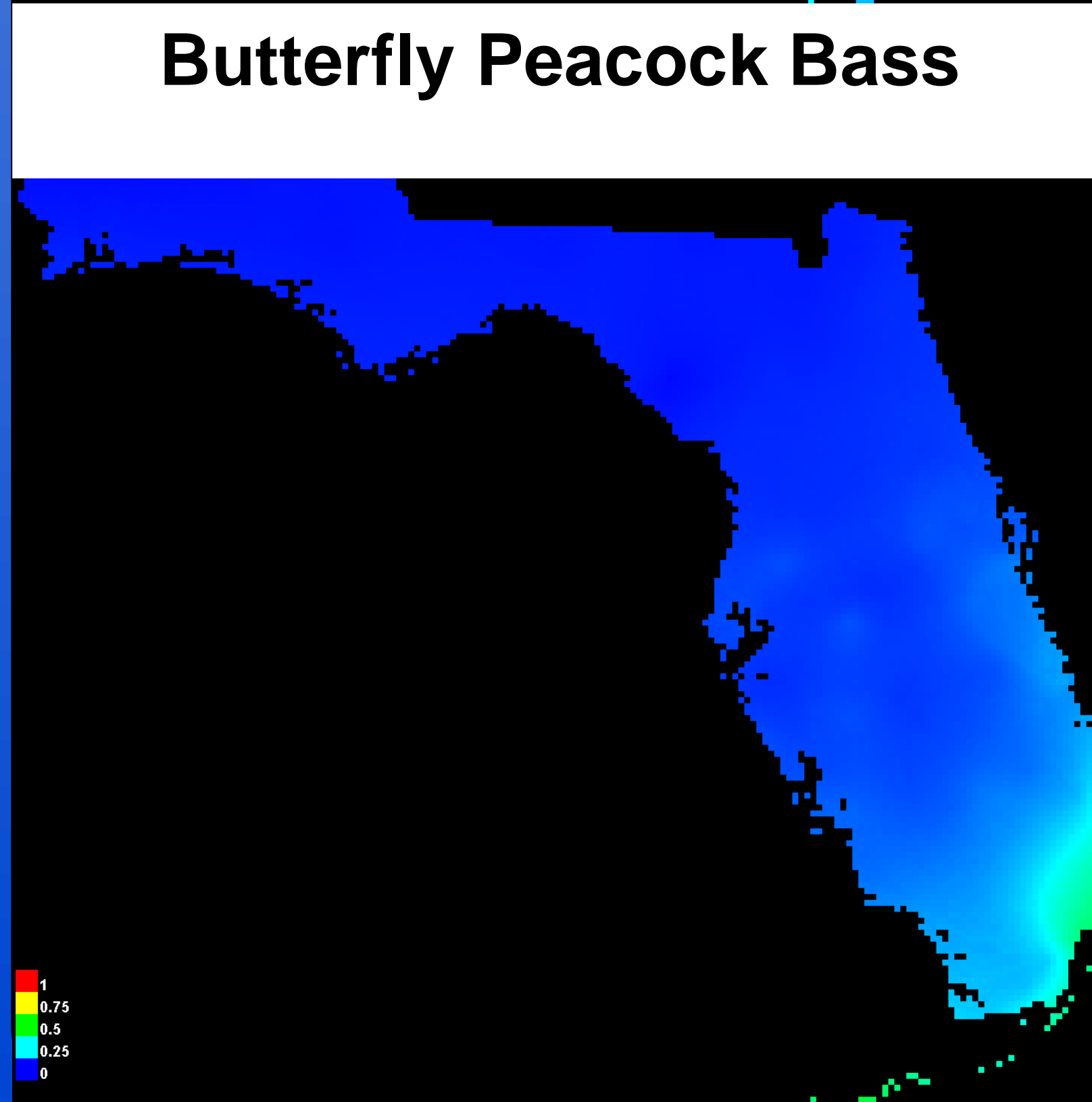
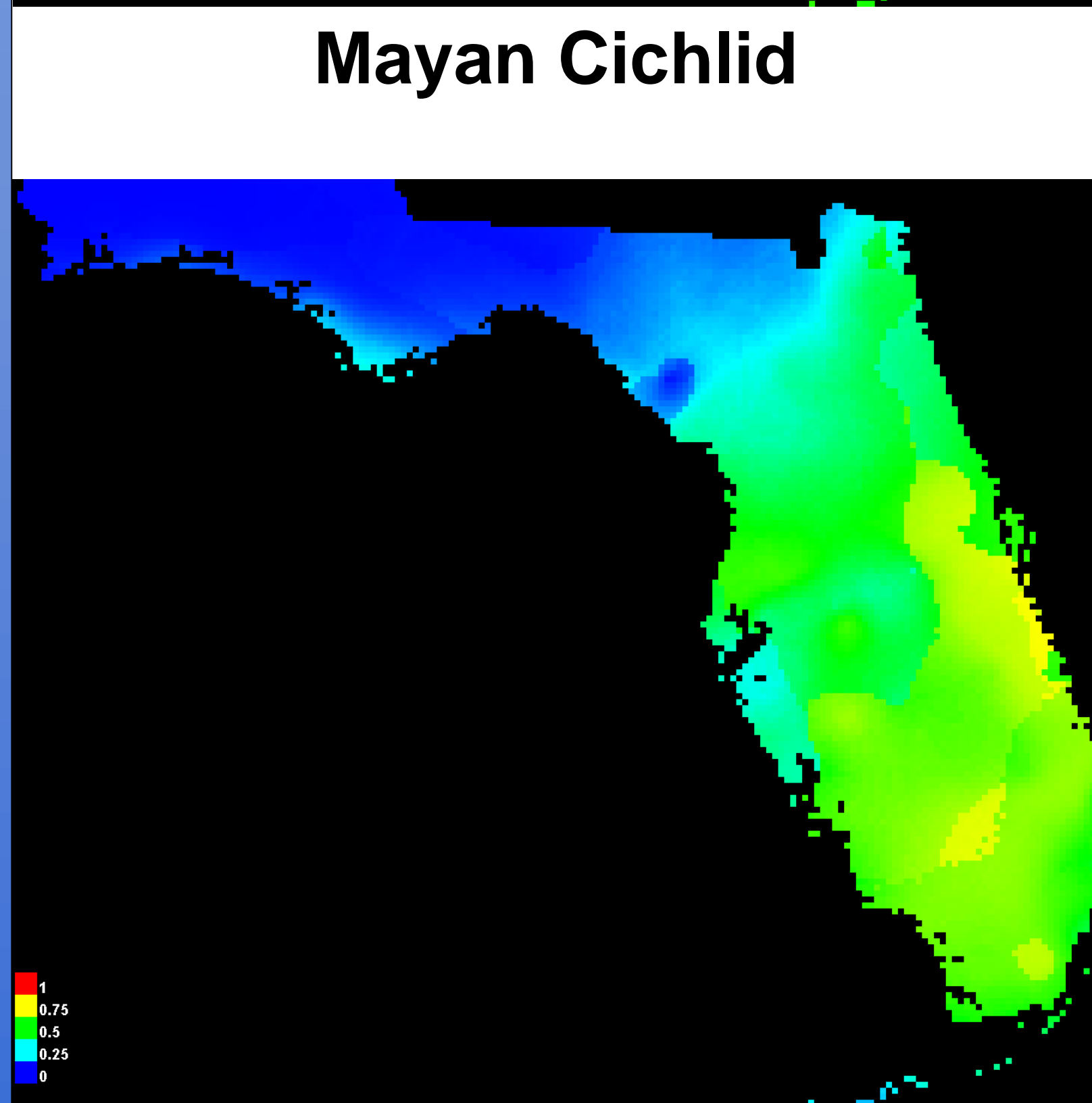
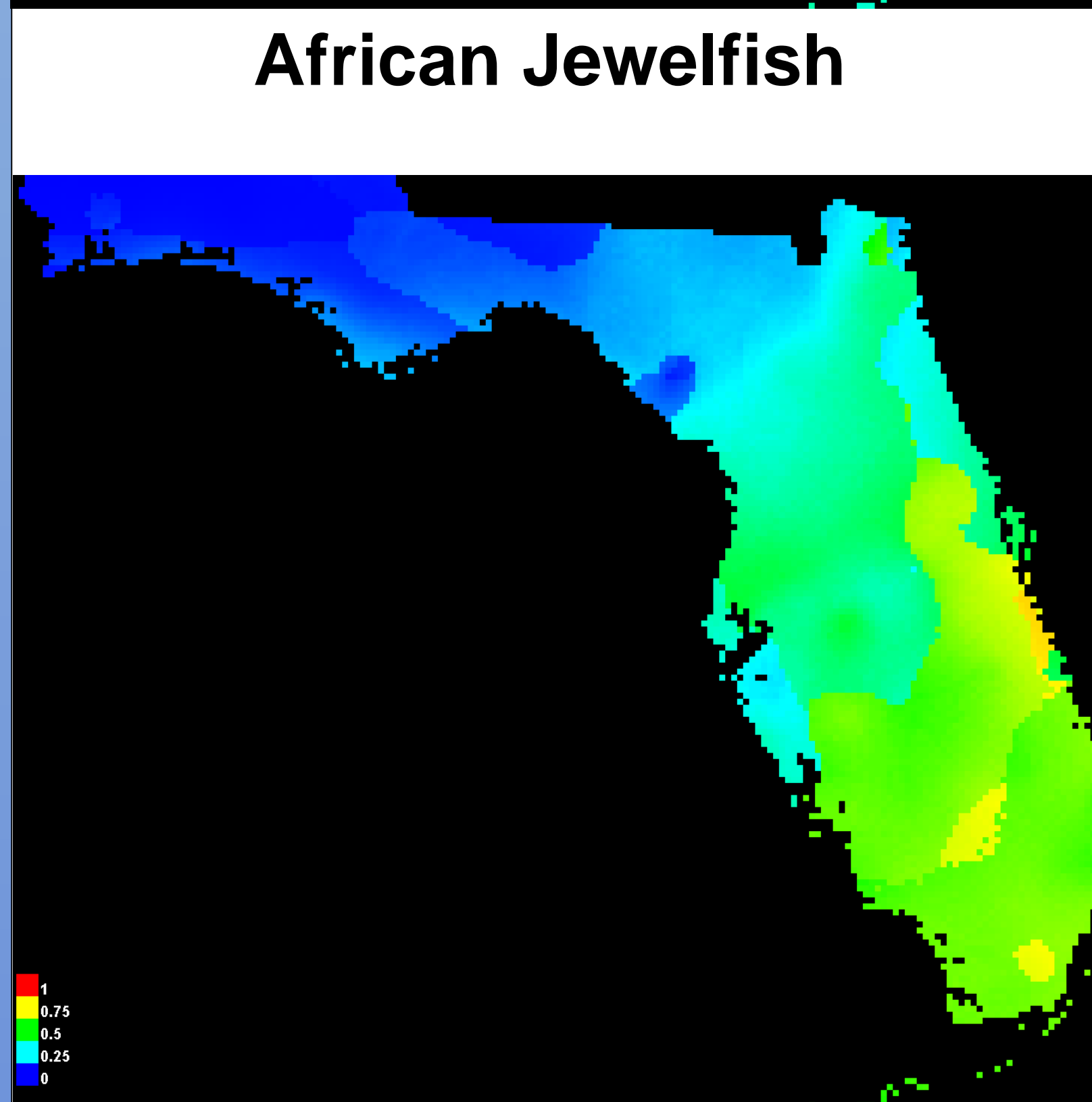
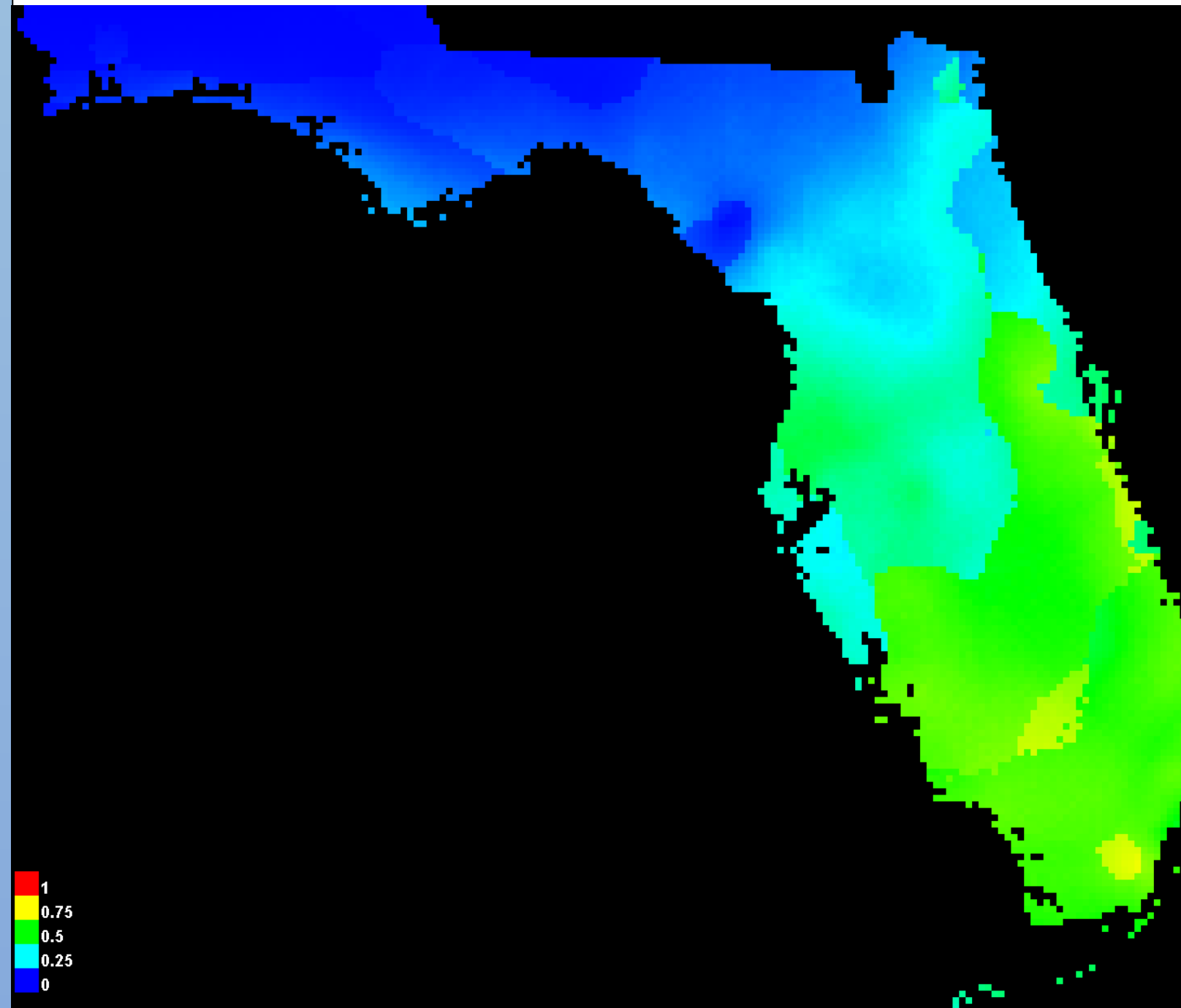
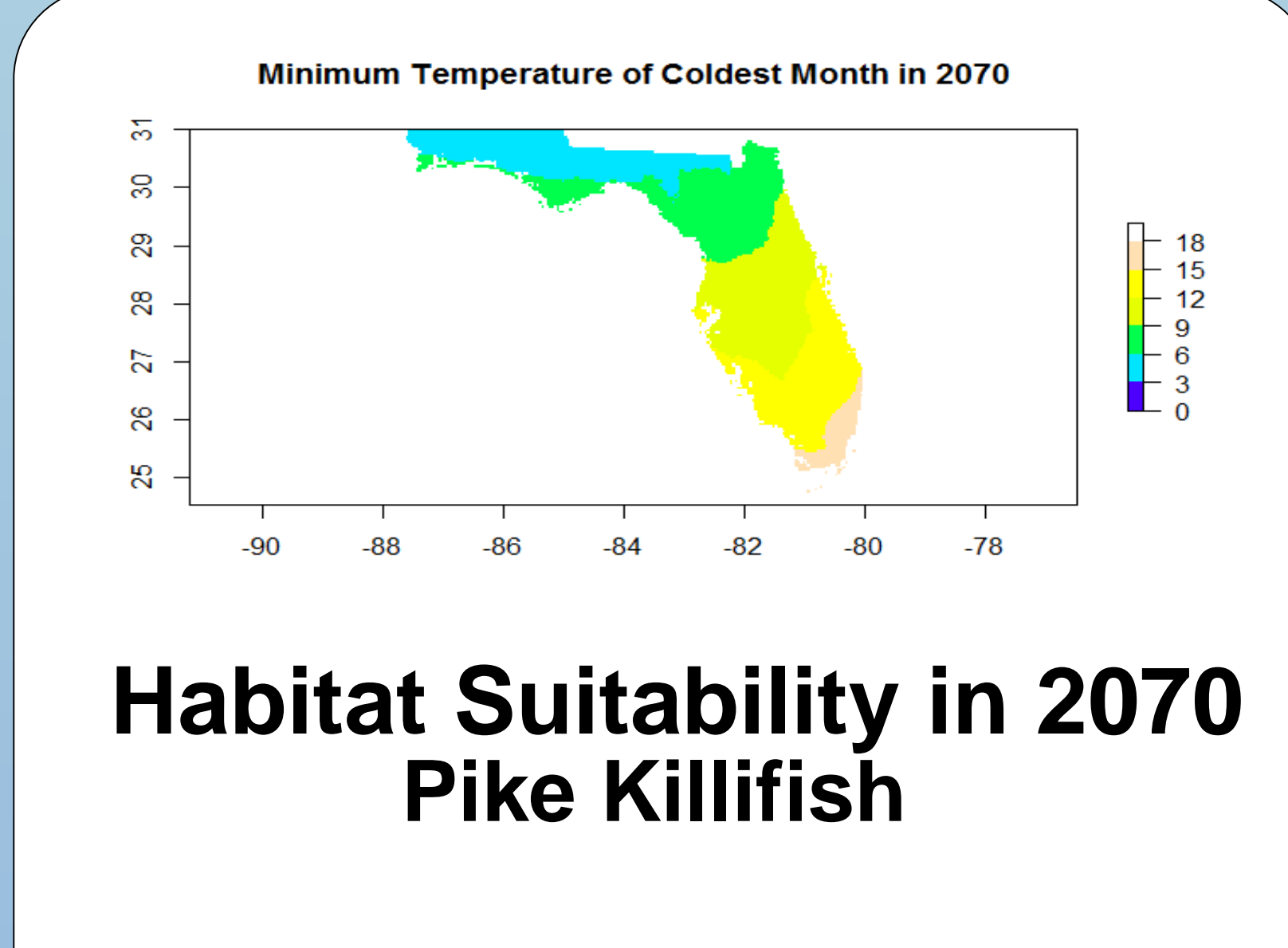
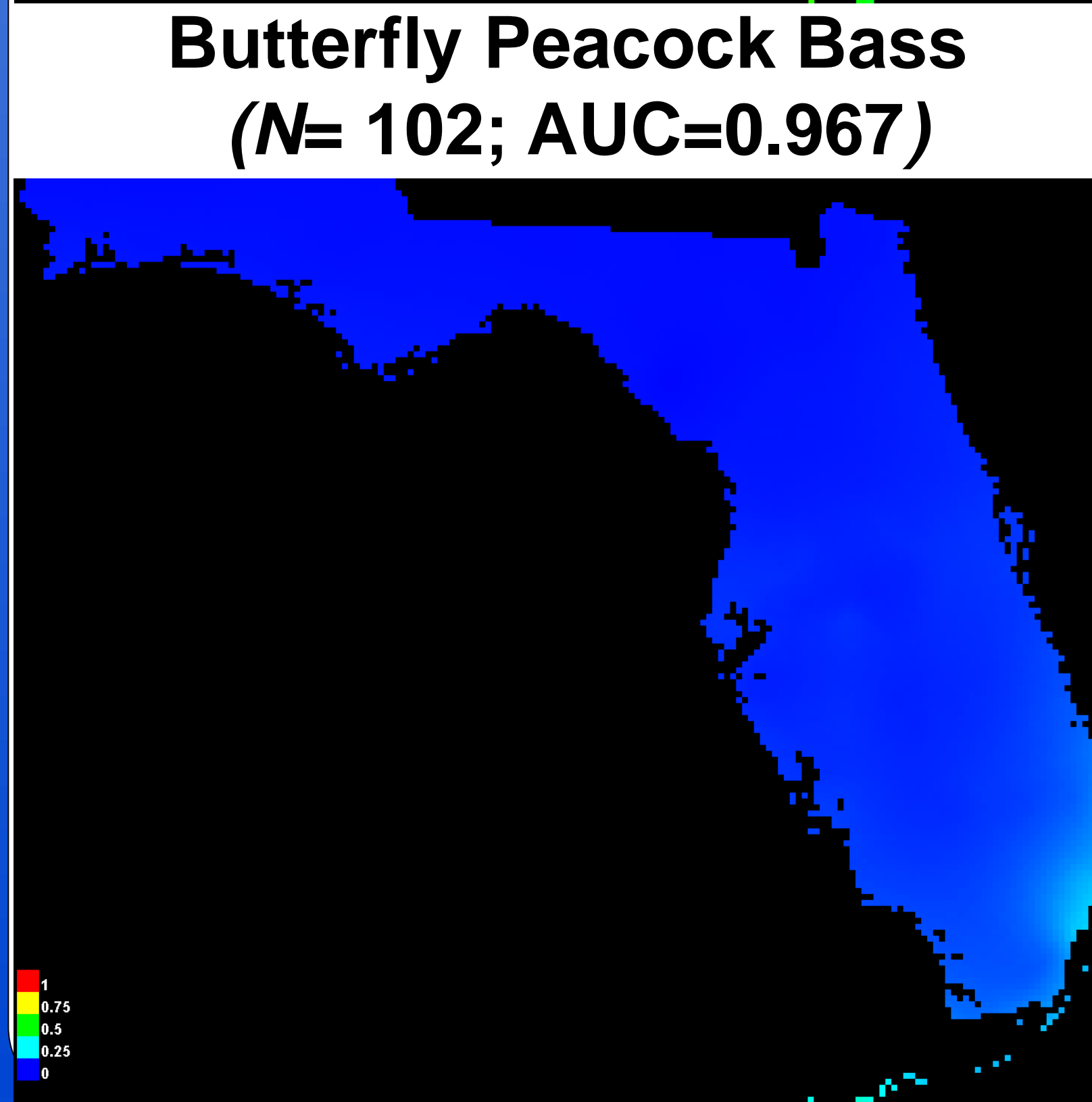
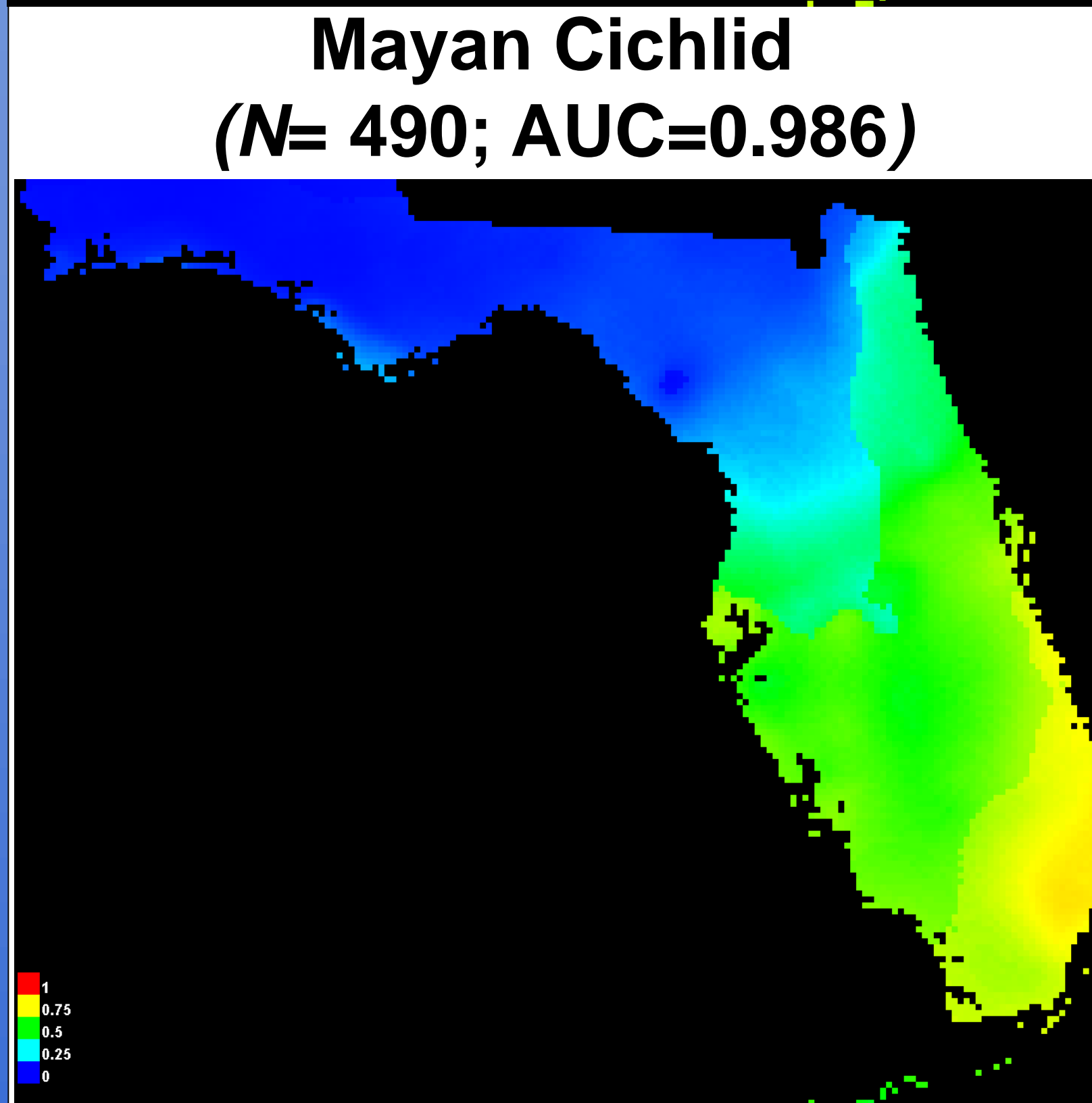
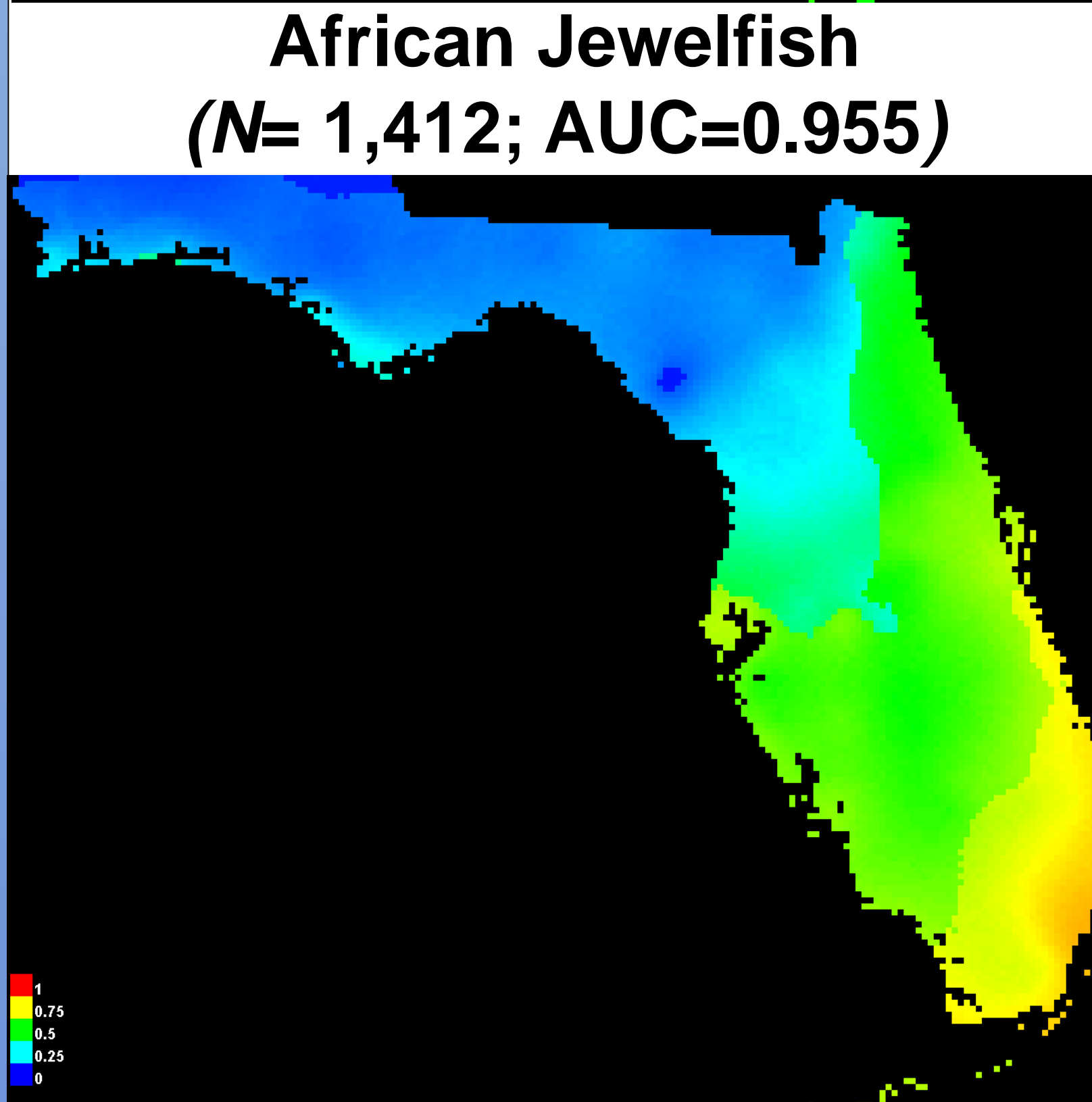
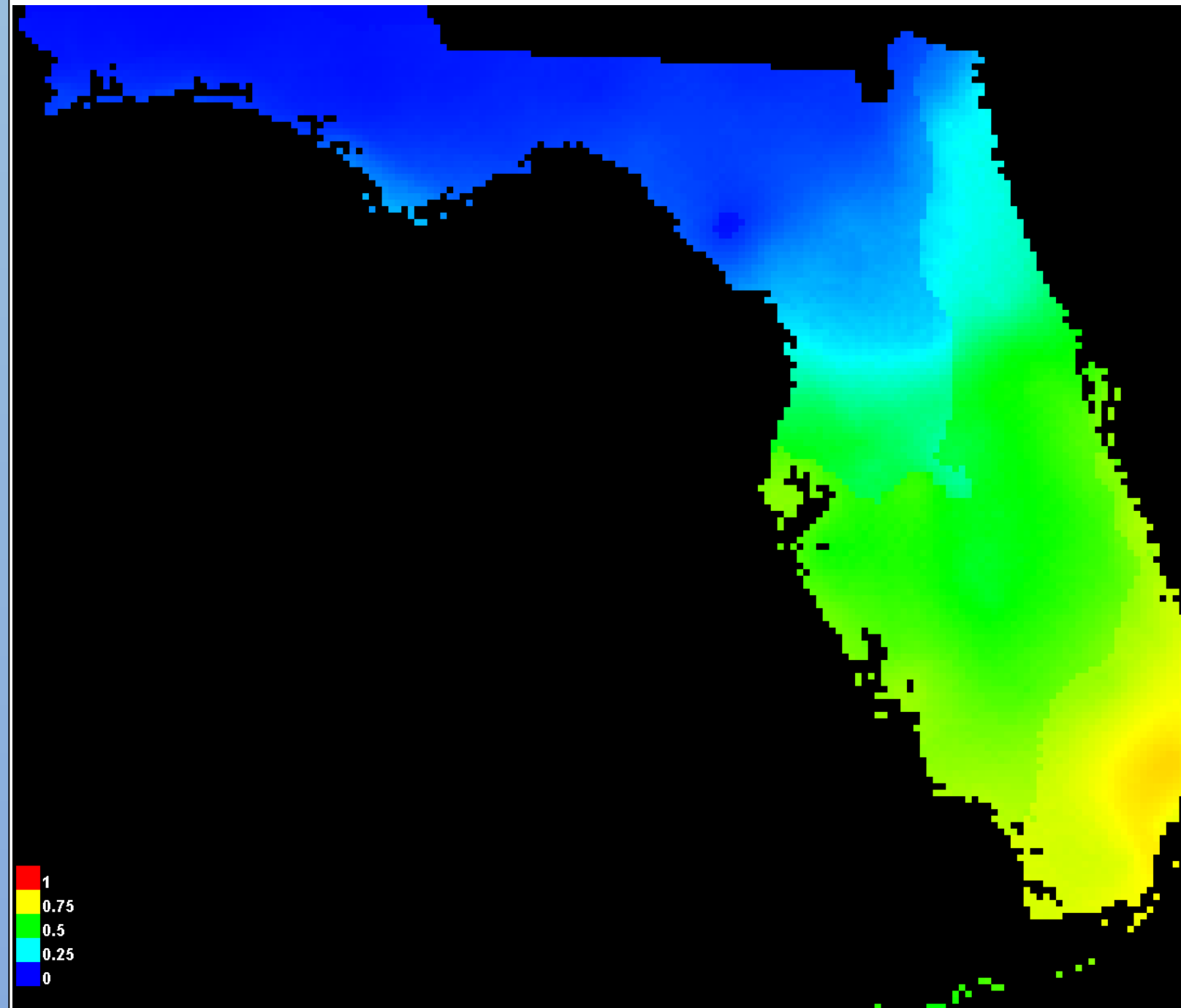
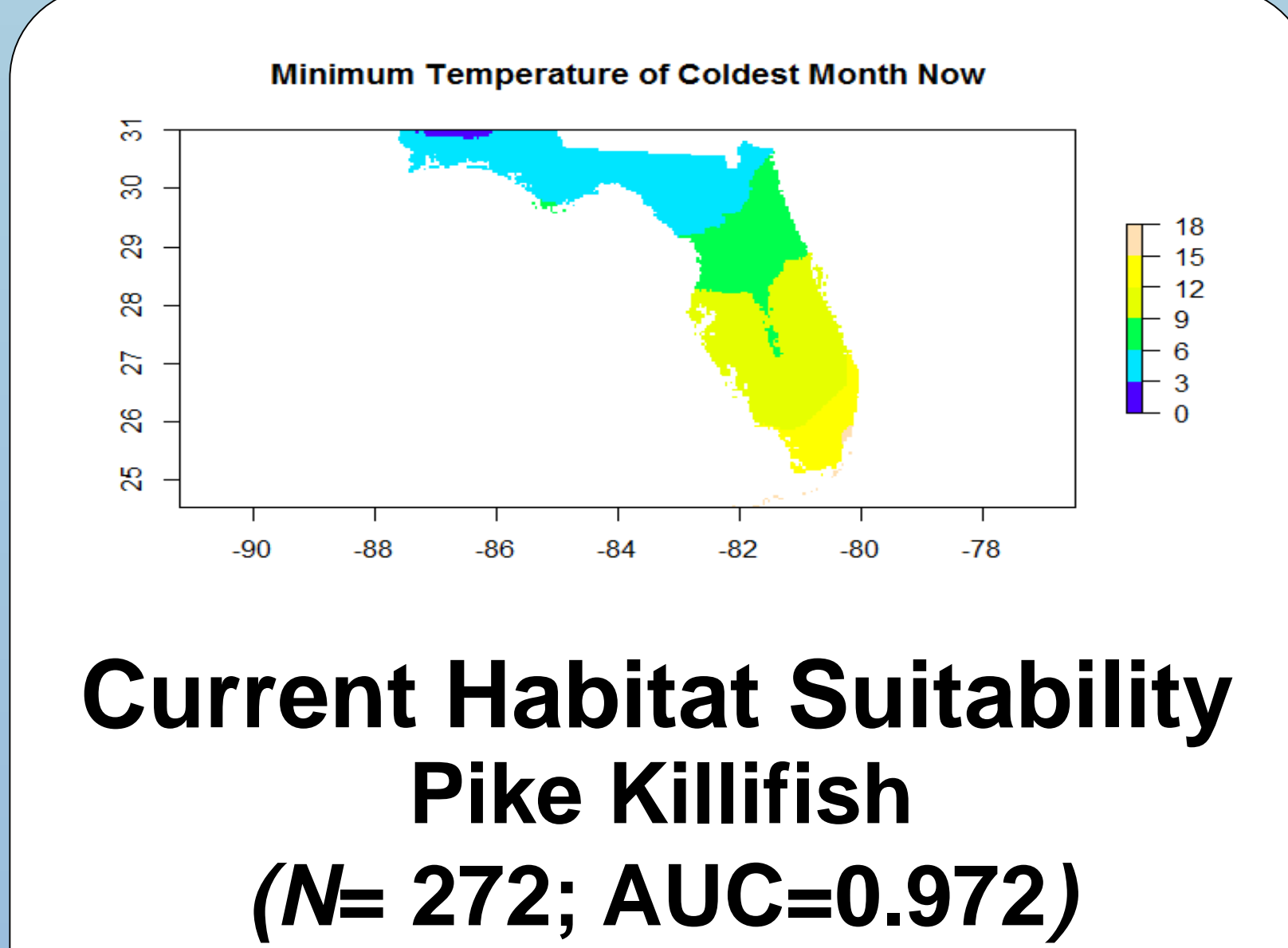
Introduction

Due to its subtropical climate, status as a major hub for the pet trade, large population size, and extensive hydrologic alteration, Florida is a hotspot for **non-native fish** introductions. Many of these **non-native fish** are both numerous and widespread, having successfully overwintered and reproduced for several decades. Some, such as the **Mayan Cichlid** and **Pike Killifish**, have been documented having severe *negative impacts* on **native fish** populations. While their current Floridian ranges are largely well documented, *one big unanswered question remains:*

*How will **non-native fish** ranges respond to climate change?*

Research Methods

- Species distribution modeling (SDM) using Maxent
 - Relates current presence records with geospatial bioclimatic data
 - Predicts future habitat suitability as a result of **climate change** (since ecological niches are conservative through time)
- Presence records:
 - **US invasive range:** USGS NAS database
 - **Native and invasive range elsewhere:** GBIF
 - Only where Minimum Temperature of Coldest Month (BIO6) was above published lower lethal limits for each species
- WorldClim bioclimatic layers:
 - Only layers relevant to non-native fish biology in Florida included
 - Autocorrelated factors removed
 - 2.5 minute resolution
 - Cropped to include HydroSHEDS watersheds where thinned presence records occurred



Bioclimatic Layers

- Minimum Temperature of Coldest Month (BIO6)
- Mean Temperature of Driest Quarter (BIO9)
- Precipitation of Wettest Month (BIO13)
- Precipitation of Driest Month (BIO14)

Analysis of Variable Contribution

	Percent Contribution	Permutation Importance
Pike Killifish	BIO6 (54%) BIO14 (12.9%)	BIO6 (68.8%) BIO9 (14.2%)
African Jewelfish	BIO6 (68.8%) BIO9(15.8%)	BIO6 (78.4%) BIO9 (15.1%)
Mayan Cichlid	BIO6 (54%) BIO14 (30.7%)	BIO6 (73.6%) BIO14 (13.5%)
Butterfly Peacock Bass	BIO6 (87.8%) BIO14 (11.6%)	BIO6 (94.7%) BIO14 (4.9%)

Synthesis and Significance

- Nearly all non-native fishes are predicted to expand their distributions in Florida
- but **the Everglades** will become **less** suitable for three of the species we modelled
- **African Jewelfish and Mayan Cichlids** are already dominant in areas of the Everglades
- If it becomes **LESS** suitable for them, what will this mean for the **native community**?
- The **Butterfly Peacock Bass**, a species with the highest lower lethal limit, is predicted to expand into more of **the Everglades**. What will this mean for the native community?
- These predictions are **CONSERVATIVE**
- Freshwater springs may serve as thermal refugia permitting **non-native** persistence north of our predictions
- Many of these species can tolerate saltwater → salinity bridge dispersal?
- Unless we intervene, uninvaded ecosystems may be colonized by these potentially **invasive species** with unpredictable consequences