Population Genomics and Morphology Support a New Species of Tiger Beetle Found on Isolated Saline Habitats in East Texas

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Introduction

- Our planet contains an immense amount of biodiversity, yet despite advancements in science and identification, it is estimated that millions of species remain undescribed
- Across North America, tiger beetles are diverse in association with many different habitats[1]
- Morphological diversity within and between species makes it difficult to identify divergence
- In Texas, *Eunota circumpicta* are sometimes found on unique, highly saline environments which may drive genotypic and phenotypic divergence

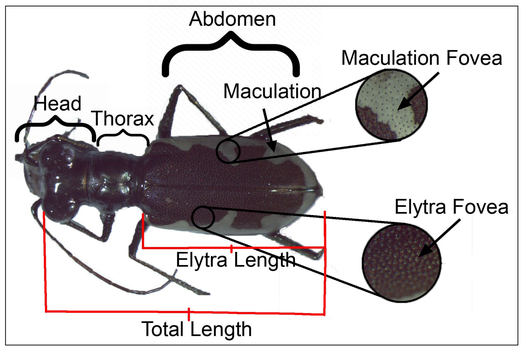

Figure 1. Annotated *circumpicta* photograph. Labelled morphological data is used to generate comparison data. Elytra length is taken from the posterior of the abdomen to the anterior of the abdomen. Total length is taken from the posterior of the abdomen to the anterior of the head. Fovea are depressions on the surface of a Beetle.

Questions

1. Are there populations of undescribed tiger beetle sister to *Eunota circumpicta*?
2. What data, morphological, genetic, or both, is more informative when testing for a potential new species?

Hypothesis

In our populations of study, we expect that morphological data and genetics will show our group, referred to as *houstoniana*, as divergent to *Eunota circumpicta.*

Methods

- Tiger beetles were collected by ariel net or donated from private collector/museums[2]
- Two lengths, elytra length and total length (Figure 1), as well as fovea count data (Figure 2) was collected from each specimen
- DNA was extracted and genomic data was produced through RADseq[2]
- Loci assembled from genomic data with iPyrad and used to produce a PCA and maximum-likelihood tree[3]

Morphology Comparison

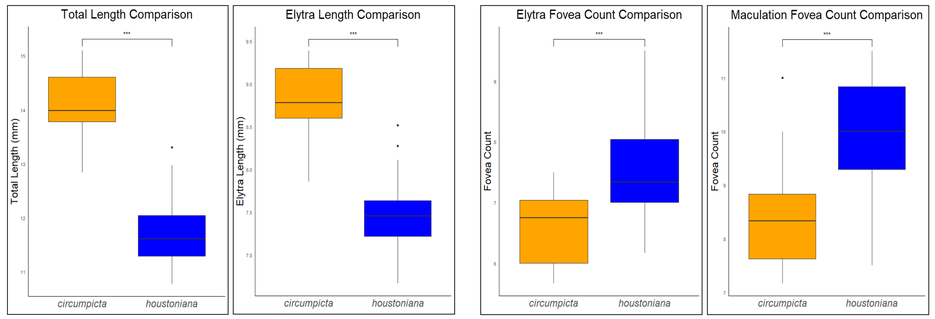

Figure 2. Boxplot comparisons of significant morphological differences in *circumpicta* and *houstoniana*. A student's t-test was used to test statistical difference. *** indicates a p-value of less than .001. Length comparisons of 20 samples of each species were done in Leica Application Suite using annotation. Fovea counts were done by overlaying a grid on close-up photographs (2.5x magnitude) of the beetles' elytra. 6 squares in elytra and maculation were selected for a total of 120 squares per species per section (118 x 118 pixel squares, 1mm = 400 pixels in the photo). Each square covered an area of .087mm^2.

Genetic Analysis

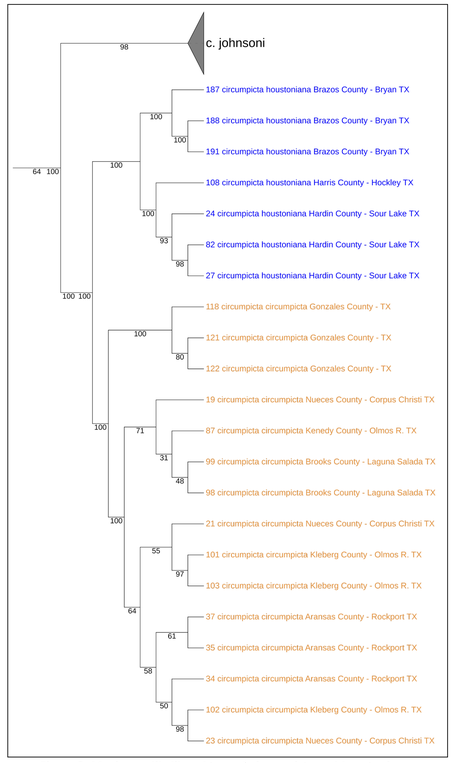

Figure 3. Maximum-likelihood tree of *circumpicta* and *houstoniana*. Analysis considered 110,778 loci identified by ipyrad. Bootstrap values out of 100 are displayed for each node. Tree annotation was conducted in Interactive Tree of Life. In blue are *houstoniana* and in orange are nominate *circumpicta*.

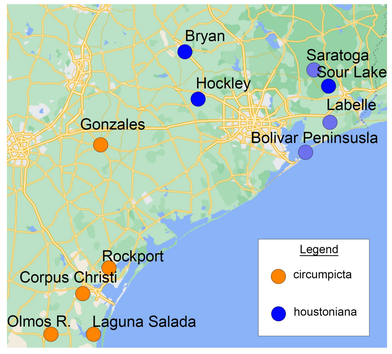

Figure 4. Map of localities where *circumpicta* and *houstoniana* were collected. The faded blue locations (Sour Lake, Labelle, and Bolivar Peninsula) indicate areas with unconfirmed *houstoniana* populations.

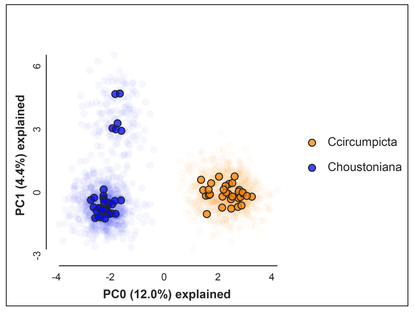

Figure 5. Principal Component Analysis (PCA) of 890 SNPs. Loci were filtered out if it was not found in 50% of individuals in a group 75% of all individuals.

Discussion

- Genetic data shows a clear divide species relationship, and they group together
- Morphological data shows statistical significance in length and fovea, while geographic data shows a clear habitat divide
- The novel species, which we refer to as *Eunota houstoniana*, has gone mostly unnoticed for years
- Other species may be undescribed or mislabeled due to past reliance on morphological data
- Integrative taxonomy, or the combining of genomic, morphological, and geographic data, is the future biodiversity research

Future Research

- More specimens across Texas and more morphological description and tests
- Integrative taxonomy in other genera and study groups

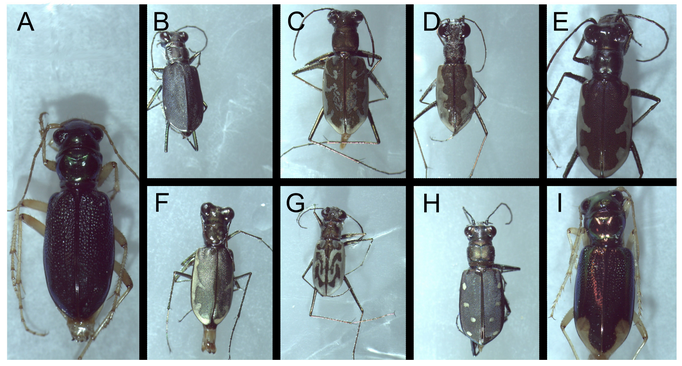

Figure 6. Tiger beetle specimens from saline habitats in East Texas. The genus and species of each goes as follows: **(A)** *Tetracha virginica* **(B)** *Cicindelidia punctulata* **(C)** *Ellispotera hamata* **(D)** *Eunota togata* **(E)** *Eunota circumpicta* **(F)** *Eunota houstoniana* **(G)** *Cicindelidia dorsalis* **(H)** *Cicindelidia ocellata* **(I)** *Tetracha carolina*

References

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