

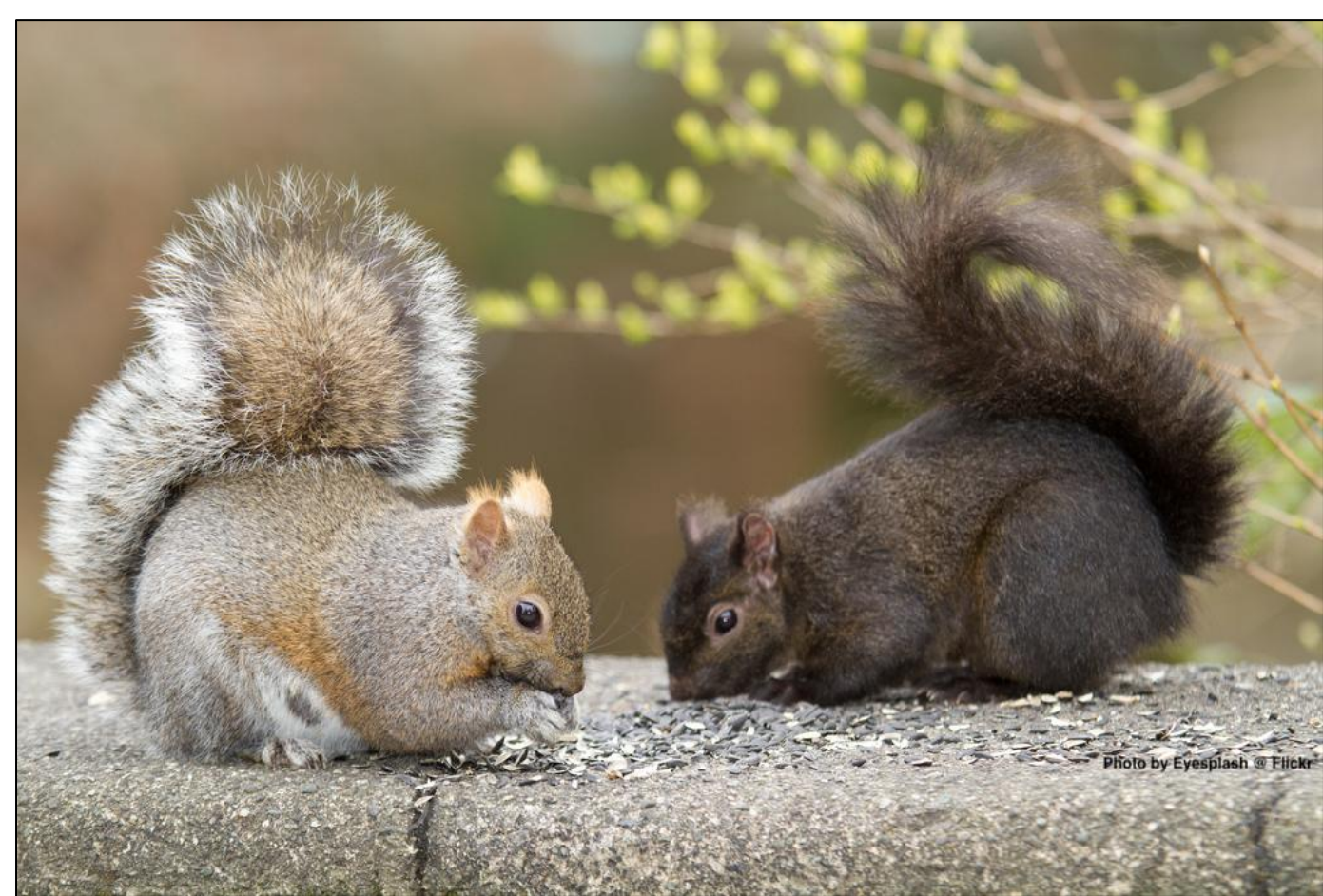
Melanism in the Eastern Gray Squirrel: using multiple methods to quantify an urban-rural cline

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INTRODUCTION

- The Eastern Gray Squirrel (*Sciurus carolinensis*) exhibits two color morphs, gray and melanic (black), the latter of which was the prevailing morph in northeastern forests prior to the 1800s, but which is now only common in some cities.



Gray squirrels occur in two color morphs – gray and black – inherited in a simple Mendelian fashion at the melanocortin-1 receptor gene.

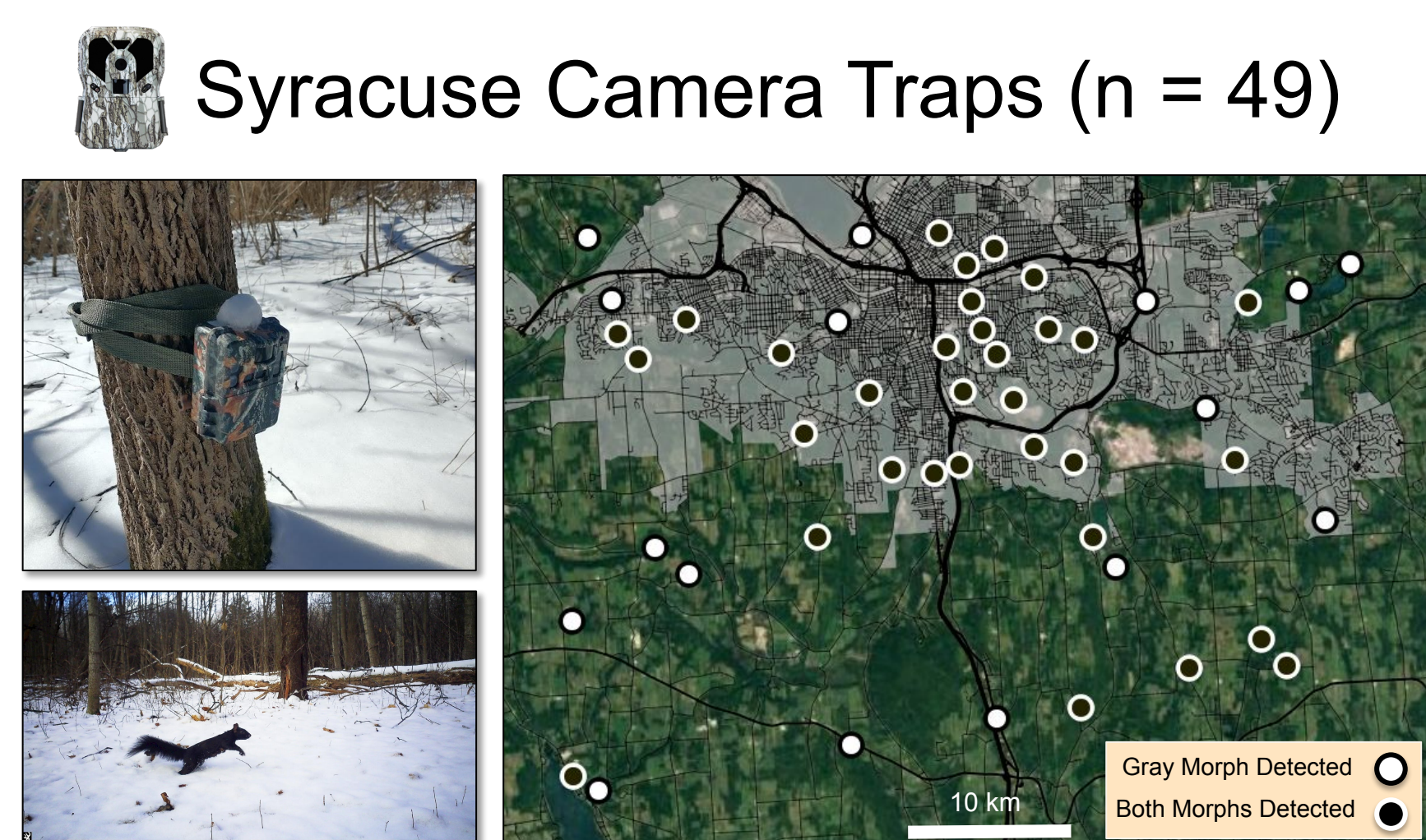
- Previous work suggests differences in crypsis between the color morphs in urban and rural environments (e.g. differential survival) may generate clines in melanism. However, widespread tests for urban-rural clines in squirrel melanism have been limited to analyses of incidental observations collected via community science.
- Here, we present a novel implementation of the Royle-Nichols (2003) model to estimate the proportion of melanic squirrels using data from a standardized camera trap network in Syracuse, NY.
- We compare the estimated cline from our model to clines generated from other forms of incidentally collected data: iNaturalist, a targeted citizen science program (SquirrelMapper), and road kill data collected by trained wildlife ecologists.

RESEARCH QUESTIONS

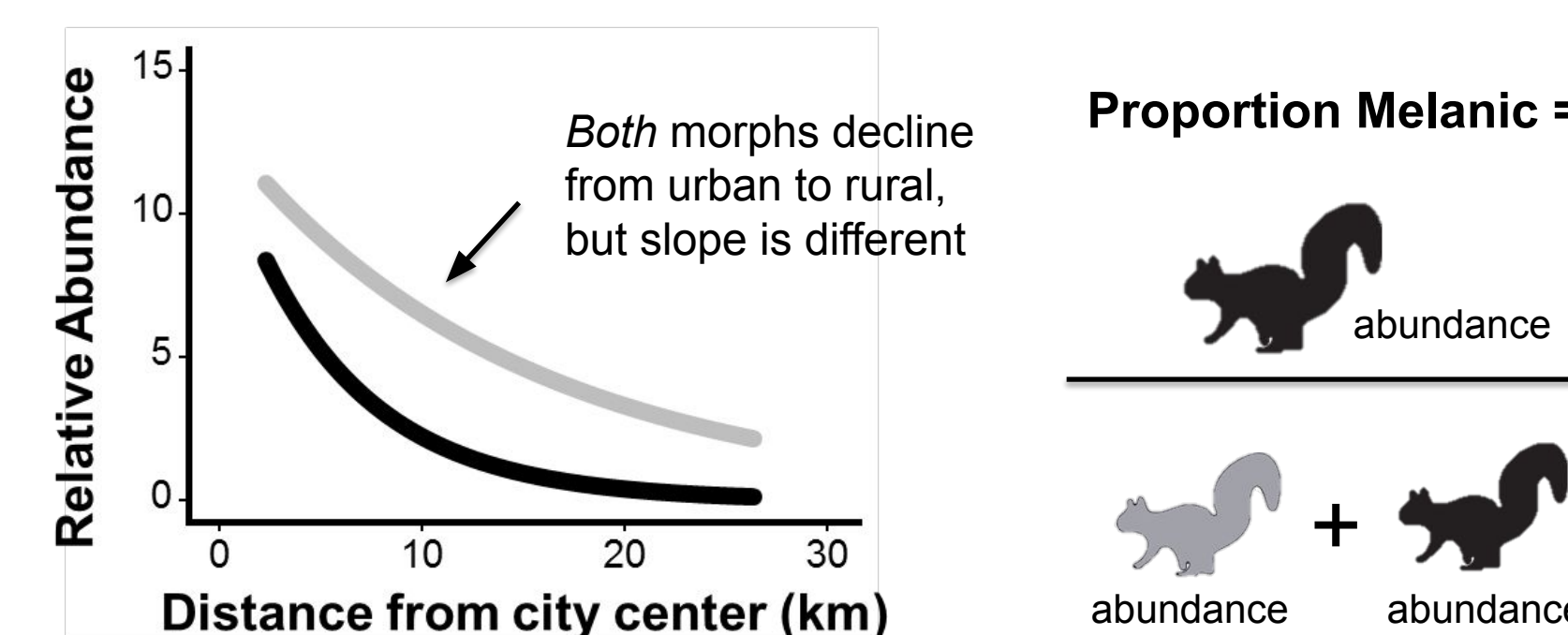
- Can we use standardized methods to quantify melanism prevalence across the urbanization gradient?
- How do standardized approaches compare to incidentally collected data?

STUDY SITE AND METHODS

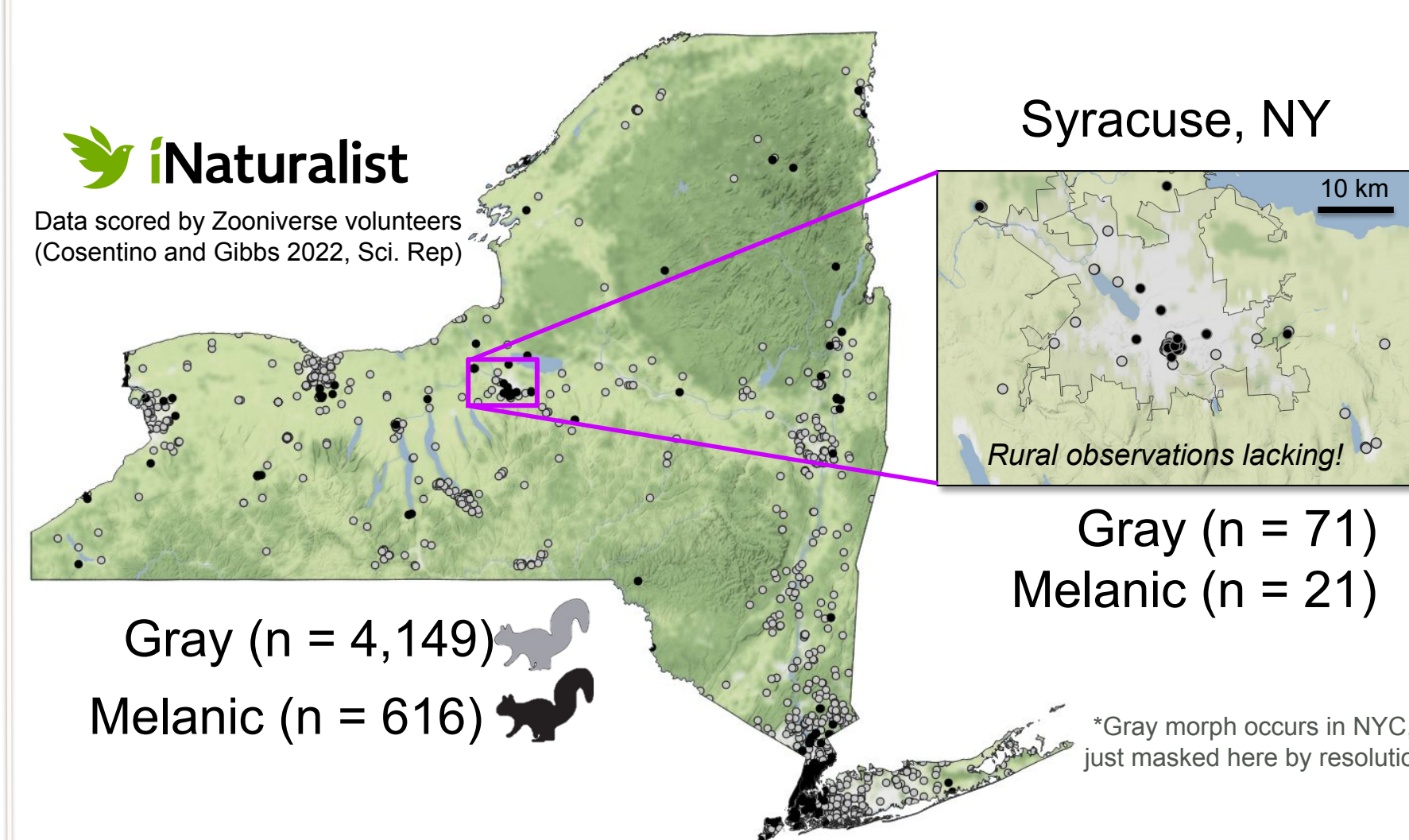
Royle-Nichols (2003) Model “Abundance from Occupancy Data”



Infer morph-specific “abundance” from variation in daily detection histories → Estimate proportion melanic using relative abundance estimates

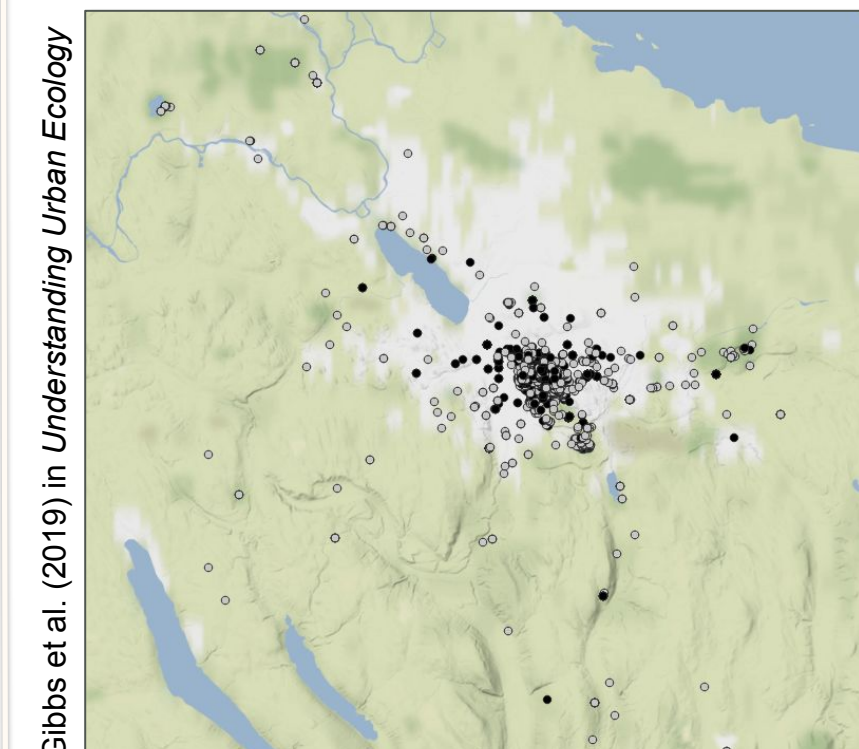


Incidental Data



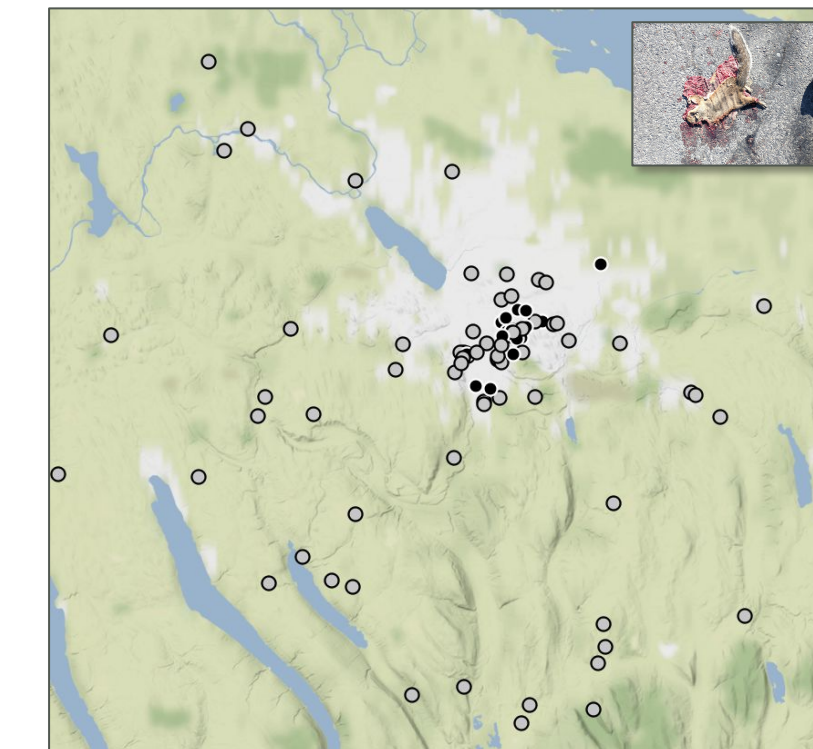
Gray (n = 4,149)
Melanic (n = 616)

SquirrelMapper



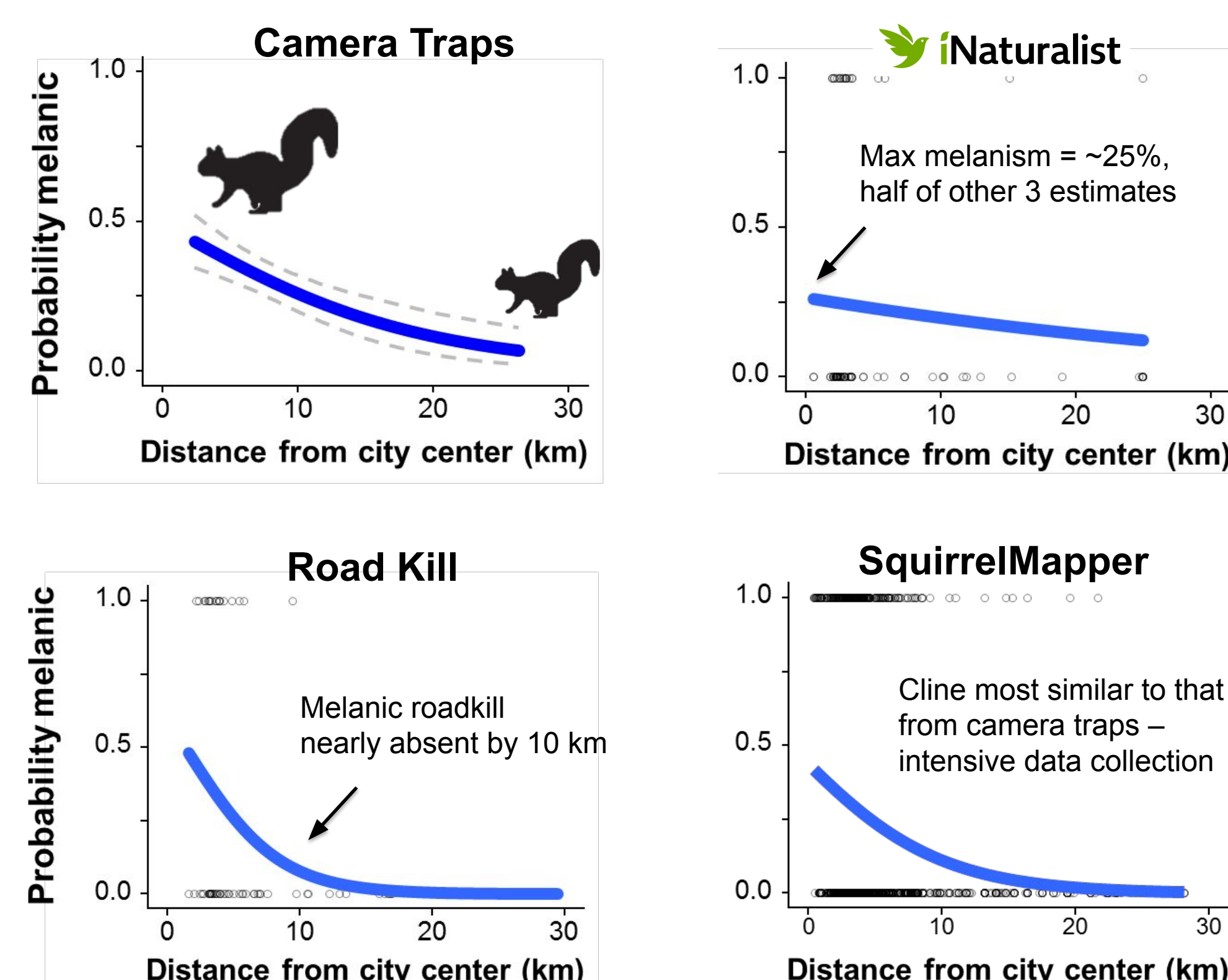
Gray (n = 953)
Melanic (n = 322)

Road Kill



Gray (n = 71)
Melanic (n = 18)

RESULTS – CLINE ESTIMATION



KEY POINTS

- Camera traps and Royle-Nichols (2003) model can be used to estimate clines
- Melanism declines from city center in all models, but shape varies by data type
- Camera traps reveal presence of rare alleles missed by incidentally collected data
- iNaturalist observations greatly underestimate cline

DISCUSSION

- We detected the gray morph at all camera locations. Cameras also revealed melanism occurs in rural areas, but at low levels making incidental observations unlikely (low detection probability).
- Royle-Nichols (2003) model produced ecologically plausible estimates of squirrel “abundance” at each camera location, possibly interpreted as the number of squirrels with home ranges overlapping each camera’s detection distance (~5 m).
- iNaturalist data appears to underestimate the prevalence of melanism in Syracuse by nearly 50%, suggesting prevalence of melanism could be higher in other cities with only a few melanic observations.
- Use of citizen or community science data has enormous potential to help answer questions in ecology, evolution, and conservation. However, care must be taken to critically evaluate biases.

FUTURE DIRECTIONS

- Refinement of our Royle-Nichols (2003) model to include random-effects and city specific covariates plus integration of standardized point count data to fill gaps where cameras cannot be placed.
- Expand cline estimation to include standardized camera trap data from partner cities across the eastern US and Canada. **Contact us for more info!**
- Experimental and genetic work to examine urban evolution and natural selection, including a translocation experiment, assessment of crypsis, and testing attack rates on taxidermied squirrels.

ACKNOWLEDGEMENTS

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