The puma *(Puma concolor)* as a potential top down agent of community structure and ecosystem function

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I. Introduction

All animals have an inherent drive to live, a fact that dictates how they move across their environment. It is perhaps not surprising then that prey animals tend to avoid their predators, moving and congregating in areas that have the lowest risk of predation. This phenomenon, dubbed the "Landscape of Fear" by Laundre et al. in 2001, is a well-documented occurrence shown to impact how a given prey species is distributed in its environment based solely on the threat of predation. These resulting spatial distribution patterns have been shown to have cascading effects on subsequent trophic levels in a variety of ecosystems, with top predators exerting profound, indirect effects on their community structure and function (Laundre et al., 2001; Lima 1998).

Pumas *(Puma concolor)* have been implicated in these top-down processes in the western United States, affecting the movements of their large ungulate prey, mule deer *(Odocoileus hemionus)* (Lee, 2005). We attempted to see if a "Landscape of Fear" existed in our New Mexico study site. To determine habitat utilization between puma and their prey species deer, our study aimed to answer two basic questions: **1) Is selected puma habitat significantly different from selected deer habitat?** and **2) Do puma and deer use the habitat in a predictable, non-random way?**

II. Materials and Methods

Study site: All data were collected on Kirtland Air Force Base (KAFB) near Albuquerque, NM **(Fig. 1)**.

Data collection: Field

•Random pellet plots to survey deer locations

•Puma locations determined by GPS collar data (**Fig 2).**

•Data Collection: GIS

• All Environmental raster data taken from the New Mexico Resource Geographic Information System Program: RGIS, http://http://rgis.unm.edu/browsedata

•Used 4 environmental variables for analysis: **Solar gain, distance to stream, topographic ruggedness**, and **vegetation** . Solar gain generated from spatial analysis tools. Stream layer generated using DEM and hydrology tools in spatial analyst. Distance to stream generated using euclidean spatial analyst and distance tool. Topographic ruggedness taken as variance in elevation in moving window around focal cell.

•Random points generated using Hawth's tools.

•Hawth's tools, Analysis, intersect point tool to attach raster data to point attribute data

Statistical Analysis:

1) Is selected puma habitat significantly different from selected deer habitat?

Used primary component analysis (PCA) to reduce habitat data complexity.

Generated principle component score for each puma and deer point

Compared PC scores of puma and deer points using t-test.

2) Do puma and deer use the habitat in a predictable, non-random way?

Conducted a multiple logistic regression to produce the linear combination of variables that best distinguishes between 1. Puma points and random points and 2. Deer points and random points.

***All maps created with ESRI Arcdesktop 10 (2012).

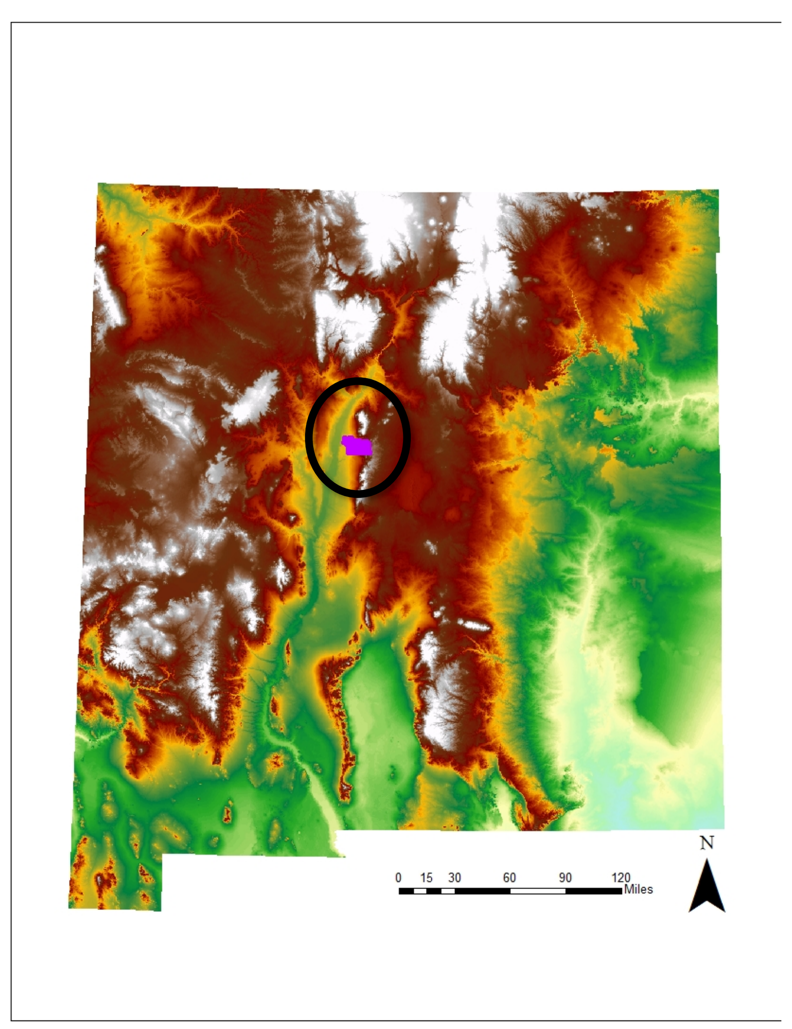

Figure 1: Digital elevation map of New Mexico. Study site Kirtland Air force Base (KAFB) near Albuquerque, New Mexico (in purple).

Fig 2: Fixing a GPS collar to a study animal. Position coordinates were recorded 8 times daily.

III. Results

We found deer and puma both utilize habitat patches non-randomly **(Fig 3, Fig 4)**. We also found significant habitat segregation between deer and puma **(Fig 5).**

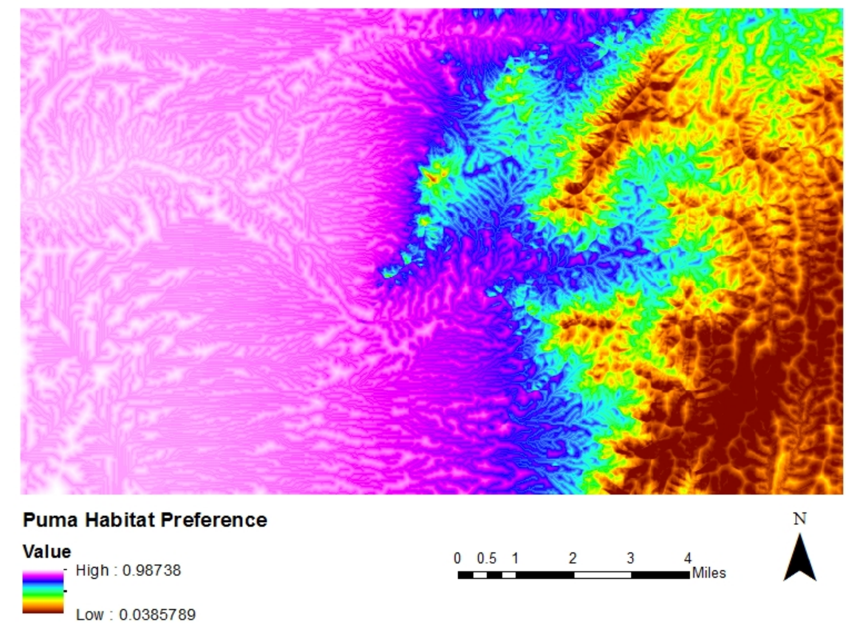

Fig 3: Map of predicted puma habitat using PCA and multiple logistic regression (p< .0001). Warmer colors indicate preferred puma habitat.

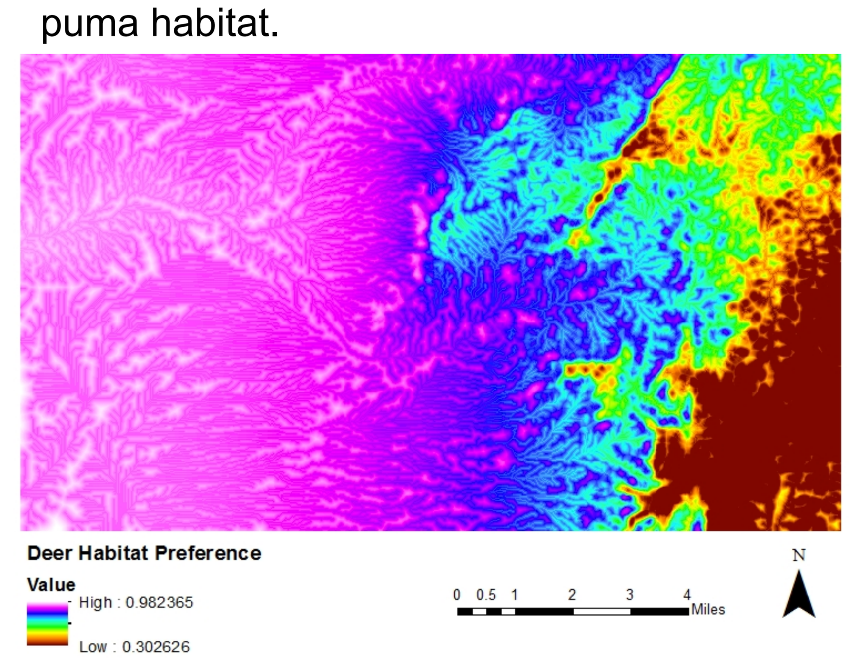

Fig 4: Map of predicted deer habitat using PC scores and multiple logistic regression (p< .0001). Warmer colors indicate preferred puma habitat.

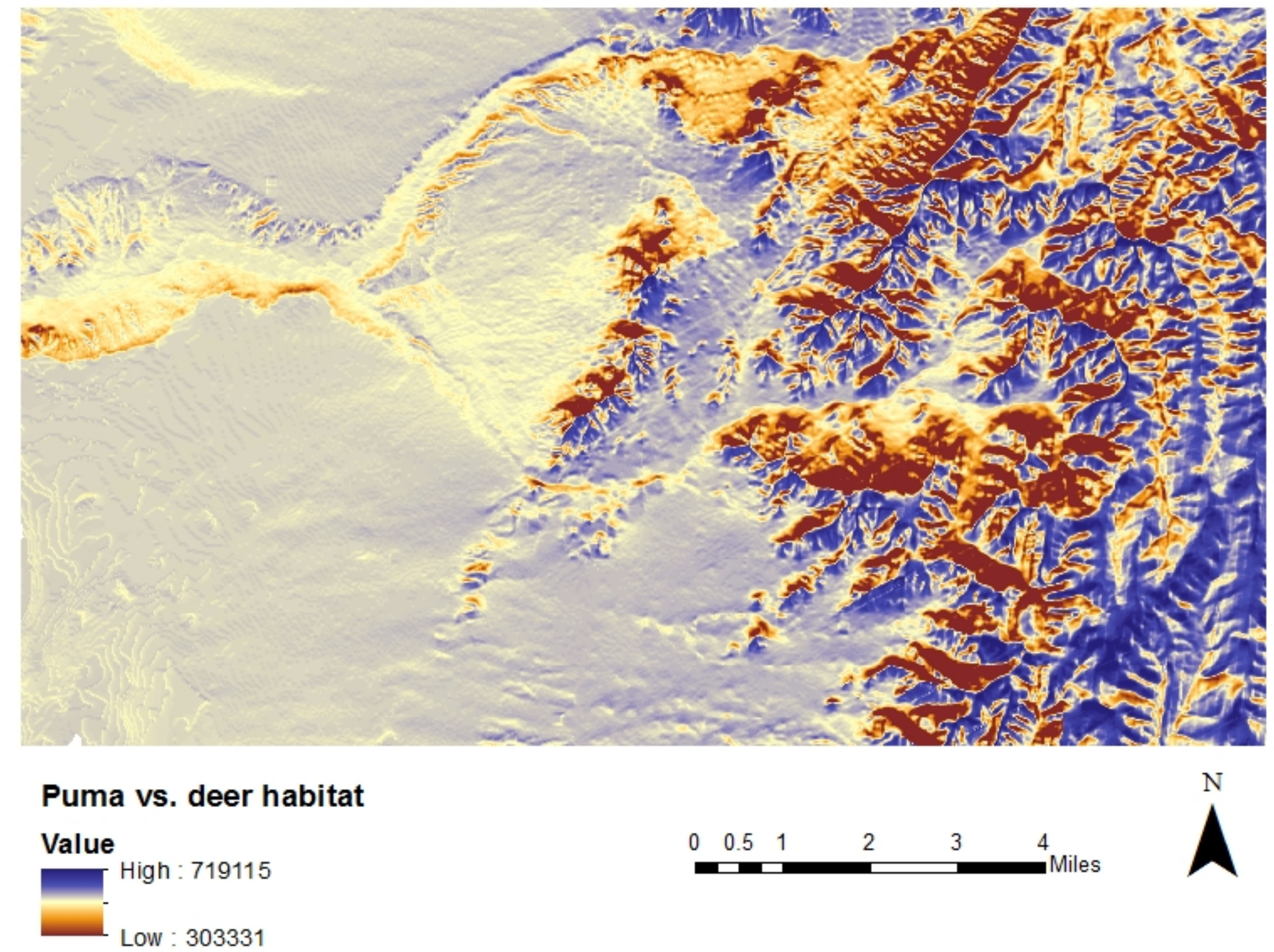

Fig 5: Map of predicted puma habitat vs. predicted deer habitat using PC scores and t-test (p < .0001). Red models optimal puma habitat, blue indicates optimal deer habitat.

V. Discussion

Pumas and deer both exhibited non-random spatial distribution patterns, indicating both species deliberately utilize habitat patches differently. We also found significant habitat segregation between puma and their prey, suggesting a "Landscape of Fear" effect may be influencing deer movements in our New Mexico study area, though it is difficult to establish a direct, causal relationship between puma location and prey distribution with these data. Nevertheless, our optimal habitat models for puma and deer can have immediate implications for conservation and management polices, as both study species are hunted in New Mexico and other western states, with tags for deer approaching ten thousand dollars or more on private ranches. Optimal habitat models such as these allow ranch managers to make more informed and precise decisions about hunting populations' habitat requirements, leading to better management policies and, thus, an increase in profits. These models can help conservationists predict what animals are utilizing a given tract of land as well, helpful if puma prey conserved species, as is the case with desert bighorn sheep (*Ovis canadensis nelsoni)* in Arizona. Future research including an analysis of remote camera data may help strengthen the case for a causal relationship between puma and prey distribution. Applying these habitat models to rare or endangered animals in the future could vastly improve the efficiency of subsequent habitat conservation, an important point to consider as available habitat patches shrink with increasing human encroachment.

VIII. Acknowledgements

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VII. References

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