Using individual-based models and animal movement to evaluate habitat-use intensity in fragmented landscapes: a case study from central Brazil

Jennifer Bradham[1], Maria Luisa Jorge[1], and Clara Yip[2]

[1]Vanderbilt University, Department of Computer Science

[2]Vanderbilt University, Department of Earth and Environmental Sciences

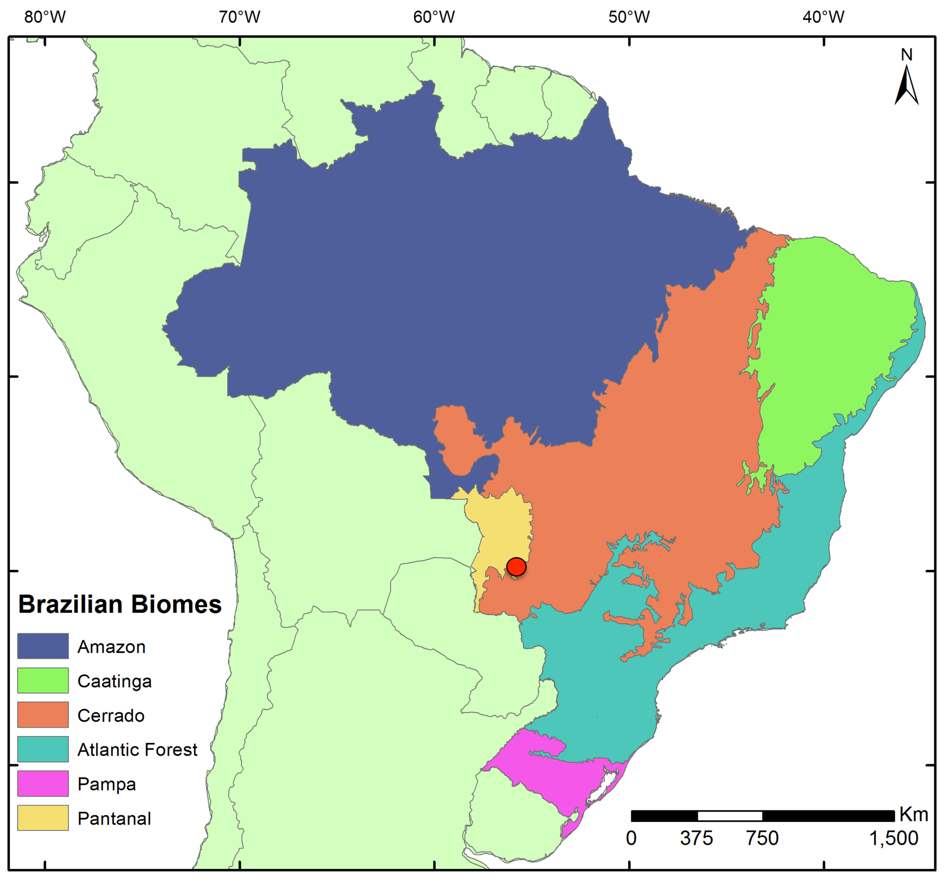


Figure 1: Map of Brazilian biomes. Red dot indicates field site where movement data was collected.

White-lipped Peccary (*Tayassu pecari*)

Tropical ecosystems regulate global climate, act as carbon sinks, and contain some of the highest levels of biodiversity in the world[1-2]. Yet, they are also among the most threatened ecosystems on the planet[3]. Large herbivores provide a unique angle with which to evaluate changing tropical ecosystems, as they can directly moderate plant diversity and abundance, amount of available habitat for other organisms, and ecosystem services[4-6].

Research Questions

1) How does fragmentation affect landscape use by large herbivores?
2) How will changes in habitat use affect the landscape over time?

photo by Onçafari

How does fragmentation affect landscape use by large herbivores?

Table 1: Percent of the landscape that is native forest vegetation (green) and percent of GPS relocations found in the native vegetation for individual peccaries.

Forest Use

Name	% Forest
Landscape	*33%*
Tainara	95%
Jay	92%
Cleide	96%
Julia	74%
Lurdes	87%
Malu	87%
Tony	80%
Valentina	91%

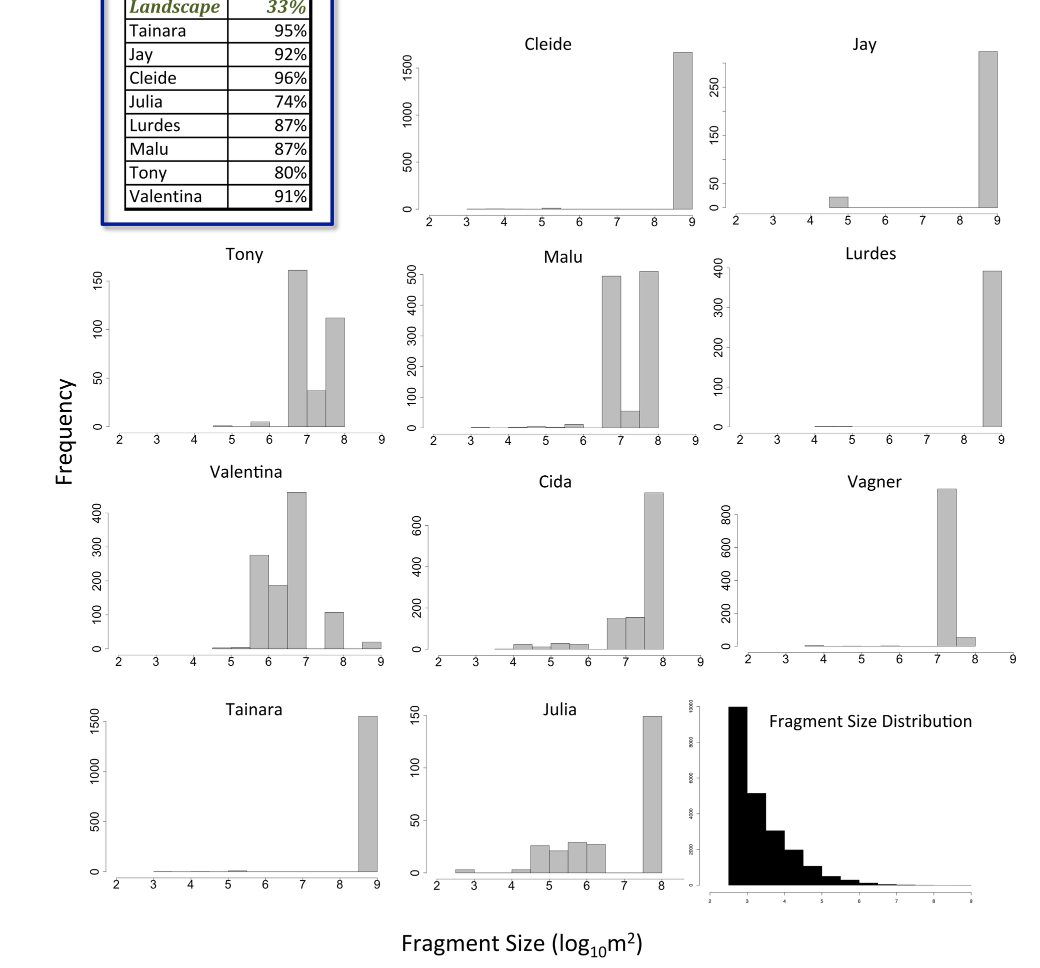


Figure 2: Frequency histograms of fragment sizes used by individual peccaries (gray) in the Brazilian Cerrado and frequency distribution showing the area of available native forest fragments (black) in the same location.

In fragmented ecosystems, white-lipped peccaries do not utilize the matrix, are heavily restricted to the forest, and prefer large forest fragments.

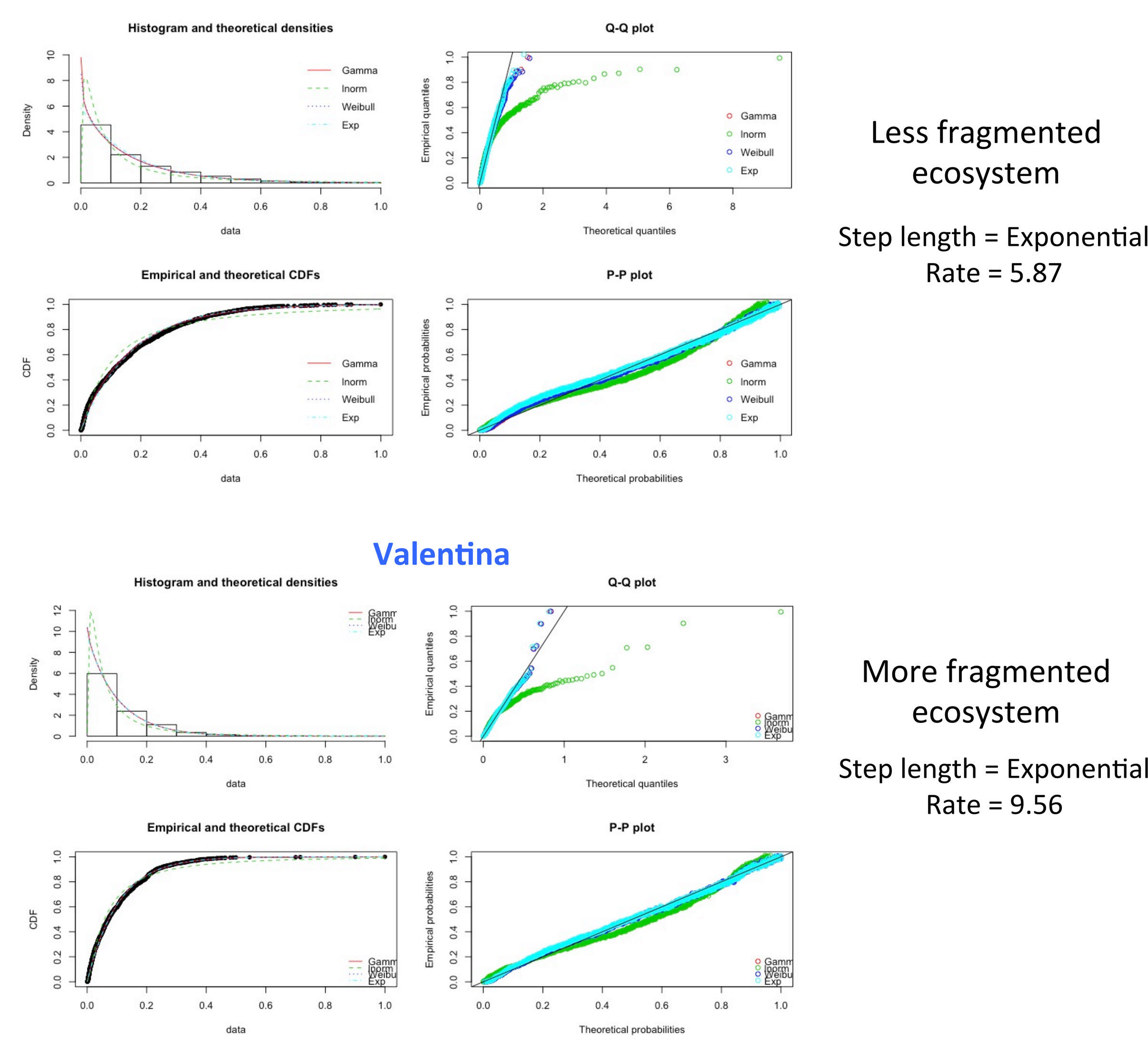


Figure 3: Statistical tests fitting step lengths to distributions. AIC values indicate step lengths for both Cleide and Valentina are best represented through an Exponential Distribution, yet with different rate parameters.

White-lipped peccaries may alter movement patterns as a result of fragmentation.

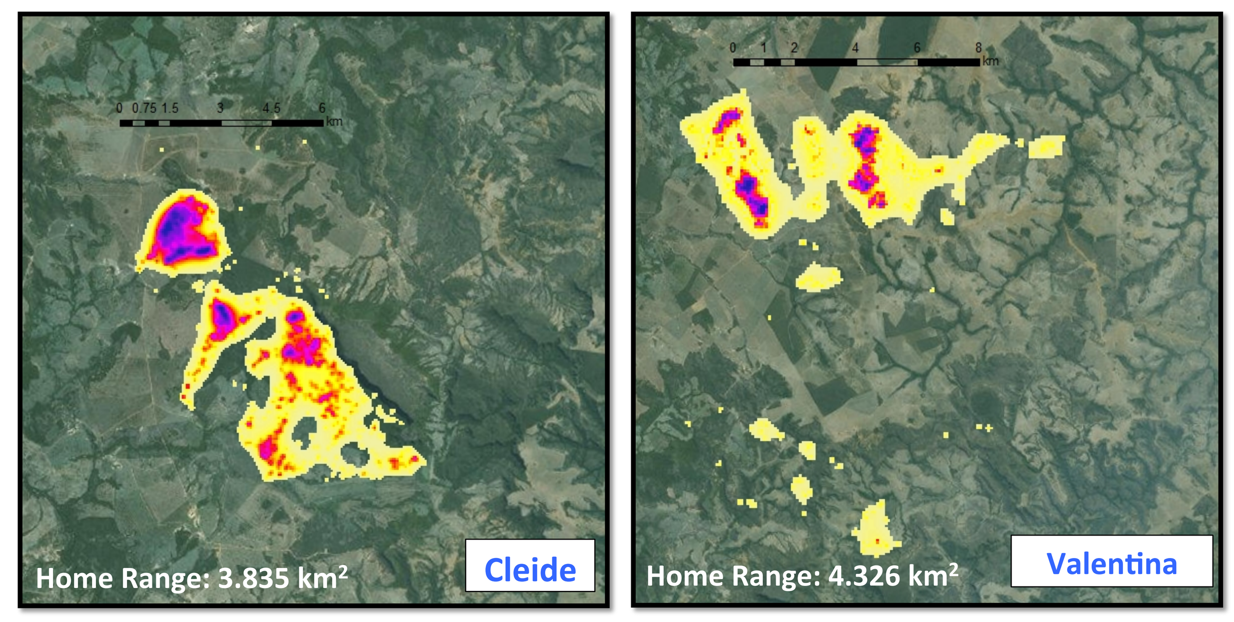


Figure 4: 95% Utilization distribution maps for Cleide (left; 222 days) and Valentina (right; 149 days) from the Corguinho Highlands region of the Brazilian Cerrado.

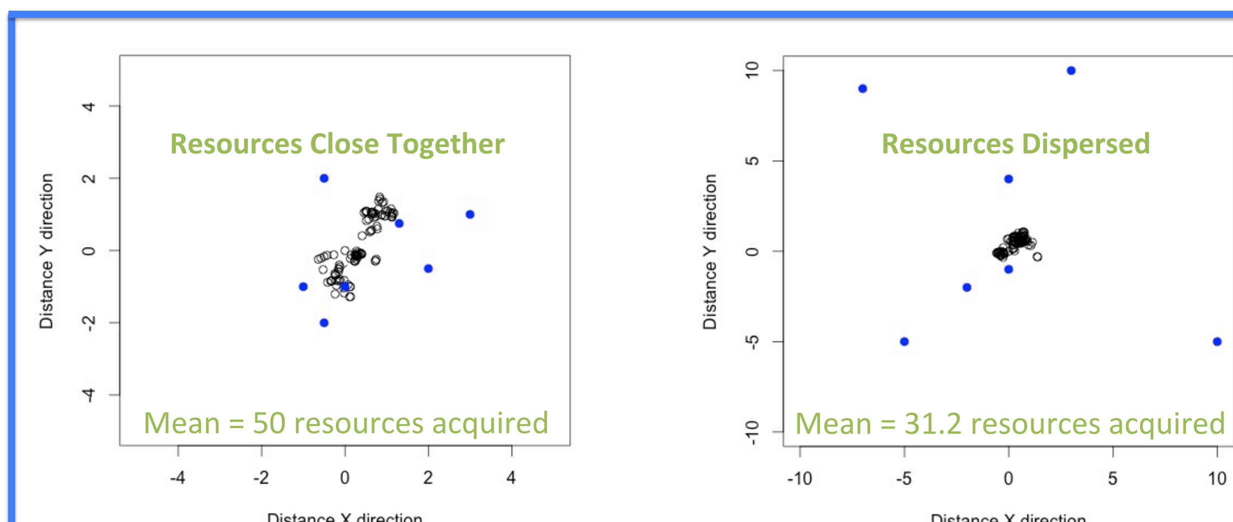


Figure 5: Results from a random walk simulation evaluating resource acquisition success with step lengths chosen from an exponential distribution where rate parameter equals six and angles from a circular uniform distribution. Blue dots indicate resources. Note the difference in scale on the x and y axes.

Changes to movement patterns may be resource driven.

How will changes in habitat use affect the landscape over time?

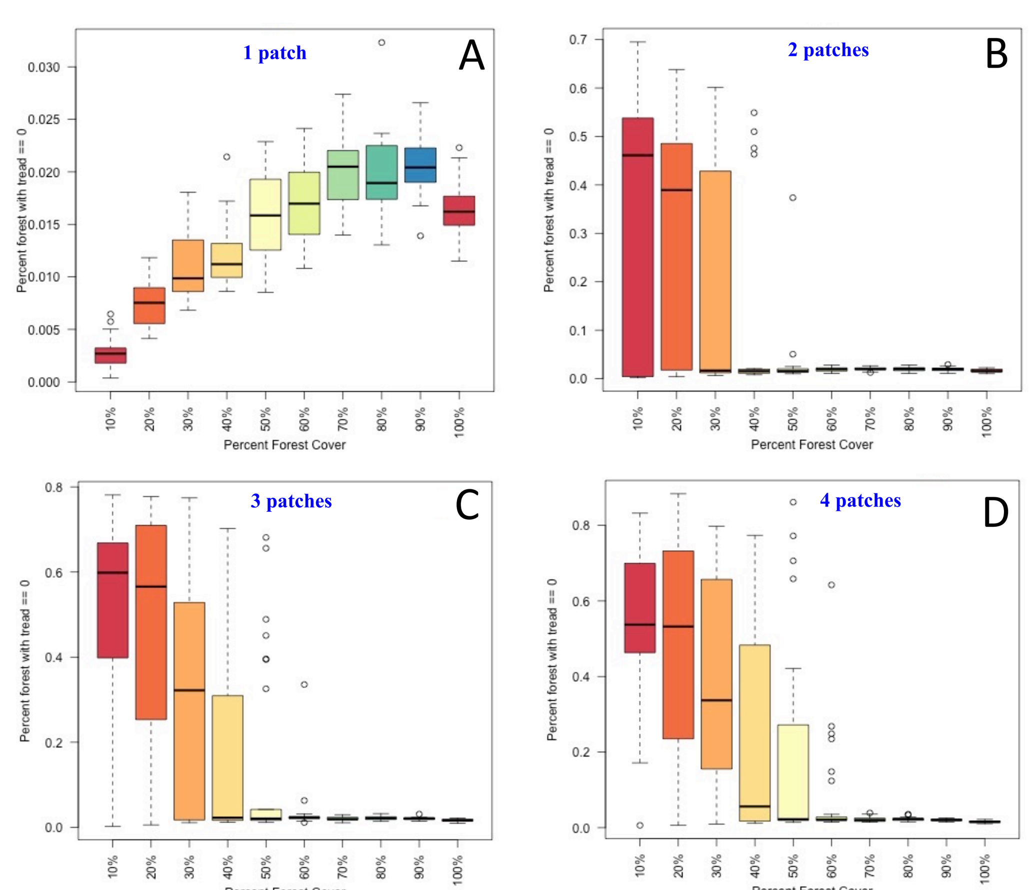
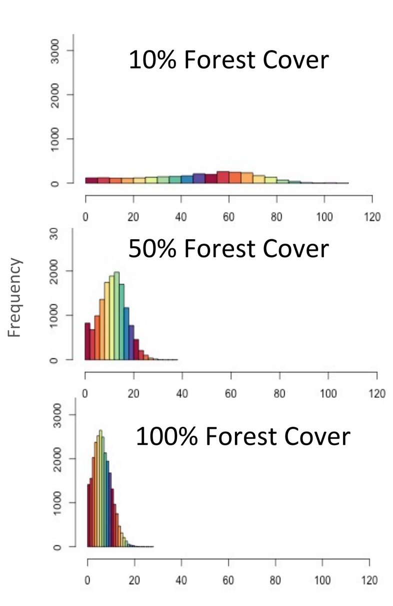


Figure 7 (left): Results of an individual-based model simulation quantifying the percent of unused forest after 5 years of white-lipped peccary habitat use in differing fragmentation scenarios: (A) a fully connected landscape, (B) a landscape with 2 forest patches, (C) a landscape with 3 forest patches, and (D) a landscape with 4 forest patches.

Figure 8 (right): Frequency histogram depicting habitat use intensity after a herd of white-lipped peccaries moves across a landscape with varying degrees of forest cover (no fragmentation) for 5 years.



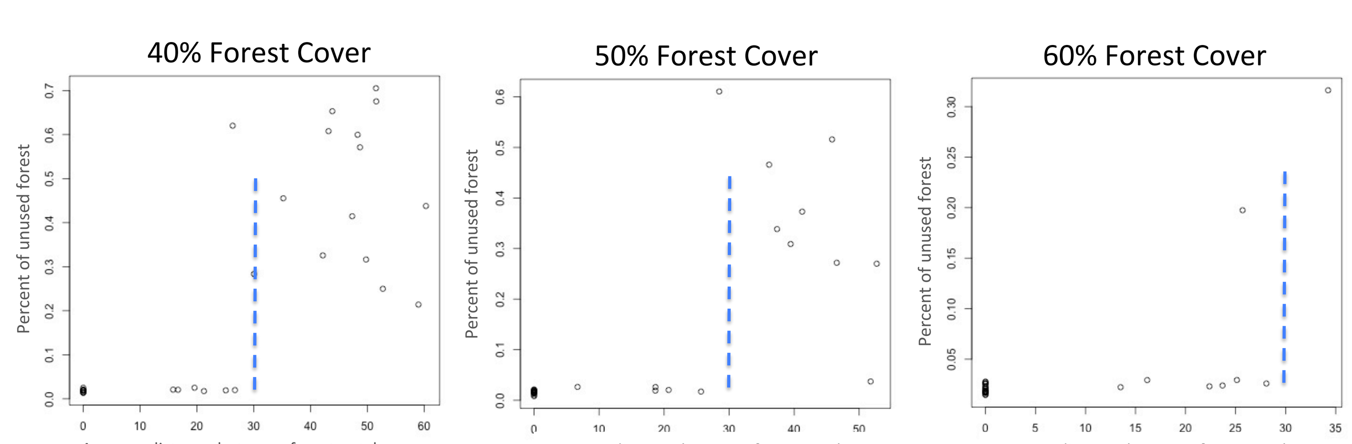


Figure 9 (left): The percent of unused forest and average distance between patches (after 30 simulations). Results shown are from 3-patch fragmentation scenarios. However, the same pattern remains for all fragmentation scenarios tested. Blue dashed line marks 30 unit distance between forest fragments.

Below 30% forest cover in a fragmented landscape, habitat use is driven by degree of connectivity between forest patches. Above 60% forest cover, spatial configuration is no longer the driving factor of habitat use. Between 40% and 60% forest cover, habitat use is a function of both connectivity and percent forest cover (Figure 7), with fragmentation scenarios having patch distances less than 30 units functioning as 'connected' landscapes (Figure 9). When the landscape is fully connected, habitat use intensity becomes more heterogeneous as percent forest cover decreases (Figure 8).

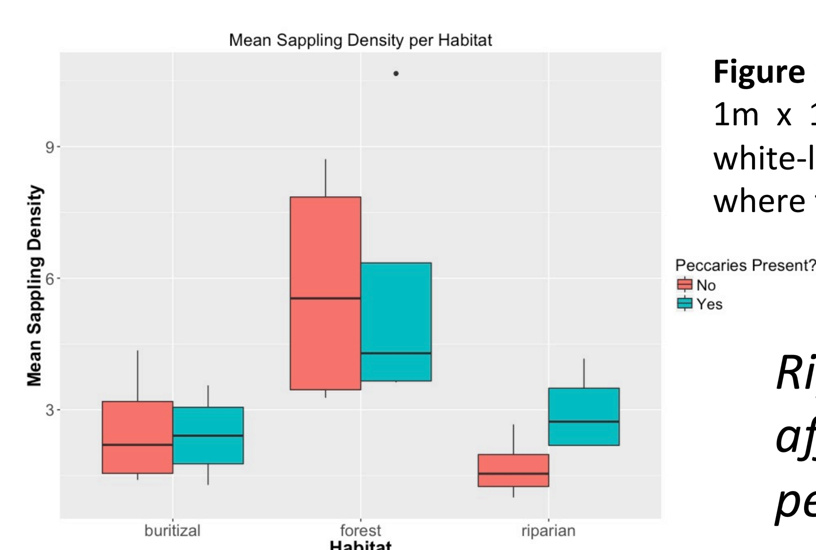


Figure 10: Boxplot of mean seedling density per habitat for 72 1m x 1m plots in the Cerrado -- 44 plots in locations where white-lipped peccaries are heavily present and 28 in locations where they are absent.

Riparian zones may be the most adversely affected by the loss of white-lipped peccaries.

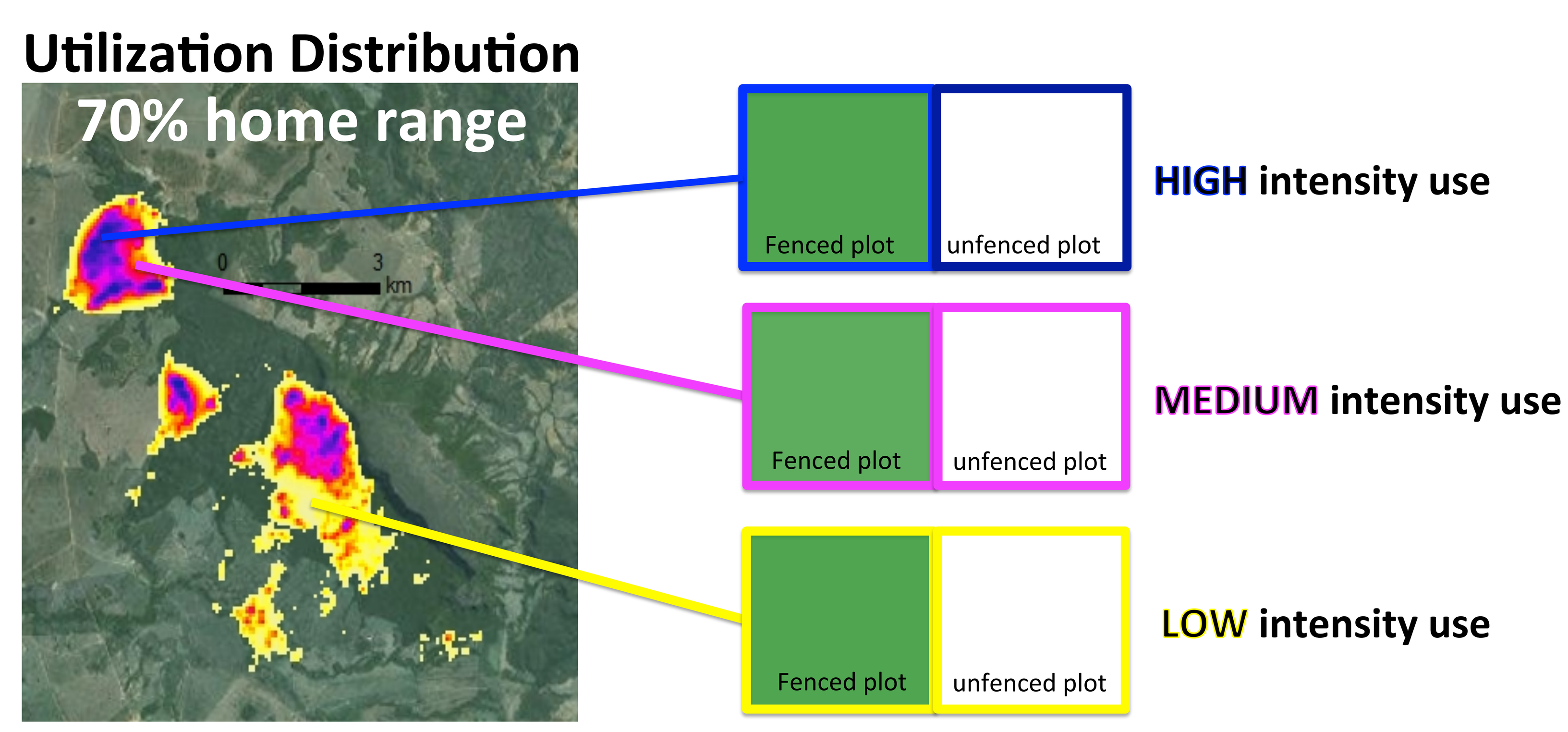


Figure 11: 70% Utilization Distribution map of Tainara (left). Schematic of an exclosure plot study designed to analyze impacts of large herbivores on forest regeneration (right).

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Works Cited

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