Sampling Barn Owl Nest Boxes and their Surrounding Habitat in Napa Valley, California

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GIS 270

Introduction

With a growing human population and rising middle class, there is an increasing demand for luxury agricultural goods, such as coffee, chocolate and wine (Catry 2003; Sumner 2012). Luxury agricultural products are primarily produced in Mediterranean and tropical climates (Ricketts et al. 2004; Jones et al. 2005), which comprise the most sensitive, biologically rich ecosystems on the planet (Myers et al. 2000). From 1988-2010 winegrape cultivation increased approximately 70% worldwide due to increased demand for fine wines (Viers et al. 2013). Viticulture is one of the top drivers of land conversion in the Mediterranean biome (Viers et al. 2013). Therefore, better knowledge of alternative methods of pest management in vineyards may lessen the burden in an already stressed ecosystem. Additionally, wineries are in a good position to benefit from the ecological and economic benefits of conservation through the ecosystem services that wildlife provide, as well as the positive public image that comes with "going green" (Viers et al. 2013). This study will examine how barn owl (*Tyto alba*) nest box occupancy can be used as a natural method of rodent control in Napa Valley vineyards.

Rodent pests cause significant damage in vineyards (Moore et. al 1998; Ross 2009). Pocket gophers (*Thomomys bottae*) and voles (*Microtus* spp.) are the most problematic rodent pests in Napa Valley (Salmon and Baldwin 2009; Salmon and Gorenzel 2010; Pedemonte 2014). They prune roots and gnaw bark, slowing the

growth and productivity of vines (Ross 2009). Utilizing natural predators to reduce pests is part of a comprehensive integrated pest management plan (Bottrell 1979).

Barn owls in North America feed almost exclusively on small mammals, especially voles and gophers (Parker 1988; Taylor 1994). Barn owl's worldwide distribution makes them valuable predators in a variety of agricultural systems. The predatory benefits of barn owls have been studied in rice paddies (Wood and Fee 2003) and oil palm plantations (Duckett 1976) in Malaysia, row crops in Israel (Meyrom et al. 2009), and orchards worldwide (Askham 1990; Taylor 1994). Napa Valley (Figure 1) farmers have keyed in on barn owls as a potential way to reduce rodent pests, resulting in the placement of barn owl nest boxes throughout Napa vineyards (personal observation).

Figure 1. Map showing the location of Napa Valley in California.

Although using nest boxes in vineyards to attract owls is not a novel idea (Walter 1994), this system has never been rigorously studied by ecologists. Farmers are investing time and money to build, install and maintain barn owl nest boxes without a good understanding of the best places to erect the boxes for the highest chance of occupancy. Simply, saturating the landscape with nest boxes does not insure occupation. Low occupation rates of nest boxes results in poor or non-existent rodent removal services (Byron 2008).

To understand what drives nest box occupation I will test a set of habitat characteristics surrounding established nest boxes in Napa Valley vineyards during the 2015 breeding season. For this project I analyzed one of the variables, average distance to buildings that I will use in my final analysis. I used a geographic information system (GIS) to map barn owl box locations on farms distributed throughout Napa Valley. I also calculated the average distance to the nearest building for each barn owl nest box as an index of disturbance. For this project, I used a small sample of the 300 nest boxes that I am going to monitor for occupancy for my Master's thesis.

Methods

I marked waypoints of barn owl nest box locations on five vineyards in Napa Valley (Figure 2) with a Garmin Etrex GPS. I did not test the accuracy of the GPS. For the scope of this project I analyzed three farms (Hardisty, Raymond and Hall). I used ArcMap 10.1 for my analysis. First, I put the nest box points on a Google Earth base map. Then, I added line features (one in each quadrant) from each nest box to the four nearest buildings. I calculated the distance of each line by creating a field in the attribute table named lengths then calculated geometry for that field. I then selected by attribute to add up the four lengths for each box. I used the statistics tool to find the average distance to the nearest building for each box. Finally, I averaged the distances for each farm, in Excel, as an index of disturbance on a farm scale.

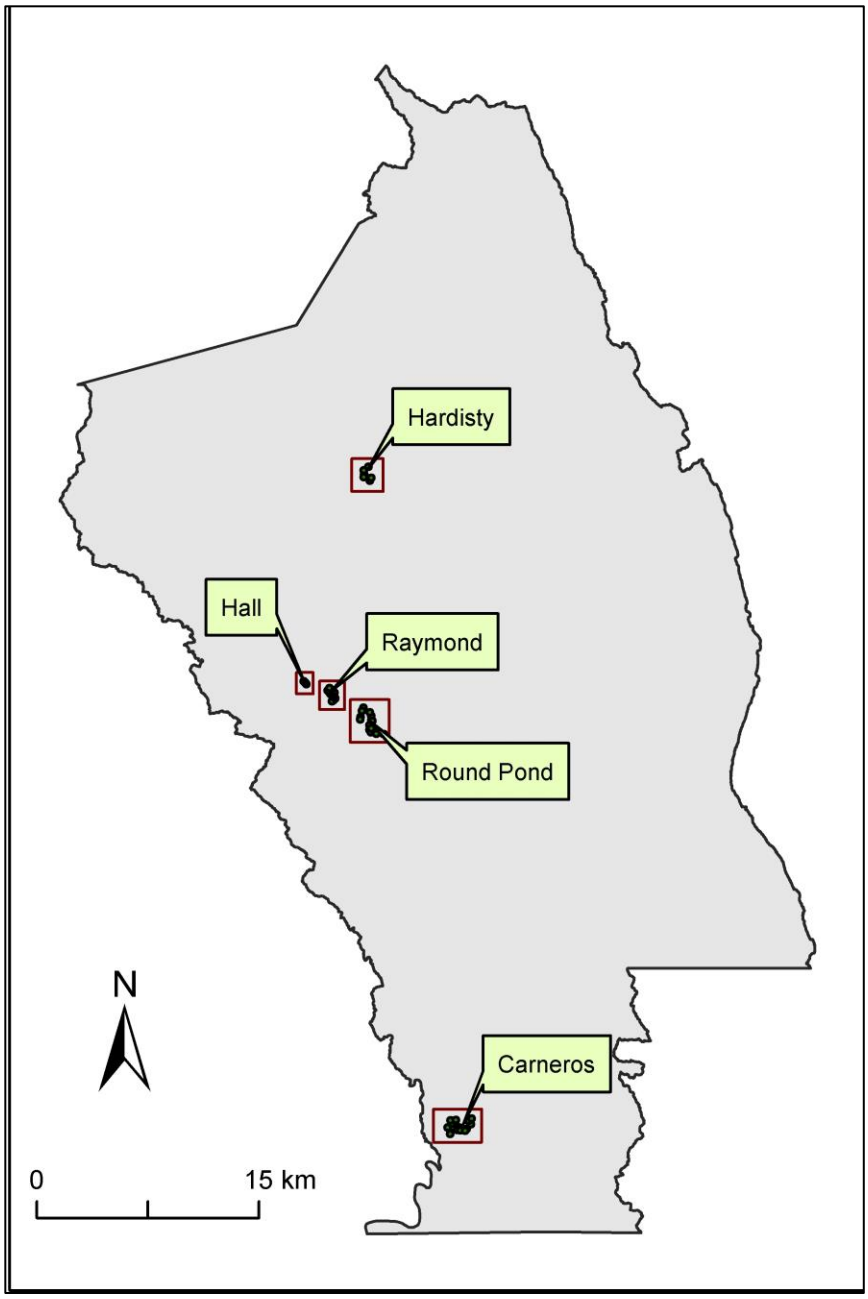

Figure 2. Map of farm locations within Napa County. For this project I focused on Hardisty, Raymond and Hall vineyards.

Barn owls are thought to be tolerant of human disturbance (Taylor 1994). I will test this for my thesis by building linear models relating nest box occupancy with the average distance to the nearest building. The sample of nest boxes I used for this project are spread all over Napa Valley in areas with varying building densities,

therefore making the average distance to buildings an important proxy for disturbance.

Results

I sampled a total of 18 barn owl nest boxes on 3 farms. The vineyards are too far apart to show all the boxes on one map. Therefore, I made multiple farm scale maps showing the locations of the barn owl boxes with the line segments layer turned on. The following maps show the locations of the barn owl boxes on each vineyard and the lines I calculated to measure distance to the closest building in each quadrant (Figures 3-5).

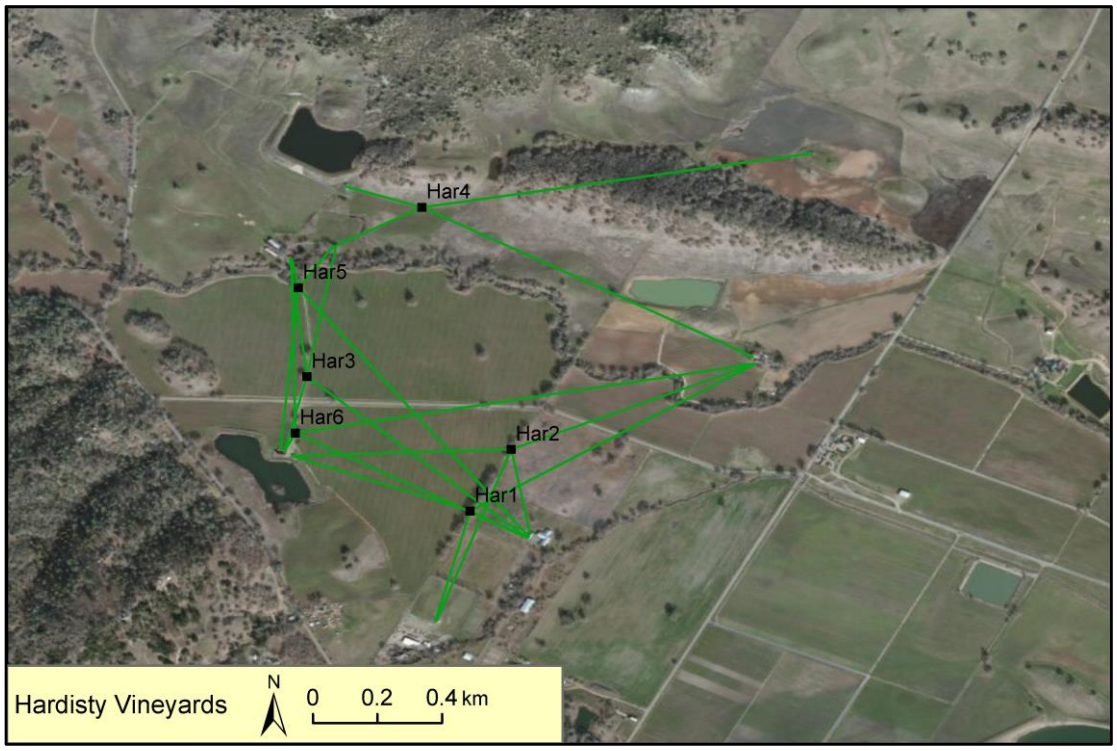

Figure 3. Map of Hardisty vineyard with line segments showing the distance from each barn owl box to the closest buildings in each quadrant

Figure 4. Map of Hall vineyard with line segments showing the distance from each barn owl box to the closest buildings in each quadrant

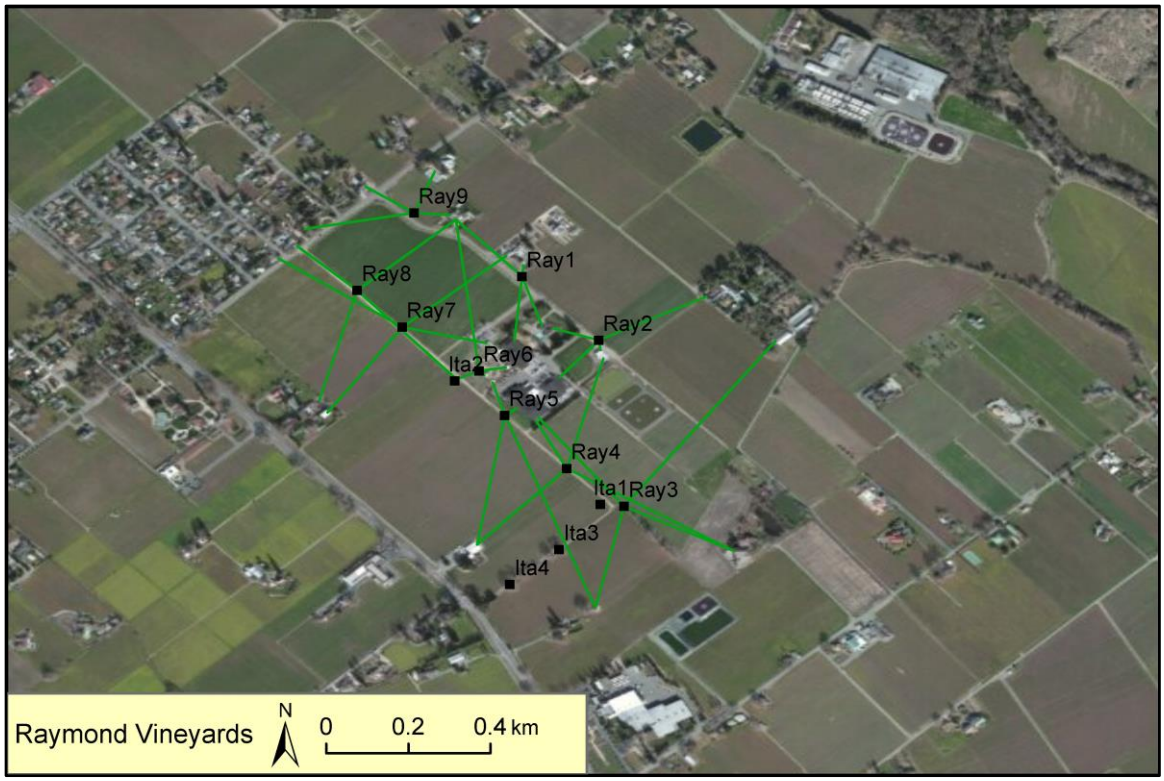

Figure 5. . Map of Raymond vineyard with line segments showing the distance from each barn owl box to the closest buildings in each quadrant

The average distance to buildings for each box and the average distances for the farms are shown in table 1.

Table 1. Average distance to a building for each nest box and average distances for each farm.

Farm	Box ID	Av. Dist. to Building (m)	Av. Dist. for Each Farm (m)
Hardisty Vineyards	Har1	450.61	
	Har2	501.04	
	Har3	435.48	
	Har4	580.42	
	Har5	424.62	
	Har6	595.66	497.97
Hall Vineyards	Hall1	151.49	
	Hall2	204.18	
	Hall3	191.05	182.24
Raymond Vineyards	Ray1	124.02	
	Ray2	116.06	
	Ray3	313.73	
	Ray4	258.28	
	Ray5	232.31	
	Ray6	121.04	
	Ray7	242.84	
	Ray8	244.43	
	Ray9	125.29	197.56

Discussion

There was significant variation in average distances between nest boxes and between farms. Average distances to buildings for individual nest boxes ranged from 116 m to 595 m. Hall vineyard had buildings closest to barn owl boxes (average of 182 m) while the Hardisty vineyard boxes had the furthest away

buildings (average of 497 m). These patterns were expected, as building density could be seen in the vineyard maps. Hall vineyards is on the edge of the town of St. Helena while Hardisty vineyards is more remote. Measuring average distances to buildings on a nest box and farm scale allows for quantification of landscape variables that can be further analyzed with advanced statistics. For my thesis I will use these averages, and a suite of other variables, to build logistic regression models to predict nest box occupancy.

At this point, I am unable to conclude what factors drive occupancy for each nest box, because I do not know which boxes will be occupied in the spring. This project allowed me to see the variation in the landscape and local variables, which I predict drive nest box occupancy. I expect to find fewer occupied nest boxes on farms that are on average closer to buildings. I also expect to that proximity to buildings will influence occupancy on a nest box scale.

This project taught me how to use many useful tools in ArcMap. It was also helpful to visualize the scope of my thesis work and work through some of my methods.

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