



## AN ABSTRACT OF THE THESIS OF

Stephanie E. Caldwell for the degree of Honors Baccalaureate of Science in Zoology  
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Title: Abundances of raptors wintering in the Willamette Valley, Oregon, before and after  
a ban on grass field burning.

Abstract approved:

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Doug Robinson

### Abstract

For the past 50 years, open-field burning has served as the main method to manage postharvest residue in grass seed fields within the Willamette Valley. Recently, farmers have implemented the full straw load and clean-nonthermal methods to remove straw after harvest. We hypothesized that these two alternative methods have caused rodent populations to increase and that this increase would be reflected in raptor numbers. Roadside surveys were conducted from 2004 to 2013 in the Benton, Lane, Linn, Marion, Polk, and Yamhill counties to gather data for abundances of raptors around grass seed fields. We compared the means of Red-tailed Hawks, American Kestrels, Northern Harriers, and Rough-legged Hawks before and after 2007. We found that there were no significant changes in numbers of any species before or after 2007. Data on rodent populations within burned fields and non-burned fields are needed to determine if the decrease in burned acreage has affected the abundance of raptors.

Key words: Raptors, Willamette Valley, Open-field Burning, Abundances, Grass Fields

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Abundances of raptors wintering in the Willamette Valley, Oregon, before and after a ban  
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I understand that my project will become part of the permanent collection of Oregon State University, University Honors College. My signature below authorizes release of my project to any reader upon request.

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Stephanie E. Caldwell, Author

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# **Abundances of raptors wintering in the Willamette Valley, Oregon, before and after a ban on grass field burning**

## **Introduction**

Western Oregon is currently the world's leading producer of cool-season forage and turf grass seed. At the height of its production, grass seed was grown on about 480,000 acres (Griffith et al. 2002). This crop is extremely important to Oregon's economy. According to the Oregon Seed Council (2014), there are 1,500 grass seed farmers who provide nearly 10,000 jobs for Oregonians. In 2009, the industry was worth \$300 million. An industry this large requires intensive management in order to maintain maximal profits.

Open-field burning was previously the primary method used by farmers in Western Oregon to remove straw after harvest. For the past 50 years, burning has been used to remove straw, reduce disease, return nutrients to the soil, and reduce pests such as voles (Hart et al. 2012). Beginning in the mid-1980s, legislation significantly diminished the number of acres being burned each year. Burned acreage declined from about 230,000 acres in the mid-1980s to less than 10,000 acres in 2007 (Hart et al. 2012).

Decreased use of open-field burning has left farmers with the dilemma of finding alternative ways to remove straw after harvest (known as postharvest residue). Currently, the two main techniques are the full straw load and clean-nonthermal methods. The full straw load method allows straw to remain in the field to decompose and return nutrients to the soil. The straw is often mowed to trim down the height of the stubble. The clean-nonthermal method employs the removal of straw from the field after harvest by baling (Hart et al. 2012). All of these practices, including burning, influence rodent populations (Steiner et al. 2007).

Two primary factors are necessary to sustain vole populations: food and cover (Jacob 2003). Reduction of straw length can leave voles and other rodents susceptible to predation (Jacob 2003, Edge et al. 1995, Steiner et al. 2007, Sheffield et al. 2001) perhaps owing to behavioral changes (Jacob 2003, Sheffield et al. 2001). Avian predators, such as raptors, have a preference for hunting in short vegetation within the Willamette Valley (Sheffield et al. 2001, Steiner et al. 2007). Under the full straw load method it is presumed that the leftover straw enhances habitat for the gray-tailed vole (*Microtus canicaudus*) (Hart et al. 2012), which is the dominant species in Western Oregon agricultural fields (Steiner et al. 2007, Edge et al. 1995). Edge et al. (1995) found that mowing in alfalfa fields reduced vole populations by fifty percent; however, they quickly recovered after the disturbance. Even though the vegetation height is sometimes reduced by mowing for the full straw load method, other studies have found that the residue is still sufficient to maintain vole populations (Hart et al. 2012). Under the clean-nonthermal method no residue is left in the fields, however, the crown re-growth of grass provides adequate cover (Hart et al. 2012). Hart et al. (2012) also reported that the leftover seeds and exposed roots from harvest provide ample food for rodents.

In contrast to these new management practices, open-field burning had served as a method for pest management. Although we found no studies designed to address effects of open-field burning on voles in the Willamette Valley, two studies in other grasslands have examined rodent responses to fire. Fire killed all the species of mice that were present in a mixed brush and grassland environment either directly by the fire (especially those with shallow burrows) or by elimination of food and cover (Cook 1959). In a tallgrass blackland prairie, rodents experienced population declines after a prescribed

burn (Kirchner et al. 2011) and were confirmed to be directly killed by fire. In western Oregon, Steiner et al. (2007) suggested that a lack of data indicates it is currently unclear if voles have increased or decreased since the implementation of a ban on field burning.

In light of all the evidence, we hypothesized that rodent populations have been on the rise since the anti-burning legislation took effect and that the increase could be reflected in changes in numbers of raptors in western Oregon during winter. Small rodents serve as the main food source for wintering raptors in western Oregon (Preston and Beane 2009, Bechard and Swem 2002, Smallwood and Bird 2002, Smith et. al. 2011, Sheffield et. al. 2001, Collopy and Koplin 1983). To evaluate this hypothesis, we took advantage of a long-running citizen science project that surveys raptors along roadside routes throughout the Willamette Valley. The surveys identify and count all raptors seen along routes from December through February. The surveys began before the open-field burning ban and have continued annually. If the field burning ban influenced regional availability of rodents as food for raptors, we hypothesized that these surveys would show regional increases in numbers of raptors in the years since burning was limited.

## Methods

The data were collected via roadside surveys conducted in the Willamette Valley. Routes were constructed around grass seed fields in the Benton, Lane, Linn, Marion, Polk, and Yamhill counties. Surveys were taken between the months of December and February beginning the winter of 2004-2005 to the winter of 2012-2013. There were three routes for Benton County: central, north, and south. Surveys for the northern route were not driven until the winter of 2005-2006. For the winters of 2004-2005 and 2005-2006, the central and southern routes were driven as one route. Two raptor routes for Lane County were used in this study. Four routes for Linn County were used. Linn County Unit 3 began as one route but was separated into two routes (Linn County Unit 3A was west of I-5 and Linn County Unit 3B was east of I-5) the winter of 2007-2008. When Linn Co. Unit 3 was separated, several road segments were added to each route to acquire more coverage of the area (see appendix of routes). Linn County Unit 5 was not driven until the winter of 2005-2006.

Routes were driven primarily by volunteers who identified and counted raptors with the aid of spotting scopes and binoculars. Routes were broken into segments based on roads traveled and numbers of raptors were kept separately for each road segment. However, no habitat data were recorded so we have no information on which road segments were adjacent to burned or unburned fields. If the species could not be identified it was recorded as “unknown”; we excluded this small percentage of birds from our analyses.

Our study focused on four species of raptors: Red-tailed Hawk (*Buteo jamaicensis*), American Kestrel (*Falco sparverius*), Northern Harrier (*Circus cyaneus*),

and Rough-legged Hawk (*Buteo lagopus*). These four species were chosen because their winter diets are highly dependent on small mammals such as voles, mice, and other rodents (Preston and Beane 2009, Bechard and Swem 2002, Smith et. al. 2011, Sheffield et. al. 2001).

## Results

We compared the mean number of each species for all of the surveys (December, January, and February) before and after 2007. We chose this year because there was a significant decrease in the amount of acres burned in the Willamette Valley after 2007. In all cases, confidence intervals overlapped indicating no evidence for changes in raptor abundances before and after the burn ban. The mean number of Red-tailed Hawks per 50 miles before 2007 was 30.0 with a 95% confidence interval of (14.1, 45.9). The mean after 2007 per 50 miles was 27.1 with a 95% confidence interval of (12.1, 42.1) (Fig. 1). Figure 2 shows a 95% confidence interval of (16.8, 34.8) for a mean number 25.8 American Kestrels per 50 miles before 2007. The mean after 2007 per 50 miles was 21.2 with a 95% confidence interval of (12.4, 30.0). Before 2007, the mean number of Northern Harriers per 50 miles was 7.3 with a 95% confidence interval of (-0.3, 14.9). After 2007, the mean per 50 miles was 7.3 with a 95% confidence interval of (1.5, 13.1) as shown in Figure 3. Figure 4 shows the mean number of Rough-legged Hawks was 0.8 with a 95% confidence interval of (-0.1, 1.7) before 2007. The mean after 2007 was 1.7 with a 95% confidence interval of (-0.3, 3.7).

We also compared the mean number of each species for one survey per route per year before and after 2007. We chose January because that is the time of year when most raptor species are no longer migrating and are more likely to be winter residents. We found that the mean number of Red-tailed Hawks was 30.0 per 50 miles with a 95% confidence interval of (15.1, 44.9) before 2007 (Fig. 5). After 2007, the mean was 27.5 with 95% confidence interval of (13.3, 41.7). For the American Kestrels, we found that the mean before 2007 was 27.8 with a 95% confidence interval of (18.8, 36.8) (Fig. 6).

The mean was 21.3 with a 95% confidence interval of (12.3, 30.3) after 2007. Figure 7 shows that the mean for Northern Harriers was 8.8 before 2007 with a 95% confidence interval of (0.9, 16.7). 7.3 was the mean after 2007 with a 95% confidence interval of (1.2, 13.4). Lastly, the mean before 2007 for Rough-legged Hawks was 0.9 with a 95% confidence interval of (0.0, 1.8) and after 2007 the mean was 1.7 with a 95% confidence interval of (-0.3, 3.7) (Fig. 8).



## Discussion

The mean numbers of each species detected along raptor survey routes in December, January and February showed significant overlap of confidence intervals before and after 2007. We found that this was also apparent in the comparison of the means for just the January surveys. Numbers of raptors were so variable across years that confidence intervals were large. Because of the extended overlap in confidence intervals, the data do not support the hypothesis that wintering raptors were affected by the decrease in burned acreage in the Willamette Valley.

There are several reasons that may explain why there were no changes in abundances of raptors. According to Preston (1990), hunting success for raptors is dependent on habitat structure, the abundance of prey, and vegetation density. Preston (1990) found that rodent numbers were higher in wetland habitats in Arkansas even though Red-tailed Hawks preferred old field patches. He concluded that there was no relationship between prey biomass and raptor foraging distribution. This conclusion was supported by Chaves-Ramirez and Pietro (1994) who researched the effects of fires on habitat use by wintering raptors. They stated that raptors forage in fields depending on the vegetative structure rather than the abundance of prey. Another study found that American Kestrels preferred short vegetation and gray-tailed voles preferred dense vegetation (Sheffield et al. 2001). If rodent populations are increasing due to the changes in farming practices it may not be apparent in raptor numbers due to these factors. Further data analysis may also provide a clearer picture of trends and patterns in raptor numbers in relation to the decrease in burned acreage over the years, but the highly

variable numbers from year to year suggest there will be no clear trends to be associated with the burning ban.

There are other farming practices that influence rodent populations as well. Many of these are dependent on the type of crop that is grown. It has been confirmed that tillage (Steiner et al. 2007, Jacob 2003), rotating crops (Steiner et al. 2007, Hart et al. 2012), and promoting predator habitat (Jacob 2003, Steiner et al. 2007, Sheffield et al. 2001) can reduce populations of voles. Perennial stands, as well as direct-seed planting (Steiner et al. 2007), can provide stable environments for rodents due to the lack of disturbances (Hart et al. 2012). Annual grass seed stands provide a less stable habitat since disturbances such as tillage are more frequent (Hart et al. 2012). However, it is unlikely that these farming practices would cause any obvious or lasting effects on raptor numbers due to the mobility of raptors.

Future studies could improve our understanding of how raptors respond to field burning. According to the Oregon Seed Council (2014), there are still 15,000 acres burned in the Willamette Valley per year. Researchers could trap rodents within burned fields as well as fields that are managed using the full straw load and clean-nonthermal methods to estimate population sizes of rodents. Raptor surveys and observations of fields exposed to particular treatments would clarify how often raptors forage in burned and unburned fields. Once those relationships were quantified, it would be possible to create landscape models that predict changes in regional numbers of raptors. A less experimental approach that could also provide similar data would be to add collection of habitat data to raptor surveys. If citizen scientists recorded information on condition of

fields where they see raptors, this accumulated data might inform our understanding of choices that raptors make regarding habitat use.

Based on current analyses, it appears that raptor numbers were not influenced by the ban on open-field burning. However, further data on raptor numbers in specific fields are needed to more completely determine the relationship between field management practices and the abundances of raptors.

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### Appendix of Routes

Route Name	Average Length (miles)	Years Sampled
Benton County Central	62.3	2004-2013
Benton County North	50.8	2005-2013
Benton County South	65.0	2004-2013
Lane County Unit 1	61.0	2004-2013
Lane County Unit 2	82.2	2004-2013
Linn County Unit 2	85.1	2004-2013
Linn County Unit 3	176.9	2004-2013
Linn County Unit 4	132.9	2004-2013
Linn County Unit 5	65.4	2005-2013
Marion County North	107.0	2004-2013
Marion County South	91.7	2004-2013
Polk County North	112.1	2004-2013
Polk County South	97.3	2004-2013
Yamhill County	103.6	2004-2013

## Appendix of Figures

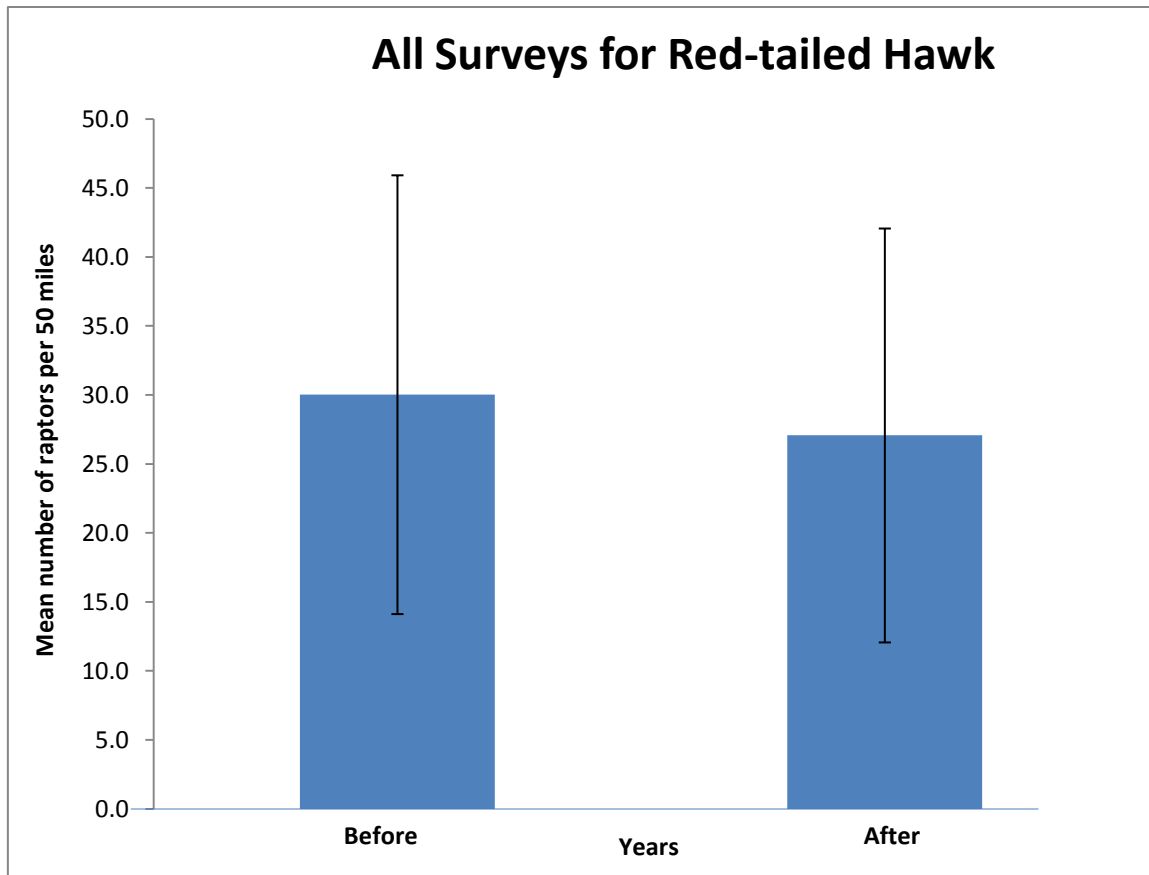


Figure 1. Mean number of Red-tailed Hawks per 50 miles before and after 2007 with  $\pm$  95% confidence intervals.

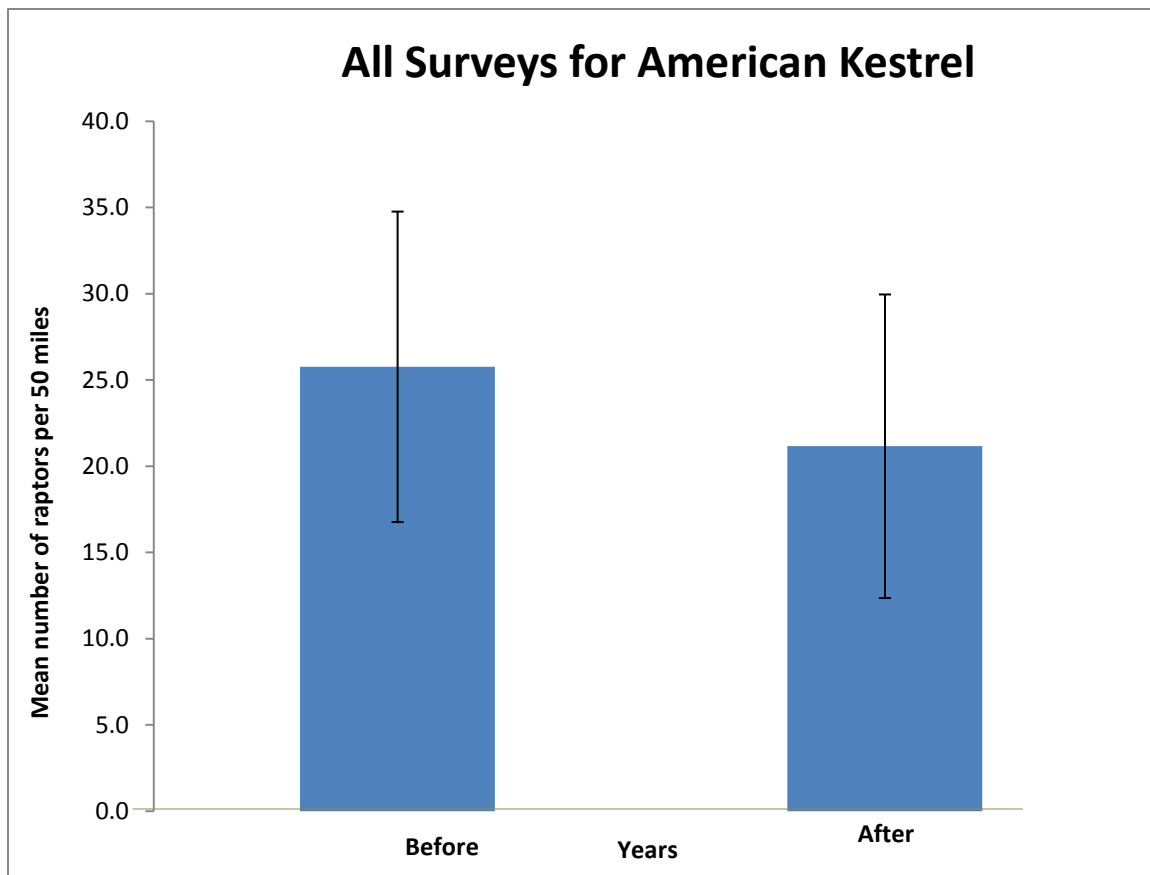


Figure 2. Mean number of American Kestrels per 50 miles before and after 2007 with +/- 95% confidence intervals..



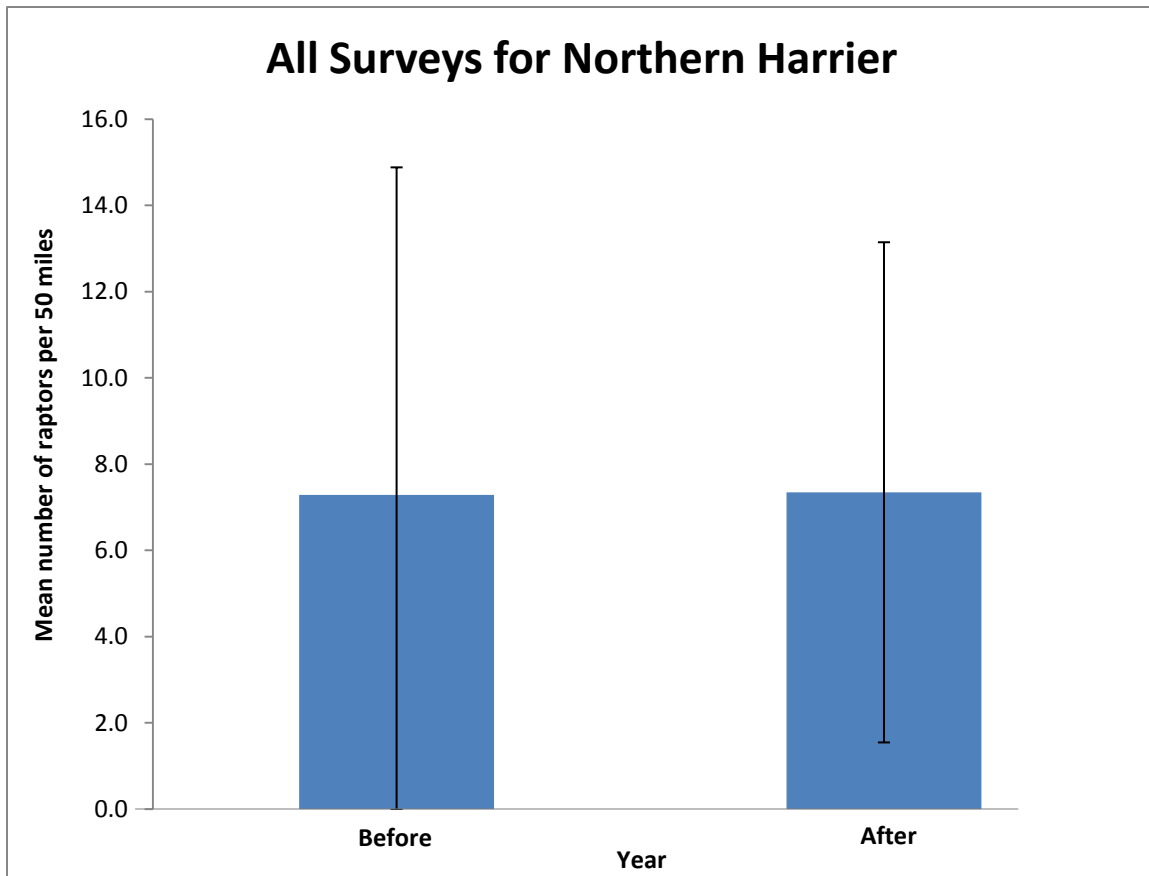


Figure 3. Mean number of Northern Harriers per 50 miles before and after 2007 with  $\pm$  95% confidence intervals.

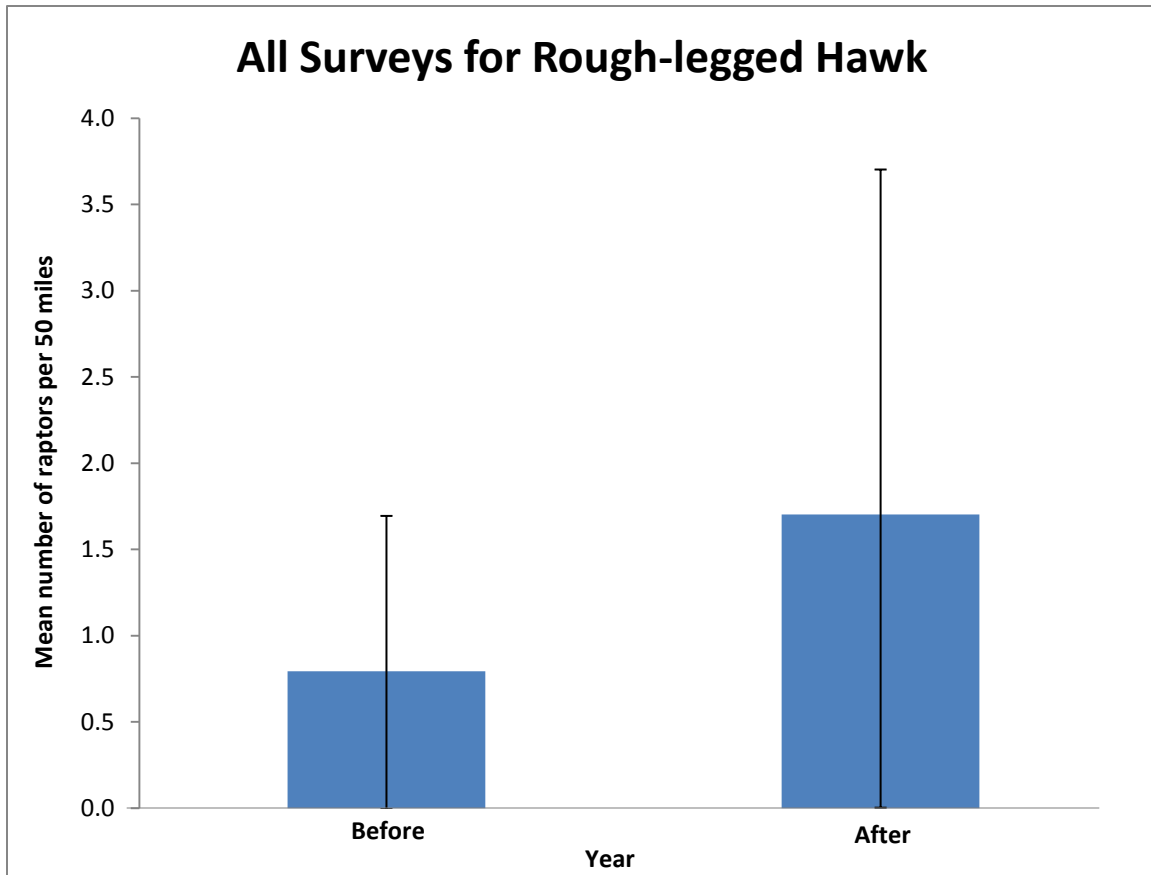


Figure 4. Mean number of Rough-legged Hawks per 50 miles before and after 2007 with  $\pm$  95% confidence intervals.

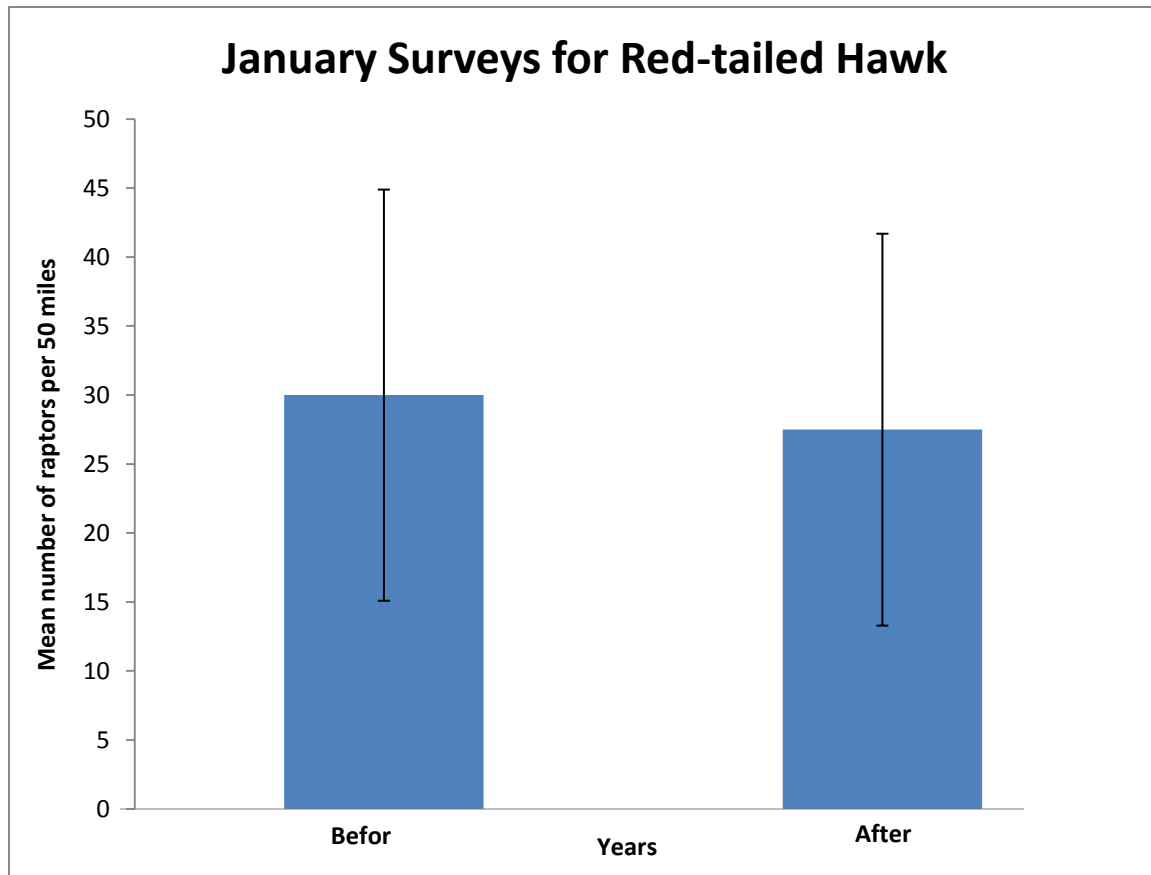


Figure 5. Mean number of Red-tailed Hawks per 50 miles before and after 2007 with +/- 95% confidence intervals.

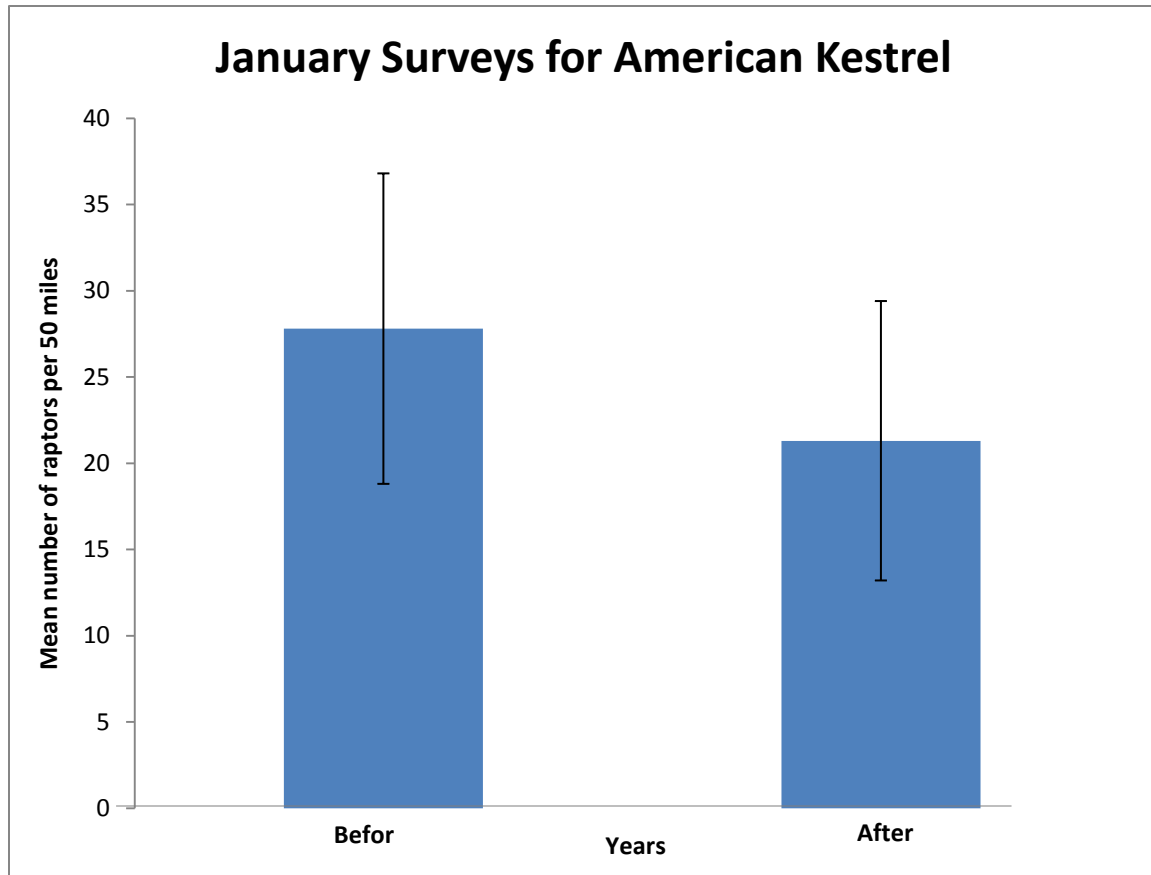


Figure 6. Mean number of American Kestrels per 50 miles before and after 2007 with  $\pm$  95% confidence intervals.

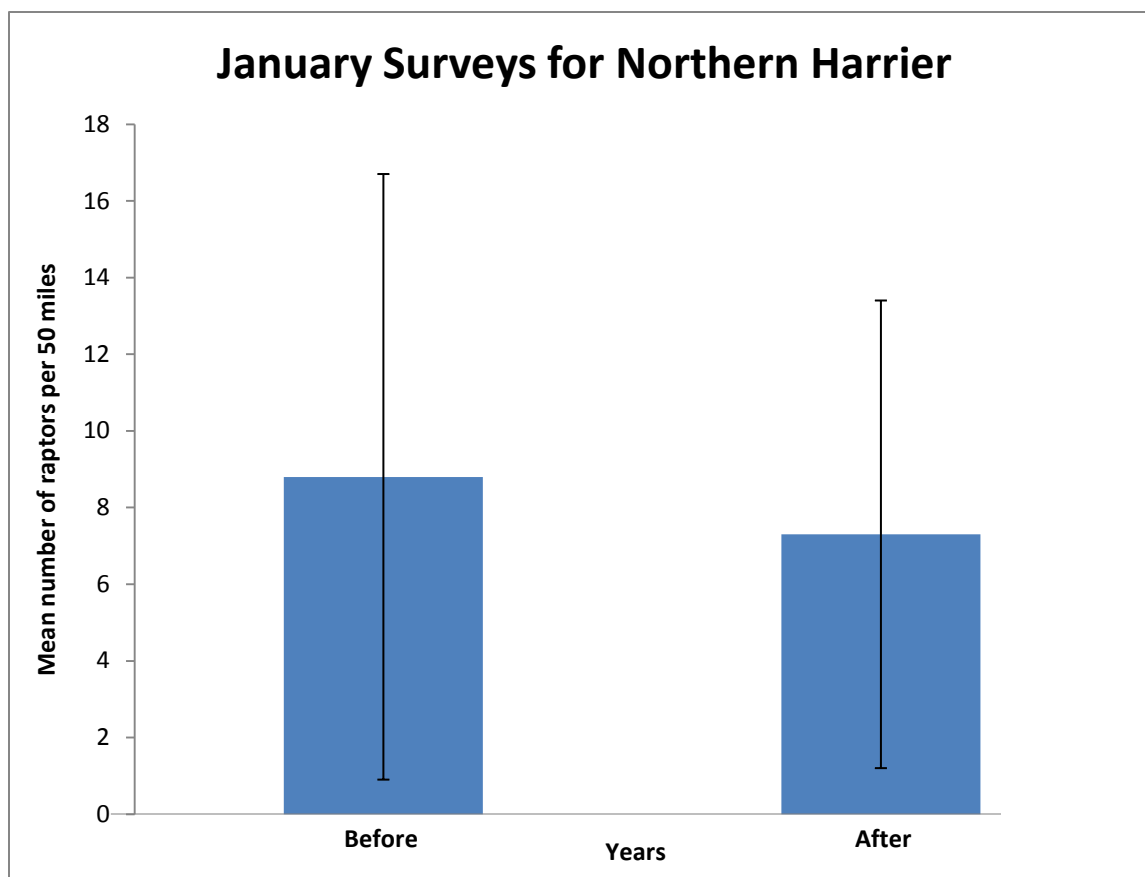


Figure 7. Mean number of Northern Harriers per 50 miles before and after 2007 with  $\pm$  95% confidence intervals.

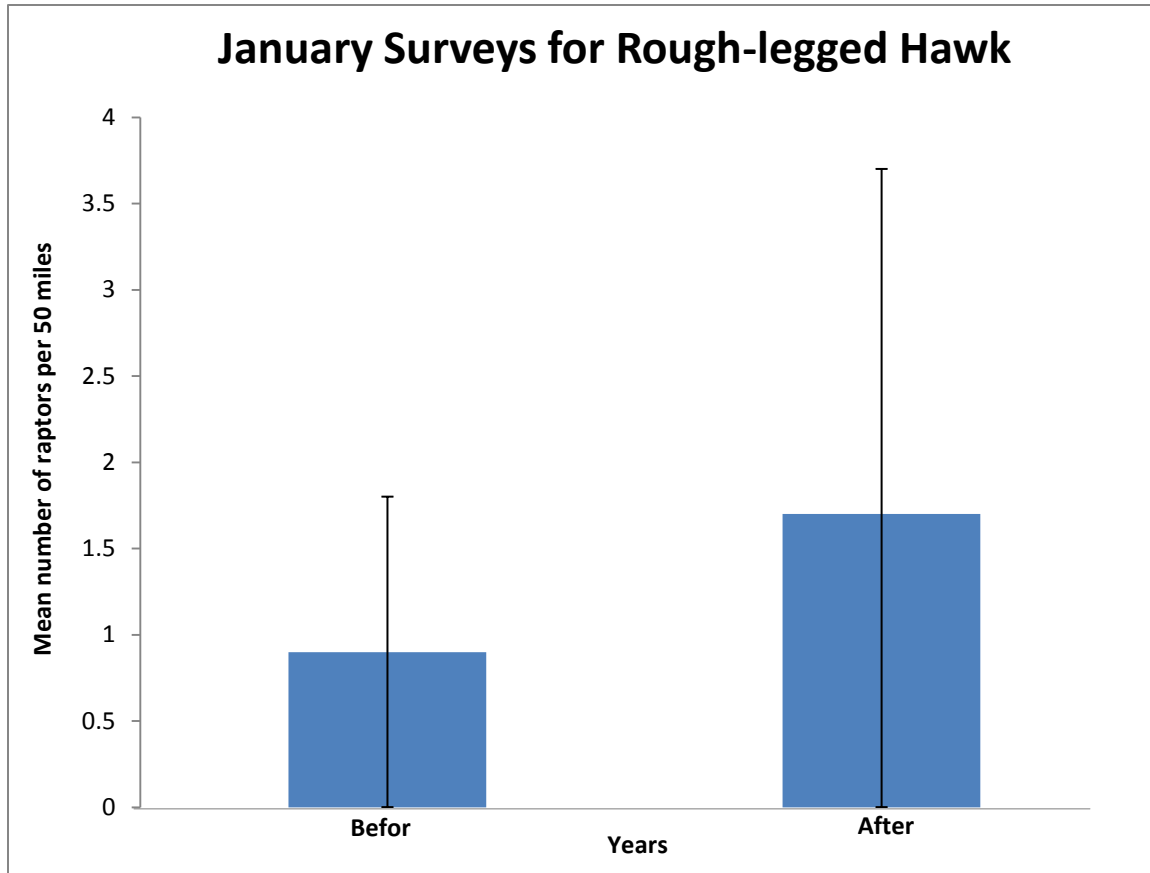


Figure 8. Mean number of Rough-legged Hawks per 50 miles before and after 2007 with  $\pm$  95% confidence intervals.

