Central Valley Winter Raptor Survey (2007-2010): Perch Selection and the Influence of Weather on Raptor Behavior

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Nearly all raptors spend most of their day on a perch, and most hunt from a perch either as their primary strategy or as one of several strategies. While there are many studies of raptor perch behavior, few are recent, and none have studied perch preference and behavior in the Central Valley (CV). As part of the protocol for the CV Winter Raptor Survey (Pandolfino et al. 2011, Pandolfino and Smith 2011), we recorded behavior when each bird was first seen (flying or perched and perch type). This allowed us to compare frequency of flying versus perching and the type of perches used by each species. We also recorded data on wind speed and cloud cover, and report on effects of those weather conditions on raptor behavior.

STUDY AREA AND METHODS

Survey methods are described in the accompanying overview and methods paper (Pandolfino and Smith 2011). We used all observations for each species to determine the relative frequency (percent of observations) of flying or perching and perch use. Analyses were based on the behavior seen when the bird was first observed. To assess effects of wind speed on behavior, we computed the average Beaufort Scale (Table 1) wind speed by averaging the wind speed estimate at the beginning and end of routes. Likewise, we averaged sky conditions at the start and end of surveys using a scale similar to that used for Breeding Bird Surveys (0 = clear, few clouds, 1 = partly cloudy, 2 = cloudy or overcast, 4 = fog or smoke, 5 = drizzle). Average sky conditions of 0 or 0.5 were considered sunny, and values above 0.5 were considered cloudy. Surveys were not conducted, however, when wind speed was consistently at Beaufort Scale 4 or above or when fog or rain impaired visibility to less than 500 m.

Table 1. Beaufort Scale of Wind Speed.

Beaufort No.	Indicators of Wind Speed	Wind speed (km/hr)
0	Smoke rises vertically	< 2
1	Wind direction shown by smoke drift	2-5
2	Wind felt on face; leaves rustle	6-12
3	Leaves, small twigs in constant motion	13-19
4	Raises dust and loose paper, small branches move	20-29

To determine wind effects on behavior, we plotted the percent of birds seen in flight versus wind speed and conducted linear regression analysis to look for significant relationships, using $p < 0.05$ to indicate a significant effect.

Perch sites were assigned to seven categories:

Ground: the ground, rock outcrop, or very low vegetation such as rice stubble.
Fence: fence post or fence wire.
Utility Pole: the top or cross bar of a utility pole (but not high-voltage electrical towers).
Utility Wire: utility line, including both transmission and distribution lines
Tree: Live or dead tree or large woody shrub.
Other: high voltage electrical towers and any other man-made structures not included in other categories.

RESULTS AND DISCUSSION

Flying versus Perching

Northern Harriers were the most aerial of the species we observed, with 80% of harriers observed in flight (Figure 1). This is consistent with prior studies (Craighead and Craighead 1956 and Bildstein 1987) who also observed a higher proportion of harriers in flight than for any other raptor studied. This species hunts almost exclusively by low patrolling flights (Smith et al. 2011). Turkey Vultures also forage almost exclusively by searching during long soaring flights, therefore, our observation that they were observed in flight more than three-fourths of the time was expected.

The three open-county Buteos, the Red-tailed, Ferruginous, and Rough-legged Hawk showed different tendencies, with Rough-legged Hawks the most likely to be seen flying and Red-tailed Hawks the least likely. These observations also are consistent with prior studies (Craighead and Craighead 1956, Schnell 1968, Bildstein 1987) that compared those two species. No prior work directly compared this aspect of behavior for Ferruginous Hawks to the other two Buteos so our finding that this species' flight-vs.-perched tendency was intermediate between Red-tailed and Rough-legged hawks appears to be new.

Thirty-five percent of White-tailed Kites we observed were flying, in general agreement with time budget studies in winter in northwestern California, in which kites spent approximately 20% of daylight hours in flight (Koplin et al. 1980). American Kestrels were among the most likely species to be seen perched, with 79% of our observations of perched birds. Prior studies found between 69 and 89% of American Kestrels perched (Craighead and Craighead 1956, Rudolph 1982, Bildstein 1987), and time budget studies

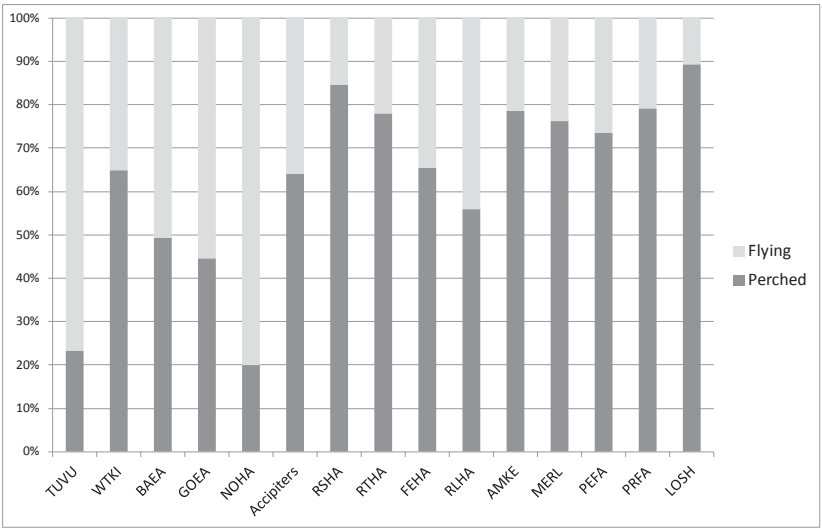

Figure 1. Comparison of behavior, flying or perched, for a variety of species. (TUVU = Turkey Vulture, WTKI = White-tailed Kite, BAEA = Bald Eagle, GOEA = Golden Eagle, NOHA = Northern Harrier, Accipiters = Cooper's, Sharp-shinned hawks and all unidentified Accipiters, RSHA = Red-shouldered Hawk, RTHA = Red-tailed Hawk, FEHA = Ferruginous Hawk, RLHA = Rough-legged Hawk, AMKE = American Kestrel, MERL = Merlin, PEFA = Peregrine Falcon, PRFA = Prairie Falcon, LOSH = Loggerhead Shrike).

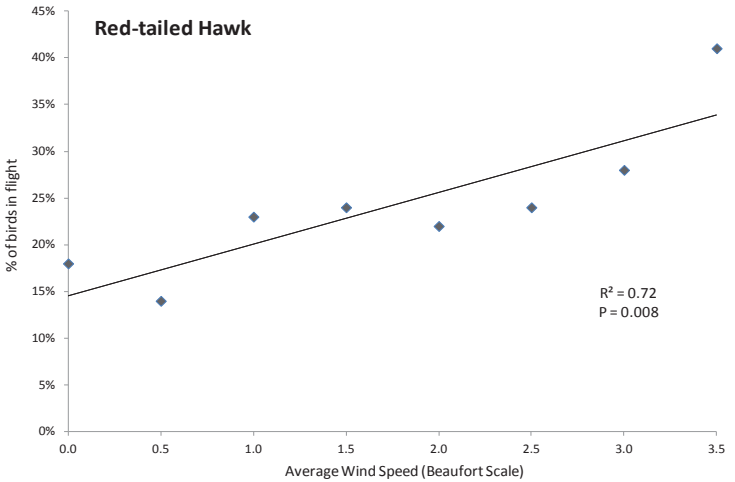

Figure 2. Scatter plot of percent of Red-tailed Hawks seen in flight versus wind speed. The trendline,R-squared value, and p-value are based on linear regression analysis.

in California estimated that they spend less than 7% of the daylight hours in flight (Koplin et al. 1980). Although kestrels frequently hunt while hovering, perch-hunting is the most common and energy-efficient strategy (Smallwood and Bird 2002).

We observed Prairie Falcons perching in the large majority of observations. This result may seem surprising in light of several breeding season studies (reviewed by Johnsgard 1990 and Steenhof 1998), which suggested that soaring or low level, "ambush" flights are common hunting strategies for this falcon. Enderson (1964), however, found that in winter and in particular when prey was abundant, most Prairie Falcons frequently used perches and initiated most hunting attempts from those perches. Loggerhead Shrikes were perched during a larger proportion of observations (89%) than any other species we recorded, consistent with prior studies from California (Craig 1978, Morrison 1980) and elsewhere (Bohall-Wood 1987, Yosef 1996).

Effects of Weather on Flying vs. Perching

We obtained sufficient data on four species (Turkey Vulture, Northern Harrier, Red-tailed Hawk, and American Kestrel) to assess effects of wind and sky cover on behavior. Bildstein (1987) also examined the effects of wind and sky cover on behavior of the harrier, Red-tailed Hawk, and the kestrel in winter in Ohio and his results provide interesting comparisons

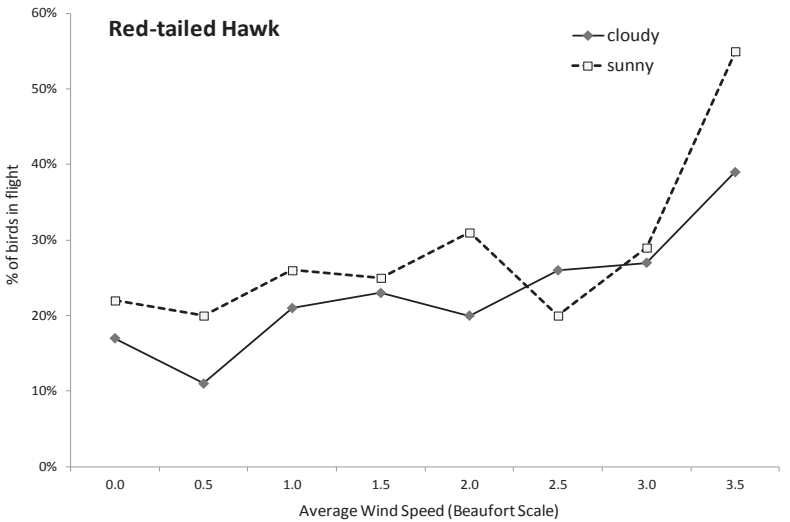

Figure 3. Percent of Red-tailed Hawks seen in flight versus wind speed for sunny and cloudy conditions.

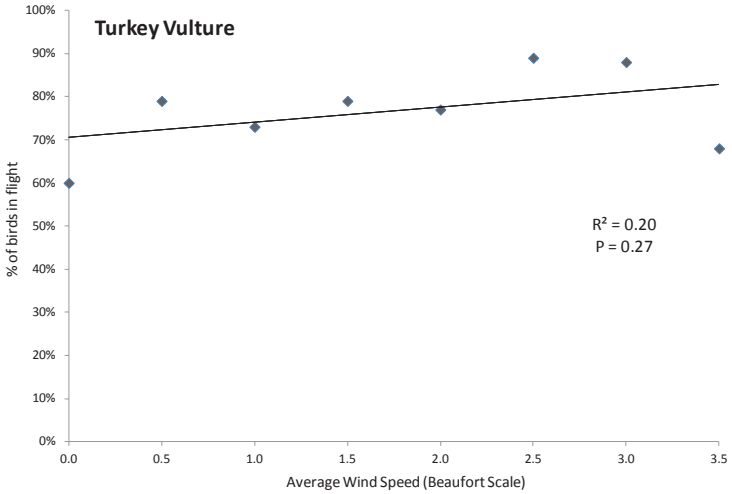

Figure 4. Percent of Turkey Vultures seen in flight versus wind speed. The trendline, R-squared value, and p-value are based on linear regression analysis.

with ours. Red-tailed Hawks showed a significant positive correlation between wind speed and proportion of birds in flight (Figure 2). Bildstein (1987) showed that a significantly higher percent of Red-tailed Hawks flew when wind speeds exceeded 10 km/hour (roughly equivalent to Beaufort number 2). Presumably, higher winds provide added lift which makes soaring more efficient for this large hawk. We also found that at nearly all wind speeds, a higher percent of Red-tailed Hawks flew on sunny days than on cloudy ones (Figure 3), again consistent with Bildstein (1987). Sunny conditions can create thermals (columns of rising warmer air) which this species uses to aid in soaring (Preston and Beane 2009). Bildstein (1987), however, found no consistently significant effect of sunny conditions on flight versus perch frequency for any of the other species he studied.

Turkey Vultures rely nearly exclusively on soaring flight to forage and make ample use of thermals and winds to increase flight efficiency (Kirk and Mossman 1998). Therefore, increases in wind speed and sunny days should cause a higher proportion of vultures to be flying. When we examined the effects of wind speed, we found no significant correlation across the full spectrum of wind speeds (Figure 4). However, when we removed data for the windiest conditions (Beaufort number = 3.5) the correlation became positive and significant ($R^2 = 0.72$, $P = 0.01$). It may be that the beneficial effects of increasing wind speed are lost above a certain level for this vulture. When we compared the proportion of birds in flight on sunny and cloudy conditions (Figure 5), we found that the proportion was consistently

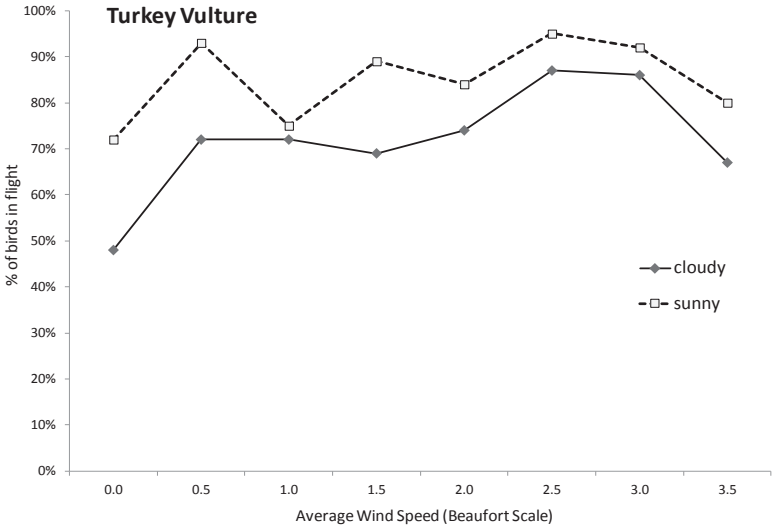

Figure 5. Percent of Turkey Vultures seen in flight versus wind speed for sunny and cloudy conditions.

higher on sunny days, consistent with increased access to thermals.

Bildstein (1987) found a significantly larger proportion of American Kestrels in flight when wind speeds were over 10 km/hour. Our results were consistent with that observation (Figure 6) with a significant positive correlation between wind speed and proportion of flying observations. The higher wind speed presumably allows kestrels to hover more efficiently or may make flying insect prey easier to capture as insects may be less able to evade kestrels under windy conditions. We found no consistent effect of sky cover on the frequency of flying by American Kestrels. We also found no significant effects of either wind or sun on Northern Harriers, also consistent with Bildstein (1987).

Perch Type Selection

We recorded the presence or absence of utility poles and fences, but no other perch types, in the habitat blocks we surveyed. Utility poles were present in 85% of the blocks surveyed and fences were present in 82%. Only 3% of habitat blocks lacked both fences and utility poles and 70% included both. Because we did not quantify overall perch abundance, it is not possible to determine statistical significance of the perch use we observed. That is, we cannot say with certainty that particular types of perches were selected more often than others in comparison to their availability. However, the pattern of perch selection for each species was qualitatively

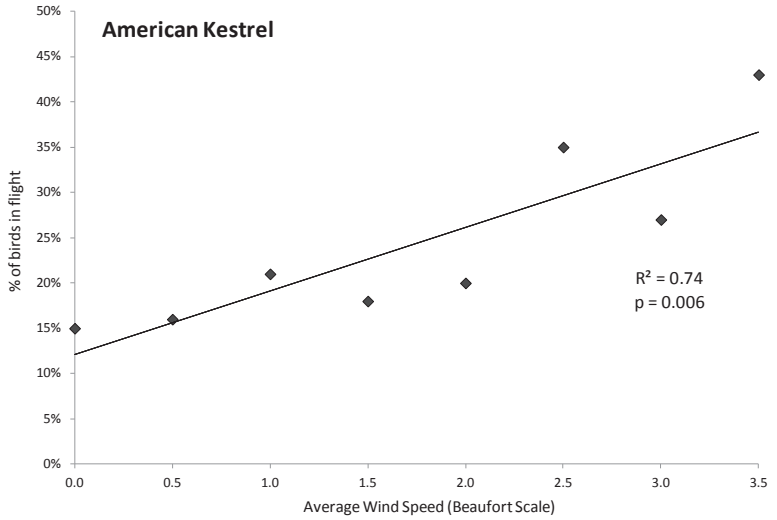

Figure 6. Percent of American Kestrels seen in flight versus wind speed. The trendline, R-squared value, and p-value are based linear regression analysis.

consistent from year to year and from route to route, supporting the likelihood that observed perch use is reflective of the species' preference.

The four species of Buteo differed in their use of perches (Figure 7). Red-tailed Hawks used higher perches, including trees and utility poles, much more frequently than Ferruginous Hawks or Rough-legged Hawks. Ferruginous and Rough-legged Hawks perched on the ground or on fences in more than half of all observations, respectively, whereas Red-tailed Hawks used the ground or a fence in only 14% of observations. Direct comparison of percentages between different study sites is complicated by the different proportions of perch types in each area. However, the relative preference for trees or poles for Red-tailed Hawks versus ground or fence for Rough-legged Hawks has been shown by Bildstein (1987) and Schnell (1968) for Rough-legged Hawks and by Plumpton and Anderson (1997, 1998) for Ferruginous Hawks. Langley (1999) and Fischer et al. (1984) concluded that Red-tailed Hawks prefer poles over trees, whereas Leyhe and Ritchison (2004) found the opposite. We found slightly more Red-tailed Hawks using poles than trees, but without having quantified availability of perch types, we can't determine if the difference reflects active selection by the species. Red-shouldered Hawks, a species closely associated with riparian and other wooded habitats (Dykstra 2008), perched mainly in trees (61%).

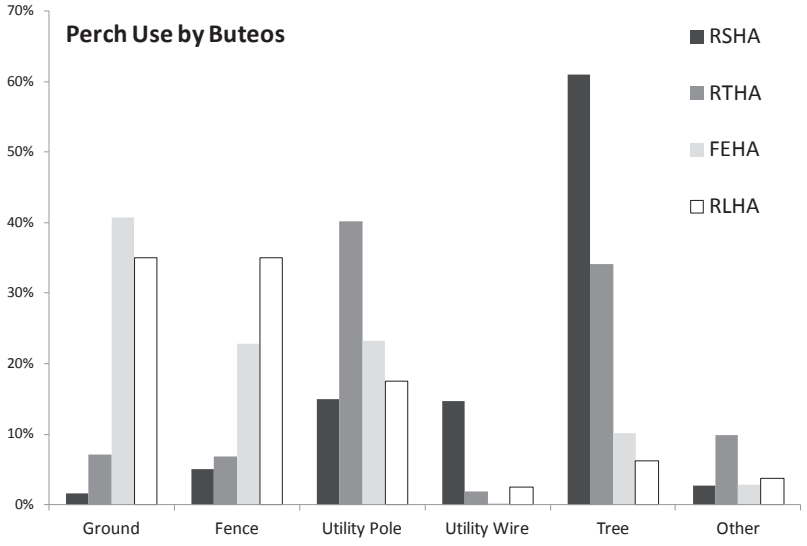

Figure 7. Perch type selection (% of perched birds using each perch type) for Red-shouldered Hawk (RSHA), Red-tailed Hawk (RTHA), Ferruginous Hawk (FEHA), and Rough-legged Hawk (RLHA).

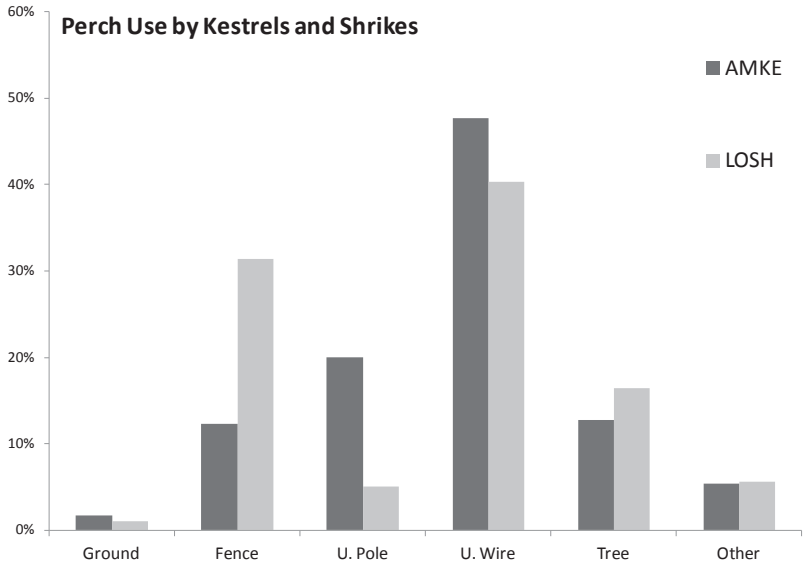

Figure 8. Perch type selection (% of perched birds using each perch type) for American Kestrel (AMKE) and Loggerhead Shrike (LOSH).

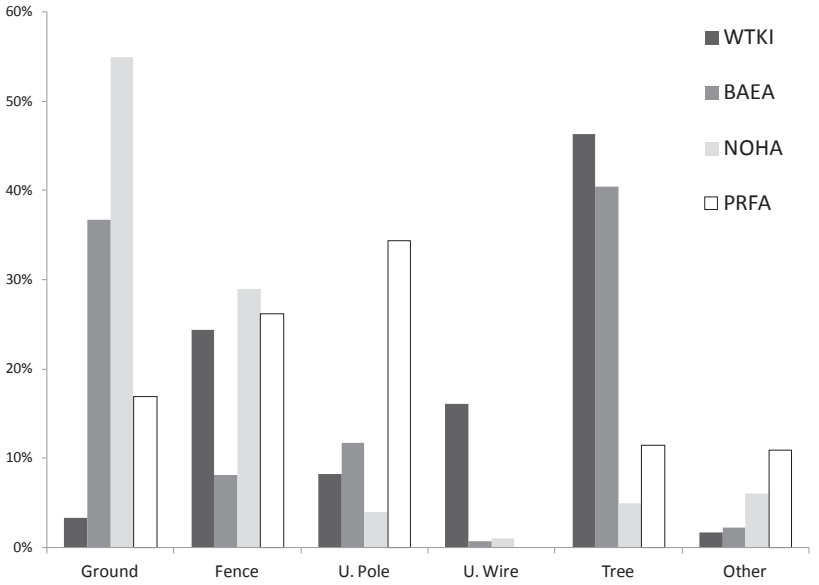

Figure 9. Perch type selection (% of perched birds using each perch type) for White-tailed Kite (WTKI), Bald Eagle (BAEA), Northern Harrier (NOHA), and Prairie Falcon (PRFA).

American Kestrels and Loggerhead Shrikes show considerable overlap in their prey selection, and their perch preferences also were similar (Figure 8). Both species perched on utility wires more often than any other perch type, consistent with prior work on American Kestrels (Bildstein and Grubb 1980, Bildstein 1987, Fischer et al. 1984) and Loggerhead Shrikes (Bildstein and Grubb 1980, Bohall-Wood 1987, Gawlik and Bildstein 1993). The greatest difference we observed among these species was in perch height, with American Kestrels perching much more often than shrikes on utility poles and shrikes more often using fences. Although we found slightly more shrikes than kestrels in trees, shrikes were almost exclusively found in smaller trees and large shrubs.

Of the Northern Harriers observed perched, 84% were either on the ground or on fences (Figure 9), similar to the proportion (92%) found by Bildstein (1987) for those same perches. We found White-tailed Kites using trees as their primary perch, with fences and utility wires next-most common. Prairie Falcons generally avoided trees, perching on utility poles most often. They also used fences frequently and were often found on the ground (usually on rock outcrops). Prairie Falcons used high tension towers (in the "Other" category) in 10% of the observations, more than any other raptor. We are aware of no previous research that quantified perch selection for either the White-tailed Kite or Prairie Falcon. Bald Eagles, which were found

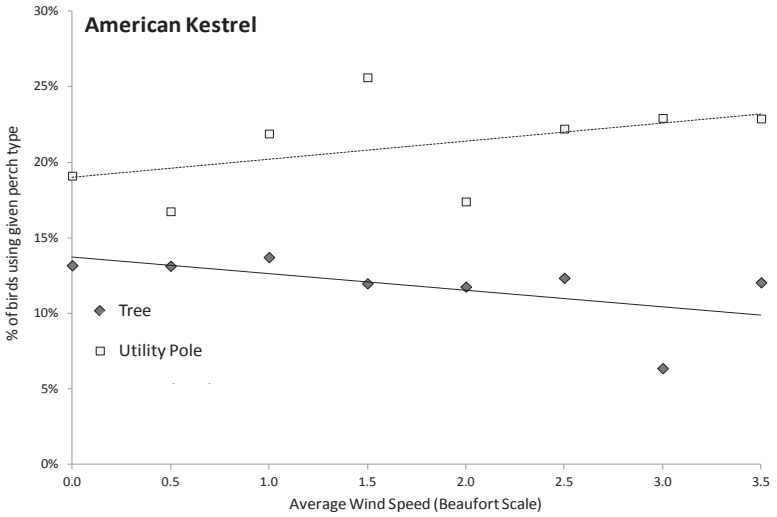

Figure 10. Percent of perched American Kestrels using trees or utility poles as perches versus wind speed. The trend lines are based linear regression analysis.

in rice much more often than other habitat types (Pandolfino and Smith 2011), were frequently seen perched on the berms between flooded rice fields. Over half of the perched Bald Eagles we observed were on the ground.

Effects of Weather on Perch Type Selection

Of all the species analyzed, only American Kestrels showed evidence of an effect of weather on perch site selection. While the trends were non-significant, the pattern suggested a switch from perching in trees to perching on utility poles as wind speed increased (Figure 10). This same phenomenon was noted by Bildstein (1987) and may reflect a desire to choose a more stable perch in higher winds.

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