FORAGING ECOLOGY IN WHITE-TAILED KITES (*ELANUS LEUCURUS*)

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ABSTRACT

Currently, white-tailed kites *(Elanus leucurus)* are listed as a Species of Special Concern by the state of California. Information about their foraging habitats is limited and needed for conservation of this species. Kites forage in agricultural areas in Grizzly Island Wildlife Area, near Suisun Marsh, California. This was a non-invasive study on forging ecology of white-tailed kites with a total of 757 hunting flights made during 57 hours of observed foraging behavior.

The objectives of this study were to: 1) identify differences in foraging behavior by age, gender, and season; 2) evaluate how hunting behavior differs in relation to habitat types; and 3) identify effects of other raptorial birds on kite hunting success.

Juvenile kites hunted for longer durations, made greater number of completed strikes at prey per hunt, and had fewer captures of prey per hunt than adults. Male kites hunted for longer durations, and had a higher number of prey captures per hunt than the females. The number of successful prey captures per hunt varied by season, with greater success rates during the winter and spring. Kites hunted for a longer duration in barley habitat when

compared to fallow habitat, but did not differ in their successful prey capture rate among habitat types.

When hunting interference occurred by another bird, kites had fewer prey captures than when no hunting interference occurred. However, kites rarely relinquished their prey to other raptors.

Understanding foraging behavior of white-tailed kites and their relationships to sympatric raptors has conservation and management applications. People have severely impacted and changed the environment with development and agriculture practices in many areas. A continued effort should be made to understand anthropogenic impacts before making major land use changes. Based on this research and others, irrigated agricultural land may provide good foraging habitat for some raptors. Irrigated agricultural habitats are wide spread in California, have changed dramatically over the past several decades, but have been associated with an increase in kite populations. Hopefully, it is possible to find a healthy balance between agricultural land and healthy raptor populations.

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INTRODUCTION

The white-tailed kite (*Elanus leucurus)* is a small diurnal raptor historically found in California (Dunk, 1995). More recently, smaller populations have been identified in Texas (Larson, 1980); Oregon and Washington (Fry, 1966; Jaksic, 1984); and Mississippi, Louisiana, and Alabama (Toups, et al. 1985). Factors contributing to white-tailed kite range expansion are not well understood (Larson, 1980), but may be attributed to the expanding range of some rodents (Pruett-Jones et al. 1980; Warner and Rudd, 1975). Kite populations declined dramatically during the 1920's and extinction was predicted for this species in California (Pickwell, 1930). Reasons for population decline included poaching, egg collection, and habitat loss (Pickwell, 1930; Stendell, 1972). Currently, kites are listed as a Species of Special Concern by the State of California. Kites have not been widely studied and more data are needed for conservation of this species.

Kites forage predominantly in semi-arid grasslands, riparian, and agricultural areas (Barnard, 1987; Johnsgard, 1990; Larson, 1980). Their primary prey is voles (*Microtus* spp.), but they will also capture other rodents such as house mice and western harvest mice (*Mus* spp. and *Reithrodontomys* spp.; Hawbecker, 1942; Larson, 1980; Waian,

1973). White-tailed kites are not migratory, but are nomadic during periods of low prey abundance (Brown, 1968; Pruett-Jones, et al. 1980; Stendell, 1972).

White-tail kites rely almost exclusively on hovering while foraging (Dunk, 1995; Mendelsohn and Jaksic, 1989). Kites actively defend their territories and compete for hunting areas with other kites and raptors during the breeding season (Erickson, 1995; Palmer, 1988). The studies on white-tailed kite foraging behavior are limited, and most were conducted between 1920 and 1970, with only a few publications in the past 30 years. The habitats previously studied were primarily agricultural areas surrounded by riparian habitats in California (Erickson, 1995; Warner and Rudd, 1975). This study site has some agricultural areas, but was surrounded by open marshland and was selected because of the high density of kites (Stendell, 1972). Kites can be difficult to trap, but their conspicuous foraging behavior and non-migratory movements make them excellent subjects for an observational study on feeding ecology.

Hunting guilds are formed when various bird species simultaneously use the same location to hunt prey (Jaksic, et al. 1981). During this study, short-eared owls (*Asio*

flammeus), red-tailed hawks (*Buteo jamiacensis)*, northern harriers (*Circus cyanus)*, and American kestrels (*Falco sparverius)* foraged in the same fields as kites and hunt similar prey (Baker and Brooks, 1981; Korpimaki and Norrdahl, 1991). Most predator-prey research has evaluated how predators can affect their prey, however Hamerstrom (1979) found that prey density can actually increase predator populations. Baker and Brooks (1981) correlated high raptor density with high vole density, but not all habitats that had high vole density had the highest raptor density. Understanding these guilds and the foraging relationships between white-tailed kites and other raptors can be used for conservation purposes.

The objectives of this study on white-tailed kites were to: 1) identify differences in foraging behavior by age, gender, and season; 2) evaluate how hunting behavior differs among habitat types; and 3) quantify the effects of behavior from other raptorial species on kite hunting success.

MATERIALS & METHODS

Study Site

The study site at Grizzly Island Wildlife Area, California consisted of open grassland and agriculture, with few trees and little topographic relief. The study site was surrounded by salt marsh but was protected from tidal influences by dikes. Hunting data was collected by Dr. Rey Stendell between May 1970 and August 1971 and these data are the basis of this thesis.

A total of 248 kite foraging hours were collected with the aid of a 20-60 magnification spotting scope, 8x30 binoculars, stopwatch, and a field notebook. Observations were performed from the best vantage point of observation in each field and the location of the observer remained the same throughout the day. A total of 757 hunting flights were documented over 57 hours of observations. The earliest observations occurred at 0530 hours (18 minutes before sunrise) and the latest at 2050 hours (13 minutes after sunset).

Recorded data included: time of sunrise and sunset, duration of each hunt, number of position changes during each hunt, number of incomplete strikes and complete strikes per hunt, number of successful prey captures, and

incidences of stolen prey by other raptors. When possible, age and gender were recorded for all of these categories.

This was a non-invasive observational study on forging ecology, so birds were not trapped or individually banded. These data reflect hunting activity by habitat type for this local population of kites, rather than individual foraging patterns. Fields chosen for observation were selected based on land access and year-round kite activity. Habitat type of each field was determined both by historical maps supplied by California Department of Fish and Game and from previous vegetation sampling at this location by Dr. Rey Stendell (Stendell, 1972). All fields were under management by the California Department of Fish and Game during the study period.

Definitions of Variables

The foraging flight pattern of a white-tailed kite is called a hover, and is easily distinguished from other forms of flight. When a kite hovers, it maintains an aerial position in the air by rapidly flapping its wings and looking down at the ground for prey.

There were eleven foraging variables that were identified for this study. The first seven were

categorized as discrete variables: 1) Age (adult or juvenile). 2) Gender (male or female). 3) Seasons; all hunting behavior was divided into one of four seasons: spring (March-May), summer (June-August), fall (September-November), and winter (December-February). 4) Habitat; five fields were selected on Grizzly Island Wildlife Area and categorized into three habitat types; fallow, transitional, and barley. The vegetation in the two fallow fields consisted of mixed annual grasses. The single transitional field consisted of mixed annual grasses and remnant barley from previous years. The last two fields were exclusively cultivated barley. 5) Prey capture; a hunt was successful or not depending on prey capture. 6) Hunting interference occurred when a kite was hunting and either another kite or another raptorial species exhibited antagonizing behavior to the kite that was foraging. This was observed as aggressive flights around the kite, occasionally making contact with it, or chasing the kite out of the area. 7) Prey stealing; once a kite captured prey and hunting interference occurred, the prey item was occasionally taken from the kite by another raptor.

The other four variables are categorized as continuous variables: 8) Hunt duration was how long the bird was in

the air hunting from start to finish. A hunt began when a kite either left a perch and began hunting, or appeared in sight of the observer. The hunt terminated when the bird returned to a perch of flew out of sight from the observer. 9) A position change was a horizontal aerial movement from one hovering location to another while the kite hunted. 10) A completed strike was a drop from the hovering position with legs extended downwards and wings held in a dihedral position until contact was made with the ground (Dunk, 1995). 11) An incomplete strike occurred when the kite began a dive, but then stopped and ascended to resume foraging (Mendelsohn and Jaksic, 1989; Tarboton, 1978). Each hunt often had multiple incomplete and complete strikes.

Age and Gender Classification

Age differences between juvenile and adult white-tailed kites were distinguished by different feather colors and patterns on wings and body (Figure 1). Juvenile kites have brown contour feathers that streak their body and white scalloping on the dorsal surface of their wings (Palmer, 1988). Adults have all white contour body feathers without scalloping on the dorsal surface of their wings (Johnsgard, 1990). Juveniles do not molt into adult

Figure 1. Juvenile white-tailed kites (left) can be identified easily from adults (right) during the first few months of life by their plumage differences. The arrows on the juvenile indicate white scalloping on the wings and brown streaks on the body, both which are absent on the adult. Also, juveniles have dark eyes that turn bright orange-red once they mature. Photos taken by the author.

plumage until they are 4 to 6 months of age. As a result, juveniles were only reliably identified from July through October in this study. Only when the plumage of the bird was identifiable, was it assigned an age. All birds from November through June were categorized as adults because juveniles could not be visually identified.

Juvenile birds cannot be reliably sexed (Johnsgard, 1990). Adult white-tailed kites do not have reliable dichromism or dimorphism, so gender was determined in adult birds based exclusively on their position during copulation because the male always mounts the female from above (Warner and Rudd, 1975). Hunts that were seen immediately before or after copulation were assigned to birds of the appropriate gender. Therefore, males and females were only reliably identified during the breeding season of May and June. Only when copulation was observed were the birds assigned a gender.

Statistical Analyses

All data were entered into SYSTAT 10.2 (SPSS Incorporated, Chicago, IL) for analyses. The twelve variables were analyzed and categorized as discrete or continuous. Discrete variables were: age (adult or juvenile), gender (male or female), seasons (spring,

summer, fall, and winter), habitat (fallow, transitional, or barley), prey captures by kites (successful or unsuccessful), hunting interference by other birds (presence or absence), and prey stolen (or not) from kites by other raptors. Continuous variables were: hunt duration, number of position changes, of complete strikes, and number of incomplete strikes.

One-way analysis of variance (ANOVA) compared the number of complete strikes (by gender and by age), number of incomplete strikes (by gender and by age), and the duration of hunts among habitats. One-way analysis of covariance (ANCOVA) compared the slopes of hunt duration and position changes (by age and by gender). A 2 X 2 contingency table analysis was used for all the remaining comparisons: number of successful prey captures (by gender, by age, and by season), number of prey captures among habitats, hunting interferences from other raptors (by gender and by age), hunting interferences among habitats, and number of prey stolen from other raptors (by age and by gender). All statistical tests were conducted at the alpha equals 0.05 level.

RESULTS

Of all 757 hunts observed, 44.4% of the kites were adults (8.5% were identifiable as males and 3.7% were identifiable as females), 24.0% were juveniles, and 32.6% were of unknown age (Table 1).

Age and Gender Hunt Differences

Hunting behavior and success varied between adult and juveniles. Adults had a greater number of successful prey captures (χ^2=13.8, df=1, p=0.00) than juveniles. Juveniles had a significantly greater overall number of incomplete strikes per hunt than adults (ANOVA F=9.99, df=1, p=0.00) but no significant difference was found between age in overall number of complete strikes per hunt (ANOVA F=0.19, df=1, p=0.66).

Copulation (pre and post hunt) was used to determine gender, therefore males and females were observed in equal numbers for May and June. Both genders hunted throughout every day of observation and hunted in the same habitats. Males hunted 72% and females hunted 28% of the observation period. Males had a higher prey capture rate than females (χ^2=8.86 df=1, p=0.00). Females made significantly more incomplete strikes per hunt than males (ANOVA F=7.46, df=1,

Table 1. Mean (± standard deviation) hunt duration, number of position changes, and successful prey captures for white-tailed kites by age and by gender. Observations occurred at Grizzly Island Wildlife Area in California between May 1970 and August 1971.

Age and Gender	Number of Hunts	Mean ± SD Hunt duration (minutes)	Mean ± SD Number of Position changes	Mean Successful capture rate (percent)
All birds	757	4.5 ± 0.2	12.1 ± 0.5	32.2%
Adults	336	4.0 ± 0.2	10.3 ± 0.6	44.7%
Juveniles	182	5.9 ± 0.4	16.3 ± 1.3	24.5%
Males	64	3.8 ± 0.4	8.1 ± 0.9	60.9%
Females	28	5.9 ± 1.1	12.6 ± 2.4	39.3%

p=0.00) but no significant difference was found between genders in the number of complete strikes per hunt (ANOVA F=0.25, df=1, p=0.87). Number of position changes and duration of the hunt were interdependent on each other. The longer a kite hunted, the more likely it was to change positions. There was a positive relationship (ANCOVA F=30.8, df=1, p=0.00) between the number of position changes and the duration of a hunt in both adults and juveniles (Figure 2). There was a positive relationship (ANCOVA F=24.2, df=1, p=0.01) between the number of position changes and the duration of each hunt in both males and females (Figure 3).

Seasonal Variation

To determine whether success varied among seasons, all observed hunts were categorized into one of four seasons: spring 14% (n=103), summer 37% (n=280), fall 33% (n=252), and winter 16% (n=122). Significant variation occurred in the prey capture rate among seasons (χ^2=14.06 df=3, p=0.00). All kites had a relatively higher percent of prey captures in the winter and spring and fewer prey captures during summer and fall (Figure 4).

Habitat Type

Each field was categorized into one of three habitats,

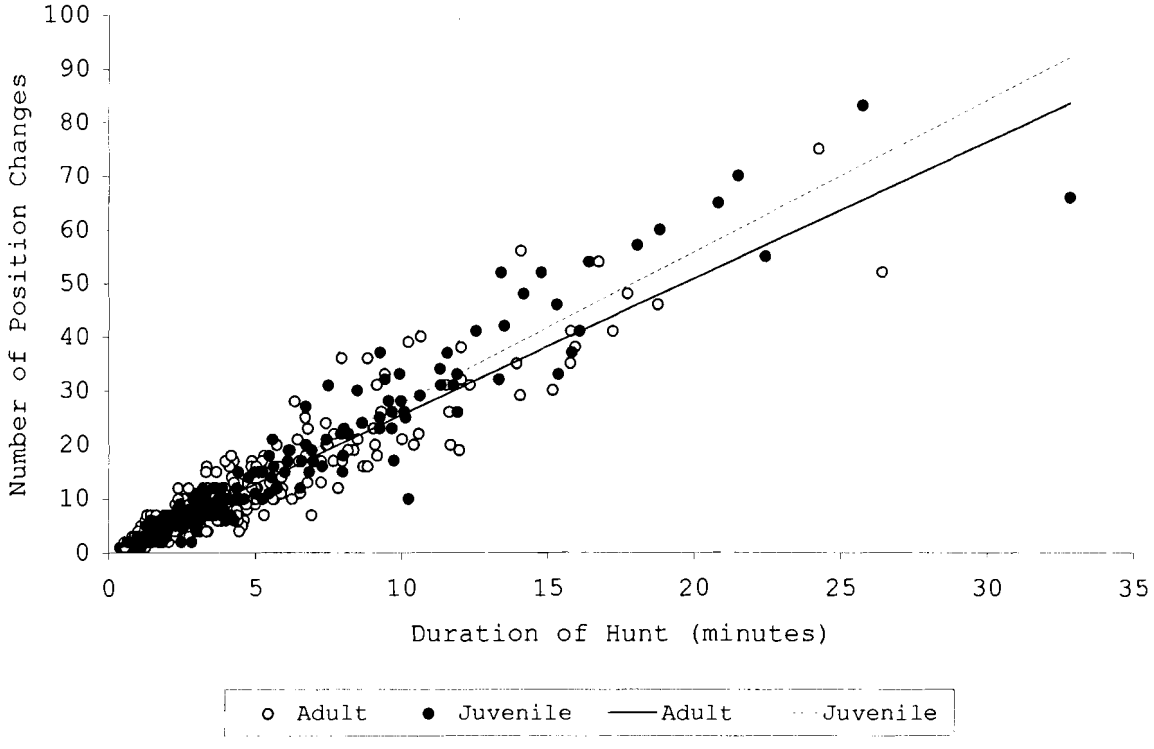

Figure 2. White-tailed kite mean hunt duration and number of position changes that occurred per hunt for both adults and juveniles. As the duration increased, so did the number of position changes for both ages. Observations occurred at Grizzly Island Wildlife Area in California from May 1970
to August 1971.

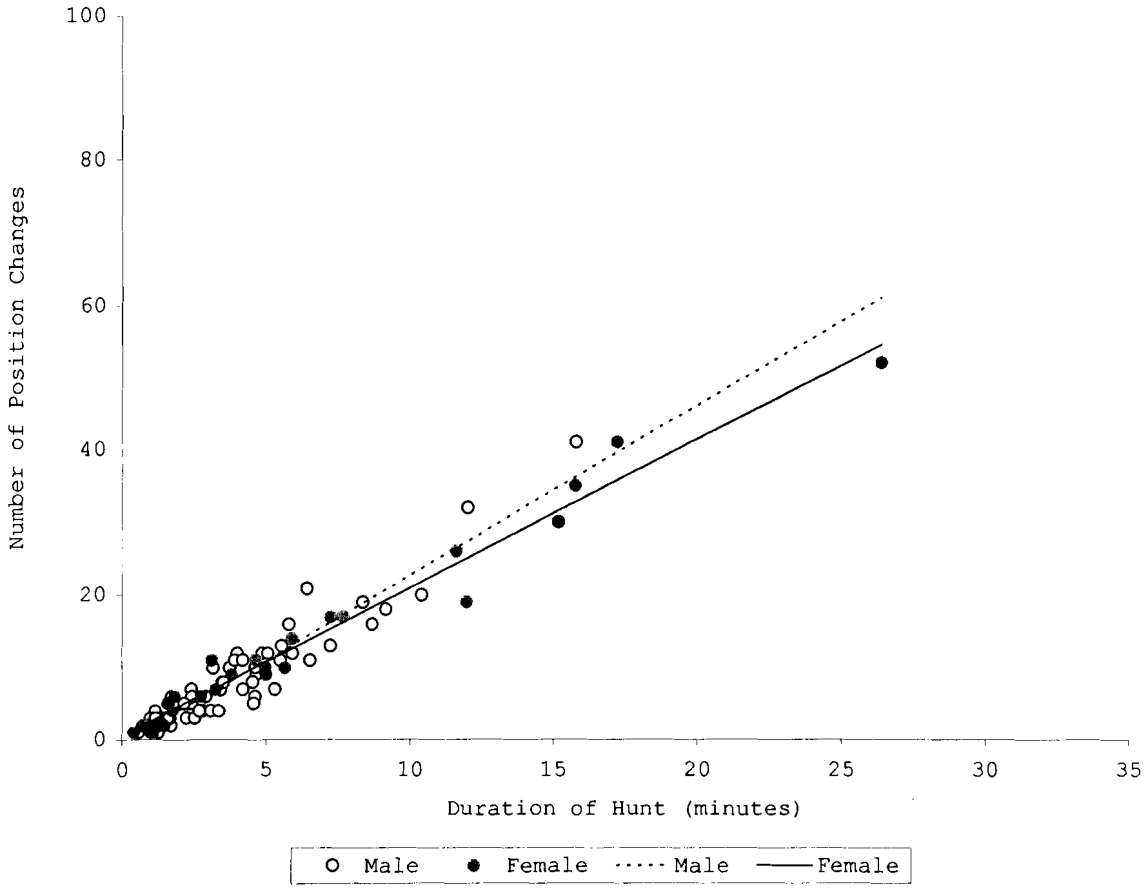

Figure 3. White-tailed kite mean hunt duration and number of position changes that occurred per hunt for both males and females. As the duration increases, so do the number of position changes for both genders. Observations occurred at Grizzly Island Wildlife Area in California from May 1970 to August 1971.

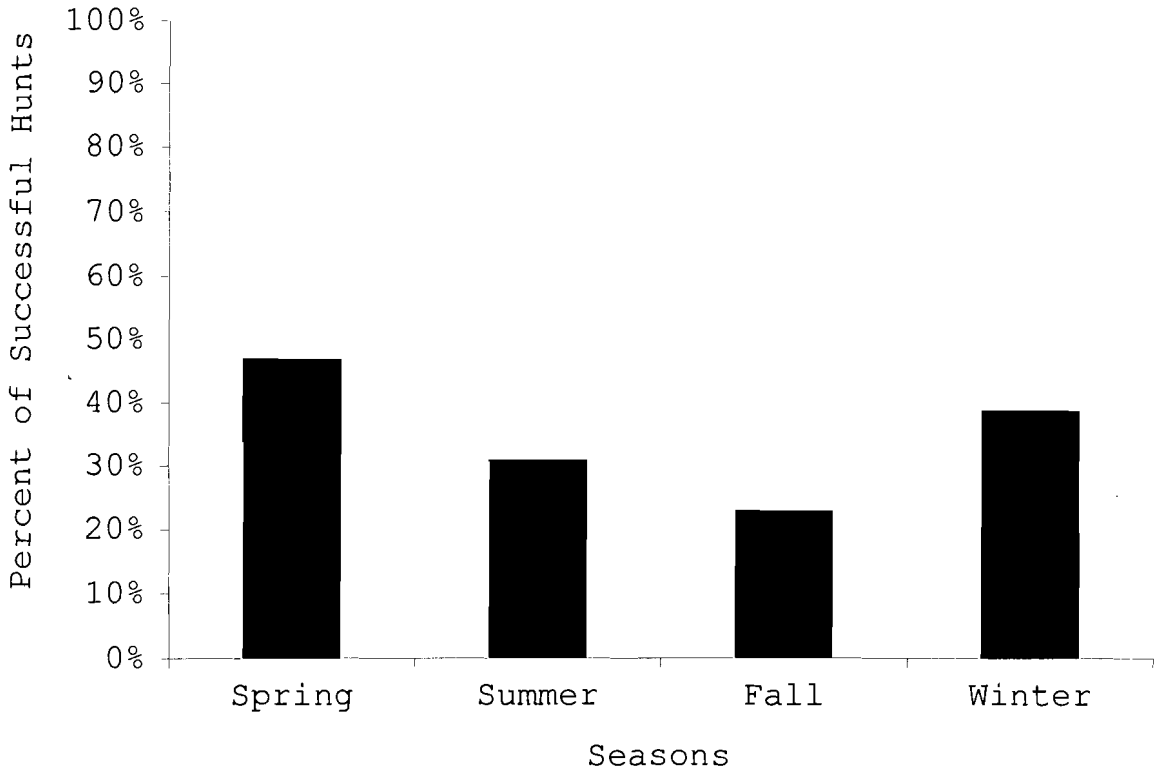

Figure 4. Success rate of white-tailed kite hunts by seasons. These are the number of hunts that resulted in prey capture divided into the total number of hunts observed. Observations occurred at Grizzly Island Wildlife Area in California from May 1970 to August 1971.

types. All hunts observed occurred in one of the following habitat types; 40% (n=304) occurred in fallow fields, 9% (n=68) in the transitional field, and 51% (n=385) in the barley fields. There was no significant difference in the number of prey captures related to habitat types for juvenile kites (χ^2=1.10 df=2, p=0.57) or adult kites (χ^2=4.30 df=2, p=0.11).

There was a significant difference in the duration of a hunt related to the habitat types (ANOVA F=5.40, df=2, p=0.00). The mean hunting duration of kites was longer in the barley habitat when compared to the fallow habitat, but other pair-wise comparisons were not significant (Figure 5).

Hunting Interference

Other raptors seen at this study site during the focal scans were short-eared owls (*Athene flammeus)*, red-tailed hawks *(Buteo jamiacensis)*, turkey vultures *(Cathartes aura)*, burrowing owls (*Athene cunicularia)*, northern harriers (*Circus cyanus)*, and American kestrels (*Falco sparverius)*. Kites had significantly fewer prey captures when interference occurred from other birds (χ^2=12.47 df=1, p=0.00). Interference from other raptors occurred during

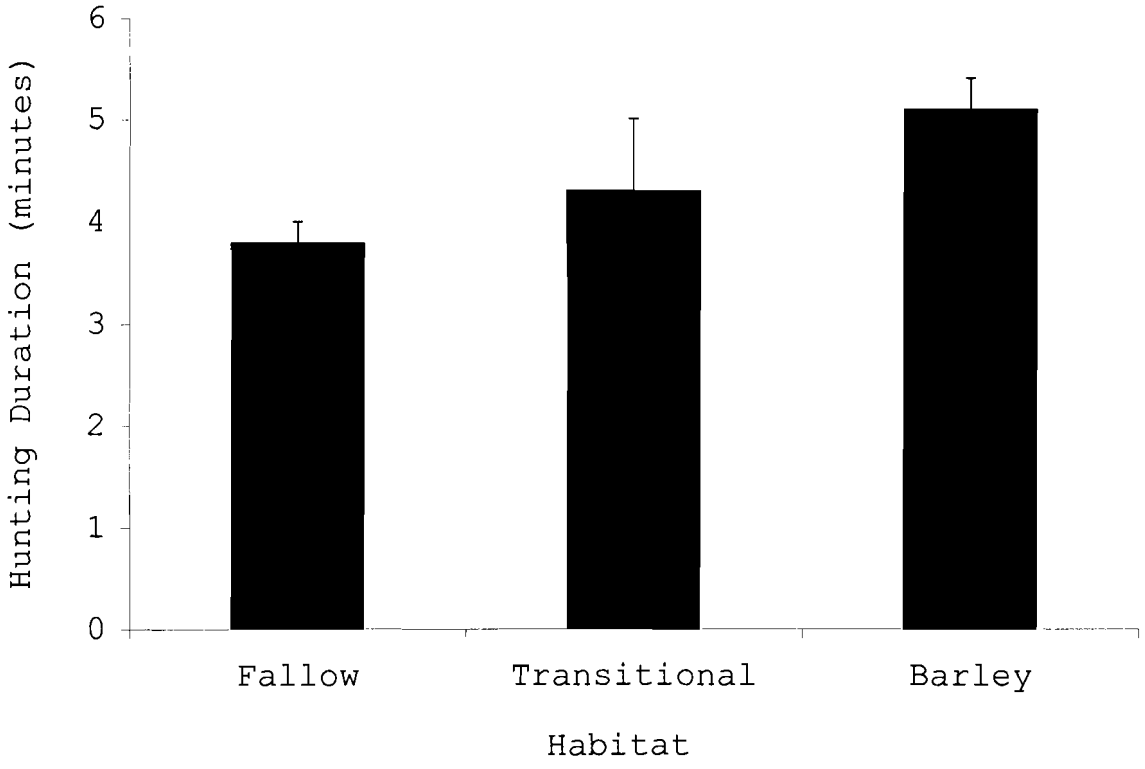

Figure 5. White-tailed kite mean hunt duration (± standard deviation) among habitats. The mean hunting duration of kites was longer in the barley habitat when compared to the fallow habitat, but other pair-wise comparisons were not significant. Observations occurred at Grizzly Island Wildlife Area in California from May 1970 to August 1971.

12% of all observed kite hunts, and was primarily from Northern harriers (5%) and other kites (7%). No significant differences were found in interference caused by other raptors for adult and juvenile kites (χ^2=0.50 df=1, p=0.53), or between male and female kites (χ^2=5.60 df=1, p=0.07). Overall, kites had significantly more interferences from other birds when they were in the fallow and barley habitats (χ^2=7.30 df=2, p=0.03) than the transitional habitat.

Prey was rarely stolen from a kite by an interfering raptor. This kleptoparasitism behavior was observed in less than 1% of all observed hunts and was not specific to either gender (χ^2=0.29 df=1, p=0.59) or age (χ^2=0.31 df=1, p=0.58).

DISCUSSION

It is difficult to compare kite hovering behavior to other raptors because most raptors do not exhibit this foraging pattern. The American kestrel is probably most similar because they often hover while hunting, but their morphology is different in many ways. Kestrels have a different diet, eat insects (Rudolph, 1982), have a smaller body mass, and often hunt socially (Varland, et al. 1991).

Energetics information on hovering raptors is limited to non-breeding individuals (Koplin, et al. 1980). Tarboton (1978) and Mendelsohn (1982) conducted energetics studies on the closest relative to the white-tailed kite, the black-shouldered kite (*Elanus caeruleus)* and found that these species have different hunting strategies. The black-shouldered kite spends the majority of its time hunting from a perch, while the white-shouldered kite hunts almost exclusively by hovering. Therefore, a valid comparision of kite foraging behavior to its closest relative would be difficult.

Age and Gender Differences

Juveniles had longer hunt duration per hunt, fewer overall prey captures, and greater number of incomplete strikes per hunt than adults. These results could be due

to the lack of hunting experience in juveniles. The post-fledging period for juveniles of the year lasts over a month, and during this time they improve their flying and hunting skills while still fed by adults (Bustamante, 1993). Many other avian species go through a similar post-fledging period and rely on parental assistance for food before they reach foraging independence (Bennetts & Kitchens, 1999; Bustamante and Hiraldo, 1989; Heinsohn, 1991; and Varland et al., 1991).

This study was limited to the use of plumage differences for age identification, so juvenile observations did not extend beyond October. By marking juveniles so they could be individually identified, observations could continue beyond the first molt to determine how long it takes for a juvenile to equal an adult in their hunting efficiency.

Males and females did not differ in the number of complete strikes, but females made more incomplete strikes than males. Males hunted more frequently and for a longer duration than females. This could be attributed to the hunting partitioning of this species during the breeding season. The male provides the majority of food to the female during nesting and incubation so that the female

only hunts infrequently during that time (Brown, 1968; Mendelsohn, 1989; Watson, 1940). The female obtains the food from the male by aerial prey transfers, and she either eats the prey, or returns to the nest to feed young once they hatch (Warner and Rudd, 1975). Males seldom feed the young directly (Warner and Rudd, 1975). This division of labor could explain why the majority of hunts were performed by males during the breeding season.

Males had a greater number of prey captures than females. However, Mendelsohn (1982) found no differences between genders, while Warner and Rudd (1975) found that females had higher number of prey captures than males. The observation frequencies were similar among these studies and all studies used copulation to identify gender. A lower prey capture rate for males was explained in the Warner and Rudd (1975) study by prey variation due to hunting a greater portion of the year when compared to females. It is not stated clearly how the males are experiencing variation in prey, so an assumption must be made that the males actually hunted during different months, time of day, or different habitats than the females.

In contrast, both genders hunted every day of

observation in this study, had overlapping hunting times throughout the day, and the hunted in the same habitats. Therefore, the prey that was available for capture to both genders in this study was likely to be similar. Males hunted more frequently than females, and supply the females with food, so may have better hunting skills and have a higher prey capture rate. There may be variation based on individual hunting ability depending on where the study site is located. If birds were individually marked and more pairs were located, observations could continue all year to obtain a more accurate success rate for males and females outside of the breeding season.

Seasonal Variation

In this study, the percent of prey captures were lower during the summer and fall and higher during the winter and spring. Warner and Rudd (1975) found that prey captures did not vary among seasons in kites, but it was not clear from the description of the methods how those data were obtained, and no statistical tests were given. In contrast, a study by Jaksic et. al (1987) found that kites had a higher number of prey captures per hunt during spring and summer than fall and winter. They attribute it to a peak in prey abundance during spring and summer. That

study only evaluates agricultural habitats and this study had three habitats, so prey abundance may be different for this whole location.

The variation in number of prey captures witnessed by season in this study can be explained by the long breeding season of kites and hatching of young over the spring and summer months. This results in a gradual recruitment of juveniles into the population. Therefore, the largest number of juveniles observed all year occurred in the fall, when most, if not all, nestlings had fledged the nest. Since juveniles captured fewer prey than adults, the prey capture success for the whole population was lower during the period of when juveniles began to enter into the population (summer and fall).

Habitat Types

The prey capture rate by white-tailed kites was not associated with different habitat types. A previous study by Warner and Rudd (1975) compared riparian areas to cultivated land and also found no difference in prey captures among habitat types. Kites hunt successfully in a variety of habitats, so the type of vegetation may not be the limiting factor to successful hunting.

Significant differences occurred in the duration of a

hunt in different habitats. On average, hunts in the fallow habitat were of the shortest hunt duration, and those in barley habitat were of longest duration. This may reflect the relative degree of difficulty in locating and capturing prey within those two habitat types.

Habitat types in this study reflected different levels of disturbance caused by man. Barley habitat underwent the highest disturbance with plowing and planting every year. It is known that disturbed habitats generated by human activities can yield greater prey abundance for white-tailed kites (LoBue and Darnell, 1959). In contrast, fallow habitat was not plowed and the exposed vole runways were well established. Baker and Brooks (1981) found that the amount of vegetation cover can have a greater influence on raptor hunting distribution than rodent densities. So, prey also may be easier to see when the runways are exposed, which might explain why kites take less time to hunt in fallow habitat than in the other habitats.

LoBue and Darnell (1959) demonstrated that voles were found at high densities along the edges of alfalfa fields, and as the alfalfa increased in height, voles increased the use of the whole field. Voles are not restricted to a certain vegetation type, even during periods of fluctuating

populations (Getz, 1970; LoBue and Darnell, 1959). However, voles may be dependent on the quality, density, and abundance of the vegetation (LoBue and Darnell, 1959; Ostefeld and Klosterman, 1986; Rice, 1983). While it is impossible to speculate about rodent densities in this study, it is reasonable to consider that before harvest, barley could offer greater aerial cover for voles. This could explain the longer hunt durations in the barley habitat when compared to other habitats.

The addition of rodent density data to this study could provide insight in the occurrence of raptors in various habitats, but previous research indicated more birds will be found where there is more prey. Korpimaki and Norrdahl (1991) found a positive correlation between the density of voles and the percentage of voles found in the diets of several raptor species. Higher rodent densities may be found in the barely fields in this study, due to human disturbance and the abundance of kites and other raptors present.

Rodent densities alone can not be used as an explanation for raptor distributions, because different bird species have different hunting methods and alternate prey species. For example, the northern harrier, seen in

abundance in this study, used acoustic cues more so than other hawks when hunting (Rice, 1983). Therefore, raptors maybe found in higher densities in the habitat that suits their hunting needs. For harriers, the important factor could be whether or not a vole produces noise while it moves through vegetation, which could be related to dryness or density of grasses around runways. If kites rely on sight more for hunting, they may be able to hunt more successfully in habitats where prey can be more easily seen.

Hunting Interference

The presence of other raptors affects foraging behavior of kites. Theoretically, when prey is more abundant in an area, raptor densities may increase, and result in increased foraging competition. Foraging competition with other raptors results in a decrease in kite territory size (Dunk and Cooper, 1994). Similar for another small raptor, the American Kestrel, territory size was limited by competition with other birds, rather than directly related to reduced food supply (Village, 1982).

This study found that kites have fewer number of prey captures when they had interference from other birds. However, once the kite captured a prey item, it was rarely

stolen from them by another bird. Interference was caused both by other kites (intraspecific competition) and by other raptorial species (interspecific competition). Kites made fewer successful prey captures when other kites or red-tailed hawks interfered with a hunt. Red-tailed hawks may have a strong negative effect because they can be a potential predator to kites. A red-tail hawk was reported killing an adult kite (Pinkston and Caraviotis, 1980). The frequency of interference may be dependent on the time of day or habitat type, rather than how long the bird hunts. For example, if there were a greater number of competing raptors present (other kites or other raptorial species) in the morning than at mid-day, there may be a higher likelihood of interference occurring in the morning. Kites had fewer prey captures when interference occurred.

It is well known that agricultural changes can affect rodent populations (Stendell, 1972; Waian and Stendell, 1970; Warner and Rudd, 1975). In turn, rodent densities can alter clutch sizes of a nest (Vinuela and Bustamante, 1992), cause egg laying dates to be more variable (Dijkstra, et al., 1982), influence raptor nest desertion if populations are low (Mendelsohn, 1982) and change the selection or size of a raptor territory (Green, 1977).

Hamerstrom (1979) found that high rodent densities can also increase nest success in birds, therefore increasing the predator population.

Understanding foraging behavior of white-tailed kites and their relationships to sympatric raptors and rodents has conservation and management applications. People have severely impacted and changed the environment with development and agriculture practices in many areas. A continued effort should be made to understand anthropogenic impacts before making major land changes. Based on this research and others (Pruett-Jones et al. 1980; Erichsen, et al., 1996; and Eisenmann; 1971), irrigated agricultural land may provide good foraging habitat for some raptors. Irrigated agricultural habitats are wide spread in California, have changed dramatically over the past several decades, and have been associated with an increase in kite populations (Erichsen, et al., 1996; Pruett-Jones et al., 1980; Waian and Stendell, 1970; Warner and Rudd, 1975). Hopefully, it is possible to find a healthy balance between agricultural land and healthy raptor populations.

In summary, juveniles were less experienced than adults. They take longer to hunt, had more incomplete strikes, and fewer prey captures per hunt. When compared

to females, males took longer to hunt, hunted more frequently, made fewer incomplete strikes, and made fewer prey captures per hunt. The successful prey capture rate is highest in fall and winter and lower in summer and fall in all hunts observed. All birds had equal prey capture rates among habitats, but the mean shortest hunt duration occurred in the fallow habitat and the longest mean hunt duration occurred in the barley habitat. The successful prey capture rate declines when either interspecific or intraspecific hunting interference occurs. Kites have the greatest hunting success when no interference occurs, and prey rarely is stolen from them after a successful prey capture.

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