Sex-Related Differences in Capture Number of American Kestrels during Non-Breeding Season in Upstate of South Carolina May Be Influenced by Habitat

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Introduction

We previously reported 66 American Kestrels (*Falco sparverius sparverius*) banded in the western piedmont of South Carolina from 1996 to 2001 during the non-breeding season (deMent and deMent 2001). Our null hypothesis of near equal capture numbers of males and females was rejected with a statistically significant excess of males captured compared to females. We proposed that this discrepancy in the number of males captured compared to females might be attributed to a predominance of males present in the study area. Other possible contributing factors were discussed. The two study areas were downtown Greenwood, South Carolina, and a semi-open rural site located in the western piedmont of Abbeville County, South Carolina.

Beginning in the winter of 2002, our American Kestrel banding expanded to include another rural, open landscape area of western piedmont in adjacent Newberry County. Banding continued in the Abbeville County and downtown Greenwood locations. The Newberry site was chosen due to its close proximity to Greenwood (home of the primary investigator), and its suitable habitat for kestrels. We decided to continue banding for an additional five years in order to further study the unexpected excess of males captured in the study area, as well as to evaluate the possibility of a previous sampling error.

Methods

All American Kestrels sighted in the three study locations were exposed to *Bal chatri* noose traps containing mouse lures (*Mus musculus)* as previously described (deMent and deMent 2001). Noose traps were pitched into the ditch from a moving automobile when an American Kestrel was sighted. Birds were captured without regard to sex during the non-breeding seasons from 1996 through 2006. The non-breeding season is defined as November through February (Cely and Sorrow 1988).

Birds were sexed and aged as HY (Hatch Year) or AHY (After Hatch Year) according to North American Bird Banding guidelines (North American Bird Banding Manual 1991, 1997). Birds were weighed to the nearest 0.1 gram and blood was collected with a sterile 23 gauge needle from a superficial vein between the hallux and second toe after thorough cleansing with an alcohol swab. Blood was smeared on a glass slide, air dried, and stored in the dark at room temperature until Wright/Giemsa batch staining was completed on an automated hematology instrument. Wing chord was measured to the nearest millimeter and the birds were photographed. Bird health status, time and date of capture, as well as location from the three banding sites were recorded prior to release of each bird. All studies were completed in accordance with Master Banding Permit 22771.

The Abbeville County banding site consisted of an approximately 15 km^2 open area containing primarily small pastures and hay fields supporting beef cattle farming. The downtown Greenwood site consisted of vacant lots adjacent to or on the grounds of several closed textile mills. The Newberry County banding location consisted of an approximately 15 km^2 area of primarily large cultivated fields and pastures associated with dairy and poultry farm operations. Statistical application was performed within group (i.e., sex of birds) with probability formula and Z chart comparison, while inter-group comparisons (i.e., weight, wing chords) were performed with Tukey t testing (Graph Pad Instat, version 3 for Windows). Blood smears were examined independently by two pathologists for hematozoa (qualitative identification) as previously described (deMent et al. 2002). Statistical significance was achieved at $P \leq 0.05$.

Results

A total of 170 American Kestrels were banded from the three sites during the study period, with 203 total captures (Table 1). Sixty-six of the 170 kestrels had been previously reported (deMent and deMent 2001). Included in the 203 total captures, there were 33 recaptures of 28 different birds. One male American Kestrel foreign band encounter was documented near Cleveland, Ohio the following September, a bird that had been banded at the Greenwood urban location.

Comparisons of males vs. females were made within sites and among the three capture sites. Statistical differences were not noted for body weight of males among the Abbeville, Greenwood and Newberry locations. Likewise females showed no differences in body weights among the three locations. Males were significantly lighter than females at the Abbeville and Greenwood locations, but at Newberry the difference was not significant (Table 1). There were no significant differences in parasite incidence for males vs. females among the three capture sites. Overall, the incidence of parasitemia was 53% (males 47%, females 58%). A total of 128 American Kestrels had blood samples drawn for blood film analysis. *Hemoproteus* species were identified in 67 of the positive blood films, while *Plasmodium* species was found in one blood film.

Table 1. Number of American Kestrels banded in the 3 banding sites in upstate (western piedmont) region of South Carolina from 1996 until 2006.

	Abbeville Co. n (mean wt / % para)	Greenwood urban n (mean wt / % para)	Newberry Co. n (mean wt / % para)
Males	56 (108/ 44%) *	23 (108/ 50%) *	5 (111/ 60%)
Females	31 (119/ 53%) *	10 (121/ 67%) *	45 (122/60%)
Total birds	87	33	50
Retraps males	8	7	0
Retraps females	9	3	6

n = number of birds captured in each category
mean wt = mean weight to nearest gram of birds in each category
% para = percentage of birds in each category infected with hematozoan parasites.
* data includes 42 males and 24 females previously reported from combined Abbeville and Greenwood locations (deMent and deMent 2001)

Utilizing probability formula and Z charts comparisons within capture sites, we found significantly more males than females were captured at the Abbeville and Greenwood sites ($Z = 2.68$, $P \leq 0.01$; $Z = 2.26$, $P \leq 0.01$ respectively). In Newberry County, significantly more females were captured than males ($Z = 5.66$, $P \leq 0.01$). Inter-group comparisons were made with Tukey t tests, which demonstrated a statistical difference in the number of males captured in Abbeville and Greenwood compared to males in Newberry County ($P \leq 0.05$), but significant differences were not identified for the Abbeville versus Greenwood capture sites ($P \geq 0.05$). Statistical difference was noted for the number of females captured in Newberry County compared to Abbeville and Greenwood females ($P \leq 0.05$).

Comparisons of landscape are tabulated in Table 2, using 2005 United States Department of Agriculture National Agriculture Statistical Services (NASS) data for Abbeville and Newberry Counties. South Carolina Forestry Commission statistical data (2005) for the approximate amount of forested acreage compared to total acres in Abbeville and Newberry Counties was tabulated (Table 2).

Discussion

Table 2 provides countywide comparative statistical data for Abbeville and Newberry County farming practices. This data supports differences in farming practices in these two rural farm land locations. Beef cattle farms with pasture/hay fields are the dominant landscape in the Abbeville County banding location, while dairy and poultry farms with cultivated fields predominate at the Newberry County location. Unfortunately, more detailed farming practice data for the two 15 km^2 banding sites is not available. The downtown Greenwood banding site has several closed textile mills with associated vacant lots. In an Arkansas study, landscape differences were noted to influence reproductive success for Loggerhead Shrikes (*Lanius ludovicianus)*. According to the Arkansas study, cultivated areas promoted increased reproductive success, compared to small non-cultivated fields,

possibly related to increased prey availability and variation (Norris et al. 2001).

Table 2. Comparison of farming practices in two county locations in upstate (western piedmont region) South Carolina.

Farm Item	Newberry Co.	Abbeville Co.
Corn*	4500 acres	nr
Cotton*	800 acres	300 acres
Hay *	10,800 acres	10,300 acres
Oats *	16,000 acres	900 acres
Wheat*	4800 acres	nr
Soybeans*	3200 acres	nr
Cattle*	25,100 head	19,100 head
Dairy cows *	4200 head	nr
Chickens-broilers*	5,583,000 birds	nr
Turkeys *	387,000	nr
Chickens-layers *	1,105,000	46,000
Forested acres†	289,626	219,194
Total county acres†	403,719	316,419

* 2005 United States Department of Agriculture National Agricultural Statistical Service
† 2005 S.C. Forestry Commission estimates
nr = none reported

Non-breeding American Kestrels show sex-related differences in habitat selection in low-density wintering areas like southeastern Pennsylvania (Ardia and Bildstein 2001). In more southern latitudes (below 39°N), even higher densities of wintering American Kestrels are noted, and the distinctions in habitat selection are more pronounced. The more dominant females appear to out-compete the smaller males for prime short-vegetation (less than 0.25 meters) open fields (Ardia and Bildstein 1997, Ardia 2002). Consequently, males are displaced to less desirable semi-open lands bordered by woody vegetation. The males use this habitat to prey on readily available small birds; however, they are at higher risk of ambush by larger hawks (Ardia 2002). The non-breeding population in our study area is composed of resident and migrant American Kestrels (deMent et al. 2002). Our finding of sex-related differences in the number of male compared to female American Kestrels captured further supports previous reports that females and males select different habitats during the non-breeding season (Ardia and Bildstein 2001, Ardia 2002).

An explanation for sex-related differences in the number of American Kestrels captured in our study may relate to increased numbers of a particular sex available for capture, which in turn depends on the banding location. Our data reinforces the hypothesis that cultivated landscapes may be preferred to pasture land by female American Kestrels, perhaps due to improved visibility or prey availability as previously reported (Norris et al. 2001). Woody vegetation is reduced in cultivated areas in order to maximize

acreage available for cultivation, increase sun exposure, and improve crop yields.

Urban sites may be less desirable to females, based on our study, but without a clear explanation. Perhaps the absence of cultivated fields and the increased woody vegetation in the downtown closed textile-mill sites simulate a small field/pasture landscape.

Another explanation for the sex-related differences in capture numbers of American Kestrels observed may relate to blood parasite burden. Infected birds are presumably less available for capture compared to healthy non-infected birds. Previous studies have reported sex-related differences in blood parasite incidence in American Kestrels as well as reduced body weight in infected birds (Dawson and Bartolotti 2000). Our study does not support those findings.

Conclusion

Our study suggests that in the western piedmont of South Carolina, female and male American Kestrels may occupy different habitats during the non-breeding season, a finding reflected in sex-related differences in capture number. Females may prefer more open, cultivated landscapes with minimal woody vegetation compared to males, and also may find urban areas less desirable. With increased human population growth and escalating land values, coupled with decreased profits for small farms practicing dairy, swine, and poultry operations, suitable habitat will probably be reduced in the western piedmont of South Carolina. The long-term impact this has on American Kestrel populations remains to be determined.

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Acknowledgements

Jean Parsons, M.T., supervisor of hematology at Self Regional Healthcare, performed all blood smear staining. Dr. Stanley Baker was helpful in banding at the Newberry County location.