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Habitat Use and Movements of Sharp-shinned and Cooper's Hawks during Autumn at Fort Morgan, Alabama

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ABSTRACT

Three Sharp-shinned Hawks (*Accipiter striatus*) and three Cooper's Hawks (*A. cooperii*) were radio-tagged during autumn at a site in Alabama along the northern coast of the Gulf of Mexico. Birds were monitored continuously for times ranging from 98 - 1031 min. Both species used forested habitats almost exclusively; one Cooper's Hawk made extensive use of a residential area. Individuals spent >85% of the time perched. Known instances of birds leaving the study area occurred between 10:30 and 13:30 on days with clear skies and strong thermal activity. Roost sites were in pines (*Pinus elliottii*), and three of five roost sites were in forested habitat. Two roost sites of one Cooper's Hawk were in patches of dense vegetation within a residential area. The results suggest that preservation of forested habitats along the northern Gulf coast is important for both species.

The behavior of most raptor species during migratory stopover remains poorly known (Holthuijzen et al. 1985, Goodrich et al. 1996,

Niles et al. 1996). Several causes underlie the lack of information about stopover behavior of raptors. Although the study of marked birds is essential, capturing individuals of most species is time and labor intensive. Furthermore, the technology necessary to study secretive and wide-ranging species (i.e., radio and satellite telemetry) has become widely available only relatively recently. Finally, experiment protocols (e.g., orientation and activity studies) used with caged passerines are not amenable to the study of raptors.

Radio and satellite telemetry are the only feasible ways to study the behavior of often secretive and wide ranging raptors (e.g., Cochran 1972, 1975, Hunt and Ward 1988, Marzluff et al. 1997), and movement patterns of many common species during different times in their life cycle remain poorly known. Two telemetry studies of the behavior of Sharp-shinned Hawks (*Accipiter striatus*) during autumn stopover are those of Holthuijzen et al. (1985), and Niles (1996); no such

telemetry studies of Cooper's Hawks (*A. cooperii*) during migration seem to exist. Here I report on the use of radio telemetry to study habitat use and movement by Sharp-shinned and Cooper's hawks during autumn at a site along the northern coast of the Gulf of Mexico.

INTRODUCTION

Study Area -The 1830-ha study site ("Ft. Morgan") lies on the western third of the generally 1.5-km wide, east-west Fort Morgan Peninsula in southern Alabama (30° 10' N, 88° 00' W); the peninsula is bordered to the north by Mobile Bay and to the south by the Gulf of Mexico. Habitats present on the peninsula include: mature pine forest ("Pine"; mostly slash pine *Pinus elliottii*) with a dense understory of holly (*Ilex* sp.) and oak (*Quercus* spp.); young pine ("Short Pine"; <15 m high) forest; coastal scrub ("Scrub/Shrub"; mostly oak); "Marsh/Meadow"; sand dunes ("Dune") with sparse vegetation; and residential areas that include lawns and golf courses (see Table 1 for relative abundance of each habitat). A two-lane, paved road (Alabama Route 180) traverses the peninsula.

Although Ft. Morgan lies well within the winter range of both Sharp-shinned and Cooper's hawks, hawk count data collected at the study site during 1995 - 1998 showed nearly 3000 (mean 2970; range: 2412-3754) raptors traveling in a westward direction each autumn (Cimprich and Woltmann, unpub. data). It is possible that some of the birds on the peninsula during autumn spend the winter at Ft. Morgan, but the numbers of hawks counted each year suggest that the vast majority of birds merely pass through. Even if Ft. Morgan is not a "traditional" stopover site such as Cape May, NJ (which also lies within the winter range of both species), data from Ft. Morgan can contribute to our collective understanding of accipiter behavior.

METHODS

Data were collected during September and October, 1997 - 1998. Hawks were caught with mist nets and dho-gazas (Clark 1981, 1985) baited with either a Turtle Dove (*Streptopelia* sp., approx. 60 g) or House Sparrow (*Passer domesticus*, approx. 28 g), then measured, aged, sexed

(Canadian Wildlife Service and U.S. Fish and Wildlife Service 1991) and banded with a USFWS aluminum band. A radio transmitter was attached ventrally to the base of a central rectrix using a small cable-tie and cyanoacrylate glue (Aborn and Moore 1997). Following Gaunt and Oring (1997), transmitters weighed less than 5% of the mass of the smallest hawk. In 1997, I used 3.5 g transmitters (Custom Telemetry and Consulting, Inc., Watkinsville, GA); in 1998, I used 0.85 g transmitters (Model BD-2, Holohil Systems, Ltd., Ontario). The expected life of both types of transmitters was approximately 10 - 14 days. The range of the transmitters, using a Telonics TR-2-150 receiver and four-element antenna, extended from approximately 1 km in very dense vegetation, to at least 5 km for soaring birds.

Hawks were released 1 km east of the trapping station within 1 hr of capture. An assistant or I monitored the signal continuously for as long as possible until the hawk left the peninsula, the transmitter failed, or the transmitter was removed by the hawk. Hawks were followed on foot, on bicycle, or by car at distances of usually less than 300 m; all locations and movements were plotted on field maps (scale: 1 cm = 250 m). We generally tried to be close enough to discern subtle signal characteristics yet far enough to avoid disturbing the bird. Dense vegetation used by hawks often permitted approaches of less than 60 m without making visual contact. Birds flying at a height of >40 m were not considered to be "using" a habitat

Because the transmitter antenna ran along the tail, we could usually determine orientation of the tail, we used this information to help classify behavior of the bird. For the majority of the track time for most birds, we were able to assign behavior to one of five categories based on signal characteristics and time of day: Perched-Inactive, Perched-Active, Flight-Active, Flight-Soaring and Roosting (Table 2). These categories likely contain several very different behavioral patterns; however, more precise categories (cf. Holthuijzen et al. 1985, Niles 1996) can not be justified in this study, given the amount of time (<1%) that we had visual contact with the hawks (see Results and Discussion). For birds that spent the night on the peninsula, we monitored the bird for 20 min after last light and 20 min before first light the following

morning. Birds did not change their position within or between these times; thus, I defined "roosting" behavior as Perched-Inactive between last light and first light of the following morning.

Released hawks spent 15 - 30 min preening and picking at the transmitter immediately following release. Therefore, I considered only habitat and behavior data collected after 30 min following release. It is possible that additional time was spent picking at the band or transmitter; however, my observations and others (e.g., Raim et al. 1989) suggest that raptors acclimate quickly to these

markers. At all times, assigning a bird to a habitat was possible by triangulation. However, in dense vegetation, or if the bird could not be approached closely, signal quality was at times too poor to assign a behavior category; thus, the total track time used to assess habitat use of an individual was sometimes greater than the time used to assess behavior. The estimated accuracy of the location of the bird was usually within 10 m, based on experience with transmitters placed at known locations and visually verified birds. Accuracy decreased with distance and vegetation density, however; and it is likely that very short movements

Table 1. Available habitat and daylight habitat use of radio-tagged Sharp-shinned (SS) and Cooper's hawks (CH) during autumn on the Ft. Morgan Peninsula. Numbers presented for each individual are percent of total usable track time(n). Numbers within columns may not add to 100 due to rounding. See text for habitat descriptions.

Habitat	Available (%) ^a	Sharp-shinned Hawk ^b				Cooper's Hawk ^b			
		SS-1 HY M	SS-2 HY M	SS-3 SY F	Mean (SE)	CH-1 SY-M	CH-2 SY-F	CH-3 AHY-F	Mean (SE)
Pine	11	77	86	100	85(9)	38	85	41.3	55 (15)
Short Pine	3	17	0	0	5 (5)	53	14.5	< 1	22 (16)
Residential	25	0	0	0	0	7	0.7	56	21 (17)
Marsh/Meadow	6	0	0	0	0	3	0	0	1 (1)
Scrub/Shrub	11	0	0	0	0	0	0	0	0
Mix (Scrub/Pine/Marsh)	24	0	0	0	0	0	0	0	0
Dune	7		0	0	0	0	0	0	0
Not Applicable ^c		7	14	0	7 (4)	-	-	3	1 (1)
<i>n</i> (min)		216	98	240		384	152	1031	

^a habitat survey of western third of peninsula

^b HY, hatch year; SY, second year; AHY, after hatch year; M, male; F, female

^c birds flying at heights >40 m were not considered to be "using" a habitat

Table 2. Behavior categories based on transmitter signal consistency, quality, and time of day.

Category	Signal Consistency	Signal Orientation	Behaviors Included
Roost ^a	constant	vertical	roosting
Perch - Inactive	constant	usually vertical	resting, hunting
Perch - Active	slightly variable	alternating vertical-horizonal	resting, preening, feeding, hunting
Flight - Active	variable	horizontal	hunting, pre-migration
Flight - Soaring	variable	horizontal	migrating

^a signal behavior same as Perch-Inactive; category used only during non-daylight hours.

(<10 m) and occasionally longer ones (up to 20 m) were not detected. The inability to visually verify behavior of radio-tagged individuals requires that speculation about their movements and motivations should be done cautiously.

RESULTS AND DISCUSSION

Three Sharp-shinned and three Cooper's hawks were tracked successfully for total track times ranging from 98 to 1031 min. In total, I monitored radio-tagged birds for over 35 hr. Except for birds engaging in soaring behavior, I had visual contact with the birds for less than 20 min. Both Sharp-shinned and Cooper's hawks displayed relatively short periods of flight activity interspersed with long bouts of perching. Birds became active shortly before sunrise and made frequent perch changes within the first 3 hr of sunrise. The middle of the day was spent perching and non-migratory movements were rarely made. All three known instances of birds leaving the study area occurred between 10:30 - 13:30. Birds spending the night in the study area typically made a series of relatively rapid movements beginning approximately one hr before last light and ceased all movements approximately 30 min before last light.

The amount of time spent by Sharp-shinned and Cooper's hawks on the peninsula is difficult to state with confidence. Most hawks were caught (both focal and non-focal species) on days when there was a notable influx of birds, as determined from hawk count data collected during the study (Cimprich 2001), suggesting that they arrived the day they were caught. However, two birds (SS-2, SS-3) were caught on mornings when there had been no sizable movements for several days (Cimprich 2001), and more importantly, no hawks had been seen on those mornings until they had flown into the trapping station. SS-2 was observed leaving the peninsula later the same day; SS-3 is suspected to have left the peninsula the same day as it was trapped, but ambiguous signal behavior precluded confirmation of this.

Habitat use - Sharp-shinned Hawks used Pine and Short Pine habitats exclusively and were noted outside of this habitat only when engaging in apparently migratory and pre-migratory (Cochran 1972, Niles 1996) flights (Table 1). That a forest-

dwelling raptor would depend on forested habitats during autumn is perhaps not surprising, though it contrasts with habitat descriptions by Bent (1937) and del Hoyo et al. (1994), who suggest Sharp-shinned Hawks have more catholic habitat requirements, especially during the non-breeding seasons. During autumn, radio-tagged Sharp-shinned Hawks at Cape May, NJ, also used forested habitats more frequently than expected based on habitat availability (Holthuijzen et al 1985, Niles 1996).

Cooper's Hawks also used Pine and Short Pine extensively (range 43 - 91% of track time) but showed a greater tendency than Sharp-shinned Hawks to venture into more open areas containing at least a few scattered trees and shrubs (Table 1) Although visual contact with tagged Cooper's Hawks was slightly more frequent than with Sharp-shinned Hawks, visually verifying most of the behavior patterns of tagged Cooper's Hawks was essentially impossible.

Two roost locations of Sharp-shinned Hawks were found during the study—one in Pine and one in Short Pine. In contrast to a tendency to remain very low in vegetation during the day (typically <5 m), roosting Sharp-shinned Hawks perched at a height of 18 m and 13 m, both in the densest upper parts of pines. Both Sharp-shinned Hawk roost sites had a dense understory of hollies (*Ilex* spp) and saw palmetto (*Serenoa repens*) typical of the forested habitats at the site. Three roost sites of Cooper's Hawks were located during the study, two of these from one bird (CH-3) that stayed two nights within the tracking period. The roost of CH-1 was located within Pine habitat; the roost tree was a 12-m high slash pine in a small thicket of pines with a dense understory of holly and palmetto. The two roost trees of CH-3 were also slash pines (10- and 15-m high) but were located in thick patches of vegetation within a residential area. Again, the understory in both cases was dense and consisted mostly of holly and palmetto. Aside from the fact that two of the Cooper's Hawk roosts were in a residential area, I could detect no qualitative differences between the roost sites of Sharp-shinned and Cooper's hawks.

Behavior - Sharp-shinned Hawks spent most of the time perched (range 85 - >99% of track time)

This contrasts with values reported by both Holthuijzen et al. (1985; 25 - 44%) and Niles (1996; 37 - 41%) for Sharp-shinned Hawks at Cape May, NJ, though they are in reasonable agreement with Cochran (1972; 80%), who studied Sharp-shinned Hawks at Cedar Grove, WI. Part of the discrepancies could be due to the much larger sample sizes of both Cape May studies compared with the three birds from which I collected data.

Unambiguous behavior classification is difficult for secretive birds, and different behavior categories used by researchers at Cape May also affect comparisons between the two areas. For example, both Cape May studies included a behavior category called "hunting," defined as either "low flight in between trees and other obstacles" (Holthuijzen et al. 1985) or "alternat[ing] flying and perching behavior" (Niles 1996). However, "still" or "perch-hunting" is also a hunting tactic used by *Accipiter* described by Newton (1986:104) who stated "still-hunting is often hard to distinguish from resting, especially as a bird may do both together." Nonetheless, it is fair to conclude that Sharp-shinned Hawks at Ft. Morgan "do a lot of sitting" (Cochran 1972).

Compared to Sharp-shinned Hawks, Cooper's Hawks appeared to spend slightly more time

actively moving around the study area; but like Sharp-shinned Hawks, they spent >90% of their time perched (Table 3). These values are comparable with breeding-season studies, which indicate that Cooper's Hawks spend >85% of their time perched (references in Rosenfield and Bielefeldt 1993). Time spent soaring was certainly underestimated for Cooper's Hawks, because the transmitter on one bird failed after 2 hr, and another bird shed its transmitter after 6 hr of tracking. However, time spent soaring was probably underestimated for all hawks tracked during this study because accipiters tend to soar during mid-day and several birds could often be tracked only during morning and late afternoon hours. Moreover, all birds engaged in soaring behavior were birds leaving the study area. The third Cooper's Hawk (CH-3) was observed soaring for 38 min before the signal was lost after the bird left the study area.

Two instances of Sharp-shinned Hawks being tracked while leaving the study area provide insight into the migratory behavior of this species. At 12:18 on 21 Oct 1997, a Sharp-shinned Hawk (SS-2) that had been perched for the previous 2 hr began circling in a thermal directly over where it had been sitting. In just under 10 min, the bird rose to an altitude that rendered it invisible through 8x binoculars against a clear blue sky, though the

Table 3. Daylight behavior of Sharp-shinned and Cooper's hawks fitted with radio transmitters during autumn at Ft. Morgan. Numbers presented are percent of total usable track time(n) for each bird. During this study, it was always possible to assign a bird to a particular habitat, but signal strength was not always sufficiently clear to assign a behavior. Therefore, the amount of time used to assess behavior for three individuals is less than the total track time listed in Table 1. Behavior categories are explained in Table 2. Numbers for each individual may not add to 100 due to rounding.

Individual	Age ^a	Sex	Behavior				n (min)
			Perch-Inactive	Perch-Active	Flight-Active	Flight-Soaring	
Sharp-shinned Hawk							
SS-1	HY	M	62	29	2	7	204
SS-2	HY	M	31	54	1	14	98
SS-3	SY	F	74	25	< 1	0	240
Mean (SE)			56 (13)	36 (9)	1 (0.5)	7 (4)	
Cooper's Hawk							
CH-1	SY	M	89	7	7	0	106
CH-2	SY	F	78	15	8	0	144
CH-3	AHY	F	89	7	1	3	1031
Mean (SE)			85 (3)	9 (3)	5 (2)	1 (1)	

^a HY, hatch year; SY, second year; AHY, after hatch year; M, male; F, female

signal from the transmitter indicated that the bird was still directly overhead for at least another four min before heading westward off the peninsula. Another observation, at 13:18 on 01 Oct 1997, was also of a bird (SS-1) heading west off the peninsula; this bird was also invisible through binoculars against a clear sky. Both instances occurred on days with no cloud cover, during the hottest times of the day when thermal activity is greatest (Kerlinger 1989).

I recorded one instance of a Cooper's Hawk leaving the study area: At 10:20 on 03 Nov 1998, CH-3 made a rapid series of long flights (>500 m) in a westward direction from a residential area approximately 3 - 4 km east of the tip of the peninsula. At 11:12, the bird was observed in low (<60 m), kettling flight approximately 1 km east of the tip of the peninsula. The bird circled slowly while gaining altitude for 12 min prior to heading east-northeast over Mobile Bay using a series of long glides with occasional short bouts of flapping. The bird did not appear to reach the same altitude as the two Sharp-shinned Hawks I observed and was still just barely visible to the naked eye when it left the study site. I followed the bird's flight with binoculars until it was out of sight over Mobile Bay; the bird was out of receiver range a few minutes thereafter. The bird could not be relocated while driving up and down the peninsula for 40 min after losing contact.

Conservation Implications - Rapid rates of habitat loss for small migratory landbirds along the northern coast of the Gulf of Mexico are a conservation concern (Moore et al. 1995). Data collected during this study imply that loss of forest habitat in the region could have impacts on migrating forest raptors. Suitable stopover for any migratory bird must include appropriate habitat containing food and shelter (Moore and Simons 1992). For Sharp-shinned and Cooper's hawks, the habitat must contain forest. During autumn, Sharp-shinned Hawks at Ft. Morgan used only pine forests, and the vast majority of these pine forests occur within the Bon Secour National Wildlife Refuge. Cooper's Hawks also made extensive use of pine habitats, and the residential areas used by Cooper's Hawks contained many small patches of pines and shrubs.

The birds in this study were tracked only for relatively short periods, and it is not possible to estimate with confidence the amount of time hawks spent on the peninsula. At Cape May, Sharp-shinned Hawks typically stayed one to four days before moving on (Holthuijzen et al. 1985, Niles 1996). My data and observations of hawk migration suggest this is probably valid for Sharp-shinned Hawks at Ft. Morgan as well. Stopover duration of all raptors at different points in their migratory journeys remains very poorly known and will not be clarified until many more telemetry studies are completed. However, the fact remains that Sharp-shinned and Cooper's hawks use forested habitats almost exclusively along the northern Gulf coast, and these habitats are an important resource for birds migrating through and wintering in the area.

Larger sample sizes of radio tagged birds are needed to better understand the ecological and physiological factors that may affect habitat use. Specific questions that should be addressed in future telemetry studies are: Do age, sex, and condition correlate with different patterns of habitat use? Does the presence of large numbers of raptors or prey influence an individual's behavior or habitat use? And, does stopover length vary with the amount of habitat or prey available?

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