HABITAT USE BY MIGRATING SHARP-SHINNED HAWKS AT CAPE MAY POINT, NEW JERSEY, USA

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ABSTRACT

Sharp-shinned Hawks were trapped at Cape May while on migration and were then followed for the few days that they remained in that area. Their behaviour is analysed in relation to habitat use, and the potential impacts of habitat change on these migrating raptors is assessed.

INTRODUCTION

Cape May Point has been recognized for at least 70 years as one of the major concentration points along the east coast of the United States for southbound raptors (Allen & Peterson 1936; Stone 1937). It is located at the tip of a north–south orientated peninsula in the State of New Jersey and is bordered on the east by the Atlantic Ocean and on the west by Delaware Bay (*Figure 1*). In autumn, migrating hawks following the east coast southwards accumulate in the southernmost part of the peninsula, from which they either cross the 20km wide Delaware Bay to Cape Henlopen or fly northward along the western shore of the Bay (Dunne & Clark 1977).

For more than 15 years, fall migration counts and ringing operations have been conducted in the area around Cape May Point. These data show that hawk flights through Cape May largely consist of birds of the year (89–96%; Dunne & Clark 1977). The most numerous species is the Sharp-shinned Hawk (*Accipiter striatus*), 2500 or more of which may pass through on a single autumn day (Dunne & Clark 1977).

The southern part of the peninsula is at present composed of a mixture of fields (39%), woodlots (22%), salt marshes (14%), beach and dune (5%) and open water (3%). Urban and industrial sites cover 17 percent of the total area. However, urban encroachment is claiming increasingly larger areas in several parts of the peninsula; its effect on migrating raptors is largely unknown, because their habitat requirements during migration have not yet been studied intensively.

In this study, the habitat use of migrating female Sharp-shinned Hawks was studied in the area south of the Cape May Canal (*Figure 1*) by means of radio-telemetry. Immature females were chosen because they are larger than

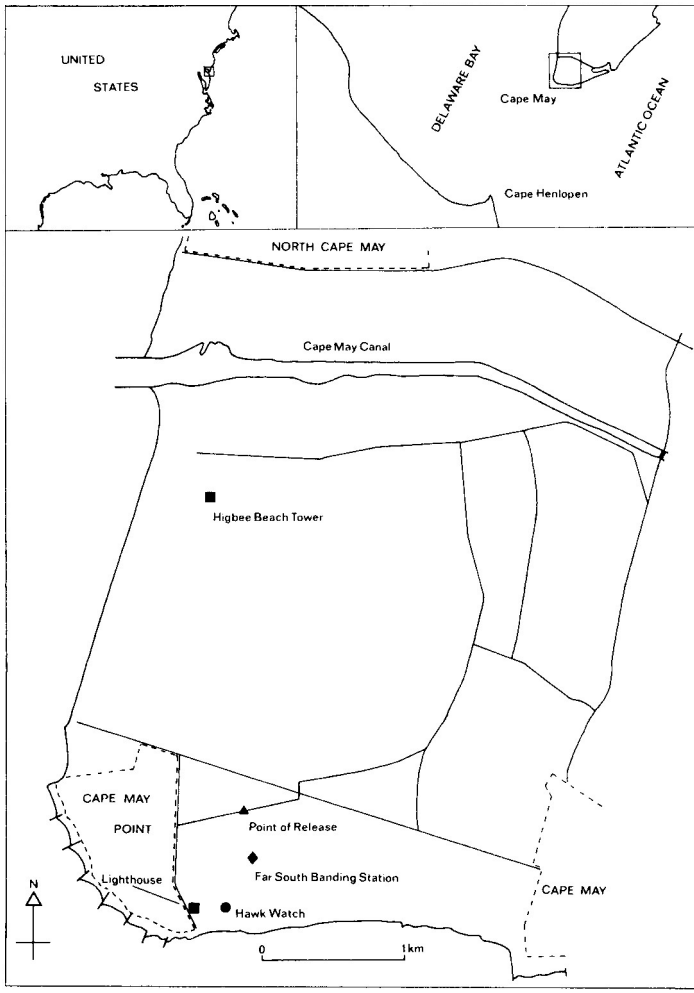

Figure 1: Location of the study area.

males (166g vs. 98g, respectively; Mueller *et al.* 1979), and would presumably be less influenced by the weight of the radio-transmitter. The specific objectives were: (1) to obtain information on the total time spent by individual Sharp-shinned Hawks in the study area during migration; (2) to identify those habitat types that were used for such activities as hunting, perching and roosting; and (3) to identify the areas most intensively used.

METHODS

The fieldwork was conducted between 28 September and 10 October 1981 at the time of greatest Sharp-shinned Hawk migration (Clark 1970; Dunne & Clark 1977). The birds were caught from 08.00–15.00hrs at the Far South Banding

Station (*Figure 1*), where they were weighed and banded before being radio-marked. The radio transmitters were constructed by LL Electronics, Mahomet (Illinois, USA) and weighed approximately 5g (about 3% of a bird's body weight). The mercury batteries had a life expectancy of about 30 days. The mounting technique used was similar to the method described by Fuller & Tester (1973). The base of one of the middle tail feathers was cleaned with medical alcohol and part of the vane close to the calamus was removed. The transmitter was then tied around the base of the ventral side of the rachis with cotton string and subsequently glued to the rachis using a quick-drying two-component epoxy. This process took about 15–20 minutes. More than one bird was usually released at the same time. The total time between capture and release varied between 45 minutes and 3 hours, with an average of 1h 40min. (s.d. = 36min.). All birds were released from the road directly north of the Far South Banding Station (*Figure 1*).

Stationary tracking units were positioned at two locations: (A) the lighthouse, about 30m high, and (B) Higbee Beach Tower, a wooden platform raised above the tree canopy about 10m high (*Figure 1*). From these tracking locations, scanning receivers (Cedar Creek Bioelectronics Laboratory, University of Minnesota) allowed the operators to regularly check the frequencies of all released birds, generally every 15 minutes. Both Higbee Beach Tower and the lighthouse were operated daily from about 06.00 until 18.00hrs. One or two mobile units were also deployed, depending on the availability of operators and cars. All stations were in continuous two-way radio contact.

Tests with the radio transmitters indicated that the maximum range of reception extended about 3km over land to the lighthouse, but only 2–2.5km to Higbee Beach Tower. The shorter range was probably due to the low elevation of the platform and interference by the surrounding vegetation and topography. The range tests were based on tests with transmitters located approximately 1.5m above the ground. The reception increased considerably when a hawk was in flight.

When a signal was received, the following information was recorded: (1) the time and compass bearing of the signal; (2) the strength of the signal (ranging from very good to very poor); (3) the consistency of the signal (consistent or intermittent); and (4) the position of the elements of the yagi antennae for optimal reception (horizontal or vertical). This information can be used to distinguish certain general behaviours (Cochran 1972; Dunstan 1972; Kenward 1978, 1980; Cedarlund & Lemnell 1980). In this study, perching, roosting, hunting and migration movements were differentiated. For single bearings, the approximate distance to the bird was estimated, based on the known location and signal strength of radio-transmitters used for testing receiving equipment.

RESULTS

In total, 34 birds were released. Little or no information was obtained from two birds with malfunctioning transmitters, and others removed or lost their transmitter within one day. Most of these transmitters (seven out of nine) were found on the ground attached to the central tail feather. Kenward (1978, 1980) noted that some hawks removed transmitters even though he fastened them to two rectrices. Information obtained from these nine birds was used only for relating habitat to behaviour and was excluded from all other analyses.

Assuming each bird was caught soon after it entered the area, the total amount of time spent in the study area varied from 1h 15min. to 69h 22min., with an average of 14h 19min. (*Table 1*). Time of release was correlated with the total

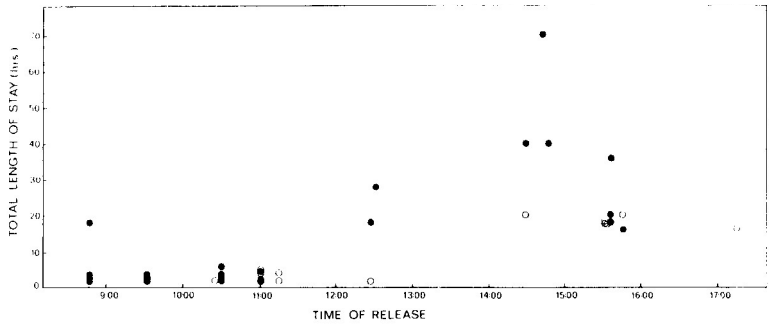

Figure 2: Relationship between time of release and total length of stay of radio-tagged Sharp-shinned Hawks. Open symbols: data from Anderson *et al.* (1980).

length of time a hawk stayed in the study area ($R^2 = 0.33$, $P < 0.004$; *Figure 2*). Birds released before 12.00hrs remained in the area for an average of four hours; the majority left on the day of release. In contrast, all birds released after 12.00hrs roosted in the area the first night after capture and then stayed for varying periods the following day(s). These birds remained in the Cape May Point area for an average of more than 31 hours (*Table 1*). This trend was supported by data collected during a preliminary telemetry study in the same area (Anderson *et al.* 1980) although during the 1980 study (27 September to 4 October 1980) the birds never spent more than 20 hours in the area (*Table 1*). In the present study, eight out of nine birds released after 12.00hrs remained for more than 20 hours.

Radio signals provided information on the hawks' location and their behaviour at the moment of signal reception. Six categories of behaviour could be distinguished, based on signal bearing, strength, consistency and aerial position (*Table 2*).

Table 1: Total periods (in hours and minutes) that radio-marked Sharp-shinned Hawks remained in the study area after release.

	1981				1980[3]			
	N	Mean	Range	S.D.	N	Mean	Range	S.D.
Group 1[1]	15	4:02	1:15–17:15	3:48	5	3:09	1:45–5:00	1:25
Group 2[2]	9	31:26	16:22–69:22	17:12	7	15:57	1:35–20:50	6:34
Total	24	14:19	1:15–69:22	17:12	12	10:37	1:45–20:50	8:13

Notes: 1. Group 1: Birds released before 1200.
2. Group 2: Birds released after 1200.
3. Data from Anderson *et al.* (1980).

Table 2: Categories of behaviour of Sharp-shinned Hawks as derived from radio-signal information.

Activity	Strength	Consistency	Bearing	Reception[1]
Perching	constant	constant	constant	V ≫ H
Hunting	constant	intermittent	changing	V, H
Milling	slow change	constant	changing	H ≫ V
Kettling	fades cyclic	constant	changing	H ≫ V

Note: 1. Refers to the position of the elements of the yagi antenna for optimal reception (V = vertical; H = horizontal).

Table 3: Total periods (in minutes) that radio-marked Sharp-shinned Hawks performed selected behavioural categories that were determined from radio-signal information.

	Activity in minutes	
Activity	Group 1[1]	Group 2[2]
Perching	43	352[3]
Hunting	36	253[3]
Milling/hunting	37	51
Milling	64	54
Kettling	14	56
N	15	9

Notes: 1. Birds released before 12.00.
2. Birds released after 12.00.
3. Indicates significant difference ($P < 0.05$).

Perching. No notable change of location from one scanning period to the next (generally 15min. later) when observed between 06.00 and 18.00hrs. This category probably included a variety of activities such as preening, resting and eating.

Roosting. No movement from 18.00 to 06.00hrs; after 18.00hrs the hawks generally did not move (Anderson *et al.* 1980) and were considered to be roosting.

Hunting. Low flight (<15–20m) in between trees and other obstacles.

Milling. Medium high flight above tree-top level (up to about 100m). This category probably included the precursor flight mentioned by Cochran (1972) and most migratory movements except kettling.

Milling-hunting. Alternating brief periods of low and medium high flight, difficult to classify as either hunting or milling.

Kettling. Circular upward flight involving more than one hawk.

Hawks released in the morning (Group I) spent less time (Manova, $P < 0.05$) perching and hunting than did those released after 12.00hrs (*Table 3*). Comparing the proportion of time that each behavioural category took up out of the total period of stay of each hawk, no differences in the frequency of behaviours by Group I *vs.* Group II were detected (*Table 4*).

Table 4: Mean proportion (%) of time that radio-marked Sharp-shinned Hawks performed selected behavioural categories that were determined from radio-signal information.

	Activity in percentage	
Activity	Group 1[1]	Group 2[2]
Perching	25.2	44.4
Hunting	19.0	39.7
Milling/hunting	22.0	4.3
Milling	26.1	5.2
Kettling	7.7	6.3
N	15	9

Notes: 1. Birds released before 12.00.
2. Birds released after 12.00.

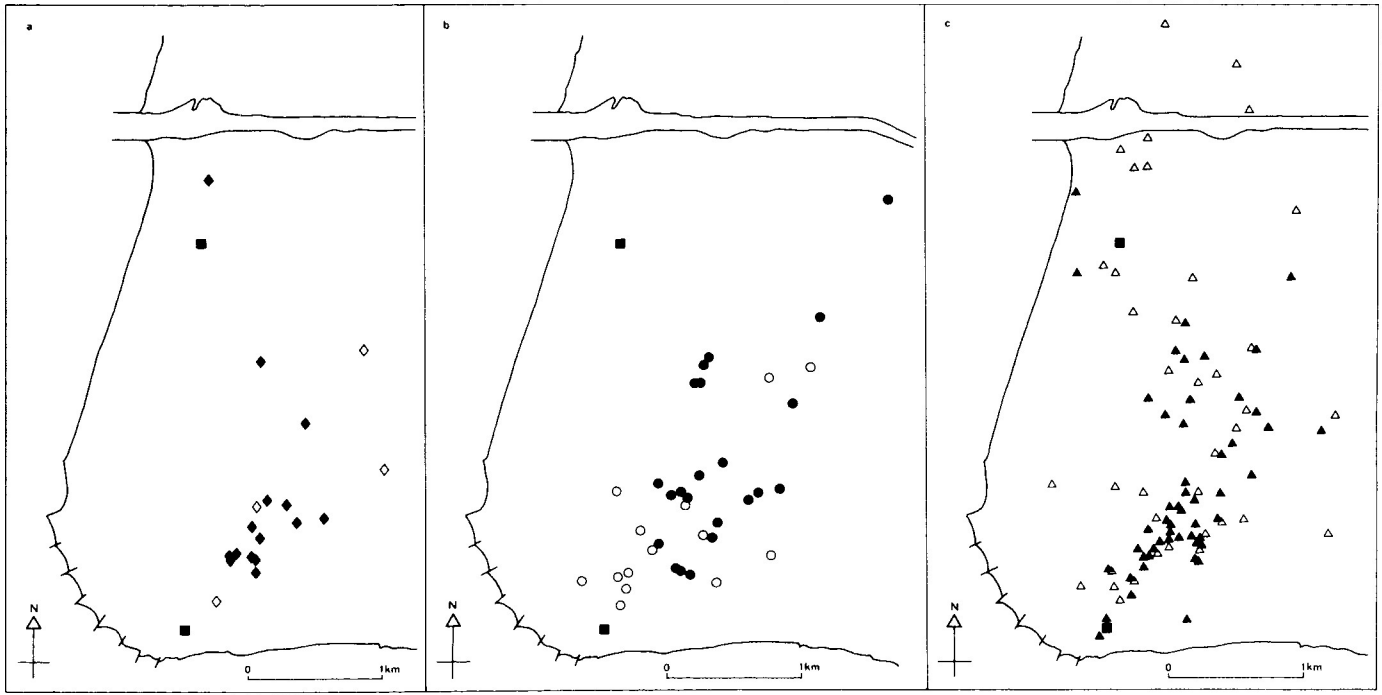

Figure 3: Location of (a) roosting, (b) perching and (c) hunting sites used by radio-tagged Sharp-shinned Hawks. Closed symbols refer to locations established by cross-bearings and open symbols represent locations estimated by single bearings.

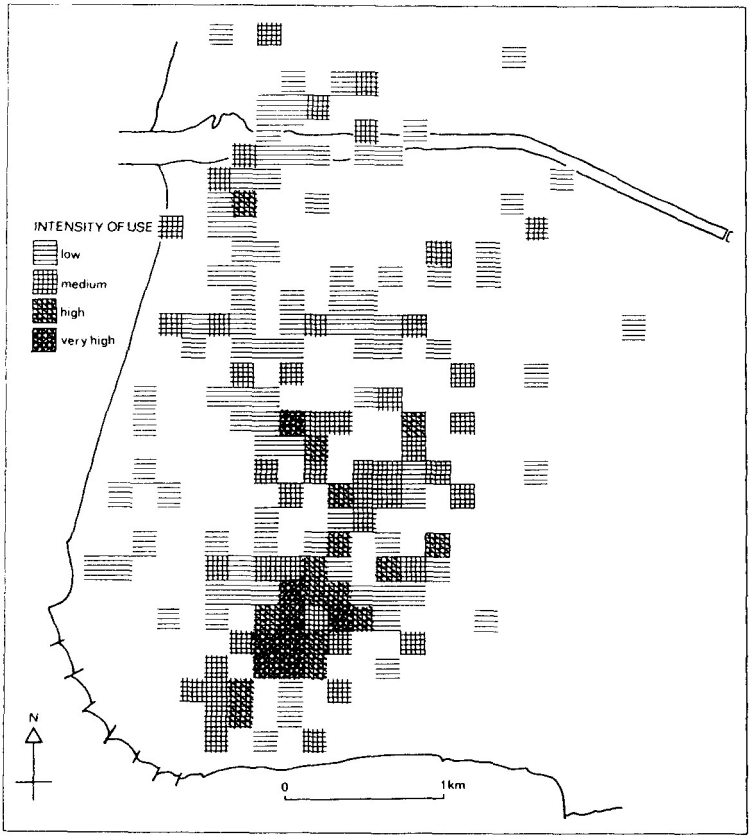

Figure 4: Use of the study area by radio-tagged Sharp-shinned Hawks at four levels of intensity.

To analyse associations between behaviour, locations and habitat, observations for the six categories for all birds were plotted on separate maps (e.g. *Figure 3*). In order to determine whether certain sites were more intensively used than others, a grid consisting of 150 × 150m cells was superimposed on a map of the study area. The occurrence of the six behaviour categories was recorded for each cell. Observations of milling, milling-hunting and kettling were combined because all three were associated with low intensity usage. Each observation of hunting, roosting and perching was weighted according to the average amount of time spent on that type of behaviour, after which an index figure was calculated per cell. Intensity of use was then classified as low, medium, high and very high. The most intensively used area was immediately east of Cape May Point and west of the urban sprawls of Cape May, near the banding station (*Figure 4*). Two additional areas of high use were located in the middle of the central marsh and a woodlot north of Higbee Beach Tower respectively.

Recent aerial photographs (1978) provided the basis for a map on which six habitat types were distinguished: woodland, marsh, field, beach and dune, water

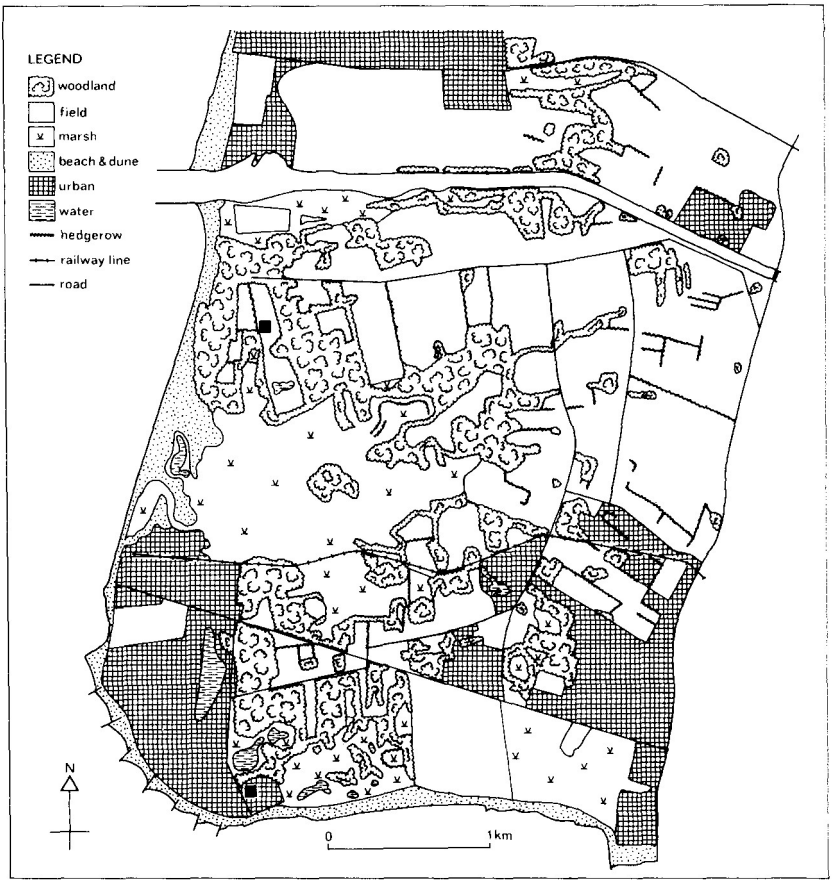

Figure 5: The distribution of the six habitat types in the study area.

and urban areas (*Figure 5*). Woodland vegetation ranged from low thickets to medium-sized trees (up to 12m in height), including oaks (*Quercus* spp.), ash (*Fraxinus* sp.), Black Locust (*Robinia pseudoacacia*), pines (*Pinus* sp.), Red Cedar (*Juniperus virginiana*) and Marsh Elder (*Iva fructescens*). The marsh habitat mainly consisted of *Phragmites communis*. Field habitat was composed of agricultural land, pastures and abandoned or fallow sites. Beach and dune combined sandy beach, bare dunes, and dunes with sparse, low vegetation. The urban areas were predominantly residential or industrial.

Each observation and accompanying behaviour was allocated to a particular habitat type (*Table 5*). The majority of the perching sites were in woodland (66%), although some were in fields (23%) and in marsh (9%). Roosting sites were almost exclusively in woodlots. Two-thirds of both perching and roosting sites occurred along the edge of woodlots that bordered a field or marsh (there may be a bias towards an edge effect due to the fragmentation of the habitat). Sixty-four percent of the hunting occurred in woodland, 20 percent in fields and

Table 5: Behaviour related to habitat type.

Habitat type	Percentage of area	Behaviour in percentages					
		Perch	Roost	Hunt	Hunt/Mill	Mill	Kettle
Woodland	22	66	95	64	40	43	30
Marsh	14	9	0	12	28	20	12
Field	39	23	5	20	27	23	46
Beach/Dune	5	0	0	1	1	2	0
Urban	3	2	0	3	1	6	8
Water	17	0	0	0	3	6	4

12 percent in marsh habitat. Thus roosting, perching and hunting activities were concentrated primarily in woodland and to a lesser extent in fields and marsh, rarely occurring in beach and dune, water or urban habitats.

The three remaining behaviour categories—milling, milling-hunting and kettling—were not closely associated with any particular habitat (*Table 5*). Occasionally hawks ventured out over water during migration movements, perhaps attempting to cross the Bay to Cape Henlopen. Woodlands were used more for milling and milling-hunting than fields and marshes, whereas kettling occurred more over fields.

DISCUSSION

The amount of time that radio-tagged Sharp-shinned Hawks spent in the study area was correlated with the time of release. Hawks released in the morning left the study area the same day. Allen & Peterson (1936), Mueller & Berger (1973) and others (cf. Heintzelmann 1975) have reported greater movements of Sharp-shinned Hawks in the morning. Birds released in the afternoon spent at least one night in the area. Factors influencing length of stay may include time of day, weather conditions and availability of food (Mueller & Berger 1976; Dunne & Clark 1977; Newton 1979). A substantial part of the daily time budget was spent hunting and perching, and those birds that remained in the study area after the day of release spent more time perched and hunting than hawks that flew from the area the same day. The absolute amount of time spent on migration-related behaviour was not significantly different for birds released in the morning versus the afternoon (*Table 4*).

Woodlands, in particular those east of Cape May Point extending northwards to the railway line, a small wooded island in the central marsh, and a small area north of Higbee Beach, were areas in which all behaviours were concentrated. Woodland comprised 22 percent of the study area, but from 30 percent to 95 percent of the behaviours were detected in this habitat. Migratory behaviour was not strongly associated with a particular habitat type, although considerably more kettling occurred over fields than other habitats.

Areas indicated as having a low intensity of use may also be important for migrants. During the ten-day study period, the Cape May Bird Observatory Hawk Watch reported an average of 1700 Sharp-shinned Hawks per day. Even if the majority moved through in less than a day, a considerable number remained overnight or longer, and made widespread use of the area.

The information from this study can be used to assess the potential impacts of habitat change on migrating Sharp-shinned Hawks. Migration flights will prob-

ably be little affected by major habitat changes. However, many radio-marked birds roosted and *all* marked hawks spent some time perching and hunting in the area. Habitat manipulations that would interfere with these activities include fragmentation and clearing of woodlots, increased urbanization, and industrialization. The present mixture of habitat types is probably favourable for Sharp-shinned Hawks. Increased disturbance may eliminate many perching and roosting sites, not only for the Sharp-shinned Hawks but also for passerines, thus affecting prey availability.

This study reveals that certain sites in the Cape May Point area are used intensively by Sharp-shinned Hawks, and thus should have high conservation priority. Some are already protected as part of the State Park at Cape May Point or the Higbee Beach Game Management Area. Future conservation efforts should be concentrated on the remaining privately owned areas.

Although Sharp-shinned Hawks were most numerous at Cape May Point, several other raptor species passed through the area in substantial numbers. Northern Harriers (*Circus cyaneus*) hunted in marshes and pastures, Kestrels (*Falco sparverius*) in agricultural fields, Merlins (*F. columbarius*) were seen along the dunes and beaches and Ospreys (*Pandion haliaetus*) over water (Dunne & Clark 1977). Sharp-shinned Hawks made little use of these habitats but any conservation strategy should be based on the behaviour of all species migrating through the area.

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