Levels of DDE In Eastern Flyway Populations Of Migrating Sharp-shinned Hawks And the Question of Recent Declines in Numbers Sighted

by Cathy Viverette, Laurie Goodrich and Mark Pokras

In the Fall of 1991, Hawk Mountain Sanctuary and the Tuft's University School of Veterinary Medicine's Wildlife Clinic, undertook a preliminary investigation of the general health and contaminant levels of Sharp-shinned Hawks (*Accipiter striatus*) in the eastern flyway.

The study was prompted by sharp declines in the numbers of Sharp-shinned Hawks observed at "coastal" hawkwatches in the Eastern United States in recent years, while counts conducted further inland and in the west have remained steady or increased during the same period (Kerlinger 1992). At Cape May Bird Observatory in Cape May, New Jersey, for example, an average of 42,672 Sharp-shinned Hawks were sighted during annual fall counts conducted from 1976 to 1985. Since 1985, however, Cape May's counts have averaged 16,427, and have declined steadily each year, with only 8,197 Sharp-shinned Hawks counted in the fall of 1992 (Kerlinger 1992). Other coastal watch sites such as Montclair Hawk Lookout in Montclair, New Jersey, and Fire Island, New York, also report declines in Sharp-shinned Hawk counts (E. Greenstone, pers. comm., Panko 1992). Spring count sites such as Sandy Hook, New Jersey, and Braddock Bay on Lake Ontario in New York, have observed declines in Sharp-shinned Hawk counts since 1987 and 1989 respectively (Dodge 1992, Kerlinger 1992).

On the other hand, Appalachian Mountain ridge sites further inland, including Hawk Mountain Sanctuary, have noted a decrease in Sharp-shinned Hawk sightings only since 1991 (Figure 1).

To determine if the source populations of Sharp-shinned Hawks passing Cape May and Hawk Mountain are the same, Hawk Mountain researchers analyzed banding data from the two sites (Clark 1985, S. Struve and L. Goodrich, unpubl. data). The ranges of hawks banded at Cape May and Hawk Mountain overlapped considerably, with an 80% overlap in breeding range and nearly identical wintering ranges in the southeastern United States (S. Struve and L. Goodrich, unpubl. data).

Hawk Mountain records a larger percentage of adult Sharp-shinned Hawks during fall migration (Goodrich, unpubl. data) than does Cape May, which reports primarily juveniles (Clark 1985). If Sharp-shinned Hawk populations are being adversely affected by events that interfere with reproduction, numbers of juveniles would decrease first, followed later by declines in the adult population. This may explain why Cape May and other coastal sites started recording a reduction in Sharp-shinned Hawks counts several years before Hawk Mountain.

Several hypotheses have been suggested for the observed decreases in Sharp-shinned Hawks counted on migration in the eastern flyway. One possibility is that the population is not declining but simply changing its migratory habits by "short-stopping," with a larger percentage of the population remaining north of most count sites.

Table 1. Blood Serum Levels Of p, p' DDE (in ppm-wet weight) In Migrating Sharp-shinned Hawks, 1985-1991

Collection Site	Mean	(Range)	[N]
Hawk Mountain 1991			
Adults	0.26	(0.07-0.49)	[3]
Juveniles	0.06	(0.02-0.13)	[7]
Great Lakes 1985 - 1991*			
Adults	0.27		[133]
Juveniles	0.02		[25]

* Elliot and Shutt, 1993.

On the other hand, if lower migration counts reflect actual population declines, then there are many possible causes. First, food supplies may be limiting. Sharp-shinned Hawks feed primarily on small songbirds (Snyder and Wiley 1976, Storer 1966). Kerlinger (1992) has suggested that acid precipitation may be decreasing the primary productivity of northern boreal forests, which in turn may be limiting populations of insect-eating birds, a major prey item of Sharp-shinned Hawks. Breeding and wintering habitat loss may also be contributing to declines in neotropical songbirds (Askins 1992, Askins et al 1990, Morton and Greenberg 1989, Robbins et al 1989, Whitcomb et al. 1981), as well as short-distance nearctic migrants, which may be important prey for Sharp-shinned Hawks on their wintering grounds (Droege and Peterjohn 1992, Witham and Hunter 1992).

Second, environmental contaminants may be involved in the current decline. Acid precipitation leaches metals such as aluminum and mercury into the food chain, which in turn, may affect avian reproduction (Mitchell 1989, Romanowski *et al.* 1989, Scheuhammer 1987,). Organophosphate pesticides, which have been used extensively on Sharp-shinned Hawk breeding grounds for insect control, can be acutely toxic to birds (Kozie 1992, Porter 1993). Sub-lethal exposure to organophosphates may also reduce fitness and affect reproductive success in birds (Busby and White 1991, Forsyth and Martin 1992, Hart 1990, Holmes and Boag 1990, Kozie 1992). In addition, despite the U.S. ban on DDT in the 1970s, the more persistent organochlorine contaminants continue to plague raptors in both the United States and Canada (Court et al. 1990, Peakall et al. 1990, Porter 1992). New Jersey has detected DDT-related egg-shell thinning in nesting Osprey (*Pandion haliaetus*) (Steidl et al. 1991), California's Peregrine Falcons (*Falco peregrinus*) were plagued by high egg levels of DDE throughout the 1980s (Clark 1990), and in 1990, the Canadian Wildlife Service reported elevated levels of DDE in eggs and tissues of some Sharp-shinned Hawks nesting in Canada (Noble and Elliot 1990).

Because environmental contaminants may be responsible for Sharp-shinned Hawk declines, we collected blood from migrant Sharp-shinned Hawks trapped and banded 48 km NE of Hawk Mountain Sanctuary at Little Gap Banding Station on the Kittatinny Ridge. We also collected tissues from birds killed accidentally and turned in at nature and rehabilitation centers in Massachusetts, Connecticut, New York, New Jersey, and Pennsylvania.

Birds trapped on the Kittatinny Ridge were given a physical exam including checks of their ears, eyes, nose, and throat, and searches for external parasites. Body mass, wing and tail length, and subcutaneous fat were also measured. Up to 1 ml of blood was collected from the jugular or brachial vein, and fluid replaced before the bird was released. Portions of selected blood samples were centrifuged and the plasma frozen for later analysis. Packed cell volume (PCV), total solids (TS) of the plasma, white blood cell counts and searches for blood parasites were performed at Tufts. The results of the clinical exam and the laboratory tests indicated the majority of birds were healthy (Powers et al. in press).

Organochlorine analyses were conducted at the Mississippi State University Chemical Laboratory, Mississippi State, Mississippi. Mercury analysis of whole blood was conducted by Research Triangle Institute, Research Triangle Park, North Carolina. Blood analyses revealed that adult levels of DDE averaged higher than those for juveniles. These results are consistent with those found by the Canadian Wildlife Service for Sharp-shinned Hawks migrating through the Great Lakes in 1990 (Elliot and Shutt 1993) (Table 1).

Necropsies on all Sharp-shinned Hawks found dead during the Fall of 1991 were conducted at Tufts, where liver tissue was removed for organochlorine and heavy-metal analysis at the University of Georgia's Cooperative Extension Service Laboratory in Athens, Georgia. All birds analyzed had detectable levels of DDE. PCBs and mercury were also detected in some birds (Table 2).

DDE levels in Sharp-shinned Hawks have not been monitored in the past and the minimum critical levels required to affect reproduction are unknown, thus we do not know if DDT and its metabolites (e.g., DDE) are playing a role in Sharp-shinned Hawk declines. However, levels detected in the eastern flyway averaged higher than those measured in birds trapped at Hawk Ridge, Minnesota (D. E. Andersen, pers. comm.).

In 1992 and 1993 we continued to investigate the levels of contaminants in eastern Sharp-shinned Hawks with the assistance of the United States Fish and Wildlife Service. The 1992 and 1993 levels appear to be similar to 1991 levels. Also, in cooperation with Paul Kerlinger of Cape May Bird Observatory, we are examining migration watch-site numbers in the east, and are investigating the possibility that some Sharp-shinned Hawks may be expanding their winter range northward through "short-stopping." Finally, we are investigating the role of the spruce budworm outbreak in eastern Canada on Sharp-shinned Hawk prey species and how their current population trends may have affected Sharp-shinned Hawk numbers.

Table 2. Liver-tissue Levels Of DDE & PCBs (in ppm-wet weight) In Migrating Sharp-shinned Hawks From The Northeast-1991

Age	Gender	Location	DDE	PCB
SY	Male	NJ	2.3	—
SY	Male	NY	3.9	—
HY	Male	NJ	2.8	1.9
HY	Female	NJ	0.17	—
AD	UN	CT	1.7	—
SY	Female	PA	11.62	—
HY	UN	PA	0.89	—
AD	Male	MA	3.61	5.90
AD	Male	NY	1.0	4.11
IM	Male	NY	23.81	35.3
AD	Female	MA	64.0	20.8
SY	Female	MA	2.3	0.9

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Trends in Abundance of Fall Migrating Raptors At Holiday Beach Migration Observatory, Essex County, Ontario, 1977-93

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Abstract

Fifteen species of raptors have been counted during their migration each September through November, 1977-93 at the Holiday Beach Migration Observatory, Essex County, Ontario, Canada. The raptors regularly counted are: Turkey Vulture (*Cathartes aura*), Osprey (*Pandion haliaetus*), Bald Eagle (*Haliaeetus leucocephalus*), Northern Harrier (*Circus cyaneus*), Sharp-shinned Hawk (*Accipiter striatus*), Cooper's Hawk (*Accipiter cooperii*), Northern Goshawk (*Accipiter gentilis*), Red-shouldered Hawk (*Buteo lineatus*), Broad-winged Hawk (*Buteo platypterus*), Red-tailed Hawk (*Buteo jamaicensis*), Rough-legged Hawk (*Buteo lagopus*), Golden Eagle (*Aquila chrysaetos*), American Kestrel (*Falco sparrerius*), Merlin (*Falco columbarius*), and Peregrine Falcon (*Falco peregrinus*). The objective of this study was to analyze the counts of migrating raptors for trends in population abundance and to compare those trends with other independent measures of abundance. Counts were standardized to birds counted per hour and a non-parametric correlation coefficient (Spearman) and a coefficient of determination were calculated to analyze for trends in each species. There was a significant increasing trend ($P<0.10$) over the past 17 years for the Turkey Vulture, Osprey, Bald Eagle, Northern Harrier, Cooper's Hawk, Red-shouldered Hawk, Golden Eagle, Merlin, and Peregrine Falcon. The Sharp-shinned Hawk, Northern Goshawk, Broad-winged Hawk, Red-tailed Hawk, Rough-legged Hawk, and American Kestrel had non-significant trends ($P>0.10$) either positive or negative. The four independent measures of raptor abundance (two breeding surveys and two regional analyses of migrating raptors) in general supported the trends found for Holiday Beach raptors. The counts of fall migrating raptors appear to be a reasonable index to population abundance of raptors in the eastern Great Lakes region.

Introduction

Counts of migrating raptors are generally accepted as an effective way of detecting trends in abundance of populations over broad geographical regions (Bednarz et al., 1990: Titus and Fuller, 1990). At the Holiday Beach Conservation Area in southern Ontario, Canada, raptors have been counted during their fall migration since 1974 (Benoit, 1993). Holiday Beach, formerly a provincial park, is located on the north shore of Lake Erie near the mouth of the Detroit River. The funnel shape of southern Ontario sandwiched between two of the Great Lakes, Huron and Erie, influences bird migration by encouraging flight corridors southwesterly over Holiday Beach. Chartier and Stimac (1993) provide a detailed description of the site and its geography. A group of counters has dedicated September through November each year to recording the number of raptors passing through the Area. The group formally organized the Holiday Beach Migration Observatory in 1986. From the earliest years, they have strived for systematic observations and are members of the international Hawk Migration Association of North America.

The raptor species regularly counted at Holiday Beach are Turkey Vulture, Osprey, Bald Eagle, Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Northern Goshawk, Red-shouldered Hawk, Broad-winged Hawk, Red-tailed Hawk, Rough-legged Hawk, Golden Eagle, American Kestrel, Merlin, and Peregrine Falcon. The objective of this paper is to analyze the counts of these migrating raptors at Holiday Breach for any trends in population abundance and to compare those trends with other measures of abundance.

Methods

Raptor counts are made at the Holiday Beach Migration Observatory by paired observers most of whom have 8 to 19 years of experience at this site (Benoit, 1993). In the early years (1974-82), only the number of days of counting was recorded without hours per day (Table 1). There were only 27 days of observations in 1974 but this increased to 50 in 1975 and 62 in 1976. From 1977 through 1982 counting days were more constant and only varied from 74 to 84 days. Starting in 1983, hours per day were