

AGE AND SEX DIFFERENCES IN THE TIMING OF SPRING MIGRATION OF HAWKS AND FALCONS

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ABSTRACT.—We trapped 994 hawks during spring migration in years between 1953 and 1972. We obtained sufficient numbers to comment on age or sex differences, or both, in the timing of migration of six species. Adults migrated earlier in most species, presumably because most adults but few juveniles breed. Adult male Sharp-shinned Hawks (*Accipiter striatus*) migrated significantly before adult females and the larger (presumably female) Red-tailed Hawks (*Buteo jamaicensis*) migrated significantly earlier than smaller individuals. Juvenile female Sharp-shinned Hawks and Cooper's Hawks (*A. cooperii*) migrated before males, probably because more juvenile females than males breed. Received 14 January 2003, accepted 3 June 2003.

Mueller et al. (2000) analyzed age and sex differences in the timing of fall migration of 10 species of hawks and falcons at Cedar Grove, Wisconsin. They found that adults migrated later than juveniles in eight species and that males migrated later than females in five of these. Mueller et al. (2000) hypothesized that prolonged occupancy of the territory during fall provided an advantage the following breeding season with the greatest advantage accruing to the sex that is the primary defender of the territory. Females migrated later than males in Cooper's Hawks (*Accipiter cooperii*) and Northern Goshawks (*A. gentilis*); females may be more attached to the breeding territory than males in these two species. Juveniles migrated later than adults in the Peregrine Falcon (*Falco peregrinus*), and there was no significant age difference in the timing of migration in the Rough-legged Hawk (*Buteo lagopus*). These two species breed in the Arctic where summers are short, adults must leave as soon as the young are independent, and adults may migrate more rapidly than juveniles.

The sex that is the primary defender of the territory would be expected to migrate earlier in spring than the other sex. Adults, which usually breed, would be expected to migrate earlier in spring than juveniles, which rarely breed in most species. It is difficult to deter-

mine the sex of most raptors in the field. Because of the sexual size dimorphism, trapping a migrant raptor permits the determination of sex in many species and an approximation of sex in others. We report here on spring migrants trapped at Cedar Grove, Wisconsin.

METHODS

We trapped 994 migrating hawks of 12 species at the Cedar Grove Ornithological Station (43° 33' N, 87° 21' W) on the western shore of Lake Michigan in Sheboygan County, Wisconsin, on 414 days during 12 springs from 1953 to 1972. We obtained sufficient individuals to distinguish age differences in five species, sex differences in adults and juveniles in four species, and sex differences in the American Kestrel (*Falco sparverius*) where age determination was not possible. We determined sex by plumage in American Kestrels and adult Northern Harriers (*Circus cyaneus*), and by measurement in Cooper's Hawks, Sharp-shinned Hawks (*A. striatus*), and juvenile Northern Harriers. Red-tailed Hawks (*Buteo jamaicensis*) could not be sexed but an estimate of sex was obtained by dividing the size distribution of wing chord into large and small individuals. This was not attempted in Red-shouldered Hawks (*B. lineatus*) because of small sample size.

We used the Mann-Whitney *U*-test to compare the timing of migration for age and sex groups. Statistics were performed in SYSTAT (Wilkinson 1989) on a Macintosh computer.

RESULTS

Adults migrated significantly earlier in spring than juveniles in the Northern Harrier, Cooper's Hawk, and Red-tailed Hawk, and in

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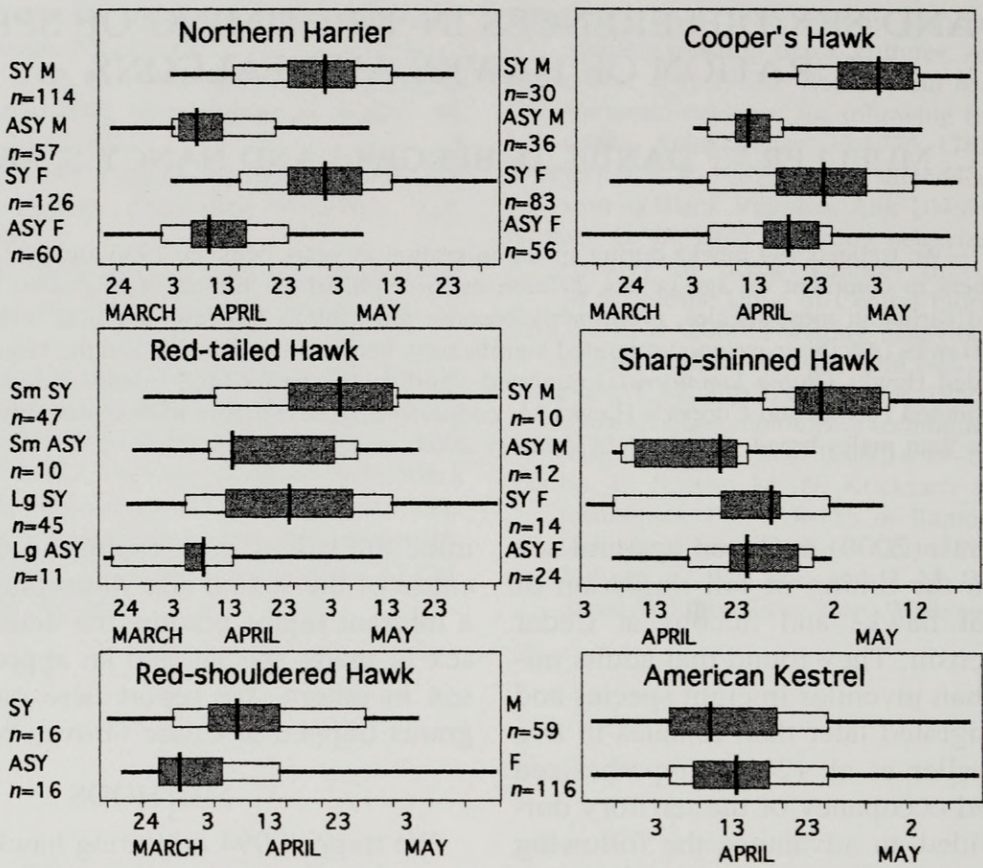


FIG. 1. Temporal distribution of hawks and falcons during spring migration along the western shore of Lake Michigan, 1953–1972. SY M are second year males (males in juvenile plumage); ASY M are after second year males (males in adult plumage); F are females; Sm (small) are Red-tailed Hawks with wing chords shorter than the mean, and thus presumably male; Lg (large) are Red-tailed Hawks with wing chords longer than the mean, and thus presumably female. The vertical lines indicate medians, and the shaded bars, white bars, and horizontal lines enclose the median, 33%, 67%, and 95% of the sample distributions.

male Sharp-shinned Hawks (Fig. 1, Table 1). There was no significant age difference in the timing of migration in Red-shouldered Hawks and female Sharp-shinned Hawks. For adults, males migrated significantly earlier in Sharp-shinned Hawks, and large individuals (presumably females) migrated significantly earlier in the Red-tailed Hawk. For juveniles, females migrated significantly earlier than males in the Cooper's Hawk and the Sharp-shinned Hawk. No other age or sex differences were statistically significant.

DISCUSSION

Adults migrated before juveniles in five species for which age could be determined, although the difference was not statistically significant in Red-shouldered Hawks and female Sharp-shinned Hawks. In most species of raptors, second year birds usually do not breed. Up to 23% of breeding female Northern Harriers are juveniles, but only 5–8% of

the males are (MacWhirter and Bildstein 1996). In Cooper's Hawks, 6–22% of breeding females are juveniles, but juvenile males apparently breed only rarely (Rosenfield and Bielefeldt 1993). Some juvenile Sharp-shinned Hawks breed, mostly females, but most do not until they are older (Bildstein and Meyer 2000). Few juvenile Red-tailed Hawks breed (Preston and Beane 1993). Usually only adults breed in the Red-shouldered Hawk, but juveniles (mostly females) have been reported breeding with adults (Crocoll 1994). American Kestrels, however, typically breed in their second year (Bird 1988). Thus, individuals that are likely to breed migrate earlier in spring than those that are unlikely to breed. Adults migrated significantly later than juveniles during fall in all five of these species (Mueller et al. 2000), suggesting that breeders are more attached to the home area than non-breeders.

In adults, males migrated earlier in four of

TABLE 1. Age and sex differences in the timing of spring migration along the western shore of Lake Michigan, 1953–1972. ASY birds migrated later than SY birds in most species. Statistical results are from Mann-Whitney tests.

Species	Comparison ^a	Sample sizes	<i>U</i>	<i>P</i>
Northern Harrier	SY M versus ASY M	114, 57	997	0.001
	SY F versus ASY F	126, 60	1,304	0.001
	ASY M versus ASY F	57, 60	1,522	0.305
	SY M versus SY F	114, 126	6,955	0.672
Cooper's Hawk	SY M versus ASY M	30, 36	112	0.001
	SY F versus ASY F	83, 56	1,787	0.012
	ASY M versus ASY F	36, 56	837	0.106
	SY M versus SY F	30, 83	1,670	0.004
Sharp-shinned Hawk	SY M versus ASY M	10, 12	10	0.001
	SY F versus ASY F	14, 24	174	0.855
	ASY M versus ASY F	12, 24	205	0.042
	SY M versus SY F	10, 14	30	0.019
Red-tailed Hawk	ASY versus SY	21, 92	1,431	0.002
	Sm ASY versus Lg ASY	10, 11	86	0.028
	Sm SY versus Lg SY	47, 45	1,239	0.156
Red-shouldered Hawk	SY versus ASY	17, 16	44	0.134
American Kestrel	M versus F	59, 116	3,282	0.656

^a SY = Second year, i.e., birds hatched the previous year.

ASY = After second year, i.e., birds hatched prior to the previous year.

M = Males.

F = Females.

Sm = Birds with wing chords shorter than the mean.

Lg = Birds with wing chords longer than the mean.

the five species where samples were adequate, but the difference was statistically significant only in Sharp-shinned Hawks. In adult Red-tailed Hawks, larger (presumably female) birds migrated significantly earlier than smaller birds. Male Northern Harriers arrive on the breeding territory before females (MacWhirter and Bildstein 1996), and the same is true of the American Kestrel (Bird 1988) but information is lacking for the other four species. The sex that is the primary defender against conspecifics might be expected to migrate earlier, but there is little information available. Males are more active in territorial defense in the American Kestrel (Bird 1988) and Cooper's Hawk (Rosenfield and Bielefeld 1993). Both sexes defend the territory against members of their own sex in the Northern Harrier. There is no published information on the other species.

Males usually are the sex most attached to the territory and are more active in territorial defense than females (Newton 1979), and leaving the territory later in fall and returning earlier in spring would be an advantage. Males provide much of the food for the female and young during the breeding season,

and prolonged familiarity with the territory might be advantageous in hunting. Adult males migrated significantly later than adult females during fall in four of the six species; the difference was almost significant ($P = 0.08$) in a fifth, the Northern Harrier; and females migrated later than males in the Cooper's Hawk. The hypothesis that the sex which is most attached to the territory migrates later in fall and earlier in spring thus fails to hold for two of the five species in this study where sex was determined. We cannot explain these differences between spring and fall in the timing of migration of the sexes.

For juveniles, females migrated earlier in three of the four species where this could be determined, but the difference was significant only in Cooper's and Sharp-shinned hawks. There was no significant difference in Red-tailed Hawks and no discernible difference in Northern Harriers. Juvenile females may migrate earlier than males because they are more likely to breed than juvenile males.

Juvenile males leave their natal areas significantly later in fall than females in 8 of 10 species (Mueller et al. 2000). Thus, we might expect juvenile males to migrate earlier in

spring than females, but the opposite was true. The Cooper's Hawk is one of two species in which adult females migrated significantly later than adult males during fall, and in this species juvenile males migrated significantly later than juvenile females during fall; the Northern Goshawk is the other species and there was no significant age (SY versus ASY) difference in the timing of migration of juveniles (Mueller et al. 2000). Females disperse farther than males in birds, both from their natal site and previous breeding site (Greenwood 1985). Natal philopatry has been studied adequately in only one species of raptor, the Eurasian Sparrowhawk (*A. nisus*), in which females dispersed farther than males (Newton 1979). Perhaps the longer residency in the breeding area during fall by juvenile males facilitates philopatry.

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