Wilson Bull., 95(3), 1983, p. 492

Examining nesting cavities with an optical fiberscope.—Many birds nest in cavities. Tools such as pole-mounted mirrors and lenses mounted on long sticks (Demong and Emlen, Wilson Bull. 87:550–551, 1975) have aided previous observations of nesting cavities, but these methods are suitable only when the cavity entrance has no more than one bend, or when the investigator's arm can reach a point where there is a straight passage to the nest. Using flexible fiber optic devices avoids these restrictions, and allows a clear view of the interior of deep cavities with irregular entrances.

The Olympus GIF Type D optical fiberscope consists of a 1 m flexible cable, 1.3 cm in diameter, with lenses at both ends. An image of the scene before the objective is internally reflected to the ocular by means of coherently arranged flexible glass fibers within the cable. The angle of acceptance at the objective tip is 75°, and the tip can be remotely articulated in two planes. Maximum depth of field is 2 cm to infinity, with resolution better than 1 mm at close range. The minimum bend radius of the image cable is 7.5 cm. The fiberscope's objective can be protected from abrasion by a lens hood made from a plastic bottle. Examination of dark cavities requires illumination; I provided this with a flashlight bulb mounted in the lens hood, but a light source beamed through the fiberscope's internal light guides would serve the same purpose.

I successfully used the fiberscope in searches for Black Guillemot (*Cepphus grylle*) and Atlantic Puffin (*Fratercula arctica*) nests in complex boulder habitat. Census work, involving the location of nest cavities and/or the determination of nest occupancy rates, is an important potential use for optical fiberscopes. The other major potential is in breeding studies, where the investigator can remotely monitor the progress of otherwise unobservable nests. These applications are appropriate for nest cavities in soil and trees as well as those among rocks.

Fiberscopes are expensive. New medical instruments cost upwards of $8000, and industrial ones are about half this. But medical devices depreciate rapidly, and my fiberscope was obtained from a local hospital for 15% of its new value. Thus, the used medical equipment market may provide ornithologists with a source for this useful device.

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Seasonal trends in body condition of juvenile Red-tailed Hawks during autumn migration.—Prior to and during migration, many long-distance migrants accumulate massive lipid reserves and increase in weight. In contrast, partial migrants which migrate shorter distances usually show little premigratory fattening. Although most raptors, including the American Kestrel (*Falco sparverius*), are partial migrants (Newton, Population Ecology of Raptors, Buteo Books, Vermillion, South Dakota, 1979), Gessaman (Wilson Bull. 91:625–626, 1979) reported the occurrence of autumnal premigratory fattening (albeit with lesser relative amounts) in American Kestrels in Utah. We lack published information for other migrant raptors. Here, we describe seasonal variations in amounts of subcutaneous fat, size, weight, and general body condition of 65 juvenile Red-tailed Hawks (*Buteo jamaicensis*) captured on migration in the autumn of 1981 at Cedar Grove Ornithological Station, located on the shore of Lake Michigan in central Wisconsin.

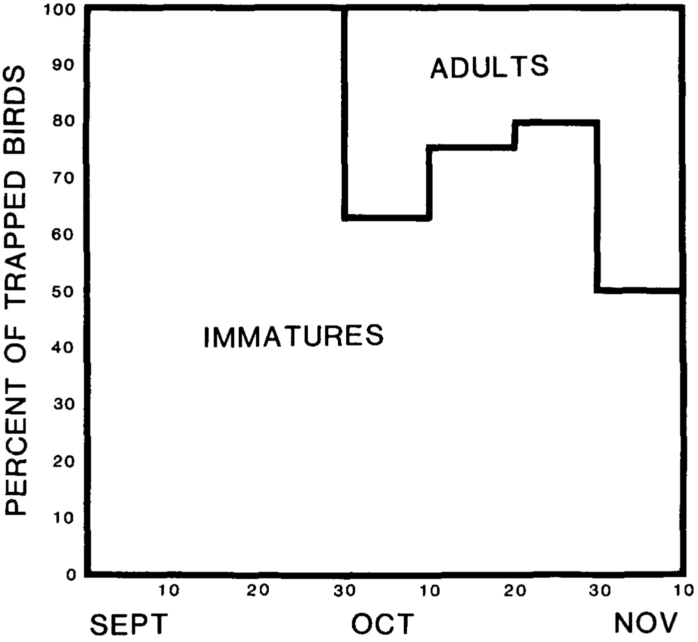

FIG. 1. Seasonal variation in the proportion of juvenile and adult Red-tailed Hawks trapped during autumn migration.

We captured migrating Red-tailed Hawks in bow-nets and dhoghaza nets as described by Mueller and Berger (Wilson Bull. 79:397–415, 1967). At capture we examined each hawk and assessed the amounts of subcutaneous fat visible through the skin on its flank and the relative size of its pectoral muscles. The amount of subcutaneous fat was ranked on a scale from 0 (none)–6 (the largest amount observed). The relative size of the pectoral muscles was assessed by eye using the cross-sectional contour at mid-sternum and rating the shape on a scale from 0 (slightly concave)–3 (well-rounded convex). We assumed that individuals with little subcutaneous fat and concave pectoral muscles were in poorer general condition, either having failed to obtain adequate food to develop fat and muscles or having lost fat supplies and muscle mass as a result of subsequent food shortage (for an example with quail see: Leopold, Game Management, Charles Scribner's Sons, New York, New York, 1933). The scales used here are subjective, but we think they describe adequately the range of variation in the sample. At the end of each trapping day the birds were weighed to the nearest 0.5 g on a triple-beam balance. Wing chord measurements (Mueller et al., Am. Birds 33:236–240, 1979) were also taken at this time.

Juvenile birds tended to migrate earlier than adults but continued to be trapped throughout the migration season (Fig. 1). Although female Red-tailed Hawks average larger in body size than males, there is broad overlap in the size of the sexes in all Red-tailed Hawk populations north of Cedar Grove's latitude (43°33′N) (Friedmann, U.S. Natl. Mus. Bull. 50, Pt. II, 1950). On the basis of 29 individuals that could be sexed because their wing chords were above or below the zone of overlap (Fig. 2a), we found no difference in the sex ratios of birds between

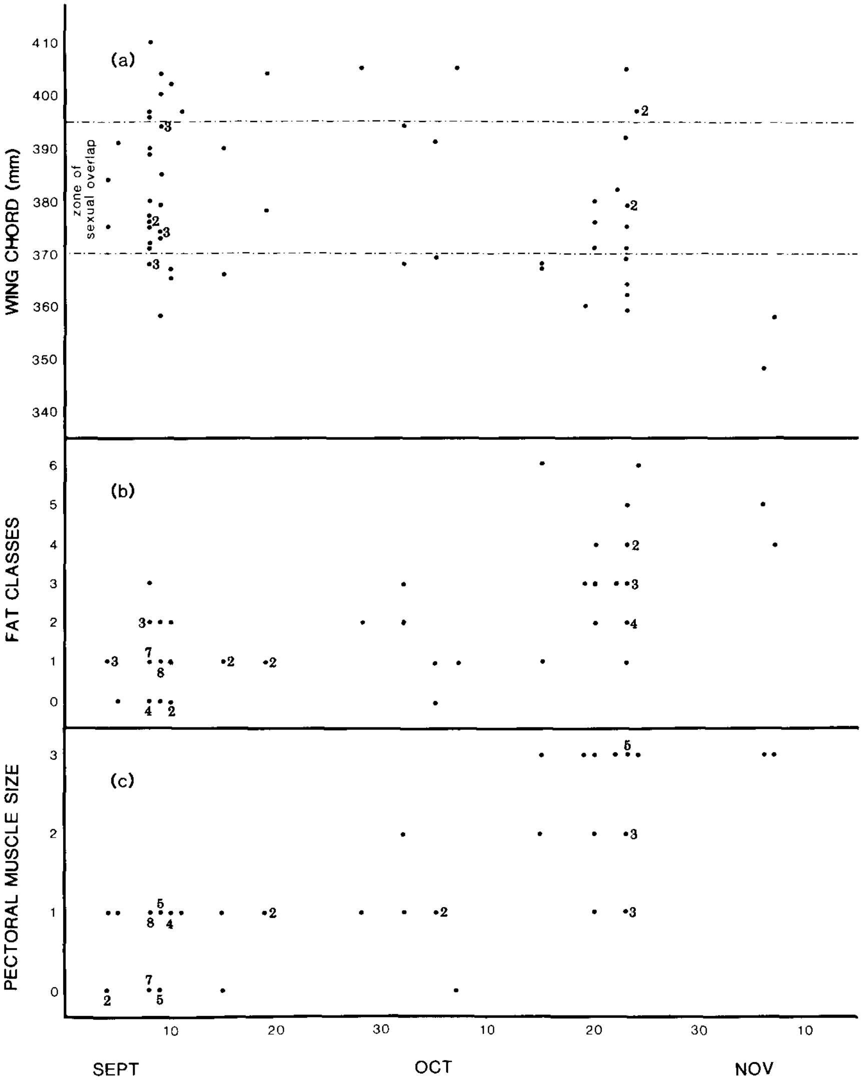

FIG. 2. Variation in wing chord length (a), subcutaneous fat (b), and pectoral muscle size (c), of juvenile Red-tailed Hawks during autumn migration. See text for explanation of the scales. Because they were tightly clustered, some points may represent more than one datum as indicated by adjacent numerals.

the first half (7 ♂♂:9 ♀♀) and second half (4 ♂♂:9 ♀♀) of the migration period ($\chi^2 = 0.513$, df = 1, $P = 0.47$). Thus, the evidence suggests that males and females apparently migrate at the same time.

We found larger amounts of subcutaneous fat on hawks trapped later in the migration season (Fig. 2b, Spearman's $r_s = 0.710$, $P < 0.01$, N = 65). Similarly, there was an increase in pectoral muscle size as the autumn migration progressed (Fig. 2c, Spearman's $r_s = 0.758$, $P < 0.01$, N = 65). A significant positive correlation existed between the amount of subcutaneous fat and the size of the pectoral muscles (Spearman's $r_s = 0.645$, $P < 0.01$, N = 65). Thus, there is a tendency for the largest amounts of fat to be found on birds with large pectoral muscles.

We found no significant seasonal trend in body weights during the migration period (Pearson's $r = 0.095$, $P > 0.25$, N = 65), and there was no relationship between body weight and subcutaneous fat (Spearman's $r_s = 0.091$, $P > 0.25$, N = 65), or between body weight and the size of the pectoral muscles (Spearman's $r_s = 0.057$, $P > 0.25$, N = 65). A significant relationship between wing chord and body weight was observed (Pearson's $r = 0.718$, $P < 0.01$, N = 65). Wing chord decreased significantly as the migration progressed (Pearson's $r = -0.318$, $P < 0.01$, N = 65) (Fig. 2a). Thus, there is a tendency for juvenile Red-tailed Hawks with the longest wing chords to migrate past Cedar Grove earliest in the season. Analyses of similar wing chord and body weight data from autumns of 1975 through 1980 at Cedar Grove showed seasonal trends each year that paralleled the trends in 1981.

We found wing chord length to be correlated inversely with both the amount of flank fat and size of the pectoral muscles (Spearman's $r_s = -0.293$, $P < 0.05$, N = 65 and Spearman's $r_s = -0.371$, $P < 0.01$, N = 65, respectively). Thus, the larger birds tended to have less fat and less developed pectoral muscles than smaller individuals.

In summary, observations of 65 juvenile Red-tailed Hawks revealed that those trapped later in autumn migration were increasingly fat, well muscled, and smaller in body size. Thus, many of the largest birds appeared to be in the poorest condition.

Almost all populations of Red-tailed Hawks north of Cedar Grove's latitude migrate southward in the fall (Roberts, The Birds of Minnesota, Univ. Minnesota Press, Minneapolis, Minnesota, 1936; Wood, The Birds of Michigan, Univ. Michigan Press, Ann Arbor, Michigan, 1951; Orians, Passenger Pigeon 17:3–10, 1955; Orians and Kuhlman, Condor 58:371–385, 1956). According to the departure dates given by Bent (U.S. Natl. Mus. Bull. 167, Pt. 1, 1937), there is a marked trend for the northernmost populations to migrate earliest and for departure dates to occur at progressively later dates farther to the south. Birds from the northern portion of the range migrate 4–6 weeks earlier than birds just north of Cedar Grove and appear to migrate past local birds in leap-frog fashion.

Juvenile Red-tailed Hawks trapped at Cedar Grove tended to be largest earlier in the season. In view of the geographic variation in departure dates, our data would be consistent with a geographic trend in body size of Red-tailed Hawks that follows Bergmann's Rule.

Red-tailed Hawks breed later in the year at higher latitudes (Bent 1937, Orians 1955). For example, in central Alberta (54°23′N), the normal fledging date is mid-July (Luttich et al., Auk 88:75–87, 1971), whereas in southern Wisconsin (43°11′N), near the northern limit of the range in which Red-tailed Hawks are permanent residents, the normal fledging date is early June (Petersen, Wisc. Dept. Nat. Resour. Tech. Bull. 111, 1979).

In view of their later fledging dates and earlier migration, juveniles in northern populations have a shorter time than juveniles farther south to develop their muscles and accumulate fat before migrating. This may account for the hawks that migrate past Cedar Grove earliest being in poorest condition in terms of muscle size and fat reserves. Furthermore, the earliest migrants also may have traveled the longest distance before reaching Cedar Grove and may have depleted their fat reserves while migrating.

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