

HEMATOCRITS AND ERYTHROCYTE NUMBERS FOR COOPER'S AND SHARP-SHINNED HAWKS¹

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Hematocrits and RBC counts have been used to evaluate the "health" of the oxygen transport system in raptors. Few values of hematocrit and erythrocyte (RBC) numbers have been reported for North American accipiters. Values for Northern Goshawks (*Accipiter gentilis*) and Cooper's Hawks (*A. cooperii*) were reported by Elliott et al. (1974) and by Hunter and Powers (1980). Our objective was to provide a larger database of hematocrit values and RBC counts for healthy wild accipiters. The scant information on hematocrit and RBC counts of raptors is mostly from captive, relatively inactive birds at low altitudes. In contrast, the migrating accipiters in this study had been ac-

tively flying, probably for several hours each day at relatively high altitudes, prior to being captured. Indirect evidence suggest that healthy, migrating raptors may have significantly different hematocrits and RBC counts than healthy captives. For example, it is well known that living at high altitudes stimulates increased production of RBCs. Secondly, acute dehydration can increase the RBC count without a concomitant increase of red-cell mass; Hart and Berger (1972) speculated from experimental investigations of three avian species (non-raptors) that dehydration occurs in migrating birds.

METHODS

We trapped accipiters on the ridgetop (elev. 2,740 m) of the southern end of the Goshute Mountains, Elko County, Nevada, in September 1983. Once captured, the hawks were immobilized by slipping them into a loose-fitting can or tube where they remained at rest for 20 min to 1 hr before a blood sample was collected. Each bird was placed

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TABLE 1. Hematocrits of Cooper's and Sharp-shinned hawks. Values in the table are means \pm SD (*n*) followed by (ranges) in %.

Species	Sex	Hematocrit by age		Hematocrit by sex	Overall hematocrit
		Immature	Adult		
Cooper's Hawk	Male	49.6 \pm 2.0 (13) (46.4-53.2)	50.0 \pm 3.6 (13) (44.7-55.3)	49.8 \pm 2.9 (26)	49.2 \pm 2.6 (55)
	Female	47.4 \pm 2.0 (13) (43.2-50.0)	49.8 \pm 1.7 (16) (46.2-53.6)	48.7 \pm 2.2 (29)	
Sharp-shinned Hawk	Male	49.1 \pm 2.3 (16) (44.7-53.2)	50.7 \pm 2.5 (13) (46.5-57.4)	49.8 \pm 2.5 (29)	49.5 \pm 2.5 (67)
	Female	48.8 \pm 2.3 (21) (44.4-55.6)	49.7 \pm 2.3 (17) (46.1-54.1)	49.2 \pm 2.4 (38)	

TABLE 2. Red blood cell counts for Cooper's and Sharp-shinned hawks. Values in the table are means \pm SD (*n*) followed by (ranges).

Species	Sex	RBC count by age		RBC count by sex	Overall RBC count
		Immature	Adult		
Cooper's Hawk	Male	3.38 \pm 0.67 (7) (2.14-4.14)	3.65 \pm 0.94 (8) (2.12-5.04)	3.52 \pm 0.84 (15)	3.74 \pm 0.95 (28)
	Female	3.89 \pm 1.22 (7) (2.78-6.70)	4.10 \pm 0.67 (6) (3.08-5.11)	3.98 \pm 1.00 (13)	
Sharp-shinned Hawk	Male	3.18 \pm 0.80 (8) (1.31-4.08)	3.73 \pm 0.52 (6) (2.88-4.66)	3.41 \pm 0.74 (14)	3.39 \pm 0.65 (27)
	Female	2.75 \pm 1.04 (7) (2.53-3.68)	3.58 \pm 0.62 (6) (2.71-4.53)	3.36 \pm 0.54 (13)	

on its back, and feathers around the elbow of either wing were swabbed with water to expose the brachial vein. This vein was punctured with a lancet, and blood was collected in one or two heparinized capillary tubes and a 10- μ l Unopette capillary pipette. The tubes were centrifuged at 16,580 G for 11 min and the PCV measured with a mm ruler. Capillary tubes were centrifuged within 6 hr of drawing the blood. Blood samples were kept at 10° to 15°C between collection and centrifugation. The Unopette capillary pipette was emptied into a previously opened Unopette reservoir containing 1.99 ml of diluent (Unopette Test 5850/5851; Unopette is a trademark of Becton, Dickinson and Co., Rutherford, NJ 07070). Erythrocyte numbers were determined with a hemocytometer from 2 to 3 samples of this mixture. Mean hematological values were compared by means of Student's *t*-tests.

RESULTS AND DISCUSSION

The mean hematocrits of Cooper's Hawks (49.2%) and Sharp-shinned Hawks (49.5%) were not significantly different (Table 1). For both species, hematocrits did not differ between the sexes or between immatures and adults.

Hunter and Powers (1980) reported a hematocrit of 45.0% for one Cooper's Hawk and $52.8 \pm 3.2\%$ for two Goshawks of unknown sex. Seal (cited in Elliott et al. 1974) measured an average hematocrit of 43.3% for four captive Goshawks of unknown sex and age.

Erythrocyte counts of Cooper's ($3.74 \times 10^6/\text{mm}^3$) and Sharp-shinned Hawks ($3.39 \times 10^6/\text{mm}^3$) were not significantly different (Table 2). The counts for immatures did

not differ significantly from those of adults, nor did males differ significantly from females for either species. Campbell and Dein (1984) indicate that in general the number of RBCs and hematocrit increase with age and are higher in male than female birds. Although our data on accipiters contain no statistically significant differences, they are consistent with this trend. Hematocrits and RBC counts in the literature are too few to make any meaningful comparisons between captive raptors and our sample of free-living raptors.

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CLUTCH OVERLAP IN AMERICAN COOTS¹

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Key words: Clutch overlap; reproduction; clutch size; parental care; coots.

It is unusual for parents to begin a second clutch while their first brood is still dependent upon them for parental care. However, by overlapping two clutches, which together may be more than a pair could rear as a single clutch during the most demanding investment period, parents may overcome the constraints that clutch size maintains over the total number of offspring produced (Burley 1980). Thus, in three reported cases of clutch overlap (Siegfried and Frost 1975, Burley 1980, Hays 1984), the period of simultaneous investment in two broods occurred during the least demanding phase of offspring development for the first clutch. The length of the breeding season relative to the developmental rate of the young may be an additional constraint which prevents parents from rearing two broods unless they overlap successive clutches. Accordingly, clutch overlap in Common Terns (*Sterna hi-*

rundo) occurred only among pairs breeding early in the season (Wiggins et al. 1984).

The general success of overlapping clutches remains to be determined, and an examination of this uncommon behavior may suggest specific factors which constrain parents from rearing more young. During a four-year study of the American Coot (*Fulica americana*), I noted seven cases in which pairs overlapped two clutches and attempted to rear both broods. The period of overlap was greater than that reported for any other birds. I discuss here the characteristics of clutch overlap in coots and the potential environmental factors and parental investment patterns which influence this reproductive behavior.

I studied the breeding biology of coots along the northwest shore of Lake Washington (LW), Seattle, Washington during 1980 and 1983 and at the Turnbull National Wildlife Refuge (TNWR), Spokane County, Washington, during 1981 and 1982. Coots from these areas typically rear one brood per season. Nests were located by wading or canoeing through the marshes and were checked daily. After eggs were laid, I numbered them with a waterproof marker. All eggs were weighed with a Pesola 50-g scale to the nearest 0.1 g and measured with vernier calipers. U.S. Fish and Wildlife aluminum leg bands and individually color-coded wing tags or neck collars were placed on adult birds caught at night with nest traps (Crawford 1977).

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