North Carolina, extreme inland records include birds at Fontana Village in Graham County (Chat 13:75), Lenoir in Caldwell County (Wray 1947), and North Wilkesboro in Wilkes County (Smith 1960); all other records are from the lower piedmont and coastal plain (Marsh and Hader 1974; Chat 43:72, 45:50, 47:52 and 53, 48:58). All of these records except one have been in the fall and winter. A bird was sighted near Atlanta, Georgia, in the fall of 1981 (Bevis 1981). My record of a Red Phalarope from Pendleton, S.C., is the first report for the piedmont region of South Carolina, and one of the few inland reports in spring from both Carolinas.

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Records from "Briefs from the Files" published in *The Chat* and "South Atlantic Coast Region" in *American Birds* are not included in the literature citations.

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The Number of Fault Bars in the Feathers of Red-tailed Hawks, Red-shouldered Hawks, Broad-winged Hawks, and Barred Owls

ELIZABETH J. HAWFIELD
Department of Biology
Winthrop College
Rock Hill, S.C. 29733

J.E. Cooper (1978) claims that malnutrition or other stressful factors during feather growth can produce weak areas in the feathers called fault bars. He explains that fault bars occur in a number of species of free-living birds of prey. Evans (1960) points out that fault bars appear as slightly frayed, defined lines that sometimes extend across the entire vane. Fault bars weaken the feathers on which they occur, making the feather easier to break. Hamerstrom (1967) and Glasier (1978) note that, because fault bars are formed at the time the feather is growing, fault bars found across the entire tail at an equal distance from the base indicate that all the feathers were growing at the time the animal was subjected to stress.

TABLE 1. Percentages of primaries and rectrices with heavy fault bars.[a]

Species	No. of Feathers Examined		Percent with Heavy Fault Bars	
	Primaries	Rectrices	Primaries	Rectrices
Barred Owl (N = 17)	322	184	14%	18%
Red-tailed Hawk (N = 26)	506	295	7%	20%
Red-shouldered Hawk (N = 16)	314	188	4%	13%
Broad-winged Hawk (N = 8)	159	90	7%	22%

[a]Total number of primaries and rectrices minus lost or broken feathers

TABLE 2. Percentages of birds with heavy fault bars on primaries and rectrices.

Species	Age	N	Percent of Birds with Heavy Fault Bars	
			Primaries	Rectrices
Barred Owl	Adult	16	94%	94%
	Juvenile	1	100%	100%
Red-tailed Hawk	Adult	10	50%	60%
	Juvenile	16	69%	87%
Red-shouldered Hawk	Adult	10	20%	60%
	Juvenile	6	69%	87%
Broad-winged Hawk	Adult	3	33%	33%
	Juvenile	5	100%	80%

If fault bars occur frequently in raptors, they may be useful as indicators of past stressful conditions. In a preliminary effort to determine the relative frequency of occurrence of fault bars, adult and juvenile museum specimens of Red-tailed Hawks (*Buteo jamaicensis*), Broad-winged Hawks (*B. platypterus*), Red-shouldered Hawks (*B. lineatus*), and Barred Owls (*Strix varia*) were examined.

I examined 26 Red-tailed Hawk, 8 Broad-winged Hawk, 16 Red-shouldered Hawk, and 17 Barred Owl study skins from the North Carolina State Museum of Natural History. All primaries and rectrices were inspected for the presence of fault bars.

I placed each specimen ventral side up on an overhead projector. The primaries and rectrices were carefully separated and examined for the presence of fault bars. Fault bars were classified as faint or heavy. Heavy bars could be observed without light from the

TABLE 3. Mean number of fault bars per bird.

Species	Age	N	Mean No. Fault Bars Per Bird[a]	
			Rectrices	Primaries
Barred Owl	Adult	16	2.7 ± 2.7 (0-9)	3.0 ± 4.2 (1-17)
	Juvenile	1	1.0	6.0
Red-tailed Hawk	Adult	10	2.9 ± 3.2 (0-9)	0.8 ± 1.0 (0-3)
	Juvenile	16	3.4 ± 3.2 (0-10)	1.8 ± 2.9 (0-12)
Red-shouldered Hawk	Adult	10	1.0 ± 1.0 (0-3)	9.4 ± 0.9 (0-3)
	Juvenile	6	4.5 ± 4.2 (0-10)	2.1 ± 2.6 (0-7)
Broad-winged Hawk	Adult	3	3.0 ± 5.1 (0-9)	0.3 ± 0.5 (0-1)
	Juvenile	5	2.8 ± 2.1 (0-6)	2.6 ± 2.0 (1-6)

[a]mean ± SD (range)

projector; faint fault bars were best distinguished with the extra light source. Broken or missing feathers were subtracted from the total number of primaries or rectrices before calculations were made.

Because of small sample sizes, data from the three species of hawks were combined. Heavy fault bars occurred more frequently in the rectrices of juvenile hawks than in those of adults, but the difference was not significant: 22 of 27 juveniles with fault bars versus 13 of 23 adults ($X^2 = 3.68$, d.f. = 1, $0.10 > p > 0.05$). Heavy fault bars occurred significantly more frequently in the primaries of juveniles than in those of adults; 19 of 27 juveniles had heavy fault bars versus 8 of 23 adults ($X^2 = 6.32$, d.f. = 1, $p < 0.05$). The sample size of Barred Owls was too small to be included in Chi-square tests concerning the number of heavy fault bars in the rectrices and primaries of juveniles and adults. Heavy fault bars occurred in 6% of the primaries and in 18% of the rectrices of the three hawk species. They were found in 14% of the primaries and in 18% of the rectrices of Barred Owls (Table 1). Heavy fault bars occurred in 82% of the specimens examined (Table 2). The mean number of fault bars found in individual birds ranged from 1.0 to 4.5 per bird in the rectrices and from 0.3 to 6.0 per bird in the primaries (Table 3).

The number of faint and heavy fault bars that occurred on corresponding right and left primaries and rectrices was counted. When I compared pairs of symmetrical feathers, I found that either neither feather or both feathers were more likely to have fault bars than was expected with an independent distribution of fault bars on the two wings (primaries, $X^2 = 29.5$, d.f. = 2, $p < 0.01$; rectrices, $X^2 = 47.4$, d.f. = 2, $p < 0.01$). This indicates that the distribution of fault bars in the primaries and rectrices on the left side correlated in a symmetrical fashion to the fault bars in the primaries and rectrices on the right side.

In agreement with this study, Hamerstrom (1967) found that fault bars tended to be more prominent on rectrices than on primaries in several species of raptors. She noted

that if an adult bird was stressed while regrowing its tail feathers, fault bars occurred only on the feathers that were growing at that time. Similarly, King and Murphy (1984) found that in White-crowned Sparrows (*Zonotrichia leucophrys*) fault bars occurred more frequently in rectrices than in primaries. They suggested that fault bars result as a mild form of response to shock, producing "fright molt." King defined "fright molt" as occurring when birds are frightened or subjected to stress and instantaneously shed their feathers. He also explained that rectrices are more vulnerable to fault bars and to "fright molt" than primaries. As hawks and owls acquire these feathers symmetrically, finding that fault bars occur symmetrically supports the hypothesis that they are stress related.

Slagsvold (1982) stated that fault bars occurred more frequently in juvenile Hooded Crows (*Corvus corone cornix*) than in adults, and the bars are more common on rectrices than on primaries. I found a similar situation in hawks and owls, which suggests that young individuals are subjected to stress more frequently than are adults.

My study indicates that fault bars occur regularly in at least Red-tailed Hawks, Broad-winged Hawks, Red-shouldered Hawks, and Barred Owls. As these bars appear to record the occurrence of a stressful situation in an individual's past, their presence on the feathers of museum skins as well as on birds trapped for banding and other purposes provides researchers with a potential tool for recording the occurrence of stress in individual age and sex classes within these species. For example, researchers interested in determining the extent to which male and female siblings compete for food as nestlings might be able to use sex-specific differences or similarities in the occurrence of fault bars to test their hypotheses.

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