

## SUPERNUMERARY PRIMARIES AND RECTRICES IN SOME EURASIAN AND NORTH AMERICAN RAPTORS

W. CLARK, K. DUFFY, E. GORNEY, M. MCGRADY AND C. SCHULTZ

**ABSTRACT.**—We found nine instances of supernumerary (extra) primary feathers in six raptor species and eight instances of extra rectrices in five species. We checked nearly 11 000 migrant raptors during banding (ringing) operations at Eilat, Israel during the springs of 1984–1986 and at Cape May Point, New Jersey, USA during the autumns of 1984 and 1985. In all but one case of extra primary, there was also a corresponding extra greater upperwing covert. Most extra feathers were on the right side, and all but one were functional and similar in length, shape and color pattern to adjacent feathers. Most extra primaries were located around P3 (P1 innermost); most extra rectrices were around T5 (T1 central). The presence of supernumerary primaries and rectrices appears to bestow no selective advantage but possibly a disadvantage and probably occurs uncommonly in many raptor species.

All individuals of an avian species usually possess the same number of primary and tail feathers, except for some members of the Families Gaviidae and Phasianidae (e.g., see Short 1967). Raptors in the Order Falconiformes normally have 10 primary remiges on each wing and 12 rectrices, except for some Old World vultures and Steller's Sea Eagle (*Haliaeetus pelagicus*), which normally have 14 rectrices (Brown and Amadon 1968; Cramp and Simmons 1982). A number of references describe supernumerary or extra primaries and rectrices in other avian species (e.g., DeRoo 1967; Scott 1969; Somadikarta 1984; Hammer 1985; Melville 1985); however, few published reports exist for raptors. Miller (1924) described a Hooded Vulture (*Necrosyrtes monachus*) with an extra primary, the only reported case we could locate. We did find three references to extra rectrices. Berger and Mueller (1958) captured an American Kestrel (*Falco sparverius*) with 13 tail feathers and cited references reporting extra rectrices for the Eurasian Goshawk (*Accipiter g. gentilis*) and Barbary Falcon (*Falco peregrinoides*). Melville (1985) found an injured Black Kite (*Milvus migrans*) with 13 rectrices, and Plater (1985) mentions a Northern Goshawk (*A. g. atricapillus*) that had 13 tail feathers. Grossman and Hamlet (1964), Brown and Amadon (1968), Newton (1979) and Cramp and Simmons (1982) make no mention of supernumerary primaries or rectrices.

Herein, we report nine instances of supernumerary primaries in six falconiform species and eight of supernumerary rectrices in five species. Additionally, we cite previously unreported instances of extra rectrices for five additional raptor species.

### STUDY AREA AND METHODS

Raptors were captured at Eilat, Israel during the springs of 1984–1986 and at Cape May Point, New Jersey, USA during the autumns of 1984 and 1985 as part of long-term raptor migration banding (ringing) operations described in Clark (1976) and Clark et al. (1986). The number of primaries on each wing and the number of tail feathers were counted on every raptor captured. Individuals with supernumerary feathers were noted and photographed. Photographs of the wings and tails with extra feathers were compared to photographs of normal wings and tails of the same species to determine relative positions of extra feathers. Standard numbering of primaries and rectrices is used, with P1 being the innermost primary and T1 the central tail feather.

### RESULTS

Supernumerary feathers occurred in seven raptor species (Table 1). Nine individuals (two adults, seven juveniles) captured were found to have an extra primary on one or both wings (Table 2, Fig. 1). Most extra feathers were on the right wing (Table 2), but one Sharp-shinned Hawk (*A. striatus*) and one Cooper's Hawk (*A. cooperii*) had an extra feather in the same location on both wings. Another Sharp-shinned Hawk had a short, misshapened primary on the left wing (Fig. 1b). Eight individuals (one adult, seven juveniles) were found to have extra rectrices (Table 1, Fig. 2). Most occurred on the right side (Table 2, Fig. 2), but one American Kestrel had an extra rectrix in the same location on both sides. One Merlin (*F. columbarius*) had an extra feather on the left side (Fig. 2b). All extra tail feathers and all but one extra primary appeared functional (i.e., their removal would have left a gap). We did not

Table 1. Occurrence by raptor species of supernumerary primaries and rectrices in Elat, Israel and Cape May Point, NJ, U.S.A.

SPECIES	NO. EXAMINED	NO. CASES	
		PRIM.	RECT.
Honey Buzzard ( <i>Pernis apivorus</i> )	2		
Black Kite ( <i>Milvus migrans</i> )	91		
Bald Eagle ( <i>Haliaeetus leucocephalus</i> )	1		
Egyptian Vulture ( <i>Neophron percnopterus</i> )	1		
Marsh Harrier ( <i>Circus aeruginosus</i> )	129		
Northern Harrier ( <i>C. cyaneus</i> )	226		
Pallid Harrier ( <i>C. macrourus</i> )	19		
Montagu's Harrier ( <i>C. pygargus</i> )	11		
Northern Goshawk ( <i>Accipiter gentilis</i> )	30		
Cooper's Hawk ( <i>A. cooperii</i> )	658	1 <sup>a</sup>	2
Sharp-shinned Hawk ( <i>A. striatus</i> )	6404	3 <sup>a</sup>	1
Eurasian Sparrowhawk ( <i>A. nisus</i> )	53		
Levant Sparrowhawk ( <i>A. brevipes</i> )	287	1	
Red-shouldered Hawk ( <i>Buteo lineatus</i> )	31		
Broad-winged Hawk ( <i>B. platypterus</i> )	8		
Swainson's Hawk ( <i>B. swainsoni</i> )	1		
Steppe Buzzard ( <i>B. b. vulpinus</i> )	1221	1	1
Red-tailed Hawk ( <i>B. jamaicensis</i> )	328		
Long-legged Buzzard ( <i>B. rufinus</i> )	27	2	
Rough-legged Hawk ( <i>B. lagopus</i> )	3		
Steppe Eagle ( <i>Aquila nipalensis</i> )	11		
Golden Eagle ( <i>A. chrysaetos</i> )	1		
Bonelli's Eagle ( <i>Hieraetus fasciatus</i> )	3		
Booted Eagle ( <i>H. pennatus</i> )	30		
Lesser Kestrel ( <i>Falco naumanni</i> )	11		
American Kestrel ( <i>F. sparverius</i> )	451	1	2 <sup>b</sup>

Table 1. Continued.

SPECIES	NO. EXAMINED	NO. CASES	
		PRIM.	RECT.
Eurasian Kestrel ( <i>F. tinnunculus</i> )	101		
Northern Hobby ( <i>F. subbuteo</i> )	13		
Merlin ( <i>F. columbarius</i> )	676		2
Lanner Falcon ( <i>F. biarmicus</i> )	2		
Peregrine ( <i>F. peregrinus</i> )	98		
Barbary Falcon ( <i>F. pelegrinoides</i> )	12		
Total	10 940	9	8

<sup>a</sup> One bird captured had extra feathers on both wings.

<sup>b</sup> One bird captured had an extra feather on both sides of tail.

find extra feathers in 25 additional species on the 1216 individuals checked (Table 1).

In all cases except the misshapened extra feather mentioned above, extra primaries occurred either between P2 and P3 or between P3 and P4. In addition there was an extra greater upperwing covert corresponding to each extra primary, again except for the short, misshapened feather mentioned above. Extra rectrices all appeared to occur between T4 and T5 or T5 and T6.

Nine cases of extra primaries and eight of extra rectrices, among almost 11 000 raptors checked, yielded a ratio of occurrence of approximately 1:1000 for each condition (Table 1).

Four additional, previously unpublished occurrences of supernumerary rectrices were reported to us. One juvenile female Eurasian Goshawk and one adult female Sparrowhawk (*A. nisus*) captured in Finland each had an extra rectrix on the right side (D. Forsman, pers. comm.). A captive-bred Harris' Hawk (*Parabuteo unicinctus*) had 14 tail feathers, one extra on each side (K. Titus, pers. comm.). A Prairie Falcon (*F. mexicanus*) had an extra tail feather on the right side (C. Munson, pers. comm.). In addition Clark captured an Eurasian Kestrel (*F. tinnunculus*) in Northern Israel that had an extra tail feather on the right side.

Some raptors were captured with less than the usual number of primaries or rectrices. However, we could not determine whether the missing feather was due to molt, injury or a missing feather follicle. Empty follicles corresponding to molted feathers can

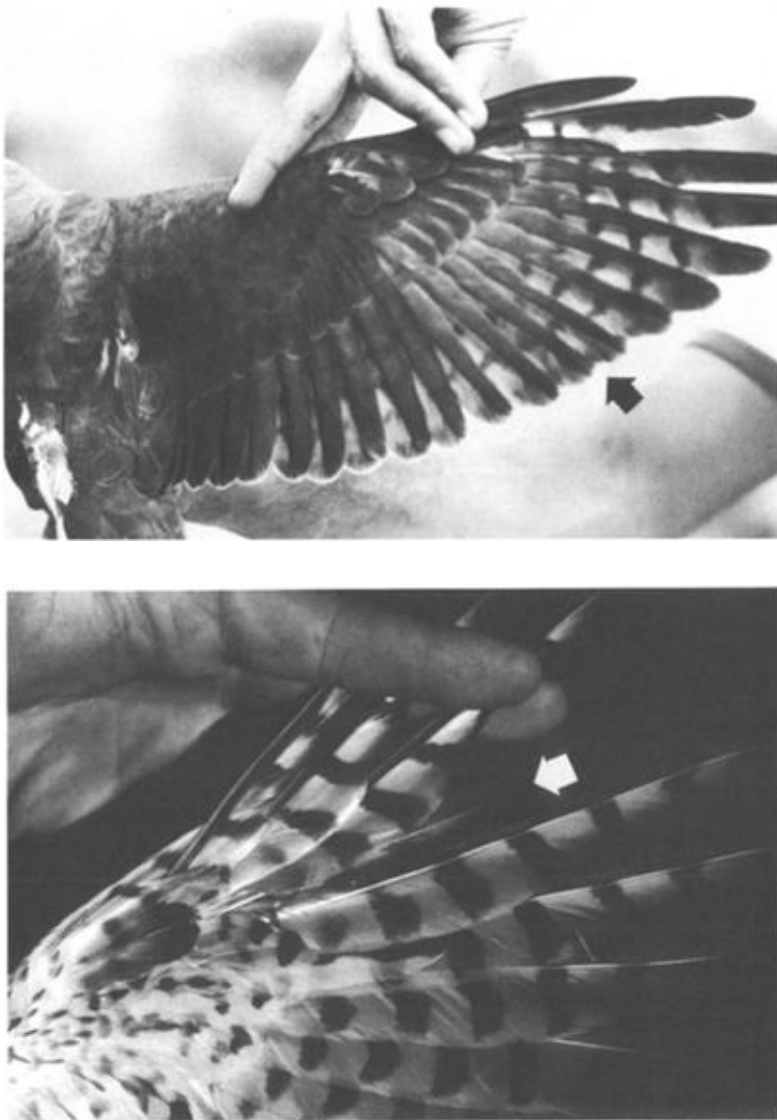


Figure 1. Examples of supernumerary primaries. (Top) Right wing of adult male Levant Sparrowhawk showing extra feather between P2 and P3 or P3 and P4 (arrow). (Bottom) Left wing of juvenile female Sharpshinned Hawk showing short, misshapen primary feather between P7 and P8 (arrow).

usually be detected by careful examination. An X-ray of the wing would be required to ascertain if follicles were missing (see Stresemann 1963).

#### DISCUSSION

Supernumerary feathers found in this study on all but one bird appeared to be normal and functional and were presumably replaced each year during an-

nual molt. Both the Sparrowhawk and Harris' Hawk mentioned above had extra feathers before and after a complete molt of tail feathers. Melville's (1985) Black Kite completed three tail molts, each time replacing the extra feather. DeRoo (1967) caught a Swift (*Apus apus*) in successive years which had extra tail feathers. Hammer (1985) captured six birds of various species with either extra or missing rectrices,

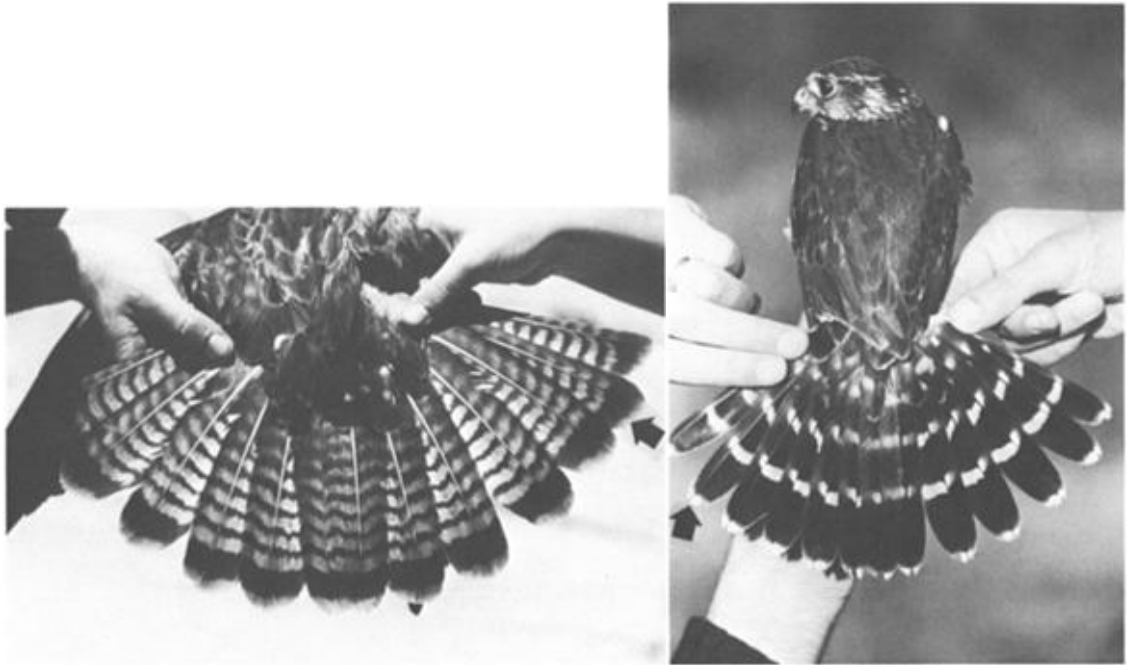


Figure 2. Examples of supernumerary rectrices. (Left) Tail of adult Steppe Buzzard showing extra feather on the right side near T5 (arrow). (Right) Tail of juvenile male Merlin showing extra feather on left side between T5 and T6 (arrow).

and the same birds were recaptured in the same condition a year or more later.

Hammer (1985) found a frequency of supernumerary rectrices of 0.2% (45 of 22 500 examined) for 23 passerine and non-passerine species, almost three times as frequent as our rate of 0.07% in raptors.

Fifteen (89%) of the supernumerary feathers we found occurred on the raptor's right side (Table 2). Stresemann (1963) reported four instances of extra right primaries. Melville (1985) found a Red-necked Stint (*Calidris ruficollis*) with an extra right primary. Miller (1924) reported two instances of extra right primaries, while Somadikarta (1984) cites nine instances of extra right rectrices but only two of left ones. Clearly a distinct bias exists for the location of extra primaries and rectrices to occur on the right for which we can offer no explanation at this time.

Melville (1985) believed that the extra primary he reported was positioned between P3 and P4. Stresemann (1963) used X-ray radiographs to determine

extra feather attachment to the metacarpus between P1 and P6, most likely between P5 and P6. Our close inspection of primary feathers showed that P1 to P4 are similarly shaped and progressively longer, with P5 to P10 having a different shape. Thus it appeared to us that extra primaries were in all but one case positioned between P1 and P4, as there were five similar, gradually longer feathers in this area compared to four on normal wings. We judged the extra feather to be inserted between P2 and P3 or P3 and P4 in all cases.

Tail feathers T1 and T6 are each distinctly shaped and patterned for most raptor species. T2 through T5 are more similar, but are usually slightly different in shape and length. Thus, determining where an extra feather was inserted was relatively easy. Forsman (pers. comm., op. cit.) felt that an extra rectrix on a juvenile Goshawk was T5 replicated. Berger and Mueller (1958) reported an extra rectrix positioned between T1 and T2 and reported that Awender thought his Eurasian Goshawk had an

Table 2. Position of supernumerary primaries and rectrices found on raptors in Eilat, Israel and Cape May Point, NJ, U.S.A.

SPECIES	INDIVIDUAL NO.	EXTRA FEATHER(S)	LOCATED BETWEEN
Cooper's Hawk	1	1 Right & 1 Left	P2-P3 P2-P3
	2	1 Right	T4-T5 or T5-T6
	3	1 Right	T5-T6
Sharp-shinned Hawk	1	1 Right & 1 Left	P2-P3 P2-P3
	2	1 Right	P2-P3
	3	1 Left*	P7-P8
	4	1 Right	T4-T5 or T5-T6
Levant Sparrowhawk	1	1 Right	P2-P3 or P3-P4
Steppe Buzzard	1	1 Right	P2-P3 or P3-P4
	2	1 Right	T4-T5 or T5-T6
Long-legged Buzzard	1	1 Right	P2-P3 or P3-P4
	2	1 Right	P2-P3 or P3-P4
American Kestrel	1	1 Right	P2-P3
	2	1 Right & 1 Left	T4-T5 or T5-T6
	3	1 Right	T4-T5
Merlin	1	1 Right	T5-T6
	2	1 Left	T5-T6

\* Short, misshapened feather.

extra feather between T4 and T5. A consensus position for supernumerary rectrices thus appears to be a replication or close replication of T5.

Both adult and juvenile raptors having extra feathers were captured at Eilat. However, no adults with extra feathers were caught at Cape May Point, probably because fewer than 10% of raptors captured are adults (Clark 1985a, 1985b).

Further investigation is required to determine if this phenomenon is the result of genetic anomaly and therefore could be inherited by offspring. Supernumerary primaries and rectrices appear to offer no selective advantage to birds but could offer dis-

advantages. Further studies on flight dynamics of raptors with extra remiges and rectrices may show adverse effects due to asymmetry or imbalance. Judging from our findings, the phenomenon is probably widespread but uncommon in various raptor species.

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#### LITERATURE CITED

- BERGER, D. D. AND H. C. MUELLER. 1958. Supernumerary rectrices in some raptors. *Wilson Bull.* 70:90.
- BROWN, L. AND D. AMADON. 1968. Eagles, hawks, and falcons of the world. Country Life, London.
- CLARK, W. S. 1976. Cape May Point Raptor Banding Station—1974 results. *N. Am. Bird Band.* 1:5-13.
- . 1985a. Migration of the Merlin along the coast of New Jersey. *Raptor Res.* 19:85-93.
- . 1985b. The migrating Sharp-shinned Hawks at Cape May Point: Banding and recovery results. In M. Harwood, Ed. Proc. Hawk Conf. IV, Rochester, NY March 1983. Hawk Migr. Assn. N. Am.
- , K. DUFFY, E. GORNEY, M. MCGRADY AND C. SCHULTZ. 1986. Raptor ringing at Eilat, Israel. *Sandgrouse* 7:21-28.
- CRAMP, S. AND K. E. L. SIMMONS. 1982. The birds of the western Palearctic. Vol. II. Oxford.
- DEROOS, A. 1967. A Swift, *Apus apus*, with twelve rectrices. *Bull. Br. Ornith. Club* 87:141.
- GROSSMAN, M. L. AND J. HAMLET. 1964. Birds of prey of the world. Bonanza, New York.
- HAMMER, D. B. 1985. Abnormal number of tail feathers. *Bull. Br. Ornith. Club* 105:91-95.
- MELVILLE, D. S. 1985. Further examples of abnormal rectrices and a case of an extra primary. *Bull. Br. Ornith. Club* 105:95-96.
- MILLER, W. D. 1924. Further notes on ptilosis. *Bull. Br. Ornith. Club* 50:303-331.

- NEWTON, I. 1979. Population ecology of raptors. Poyser, Berkhamsted.
- PLATER, M. L. B. 1985. Northeastern director's report. *Hawk Chalk* 24:18.
- SCOTT, R. E. 1969. *Corvus frugilegus* with 14 rectrices. *Bull. Br. Ornith. Club* 89:109.
- SHORT, L. L., JR. 1967. A review of the Genera of Grouse (Aves, Tetraoninae). *Am. Mus. Nov.*, No. 2289.
- SOMADIKARTA, S. 1984. Polyrectricity. *Bull. Br. Ornith. Club* 104:60-61.
- STRESEMANN, E. 1963. Variation in the number of primaries. *Condor* 65:445-459.
- 4554 Shetland Green Road, Alexandria, VA 22312. Current address of second author: P.O. Box 43, Moran, WY 83013. Current address of third author: SPNI, 4 Hashfela St., Tel-Aviv 66183, Israel. Current address of fourth author: P.O. Box 365, Cashiers, NC 28717. Current address of fifth author: 13 Pierson Drive, Shelburne, VT 05482.**

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