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A new female-like morph of juvenile male Levant Sparrowhawk (*Accipiter brevipes*) – sexual mimicry to avoid intra-specific predation?

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ABSTRACT

In migrant Levant Sparrowhawk (*Accipiter brevipes*) at Eilat, Israel, we noted that juvenile males had two different morphs – the one described to date in literature; and a second, previously undescribed morph, with female-like barring on the chest and flanks interspersed with tear-shaped elongated spots, giving an overall female-like appearance. Here we forward the hypothesis that explain the evolutionary consequences for the female-like plumage of juvenile males as that of intra-specific sex mimicry developed to avoid intra-specific predation by the larger females.

KEYWORDS

Levant sparrowhawk – intraspecific predation – avoidance – morph

INTRODUCTION

Chromatic mimicry as a strategy to avoid inter-specific predation, or to have a reproductive advantage, is well documented in many insect, amphibian and reptilian taxa (e.g. Gross & Charnov 1980; Krebs & Davies 1987). In birds, mimicry is associated mostly with song (e.g. Faaborg 1988; Brooke & Birkhead 1991), deception and sexual signalling (e.g. Rohwer et al. 1980; Flood 1984; Hakkarainen et al 1993; Saetre & Slagsvold 1996), predator avoidance in Passerine species (e.g. Slagsvold et al. 1995) or a variable expression of sexually mosaic plumage in adult female Falconiformes such as lesser kestrel *Falco naumanni*. This is generally considered to be an uncommon feature attributed to abnormalities in the endocrine system of adult birds (Tella et al 1996; Parrish et al. 1987). However, following our discovery of a new female-like morph of the juvenile male Levant Sparrowhawk (*Accipiter brevipes*), we present an alternative hypothesis that intra-specific mimicry may occur in Accipiter spp. to avoid predation by the larger females.

The Levant Sparrowhawk has dichromatism and reversed sexual size dimorphism wherein the female is larger by 9–10% than the male (Cramp & Simmons 1980; Clark & Yosef 1997). The sexes also differ in colour, and the male has blue-grey upperparts and darker flight feathers, underparts are buff or pinkish on the breast and under wing coverts and the underwing is white with black ends to the primaries (Cramp & Simmons 1980; Gensbol 1992; Forsman 1998). In contrast, females have brown-grey upper parts and the vermiculations on the chest are dark brown. Levant Sparrowhawks are considered rare (Cramp & Simmons 1980; Wallace 1983) and concentrate in the Eilat, Israel, region in great numbers (e.g. 45,000–55,000; Safriel 1968; Shirihai & Christie 1992; Yosef 1995). In the framework of the only migratory raptor ringing program of the Old World, we attempted to capture and ring a maximum number of Levant Sparrowhawks from mid-April till early May between the years 1996 and 1998.

During our ringing operations, we noticed that juvenile males had two different morphs – first, the regular morph coloured buff or pinkish on the breast with tear-shaped elongated spots on the chest (Cramp & Simmons 1980; Forsman 1998; Clark & Yosef 1997, 1998) and second, previously undescribed morph, with female-like barring on the chest and flanks interspersed with tear-shaped elongated spots, giving an overall female-like appearance.

1. METHODS AND MATERIALS

Levant Sparrowhawks were captured and ringed in Eilat, Israel. Bal-chatri traps (Berger & Mueller 1959) were used from a mobile vehicle to capture perched or low-flying raptors, and box traps and two sets of 120-m long mist nets were up in palmeries (Fornasari 1987; Clark & Yosef 1997). In addition, a fixed raptor ringing station was set up in the agricultural fields of Kibbutz Eilot that consisted of bow nets, mist nets and dho-gazas operated from a blind (cf. Clark 1970, 1981; Clark et al. 1986).

All Levant Sparrowhawks captured were fitted with appropriate sized aluminium rings. The species, age, sex, wing chord (unflattened), body mass, date, time and capture device of each raptor were noted. The following measurements were also taken from a smaller subset of birds: wing spread, length of culmen, hallux, tail and overall length.

The ageing of Levant Sparrowhawks was based on plumage and molt (Clark & Yosef 1998). In addition, eye colour was used as an indication of age – adults have brown eyes with a reddish cast and juveniles have pale brown eyes. Juveniles are usually described with upper parts a darker brown than females and heavily streaked with tear-shaped elongated spots on the chest. Under wing-coverts are narrowly barred, and only the tips of the primaries are darker. They have a pale throat divided by a dark line and the tail is paler than that in females. During the 1998 season, we quantified the relative abundance of juvenile males with dark brown female-like appearance.

We performed one-factor analysis of variance (ANOVA) on each of the measurements of the unflattened wing chord and body mass. Based on Fischer F estimates, we decided on the major discriminating factors that separate sex and age classes in the Levant Sparrowhawks.

Wing shape was examined on 101 birds caught during the spring migration of 1998, and all measurements were taken on 91 birds (Table 1). Data from 10 birds was not included in the analysis because of extreme wear of flight feathers. Starting with the outermost primary (P10), the length of each primary was measured (Norman 1997) by inserting a ruler (±0.5 mm) with a nail-stop at the beginning between adjacent feathers from the point of emergence of each feather from the skin to its tip. We also measured the projection distance between the P10 tip and the tip of the longest primary covert (DP) and from the tip of the longest secondary to the tip of the wing (DS). Subsequently, we applied principal component analysis (PCA) to elucidate the foremost sources of variation in feather length and, therefore, wing shape (Senar et al. 1994; Borras et al. 1998) by including wing length, DP and DS.

Unless otherwise stated, all measured data are presented as mean ± SD, N and range. We chose P = 0.05 as the minimum acceptable level of significance.

2. RESULTS AND DISCUSSION

During the spring migration of 1998, a total of 101 Levant Sparrowhawk were caught and all measurements were taken on 91 birds (Table 1). The data gathered are of importance, as there are few data on molt, mass, size or physiological condition of trans-Saharan migrant raptors in Eurasia. In addition, few researchers have handled migratory raptors to confirm identification of species and variations between sex or age classes (Clark 1995).

As pointed out by Clark and Yosef (1997), differences between sex and age classes are smaller if compared to similar species. Feather-dependent characters (wing cord, tail length) in other *Accipiter* species are 10–20% longer in females than in males, whilst culmen and hallux length are 14–27% longer (see Cramp & Simmons 1980). Moreover, females are heavier than males by 40–50% in Shikra (*A. badius*), 60% in Eurasian Goshawk (*A. gentilis*) and 80% in Eurasian Sparrowhawk (*A. nisus*; Cramp & Simmons 1980; Newton 1986).

2.1. Frequency and wing shape of the previously undescribed morph

Variable expression of sexually mosaic plumage has been observed in adult female Falconiformes (e.g. Lesser Kestrel) but is an uncommon feature related to abnormalities in the endocrine system of adult birds (Tella et al. 1996; Parrish et al. 1987). We found that in the Levant Sparrowhawk, the female-like morph occurred in as many as 22% (16 of 58) of the juvenile males caught during the 1998 season. These males are similar to females in plumage, but different both in body size and wing shape. However, they are significantly heavier than 'normal' males (167.1 versus 152.1 g, $t = 2.75$, $p < 0.01$), and the wing is longer, though not statistically significant (213.1 versus 210.1 mm, $t = 1.11$, $p = 0.27$) and which may be a result of a small sample size. On the first PCA axis (Fig. 2), the female-like males show a median value (score 102) intermediate between juveniles with aspect as described to date in literature (score 101) and adult males (score 104), moving towards female values (score 108 and 114, respectively, for juvenile and adult females). This effect is obtained by increasing the length of innermost primaries towards adult male values (Fig.1).

In raptors as well as in most other bird species, juvenile males are known to suffer the highest mortality rates. In *Accipiter* species, juvenile male mortality may be due also to intra-specific predation by females and has been documented in Goshawk and Eurasian Sparrowhawk (Newton et al. 1983) and in Cooper's Hawk (*A. cooperii*) in Florida (Dr. B. Millsap, U.S.A., pers. comm.) and a second-year male Sharp-shinned Hawk (*A.*

*Table 1. Biometrics of Levant Sparrowhawks (*Accipiter brevipes*) trapped at Eilat, Israel. Data are presented as mean ± SE (N), range in italics. Measurements are in millimetres (mm) and body mass in grams (g). All juvenules examined together.*

Parameter	Adult female	Juvenile female	Adult male	Juvenile male
Wing Chord	233.1±0.5 (267) *209–248*	224.4±0.5 (248) *205–245*	217.6±0.3 (370) *199–235*	210.0±0.4 (270) *188–233*
Wing span	727.9±2.3 (49) *690–760*	707.5±2.8 (73) *634–750*	682.8±1.7 (91) *640–725*	666.3±1.7 (112) *620–725*
Tail length	165.3±0.8 (102) *135–184*	160.5±0.6 (115) *139–175*	154.3±0.5 (142) *141–178*	150.2±0.5 (143) *132–167*
Body length	340.7±1.6 (55) *320–362*	332.8±1.3 (76) *305–353*	317.5±0.9 (101) *290–336*	312.7±1.5 (116) *285–350*
Culmen	14.0±0.1 (68) *11.9–19.1*	13.8±0.1 (94) *11.4–15.2*	12.8±0.1 (123) *11.1–17.2*	12.5±0.1 (128) *10.0–15.8*
Hallux	14.8±0.1 (68) *11.8–19.3*	14.9±0.1 (96) *13.1–19.8*	13.9±0.1 (124) *12.0–19.2*	13.6±0.1 (129) *11.8–17.9*
Body mass	210.5±1.5 (263) 143–332	193.6±1.4 (248) 132–245	170.6±1.0 (362) 110–275	158.8±1.1 (270) 118–245

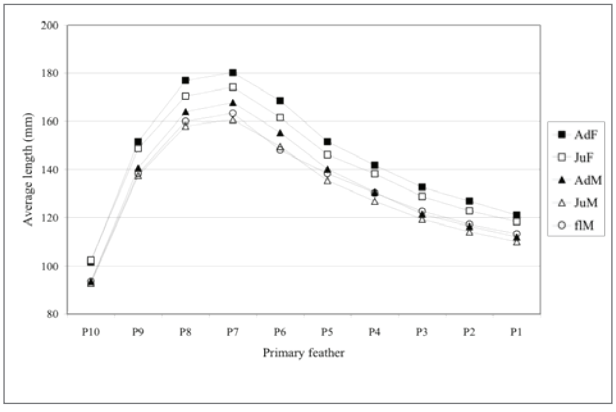

Figure 1. Average length of each primary feather per sex/age class of Levant Sparrowhawk (Accipiter brevipes). Data are consistent with the feature of a longer wing for adult females than juvenile females, adult males and shorter-winged juvenile males. Female-like juvenile males approach the female wing pattern by increasing the length of inner primaries (see text for further explanation). All juvenules examined together.

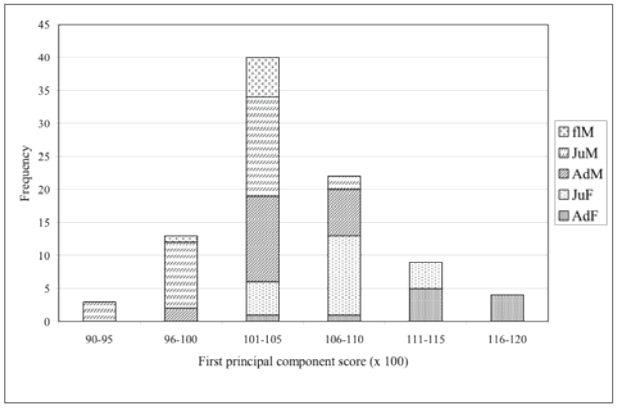

Figure 2. Sex/age classes' distribution on the first PCA axis (see text for further explanation) of Levant Sparrowhawk

striatus) being predated by an adult female in Michigan (Susan H. Craig, pers. comm.).

In conclusion, we present the hypothesis that may explain the female-like plumage of juvenile males. The appearance of a female-like plumage in juvenile males could be seen as a strategy to improve survival during the first year and as that of intra-specific sexual mimicry developed to avoid intra-specific predation by the larger females. It is not known whether the difference between male strategies is genetic, but it is easy to see that the payoff for each strategy must be frequency dependent. Hence, this strategy must also influence life his-

tory, and we speculate that second year males with female-like plumage most probably postpone reproduction to their third year. All things being equal, they should have a greater survival rate and a life expectancy at least one year longer than normal males.

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