



The removal of colour rings by Greenfinches *Carduelis chloris*

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This paper examines the effect of sex and ring colour on the frequency of removal of plastic colour rings by Greenfinches *Carduelis chloris*. Of 55 recaptures of 42 individuals, 22 (40%) had lost at least one of its colour rings. Females showed a tendency to remove colour rings more frequently than males. For both sexes, there was a similar tendency to remove more dark than light-coloured rings. While it is not possible to identify a specific reason why the birds remove their colour rings, it is possible that discomfort on the nest may play a role in ring removal by females and, more speculatively, it is possible that males might remove colour rings to manipulate their sexual attractiveness to females. Wrap-around rings might provide a solution to the problem of colour-ringing species with powerful beaks.

The use of colour rings is important in studies of the behaviour and ecology of birds, where individuals or groups may need to be identified without recapture. It has been found, however, that rings of different colours may influence the social status, mate choice and reproductive success of individuals (Burley *et al* 1982, Bennett & Cuthill 1994, Swaddle 1996, Bennett *et al* 1997, Hunt *et al* 1997, but see Zann 1994). Furthermore, it could be expected that bright or contrasting colours on colour rings might play a role as signals to potential predators, eg by attracting them to nests (Haskell 1996), as has been shown for the male plumage of the Chaffinch *Fringilla coelebs* and the Pied Flycatcher *Ficedula hypoleuca* (Götmark & Hohlält 1995). The visibility of colour rings should depend on how they contrast with background habitats and with birds' legs and plumage, as well as the visual capabilities of birds. Effects should be most markedly observable in cryptic species and sexes with dull, non-iridescent plumage, such as female Greenfinches, and should be more marked with light-coloured rings (Radwan 1993, McGraw *et al* 1999). Hence, those birds which are most affected should try, if possible, to remove colour rings, which can potentially cause problems for researchers through a loss or bias of data (Wendeln & Becker 1999). In this note, I examine the effect of sex and ring colour on the frequency of ring removal by free-living Greenfinches *Carduelis chloris* during the breeding season.

METHODS

A detailed study of the breeding ecology of an urban population of Greenfinches was carried out in Krotoszyn, western Poland (51° 41'N 17° 26'E), between 1994 and 1998 (Kosinski 2001a, b). Adult birds were captured in mist nets and colour-ringed during the breeding seasons between 1996 and 1998. Each bird was fitted with a unique combination of one metal ring with three coloured plastic split-rings (4 mm high and 3 mm wide; supplied by A C Hughes, Middlesex, UK). In total, 195 adult birds were colour-ringed, 122 (62.6%) males and 73 (37.4%) females. When birds were recaptured with an incomplete combination of rings, the missing rings were replaced. During each visit to the study area regular searches of marked birds were conducted.

It was assumed that birds could see differences in the overall brightness of the rings. The relative reflectance, or brightness, of some ring colours seems to be similar, eg white and yellow or blue and green (McGraw *et al* 1999). Accordingly, colour rings were divided into two categories; dark (blue, olive and black) and light (white, yellow, orange, light pink and red). The numbers of rings removed by the birds were compared for sex and ring colour using chi-square tests.

RESULTS

Of 55 recaptures (42 individuals) during the study, 22 (40%) had lost or removed at least one colour ring (Table 1). In eight cases birds had removed a single ring

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Table 1. The number and percentage (in parentheses) of colour-ringed male and female Greenfinches which were retrapped, or observed in the field, with complete or incomplete original colour ring combinations.

Colour combination	Females		Males	
	Recaptured	Observed	Recaptured	Observed
Complete	12 (48)	86 (61)	21 (70)	416 (76)
Incomplete	13 (52)	55 (39)	9 (30)	132 (24)

(14.5%), in five cases, two rings (9.1%) and in nine cases, three rings (16.4%). Only colour rings were removed by the birds, or lost. Of the retrapped birds, females showed a tendency to remove or lose colour rings more frequently than males, although the difference between the sexes was not significant when repeated observations of the same birds were excluded from the analysis ($\chi^2_1 = 0.77$, $P = 0.38$). Of the birds observed in the field, the frequency of ring loss was, however, greater for females than for males ($\chi^2_1 = 12.62$, $P < 0.001$). For both sexes among the retrapped birds, there was a marginally non-significant tendency for a greater loss, or removal, of dark rather than light colour rings (females, $\chi^2_1 = 3.47$, $P = 0.062$; males, $\chi^2_1 = 3.78$, $P = 0.052$; Table 2), and there was no difference between the sexes for the proportions of light and dark rings lost ($\chi^2_1 = 0.002$, $P = 0.964$). In some cases, the time between ringing and ring removal during the same breeding season was determined. In one case a female removed a ring during the first 24 hours after ringing. In five other cases females removed rings between seven and at least 18 days after ringing. Among males, one individual lost one of the rings during the first day, five others between seven and at least 46 days after ringing.

DISCUSSION

Rings can be lost through wear and damage over time, but this is unlikely to account for the short-term losses recorded in this study. Alternatively rings may slip down over the foot (Calvo & Furness 1992) although none of the recaptured birds had injuries suggestive of this. The most likely method of ring loss in this case is through active removal by the birds; the Greenfinch has a powerful beak and may compress the plastic colour rings until they crack and drop off.

Greenfinches are sexually dimorphic birds, in which the males' plumage is brighter than the females'. Females are entirely responsible for incubation, so it could be predicted that females, but possibly not males, should try to remove light-coloured rings to minimise the risk of being seen by potential predators of the nest. There

Table 2. The number and percentage (in parentheses) of light and dark rings which were fitted to, and removed by, male and female Greenfinches. Data are for birds subsequently retrapped.

	Females		Males	
	Light	Dark	Light	Dark
Number of rings Received	101 (46)	118 (54)	180 (49)	186 (50)
Removed/lost	7 (27)	19 (73)	5 (26)	14 (74)

was, however, no evidence to suggest that the sexes differed in their removal of light or dark coloured rings, and furthermore, the tendency of females to remove dark rings more frequently than expected contradicts the prediction. Haskell (1996), however, found that there was a site-specific cost of some colours (see also Götmark & Hohlfält 1995); the cost of bright red was higher for birds nesting on the ground than it was for tree-nesting birds (Haskell 1996). The Greenfinch is a tree-nesting species which changes its preference of nest site during the breeding season from evergreens to broad-leaved trees, due to changes in the risk of predation (Kosinski 2001a, b). It is possible that the cost of two or three very visible colour rings is low and does not affect the survival of incubating birds or their nest contents. The higher rate of ring removal by females suggests that another sex-related factor is involved, and I suggest that ring discomfort during egg-laying and incubation might play a role in ring loss. This species lines its nests with fine grasses, rootlets, plant down, hair, feathers or man-made fibres (Cramp & Perrins 1994, pers obs). It is possible that leg rings, especially those that had been misshapen by pressure from the beak, could become entangled with nest material thereby causing irritation of incubating females.

From a different perspective, it is possible that males might manipulate their ring colours to increase their attractiveness to females, as has been done experimentally by researchers (Burley *et al* 1982, Zann 1994, Bennett *et al* 1997, Hunt *et al* 1997). The females' preference for colours in the natural secondary sexual traits are extended to the colours in the rings. In Greenfinches, it has been shown that the size of the male's yellow tail patch may function as an indicator of an individual's ability to resist parasite infection (Lindström & Lundström 2000). It could be predicted that female Greenfinches would prefer males wearing light-coloured rings which intensify reflectance from their bright yellow outer tail feathers and edges of primaries. It is, however, hard to believe that males would deliberately remove dark-coloured rings to increase their attractiveness in this way, and the suggestion remains speculative until further experimental evidence becomes available. It is more likely that there

is something about the appearance of dark rings which makes them more susceptible to removal by the birds.

The removal of leg rings may affect population studies which rely on observations of colour-ringed birds. The return rate to the breeding area, as well as other indices, eg dispersal during the breeding season, cannot be precisely quantified, as some of the observed birds with an incomplete combination were not identifiable as individuals. In this study, the return rate of adult birds estimated from colour ring sightings would be at least 40% lower than it really was. In comparison, the incidence of missing leg rings in Cardinals *Cardinalis cardinalis* was 15% (Dickson *et al* 1982). To exclude the effect of ring removal, it may be more effective when studying powerfully beaked birds to use the wrap-around rings, as this type of ring may be less easy to remove. A complete understanding of the role of ring colours on the frequency of removal by each sex will require more studies and should include experiments as well as observation.

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