



Artificial colour mutation: do red-painted great tits experience increased or decreased predation?

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Abstract. A brightly coloured mutant may suffer increased predation (by being conspicuous) or may be favoured by reduced predation (if predators avoid novel or rare varieties). These alternatives were examined in a 2-year study of great tits, *Parus major*, by painting and ringing 1655 fledglings near 27 pairs of nesting sparrowhawks, *Accipiter nisus*. A minority (<10%) of the great tits in each hawk territory were manipulated. On average, 40.7% of the fledglings in each brood were bright red, the others controls (yellow). Based on ring recoveries at hawk nests, the percentage of red tits taken was 5.5%, compared with 4.0% for controls, indicating an increase in predation rate by 38% for red birds. The results were similar in both years. However, using hawk pairs as sample units, predation risk was not significantly higher for red tits. Hawks that caught only one painted tit did not take red ones more often than expected, whereas those that caught two or more tits tended to take red ones more often. A predation cost for bright mutants may initially be low or absent, later increasing with the frequency of the mutant. In addition, tit parents fed red fledglings more often than controls, indicating a possible parental preference for red.

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Predation is an important ecological process, often addressed by theoreticians (Taylor 1984; Crawley 1992). Unfortunately, it is often difficult to study predation in the wild. Indirect studies predominate, often concerned with anti-predator behaviour, while studies of attacks by predators and selection in prey populations are rare. Many workers have used artificial prey, models or mounts to quantify the risk of attack (Allen 1988; Yahner & Scott 1988; Götmark & Unger 1994; Brodie & Janzen 1995). These studies may have clarified components of the predation process, but caution is needed when assessing their relevance to predation on live prey (Slagsvold et al. 1995).

In the present study, we used live, manipulated birds to examine how bright coloration influences the risk of predation. Many birds are brightly coloured in black-and-white, iridescent, blue, yellow, red or other plumages. Sexual selection and other processes favour bright colours (Andersson 1994), which are usually assumed to be conspicuous and therefore disfavoured by increased

predation (Slagsvold et al. 1995). However, Cott (1947) and Baker & Parker (1979) suggested that bright birds are aposematic or unprofitable, by being distasteful, vigilant or agile. Their hypotheses are controversial and have been difficult to test (Andersson 1994).

For theoretical models, understanding the initial evolution of bright coloration is important, but the issue is 'virtually unexplored' (see Endler 1991, page 185 for discussion). In this study, we tested two alternative predictions, based on current theory. First, for both profitable and unprofitable prey, it is often assumed that a novel conspicuous mutant suffers increased predation (e.g. Curio 1976, page 117; Mallet 1990; Newton 1992, pp. 161–162; Krebs & Davies 1993, page 89). Alternatively, predation might favour conspicuous mutants, at least initially, because predators are often conservative in choice of food and avoid novel types of prey (Curio 1976; Schlenoff 1984; Endler 1988; Doherty & Cowie 1994). Moreover, apostatic selection (lower predation on rare than common varieties) has been demonstrated in many studies (Allen 1988) and also predicts reduced predation for a novel (rare) mutant.

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