Plumage Coverage is Related to Body Condition and Ectoparasitism in Blue-black Grassquits

Author(s): Rodrigo B. Magalhães, Pedro Diniz, and Regina H. Macedo
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Plumage Coverage is Related to Body Condition and Ectoparasitism in Blue-black Grassquits

Rodrigo B. Magalhães,1,2,3 Pedro Diniz,1,2 and Regina H. Macedo1

ABSTRACT.—Females may prefer elaborate sexual ornaments in males as these can be costly and may honestly indicate male viability. We used a wild population of the Blue-black Grassquit (Volatinia jacarina) in central Brazil to test whether more ornamented males have lower parasite loads (parasite-mediated sexual selection) and/or better body condition (condition-dependent sexual selection) compared with less ornamented males. We predicted that blue-black plumage coverage should be positively correlated to body condition (weight/tarsus) and negatively correlated to parasite load (Mallophaga lice). We found that blue-black plumage coverage of grassquit males was positively related to body condition score and negatively related to ectoparasite load. However, body condition was not correlated with ectoparasite load in these males. Our data are consistent with the hypothesis of sexual selection mediated by parasites as well as with the hypothesis of sexual selection mediated by body condition, indicating that nuptial plumage coverage can be an honest signal of male quality in Blue-black Grassquits, and could thus be used by females during mate choice. Received 19 November 2014. Accepted 26 April 2014.

Key words: bird coloration, condition-dependent sexual selection, parasite-mediated sexual selection, sexual selection, Volatinia jacarina.

Females may prefer males that exhibit elaborate sexual ornaments, because these can be costly to produce and maintain. In this scenario (condition-mediated sexual selection), ornamental traits could honestly indicate male viability, a hypothesis that became known as the handicap principle (Zahavi 1975). Females can use such signals associated with health and vigor as viability indicators of the potential mate, for example, through inspections of elaborate male displays (Byers et al. 2010). Further extension of the handicap principle suggests the possible co-adaptation between parasites and hosts (Hamilton and Zuk 1982), so that parasitism acts as a selective force resulting in more resistant male genotypes. According to the hypothesis, only the most parasite-resistant males may be able to develop elaborate ornaments. Consequently, females who choose more elaborately ornamented males (i.e., those that are more resistant to parasites) reap greater benefits for their offspring if the resistance is heritable and also avoid contagious infection from parasitized males. The hypothesis of parasite-mediated sexual selection suggests that the quality of a male’s ornamentation should decrease with greater parasite loads. This hypothesis has received empirical support in recent years (reviewed in Johnstone 1995, Roberts et al. 2004); however, some studies have produced contradictory results. A study of the Steller’s Jays (Cyanocitta stelleri) for example, indicated that the degree of parasitism was positively correlated with the expression of structural plumage (Zirpoli et al. 2013).

Based on the parasite-mediated and condition-mediated sexual selection hypotheses, we can expect that more highly ornamented males should have lower parasite loads, better body condition or both. We investigated this idea using a Neotropical population of the Blue-back Grassquit (Volatinia jacarina, Aves: Thraupidae), a migratory and granivorous passerine (Sick 1997, Remsen et al. 2012). Blue-black Grassquits are sexually dimorphic and dichromatic, and males exhibit an iridescent blue-black nuptial plumage during the breeding season (Maia et al. 2009). We predicted that male Blue-black Grassquits with better body condition (indicated by the index mass/tarsus) and/or with a lower load of ectoparasites (feather mites) should have a higher coverage of blue-black plumage compared with males in poorer body condition and with higher ectoparasite loads.

METHODS

We captured male Blue-black Grassquits with mist nets from December 2012 to March 2013, in
Fazenda Água Limpa (15° 56' S, 47° 56' W), a farm property of the University of Brasília, Brazil, in an area of disturbed native savanna (2.54 ha). This period encompasses the entire nesting season of the Blue-black Grassquit (Almeida and Macedo 2001, Carvalho et al. 2007). The nuptial molt occurs before and during the beginning of the nesting season, but partially molted males can also defend territories and breed (Doucet 2002, Maia and Macedo 2011). We banded males and took morphological measurements (including tarsus length and body mass) and counted the number of feather mites on both wings by spreading them and visually examining the feathers against the light (Koop and Clayton 2013). We collected a sample of the mites and identified them to the level of genus. All mites belong to the genus Trouessartia, a group that is widespread among birds in the central Cerrado region of Brazil (Kanegae et al. 2008). We used a transparent acrylic disc divided into eight parts and placed on different parts of each individual’s body (head, back, chest, and rump) to calculate the percentage of blue-black plumage coverage in each part. This method was successfully used in another study with Blue-black Grassquits (Maia and Macedo 2011), showing that the expression of iridescent plumage coloration is positively associated to relative molting speed.

We built linear models in R 2.15.0 (R Development Core Team 2012) to test the effects of body condition (score: mass/tarsus) and parasite load (number of parasites averaged across wings) upon the male’s blue-black plumage coverage (averaged across body parts). We chose mass/tarsus ratio as a condition index, because we found no correlation between mass and tarsus in our dataset ($r_s = 0.17, P = 0.45, n = 22$), which is a prerequisite in using regression residuals or to calculate the scaled mass index (Peig and Green 2009). Moreover, the mass/tarsus ratio successfully reflects intestinal parasite load and social dominance in male Blue-black Grassquits (Costa and Macedo 2005, Aguilar et al. 2007, Santos et al. 2009), which is a strong indication that this index accurately reflects body condition in this species. We included capture date and its quadratic term as two fixed predictors, since males captured later in the breeding season have higher nuptial plumage coverage (i.e., molt index; Maia and Macedo 2011). We used Type II $F$-tests to evaluate the significance of each variable and a backward stepwise procedure to obtain the most parsimonious model. The relation between body condition and ectoparasite load was evaluated with a Spearman’s correlation.

RESULTS

The blue-black plumage coverage of grassquit males was negatively correlated with the quadratic term of date of capture ($F = 5.85, P = 0.026, \beta = -0.45, CI = -0.82$ to $-0.09, n = 22$). In other words, the blue-black plumage coverage increased from the beginning to the middle of the nesting season, then decreased from the middle to the end of the nesting season. In contrast, we did not find a positive correlation between plumage coverage and date of capture ($F = 0.06, P = 0.81, \beta = 0.04, CI = -0.30$ to $0.39, n = 22$; Fig. 1A). The blue-black plumage coverage of grassquit males was positively related to the body condition score ($F = 12.39, P = 0.002, \beta = 0.58, CI = 0.26$ to $0.91, n = 22$; Fig. 1B) and negatively related to the ectoparasite load on the wings ($F = 8.20, P = 0.01, \beta = -0.47, CI = -0.78$ to $-0.15, n = 22$; Fig. 1C). The body condition index was not correlated with ectoparasite load in these males ($r_s = 0.01, P = 0.96, n = 22$).

DISCUSSION

The negative relationship found between ectoparasite load and the expression of iridescent blue-black plumage coverage supports the hypothesis of sexual selection mediated by parasites (Zahavi 1975, Hamilton and Zuk 1982). A previous study with Blue-black Grassquits showed that endoparasites (coccidian oocysts) could negatively affect the percentage coverage of iridescent plumage (Costa and Macedo 2005). Furthermore, the relationship between body condition and the coverage of iridescent plumage found in this study also supports the hypothesis of condition-mediated sexual selection. In a study with Blue-black Grassquits, Doucet (2002) found a positive relationship between body condition (growth rate of iridescent feathers) and plumage coloration. Molting speed may indicate the quality of male feathers because of an increased investment by males in plumage development (Maia and Macedo 2011). Several studies with passerines have confirmed that secondary sexual characteristics such as song (Møller 1991) and plumage color (Harper 1999) may be positively related to body condition.

As honest signals of male quality, secondary sexual characteristics should have production and
Only individuals in good condition should be able to invest resources in the production of these characteristics. We conclude that our data are consistent with the hypothesis of sexual selection mediated by parasites as well as with the hypothesis of sexual selection mediated by body condition, indicating that breeding plumage coverage can be an honest signal of male quality in the Blue-black Grassquit. Further investigations may reveal whether this cue is used by females when choosing either social or extrapair mates during breeding.

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LITERATURE CITED


