

Ketterson / Nolan Research Group Collection

This document is part of a collection that serves two purposes. First it is a public archive for data and documents resulting from evolutionary, ecological, and behavioral research conducted by the Ketterson-Nolan research group. The focus of the research is an abundant North American songbird, the dark-eyed junco, *Junco hyemalis*, and the primary sources of support have been the National Science Foundation and Indiana University. The research was conducted in collaboration with numerous colleagues and students, and the objective of this site is to preserve not only the published products of the research, but also to document the organization and people that led to the published findings. Second it is a repository for the works of Val Nolan Jr., who studied songbirds in addition to the junco: in particular the prairie warbler, *Dendroica discolor*. This site was originally compiled and organized by Eric Snajdr, Nicole Gerlach, and Ellen Ketterson.

Context Statement

This document was generated as part of a long-term biological research project on a songbird, the dark-eyed junco, conducted by the Ketterson/Nolan research group at Indiana University. For more information, please see IUScholarWorks (<https://scholarworks.iu.edu/dspace/handle/2022/7911>).

License/Disclaimer Statement

By downloading this document or using any information contained therein, you agree to the license terms outlined at <https://scholarworks.iu.edu/dspace/handle/2022/15256>, which explain terms governing use, creation of derivative research, and requirements for citing the document.



Resident females dominate intruders, but aggression not related to testosterone

Rebecca Young*, Jodie M. Jawor, and Ellen D. Ketterson

Department of Biology, Indiana University, 1001 E. 3rd St., Bloomington, IN 47405



ABSTRACT:

In socially monogamous bird species, aggressive behavior in males has been linked to fluctuations in testosterone levels. Female birds are similarly aggressive, but the hormonal basis of this aggression and its relation to monogamy are not well understood. We studied captive female dark-eyed juncos (*Junco hyemalis*) in a resident-intruder situation. First a resident male-female pair was established in a breeding aviary. Several days later an intruder female was introduced. Aggression, courtship, testosterone, and corticosterone were monitored in the females. Males bonded with the residents, but also courted the intruder and were rarely aggressive toward the intruder. As predicted, during 30 trials resident females dominated intruders in all but one case. Dominant females were significantly more likely to initiate reproduction and be aggressive. Intrasexual aggression was not related to testosterone or corticosterone. Females may enforce monogamy in juncos, but the hormonal basis is not clear.

INTRODUCTION:

1. Aggressive behavior in male birds is well studied; males may sing at, approach, or attack intruders, and these behaviors are linked to a rise in testosterone (T). In some species, female birds exhibit many of the same aggressive responses towards intruding conspecific females (Creighton 2001)
2. In temperate-zone birds, early in the breeding season, males respond to territorial intruders aggressively and exhibit a corresponding increase in T levels (Wingfield et al. 1990).
3. Females of some species also respond to social challenges with an increase in T levels (Langmore et al. 2002), but females of other species do not (Elekovich & Wingfield 2000).
4. In dark-eyed juncos, males and females show a peak in T early in the breeding season (Clotfelter et al. 2004). The response to a challenge has not been studied.
5. In this study we asked whether captive female dark-eyed juncos (*Junco hyemalis*) responded to an intruding conspecific with an increase in T levels.



METHODS:

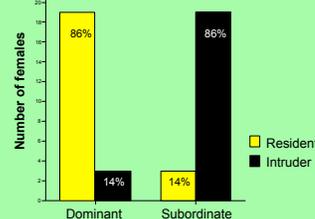
Work was conducted at Kent Farm Bird Observatory in Bloomington, IN (May-August 2004). To begin a trial, a male and female were housed together while the intruder female was isolated in a cage. Three days later the intruder was introduced, and observations of aggressive behavior collected. Dominance status was determined by the type (high or low) and number of aggressive acts displayed by each female; the female who consistently initiated aggression was determined dominant. Blood was collected from resident and intruder females before the male was introduced (first baseline), 24 hours before the intruder was introduced (second baseline), and 30 minutes after intruder was introduced (post-challenge). The plasma was later assayed for T and corticosterone (B) levels. Trios remained together and were monitored for breeding behavior for 2 weeks.

To assay for T we used an EIA kit (Assay Designs, Inc., #901-065). The plasma samples were extracted twice with diethyl ether, re-suspended in 50 μ l of ethanol, and diluted to 350 μ l with assay buffer. Average recovery for each plate was determined by adding 2000cpm of H3-T to six standards and using this to determine extraction percentages. Intra- and inter-assay variation was less than 9%.

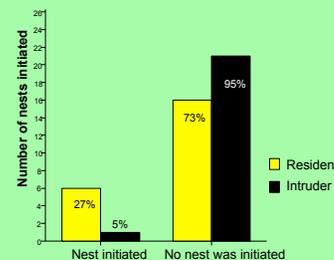
For B we used an RIA (as in Ketterson et al. 1991). Samples were extracted once with diethyl ether, and 2000cpm of H3-B was added to the samples to determine extraction percentages. Intra-assay variation was less than 8%.

RESULTS:

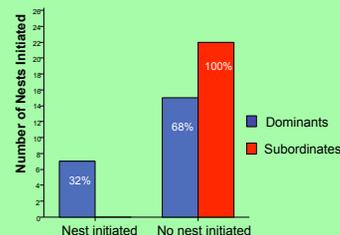
We conducted 30 resident-intruder trials involving 60 females. Blood samples were collected at all three time points (baselines 1 & 2, post-challenge) for 44 females and we limit our analyses to this subset. The male courted the resident prior to intruder introduction in all but 3 cases. Residents were more likely to behave aggressively than intruders ($\chi^2=10.87$, $df=1$, $P=0.001$), and aggressive behavior demonstrated by the resident female was directed predominantly at the intruder female. Of the 60 females, 7 built nests and laid eggs.



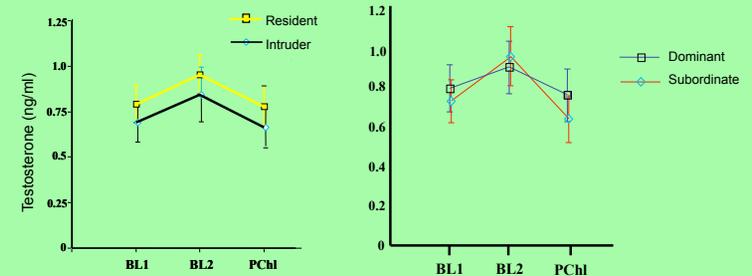
Resident females were more likely to be judged dominant than intruder females ($\chi^2=23.373$, $df=1$, $P<0.0001$).



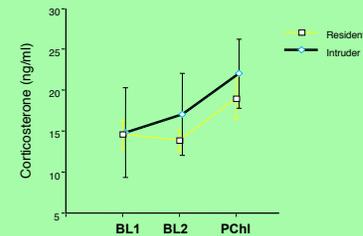
Although residents were more likely to become dominant they were not more likely to breed ($\chi^2=3.310$, $df=1$, $P=0.07$). This is most likely due to one intruder initiating reproduction.



Although most females did not breed, dominant females were more likely to build nests and lay eggs than subordinates ($\chi^2=10.87$, $df=1$, $P=0.001$).



No detectable change in T occurred over the course of the trial, and there was no effect of resident (repeated measures ANOVA $F=1.749$, $df=1$, $P=0.19$) or dominance status ($F=0.511$, $df=1$, $P=0.48$) on T (Standard error bars ± 1 SEM).



B levels rose during the experiment but not significantly (P 's > 0.50), and B was not correlated with any physiological or behavioral measure.

DISCUSSION:

1. Residents were consistently aggressive towards intruders and almost invariably dominant over them (Jawor et al. in review).
2. Only dominant females bred, thus linking dominance and reproductive success. Females could be enforcing monogamy through intrasexual aggression.
3. Female plasma T, a strong predictor of male aggression, did not rise after an intrusion (challenge).
4. It is possible that females experienced elevated T in response to intruders, but the timing of the increase did not coincide with our sampling regime. However, past data on timing on the increase in T in challenged males make this explanation unlikely.
5. Another possibility involving T is that when female juncos are challenged they increase their sensitivity to T, e.g., receptor sensitivity or binding (Moore & Evans 1999, Blaustein 2004).
6. Perhaps other hormones could be mediating the response (e.g. E2, P, LH, or DHEA).
7. Further research on the hormonal basis of female aggression and its influence on social monogamy is clearly needed.



LITERATURE CITED and ACKNOWLEDGMENTS:

Blaustein, J.D. 2004. *Endocrinology* 145(3):1075-1081.
 Clotfelter, E., et al. 2004. *Hormones Behav* 46:171-178
 Creighton, E. 2001. *Ethology Ecol. Evol.* 13:247-260.
 Elekovich, M.M. et al. 2000. *Ethology* 106:493-510.
 Ketterson, E. D., et al. 1991. *Am. Nat.* 140:980-999.
 Langmore, N.E., et al. 2002. *Proc. R. Soc. Lond. B* 269:2473-2478.
 Moore, F.L. & Evans, S.J. 1999. *Brain, Behav. Evol.* 54:41-50.
 Wingfield, J.C., et al. 1990. *Am. Nat.* 136:829-846.

We thank Nicki Gerlach, Katie Pavlis, Jen Richardson, and Eric Snajdr for assistance with data collection and analysis. Funding was provided by the National Science Foundation (IBN-0216091). Work was done in compliance with ABS/ABAB guidelines and was approved by Indiana University, Bloomington IACUC protocol # 03-115.

