

ADJUSTING TO URBAN LIFE: ENDOCRINE AND IMMUNE RESPONSES OF A SONGBIRD TO ACUTE STRESS

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Introduction

- Urban and non-urban birds live in vastly different habitats, which may result in urban birds adjusting phenotypically to their habitats.
- The stress hormone corticosterone (CORT) has a considerable effect on immune function in birds.
- Initial (= pre-stress) and stress-induced plasma CORT concentrations differ between urban and non-urban birds.¹
- Body condition differs between urban and non-urban birds and is linked to changes in immune and stress responses.^{2,4}
- An increase in plasma CORT has been associated with a decrease in plasma testosterone.

Objective

Compare initial and stress-induced plasma CORT and testosterone, immune function (lysis and agglutination capacities), and body condition in urban and non-urban (= desert) male Abert's Towhees (*Melospiza aberti*).

Hypothesis

Urban birds are in better body condition and have a better immune response than non-urban conspecifics. Urban and non-urban towhees differ with respect to their initial and stress-induced plasma CORT and testosterone responses.

Methods

- Birds were captured and sampled during their breeding season in urban (n=16) and non-urban (n=20) areas in metropolitan Phoenix, Arizona.
- Birds were caught and bled within two minutes (Initial), restrained for 60 minutes, and bled again (Stress). Standard morphometrics were measured before birds were released on site:
 - Body mass
 - Wing chord
 - Body condition (= body mass/ wing chord)
 - Furcular fat reserves
 - Size of cloacal protuberance.
- Plasma CORT and testosterone were quantified by enzyme-linked immunoassay (ENZO Life Sciences).
- Plasma lysis and agglutination capacities were quantified using a natural antibody and hemolysis assay adapted from Matson et. all (2005).³

Results

	Urban birds	Non-urban birds
Body Condition	0.514 ± 0.013	0.507 ± 0.015
Body mass (g)*	46 ± 2	45 ± 1
Wing Chord (mm)*	90 ± 2	88 ± 2
Visible fat reserves	0 ± 0	0 ± 0
Cloacal Protuberance Width (mm)	8.1 ± 0.7	7.7 ± 0.7

Standard morphometrics of urban and non-urban birds. Data represent means ± standard errors.

Urban birds were heavier and had longer wings than non-urban birds. However, both groups had similar body condition, visible fat reserves, and cloacal protuberance size.



Summary and Discussion

- Higher accessibility to food in urban habitats may account for the observed increase in body size of urban birds.
- Urban birds had lower initial plasma CORT than non-urban birds but increased it more during stress, so that stressed-associated plasma CORT did not differ between the two groups.
- Plasma testosterone declines in response to acute stress in both urban and non-urban towhees, but urban towhees had overall lower plasma testosterone.
- Acute stress decreased immune function, but urbanization did not affect this function.
- Thus, adjustments to urbanization in Abert's Towhees involve changes in body size and endocrine response, but not immune response to acute stress.

Future Direction

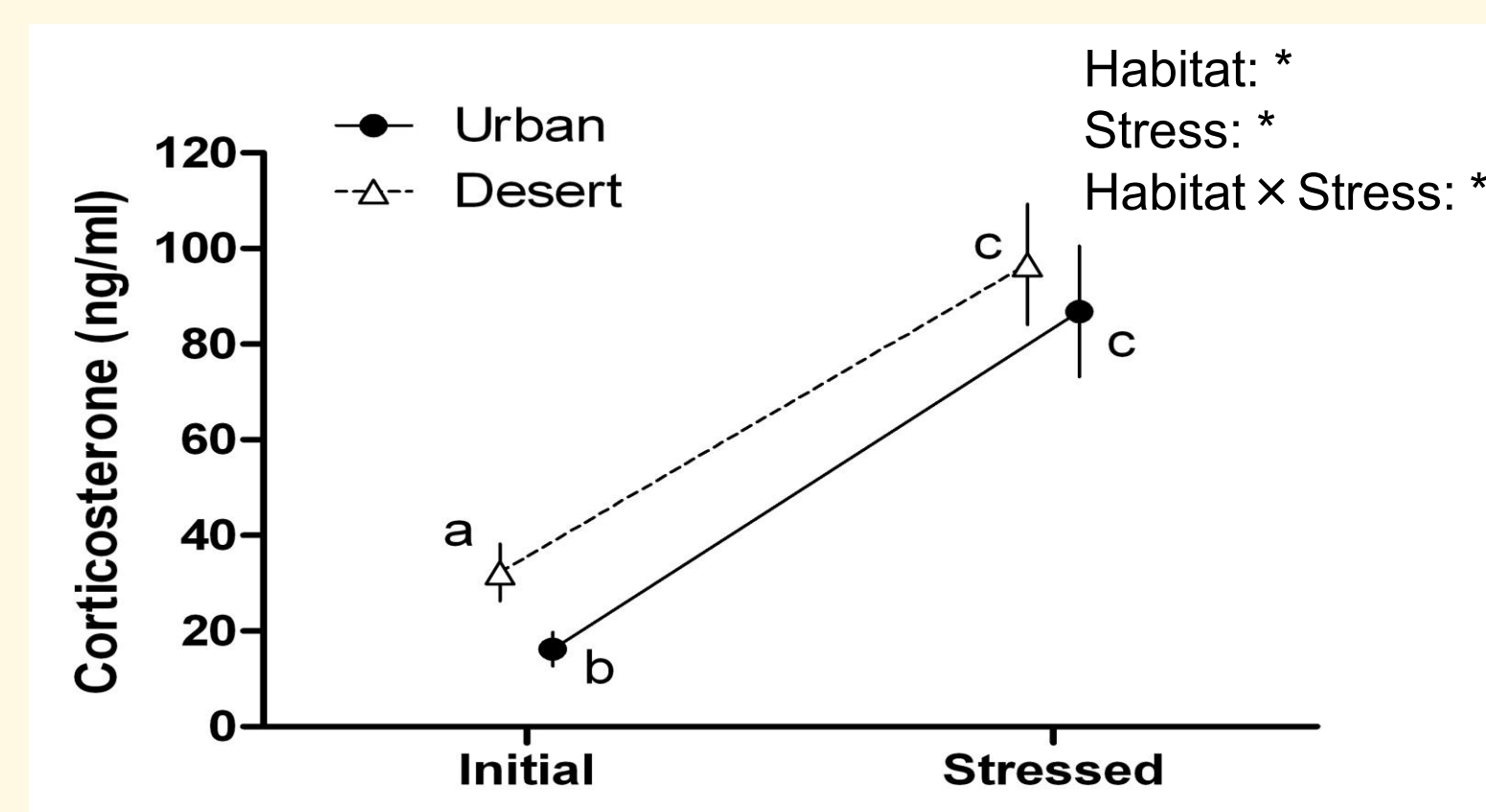
Additional studies will compare various stress markers in urban and non-urban birds to further understand the implications of urbanization on the response to acute stress. There is also a need to study whether the relationships between the physiological markers studied reflect correlations or causal relationships.

Acknowledgements

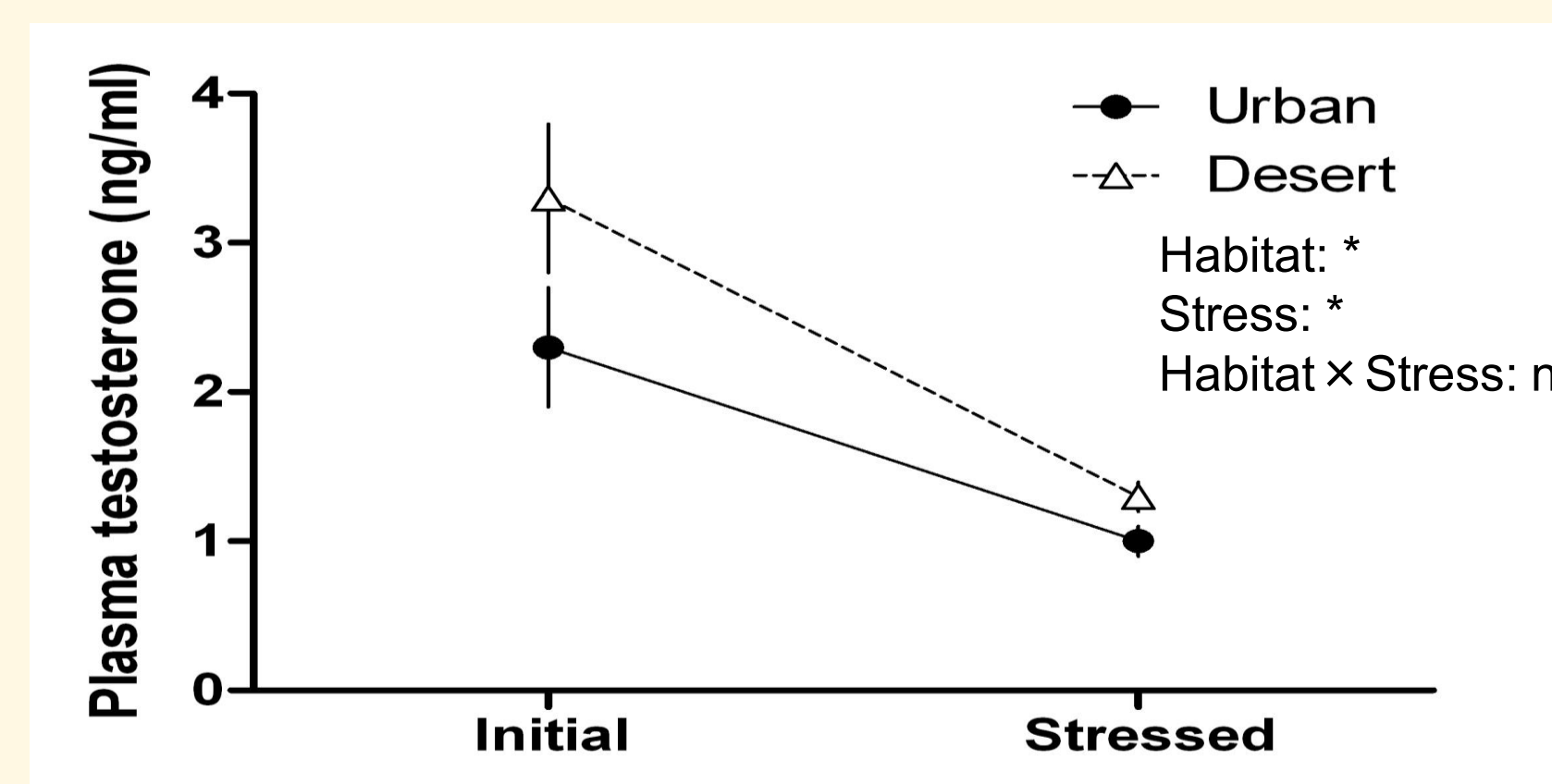
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References

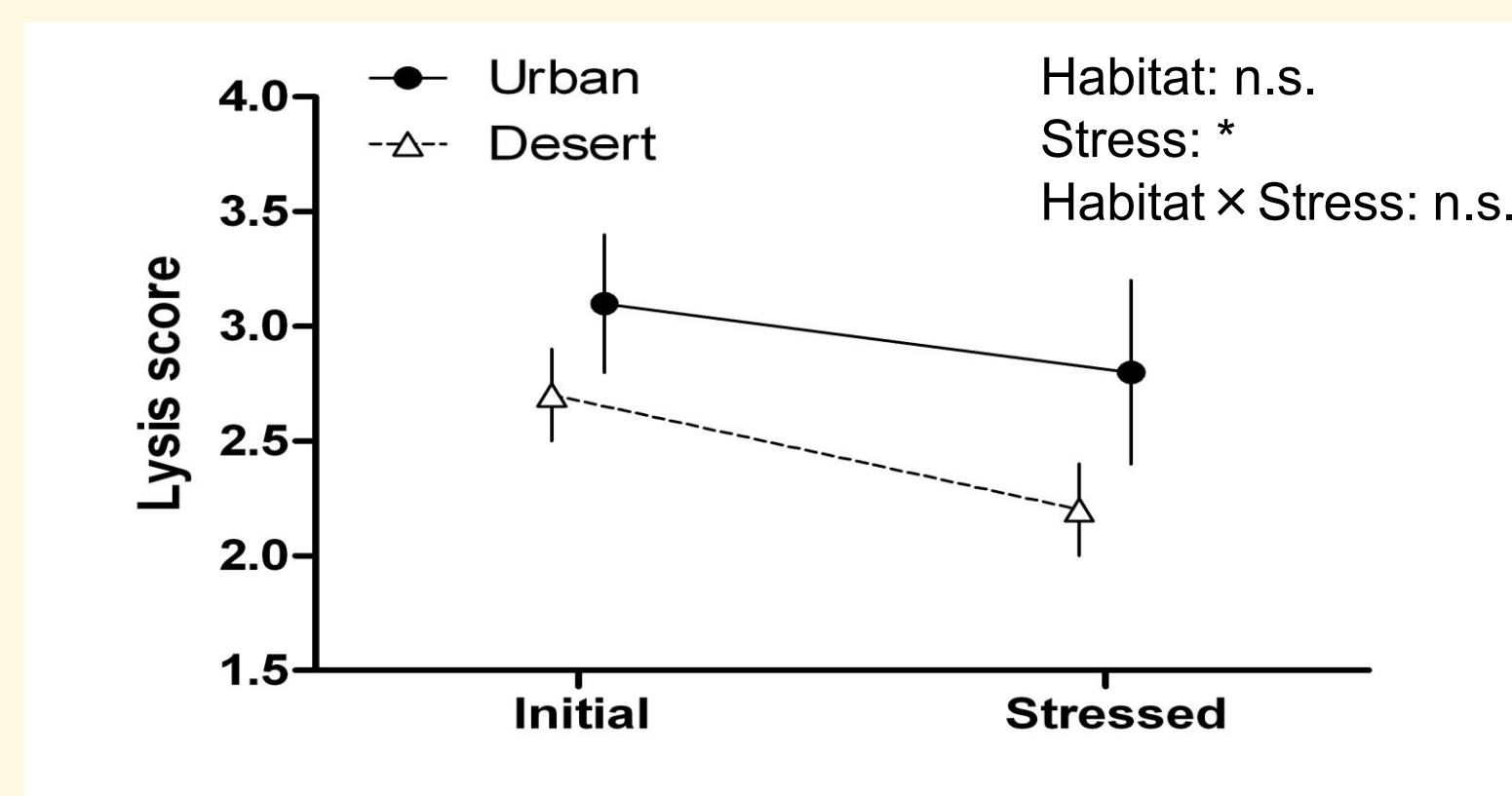
- Fokidis, H.B., Orchinik, M., Deviche, P. 2009. Corticosterone and corticosteroid binding globulin in birds: Relation to urbanization in a desert city. *Gen. Comp. Endocrinol.* 160, 259-270.
- Fokidis, H.B., Greiner, E.C., Deviche, P. 2008. Interspecific variation in avian blood parasites and haematology associated with urbanization in a desert habitat. *J. Avian Biol.* 39, 300-310.
- Matson, K. D., Ricklefs, R. E. & Klasing, K. C. 2005. A hemolysis-hemagglutination assay for characterizing constitutive innate humoral immunity in wild and domestic birds. *Developmental and Comparative Immunology* 29, 275-286.
- Navarro, C., Marzal, A., De Lope, F., Møller, A.P. 2003. Dynamics of an immune response in house sparrows *Passer domesticus* in relation to time of day, body condition and blood parasite infection. *Oikos* 101, 291-298.



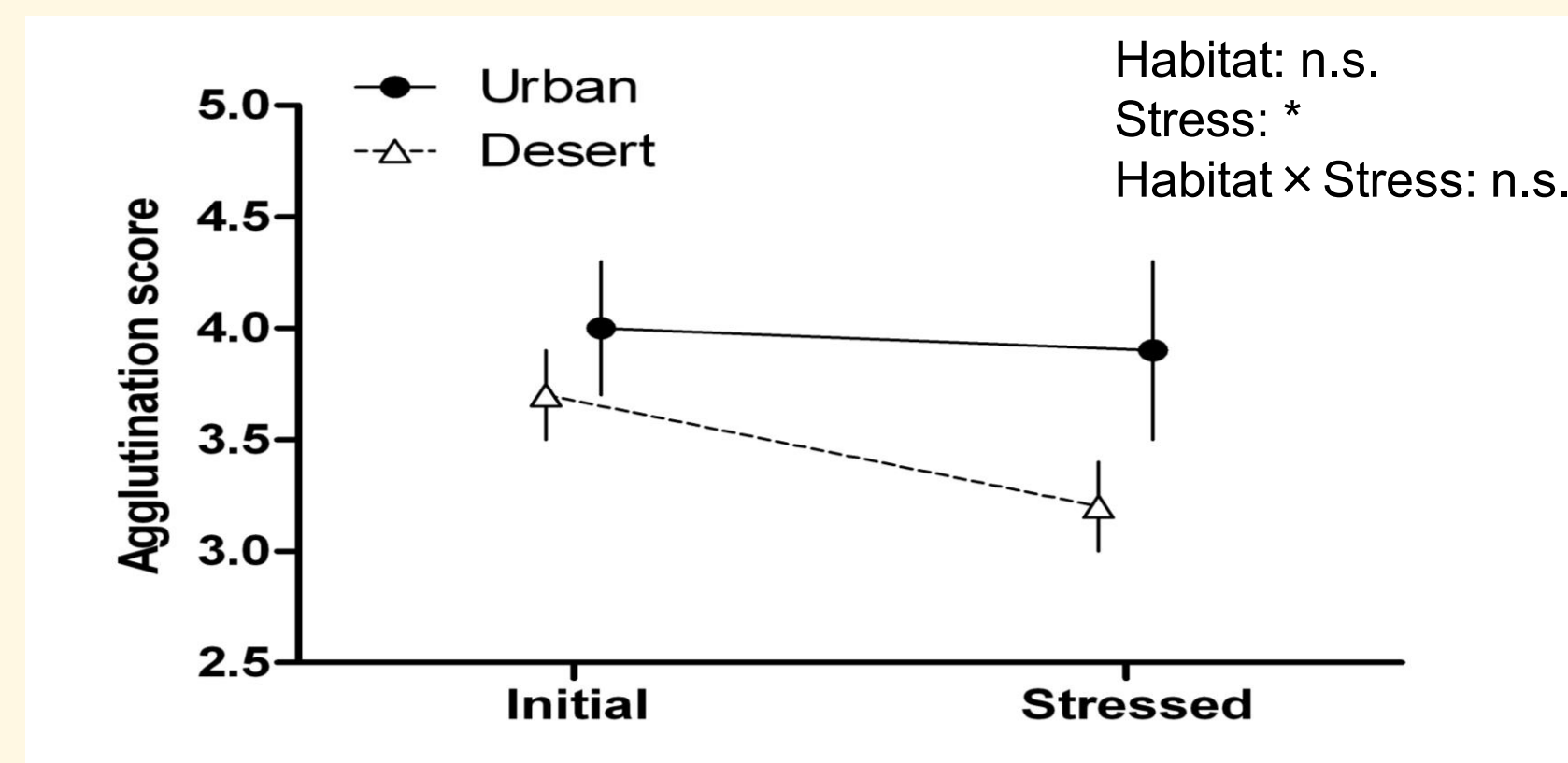
Urban birds had lower initial plasma CORT than nonurban birds, but both groups had similar stress-induced plasma CORT. *Same letter indicates no statistical significance; different letters represent significance, P<0.05



Acute stress decreased plasma testosterone. Urban towhees had lower initial and stress-induced plasma testosterone than non-urban towhees.



Initial and stress-induced lysis score in urban and desert Towhees.



Initial and stress-induced agglutination score in urban and desert Towhees.

Lysis and agglutination capacities were similar in both urban and non-urban birds. However, both lysis and agglutination capacities decreased during stress in urban and non-urban birds.