

# Breeding in an urbanizing world: Reproductive adjustments of seasonally breeding birds to urban areas

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## Introduction

- Urbanization dramatically changes ecosystem dynamics, and urban animals inhabit an environment considerably different than do their non-urban conspecifics.
- As urban spaces are widespread, often located in biodiverse landscapes, and their area will expand in the coming century, they are poised to substantially influence global biodiversity.
- For seasonally breeding birds, the timing of breeding (phenology) is a crucial adaptation to local environmental conditions.

## Objectives

- We used a meta-analytical approach to compare the timing of seasonal breeding of urban bird populations with that of their conspecific non-urban populations.
- To identify the driving force behind any difference between urban and non-urban populations, we also used meta-analysis to examine whether the change in timing of breeding is mirrored in the timing of gonad development and the seasonal increase in plasma levels of reproductive hormones.

## Methods

We included a study in our analysis if it met the following two criteria:

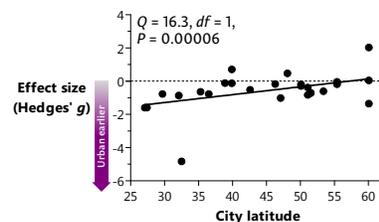
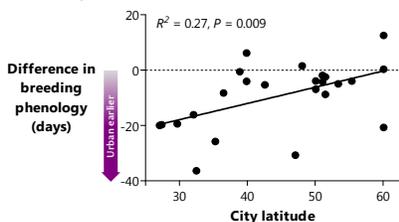
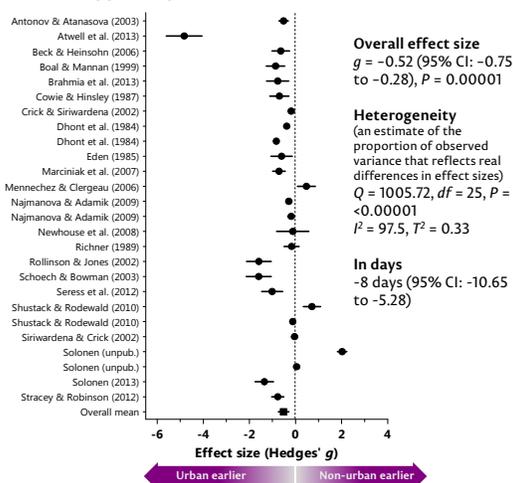
- It involved a paired comparison of both urban and non-urban populations of a bird species during the same breeding season.
- It quantified a trait associated with the timing of reproduction in birds.

A **positive effect size** indicates that the reproductive phenology of the non-urban population was advanced relative to the urban population, and a **negative effect size** indicates that the reproductive phenology of the urban population was advanced.

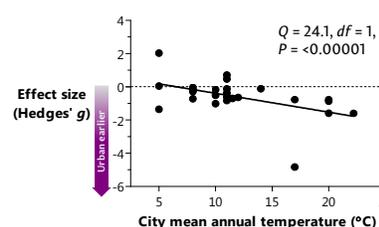
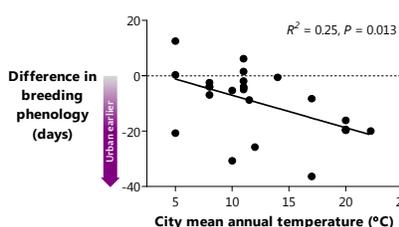
## Results

### Breeding Phenology

Urban bird populations breed, on average, 8 days earlier than do their corresponding non-urban populations (measured as the population mean date of egg laying, clutch initiation, clutch completion, or hatching).



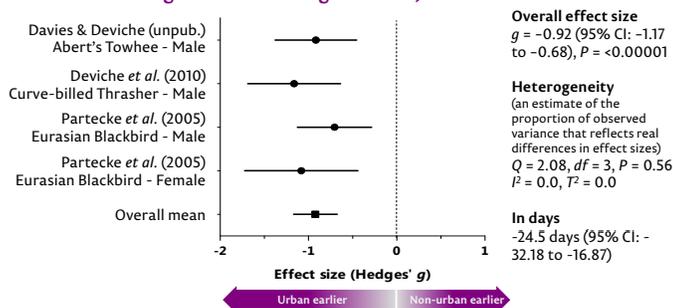
The advancement in breeding phenology is greater in cities closer to the equator.



Cities with higher annual mean temperatures are associated with a greater difference in breeding phenology.

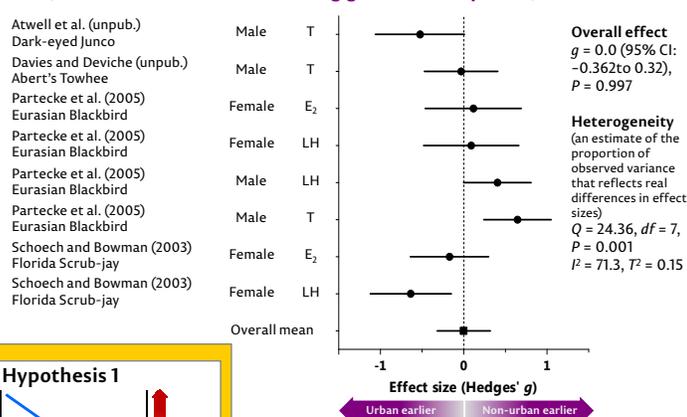
### Gonad Development

The advancement in breeding phenology of urban bird populations is reflected in the phenology of gonad development (measured as the date of attaining half maximum gonad size).



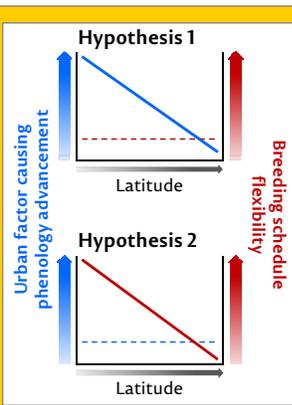
### Reproductive Endocrinology

The advancements in breeding phenology and gonad development was not mirrored in the seasonal increase in plasma levels of reproductive hormones (measured as mean level during gonad development).



## Conclusions

- We suggest two non-mutually exclusive hypotheses to explain the effect of latitude on breeding phenology:
  - A feature of urban areas advances breeding phenology and this factor increases in magnitude as latitude decreases. Prominent candidates are ambient temperature and/or primary productivity.
  - Birds closer to the equator have more flexible breeding schedules than birds at higher latitudes and the factor(s) that cause(s) urban birds to advance their breeding schedule has a greater effect at lower latitudes.
- Our finding that substantial advancements in breeding phenology and gonad development are not mirrored in the seasonal increase in plasma levels of reproductive hormones is in line with recent experimental studies (e.g., Schaper et al. 2012, *Gen. Comp. Endocrinol.*). Thus, it may be fruitful to examine factors other than plasma levels of reproductive hormones, such as hormone receptor density and ability to secrete maximum amounts of reproductive hormones.



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