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BIRDS IN AN URBANISING WORLD

THE INFLUENCE OF URBAN DEGREE & SCALE ON GREAT TIT BREEDING SUCCESS

1. CITY LIVING

The world is **urbanising rapidly** with negative effects on avifauna.
(Chace & Walsh 2006, *Landsc Urban Plan* 74: 46-69)

Cities are attractive to many birds; they offer additional sources of food, water and nesting sites. However, cities are also sources of novel **mortality** and **disturbance**, and can change avian phenology patterns and reduce breeding success.
(Chamberlain *et al*. 2009, *Ibis* 151: 1-18)

Urban effects (e.g. changes in temperature or light) on birds are likely **scale-dependent**, however the role of spatial scale in urban-avian literature has not been explicitly studied.
(Clergeau *et al*. 2006, *Trends in Ecol Evol* 21: 660-661)

QUESTION

How does breeding success vary with urbanisation at different spatial scales?

2. METHODS

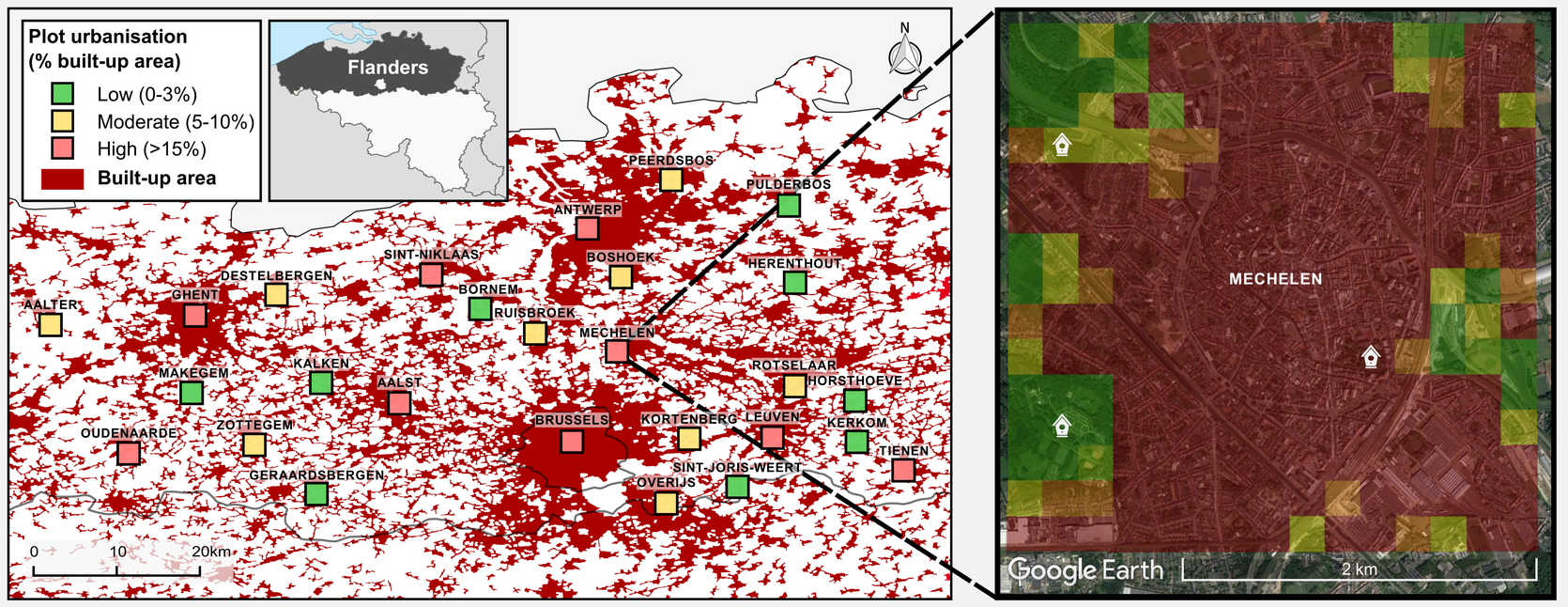
Great Tits (*Parus major*) were studied in **>400** nestboxes over two breeding seasons in a nested study design in northern Belgium.

Study sites comprised **two scales**: local subplots (200m x 200m) nested within regional plots (3km x 3km). The study design incorporated **three degrees of urbanisation**, based on percentage built-up area, defined as: '**green**' (low: 0-3%), '**yellow**' (moderate: 5-10%) and '**red**' (high: >15%) - *Fig 1*.

Breeding data (variables: **laying date, clutch size, nestling mass, fledglings per egg**) were collected over two breeding seasons (2014-2015). Response variables were regressed against urbanisation (at plot and subplot scales) and relevant ecological covariates (e.g. brood size) in generalised linear mixed effects models (GLMMs).

Fig 1 (*Left*) Map of northern Belgium showing 27 study area regional-scale plots (3km x 3km - boxes not to scale) in the context of urban spread (derived from Corine artificial land-use data: European Environmental Agency 2006). Plots classifed into three urban classes based on % built-up area within plot: green (0-3% & >20% ecologically valuable area - Vriens et al. 2006, INBO), yellow (5-10%) and red (>15%).

(*Right*) The Mechelen plot, revealing the local-scale subplots (200m x 200m) nested within. Subplots were categorised according to % urban built-up area (as for plots), and one subplot per urban degree (green, yellow, red) was chosen for placement of nestboxes (orange subplots not included in study). White nestbox logos represent clusters of nestboxes used by the study.



3. RESULTS: A BREEDING SEASON TIMELINE

Laying date varies significantly with the plot-subplot interaction. Red plot laying dates estimated to be >6 days earlier than green plot laying dates.

Clutch size varies significantly with both plot and subplot scale, but scales do not interact. Clutch size decreases with increasing urban degree at both urban scales.

Nestling mass varies significantly with the plot-subplot interaction. Nestlings in 'green subplots in green plots' are on average 2.5g heavier than nestlings in 'red in red' sites.

Fledglings per egg (FPE) varies significantly with subplot scale. Birds in green subplots estimated to have 0.89 FPE, substantially higher than those in red subplots (0.68).

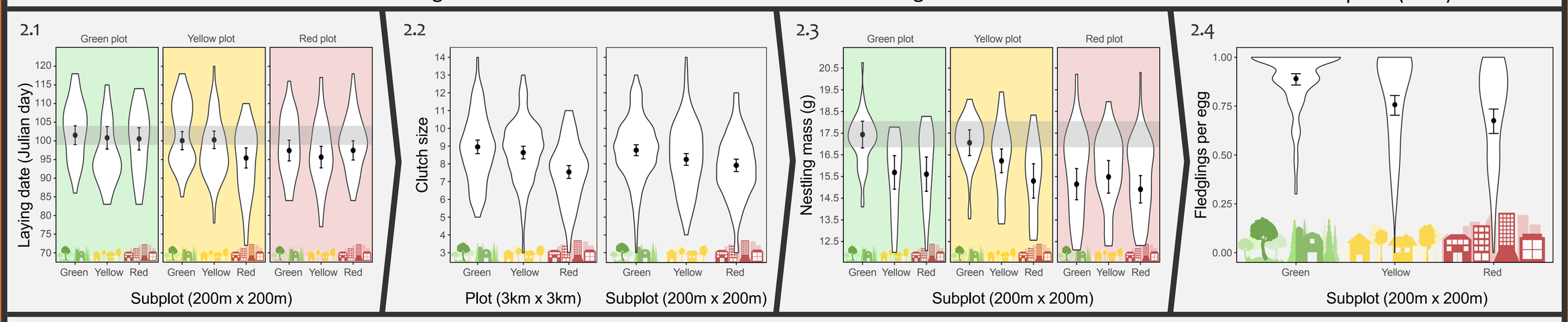


Fig 2 GLMM model-fitted estimates (points with 95% confidence interval [CI] bars) and violin plots of Great Tit laying date (2.1), clutch size (2.2), nestling mass (2.3) and fledglings per egg (2.4) in relation to urbanisation degree at subplot scale (grouped by plot scale for 2.1 & 2.3) or plot scale. Violin plots depict the data's distribution (by kernel probability density). For reference, grey-shaded horizontal bars (2.1 & 2.3) indicate 95% CI area of left-most point (rural subplot in rural plot).

4. DISCUSSION

Small green areas within cities ('green in red') **may not be able to buffer** the effects of broader-scale urbanisation.

Green spaces in cities (as well as cities themselves) could therefore represent '**ecological traps**' - the phenomenon whereby poor habitats become relatively more attractive thus baiting individuals to settle.

There is a need to **incorporate scale effects in urban-avian research** and to determine how urban changes (e.g. in food availability - thought to be a key driver of urban-rural differences) vary with both urbanisation degree and scale.

FINDINGS

1) Breeding success tends to decrease with increasing urbanisation.

2) Spatial scale effects impact all stages of the breeding cycle.

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J Ketz award

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