

Urbanisation impact on the urban avian gut microbiota: comparative and experimental approaches

Cities take up 3% of the Earth's habitable land area and are home to 1 out of 2 humans worldwide. Made of concrete, glass and steel, cities are a remarkably different habitat to the natural world wild organisms evolved in. And yet, some species appear to thrive in cities. Birds are highly conspicuous examples of wildlife in the city, and city dwellers often enjoy watching them or listening to their song. In the past decades, biologists have noted that birds in the city differ from their conspecifics in the natural world. For example, urban birds often lay eggs earlier and have smaller clutches. Urban birds are also often smaller. The question arises of how wildlife, and birds in particular, adapt to city life, given that the urban environment is so different to their natural habitat? While organisms often evolve when exposed to sustained selective pressures over long periods of time, they can also cope in the short term by means of phenotypic plasticity, that is the ability of one genotype to produce more than one phenotype when exposed to different environments.

Recently, the gut microbiota – that is the community of microorganisms residing in the animal's gut, which includes bacteria, protozoa and fungi – has been tipped to play a key role in the way animals cope with life in the city. Indeed, the gut microbiota and its community composition is likely to change relatively fast in response to environmental signals (and specifically – within an individual's life). This contrasts with the timeframes required for evolutionary changes to occur, which occur from generation to generation, and do not change during an individual's lifetime. However, **very little is known about the gut microbiota of organisms living in the city**. While some research has started to emerge suggesting that the urban environment does influence the composition of the gut microbiota in wild birds, many questions still remain unanswered.

The aim of this research is to understand (i) the impact of cities on the gut microbiota of wild birds, and (ii) the impact of gut bacterial communities on the host – great tits *Parus major* growing in a gradient of urbanisation.

- By comparing microbiota structuring in two passerine birds, we will first test whether gut microbiota is stable across species, and whether it is influenced by urbanisation and food composition.
- By performing an experiment where great tit offspring are raised by either their biological parents or foster parents while in the nest (a cross-fostering experiment), we will be able to evaluate whether the gut microbiota is influenced not only by the environment, but also by the host's genetic properties. We will identify which urban stressors are influencing the avian gut microbiota the most, and further evaluate the role of bacterial assemblages in mediating mass gain and survival in the host in a gradient of urbanisation.
- Finally, we will infer the effect of urbanisation on the development of the avian gut microbiota over time.

By comparing more than one species (a comparative approach) and by devising a field experiment (an experimental approach), this study will reveal how the gut microbiota changes with urbanisation and in time, and how it impacts the biology of urban wildlife. This will advance our understanding of how wildlife copes with life in the city, and may even shed some light on processes underlying variation in the gut microbiota of human city-dwellers.