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DOI: 10.1016/j.cub.2006.10.045

Animal Communication: City Birds Have Changed Their Tune

Birds adjust their songs to make themselves heard in the presence of ambient noise. New research comparing songs of great tits across Europe shows how animals adapt their signals to the urban din.

Henrik Brumm

Today we are witnesses of an ever-increasing urbanisation of our planet. Fifty years ago, only one third of the world's people were urban; by 2000, the proportion of city dwellers had already risen to 50 per cent, and it is projected that two thirds of the world's population will live in cities by 2030 [1]. One aspect of the urban environment we all complain about is the increase in noise. But the din of modern cities is not only an annoyance to us humans (not to mention being damaging to our health), it also affects the life of wild animals that find themselves in an increasingly urban world.

High levels of ambient noise are particularly problematic for animals that use sound to communicate, as it masks their signals and thus impairs the exchange of vital information. This is the case, for instance, in many birds, where males use their songs to attract mates and to defend their territories against rivals. This close relationship between bird song and sexual selection means that variation in signalling efficiency is likely to have major fitness consequences for the singing male. However, few studies have addressed the question of whether and how birds in cities are able to change their songs to make themselves heard. One of these investigated urban nightingales (*Luscinia megarhynchos*), and found that birds adjust the loudness of their songs to the level of background noise [2]. If there was more traffic noise, males sang louder to counter the masking of their songs.

There are many sources of traffic noise in cities: it may come from cars, motorbikes, lorries, trains or low flying aeroplanes. What these different noises all have in common is that they are mainly concentrated at low frequencies. Therefore, birds with high-pitched songs will have an advantage in cities, because their signals suffer less masking by the ambient low-frequency noise. Indeed, several studies [3–5] looking at single urban bird populations have shown that males at noisier sites tended to sing at higher frequencies than birds in less noisy areas.

In this issue of *Current Biology*, Slabbekoorn and den Boer-Visser [6] report on differences in song between urban and forest populations of great tits (*Parus major*; Figure 1). In an outstanding sampling effort, the authors recorded ten different population pairs in several European countries. They looked at whether birds, for example in London, Paris or Berlin, sang differently from their conspecifics in forests near these cities. This comparison between city and forest populations adds an important novel angle to the usual intra-population approach, and provides one of the best examples of signal adaptations to changing environmental conditions. The most striking result is that the city birds sang with higher minimum frequencies than the forest birds. And, remarkably, the authors found that this was clearly the case in all ten of the sampled population pairs, from Britain to the Czech Republic. This finding suggests that urban great tits have shifted their songs towards higher frequencies to mitigate masking from increased levels of low frequency noise.

Figure 1. An urban male great tit.

Great tits in cities sing faster and at a higher pitch compared to their conspecifics dwelling in forests, as reported in this issue by Slabbekoorn and den Boer-Visser [6]. They suggest that the birds changed their songs to make them stand out against the masking traffic noise in urban areas. Most likely, birds adapt their songs to the din of cities by using mechanisms that have evolved much prior to urbanisation to counter interference from natural noise [7]. (Photo by Edgar Müller.)

Furthermore, Slabbekoorn and den Boer-Visser [6] also observed that the tits in cities sang shorter songs than their conspecifics in forests, and they also made shorter pauses between their songs. So overall the city birds sang faster and at a higher pitch compared to the same species dwelling in woods.

These changes in song characteristics do not seem to be unique to the urban environment. For instance, a similar increase in minimum song frequency has also been found in chaffinches (*Fringilla coelebs*) in woodlands close to natural noise sources, in this case waterfalls or torrents [7]. For a singing bird it probably does not make a difference whether its songs are masked by natural or man-made noise, at least as far as signal transmission is concerned. And the natural world can be a very noisy place too — aside from waterfalls and torrents, also think of wind, rain, surf and the enormous variety of sounds produced by many different animals in some habitats. Therefore, it is quite likely that those animals that can adapt their vocalizations to the urban din do this by using mechanisms that have evolved to cope with interference from natural noise [7–10].

We do not know yet what the mechanisms underlying the reported frequency shifts in bird song are. Recent studies [11,12] have found evidence for genetic differences between city and forest populations of songbirds, and it is possible that genetic differences might play a role in the differences between songs of urban and forest birds. The fact that birds like great tits learn their songs may provide a further explanation for this phenomenon. Songbirds acquire their songs by copying those of other males, and the low-frequency components of songs might not be learned in noisy environments, simply because they are less audible because of the masking noise, possibly leading birds to sing with higher minimum frequencies. It could also be that males adjust their song repertoires according to experience: song types which are well suited to get the message across — those not masked by noise — are kept, others are dropped. One further mechanism might be the regulation of song frequencies by the individual itself, such that a bird alters the minimum frequency of a given song if it is masked by ambient noise.

Such a regulation mechanism has been found for the noise-dependent adjustment of song amplitude in birds [13]. It is questionable, however, whether individual frequency shifts of song types can account for the population-wide song differences discovered by Slabbekoorn and den Boer-Visser [6]: as they point out, shared song types that occurred in both city and forest populations did not differ in frequency, which suggests that an individual regulation of song frequencies is unlikely. According to Slabbekoorn and den Boer-Visser's [6] findings, it is most likely that different sets of songtypes are sung in cities. But it remains to be shown whether this is due to individual song repertoire adjustments or whether the urban repertoires are the outcome of evolutionary selection against birds with low-frequency songs in noisy environments.

It would be very interesting to find out whether it is some form of vocal flexibility that helps great tits to thrive in cities. By learning about how certain species manage to succeed in urban environments we can improve our understanding of why other species cannot and so decline. Hopefully, this understanding will eventually lead to improvements in the protection of those species that have a hard time coping with the spread of urbanisation and ever-increasing amounts of traffic.

Species that have settled in urban environments are exposed to different conditions from their conspecifics that remain in their original habitats. As urban habitats are very new in evolutionary terms, they provide an excellent opportunity to study how animals adapt their behaviour to the environment. In particular, cities are fruitful places for research on how animal communication systems have evolved. Slabbekoorn and den Boer-Visser's [6] study should stimulate a wide range of research addressing this topic.

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DOI: 10.1016/j.cub.2006.10.043