

FEATURE ARTICLES

SOUND TRANSMISSION AND SONG DIVERGENCE: A COMPARISON OF URBAN AND FOREST ACOUSTICS

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Abstract. Degradation of acoustic signals during transmission presents a challenging selection pressure for animals dependent on vocal communication. Sound transmission properties differ among habitats and may drive the evolution of vocal signals in different directions. Urban habitat is expanding worldwide and an increasing number of species, including many birds, must now communicate around buildings and over concrete. Urban habitats are evolutionarily new, although to some extent they may acoustically resemble rocky habitat such as cliffs and canyons. Neither urban nor these natural habitats have been studied in any detail for the selection pressure they may exert on animal communication. Dark-eyed Juncos (*Junco hyemalis*) commonly inhabit montane pine forests across North America, but for about 25 years an isolated population has been successfully breeding in an urban environment in southern California. We investigated potentially divergent selection pressures on junco songs, using sound transmission experiments with artificial sound stimuli, in natural forest habitat and in this urban habitat. Transmission properties differed significantly, resulting in tails of reflected sound with gradually declining amplitude in the forest and in multiple discrete echoes in the urban environment. We expected environmental selection in urban habitat to favor shorter songs with higher frequencies and slower trill rates. Despite the presence of relatively short urban songs, there was no significant shortening overall. There were also no differences in trill rates, but we did find a significantly higher minimum frequency in the urban junco population compared to three of four forest populations. Although the pattern of song divergence was not consistent and it is difficult to draw firm conclusions from this single urban population, our transmission results suggest that echoes could be important in shaping urban birdsong.

Key words: character shift, echo, habitat-dependent selection, junco, reverberations, song evolution, urban ecology.