RANGING BY SONG IN CAROLINA WRENS THRYOTHORUS LUDOVICIANUS: EFFECTS OF ENVIRONMENTAL ACOUSTICS AND STRENGTH OF SONG DEGRADATION

by

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Summary

Territorial male song birds most frequently hear conspecific song that has been degraded (distorted) by transmission through the environment. Their ability to use this accumulated degradation in conspecific song to assess the distance of its singer requires a receiver to discriminate between different degrees of degradation by taking into account the acoustical properties of the habitat. Ranging accurately when acoustical properties change seasonally then requires a receiver to reassess previous associations of degradation with distance.

Here I tested the possibility that Carolina wrens \textit{(Thryothorus ludovicianus)} discriminate between different levels of song degradation and change their association of degradation with distance when the acoustical properties of their territories change. In response to playback of a single song, either undegraded or degraded (at two different levels), most subjects flew to the far side of the loudspeaker only in response to degraded songs. In addition, behavioral responses beyond the loudspeaker were consistently stronger to playback of degraded songs than to playback of undegraded songs. Responses indicate that wrens discriminated between different levels of degradation and suggest that they adjusted their association of degradation with distance as habitat conditions changed. Such adjustment of associating a given level of degradation with distance is an important requirement for accurate ranging, in particular under changing acoustical conditions of the environment. In addition, rapid ranging on the basis of only one song might facilitate processing of additional information such as

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a singer's identity and motivation. Resulting selective attention to the closest rival might increase the reliability or speed of decoding such additional information.

**Introduction**

Several studies have shown that male territorial song birds can use the degradation of conspecific song during propagation through the environment to assess the distance of a singer (Richards, 1981a; McGregor *et al.*, 1983; McGregor & Falls, 1984; McGregor & Krebs, 1984; Shy & Morton, 1986; Naguib, 1995b; Wiley & Godard, 1996). This ability allows territory holders to discriminate between intruding rivals and distant conspecifics without spending time and energy approaching every singer. Estimating the distances of potential rivals then influences any further interaction among conspecific signalers and receivers, as the nature of their interactions strongly depends on their inter-individual distances. Thus, ranging plays a central role for vocal communication in song birds and in other animals with similar constraints on communication.

In order to accurately extract information from a song about the distance of its singer, a receiver needs to have some prior information about the structure of the song at its source or at about its level of degradation at different distances. In addition, a receiver will need to have some experience with the acoustical properties of its habitat. Combining this information will then allow a receiver to assess the length of a propagation path of a received signal.

When reverberation is used as a cue for auditory distance (Naguib, 1995b; Wiley & Godard, 1996), the receiver needs to take into account whether the propagation path contains few or many reflecting surfaces. Sound traveling over an open field does not accumulate much reverberation even over long distances (Michelsen, 1978; Wiley & Richards, 1978, 1982; Richards & Wiley, 1980). In contrast, dense vegetation in a forest causes sound to reverberate considerably, even over relatively short distances. Because reverberation strongly depends on the density of vegetation it increases after foliage has developed in spring (Richards & Wiley, 1980). A particular level of reverberation thus indicates a more distant bird before than after foliage has developed. Similar arguments apply to frequency-dependent attenuation. Although attenuation increases with fre-