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Gene-wide Diversity of Two Personality-Related Genes (DRD4 and SERT) in Urban and Rural Populations of House Swallows across Sri Lanka to South Pacific Indicates a Possible Demographic Expansion or Local Selection in Rural Populations

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Abstract

Urbanization-related environmental and landscape changes often negatively impact biodiversity, primarily due to habitat loss and fragmentation, forcing wildlife to migrate to new habitats. Nevertheless, urban exploiters and urban adapters seem to thrive in urban environments. Behavioral plasticity might play a role in their successful urban adaptations. However, the mechanisms of how these behavioral variations are produced and maintained at the genetic level are not well understood. Neurotransmitter-related genes DRD4 and SERT have been associated with several behaviors that might play a role in urban adaptations. House swallow superspecies complex that includes Hill swallows (*H. domicola*), Pacific swallows (*H. tahitica*), and Welcome swallows (*H. neoxena*), is an example of urban adapters that have increasingly been observed to be nesting on artificial structures. In this study, the genetic diversity of DRD4 (9.06 kb) and SERT (21.1 kb) genes were assessed in 12 House swallow populations in a wide geographic range from Sri Lanka to Oceanic Southeast Asia, Australia, and Fiji Islands. The proportion of heterozygote sites for each population was significantly higher ($P < 0.01$) in urban populations for both genes. Multi-locus heterozygosity (MLH) did not show similar patterns in the SERT gene, with no significant difference. However, a significant difference could be observed in DRD4 when the Sri Lankan population was excluded from the analysis. The Hill swallow population in Sri Lanka showed extremely low heterozygosity in the DRD4 region compared to the rest of the populations, which was not evident in the SERT region. The Sri Lankan population also had the highest number of private alleles and the highest proportion of minor alleles in both genes. More rural, Queensland, and West Australia populations (for DRD4), and Queensland, West Australia New South Wales, and Tasmania populations (for SERT) showed significantly negative Tajima's D values indicating expansion after a bottleneck or a selective sweep. The Sri Lankan population indicated a population contraction or a balancing selection scenario with a significantly positive Tajima's D value in SERT. Higher genetic diversity in urban populations and negative Tajima's D values in rural populations might suggest a demographic expansion in the lower levels of urbanization gradient with the introduction to anthropogenic resources. However, different patterns of diversity and neutrality estimates in the two genes suggest that they may be impacted by more local evolutionary processes in the genome, like adaptation through a selective sweep or balancing selection, rather than by broader demographic changes in the populations.

Keywords: Animal behavior, Fitness indicators, Local adaptation, Personality genes, Urbanization