Digest: Islands promote population differentiation in dispersive Swallows

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Abstract

How can highly dispersive species give rise to genetically distinct populations? This seemingly paradoxical pattern is common among insular birds, but not in those with continental distributions. Broyles, Myers et al. (2023) sequence the genomes of almost 150 individuals from the island-dwelling Pacific Swallow and its continental counterpart, the Welcome Swallow. They find strong population structure only among island populations, and attribute this to a behavioural reduction in dispersal propensity following island colonisation. However, wing shape remains consistent across populations, suggesting it might not accurately reflect dispersal propensity in this group. This study illustrates the interplay between dispersal, isolation and divergence, offering insights into how geographic factors affect speciation and population differentiation on islands.

Main

Geographic isolation plays a pivotal role in the speciation process by restricting the exchange of genetic material between populations. Diversification rates within continents tend to be slower than in oceanic archipelagos which, thanks to their natural isolation, often become hotspots of biodiversity and evolutionary radiations (Conway and Olsen 2019). The process of speciation on islands is complex, influenced by the interplay between dispersal and isolation. Species with strong dispersal abilities can spread into new islands, which is a necessary step for population differentiation. However, dispersal also promotes gene flow between populations, and this hinders divergence—making speciation less likely to take place. This tug-of-war between dispersal and divergence could be reconciled if dispersal propensity were to be reduced after island colonisation. Such changes might be associated with traits linked to dispersal, like wing shape and pointedness (Dawideit et al. 2009). However birds in newly colonised islands can become reluctant to cross gaps of water before any morphological changes take place, a phenomenon known as 'behavioural flightlessness', which is partly influenced by genetics in other island birds (Estandía et al. 2023). To understand how habitat structure affects speciation, we can compare the genetic structure and gene flow of closely related species in patchy and continuous habitats.

Broyles, Myers et al. (2023) take this approach using six subspecies of the Pacific Swallow (*Hirundo tahitica*) distributed across multiple Southeast Asian islands, Hill Swallows (*H. t. domicola*) from Sri Lanka, and the Tahiti Swallow (*H. t. tahitica*) from the Society Islands, and two subspecies of the Welcome Swallow (*H. neoxena*), which is mainly present in Australia and Aotearoa New Zealand (Fig. 1). The team assembles an impressive dataset that includes whole genome data for almost 150 individuals, along with measurements of a proxy for wing shape known to correlate with dispersal ability, the Hand-Wing Index. With this data in hand, they conducted population structure and demographic analyses. Their findings reveal that island populations exhibit a high degree of structure, whereas continental populations do not.

One potential explanation for this pattern is that if most birds only disperse over short distances, the colonisation of an island would be a rare occurrence, and so would any subsequent arrivals that could lead to mixing. However, the authors did not find as strong a pattern of isolation-by-distance in the continental species. They argue that this, along with the colonisation of distant islands like Fiji and Tahiti, suggests

frequent dispersal over long distances in this clade. Instead, they turn to an alternative explanation for their results: dispersal propensity is largely lost following island colonisation, a hypothesis first proposed by Diamond et al. (1976). Importantly, this change is not reflected in wing morphology—the Hand-Wing Index remains consistent across populations. This underscores that this metric, which shows little variation in swallows due to their highly aerial insectivorous foraging behaviour (Weeks et al. 2022), may not accurately reflect past or present dispersal ability.

This study provides a valuable example of how discontinuous habitats can lead to population differentiation even in groups that typically have a high dispersal tendency. Future research could formalise the expected impact of the interaction between dispersal and geographic structure on population divergence, and examine how other real-world systems align with these expectations. Ultimately, this could help determine the extent to which reductions in dispersal propensity after colonization are necessary to explain diversification in islands.

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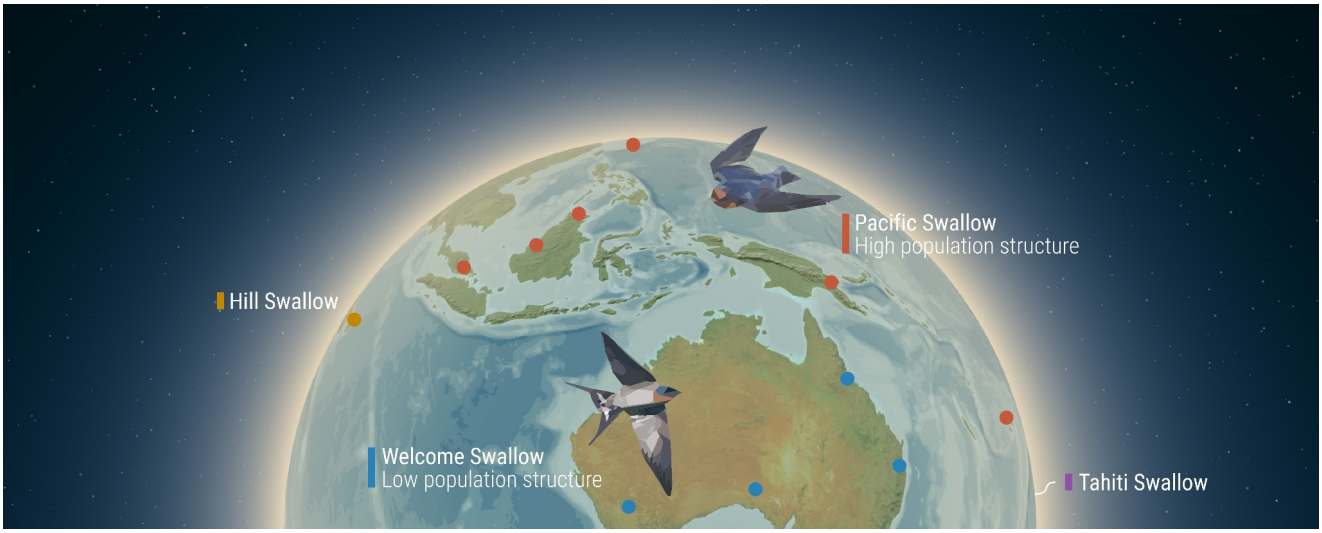

Figure 1 | Map of the region and samples in the study.
Adapted from Broyles, Myers et al. (2023). The Pacific Swallow (*Hirundo tahitica*), in red, is distributed across multiple Southeast Asian islands. In yellow, Hill Swallows (*H. t. domicola*) from Sri Lanka, and Tahiti Swallow (*H. t. tahitica*) from the Society Islands in purple. Samples from two subspecies of the Welcome Swallow (*H. neoxena*) are shown in blue (Tasmanian population not shown).