Human-driven extinctions have erased the evolutionary history of flightlessness in island birds

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Abstract

While being able to fly is one of the most distinctive traits of birds, several lineages have lost this ability in some environments, such as oceanic islands. If we only consider extant species, the evolution of flightlessness appears to be extremely rare, occurring in only 38 out of more than 8500 species of terrestrial birds. However, these patterns might be biased by anthropogenic impacts, especially by human-caused extinctions on islands. Oceanic islands are peculiar for two reasons, when compared to larger landmasses. First, this is where we expect species to evolve towards flightless forms, due to the general lack of predation. Secondly, islands have the highest proportion of extinctions – up to 90% of recent vertebrate extinctions, according to IUCN. Since flightless birds are particularly vulnerable to new predators, we expect such species to be disproportionately represented amongst extinctions, making it difficult to understand how this trait has evolved if only focusing in extant species. In this study, we aimed to infer the evolutionary history of flightlessness in island colonizing lineages, by reconstructing the community of island birds worldwide before human disturbance. We compiled an exhaustive list of bird species that are known to have occurred on islands but have gone extinct since human arrival, totaling 472 species from 68 families. For those with sufficient morphological data, we estimated flight ability based on wing to hindlimb ratios. We accordingly classified 149 species as flightless or weak-flyers. These species quadruple the list of known flightless birds compared to extant species, and more than double the number of families with flightless representatives (from 11 to 27 known families). If we consider each flightless genus within an archipelago as

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an independent colonization by a flying ancestor, our data suggest that flightlessness could have evolved at least 100 times in the evolutionary history of birds, which is likely still to be an underestimate considering that the fossil record is highly incomplete. These findings highlight that humans, through non-random extinctions, have dramatically influenced the diversity and distribution of species and their traits, which must be taken into account when trying to understand natural macroevolutionary patterns.

Keywords: Birds, Flightlessness, Extinctions, Anthropogenic biases