Why every island's wildlife ends up looking alike

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Credit: Ella Ragasa from Pexels

Located to the east of Madagascar, the bountiful, volcanic French island of Réunion has sometimes been called a sister to Hawaiian volcanoes because of the similarity in their climate and geographical nature. Those familiar with its seemingly pristine vegetation may be surprised to find out that half of the plants there were introduced by humans, even though they arrived on the island in the 16th century. So how and why did some

species arrive and not others?

Those are the questions that a team of five scientists from the University of Paris Saclay, China's Ocean University and the Institute for Biodiversity Research in Berlin have set out to answer. Humans have long ferried species around the world, prompting scientists to wonder about the impacts of these movements. The United Nations' scientific body tasked with studying biodiversity, IPBES, have situated the global number of non-native species to hover around 37,000. Every year, an estimated 200 species enter new territories, prompting 1,215 local species to go extinct.

Humans are the first cause of the introduction of non-native species throughout the living world, whether they crawl, climb, swim or fly. Indeed, perhaps counter-intuitively, we have played a decisive role in shaping island bird communities. While native species have taken millions of years to adapt to these islands' very specific climatic, geological and environmental constraints, our arrival has drastically disrupted these communities within a few hundred years alone, both at ecological and genealogical levels.

But what are the factors that explain why some islands are home to more non-native species than others?

Biodiversity on islands: A subject that has been raised since Darwin

The question of island biodiversity has been on scientists' minds since Darwin.

In 1957, the American biologists Robert H. McArthur and Edward O. Wilson sought to understand the distribution of native species on islands,

a science now known as biogeography. Meticulous study of the species present on different islands led them to make a number of observations: the islands furthest from the continents had the fewest species; the largest islands, on the other hand, had the most.

The two biologists thus formulated two mathematical laws to explain the greater or lesser diversity of species living on islands. These two laws formed the basis of the dynamic equilibrium theory of island biogeography: the larger the island, the more species it can support (the area-species law); the further the island is from the mainland, the less species diversity there is (the isolation-diversity relationship).

When humans mess up biogeography laws

But what the two men had no idea of at the time was how, in barely sixty years, humans were going to force scientists to rethink biogeographical laws. This is what scientific research has been trying to get its head around for some years now, with our latest study representing yet another contribution in this area. We were specifically interested in studying birds, which account for more than 10,000 species worldwide, nearly a hundred of which have already disappeared, mainly due to the introduction of non-native species. This is the case, for example, of the Socorro dove, which was endemic to a handful of Mexican islands and has now disappeared in the wild due to cat predation.

Working on birds is particularly fascinating because they are one of the best-studied animal groups on Earth, benefiting from a vast data collection on their habitats, feeding habits, or even the size of their beaks or wings. This wealth of information makes them a valuable group to understand the relationship between humans and non-native species.

By studying this group, we were able to demonstrate that tourism, sea and air freight, the development of urban areas and agriculture, and

human population density all play a key role in the diversity of non-native birds on islands, even before biogeographical factors.

The critical question of airports

The islands of the Hawaiian archipelago are more than 3,000 km from the mainland. Yet, because of their large number of ports and airports, they are very well connected to it and exposed to mass tourism. They also now contain several dozen species of non-native birds.

In contrast, the Cape Verde islands to the west of Senegal are only 650 km from the mainland coast, but have a smaller human population and fewer transport infrastructures. The number of non-native birds on these islands is less than five species.

Another worrying phenomenon is that humans not only bring species to places where nature would not have placed them, they also carefully select certain families of species whose characteristics are of interest to them. Introduced birds tend to be herbivores that feed on the ground and aren't very fussy about where to live, since they can survive in a wide range of habitats and are even more inclined to live in disturbed habitats. Over time, all non-native bird species become increasingly similar, in their feeding habits, habitat or general lifestyle.

Invasive species that follow one another and look alike

The non-native birds introduced to the islands are also more closely related than would be expected in the absence of humans. Indeed we know humans select the species introduced (whether voluntarily or not), and that they tend to belong to the same family or closely related families that tend to resemble each other, as in the case of the

Gallinaceae family (such as hens, turkeys and pheasants), which originated in Asia, Africa or America but were spread to the islands by European settlers who transported domesticated populations for food or hunting.

Nowadays, these species have reverted to wild populations on many of the world's islands, wreaking havoc on local communities. These species share common ecological characteristics, such as high body mass or a general diet, and the different populations introduced across the world's islands are leading to increasingly similar communities.

By studying the spatial distribution of non-native birds, we have been able to highlight hotspots of non-native diversity, i.e. places where many species have been introduced and established in large numbers compared with other regions. Some islands, such as Hawaii, New Zealand and Reunion Island, contain large numbers of non-native birds, with a variety of characteristics and families that have been introduced. In contrast, the islands of the North Atlantic, the Seychelles in the Indian Ocean and the large islands of Indonesia and Papua New Guinea have lower numbers of non-native birds. However, these birds still have distinctive profiles, including traits that have been primarily selected to benefit humans.

A definite threat to island resilience in the face of change

All of this paints a very worrying picture for island biodiversity, and that's without mentioning threats beyond biological invasions.

We already know that invasions are the leading cause of extinction in islands. Added to this is the selection of introduced species, which has a direct impact on new bird communities. We are also witnessing a form of homogenization on the islands: if all the species that are transported,

introduced and then become established have the same characteristics, then the communities on the islands, even if they are geographically very distant, will end up looking very similar.

Over and above the aesthetic concerns about the possibility of having bird communities that look more and more alike in tropical islands, the lack of diversity considerably reduces the possibilities for these species to adapt to global changes, such as climate change, habitat loss, pollution and over-exploitation. Bird communities that are increasingly similar through extinctions on the one hand, and the introduction of invasive species on the other, pose a serious problem for the future of biodiversity and its resilience in the face of these increasingly present global changes.

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