Response to Comment on “Avian Extinction and Mammalian Introductions on Oceanic Islands”

We previously reported a positive correlation between the number of mammalian predator species established by Europeans on 220 islands and the extinction probability of bird species on those islands after European arrival (1). We argued that this suggests that introduced mammalian predators have been an important cause of avian extinctions on islands across the world. In establishing this correlation, we carefully controlled for other potentially confounding factors, including biogeographic features of islands (such as area and isolation) and time since human colonization. In particular, we showed that, although the number of introduced mammal predator species is correlated with extinction probability, the numbers of introduced mammal herbivores and introduced bird species are not. This argues against a spurious correlation due simply to more extensive habitat modification leading to both more native extinction and more exotic species establishment (1).

Didham et al. (2) argue that we focused on a single-factor explanation and failed to consider other causes of extinction, notably habitat loss, that may correlate with the number of introduced predator species across islands, thus leaving open the question of causality. We certainly do not argue that extinctions are caused by a single factor; there is considerable unexplained variation in our data, and our other work has shown that, in addition to predation, factors such as habitat loss are important (3). Furthermore, we show that the number of introduced predator species fails independently to explain variation in the current levels of threat faced by island bird assemblages, so that other factors must be important (1). Nevertheless, our analyses do strongly suggest that mammal predators have played a major role in post-European avian extinctions on islands across the world. In this, they generalize the results of many studies linking the decline and extinction of birds on oceanic islands to the impact of exotic predators (4–7).

As Didham et al. (2) observe, habitat loss data are not readily available for all islands in our data set, which is why we used other approaches to account for such confounding factors. However, a study published at the same time as ours (8) includes data on the extent of pre-European forest loss and replacement by exotic cover for a small subset of the islands we studied, and Didham et al. use these data to argue that rates of avian extinction, mammalian introduction, and forest modification are confounded. There are correlations in these data, but they do not support the point that Didham et al. wish to make.

Our study (1) was restricted to an analysis of post-European (historic) introductions and extinctions. (We noted that our findings held when we included the available data for pre-European introductions and extinctions, but this result must be regarded as provisional, given the incomplete and much less reliable pre-European record.) The habitat data that Didham et al. use (8) records the extent of pre-European forest modification, which they correlate with the total (pre- and post-European) proportion of avian extinctions [figure 1A in (2)] and the number of post-European introduced mammal species [figure 1B in (2)] across islands. It is unclear what these comparisons mean, given that they mix events in different time periods. Pre-European deforestation typically pre-dates European arrival and the subsequent wave of European-induced extinctions by several hundred years, as in New Zealand (9). This may explain why Didham et al. do not find a significant correlation between the extent of deforestation (pre-European) and the number of introduced mammal species (post-European) (2), a correlation we would expect if habitat loss, extinction, and mammalian introductions were confounded.

What Didham et al. do report is a strong negative correlation between the number of introduced mammal species and an index of forest replacement (2): Islands that have suffered greater habitat modification through forest replacement by exotic cover have fewer introduced mammal species. This result contradicts the argument that greater habitat conversion leads both to more introduced species and to more extinctions. The trend for introductions is in the wrong direction, unless we argue that more exotic cover equates to less habitat modification.

Didham et al. use New Zealand as an example to support their arguments, noting that the probability of avian extinction in this archipelago is consistent with that expected on the basis of habitat loss. We have concerns with this analysis, but here simply note that Brooks et al. (10) performed identical analyses on data from New Zealand (and other areas) with quite different conclusions: “For birds, the extent of habitat loss only significantly underestimates threat [including extinction] in two hotspots: New Zealand and Polynesia-Micronesia,” because “Oceanic islands have suffered massive recent extinctions due to the naivete of their species” (10). The New Zealand avifauna is perhaps unique in that it suffered heavily from extinction following human colonization, but its composition has been reconstructed more or less in its entirety by extensive and exemplary paleontology (11). This work has allowed predictions to be tested about which characteristics should make species vulnerable to different extinction drivers. In all cases, the species that became extinct are predominantly those predicted to be vulnerable to introduced predators (including Homo sapiens) (6, 7, 12).

An analysis that incorporates both habitat loss and introduced predators as predictors of island bird extinction would certainly be worthwhile. As Didham et al. note, both factors currently threaten extant species. Meanwhile, conservation agencies in New Zealand are struggling to save tiny populations of native birds on predator-free islands and behind expensive predator-proof fences, while vast areas of native forest harbor introduced mammal predators but are largely empty of native birds. We maintain that current evidence points most strongly to the importance of exotic mammalian predators in driving island bird extinctions following European colonization, albeit not to this driver alone.

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References

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