

# Invasive species are a leading cause of animal extinctions

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In a recent Opinion article in *TREE* [1], Gurevitch and Padilla concluded that the importance of invasive species in causing declines and extinctions of species is unproven. They analyzed the IUCN Red List database [2] and stated that only 6% of the taxa are threatened with extinction as a result of invasion by alien species and <2% (ten terrestrial plants and no animal species) of the 762 extinctions were the result of the introduction of alien species. We believe that these figures and the message of the article are misleading.

The IUCN database includes a searchable hierarchical classification of threats to wildlife (e.g. habitat loss, invasive alien species, harvesting, and so on), which was used by Gurevitch and Padilla in their article [1]. However, this classification system is used in only 5.1% (39 out of 762) of the extinct species (e.g. there are 129 extinct species of birds, but none of them has been assigned an extinction cause, despite the fact that many are among the best documented cases of extinction) and detailed information about the causes of extinction is provided in other fields of the database (e.g. the robust white-eye *Zosterops strenuus*, endemic to Lord Howe Island, Australia, 'was common before 1918, but plummeted to extinction following the arrival of black rat'). We reanalyzed the extinctions included in the IUCN Red List database on a species-by-species basis and reassessed the role of invasive species in those extinctions.

The conclusion is radically different from that reached by Gurevitch and Padilla. Of the 680 extinct animal species, causes could be compiled for 170 (25%), of which 91 (54%) included the effects of invasive species. For 34 cases (20%), invasive species were the only cited cause of extinction. Habitat destruction and harvesting (hunting and/or gathering) were cited for 82 and 77 species, respectively.

Our results agree with those of recent statistical analyses [3,4], modelling of future scenarios [5], and

several reviews of particular taxa by expert groups that have concluded that invasive species are the leading cause of extinction of birds (65 out of 129 spp.) [6] and the second cause of the extinction of North American fish (27 out of 40 spp. [7]), world fish (11 out of 23 spp. [8]) and mammals (12 out of 25 spp. [9]). Although extinction is often the end result of invasions, there are other ecological and evolutionary impacts of biotic homogenization that are less understood [10,11], thus prevention and the precautionary principle are of particular relevance to invasive species.

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