Conservation Biology

Contributed Paper

Quantifying the global threat to native birds from predation by non-native birds on small islands

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Abstract: Although invasive non-native species can adversely affect biodiversity in many ways, predation of native species by non-native species on islands can be severely damaging. Results of numerous studies document non-native birds preying on birds on islands, but our understanding of the number and type of species affected has been limited by the lack of a global review of these impacts. I identified the non-native bird species that have been recorded preying on birds, the locations where this predation occurred, and the bird species affected. Because the impacts of non-native birds can be particularly severe on small islands, I then identified the islands <500 km^2 around the world that are occupied by predatory non-native birds. By taking into account their life-history traits and predation history, I also identified the near-threatened and threatened bird species on these islands that they may prey on. The results indicated that predation by non-native birds was primarily a concern for threatened bird conservation on small islands; almost all predation impacts (91%) on near-threatened and threatened birds were recorded on islands, and median island size was 106 km^2. I also found non-native bird predation was a poorly known and widespread potential threat to avian biodiversity; worldwide, 194 islands of <500 km^2 were occupied by predatory non-native birds, but information on their impacts was unavailable for most of these islands. On them, where the impacts of non-native species can be severe, non-native birds may be preying on approximately 6% of the world's near-threatened and threatened bird species. Four non-native bird species I identified have been successfully eradicated from islands. If they were eradicated from the small islands they occupy, 70% of the near-threatened and threatened bird species I identified would no longer be affected by nest predation by non-native birds on small islands.

Keywords: biological invasion, Common Myna, extinction, raptor, seabird, shorebird

Resumen: Aunque las especies invasoras no nativas pueden afectar de muchas maneras adversas a la biodiversidad, la depredación de las especies nativas por especies no nativas en las islas puede ser de un daño muy severo. Los resultados de numerosos estudios documentan la depredación de aves por aves no nativas en islas, pero nuestro conocimiento del número y tipo de especies afectadas ha estado limitado por la falta de revisión mundial de estos impactos. Identifiqué a las especies no nativas de aves que han sido registradas como depredadoras de aves, las localidades en donde ha ocurrido esta depredación y las especies de aves que han sido afectadas. Ya que el impacto de las aves no nativas puede ser particularmente severo en las islas pequeñas, identifiqué a las islas menores a 500 km^2 que cuentan con ocupación de aves depredadoras no nativas en todo el mundo. Cuando consideré las características de la historia de vida y la historia de depredación de estas aves logré identificar también a las especies de aves amenazadas y casi amenazadas presentes en estas islas y que podrían fungir como presa. Los resultados indicaron que la depredación por aves no nativas es un tema primario para la conservación de aves amenazadas en islas pequeñas; que casi todos los impactos por depredación (91%) de aves amenazadas o casi amenazadas fueron registrados en islas y que la mediana del tamaño de las islas fue de 106 km^2. También descubrí que la depredación por aves no nativas es una amenaza potencial poco conocida y ampliamente distribuida para la diversidad aviar; a nivel mundial, 194 islas menores a 500 km^2 presentaron ocupación por aves depredadoras no

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nativas, aunque la información sobre sus impactos no estuviera disponible para la mayoría de estas islas. En estas islas, en donde el impacto de las especies no nativas puede ser grave, las aves no nativas tal vez estén depredando aproximadamente el 6% de las especies de aves amenazadas y casi amenazadas del mundo. De las especies de aves no nativas que identifiqué, cuatro han logrado ser erradicadas exitosamente de las islas que ocuparon. Si lo anterior se lograra con las demás aves no nativas, el 70% de las especies de aves amenazadas y casi amenazadas que identifiqué ya no se encontraría afectado por la depredación de nidos por aves no nativas en islas pequeñas.
Palabras Clave:ave costera, ave marina, extinción, invasión biológica, miná común, rapaz

Introduction

Invasive non-native species are 1 of the 5 main drivers of biodiversity decline worldwide (IPBES 2019); identifying and managing their impacts is a global conservation priority (Convention on Biological Diversity 2020). The Environmental Impact Classification for Alien Taxa (EICAT) (Blackburn et al. 2014), which is the formal International Union for Conservation of Nature (IUCN) metric for quantifying and categorizing the impacts of non-native species, identifies 12 broad mechanisms through which non-native species affect native species. Predation is one of these mechanisms, and measured by native species extinctions, possibly the most damaging (Doherty et al. 2016).

At least 15 bird species that are known to prey on birds have been introduced to islands (Long 1981; Lever 2005). Some were introduced to control pests (e.g., the Common Myna [*Acridotheres tristis*] on the Cook Islands [McCormack 2005]), some to be kept as pets (e.g., the American Crow [*Corvus brachyrhynchos*] on Bermuda [Wingate 1975]); and others for conservation purposes (e.g., the Weka [*Gallirallus australis*], a threatened species translocated to New Zealand's nearshore islands [Beauchamp et al. 1999]). Many threatened native bird species are restricted to islands (BirdLife International 2017). An unintended consequence of these non-native bird introductions is the predation of threatened birds (Evans et al. 2016).

Non-native species can have severe impacts on islands (Bellard et al. 2017), including predatory non-native birds. For example, predation by the Great Horned Owl (*Bubo virginianus*) is believed to have caused the Marquesas Kingfisher's (*Todiramphus godeffroyi*) extirpation on Hiva Oa (Autai et al. 2012). However, negative effects on birds caused by non-native birds tend to be particularly severe on small islands (Evans et al. 2021; Appendix S1). Indeed, extinction rates for island birds increase with decreasing island size (Valente et al. 2020).

Information on the environmental impacts of non-native birds is unavailable for 187 (76%) of the 247 regions of the world that they occupy, and of the regions that lack impact data, 87 (47%) are islands (Evans & Blackburn 2020). Non-native species research tends to focus on species that are perceived to have the most severe impacts (Pyšek et al. 2008). However, the availability of data on the impacts of non-native birds across the regions that they occupy is not associated with the severity of these impacts; rather, it is positively associated with human development, non-native bird species richness, and non-native bird residence time (Evans & Blackburn 2020). Therefore, one cannot assume that regions lacking impact data do so because the impacts sustained within them are less severe. It is possible that damaging predation impacts are being overlooked on islands.

Although many studies describe predation of birds by non-native birds on islands (e.g., Raine et al. 2019), a review of the global distribution of predatory non-native birds and their impacts on native birds on islands has yet to be undertaken. Yet, such a review may reveal the islands where predatory non-native birds have damaging impacts on native birds, the islands where predation impacts may be going unnoticed, and the threatened bird species that may be affected. This information may inform conservation interventions to protect birds (e.g., the nest box program reducing American Crow predation of White-tailed Tropicbirds [*Phaethon lepturus catsbyii*] on Bermuda [Madeiros 2011]). Given the continued deterioration in the status of the world's bird species (at least 40% of which have declining populations, and 1 in 8 are globally threatened with extinction [BirdLife International 2018]), this may be of benefit to conservation science.

Here, I identified the non-native bird species that have been recorded preying on birds, the locations where this predation occurred (mainland and island locations), and the number and type of bird species affected. Because native birds are more vulnerable to the impacts of non-native birds on small islands, I also identified the small islands around the world that are occupied by predatory non-native birds, and the near-threatened and threatened bird species on these islands that they may be preying on. I then tested whether the distribution of recorded and potential predation impacts varies across orders of bird species that sustain impacts; orders of non-native bird species that cause impacts; and geographic regions. By identifying such variation, I aimed to improve our understanding of the nature of these impacts and to identify knowledge gaps that may inform future research.

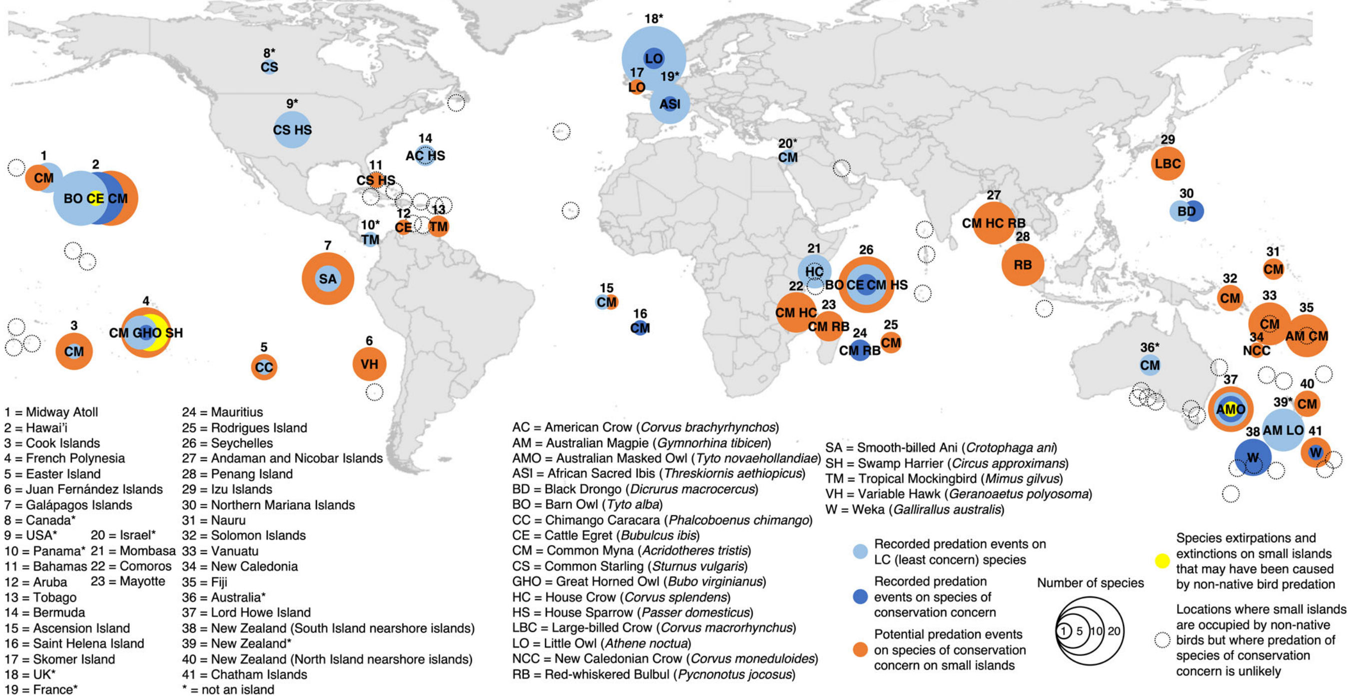

Figure 1. The global distribution of recorded and potential predation events on birds caused by non-native birds.

Methods

Recorded and Potential Predation Events

I undertook a literature review to identify information describing predation of birds by non-native birds (see Appendix S1 for details). From the literature obtained, I created a schedule of recorded predation events, including the non-native bird species that have been recorded preying on birds and the bird species that they prey on (Appendix S5). I defined a recorded predation event as an interaction between a non-native bird species and another bird species at a given location that resulted in at least 1 documented instance of predation.

I undertook a second literature review (see Appendix S1 for details) to identify the presence of non-native bird species on islands <500 km^2 (hereafter small islands). I reviewed the predation history (if any) of these non-native bird species, creating a schedule of the small islands occupied by non-native birds that have been recorded preying on other birds (in either their native or non-native range) (Appendix S6).

I then identified the near-threatened (NT), vulnerable (VU), endangered (EN), and critically endangered (CR) native bird species that may be preyed on by these non-native birds on small islands (grouped together, these NT, VU, EN, and CR native bird species are hereafter referred to as species of conservation concern). I collated data on the relevant life-history traits of each predatory non-native bird species occupying a small island, along with its predation history, to determine the likelihood of it preying on each bird species of conservation concern present on that island (Appendix S3).

I then calculated the number of potential predation events occurring on small islands, including the non-native bird species that may prey on birds, and the bird species of conservation concern that they may prey on (Appendix S5). I defined a potential predation event as a potential interaction between a predatory non-native bird species and a bird species of conservation concern on a small island that may result in predation. I also calculated the number of native bird species extirpations and extinctions that have occurred on small islands that may have been caused by non-native bird predation (Appendix S5).

Analyses

I carried out my analyses in R (version 3.5.3) (R Core Team 2019). I used contingency table tests (chi-squared tests in the FunChisq package [Zhong & Song 2019]) to examine the distribution of recorded and potential predation events across bird orders sustaining impacts, non-native bird orders causing impacts, and island locations (see Appendix S2 for details).

I produced Fig. 1 in R (version 3.5.3) (R Core Team 2019) with the Natural Earth mapping data set

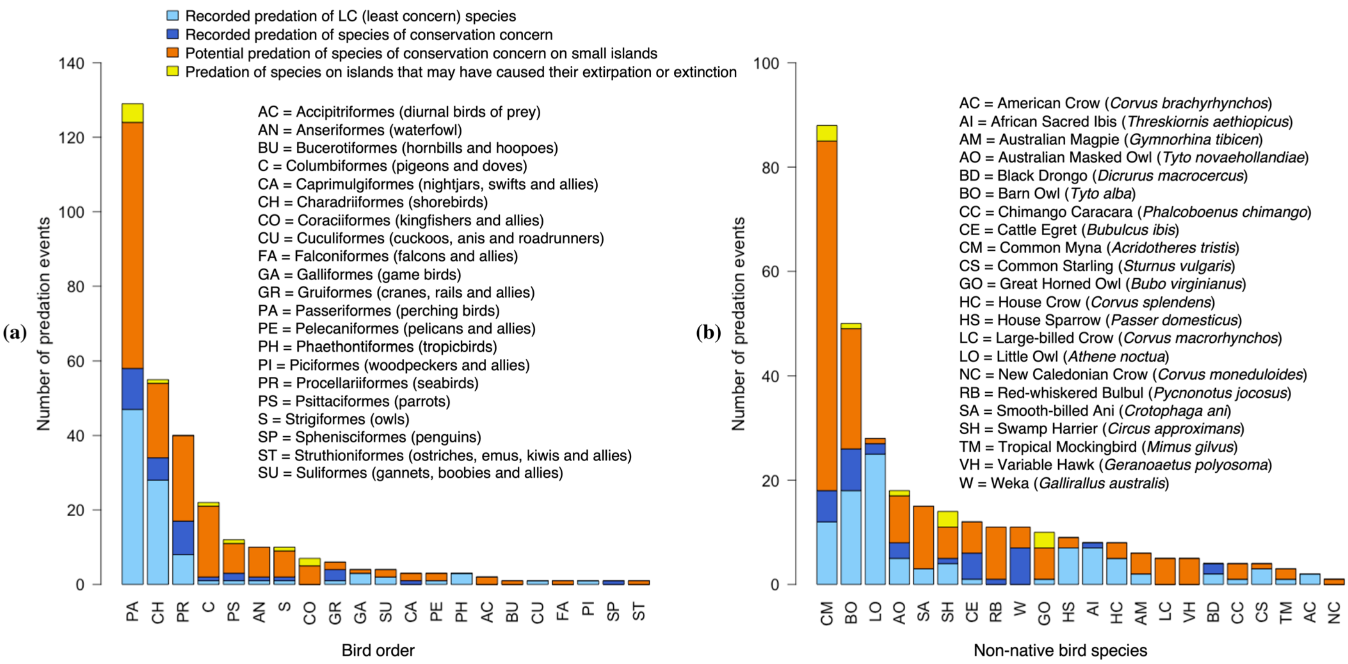

Figure 2. The number of recorded and potential predation events that are (a) sustained by birds from each of 21 orders and (b) caused by each of 22 non-native bird species. A predation event is an interaction between a non-native bird species and another bird species at a given location that results in at least 1 recorded or potential instance of predation. Predation of a specific bird species by the same non-native bird species on more than 1 island in an island group is 1 predation event.

(1:10 m cultural vectors [http://www.naturalearthdata.com/downloads/10m-cultural-vectors]) and the following packages: sp (Bivand et al. 2013), rgeos (Bivand & Rundel 2017), rgdal (Bivand et al. 2017), raster (Hijmans 2016), and maptools (Bivand & Lewin-Koh 2017).

Results

Recorded Predation Events

The literature review identified 145 documents describing recorded predation events (Appendix S5). Predation events were recorded at 24 locations (Fig. 1). Sixteen (67%) of these locations were islands, and their median size was 106 km^2. Recorded predation events were sustained by 108 bird species; 33 (31%) were species of conservation concern (Appendix S5). Some species sustained recorded predation events at more than 1 location; there were 134 recorded predation events to these 108 species.

Approximately 91% of the 35 predation events on species of conservation concern were recorded on islands. At mainland locations, 3 predation events involving NT species were recorded. All other recorded predation events at mainland locations involved species of least concern (LC). No association was found regarding recorded predation events to species of conservation concern across islands of the Atlantic, Indian, and Pacific Oceans (given the number of possible interactions on islands with recorded impacts between non-native bird species and species of conservation concern) ($\chi^2 = 3.73$, df $= 2$, $p = 0.13$, estimate $= 0.07$) (see Appendix S4 for all contingency table test results). Approximately 55% of all island predation events were recorded on islands that had an important bird and biodiversity area (IBA) for which the affected native bird was a trigger species (a species for which the IBA was selected [BirdLife International 2020a]) (Appendix S5).

Approximately 81% of recorded predation events were sustained by species from 3 orders: Charadriiformes (shorebirds), Passeriformes (perching birds), and Procellariiformes (seabirds) (Fig. 2a). No association was found regarding the distribution of recorded predation events to species of conservation concern among different bird orders (given the number of possible interactions on islands with recorded impacts between non-native bird species and species of conservation concern) ($\chi^2 = 0.29$, df $= 3$, $p = 0.96$, estimate $= 0.02$).

Recorded predation events were caused by 19 non-native bird species. The Common Myna had recorded predation events at 9 locations, and the Barn Owl (*Tyto alba*), Cattle Egret (*Bubulcus ibis*), Common Starling (*Sturnus vulgaris*), House Sparrow (*Passer domesticus*), Little Owl (*Athene noctua*), and Weka at 2. The 12 other species had recorded predation events at 1 location each (Fig. 1). The Barn Owl, Common Myna, and

Little Owl together caused 53% of all recorded predation events (Fig. 2b). Approximately 55% of recorded predation events resulted from direct predation; the remainder were caused by nest predation.

Recorded predation events on species of conservation concern were nonrandomly distributed across non-native bird orders ($\chi^2 = 21.55$, df $= 4$, $p < 0.001$, estimate $= 0.13$). In particular, more predation events were caused by raptors (birds of prey) and fewer were caused by Passeriformes (perching birds) than would be expected by chance (given the number of possible interactions on islands with recorded impacts between non-native bird species from these orders and species of conservation concern).

Potential Predation Events on Small Islands

Non-native birds that have been recorded preying on birds occupied 194 small islands (Appendix S6). Potential predation events to species of conservation concern may be occurring on 78 (40%) of these islands. Some are single islands, whereas others are part of an island group. These islands are distributed across 27 widespread locations (Fig. 1). On the other 116 islands, interactions between predatory non-native birds and species of conservation concern (and hence predation events) are unlikely (based on documented evidence of predation by these non-native bird species to date). These islands are distributed across 48 widespread locations (Fig. 1).

Potential predation events to species of conservation concern were nonrandomly distributed across small islands of the Atlantic, Indian, and Pacific Oceans and Caribbean Sea ($\chi^2 = 23.84$, df $= 3$, $p < 0.001$, estimate $= 0.09$). In particular, there were fewer potential predation events on small islands of the Caribbean Sea and Atlantic Ocean than would be expected by chance (given the number of possible interactions on these small islands between non-native bird species and species of conservation concern). On 109 of the 116 islands where potential predation events were unlikely (94% of these islands), the only predatory non-native bird species present were Passeriformes (perching birds). Indeed, on 67% of these 116 islands, the only predatory non-native bird species present were the Common Starling or the House Sparrow (perching bird species) or both.

There were 129 species of conservation concern on small islands that may sustain predation events (Appendix S5). Some species of conservation concern may sustain predation events from more than 1 non-native bird and at more than 1 location; there were 171 potential predation events on these 128 species. Almost all potential predation events (94%) were on species from orders affected by recorded predation events (Fig. 2a). The 3 orders sustaining over 80% of recorded predation events (Charadriiformes [shorebirds], Passeriformes [perching birds], and Procellariiformes [seabirds]) sustained 64% of all potential predation events.

Potential predation events on species of conservation concern were nonrandomly distributed across bird orders ($\chi^2 = 113.15$, df $= 7$, $p < 0.001$, estimate $= 0.14$). In particular, more Passeriformes (perching birds) and Columbiformes (pigeons and doves) and fewer Charadriiformes (shorebirds) sustained potential predation events than would be expected by chance (given the number of possible interactions on small islands between non-native bird species and species of conservation concern from these orders). Almost half of all potential predation events (47%) were on trigger species for IBAs on the affected island (Appendix S5).

Potential predation events were caused by 22 non-native bird species (Fig. 2b) (approximately 5% of the 415 non-native bird species known to have self-sustaining populations worldwide). The Common Myna was associated with potential predation events on the most islands and on the most species (43 islands, 65 species, and 14 orders), followed by the Barn Owl (19 islands, 22 species, and 11 orders). Ten non-native bird species were associated with potential predation events on 1 island each.

Potential predation events on species of conservation concern were nonrandomly distributed across non-native bird orders ($\chi^2 = 99$, df $= 4$, $p < 0.001$, estimate $= 0.17$). In particular, more potential predation events were caused by raptors and Cuculiformes (cuckoos and allies) and fewer were caused by Passeriformes than would be expected by chance (given the number of possible interactions on small islands between non-native bird species from these orders and species of conservation concern).

Species Extirpations and Extinctions on Small Islands

Together, 4 non-native raptors (birds of prey) may have caused the extirpation of 4 bird species from small islands, and the extinction of 4 bird species. The Common Myna was implicated in the extirpation of 1 of these species and the extinction of another 2 (Fig. 2b & Appendix S5). These extirpations and extinctions occurred on French Polynesia, Hawaii, and Lord Howe Island (Fig. 1).

Discussion

The majority of the locations where non-native birds were recorded preying on birds were islands, and their median size was 106 km^2. Almost all predation events on species of conservation concern were recorded on these islands. Just 2 NT species were affected at mainland locations, and all remaining impacts at mainland locations were on LC species (Appendix S5). This suggests that predation by non-native birds is primarily a concern for the conservation of threatened birds on small islands. Non-native birds that have been recorded preying on birds occupied many small islands around the world, but their impacts were recorded on <15% of them. Non-native bird predation is, therefore, a poorly known and widespread potential threat to avian biodiversity. Indeed, on small islands, where the impacts of non-native species can be severe, non-native birds may be preying on approximately 6% of the world's NT and threatened bird species. This may be because on small islands, species richness often varies from what island biogeography would predict (the small island effect [Lomolino & Weiser 2001]). However, the scale and frequency of predation events across these islands is likely to vary. For example, some predatory non-native bird populations may be small, and as a consequence, their impacts may not affect the long-term abundance of threatened bird populations. Furthermore, some predatory non-native birds may occupy islands that support abundant prey species other than birds; thus, they may never, or only occasionally, prey on other birds. However, information on non-native bird population dynamics and feeding preferences on islands is limited (or nonexistent). In the absence of this information, identifying potentially vulnerable species may help to identify predation impacts. Indeed, my results may be used to update the Threatened Island Biodiversity Database (TIBD) (www.islandconservation.org), which has been developed to direct conservation interventions to mitigate the impacts of non-native species (Spatz et al. 2017). Four predatory non-native bird species and more than 20 small island locations I identified are not currently listed in the TIBD.

Research on the impacts of non-native species tends to be carried out in the developed world (Pyšek et al. 2008; Bellard & Jeschke 2015), including for non-native birds (Evans & Blackburn 2020). There are many islands located in less-developed regions that are occupied by non-native birds that prey on other birds, but predation events have yet to be recorded on many of them. They include, for example, islands of the Andaman and Nicobar archipelago, the Comoros, Fiji, and Vanuatu (Fig. 1). It is likely that predation impacts are being overlooked on these islands. For example, the Common Myna, which has been recorded depredating the nests of the Eurasian Scops-owl (*Otus scops*) in Israel (Charter et al. 2016), may be depredating the nests of the Moheli Scops-owl (*Otus moheliensis*) (EN) and the Anjouan Scops-owl (*Otus capnodes*) (EN) on the Comoros; the Seychelles Scops-owl (*Otus insularis*) (EN) on the Seychelles; and the Nicobar Scops-owl (*Otus alius*) (NT) on the Nicobar Islands.

A broad range of bird species (from 16 orders) were associated with recorded predation events (Fig. 2a), perhaps because predatory non-native birds are widely distributed across the globe, where they may prey on many different bird species, and because 12 of the 19 non-native bird species recorded preying on birds are habitat generalists (each occupying 5 or more broad habitat types [Evans et al. 2017]). Habitat generalism is a trait associated with more severe non-native bird impacts (Evans et al. 2018a) and the availability of data describing the impacts of non-native birds (Evans et al. 2018b), most likely because generalism increases the number and type of species that a non-native bird may interact with and hence affect. The broad range of bird species sustaining recorded predation events may also be explained by the fact that some predatory non-native bird species are large-brained relative to their body size. This is a trait associated with ecological flexibility in non-native birds (Sol et al. 2005). When introduced to new environments, large-brained species tend to be better able to adapt in order to exploit available resources. For example, the Barn Owl, Little Owl, and Australian Masked Owl (*Tyto novaehollandiae*) are large-brained relative to body size and are opportunistic predators able to switch prey items depending on their relative availability (Tores et al. 2005; Todd 2012; Chenchouni 2014). Together, these raptors have been recorded preying on 54 bird species from 9 orders. This may be why more recorded and potential predation events are caused by raptors than would be expected by chance (Appendix S4). The Common Myna also displays high levels of ecological flexibility (e.g., Sol et al. 2011; Sol et al. 2012); it has been recorded preying on 16 bird species from 5 orders.

Because ecological flexibility is also linked to higher rates of invasion success among non-native birds (Sol & Lefebvre 2000) and to lower rates of avian mortality (Sol et al. 2007), it is also more likely that these species will establish, spread, and thrive when introduced to new environments. Ecologically flexible, predatory non-native bird species such as these may, therefore, represent a predation threat to other birds wherever they are introduced. Indeed, the Common Myna and 4 raptor species are implicated in native bird species extirpations and extinctions on small islands (Fig. 2b & Appendix S5). The lack of information on the impacts of these species is of concern. For example, on French Polynesia, the Swamp Harrier (*Circus approximans*) has only been recorded preying on 4 LC and 1 NT species, despite occupying several of the Society Islands, and the Great Horned Owl has only been recorded preying on the Red Junglefowl (*Gallus gallus*) on Hiva Oa. Predation events caused by the Swamp Harrier and Great Horned Owl are likely to be going unnoticed on French Polynesia, and together these species may be preying on 9 species of conservation concern. Predation of threatened bird species is also likely to be going unnoticed on the Galápagos Islands. Here, several threatened bird species are vulnerable to predation by the Smooth-billed Ani (*Crotophaga ani*) (the only non-native Cuculiform species in this study), which has more potential predation events on species of conservation concern than would be expected by chance (Appendix S4).

Native Passeriformes (perching birds) and Columbiformes (pigeons and doves) were associated with more potential predation events and native Charadriiformes (shorebirds) with fewer than would be expected by chance (Appendix S4). This result may in part be explained by body size. Small native bird species are more vulnerable to the impacts of non-native birds, particularly predation impacts (Evans et al. 2021), and perching bird species tend to be relatively small. However, this result may also be explained by the distribution of breeding bird species of conservation concern across small islands. Many perching bird and pigeon species breed on islands and are, therefore, vulnerable to both direct predation and nest predation. Conversely, over half of the 14 shorebird species that potentially sustain predation events only overwinter on these small islands; they do not breed on them. Therefore, despite being present on many islands, shorebird species are often not vulnerable to nest predation.

That said, shorebirds did sustain many recorded and potential impacts relative to birds from other orders (Fig. 2a). This is likely to be because islands are important breeding and wintering grounds for many shorebird species (e.g., Birds Australia 2010) and because shorebirds often nest in open areas, where they are susceptible to predation by birds (e.g., nest predation of black-winged stilts [*Himantopus himantopus*] by the African sacred ibis [*Threskiornis aethiopicus*] in western France [Yesou & Clergeau 2005]). Shorebirds are experiencing severe declines globally (e.g., North American Bird Conservation Initiative Canada 2019), and predation by non-native birds may be a contributing factor. Fifteen (15%) of the world's NT and threatened shorebird species are associated with recorded or potential predation events. Islands are also important breeding grounds for Procellariiformes (seabirds) (e.g., Great Barrier Reef Marine Park Authority 1997), which may explain the relatively large number of recorded and potential predation events they sustained in comparison with birds from other orders (Fig. 2a). Seabirds are one of the most threatened vertebrate groups (Dias et al. 2019), and because seabird species tend to be long-lived and to delay the onset of breeding, predation can limit their populations (Roos et al. 2018). Predation by non-native birds may, therefore, be contributing to their plight; 20 (23%) of the world's NT and threatened seabird species are associated with recorded or potential predation events. Passeriformes (perching birds) also sustained many recorded and potential predation events relative to birds from other orders (Fig. 2a), which may reflect the sheer number of species in this order.

On 60% of the islands occupied by predatory non-native birds, species of conservation concern are unlikely to be preyed on (based on documented evidence of predation by these non-native bird species to date). The only predatory non-native bird species occupying over two-thirds of these islands are the Common Starling and the House Sparrow (Appendix S6). These cavity-nesting Passeriform (perching bird) species sometimes destroy the eggs and kill the chicks of other cavity-nesting bird species when competing for nest cavities (e.g., Weisheit & Creighton 1989), but there are no cavity-nesting species of conservation concern on these islands. This is likely to be why fewer potential predation events are caused by perching birds than would be expected by chance (Appendix S4). That said, the Common Starling and House Sparrow were associated with potential predation events on a cavity-nesting species of conservation concern (the Bahama Swallow [*Tachycineta cyaneoviridis*] on the Bahamas). The Common Starling and House Sparrow were the only predatory non-native bird species that occupied many islands in the Caribbean Sea (e.g., the Virgin Islands) and Atlantic Ocean (e.g., the Azores). This may be why there were fewer potential predation events on small islands of the Caribbean and Atlantic than would be expected by chance (Appendix S4).

Non-native birds have been successfully eradicated from several islands (> 10 islands) (Appendix S7). They include large populations of Red-whiskered Bulbuls (*Pycnonotus jocosus*) and Common Mynas (5279 individuals on Assumption Island and 1186 on Denis Island, respectively) (Feare et al. 2017; Bunbury et al. 2019), House Crows (*Corvus splendens*) on Socotra Island (Suliman et al. 2010), and Wekas on New Zealand's offshore Islands (Beauchamp et al. 1999). These eradications are few in number compared with those undertaken for non-native mammals, perhaps because the impacts of non-native mammals tend to be far more damaging than those caused by non-native birds (Holmes et al. 2019). Indeed, non-native mammal eradications on islands have resulted in recolonizations by 88 formally extirpated seabird species (Jones et al. 2016). Nevertheless, these non-native bird eradications demonstrate that the removal of large, established non-native bird populations from islands is possible, including for 2 species that are distributed across several small islands (the Common Myna and Red-whiskered Bulbul). This suggests that it may be possible to eliminate much of the threat posed by predatory non-native birds. For example, by eradicating all small-island populations of the 4 predatory non-native birds species that have been successfully eradicated from other islands to date (the Common Myna, House Crow, Red-whiskered Bulbul, and Weka), 70% of the species of conservation concern I identified would no longer be threatened by non-native bird nest predation on small islands. If the 3 other predatory non-native corvid (crow) species occupying small islands were also eradicated (the Australian Magpie [*Gymnorhina tibicen*], New Caledonian Crow [*Corvus moneduloides*], and Large-billed Crow [*Corvus macrorhynchus*]), this figure would increase to 79%. There are no examples of permanent non-native raptor eradications on islands. However, the proposed eradication of the Australian Masked Owl on Lord Howe Island (Lord Howe Island Board 2016) may provide insights regarding the feasibility of such eradications. On islands where predation by raptors (or other non-native bird species) may threaten the survival of threatened bird species (e.g., potential Common Myna and Swamp Harrier predation of the Moorea reed-warbler [*Acrocephalus longirostris*] [CR] on Moorea) (BirdLife International 2020b; Ornithological Society of Polynesia 2020) and where eradications may be too challenging, predator control at sites known to be important to threatened birds should be considered.

Predation is 1 of the 5 impact mechanisms through which non-native birds may affect other birds (the others are competition, hybridization, disease transmission, and brood parasitism) (Evans et al. 2016). Of these mechanisms, predation impacts are the most frequently reported and the most damaging. Over half of all recorded negative impacts on birds worldwide, including approximately two-thirds of all native bird species extirpations and extinctions, were caused by predation (Evans et al. 2021). Nevertheless, on small islands, native bird species extirpations and extinctions have also resulted from competition and hybridization with non-native birds (Evans et al. 2021). An avenue for future investigation would, therefore, be to identify the small islands supporting non-native birds that may affect native birds through other impact mechanisms, and the threatened bird species that may be affected. Furthermore, non-native birds are also implicated in the extinction of invertebrate species on small islands (e.g., the Bermuda Cicada [*Tibicen bermudiana*]) (Department of Environment & Natural Resources 2020). Understanding of threats faced by invertebrates tends to be poor in comparison with other taxonomic groups (Bland et al. 2015). The identification of threatened invertebrate species vulnerable to predation by non-native birds on islands may, therefore, also be of benefit to conservation science.

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Supporting Information

Additional information is available online in the Supporting Information section at the end of the online article. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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