Conservation Biology

Contributed Paper

When all life counts in conservation

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Abstract: Conservation science involves the collection and analysis of data. These scientific practices emerge from values that shape who and what is counted. Currently, conservation data are filtered through a value system that considers native life the only appropriate subject of conservation concern. We examined how trends in species richness, distribution, and threats change when all wildlife count by adding so-called non-native and feral populations to the International Union for Conservation of Nature Red List and local species richness assessments. We focused on vertebrate populations with founding members taken into and out of Australia by humans (i.e., migrants). We identified 87 immigrant and 47 emigrant vertebrate species. Formal conservation accounts underestimated global ranges by an average of 30% for immigrants and 7% for emigrants; immigrations surpassed extinctions in Australia by 52 species; migrants were disproportionately threatened (33% of immigrants and 29% of emigrants were threatened or decreasing in their native ranges); and incorporating migrant populations into risk assessments reduced global threat statuses for 15 of 18 species. Australian policies defined most immigrants as pests (76%), and conservation was the most commonly stated motivation for targeting these species in killing programs (37% of immigrants). Inclusive biodiversity data open space for dialogue on the ethical and empirical assumptions underlying conservation science.

Keywords: biodiversity, biogeography, conservation ethics, IUCN Red List, nativism, novel ecosystem, rewilding

Cuando Toda la Vida Importa en la Conservación

Resumen: La ciencia de la conservación involucra la recolección y el análisis de datos. Estas prácticas científicas emergen de los valores que forman quién y qué se cuenta. Actualmente, los datos de conservación son filtrados a través de un sistema de valores que considera a la vida nativa como el único sujeto apropiado para el interés de la conservación. Examinamos cómo cambian las tendencias de riqueza de especies, distribución y amenazas cuando se considera a toda la vida silvestre con la adición de las poblaciones denominadas como no nativas y ferales a la Lista Roja de la Unión Internacional para la Conservación de la Naturaleza y a las evaluaciones de riqueza local de especies. Nos enfocamos en las poblaciones de vertebrados que cuentan con miembros fundadores llevados y extraídos de Australia (es decir, migrantes). Identificamos 87 especies inmigrantes de vertebrados y 47 especies

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emigrantes. Los informes formales de conservación subestimaron los rangos globales por un promedio del 30% para las especies inmigrantes y del 7% para las especies emigrantes; las inmigraciones rebasaron las extinciones en Australia por 52 especies; las especies migrantes estuvieron amenazadas de manera desproporcionada (33% de las especies inmigrantes y 29% de las especies emigrantes estaban amenazadas o declinando en sus distribuciones nativas); y la incorporación de las poblaciones migrantes a las evaluaciones de riesgo redujeron el estado mundial de amenaza para 15 de las 18 especies. Las políticas australianas definen a la mayoría de las especies inmigrantes como plagas (76%) y se citó a la conservación como la principal motivación para enfocarse en estas especies durante los programas de erradicación (37% de las especies inmigrantes). La información inclusiva de conservación genera un espacio para el diálogo sobre las suposiciones éticas y empíricas subyacentes en la ciencia de la conservación.

Palabras Clave: biodiversidad, biogeografía, ecosistema novedoso, ética de la conservación, Lista Roja de la UICN, nativismo, reintroducción a la vida silvestre

Introduction

The values driving conservation science have been richly variegated since its inception, as conveyed in different understandings of how, why, and for whom humans should protect nature (Soulé 1985; Callicott 1990; Mace 2014). One perspective that has become widely accepted among conservationists is encapsulated in a worldview called *nativism* (Chew & Hamilton 2011; Wallach et al. 2018a). Nativism attributes intrinsic value to perceived native elements of the more-than-human world, identifying them as worthy targets of moral concern. In this sense, conservation can be seen as an ethically inclusive worldview, moving beyond purely anthropocentric values to also admit certain nonhuman entities within the scope of moral concern. However, nativism also establishes clear exclusions. Constituents deemed not to be native are set firmly outside conservation's moral world (Wallach et al. 2018a). Nativism has been highly influential in guiding conservation research and policy. It even filters the most fundamental empirical information available to conservation: species counts.

Species counts underpin analyses of distribution, population size and trend, biogeographic diversity, and extinction risk. They are, therefore, fundamental to our understanding of, and responses to, the living world. The International Union for Conservation of Nature (IUCN) Red List is the most comprehensive and widely used repository of the conservation status of the world's species. It is used by scientists, governments, and activists to inform regional and global policy (Rodrigues et al. 2006). The stated aim of the red list is to serve as a "complete barometer of life" (IUCN 2018). However, like similar regional data sets, it excludes those that do not conform to some operative notion of nativeness. As a result, non-native populations are effectively expunged from the record before they can even be assessed for their potential relevance to conservation (Schlaepfer 2018). We contend that this is a critical shortcoming.

Despite its influence on conservation science, nativism is a contested concept (e.g., Chew & Hamilton 2011; Srinivasan & Kasturirangan 2017; Pereyra 2019). It is based on assumptions of ecosystems in static equilibrium, which have been challenged by interpretations of ecosystems as dynamic and open-ended (Pickett 2013). It is also based on problematic value judgments about where nonhuman entities belong (Thompson 2014). It is important to ask, independent of these judgments, what might be revealed if biodiversity data sets were fully inclusive? How might our empirical and ethical views be shaped by data sets revealing, for example, that some species with small and decreasing populations inside their native ranges have large and increasing populations outside them; that some domesticated species have established wild populations; and that some regions contain more species today than they have had for thousands of years?

The IUCN Red List is a testament to humanity's commitment to adopt an expansive ethic. For example, it is well recognized that some taxonomic groups (e.g., mammals) receive more research attention than others (e.g., insects), mirroring common moral and biological inclinations (Trimble & Van Aarde 2010). Therefore, the IUCN is increasing efforts to add species to the list from less known taxonomic groups (IUCN 2018) to ensure that their methods align with their scientific mission to be a transparent, consistent, and inclusive source of knowledge (Rodrigues et al. 2006). Each species added to the red list grows not only scientific knowledge, but also the community of organisms included in conservation's moral world. Removing nativist filters to include all life is consistent with this mission.

Studies based on inclusive data sets have found noteworthy trends that differ from those relying on conventional data sets (e.g., McGill et al. 2015; Thomas & Palmer 2015; Lundgren et al. 2018). For example, nativist-filtered data portray Australia as empty of terrestrial megafauna, even though there are 8 species (Lundgren et al. 2018). Postdomestic (so-called feral) species are also not recognized in nativist data sets, although they may have more in common with their predomestic ancestors than with their domestic relatives (e.g., Hernández et al. 1999). Whether populations should be valued differently inside and outside their historic native ranges or whether postdomestic animals should be valued differently from their predomestic ancestors are ethical questions that require deft and deliberate handling. But it is undeniable that these populations are actual components of the living world. Conservation science should reflect that reality.

We examined how inclusive species counts may change conservation metrics, such as species richness, distribution, and threat status. We focused on revealing one component of Earth's wildlife so far excluded from conservation assessments: vertebrate populations whose ancestors were moved by humans into and out of Australia since European establishment. We identified where they were moved from and to; the extent of their distributions outside their historic native ranges; their numeric contributions to species richness; and the policies and actions that affect them.

We used the language of migration rather than invasion to facilitate less divisive discourse (Larson 2005). We acknowledge that *migrant* is still an imperfect metaphor because the individuals in question did not choose to move and their descendants were born there. We used the term *native* to correspond with existing definitions (e.g., IUCN Red List) while acknowledging the concept is problematic (Chew & Hamilton 2011; Pereyra 2019).

Although we believe that every life does and should count, in a moral sense, our primary goal is not to promote a particular worldview or set of values. Our main argument is that species lists that purport to be comprehensive should be as inclusive as possible, so that a broad spectrum of values can be expressed and debated. We hope to open space for transparent dialogue and critical reflection on the value judgments underpinning conservation biology.

Methods

We assessed the taxonomic composition, geographic range, and conservation status of Australia's migrant vertebrate species, including immigrants, defined as populations whose founding members were introduced into Australia, and emigrants, defined as populations whose founding members are considered native to Australia and were introduced elsewhere (from Australia or another part of their native range). Postdomestic animals were defined as migrants across their range, and were merged with their predomestic ancestors for inclusive assessments (Lundgren et al. 2018). Species were only included as migrants if we found evidence of self-sustaining populations (e.g., populations maintained only by reliance on human provisioning and continual introductions were excluded). Populations were considered native where they occurred within their native ranges, as specified on the IUCN Red List (IUCN 2018), and if their ancestors were never domesticated. Vertebrates moved within Australia's political boundaries were also included in the native category.

Migrant lists, their conservation statuses (in their native ranges), and their native and full distributions were sourced from the peer-reviewed literature, online databases, and government sources, including Atlas of Living Australia (ALA 2018), Australian federal and state government sources, eBird Australia (eBird 2018), Fishbase (Froese & Pauly 2018), Global Invasive Species Database (GISD 2018), IUCN Red List (IUCN 2018), and the U.S. Geological Survey (USGS 2018). Lists of extinct natives and conservation statuses of extant natives were sourced from Australia's Environmental Protection and Biodiversity Conservation Act (EPBC 2018) and Chapman (2009). Migrant and native lists were compiled and analyzed at a species level.

Native and migrant ranges for each species were mapped in QGIS 3.2.3. The highest level of detail available was used, which included georeferencing published range maps. We constructed an interactive site for each species' distribution map (https://feralglobe.shinyapps.io/australian_migrants_app/) using the R packages sf (Pebesma 2018), leaflet (Graul 2016), and shiny (Chang et al. 2019). To assess the contribution of migrant ranges to total species distributions, ranges were transformed to the World Behrmann equal-area projection and area was calculated using the R package sf 0.6-3. For species whose geographic range was available only at coarse scales (e.g., at a country level), either in full or in part (31 immigrant species), we estimated their range size by averaging the maximum possible range (100%) with a defined minimum value (10%) (55% of the region's area). We acknowledge that possible inaccuracies in the data have the potential to bias our results (e.g., native populations may be underestimated, whereas migrant populations overestimated).

We calculated the change in Australia's vertebrate richness since European establishment by adding immigrants to extant and extinct native vertebrate lists. We obtained the conservation status and population trends of migrant species in their native ranges from the IUCN Red List (IUCN 2018) and created 3 risk categories: threatened, at risk, and secure. Threatened included species listed as vulnerable, endangered, and critically endangered. At risk, a broader category encompassed those assessed as threatened, as well as those listed as near threatened, and decreasing. Secure was inclusive of species listed as least concern that are stable, increasing, or have unknown population trends. Postdomestic animals whose predomestic ancestors are extinct were included in the threatened category (Lundgren et al. 2018). We then compared the proportion of migrant vertebrates that are threatened with the proportion of Australian and global native vertebrates that are threatened (IUCN 2018).

We determined what the global conservation status of threatened species would likely be if migrant populations and postdomestic animals were included in conservation data. We did this by adding migrant ranges and,

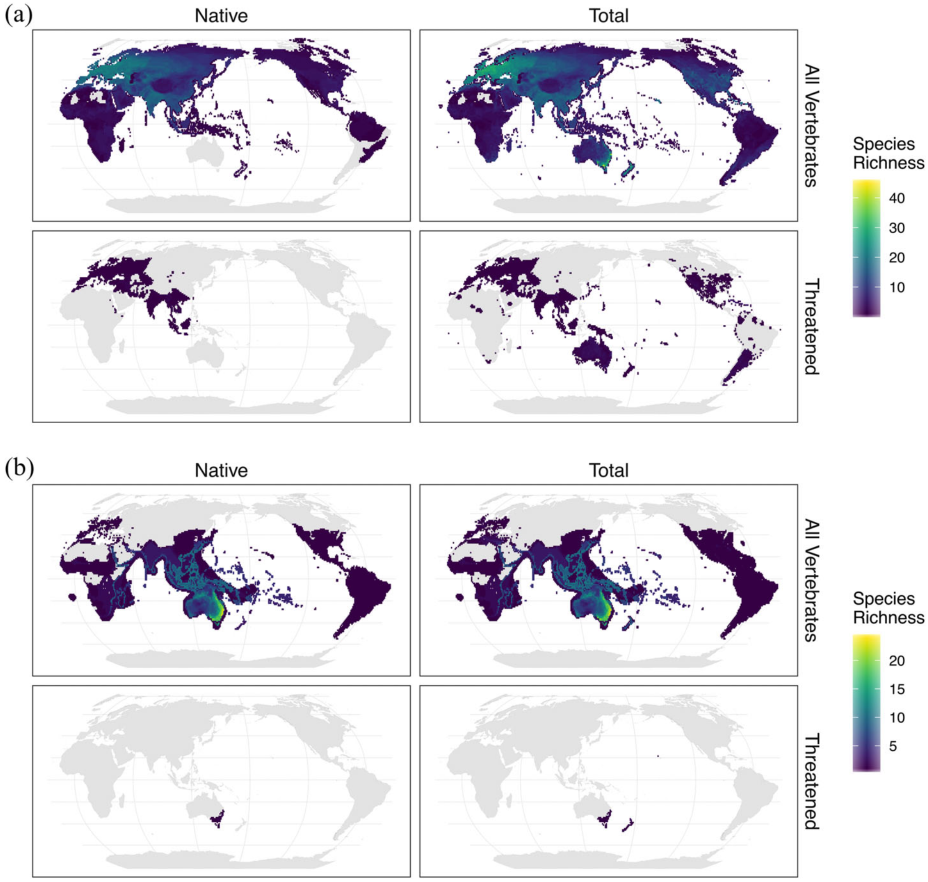

Figure 1. Distribution of Australia's (a) immigrant and (b) emigrant vertebrate species limited to their historic native ranges (left) and expanded to include their migrant ranges (right). Top rows include all migrant species, and bottom rows focus on those threatened in their native ranges. Individual species' distribution maps are available from: https://feralglobe.shinyapps.io/australian_migrants_app/.

where possible, migrant population sizes to their existing listings and followed red-list guidelines (IUCN 2017) to assess which species could be downlisted or delisted.

To assess threats to migrants (outside their native ranges), we compiled information on policy categories and recommendations pertaining to each species. We focused on immigrants to limit the search to a single country. We calculated the proportion of immigrants defined in policy as pests in at least one state or territory (e.g., declared pest in Western Australia and priority pest species in New South Wales) and the proportion subjected to killing programs. We compared this with their threat status in their native ranges. Information on killing programs was sourced from government, nongovernmental organizations, and special-interest websites. We grouped killing programs according to their stated motivations (e.g., conservation, farming, and sport). Data collection ended in September 2018.

Results

Immigrants

We identified 87 immigrant vertebrate species from 20 orders and 37 families (Supporting Information) originating from all continents, apart from Antarctica. They have established across Australia, particularly in the southeast, as well as in New Zealand, North and South America, and the Pacific (Fig. 1a & Supporting Information, https://feralglobe.shinyapps.io/australian_migrants_app/). On average, 30% of immigrants' global distribution was outside their native ranges (Fig. 2), and 11% was in Australia. Immigrant mammals had the largest proportion of their distribution outside their native range (60%) and inside Australia (29%), followed by reptiles (53% migrant range, 4% in Australia), fishes (21% migrant range, 6% in Australia), birds (14% migrant range, 4% in Australia), and amphibians (7% migrant ranges, 5% in Australia) (Fig. 2 & Supporting Information).

The net effect of immigrations and extinctions of natives on Australia's vertebrates was to increase richness by 52 species (0.7%), including increases in fishes (by 35 species, 0.69% of fishes), birds (by 15 species, 1.79%), mammals (by 2 species, 0.49%), and reptiles (by 2 species, 0.22%), but a decrease in amphibians (by 2 species, −0.87%) (Fig. 3a). Overall, immigrants represented 1.2% of Australia's extant vertebrate species richness.

Seventy immigrants were assessed for extinction risk in their native ranges. Of these, 23 (33%) were at risk, including 11 that were threatened, most of which were mammals (Fig. 4a). Most immigrant species that are threatened in their native ranges originated from Eurasia and

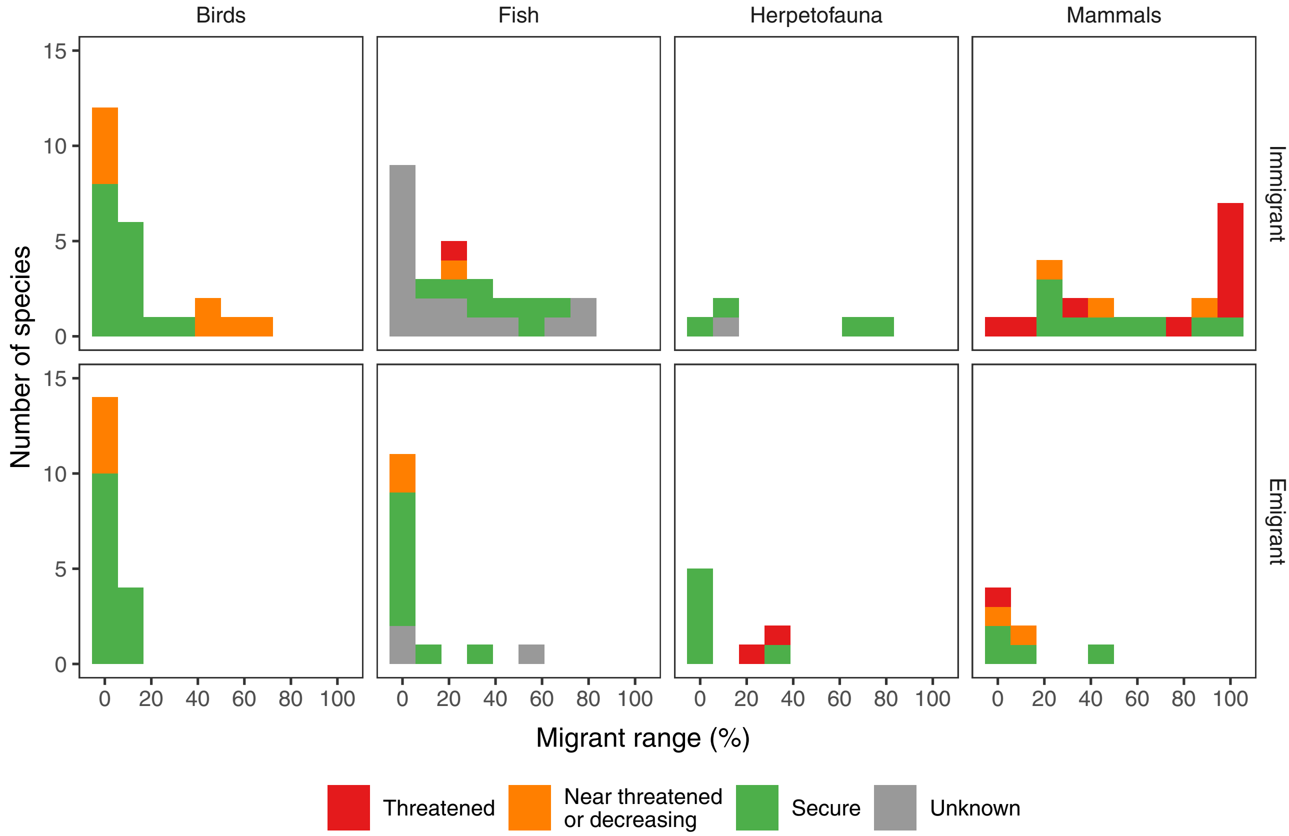

Figure 2. Percent of distribution of Australia's migrant vertebrate species outside their historic native ranges, and their risk status in their native ranges.

established across Australia and on all other continents, apart from Antarctica (Fig. 1a). At a class level, 13 immigrant mammals were at risk in their native ranges (65% of assessed immigrant mammals), including 10 threatened species (50%); 4 birds were at risk (33%); and 2 fishes were at risk (10%), 1 of which was threatened (3%). The 2 reptile and 2 amphibian species assessed in their historic native ranges were secure.

The proportion of threatened immigrants (12.6% of all immigrants) was about 3 times higher than the proportion of natives that were threatened (approximately 4%, 310 of approximately 7500 native vertebrate species) (Fig. 3b). Most threatened immigrants were mammals (10 species, 45% of immigrant mammals), which was over twice the rate of threatened Australian native mammals (74 species, 19% of native mammals) (Fig. 3b) and higher than the global rate (25%, IUCN 2018). If immigrant populations were included in extinction risk assessments, all threatened and near threatened species could be delisted or downlisted (Fig. 5 & Supporting Information).

Policies defined most immigrants as pests (76%), including all mammals, reptiles, and amphibians, and most fishes (69%) and birds (58%). Most immigrants at risk in their native ranges (82%), including all those threatened, were declared pests (Supporting Information). Over half of all immigrants were targeted in killing programs (56%), including all mammals. Conservation was the most commonly stated motivation (37%) (Fig. 6).

Emigrants

We identified 47 emigrants, representing 18 orders and 28 families (Supporting Information). Nearly half (21 species) were once endemic to Australia, and the rest had native ranges that encompassed all continents but Antarctica, as well as 3 oceans. Their distributions expanded across the globe, most notably to New Zealand and the Gulfs of Mexico and Panama (Fig. 1b & Supporting Information). On average, 7% of emigrant species' distributions were outside their native ranges (Fig. 2). Emigrant amphibians had the largest proportion of their distribution outside their native ranges (average 24% migrant range), followed by mammals (9%), fishes (8%), birds (2%), and reptiles (1%) (Fig. 2).

Emigrants represented 0.6% of native Australian vertebrate richness. Emigrant mammals (7 species) represented the highest proportion of their class richness (1.81% of native mammals are emigrants), followed by reptiles (1.76%), fishes (1.69%), amphibians (0.44%), and birds (0.36%).

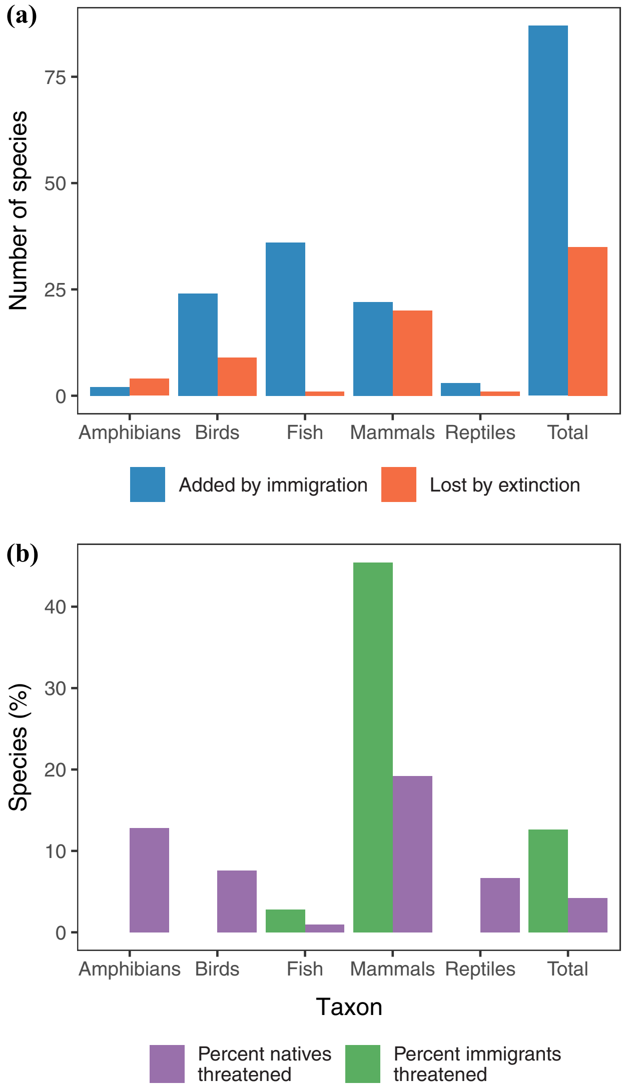

Figure 3. (a) Number of vertebrate species by class added by immigration and lost to extinction in Australia and (b) percentage of Australian immigrant and native species threatened in their native ranges.

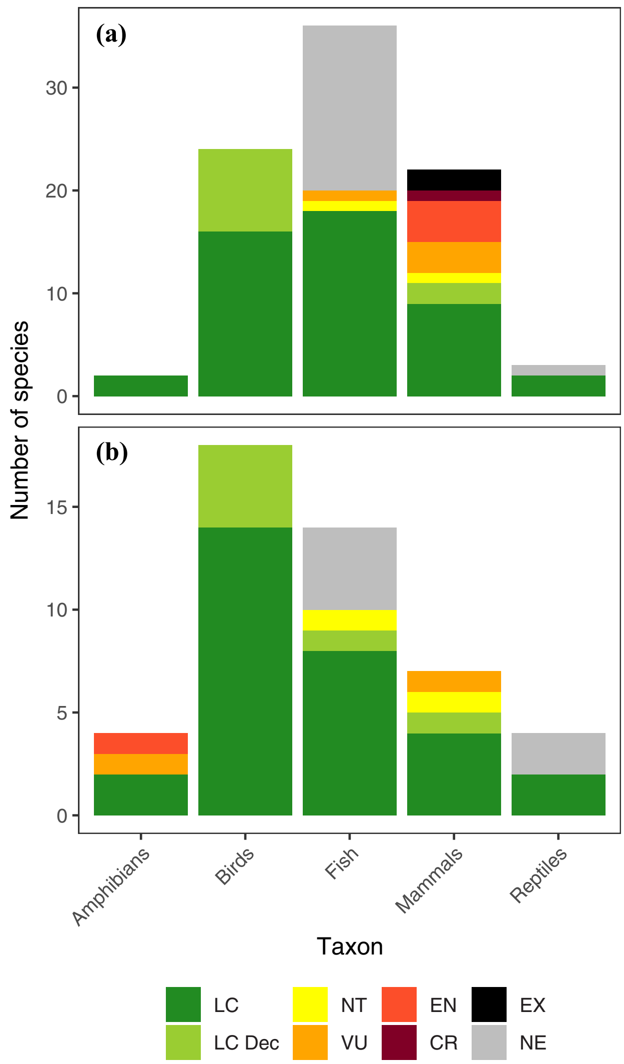

Figure 4. Number of Australia's (a) immigrant and (b) emigrant vertebrate species in 8 threat categories (LC, least concern, population stable, increasing, or unknown; LC Dec, least concern, population decreasing; NT, near threatened; VU, vulnerable; EN, endangered; CR, critically endangered; NE, not evaluated or data deficient [IUCN 2018]; EX, extinct predomestic species).

Of 41 emigrants with conservation status assessments, 12 (29%) were at risk, including 3 (7%) threatened species (Fig. 2b), which was higher than the proportion of threatened nonemigrant vertebrates. The 3 threatened emigrants were all endemic before establishing in New Zealand and Hawaii (Fig. 1b). At a class level, 4 mammals were at risk (57% of assessed emigrant mammals), including 1 threatened species (14%); 4 birds were at risk (22%); 2 fishes were at risk (20%); and 2 reptiles were threatened (7%). If included in formal risk assessments, 2 threatened amphibians could be downlisted (Fig. 5 & Supporting Information).

Discussion

Inclusive conservation data can change our understanding of the living world. Using Australia's migrant vertebrate species as a case study, we found that formal conservation accounts can underestimate species' global distributions; that migrant populations can provide a safeguard for species threatened in their native ranges; and that they can increase local species richness even where extinction rates are high. The implications of these findings for conservation are not self-evident. There are many

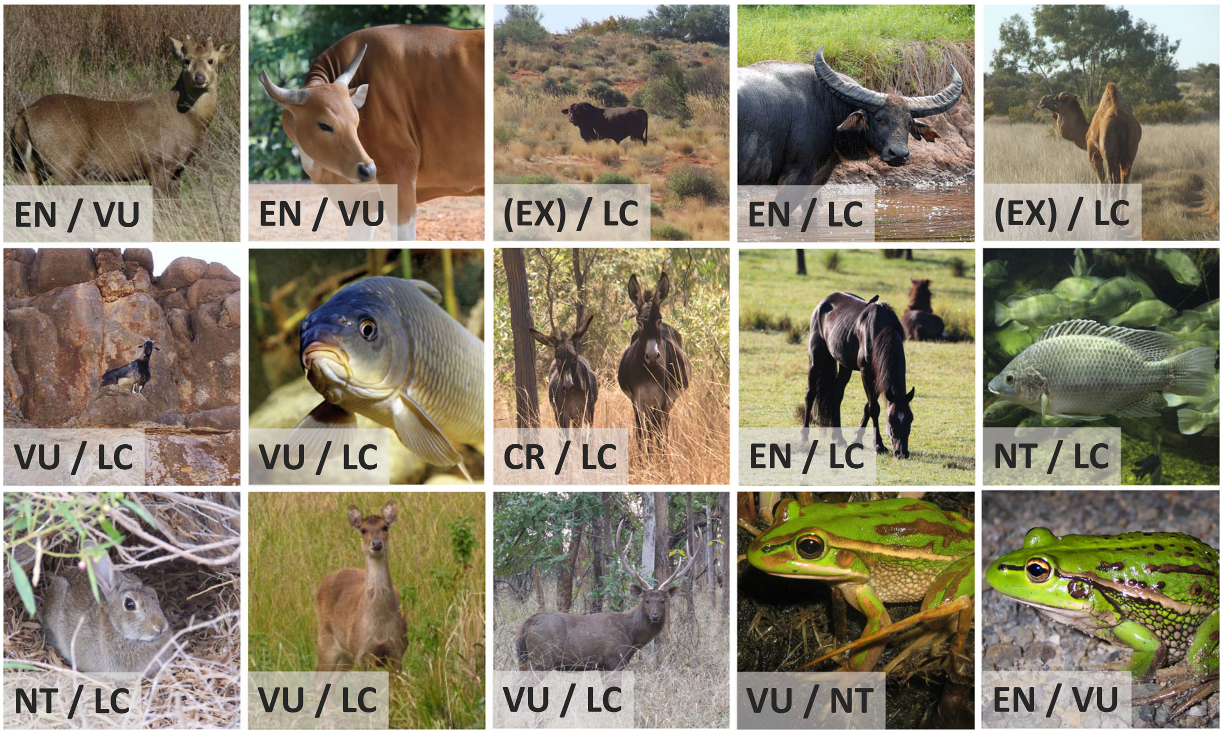

Figure 5. Australia's immigrant and emigrant vertebrate species that could be delisted or downlisted if migrant and postdomestic populations were included in extinction risk assessment. Conservation status for each species are reported first for native ranges and extant predomestic species (IUCN 2018), followed by a reassessment when all populations are included (see Supporting Information for details) (LC, least concern; NT, near threatened; VU, vulnerable; EN, endangered; CE, critically endangered; EX, extinct predomestic species). From left-to-right: top row, immigrants Axis porcinus, Bos javanicus, B. taurus, Bubalus bubalis, Camelus dromedaries; middle row, immigrants Capra hircus, Cyprinus carpio, Equus asinus, E. caballus, Oreochromis mossambicus; bottom row, immigrants Oryctolagus cuniculus, Rusa timorensis, R. unicolor, and emigrants Litoria aurea, L. raniformis. Photos by Wayne Martin, A. pornicus (Atlas of Living Australia); cuatrok77 (Flickr.com, CC BY-SA 2.0), B. javanicus; A.W., B. taurus, C. dromedaries, C. hircus, E. asinus, O. cuniculus, and R. timorensis; Djambalawa (Wikimedia, CC BY 3.0), B. bubalis; IA CRC, C. carpio; Andrea Harvey, E. caballus (used with permission); Greg Hume (Wikimedia, CC BY-SA 3.0), O. mossambicus; LiquidGhoul (Wikimedia, CC BY-SA 3.0), L. aurea; and Tnarg (Wikimedia, CC BY-SA 3.0), L. raniformis.

ways biodiversity is imagined and measured (Kaennel 1998; McGill et al. 2015).

Human-assisted migration is widely considered to reduce beta diversity even if local richness increases (McKinney & Lockwood 1999). We did not explicitly test this, but our results suggest that homogenization rates of Australia's vertebrates are low and that at least in some cases migration contributed to increased beta diversity. Both immigrants and emigrants represented only a small fraction of Australia's vertebrate species richness (approximately 1%). In other words, Australia remains a distinct ecological community. Moreover, while it is a well-documented source of concern that Australia lost 35 endemic vertebrates to extinction (EPBC 2018), that Australia also gained a new endemic species has not been broadly considered: dromedary camels (*Camelus dromedarius*) were extinct in the wild for approximately 5000 years until they established a wild population in Australia (Root-Bernstein & Svenning 2016). Australia also supports over half of the global ranges of 5 additional immigrants, including Javan rusa (*Rusa timorensis*) (89% of their range is in Australia). Such animals, arguably, make Australia more regionally distinct.

Migrants with large global ranges may also become more distinctive over time, eventually even endemic, if they remain isolated for long enough. Indeed, some migrant populations have already come to acquire distinctive traits. For example, approximately 900 migrant European rabbit (*Oryctolagus cuniculus*) populations are isolated (E.L., personal observation), many for hundreds of generations, and some are morphologically distinct. Charles Darwin observed that rabbits introduced to Porto Santo island could have been "ranked as a distinct species" due to their unique size, coloration, and behavior (Darwin 1868). Indeed, similar trait differences are the basis for the categorization of rabbits as subspecies

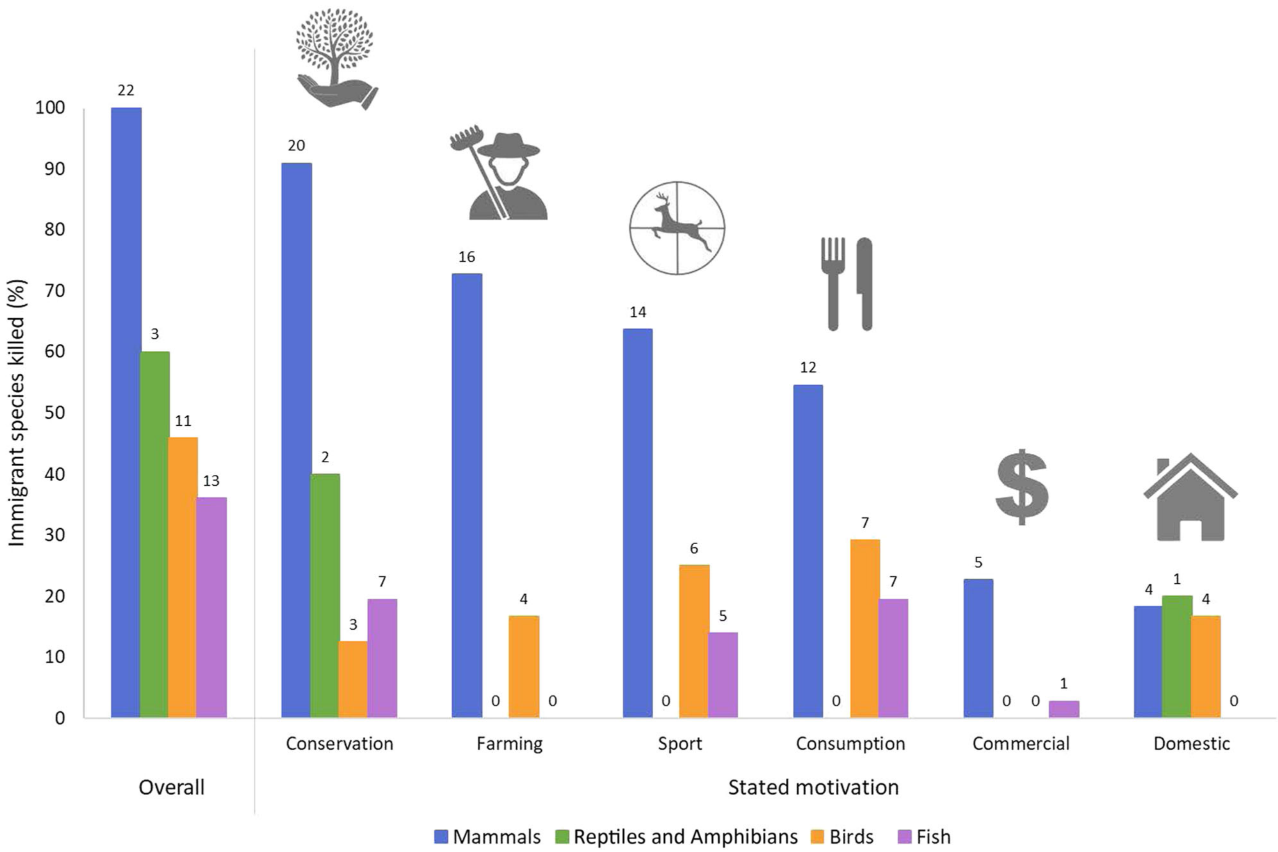

Figure 6. Stated motivations for killing Australia's immigrant vertebrate wildlife shown as percentages of species targeted per class (numbers above bars, absolute number of species targeted).

in their native range (*O. c. cuniculus* and *O. c. algirus*) (Ferreira et al. 2015). Yet nativism does not allow for taxonomic distinction to be contemplated for migrant populations (Chew & Hamilton 2011).

Ultimately, value assumptions determine how processes, such as migration, speciation, and extinction, are interpreted and what actions we believe should follow. Even the concept of species, the fundamental unit being counted in studies such as this, is both biological and social (Hey 2001). But we suggest that our results are at least pliant to the interpretation that migrants have expanded their species' ranges, thereby providing safeguards, particularly for those threatened in their native range. It is only by utilizing more inclusive data sets that one even has an opportunity to recognize this possibility.

Although our intent is primarily to recommend a descriptively inclusive account of life, we would be remiss by failing to mention the normative or ethical aspects of inclusiveness as well. Native populations and organisms are, of course, proper subjects of moral concern, and may be special objects of care where they are endemic, endangered, or of unique cultural value. Such value does not diminish by acknowledging the presence (or the moral standing) of additional lifeforms (Wallach et al. 2018a). Nor does the inclusion of migrants in conservation data negate the need to ask questions about how they influence local ecologies or to debate how policy ought to most ethically deal with conflicts. But value judgments and policy decisions about migrants and their effects need to be made after we have data and in light of values that are made explicit and subjected to critical and transparent ethical analysis (Yanco et al. 2019).

Compared with the time of European colonization, Australia today has 52 more vertebrate species. It is important to be explicit that reporting this number does not equate with a claim that Australia's biodiversity is higher or better today. We are unequivocally not arguing that immigration cancels or diminishes the harms of extinctions. Nor do we believe that it negates the historical wrongs enacted against Australia's original inhabitants and against those forcibly taken to Australia. Our argument here is that these perspectives ought to be debated openly on empirical and ethical grounds and not smuggled into species lists. The meaning one gives a number (e.g., species richness change = 52) depends on the conceptual and ethical lens one applies.

Even the simplest form of assessing biodiversity—species richness—is a potentially complex space for scientific and ethical analysis because it depends, for one, on the spatial and temporal scale at which it is measured

(McGill et al. 2015). Comparing current species richness with a more distant point in time (e.g., to the Pleistocene) may show a negative trend (Lundgren et al. 2018), whereas attempting to predict future trends depends on future extinctions of both natives and immigrants, establishment of new immigrants, and rates of speciation (Thomas 2013). Even a number such as 52 could change depending on which species concept is used (Hey 2001).

Invasion biologists consider most immigrants a leading cause (and potential future cause) of extinction of native species that are vulnerable to rapid ecological changes and incapable of sufficiently rapid adaptation (Sih et al. 2010). This leads them to conclude that it is inappropriate to count migrants and natives together. Alternatively, novel ecosystem scientists posit that the diversity of migrant species reflects a diversity of ecological threats and opportunities (Davis et al. 2011). From this worldview, some may argue for a form of counting based on perceived costs and benefits. Pleistocene rewilding is a worldview that considers current ecological changes and human impacts within longer time frames. Proponents are more likely to consider immigrants as potentials for recovery of ecological functions lost in the more distant past (Lundgren et al. 2018). Yet another ecological and evolutionary perspective considers immigration as a key mechanism of resilience to change (Thomas 2013). Increased vertebrate species richness in Australia could, from this view, be seen as a form of flourishing. Finally, another important perspective is that of the individual migrants themselves, who, being born where they are, would not identify as migrants at all (Celermajer & Wallach 2019).

Changing who and what counts in conservation would also influence conservation practice. One possible policy direction is to stay the course by continuing to attempt to eradicate migrant populations and stop new ones from establishing (Fig. 6). An opposite approach would be to promote migrations, particularly for those threatened in their native range. For example, the Australian Rhino Project's aim to establish rhinoceroses in Australia—to "act as an insurance population should the rhino become extinct in its African homeland" (www.theaustralianrhinoproject.org)—is a contentious one (Hayward 2016). In between these opposing approaches are various options for protecting existing migrant populations (Wallach et al. 2018a); allowing for limited forms of migrations and assisted colonization (Scheffers & Pecl 2019); and stemming the establishment of new migrant populations (Russell et al. 2005).

The current policy direction, as shown in our study, leads conservation to be the most common motivator for killing immigrant vertebrates in Australia. This reflects a belief that further extinctions of endemic wildlife will occur unless immigrants are controlled and eradicated. There are several reasons to question this binary: many migrants are themselves threatened, as our results showed; species richness and diversity is potentially boundless, thus adding one species does not necessitate losing another (Cornell 2013); most migrants do not cause extinctions or have ecological effects that could be clearly defined as "harmful" (Davis et al. 2011); native species can develop ecological dependencies on non-native species (Schlaepfer et al. 2011); most killing programs are not science based (Doherty et al. 2019; Lynn et al. 2019); many situations where migrants do contribute to extinctions arise as an artifact of other human-caused stressors (Doherty et al. 2015; Wallach et al. 2015); and, finally, creative and compassionate approaches that focus on enabling coexistence can be more lasting and just (Wallach et al. 2018a).

The contribution of migrant populations to their species' global distributions can be viewed as a process of rewilding at a scale unparalleled by controlled conservation programs. Fifteen (of 18) migrants threatened or near threatened in their native ranges could have their statuses downlisted or delisted if their full global populations were included. Similar results have been found for migrant plants and animals in Israel (Wallach et al. 2018b), and terrestrial megafauna worldwide (Lundgren et al. 2018). If the task of conservation is to ensure the persistence of Earth's diverse lifeforms, this is good news. Incorporating migrant populations need not reduce conservation efforts for populations in their native ranges, just as many defined subspecies and geographically separate populations are included in the IUCN Red List (IUCN 2018). The conservation community could come to regard threatened migrants as refugees to be harbored, rather than invaders to be targeted.

How and whether to include migrant species in conservation's moral world has long troubled conservation scientists (Soulé 1990). Inclusive conservation lists, we argue, provide space for dialogue on what constitutes the good conservation aims to protect. The global conservation community is ethically pluralistic, including on whether non-native species have conservation value (Sandbrook et al. 2019). Species lists are imbued with ethics, but the values that inform them have been narrowly defined. Putatively comprehensive accounts of nature that are filtered through unacknowledged values create hidden biases and preclude the expression of alternative perspectives. Nativist-filtered lists should not be uncritically accepted as an ethical default for conservation or, worse, as value-neutral accounts of reality.

Founding species lists and counts, maps, and threat assessments on an inclusive ethic can do more than change understanding of the world and open space for pluralism in conservation. It can also help place the burden of proof (appropriately, in our opinion [Wallach et al. 2018a]) on those who wish to deny moral concern for large swaths of the living world by requiring them to actively and intentionally exclude certain entities from their moral circle (Laham 2009). As such, inclusive conservation data could help enhance humanity's moral concern for all life on Earth.

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Supporting Information

Conservation status and range sizes of migrant vertebrate species (Appendix S1), inclusive conservation status of threatened and near threatened migrant vertebrate species (Appendix S2), declared pest status and killing motivations targeting immigrant vertebrate species (Appendix S3), and local declared pest status of immigrant vertebrate species (Appendix S4) are available online. 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. Full range maps of Australia's migrant vertebrate species are available from https://feralglobe.shinyapps.io/australian_migrants_app/.

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