



Invisible megafauna

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A significant proportion of Earth's wildlife has been erased, not from the world, but from our collective depiction of nature. Even the most noticeable animals, terrestrial herbivorous megafauna weighing 100–4,000 kg, have been made nominally invisible. Wildlife outside native ranges are conspicuously missing from conservation data sets, distribution maps, population estimates, and conservation statuses. They are to be found, instead on invasive species lists (Lundgren et al. 2017). Introduced megafauna are a wonder of the Anthropocene hidden in plain sight (Fig. 1).

Many regions have an immortalized moment “when the first white man stepped off the boat,” heralding the beginning of Western civilization and the end of nature (Marris 2013). Organisms caught in humanity's globalization currents were branded products of man, not of nature (Chew & Hamilton 2011). Conservation databases depict Australia as empty of megafauna, despite being home to 8 species (Ripple et al. 2015), because they established after James Cook landed at Botany Bay in 1770. A similar number of species are excluded from formal accounts of North American megafauna because they arrived after Christopher Columbus. Valuing only ideals of untouched wilderness excludes much if not all the biosphere, perpetuates colonial ideologies, and fails to acknowledge thousands of years of human ecology.

Wild megafauna whose ancestors escaped domestication disrupt notions of human control and archetypal wilderness even further (Gibbs et al. 2015). From these feral populations, 2 lost megafauna have been resurrected. Dromedary camel (*Camelus dromedarius*), extinct in the wild for thousands of years, are thriving in the deserts of Australia. Predomestic cattle (aurochs [*Bos primigenius*]), hunted to extinction hundreds of years ago, live on in their postdomestic progeny (*B. taurus*).

These inadvertent processes of rewilding have occurred not by human direction, but through the pioneering capacities and agency of animals that have survived human exploitation.

The redistribution of megafauna has driven a global process of rewilding. All continents have more megafauna species today than in the Holocene (Lundgren et al. 2017). Humans are implicated in the Pleistocene megafauna collapse (Sandom et al. 2014) and in the current decline of 60% of extant species within native ranges (Ripple et al. 2015). Yet humans have also increased megafauna richness to levels approaching the Pleistocene, through redistribution and rewilding (Lundgren et al. 2017). The call to protect Earth's remaining megafauna (Ripple et al. 2016b) must expand beyond arbitrary lines.

The proportion of megafauna populations outside their historic native range is considerable for many species (Lundgren et al. 2017). The small population of Colombian hippopotamus (*Hippopotamus amphibius*), descendants of “cocaine hippos” that escaped the abandoned hacienda of Pablo Escobar, is expanding despite sterilization efforts (O'Bryen 2013). Several species have proven resilient to control and now exist mostly or solely in the diaspora. The International Union for Conservation of Nature (IUCN) lists wild horses (*Equus ferus*) as surviving only in Mongolia, even though hundreds of thousands are also found across North America, Australia, South America, and Europe.

Globalization has driven a countercurrent to extinctions for several species. Of 22 introduced megafauna species, 64% are threatened, extinct, or decreasing in their historic native ranges. Barasingha (*Rucervus duvaucelii*) are vulnerable in India and have been introduced to North America. Sambar deer (*Rusa unicolor*)

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Figure 1. Examples of Earth's invisible megafauna. Postdomestic megafauna, top row, left to right: dromedary camel in Australia, horse in North America, and cattle in a tiger reserve in India. Other introduced megafauna, bottom row, left to right: caribou (*Rangifer tarandus*) in Adak Island, hippopotamus in Colombia, and muskox (*Ovibos moschatus*) in Norway. Conservation status in native ranges (IUCN 2017): LC, least Concern; VU, vulnerable; EN, endangered; EX, extinct). Photos by A.W., wild camel and wild cattle; James Marvin Phelps (Flickr.com, CC BY-NC 2.0), wild horse; Travis (Flickr.com, CC BY-NC 2.0), caribou; Paula Funnell (Flickr.com, CC BY-NC-ND 2.0), hippopotamus; and Dration, muskox (used with permission).

are vulnerable in Asia and are also established in Australia, New Zealand, South Africa, and North America. Argali (*Ovis ammon*) are near threatened in Central Asia and also occur in the Americas and Europe and on several islands.

Ignoring introduced populations hides not only rewinding successes but also conservation and animal-welfare harms. Over 300 native mammals are threatened by the wildlife trade; megafauna are particularly vulnerable (Ripple et al. 2016a). Wildlife trafficking knows no borders, and introduced megafauna face similar threats. Skins of wild and domestic donkeys (*E. asinus*) are being traded and trafficked worldwide to produce *ejiao* for the Chinese medicine industry (Fig. 2). The growing demand is driving crime, animal cruelty, and poverty, and some of the skins are traded along the same networks that traffic in CITES listed species (The Donkey Sanctuary 2017). Meanwhile, their predomestic ancestor (African wild ass [*E. africanus*]) has a population of 50–200 mature individuals (IUCN 2017). Protecting this native population is paramount, but to ignore or even beget the extinction of their postdomestic relatives may extinguish any wild future for this animal.

Humans are driving rapid global change. Valuing populations only within historic ranges offers but

one perspective on how to protect Earth's diversity (Davis et al. 2011). Broadening our view of nature illuminates processes that enable wildlife to adapt to the Anthropocene (Hobbs et al. 2017). Protecting megafauna in their introduced range can supplement rather than supplant existing conservation efforts. Recovery programs for regionally, but not globally, threatened species is standard practice. Subspecies are treated as distinct units, and the IUCN lists over 1,000 globally threatened subspecies. It is possible to protect brumbies and mustangs without abandoning takhis (*E. f. przewalskii*).

Accepting introduced megafauna as part of nature would enable more accurate threat assessments and informed policy. Although controversial, it is not unheard of. Only 20–30 fallow deer (*Dama dama*) remain in their native range (in a fenced reserve in Turkey), but the species is listed as least concern globally because of extensive populations across Europe that were introduced during the Neolithic and later by Phoenicians and Romans. Introduced populations include unique, threatened, and extinct megafauna. Brown bear introduced to North Africa by Romans for spectacle fighting are recognized as an extinct subspecies (*Ursus arctos crowtheri*) (Calvignac et al. 2008). Sardinian mouflon (*Ovis orientalis musimon*), Corsican red deer (*Cervus elaphus*



Figure 2. Donkeys are threatened by legal and illegal global trade in body parts. Wild donkeys in Australia, where they are considered pests and are exposed to the trade (top left); ejiao, a Chinese medicine, is made of donkey skins (top right); pen of donkeys at Dodoma market, Tanzania (bottom left); and remains of stolen donkeys, Tanzania (bottom right). Photos by A.W., wild donkey; Deadkid dk (CC BY-SA 3.0, Wikipedia.com), ejiao; The Donkey Sanctuary, pen and remains of donkeys (used with permission).

corsicanus), and Montecristo goats (*Capra* sp.) are threatened in their introduced range. If species were assessed across their full range, 6 megafauna would be globally delisted (postdomestic cattle, camel, donkey, horse, water buffalo [*Bubalus bubalis*], and sambar deer) and 2 down listed (postdomestic banteng [*B. javanicus*] and argali), which would reduce the number of threatened megafauna by about 13%.

Incorporating introduced populations into conservation is opposed due to concern that it will harm local species. Like native megafauna, introduced populations both benefit and challenge co-occurring species. Wild water buffalo (*Bubalus bubalis*) in Australia suppress ground-level vegetation but promote tree growth (Werner 2005). Megafauna can exert strong herbivory pressure to the detriment of other species, especially where apex predators are absent (Estes et al. 2011). Red deer suppress tree regeneration in their introduced range on predator-free islands and in their native range where predators have been eradicated (Wallach et al. 2015). Due to their large body mass, megafauna contribute unique ecological functions as long-distance dispersers of large seeds, digesters of coarse plant material, creators of open habitat, enrichers of soil, and prey of large predators and scavengers (Ripple et al. 2015). These functions

create ecological interdependencies. Wild donkeys dig for water in the drying riverbeds of the Sonoran Desert (U.S.A.), and their wells provide drinking water for a multitude of local wildlife (Lundgren et al. 2017).

The challenges facing wildlife are global phenomena, consequently conservation cannot be restricted to delimited geographic and temporal scales. It must expand to incorporate an “Earth ethic” (Callicott 2014) aligned with understanding of ecologies in flux (Pickett 2013). The very populations excluded from conservation are arguably manifestations of a key mechanism that enables life to adapt to change. The stories of flourishing displaced wildlife shatter the idea that everything touched by humans is forever bound to us and humbles our view of ourselves as so-called wildlife managers.

When we incorporate introduced populations in the ethical universe of conservation, in formal lists and maps, and in assessments of population sizes and trends, we find that the Anthropocene is astoundingly rich in megafauna, and in some places getting richer. We uncover new dimensions of the forces that create and destroy biodiversity and new conservation opportunities and threats. Were we to paint a new picture of nature, one that celebrates all those populations out of place and out of time, what wonders might we see and be willing to fight for?

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