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Australia's faunal extinction crisis

Submission to

Senate Environment and Communications References Committee

Inquiry into Faunal Extinction

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ABOUT THE AUSTRALIAN ENVIRONMENT FOUNDATION

The Australian Environment Foundation (AEF) is a not-for-profit, membership-based environmental organisation that has no political affiliations. It is dedicated to informing and educating Australians about environmental issues and solutions to environmental problems that enhance the wellbeing of all Australians and preserve the rule of law, property rights and the freedoms of the individual on which that wellbeing is based.

The Foundation takes an evidence-based, solution-focused approach to environmental issues. In this respect we support the great 19th Century biologist, Thomas Henry Huxley, who said, *'The deepest sin against mankind is to believe things without evidence'*. The process by which the evidence is evaluated, however, has to be completely transparent, open to participation by all, rational, and rigorous—with a full and proper recognition of the inherent limits to knowledge in all centralised decision-making.

Many of the AEF's members are practical environmentalists – people who actively use and also care for the environment in their day-to-day lives. They appreciate that successful environmental protection and sustainable resource use are generally compatible. People are an integral part of the natural environment and provide the only means to protect and enhance it for the benefit of all.

For more information on the AEF please go to www.australianenvironment.org

The Issue and Related Agenda

Species preservation encompasses a number of different goals and, perhaps, some hidden objectives. Many see the goals of species preservation as extending beyond mankind's interests. Some confuse the issue of species preservation with such notions as animal rights, with these sometimes further broadened to encompass trees. Although wanton destruction and cruelty is to be avoided, this does not oblige man to afford equal treatment to other sentient beings.

The issue of species preservation arises in the context of two human activities: the production of goods and the production of services. The former include the important role that species diversity plays in disease eradication, and repairing and improving food yields. The latter recognises the beauty of species and the attraction of its diversity; wildlife, for example, is a major attraction of wilderness areas.

Some species we would wish to see made extinct under other than highly controlled circumstances. These include disease carrying bacillus, the tsetse fly and, at least in areas where human populations exist, those animals that would hunt and kill humans or cattle.


The Number of Species and the Extent of their Loss

Wikipedia reports "More than 99 percent of all species, amounting to over five billion species that ever lived on Earth are estimated to be extinct. All species, including our own are on this basis some 99 per cent certain to become extinct at some stage.

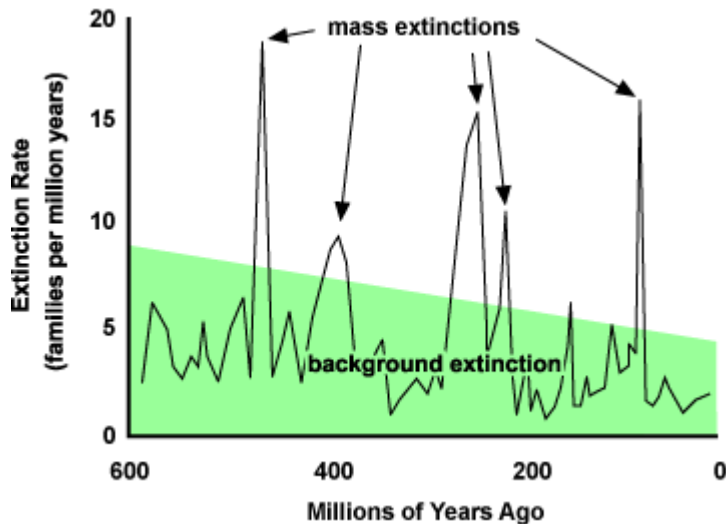
Estimates on the number of Earth's current species range from 10 million to 14 million¹ of which about 1.2 million have been documented and over 86 percent have not yet been described². More recently, in May 2016, scientists reported that 1 trillion species are estimated to be on Earth currently with only one-thousandth of one percent described³."

Species loss has occurred as a result of past climate changes which were far more abrupt than those even the most extreme forecasts suggest today. Five events each led to the loss of 50 per cent of species.

¹ G. Miller; Scott Spoolman (2012). Environmental Science – Biodiversity Is a Crucial Part of the Earth's Natural Capital. Cengage Learning. p. 62. ISBN 1-133-70787-4. Retrieved 2014-12-27.

² Mora, C.; Tittensor, D.P.; Adl, S.; Simpson, A.G.; Worm, B. (23 August 2011). "How many species are there on Earth and in the ocean?". PLOS Biology. 9: e1001127. doi:10.1371/journal.pbio.1001127. PMC 3160336  . PMID 21886479.

³ Staff (2 May 2016). "Researchers find that Earth may be home to 1 trillion species". National Science Foundation. Retrieved 6 May 2016.



Source: <https://www.learner.org/courses/envsci/unit/text.php?unit=9&secNum=6>

In the more recent past, the species that have disappeared have largely been those in previously isolated ecosystems - over 80 per cent of North American extinctions have been in Hawaii or the southwest desert region. Moreover, Puerto Rico, where 90 per cent of the forest was destroyed then allowed to recover⁴ (with little loss of species), demonstrates the resiliency of natural areas.

The environmentalist, Norman Myers⁵ estimated that about 1000 species per year were becoming extinct although the methodology used in arriving at that estimate is likely to overstate the true magnitudeⁱⁱ⁶. This and other such estimates are based on projected loss of natural habitat (largely in the tropical forests) and observed diminution of species in remote locations following such losses.

These numbers are less than one thousandth of the numbers estimated to be occurring. Since the year 1500, globally roughly 80 mammal species have become extinct⁷. Australia's unique fauna has seen a species loss of 10% of its 273 terrestrial mammals, since European settlement brought agriculture and new predatory species. Twenty three of the IUCN Red Book's 80 species identified as extinct are from Australia. Almost all the other extinctions are also of species unique to a particular island like Madagascar.

The reasons given for the discrepancy is the transferral of Amazonia and other species-rich tropical forests from wilderness to farmland (or, in the view of many, to desert). But it is clear there are other factors at play. Not the least of these is the very definition of a species – which is not confined to an ability to breed within itself and the difficulty of identifying some species that are, naturally, rare. In this respect, decisions on some extinctions having been recorded are later reversed as recently has been recorded by the IUCN reporting the rediscovery of four South American amphibian species previously thought to be extinct.

If species are becoming extinct at the rate some biological scientists estimate, this represents both a dramatic break with the past and a puzzling irreconcilability between certainty and speculation.

⁴ https://www.fs.fed.us/global/iitf/pubs/IITF_gtr35.pdf

⁵ Mayer N "The Exhausted Earth" Foreign Policy No 42 Spring 1981 p141-155

⁶ see Harrington W and Fisher AC "Endangered Species" in "Natural Resource Policy" Ed Portnoy PR. John Hopkins, Baltimore 1982

⁷ Ceballos, G.; Ehrlich, A. H.; Ehrlich, P. R. (2015). The Annihilation of Nature: Human Extinction of Birds and Mammals. Baltimore, Maryland: Johns Hopkins University Press. ISBN 1421417189. "69"

Thus, in North America some 500 species (plant, animal and insect) are known to have become extinct during the last 500 years⁸ compared to only 100 during the 3000 years of the last Ice Age⁹.

By the same token, the relatively small species loss during the last Ice Age indicates a greater resilience of species to climate change than is maintained by many of those promoting the notion of global warming. One plausible example of vulnerability is an Australian reptile, the Bartle Frere Cool-skink (*Techmarscincus jigurru*), a cold-adapted species found only on the summit of Queensland's tallest mountain, Mount Bartle Frere. A 1°C increase in temperature is said to be likely to result in a loss of 50% of the Cool-skink's population within 30 years, as there are no cooler areas for the animal to move to¹⁰. Even that is not extinction.

The diversity of numbers of species under various forms of stated threat gives rise to concerns, prevalent throughout science, of researchers not applying the rigour that was once central. Many such concerns have come to light in the so-called replication crisis¹¹.

Naturally, scientists are defensive about claims which threaten future funding. Peter Ridd¹² a former professor at JCU was sacked for suggesting some of the data that is propelling research funding for the Great Barrier Reef is suspect. The IUCN itself is dependent on funding that will not materialise if no concerns are found.

Though massive increases in species loss is often projected (e.g. Matias et al¹³) there is only a small number of actual recordings of species loss (as opposed to projections). So we see alarmist projections like the following:

⁸ <https://www.fws.gov/nativeamerican/pdf/why-save-endangered-species.pdf>

⁹ <https://www.ncbi.nlm.nih.gov/books/NBK232371/>

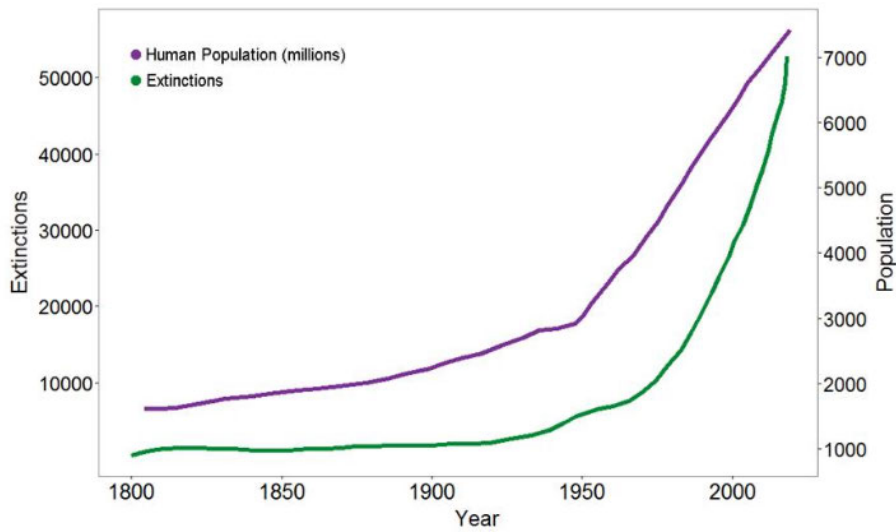
¹⁰ <https://www.birdlife.org/worldwide/news/red-list-update-australian-reptiles-crisis-surprise-toad-rediscovery>

¹¹ <https://thewire.in/science/replication-crisis-science>

¹² <https://atlasmonitor.wordpress.com/2018/02/10/replication-crisis-in-science/>

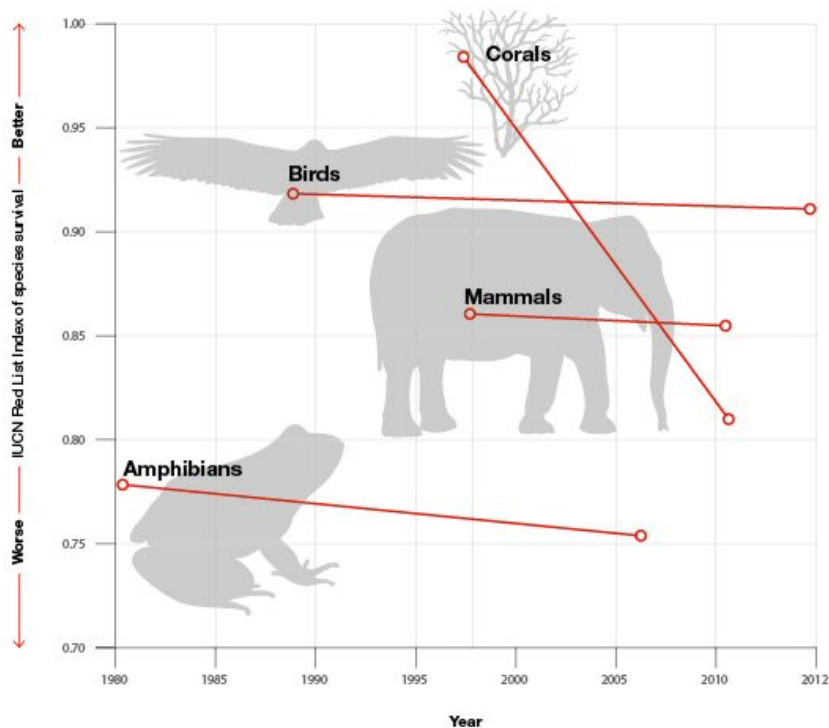
¹³ http://www.cbtm-moulis.com/fichiers_site/a2992ctm/contenu_pages/Matias_et_al_Ecography_2014.pdf

Humans & The Extinction Crisis



Data source: Scott, J.M. 2008. *Threats to Biological Diversity: Global, Continental, Local*. U.S. Geological Survey, Idaho Cooperative Fish and Wildlife, Research Unit, University Of Idaho.

Somewhat more soberly, the IUCN list shows the risks, at least to mammals and birds, showing little change.



Source: <http://www.iucnredlist.org/about/summary-statistics>

According to the IUCN Red Book¹⁴ “The total number of extinctions listed by IUCN has increased from 766 in 2000 (Hilton-Taylor 2000) to 784 in 2004 (Table 3.1; Appendix 3i). However, because the documentation of the number of extinctions remains very incomplete, this increase does not provide much information on the rate at which extinctions are occurring, or the number of extinctions between 2000 and 2004.”

Bird extinctions appear to exhibit little sign of mounting crisis (some 10,000 bird species have been described¹⁵).

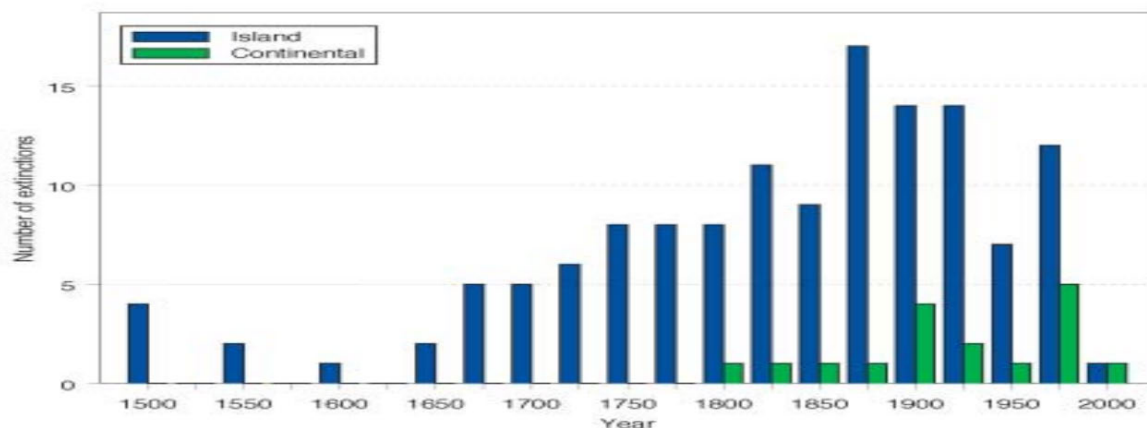


Figure 3.2
The number of bird extinctions that have occurred on islands and continents since 1500 AD.

The IUCN in 1992¹⁶ produced the following time series of extinctions but this does not appear to have been updated, perhaps because it is not sufficiently supportive of the agenda. More recent data again fails to substantiate mass extinctions; in summarising this of the 44,838 species assessed worldwide using the [IUCN Red List criteria](#), 905 are extinct and 16,928 are listed as threatened to be extinct¹⁷.

¹⁴ <https://portals.iucn.org/library/sites/library/files/documents/RL-2004-001.pdf>

¹⁵ Human impacts on the rates of recent, present, and future bird extinctions
Stuart Pimm, Peter Raven, Alan Peterson, Çağan H. Şekercioğlu, and Paul R. Ehrlich. PNAS July 18, 2006. 103 (29) 10941-10946; <https://doi.org/10.1073/pnas.0604181103>

<http://www.pnas.org/content/103/29/10941>

¹⁶ <https://www.biodiversitylibrary.org/item/97636#page/224/mode/1up> P200.

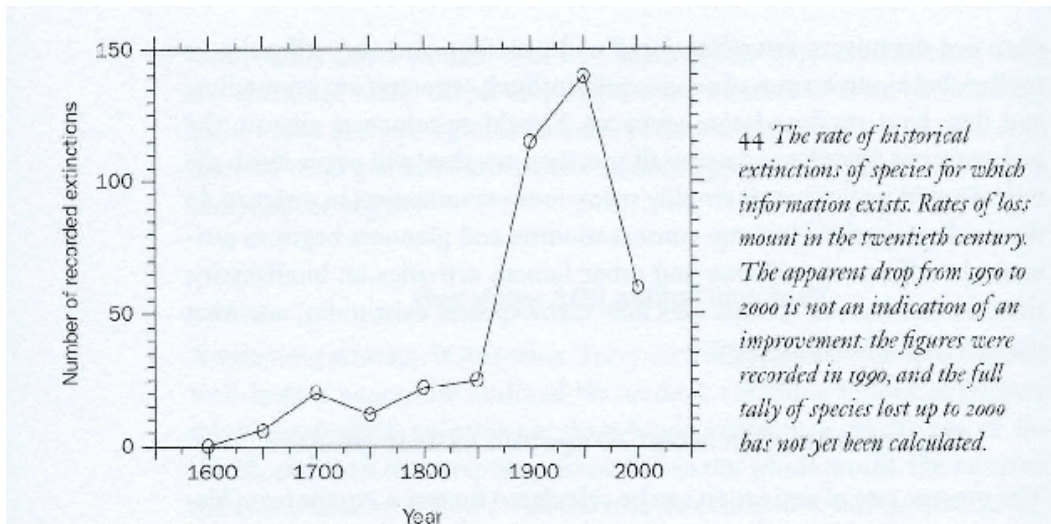
¹⁷ <http://www.endangeredspeciesinternational.org/overview1.html>

Table 16.2 Time series of animal extinctions on islands and continents

TOTALS	ISLANDS					CONTINENTS					COMBINED TOTAL
	MOLLUSCS	BIRDS	MAMMALS	OTHER	TOTAL	MOLLUSCS	BIRDS	MAMMALS	OTHER	TOTAL	
1600–1629	0	2	0	1	3	0	0	0	0	0	3
1630–1659	0	4	0	1	5	0	0	0	0	0	5
1660–1689	0	9	0	0	9	0	0	0	0	0	9
1690–1719	0	5	0	2	7	0	0	0	0	0	7
1720–1749	0	4	0	0	4	0	0	0	0	0	4
1750–1779	0	10	1	0	11	0	0	0	0	0	11
1780–1809	0	2	0	4	6	0	0	1	0	1	7
1810–1839	0	8	0	1	9	0	1	2	0	3	12
1840–1869	2	9	2	3	16	0	1	1	1	3	19
1870–1899	67	16	3	4	90	0	1	6	1	8	98
1900–1929	11	19	3	18	51	6	4	3	7	20	71
1930–1959	37	10	2	6	55	25	2	7	15	49	104
1960–	9	5	3	7	24	4	2	2	12	20	44
No date	25	1	20	27	73	5	0	2	10	17	90

Note: these summaries do not take into account 4 species (2 birds, 1 mammal and 1 'other') which are not assignable to either island or continent.

The University of California produced the following chart on the rate of extinctions over time.

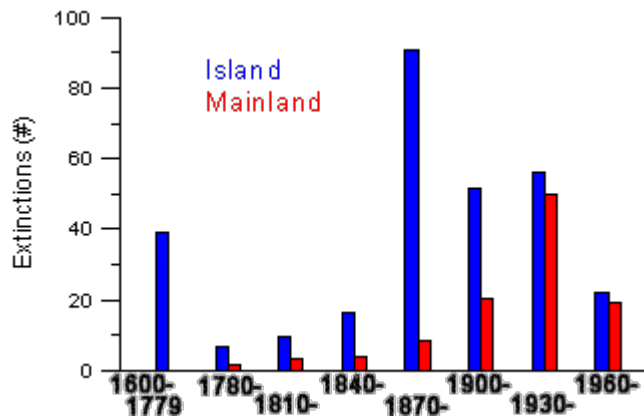


It suggests that the decline in the rate of extinctions may be inaccurate since the latter half of the 20th century was not compiled at the time. The chart has not been updated.

Another documentation¹⁸ based on the work of Brown and Lomolino¹⁹ is shown below

¹⁸ <https://www.geo.arizona.edu/Antevs/ecol438/lect17.html>

¹⁹ <https://onlinelibrary.wiley.com/doi/abs/10.1002/mmnz.20000760118>



Species loss in Australia: causes and effects

In Australia human causes of species loss fall under three categories.

The first is the destruction caused by introduced species killing or outcompeting indigenous species. The second cause is habitat destruction, often the corollary of human settlement where the plant and animal life is destroyed or displaced by urbanisation, agriculture and forestry. The third is hunting.

Introduced species

The effect of introduced exotic fauna is to replace or reduce the populations of various indigenous species and this appears to be the dominant factor impacting the Australian continent and other geographically isolated islands. Elsewhere, indigenous species have developed sufficient adaptability to accommodate introduced species without facing the risk of catastrophic decline in numbers.

There is a variety of reasons why a predator will rarely hunt its prey to extinction. As a species becomes rarer, the diminished population becomes harder to find and experimental studies have demonstrated the occurrence of “prey switching” where the predator switches its searches to alternatives simply because they involve less effort.

In Australia cats and foxes are thought to have hunted or be in the process of hunting some species of small mammals to extinction. One infamous case is that of the Stephen Island wren, a flightless bird comprising only a dozen or so individuals, which was wiped out by the Lighthouse keeper’s cat²⁰).

Habitat destruction

Mankind’s activities have had a more direct effect on the land, its vegetation and natural features, and on the creatures inhabiting it. Human dominance on the land is now virtually complete and control is rapidly extending to the oceans.

The concern to many people is the dominance of humans over other elements of nature since the human population commenced its rapid rise four centuries ago. In the Americas and Oceania, European settlement brought agricultural practices which had a greater impact on fauna than had previously been the case.

²⁰ <https://trove.nla.gov.au/work/24914996?q&versionId=45431979>

The species most at risk from mankind are the large animals. There has been little evidence that species of insects and fungi and algae for example being forced to extinction by mankind replacing surface soil and foliage. Moreover, many species even larger species like kangaroos, may have increased as a result of the introduction of more nutritious grasses and more dependable water resources. Other native animal species thrive in urban environments.

Hunting

Hunters have been the cause of much loss of wildlife and some loss of species. However threats to extinction from this activity, especially by humans, are now rare and, indeed, the value animals from sport is likely to foster that survival. Species of prey on domesticated animals or humans have always been hunted, sometimes in ways that many opponents answering believe exhibit wanton cruelty. Some opposition is based on radical 'animal rights' agendas. Opposition to foxhunting in the UK and duck hunting in Australia may reflect these sentiments.

Paradoxically to some, the ability to hunt a species increases its value and health to ensure that wild species are preserved. The wetland areas in several locations have been fenced to ensure availability of private duck shoots - killing ducks in this way ensures their survival as a species.

Australia's reptiles face rising threats from invasive species and climate change, with 7% now classed as threatened with extinction according to the IUCN Red List. The Red List now identifies 975 Australian reptile species and almost all of the threatened species are endemic to the continent.

Invasive species are the main threat to the survival of over half of these threatened reptiles. A recent study²¹ found that invasive feral cats alone are estimated to kill about 600 million reptiles each year. One of the many species of reptile predated by feral cats is the Grassland Earless Dragon (*Tympanocryptis pinguicolla*), which moved from the Vulnerable to the Endangered category. Changes to the intensity and frequency of fires – caused by a combination of agricultural management, the loss of traditional indigenous burning practices and invasive weeds – are an additional threat to this species. Like many Australian species, the Grassland Earless Dragon is naturally adapted to the semi-natural wildfire patterns that were in place prior to European settlement.

Another invasive species threatening Australia's reptiles is the toxic Cane Toad, which was introduced to Australia in 1935. For the Mitchell's Water Monitor (*Varanus mitchelli*), which enters the Red List as Critically Endangered, dining on the toxic Cane Toad has resulted in population declines of up to 97% in some areas, following the arrival of toads. Australia's reptiles are particularly vulnerable to poisoning by the Cane Toad as Australia has no native toads or other species that produce the same toxins. However, it would appear that native animals have adapted to the cane toad²².

Australian species loss in perspective

While the loss of any species is likely to be a matter of concern, given Australia's previous isolation, native species' lack of defences against introduced species, together with the absence of any preservation policy until recent years, Australia's loss has not been great. Most extinctions that have been recorded took place before the 20th century at a time when species preservation was not

²¹ <https://www.iucn.org/news/species/201807/australias-reptiles-threatened-invasive-species-climate-change-iucn-red-list>

²² Llewelyn, J; Webb, J; Schwarzkopf, L; Alford, R; Shine, R (2009). "Behavioural responses of carnivorous marsupials (*Planigale maculata*) to toxic invasive cane toads (*Bufo marinus*)". *Austral Ecology*. 35 (5): 560–567. doi:10.1111/j.1442-9993.2009.02067.x.

accorded a high priority by humans. The IUCN Red Book lists only three Australian species as endangered or critically endangered.

There are claims²³ that some 21% of Australia's mammals are threatened with extinction; unlike in most other continents, the main cause is predation by feral species, such as cats. These numbers differ from those assembled by the Resources Assessment Commission²⁴, which put seventeen of the 200 species of mammals known to be present 200 years ago presumed extinct plus one of the 730 species of bird. Figures provided by the [EPBC](#) put extinctions at 54²⁵.


But we see alarmist reports like this from [The Guardian](#) claiming a national disgrace is unfolding or this report in The Conversation

Threatened Species Commissioner Gregory Andrews [told ABC radio](#) that land clearing is not the biggest threat to Australia's wildlife. His claim caused a stir among Australia's biodiversity scientists and conservation professionals, who have plenty of evidence to the contrary.

The ecologist Jared Diamond has described an "[evil quartet](#)" of threatening processes that drive species to extinction: habitat destruction; overhunting (or overexploitation); the presence of introduced species; and chains of linked ecological changes, including co-extinctions.

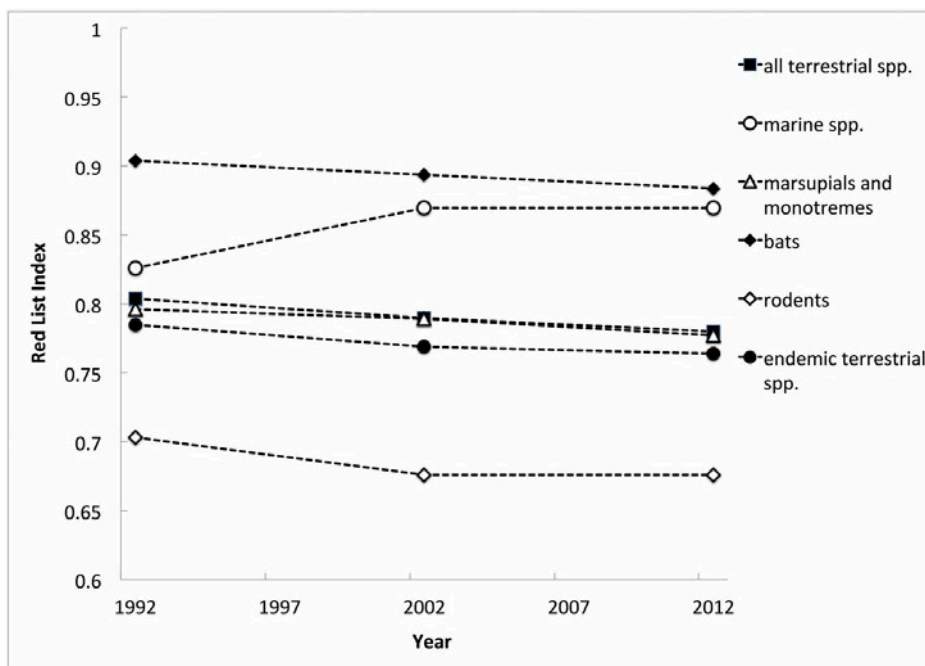
The ABC's "[fact check](#)" has found "Senator Di Natale's claim that Australia has "one of the highest loss of species anywhere in the world" is correct." It would be astonishing, given the continent's isolation and unique flora and fauna if this were not the case.

More scholarly data provide an even more sober picture. Even though they express concerns about species loss [Woinarski, Burbage and Harrison](#) produce this chart which shows a declining vulnerability:

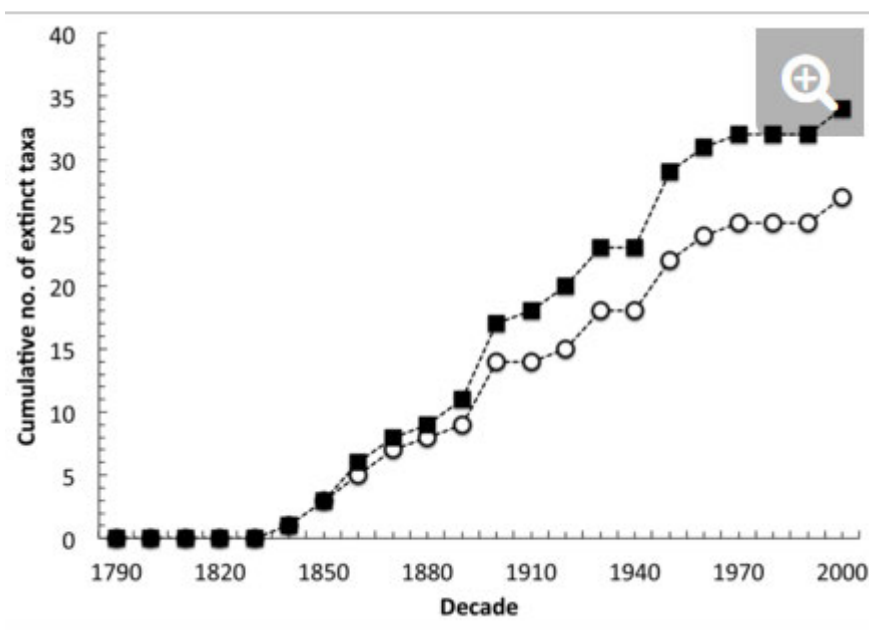
²³ Woinarskia, John C. Z.; Burbidge, Andrew A.; Harrison, Peter L. (2015). "Ongoing unraveling of a continental fauna: Decline and extinction of Australian mammals since European settlement" (PDF). *Proceedings of the National Academy of Sciences of the United States of America*. 112 (5): 4531–4540. doi:10.1073/pnas.1417301112. PMC 4403217 . PMID 25675493.

²⁴ Resources Assessment Commission "Australia's Forest and Timber Resources" Background Paper March 1990

²⁵ <http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna>



Woinarskia et al also produce this chart (Open circles denote species; filled squares also include subspecies) which indicates a less than alarming rate of species loss



There are doubtless many more species endangered in a particular area. The Growling Grass Frog (*Litoria raniformis*) is one such in Victoria, which, listed as endangered, has required considerable land set-asides, but is actually common throughout the state and in NSW²⁶.

Many wish to see protection of “unique ecological communities” but the notion of this is so imprecise that it could cover thousands of situations and it has little relevance to species protection.

²⁶ http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1828

The Value of Species for Medicine and Food

Mankind cultivates about 150 species of plant (with wheat, corn and rice accounting for half of the output). However in addition to these plants other varieties have immense value as medicines and for hybridization.

About half of all drugs contain substances derived from living matter and in many cases the substance is unique to one species. The armadillo is the only creature, except man, known to contract leprosy and was therefore of major value for growing the bacillus before it could be synthesized. Certain species of crustaceans might prove equally useful in developing cures for cancers.

The use value of wild biota for medicinal purposes has tended to decline over recent years. This may, in part, reflect a diminished incentive to search for new pharmaceuticals as a result of increased regulatory barriers and liability concerns. The conventional view is that given by Ehrenfel²⁷, which stressed the lower costs of laboratory work over field searches.

All crops are derived from wild plants and many wild varieties of cultivated crops have proven to have immense value in the creation of hybrids. The resistance of cultivated strains to disease tends to atrophy and their genetic material needs to be reinvigorated - plasma from a wild variety of peanut found in the Amazon has been used to counteract the vulnerability of cultivated varieties to disease and saved an estimated \$500m. There are prospects of crossing corn with perennial wild varieties saving perhaps \$20B worldwide in planting costs. America's durum wheat was largely wiped out in the early 1950's by stem rust whilst European vines in the nineteenth century were decimated by phylloxera - in both cases the introduction of exotic strains enabled restoration.

All that said, the need for such "natural" means of combating a decline in crop resilience has all but disappeared in recent years with the advent of Genetic Modification, both to increase plant productivity and to reduce risks of plant disease.

The Value of Species for Aesthetic, Recreational and Other "Intangible" Uses

One response to earlier publicised threats to genetic diversity has been the 1975 signing of the Convention on International Trade in Endangered Species (CITES). This has allowed lists to be established of species which may not be traded. This response is related to earlier movements for the protection of animals from slaughter, movements related to the foundation of the forerunner of the Royal Society for the Prevention of Cruelty to Animals in 1824. Particular focus of the Society was on killing of birds and its Indian branch was behind perhaps the earliest laws against international wildlife traffic, the banning of exports from India of bird skins and feathers in 1902.

CITES has not been successful in preventing the taking of many highly prized species like elephant and rhino. However, in these cases and others, where the product of the wildlife attracts a high commercial value, institutionalized protection by banning the taking and export is a misplaced policy.

According to Myers²⁸, "for much of emergent Africa the only long term hope for the big mammals of the savannahs depends in part on the notion "you either use the wildlife or lose it".

Vesting of property rights to wild herds of species in particular areas makes use of the potency of individual property in preserving things of commercial value. Even for highly migratory animals, property rights vesting can allow control to be exercised. Export bans unfortunately lead to

²⁷ Ehrenfeld D. "Why put a value on biodiversity?", in Wilson E.O. (ed.) "Biodiversity", National Academy Press, p 212-2161988

²⁸ Myers N "A Farewell to Africa" International Wildlife, Nov/Dec 1981, p36

excessive taking (the poacher has no interest in preservation since he cannot benefit from it) and excessive loss of the product due to the clandestine methods of transport which smugglers must use.

Examples of property right arrangements that ensure sound resource management have been identified and researched in the preservation of wildlife. Traditionally in Europe private land ownership had enabled deer, boar and bears to survive as fugitive animals to be hunted. More recently, allowing private ownership of wild elephant herds in Africa has had dramatic effects quite contrary to those experienced in publicly owned game reserves. Simmons and Kreuter²⁹ detail the different experiences of contrasting property regimes on elephant herds. Kenya, where the national parks are owned by the government, has seen its elephant herds depleted by poachers and encroaching peasants over many decades. Between 1979 and 1989 the country's elephant population fell from 65,000 to 19,000. This is in spite of trade in elephant products being banned and poachers facing the most severe punishment. By contrast in Zimbabwe and Botswana, where elephant hunting is permitted and peasant villages have forms of property rights to the elephant and allow hunting and sale of products, numbers have risen. Over the 1979 to 1989 period growth in the herds of Zimbabwe and Botswana exceeded Kenya's loss.

The reaction of the world community to the plight of the elephant is misjudged. Rather than encouraging preservation approaches which have enjoyed such spectacular success in southern Africa, the response to Kenya's problem has been for developed countries to ban elephant product imports. While reducing the incentive to hunt wild elephants, this does little to discourage the encroachment by peasants of land used by elephants in Kenya. Moreover, it vastly devalues the worth of southern Africa's protected and harvested resource - income producing assets are at a stroke transformed into pests which trample crops to the detriment of peasants' income earning potential. The outcome will almost certainly be contrary to the intentions of the sponsors of the ban. Unless the approach is reversed the herds in southern Africa will, like those in eastern Africa, become endangered because they have become a liability.

The Potential for Further Use of Property Rights Solutions

Privatising control over an asset, whether it be land, wildlife or housing generates considerable incentives for its preservation. Just as mediaeval European princes went to great lengths to prevent their wildlife from being poached, self-policing of this nature is considerably more effective in African game parks. However self-policing requires adequate incentives to allow income to be earned or utility to be enjoyed equivalent to that of alternative uses of the resource. Denial of markets prevents this occurring.

The issue becomes more complex where the wildlife or wilderness land competes with other uses for which it is incompatible. Africa's growing population and need for crop and rangeland make it barely conceivable that wildlife numbers could continue at the level of their previous eras. African gazelles compete with cattle for fodder; elephants do likewise and in the process trample crops; lions prey on native cattle.

Although European settlement in Australia brought increased numbers of native animal species, as a result of the introduction of more productive grasses, this rather felicitous outcome is unlikely to occur elsewhere. Nonetheless, the importance of tourism, the natural adaptation of the larger native animals to Africa and the value of the products from these animals means that their preservation is not at risk if sound policy approaches are followed. These must be based on individual and not government ownership.

²⁹ Simmons RT and Kreuter UP "Herd Mentalities" Policy Review, p46-49 Fall 1989

For species of known commercial value, the property rights solution would see an individual or organisation acquiring rights, say, to the taking of parrots over a particular area. Having such rights in perpetuity (which may be coterminous to the rights of farmers in the area) the rights holder would take steps to ensure the birds' survival. This may involve coming to arrangements with landowners to prevent them shooting birds and to ensure the maintenance of critical habitats both in the areas where they are harvested and over areas to which they migrate.

Although a property rights approach might be applicable for certain species, it is much less easy to envisage such solutions to ensuring the continuation of species for which no value is presently envisaged. Some such species we want to eradicate or at least to maintain only under the most controlled circumstances. Thus the armadillo's usefulness for investigating leprosy is a means to an end of exterminating the organism responsible for the 34,000 annual cases of the disease. Few would wish to see the sleeping sickness bearing tsetse fly preserved in any great number.

The option for preservation in these cases are in situ or ex situ preservation. Zoos and wildlife parks are major ways of ensuring ex situ preservation of animals. The International Board of Plant Genetic Resources has stored about one million species of plant. Neither of these methods is fully satisfactory. The species kept under such conditions do not evolve alongside their natural predators; moreover the keeping of genotypes of such species is totally impracticable.

Refugia - lands set aside - especially those with an abundance of species, offer a better, though much more expensive solution. The more important of such areas are found in the tropics. Some tropical developing countries, notably Brazil and Indonesia have already set aside large areas of land as refugia. Well endowed environmental bodies in the west have likewise bought large tracts as land in tropical countries as refugia. This makes use of "clubs" of interested individuals coming together to promote and fund ventures for which they share a common goal.

Where ownership is not possible, bans on taking may be the only recourse but, where the species' activities conflict with farming and where its appeal as a tourist site is slender, its future existence is likely to be precarious. Moreover, where absolute bans are placed on activities which harm endangered species, it is likely that previously unknown species will be discovered when major developments are in prospect. Such discoveries present difficult political decisions - as has occurred in the US case of the Tenneco Dam and the previously unknown dart minnow (a species which research later showed was widely located and not vulnerable). Similar such claims accompany almost every major prospective development- even mines like Adani which have a small footprint. The claims require considerable resources, private and public, and adversely affect national income.

In spite of competing demands, increased tourist accessibility means acceptable balance can be developed for a great many species of fauna and flora, a balance that is best ensured by defining and protecting private property rights so that the costs of resource use on the environment are recognised.

Part of the problem of assigning values is the free access which is made available by publicly owned wilderness areas. The lack for the most part of an entry price into these areas means that, first inadequate revenues are gathered to ensure their protection and secondly no mechanism is in place to allow rationing and mitigate congestion.

There remain four classes of species for which market solutions based on property rights are more problematical. These comprise first, that which is not valued because nobody would pay to use or see it; secondly the previously mentioned taxa with negative value – species like the brucellosis organism or tsetse fly for example; thirdly species that are undiscovered or at least undocumented; and fourthly, migratory species around which boundaries cannot readily be drawn and ownership defined in some way.

The lack of (or negative) value placed on these species can be argued as equivalent to placing a minimal value on their preservation and ways are being explored to allow a more accurate value to be placed on these species by assigning ownership. Some "unvalued" species are already in reality valued:- people voluntarily pay to preserve them through subscribing to organisations like the Wilderness Society that allocate funds for particular causes on behalf of the subscribers. In this respect, the US has a number of private foundations, of which the Nature Conservancy and the Audobon Society are the best known, which between them own considerable landholdings. Not only do these sorts of agencies provide a genuine measure of what people are willing to contribute to conservation, but they have two other advantages. First, they are competing one with the other for funds; they must therefore ensure their expenditures are targeted to those ventures subscribers consider to be most worthy, while maintaining a cost effective organisation. Secondly, because they are operating within the conventional market, they have less opportunity to adopt the route of lobbying for a regulatory alternative to making expenditures; such an alternative is never costless and offers no commercial yardstick on the true costs.

Concluding Comments

Considerable uncertainty remains about the rate of loss of species and the effect this might have on human welfare and happiness. It must always be recognised that not all things are worth preserving. Some 99 per cent of all the creatures which have ever existed are now extinct and only a tiny proportion of these extinctions are due to mankind.

Government control and intervention has been the most frequent advice to the resolution of environmental questions like those species preservation. The input of economic analysis has largely involved cost benefit analysis based on shadow prices people are estimated to be prepared to pay for the preservation of certain conditions. In recent times, cost benefit analysis has been augmented by the application of market research techniques through the contingent valuation method.³⁰ Such methodologies do however tend to result in higher valuations than appropriate since people are asked about a single or limited number of conservation options and as with the reaction to the "third door-knocker" on a Sunday morning, budget limitations will tend to reduce the values once they are confronted by all claims for conservation.

There is a considerable increase in the creation of land and waters conservation areas.

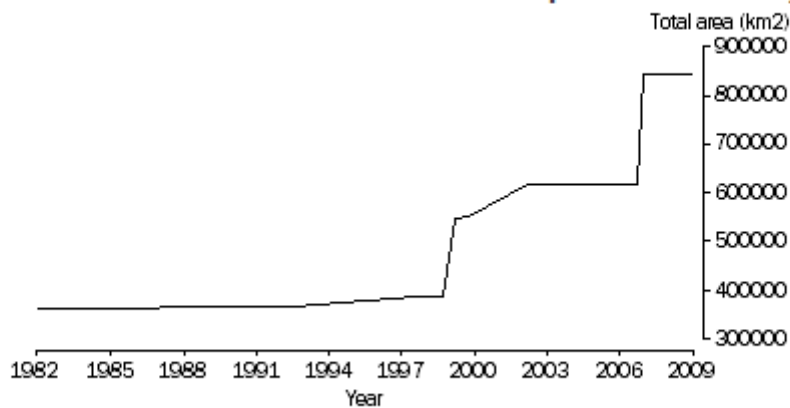
³⁰ see Mitchell, R.C. and Carson R.T., "Using Surveys to Value Public Goods", Resources For the Future, Washington D.C., 1989.

9. Increase in Area of Terrestrial Protected Areas in Australia, 1968-2008



Source: Department of Environment Water Heritage and the Arts, 2009b

10. Increase in area of Commonwealth marine protected areas, 1980-2009



Source: Department of Environment Water Heritage and the Arts, 2009b

The agenda is being set to increase these.

It is difficult to see a species crisis taking place. Many use claims of this as a means of seeking further to control private land ownership with additional layers of oversight. The ACF has called for more rigorous laws against logging and land clearing as well as new institutions with greater powers over landowners and a \$1 billion fund.

Such oversights not only infringe on ownership rights but inevitably bring greater costs stemming from farmers and other landholders being required to undertake considerable expenditures to persuade the authorities that their commercial activities are not impinging on the survival of species. It would be most regrettable if this inquiry were to add further to the regulatory burdens on farmers, businesses and individuals. This is especially so since the risk of species loss, at least as a result of such commercial activities, is negligible.

The losses projected are largely as a result of introduced feral animals, especially cats. It would seem that this could be countered in two ways. First by measures to limit cat numbers – perhaps by introducing a bounty on feral cats (easily differentiated from domestic cats) and second by encouraging “exclosures”, areas of preservation in which feral animals – including rabbits and dogs as well as cats – are kept out.

If we wish to reduce the impact our own activities have on some natural rate of extinction, property rights, markets and voluntary action offer useful approaches. By substituting compulsion for willingness governmental intercession will often serve to frustrate the effectiveness of markets. Property rights arrangements, by providing an environment of self-policing and taking into account the costs entailed in resource use, increase the effectiveness of the search for innovation solutions to wildlife preservation.

Recommendations

1. Recognise that there is no species eradication crisis in Australia;
 2. Protect existing property rights to the maximum extent possible and fully compensate landholders for regulatory imposts to promote biodiversity conservation;
 3. Provide for equivalent biodiversity conservation offsets when regulating the clearing of land for economic development;
 4. Remove any legal impediments to innovation in biodiversity conservation on privately owned land;
 5. Minimise the use of 'command and control' regulation;
 6. Cease incurring needless expenditure and limitations on private land-holders to address this matter. Where any limitations of land use are sought, owners should be fully compensated from the public purse;
 7. Remove the impediments to markets for biodiversity conservation, including by paying landholders for specified conservation outcomes and allowing biodiversity conservation obligations to be traded;
 8. Recognise that the cost effective means of addressing the residual species eradications that are deemed likely is to do so directly by devising measures to eradicate feral predators
 9. Consider measures that will encourage the development of "exclosures" that eliminate feral species and prevent their reinfestation:
 10. Review blanket bans on exports of certain species and instead consider mechanisms including ownership vesting to allow their harvesting. Remove the legal impediments to the commercial exploitation of Australian wildlife, including its ownership, use, domestic exchange, and exportation.
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