Australia's Terrestrial Vertebrate Biodiversity: The Survival Challenge

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Writer's introduction: When I took Dr. Peter Cranston and Dr. Penny Gullan's Biodiversity class in my first quarter of freshman year, I was intrigued to learn about not only the rich biodiversity of Australia, but also the severe problems that threaten it. I chose this topic for my research paper to satiate my curiosity and to explore the reasons behind Australia's ironically dire situation. Keeping in mind (with some paranoia) that my professors themselves were from Australia, my main worry was how to tackle my first college term paper, let alone a scientific paper on a topic of their expertise. I thank Pete and Penny for their critical comments, helpful examples of good scientific writing, and most of all, patience. My experience in writing this paper introduced me to the challenges and satisfaction of scientific research while giving me more incentive to further improve my writing. Lastly, I hope this paper can spark interest in biodiversity and conservation biology.

— *Marianne Dominguez*

Instructors' comment: Marianne came to our class (ENT/EVE 002, Biodiversity) as a freshman with some admitted trepidation: the topic seemed so broad and our expectations appeared to be so great. How could she handle a GE course with two required term papers without having written even one before? Fortunately, Marianne immediately was comfortable with the course objectives, namely to gain a global overview of biodiversity issues. She used a first 'common-to-class' term paper to develop her writing skills and to understand the distinctiveness of scientific presentation. In this contribution, the second paper on a topic of her choice, she used much that she had learned in class and brought to the subject an impressive amount of her own research reading, synthesized into a coherent and lucid whole. That her topic was one close to our own interests was certainly a challenge, but she clearly succeeded in finding her own voice in a distinctive and perhaps counter-intuitive perspective.

— *Peter Cranston and Penny Gullan, Entomology Department*

Australia. What comes to mind? Indeed, scientist and tourist alike envision an array of its unique native animal species. A visit to this island continent entails the opportunity to pat a fluffy-eared koala or see a kangaroo hopping along the 18th hole of golf or even served for supper. Yet amidst the ecotourism appeal, Australia's higher vertebrate fauna presents a distressing call for help when one delves into the harsh reality of threats to Australian biodiversity.

Australia's terrestrial vertebrate biodiversity refers to the variety of non-fish vertebrates—amphibians, reptiles, birds, and mammals—as well as the complex ecological systems in which they occur. Being one of seventeen megadiverse countries, Australia boasts the highest level of endemism and the most variety of species compared to any other country in the world. Geographic isolation has reduced competition, allowing the speciation of animals found only in the country. Now here's the catch: Australia's record of protecting its biodiversity is far from world-leading, given the enormous task of sustaining a significant fraction of the world's vertebrate biodiversity. The dilemma lies in how Australia can preserve its distinctive fauna given all the factors that work against it.

To better asses the magnitude of the problem, we must first understand the scope of Australia's biodiversity and the corresponding challenges strikingly similar to each group of vertebrates. Using data from the Conservation International and published works from the Commonwealth of Australia and other organizations, The Wilderness Society (1999) has compiled the information in Table 1, which shows that there are about 2,000 species of non-fish vertebrates, about 70% of which are endemic; 83% of mammals, 89% of reptiles, and 93% of amphibians are only found in Australia. However, the IUCN Red List of Threatened Animals (1996) reveals that Australia has more threatened non-fish vertebrate species than 98% of the 229 listed countries listed in the report. Even more distressing is Australia's record for mammal extinction, which is the worst in the world. These figures give a general idea of Australia's vertebrate biodiversity, emphasizing the notion that high levels of endemism and species richness reflect the country's unique environment. Figure 1 illustrates Australia's highest level of endemism for non-fish vertebrates compared to 16 other megadiverse countries.

It is interesting to note that all 207 amphibian species in Australia are frogs. This means that Australia has the most native frogs of any

Table 1: Australia's Biodiversity

Biodiversity Grouping	No. of species/ rank in world	No. of endemics/ rank in world	No. of endemics as % of our total and world total species	No. of threatened species	No. of extinct species
Higher (vascular) plants	15,636 sp. Ranked 13— more plants than 94% of countries	14,458 sp. Ranked 5— more than 98% of countries	92% (ours) 5.8 (world)	1,072 sp. 6.8% of our species	83 worst record on earth
Non-fish vertebrates	1,984 sp. Ranked 11— more than 95% of countries	1,350 sp. Ranked 1— more than any other country	5.7 (world)	219 sp. 11% of our species, 0.9% of the world's total species	40
Mammals	268 sp. Ranked 16— more than 95% of countries	210 sp. Ranked 1— more than any of countries	83% (ours) 5.0 (world)	54 20% of our species	19 worst record on earth
Birds	740 sp. Ranked 47— more than 79% of countries	355 sp. Ranked 2— more than 99% of countries	45% (ours) 3.9 (world)	98 13% of our species	21
Reptiles	794 sp. Ranked 1— more than any other country	616+ sp. Ranked 1— more than any other country	89% (ours) 9.8 (world) species	52 6.5% of our	0
Amphibians	207 (all frogs) Ranked 11— more than 95% of countries	169 sp. Ranked 5— more than 97% of countries	93% (ours) 4.0 (world)	15 7% of our species	37

Source: The Wilderness Society (1999)

other country on earth. According to the IUCN (1996), Australia also has the greatest number of threatened amphibians. Causal factors for amphibian decline come mainly from human activities such as insecticide use, land drainage in wetlands, and conversion of ponds to dams

Figure 1: Australian Endemism
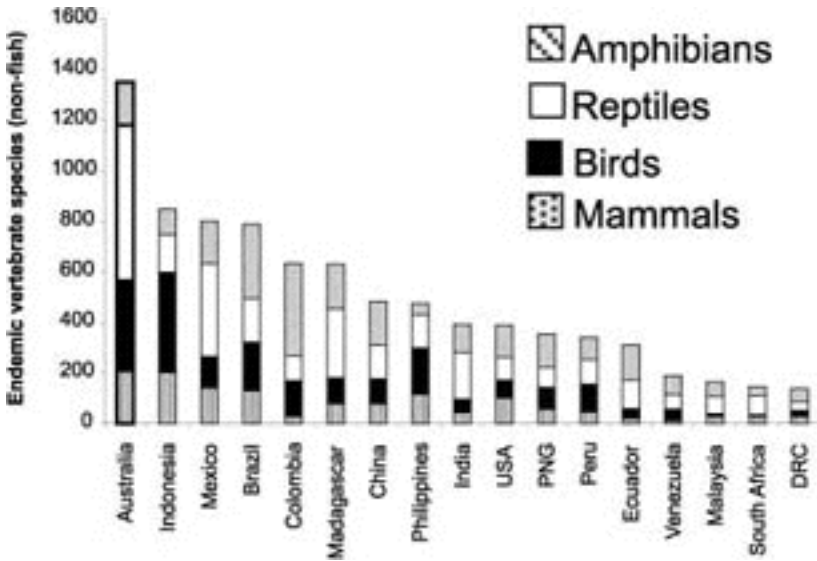
Source: Conservation International (2000)

resulting in habitat loss (Tyler 1997). Moreover, one feral amphibian, the cane toad, was introduced as a biological control for the sugar cane beetle. Ironically, it has created extensive damage to the native fauna and is now considered a major pest. Though several failed attempts tantamount to a declaration of war to control the toxic toad have failed, the fight against it persists.
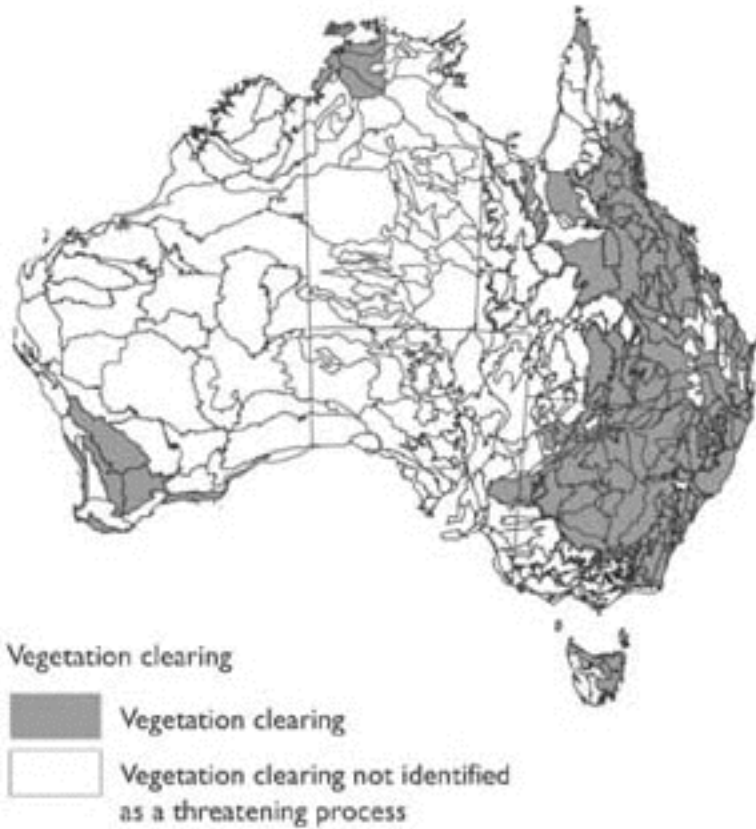
As for reptiles, Australia has more endemic species than any other country. In fact, a tenth of the world's reptiles live only in Australia. But like their amphibian neighbors, Aussie reptiles are threatened more than those in any other country on earth. Reptile biodiversity include such species as the salt water crocodile, which is the largest reptile alive; legless lizards; and all ten of the world's most venomous snakes. The Australian Nature Conservation Agency (1993) identified habitat clearance or modification, overgrazing by stock, cropping, urban development, and predation by introduced mammals as main threatening processes.

Over 700 species of birds are found in Australia (Bird Australia 2003). The Wilderness Society points out that Australia has more threatened birds than 95% of the world's countries as listed by the IUCN (1996). Birds such as the large flightless emu, the laughing kookaburra, and the threatened albatrosses illustrate the range of bird biodiversity. A growing number of native birds are threatened by deforestation and agricultural activities.

Finally, mammals are the group of vertebrates that arguably receive the bulk of attention among Australia's characteristic terrestrial fauna. Marsupials such as kangaroos and koalas have become national icons worthy of conservation for their popular appeal. Monotremes (egg-laying mammals) such as the platypus and the echidna are only found in the Australian plate. With the highest level of mammal endemism, with more species than 93% of 229 countries listed by IUCN (1996), and with more species extinct than any other part of the world, Australia continues to address the key threats to its mammalian biodiversity.
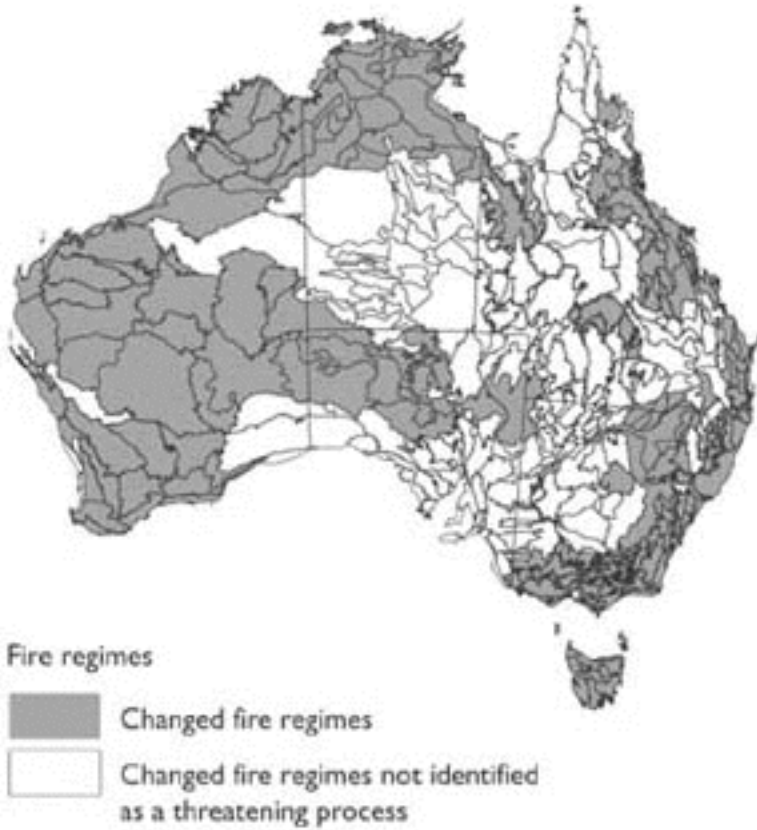
There is a stark contrast between the exploitation of Australian fauna by the Aboriginal people and European-Australians. Whereas 40,000 years of Aboriginal exploitation has resulted in "almost a complete lack of deleterious effects," European exploitation in 200 years has already resulted in the extinction of 19 mammal species (Thomson *et al*. 1987). Furthermore, what sets Australia apart from other megadiverse nations is the fact that it is the only economically-stable nation with a low population density, implying that it has less population pressure to use the bush. However, the two main threats to mammals are land degradation and feral species (SoE 2001, ACF 2001). Agricultural land use to support both the needs of the growing Australian population and the export market has led to a severe land damage deficit of at *least* $60 billion (Archer 2002). Imagine such habitat loss at the rate of 50 football fields every hour! Land damage includes changing fire regimes, which alter the composition of the bush. The Australian Terrestrial Biodiversity Assessment (2002) reveals that more species of birds and mammals are declining in areas thought to be untouched, such as Northern Australia. The following maps in Figures 2–4 show the effect of three threats to Australian vertebrates. Damage to protected areas highlight the need for more cost-effective approaches to threat abatement.

Figure 2: Vegetation Clearing

Vegetation clearing

▣ Vegetation clearing

☐ Vegetation clearing not identified
   as a threatening process

Source: National Land and Water Resources Audit,
Assessment of Terrestrial Biodiversity 2002 Database

Figure 3: Fire Regimes

Fire regimes

■ Changed fire regimes

□ Changed fire regimes not identified
as a threatening process

Source: National Land and Water Resources Audit,
Assessment of Terrestrial Biodiversity 2002 Database

Figure 4: Feral Animals
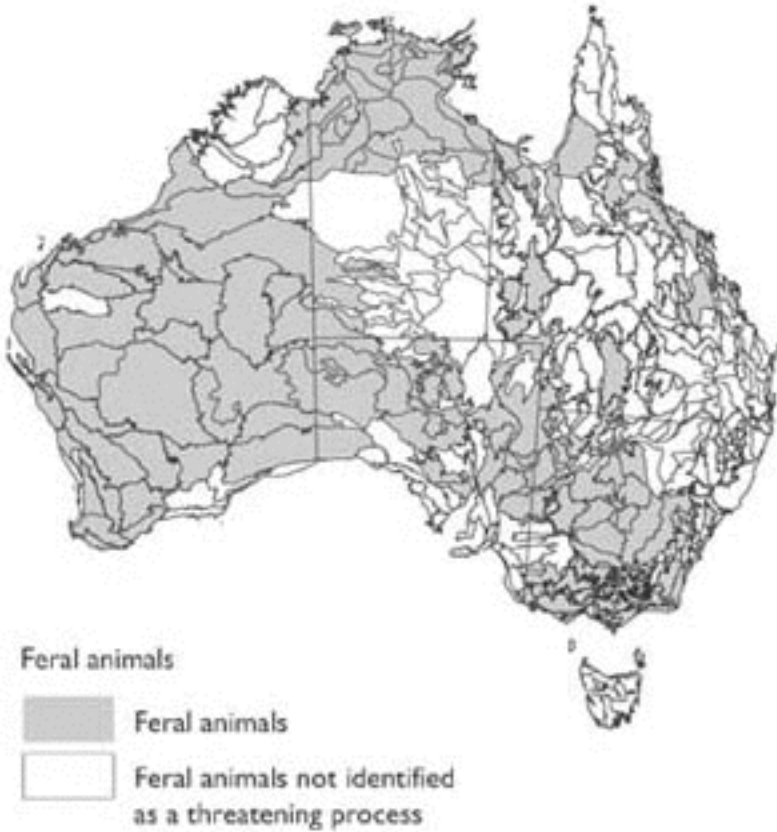
Feral animals

▨ Feral animals

☐ Feral animals not identified
as a threatening process

Source: National Land and Water Resources Audit,
Assessment of Terrestrial Biodiversity 2002 Database

Invasive species such as the fox, rabbit, cat, and goat compete with native species that have not had the evolutionary advantage of adapting mechanisms suitable to deal with feral predators (Short *et al.* 2002). Hence, feral species account for the decline of many medium-sized marsupials.

So after taking in all these alarming facts and figures, what is left to do? While scientists strategically battle the growing threats, we must also keep in mind the ethical and political implications of preserving biodiversity. One essential approach is the increased involvement of indigenous people for their extensive ecological knowledge. The development of the Indigenous Protected Area Program ensures that Aboriginal people are more integrated in land management (SoE 2001). Likewise, national parks have proved to be successful in protecting biodiversity, inspiring action, and generating economic activity. Therefore, as Penelope Figgis argues, there needs to be a reassertion for traditional nature conservation besides a call for more effective management (2002). Pressing issues involve changing roles and responsibilities beyond land management as more people recognize and appreciate the value of biodiversity. Controversy arises with newer approaches such as the concept of a native animal pet industry geared towards conservation or the prospect of recreating extinct species in the future through genetic libraries. Is the solution to clone animals upon extinction? Continued debates over alternative conservation strategies indicate that not one strategy is most effective for every unique situation. Nevertheless, inspiring the community about conservation issues through the popular press and media will do wonders in spreading the values of biodiversity. More than ever, public awareness of human effects on the environment is required to make an impact and to maximize the effectiveness of conservation plans.

Clearly the challenge to find the most successful ways of conserving Australia's biodiversity involves a nationwide effort. Such an effort is only effective when Australians understanding and appreciate how Australia's terrestrial vertebrates survive the considerable risks that humans poses to their existence.

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