

Assessing the risk associated with importing and keeping exotic vertebrates in Australia

Australia is a geographically isolated continent with a rich diversity of indigenous flora and fauna. This diversity was even greater 200 years ago before European settlement and the consequent habitat modification and ecosystem imbalance caused in part by the introduction of new species.

The development of agriculture in Australia relied on the introduction of exotic animal species, such as goats, pigs and horses, some of which subsequently established widespread wild populations and became pests. European rabbits *Oryctolagus cuniculus* were brought in with the first European settlers for food, fur and skins and have subsequently become Australia's most widespread and significant pest animal (Australian Bureau of Statistics 1996). Other exotic species which have subsequently become pests were brought in as companion animals (for example cats, *Felis catus*), for sporting purposes (for example European red foxes, *Vulpes vulpes*), or simply to make Australia seem more 'European' (for example European starlings, *Sturnus vulgaris*). Ironically, a few species were brought in to control existing pests and became pests themselves (for example cane toads, *Bufo marinus*). The result is a suite of introduced animal species—about 20 mammals, 30 birds, 20 freshwater fish, several amphibians and around 500 invertebrates—which are pests of agriculture or the environment (Australian Bureau of Statistics 1996). Hindsight provides the opportunity to prevent additions to this extensive inventory of pests and risk assessment provides a mechanism.

Risk assessment processes for importing and keeping exotic vertebrates have an important role to play in reducing the likelihood of new species establishing and causing adverse impacts in Australia. Risk assessment involves identifying hazardous events (in this case the establishment of new exotic pest species in Australia) and estimating the likelihood that such events will occur and the probable consequences if they do (Beer and Ziolkowski 1995).

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This paper describes the regulation of exotic animal imports in Australia and outlines the risk assessment approach developed by Bomford (1991) that is currently used in Australia. Ways to improve this process by developing a more quantitative approach are then discussed.

The risk

There is an increasing demand for exotic species imports around the world to meet recreational, economic and conservation goals (Nilsson 1981, Lodge 1993). These species have the potential for adverse impacts on agricultural, environmental and urban systems. Future community demands and international obligations under World Trade Organisation agreements concerning free trade are likely to allow increasing numbers of species to be imported into and kept in Australia.

There is a risk that new imported species, or exotic species that are currently kept in private collections and zoos, could escape and establish wild pest populations. For example, the Somali dwarf mongoose *Helogale undulata rufula* is a small colonial carnivore that has significant potential to inflict damage on Australian wildlife if a wild population established. Yet breeding colonies of this species are kept in open enclosures in Australian zoos. Ferrets have established wild populations in New Zealand and have had highly detrimental effects on wildlife (Lever 1985). Yet ferrets can be kept without any permits or restrictions in Australia and a small wild population is believed to have established in Tasmania.

The forms of adverse impact that an established population of an escaped exotic animal could inflict include:

- reduction of agricultural productivity (competition with grazing stock for feed and water, damage to horticultural

crops, predation on stock and land degradation);

- environmental damage (competition with native species for food, water, shelter and nest sites; predation; alteration of vegetation communities through selective grazing and land degradation);
- spread of parasites or diseases;
- attack, harass or annoy people or companion animals, particularly in urban environments;
- structural damage; and
- cost and collateral impact of control measures.

Benefits and issues

Exotic species can bring many benefits to agricultural production, recreation, tourism, scientific and medical research, international conservation efforts and education.

Many of Australia's agricultural and recreational industries are based on introduced animals and there is continuing demand to import new species and genotypes. A number of zoos in Australia are involved in coordinated breeding programs for endangered species, both for release programs and to maintain the genetic integrity of zoo populations. The display of such species may also educate the public about environmental and biodiversity issues.

Key issues relating to assessing the risk of importing and keeping exotic vertebrates are:

- What is an acceptable level of risk relative to potential benefits for the import and keeping of exotic species?
- How can risk exposure be minimised and accepted risk be managed?
- What criteria can be used to assess the potential costs and benefits of importing and keeping exotic species in Australia?

Regulating exotic animal import and keeping

Legislative control over the import of exotic animals is held jointly by the peak Commonwealth environment agency, Environment Australia, and the Common-

wealth quarantine agency, the Australian Quarantine and Inspection Service (AQIS). Both organisations rely on advice on the 'pest potential' of species from a national Vertebrate Pests Committee (VPC) whose members represent relevant State and Federal government agencies. VPC is responsible for examining and reporting on arrangements necessary for the exclusion and control of mammals, birds, reptiles and amphibians, but not fish.

Until 1991, VPC, Environment Australia and AQIS had no framework or guidelines for assessing the risks associated with the import and keeping of potential vertebrate pest species in Australia. Risk assessments were made in a fairly subjective way and were difficult to justify if political pressure was brought to bear on a decision.

Transparent, evidence-based risk assessment processes can be used to increase decision-making objectivity and reduce the influence of social, economic and political pressures. It is essential to get the risk assessment process right prior to the import of an exotic species, because once permission is given to allow a species into the country, it is extremely difficult to reverse it.

The VPC currently lists exotic species in one of five categories based on the threat they pose to agriculture and the environment:

- **Category 1:** 'entry and keeping prohibited';
- **Category 2:** 'restricted to high security collections';
- **Category 3:** 'other collections';
- **Category 4:** 'entry and keeping unrestricted'; and
- **Category 5:** 'pests already widespread'.

Since 1994, VPC has used the risk assessment model developed by Bomford (1991) to determine whether the benefits will outweigh the risks for all species recategorisation applications. Applications are made to VPC by public and private zoos and individual keepers to downgrade category listing for species that they want to import, or species that are already in Australia but that they want to keep in a lower security collection. Linked to the recategorisation process are assessments for 'Approved Collection Status' (ACS) to allow a particular institution to keep a species.

This takes into account the security, credentials and financial viability of the proponent organisation. It also takes into account how conducive the surrounding environment is likely to be to establishment of the proposed species.

The risk assessment model

Bomford's (1991) model was developed on the premise that the import and keeping of exotic vertebrates should be subject to a balanced and rigorous assessment of risk, take account of both potential benefits and harmful impacts, and make use of ecological theory and information on the biology of the species being assessed. The component processes considered are the probability of:

- an exotic species escaping;
- the escapees establishing a wild population;
- the escapees or established population being eradicated; and
- harm associated with the three former factors outweighing the potential benefits associated with the species being imported.

Clearly, some species possess attributes that enhance their ability to escape. Security of premises and keeping restrictions can be used to manage this risk. However, no physical barriers are completely proof against: natural disasters such as floods, cyclones, fires and earthquakes; wilful removal by groups such as animal liberation or illegal traders; and/or vandalism, terrorism, civil unrest or war.

A review of the ecological literature on the factors that affect exotic animals establishing, including analyses of previous successful and unsuccessful introductions, was used to draw generalisations about factors that may increase the probability of establishment in Bomford's model. These include: escape conditions; environmental factors; species attributes associated with establishment; and, public attitudes. There has been little research to identify or quantify the relative significance of these factors or how they might interact.

Contingency plans for mounting a rapid response to the escape of exotic animals from captivity enhance the probability of early detection and eradication and reduce the probability of establishment. The existence and adequacy of such plans may be taken into account in the risk assessment process (Moller and Barret 1996). Once a population is established, eradication chances are likely to be low or non-existent due to high costs, lack of political will and, for many species, the extreme difficulty of the task (Bomford and O'Brien 1995).

There are no cases of any widespread exotic vertebrate population being eradicated on any continent. It is therefore critical that there are contingency plans and associated resources for early

detection and eradication of newly escaped individuals or small localised populations that become established.

Bomford's model weighs estimated adverse impact against estimated potential benefits. A key factor in estimating potential environmental and agricultural damage is the prediction of the probable population densities and distributions achieved by the introduced animal in Australian environments. This is an extremely difficult task, although bioclimatic and landuse matching between the species overseas range and Australian conditions may assist with this task, and is discussed more fully by Bomford and Hart (in press).

Species assessments

Since VPC accepted Bomford's model in 1994, it has been used to assess 14 mammals (11 approved for lower security categories), two reptiles (both approved for lower security categories) and 30 birds (mixture of higher, lower and unchanged security categories approved). The main grounds given by VPC members for rejecting applications was the perceived high risk that the species could establish a wild population, and the associated pest potential, particularly in relation to potential competition with native species and damage to agricultural crops.

Little consideration appeared to be given to potential benefits by VPC. Environment Australia has used the model to assess about 350 exotic bird species known to be present in Australia, to determine the level of risk they posed and hence determine appropriate security requirements for their keeping under the National Exotic Bird Registration Scheme.

An example of the use of the exotic species risk assessment process in Australia is the recent rejection of an application to import the rock hyrax *Procapra capensis*.

This rodent-like mammal is considered hard to contain and has a number of features that indicate a high risk of rapid establishment and spread and the possibility of agricultural and environmental damage including small, fast-moving and secretive; high reproductive and dispersal rates and opportunistic feeding; and potential for wide distribution and high abundance, coupled with generalist.

Quantifying the risk assessment model

Bomford's (1991) model does not use a quantitative scoring system because she considered that this could give a

misleading impression of objectivity and accuracy. Instead, the model was designed to operate as a checklist and decision guide to assist VPC decision makers by ensuring all relevant information was considered. Bomford's model has proved a valuable tool for ensuring all relevant information is taken into account in risk assessments, and also for providing a reasonable level of consistency in assessments. However the model requires a lot of data which is time consuming to collate and assess and for some species data are unavailable to assess particular criteria, particularly criteria for assessing potential benefits and harmful impacts. This can lead to subjective risk assessments. This is a common problem, and although there has been a trend towards more quantitative risk assessment models in the last decade, most biological risk assessments are at best semi-quantitative, due to incomplete information.

VPC is currently considering the feasibility of modifying Bomford's model to incorporate a more quantitative approach to make assessments simpler, less subjective and, hopefully, more reliable. One way to develop a more quantitative risk assessment process is to consider past animal introductions into Australia and compare the attributes of species that established to those that failed. The Bureau of Rural Sciences in the Commonwealth Department of Agriculture, Fisheries and Forestry is assessing the feasibility of developing such a quantitative scoring system based on past successful and unsuccessful bird and mammal introductions into Australia. Of species that established, the attributes of species that became widespread or caused damage can be compared to those that remained localised or did not become pests. Attributes strongly associated with establishment could be allocated a high 'establishment risk' score and attributes strongly associated with environmental or agricultural damage could be allocated a high 'pest damage risk' score. Less strongly associated attributes could be given lower scores. If particular combinations of attributes were strongly associated with establishment and/or damage then these combinations could be allocated additional scores.

Any new species proposed for import or keeping into Australia could have its total 'establishment risk' and 'pest damage risk' scores calculated based on its attributes. Assuming that attributes associated with past successful introductions will indicate the risk for future introductions, and that attributes

associated with current pests are also likely to be associated with future pests, then the total risk score for a species will give an indication of the probability it will establish and become a pest. A score for the bioclimatic match between a species' current distribution and Australian environments could also be included in the total 'establishment risk' score. Such a quantitative scoring system model could be validated by testing its ability to correctly predict the success or failure of past introductions of exotic animals to other countries with similar climates and land uses to Australia, or its accuracy in predicting the success of future introductions to Australia. The model could then be refined to improve its predictive capacity.

Conclusions

There is a need to assess and manage the risk that exotic animal species imported into Australia for keeping in captivity could escape and establish wild populations capable of damaging agricultural production or native species and natural environments. The ecological literature on animal invasions indicates that a range of attributes are often associated with successful establishment of exotic animals and with their potential to become pests. This information has been used to develop a largely qualitative model (Bomford 1991) of risk assessment which has been used successfully since 1994. Due to a perceived need for more quantitative and simpler risk assessments, a review of the process is now being undertaken by VPC.

There is a high degree of uncertainty in assessing the likelihood that a species could establish in a new environment. This is largely due to the variability of factors associated with successful establishment; inadequate information on the ecology, physiology and behaviour of most species; and the cost and long-term nature of research needed to obtain these data. The unpredictability of changes to species' ecology, behaviour, phenotype or genotype in new environments also contributes to uncertainty in predicting whether species will establish and become pests. Although it is desirable to develop more quantitative approaches to risk assessment, these uncertainties will limit the extent to which this is feasible. Hence there will remain a need for a wide margin for error when assessing and managing the risks that new exotic species could establish wild populations that have harmful impacts.

There is also a pressing need to develop contingency plans to respond effectively

to escapes of exotic species to prevent wild populations establishing and spreading. Because there can be no guarantee that escape can be prevented or eradication be possible, species considered to pose a high risk should be prohibited even if they represent significant potential benefit. Despite the risks posed by exotic species imports, there are also economic and social benefits that need to be considered in decisions on allowing imports. Banning imports poses the risk of encouraging illegal smuggling. Hence a scientific and evidence-based, transparent risk assessment model, which is quantified to increase objectivity and reliability where adequate information is available, is the best approach to manage these risks. This will allow the balance between free trade and risk to agriculture and the environment to be optimised.

Australia has an extremely high expenditure on exotic vertebrate pest control. By contrast, little money or resources are used to assess or manage the risk of further exotic species becoming pests. It is appropriate that adequate resources be invested in the risk assessment and management process.

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News...

8th IDNDR Pacific Regional Disaster Management Meeting

The 8th IDNDR Pacific Regional Disaster Management Meeting was held in Apia, Samoa on 6–10 September. On the first evening, the Samoan Government generously hosted a kava ceremony, opening ceremony and cocktail party officiated by the Samoan Minister for Agriculture, Forests, Fisheries, and Meteorology, and attended by the Prime Minister of Samoa.

The meeting considered many important issues relating to disaster management in the region, including the implementation of agreed disaster reduction work programmes and the transition of regional coordination of disaster management activities to the South Pacific Applied Geoscience Commission (SOPAC). Participants expressed support for the continuation of these meetings beyond the end of the International Decade, although this was to be the last one to be held under the IDNDR banner. These meetings now provide an important focus for disaster management activities in Pacific Island Countries and are a key forum for the exchange of ideas and facilitation of regional cooperation.

New Books

Fire-related aspects of the Northridge earthquake

Scawthorn C; Cowell A. and Border F. 1998, *International Inc., San Francisco, Calif, EQE*.

Fires following earthquakes are a potentially serious problem due to multiple, simultaneous ignitions at a time when emergency response is seriously impaired. The January 17, 1994 Northridge earthquake was the largest to occur in a U.S. city in more than 20 years, sparking about 110 earthquake-related fires. This report provides the results of research performed with the support of the National Institute of Standards and Technology. It contains information on the Northridge quake and its impacts, including seismology, building damage, the effects on water and gas supplies, and fire department response. It also includes sections on data on fires following the quake, a comprehensive analysis of distribution and ignition characteristics, information on operations at selected fires, and lessons and observations. (1 v.)

Gresford: the anatomy of a disaster

Williamson, Stanley
1998, *Liverpool University Press, Liverpool, 224pp*.

The first readily available account of the worst disaster of the North Wales coalfield and one of the worst in the history of the British mining industry. The disaster occurred in 1934: 256 men lost their lives, 200 women were widowed and 800 children lost their father, causing massive devastation of a small community. A great wave of public sympathy followed and a public appeal resulted in donations to disaster funds amounting to 560,000 pounds, an immense sum for those times. At a subsequent inquiry, of great significance for the future of the mining industry and its safety, the North Wales miners were represented by Sir Stafford Cripps. The disaster was also a great influence in the establishment under Lord Rockley in 1935 of a Royal Commission on Safety in Coal Mines.

Scrutiny of evidence relating to the Hillsborough Football Stadium disaster

Stuart-Smith, Murray, Sir
1998, *Stationery Office, London, 222pp*.

The report is divided into seven chapters, with Appendices. Chapter 1 sets out the background to the Hillsborough disaster and the sequence of events since. Chapter 2 deals with allegations about video evidence relating to the disaster. Chapter 3 discusses allegations about the inquest and the rescue operation following the disaster. Chapter 4 is about suggestions that improper pressure has been put on witnesses to the disaster. Chapter 5 and 6 deal with issues that have been put by relatives of victims and some other miscellaneous points. Chapter 7 summarises the findings.

Organizational learning under fire: theory and practice

Carley K. and Harrald J., 1997, reprinted from *American Behavioral Scientist, Vol 340, no. 3, pp 310–332*.

Explores the differences between organisational learning in theory and in practice as demonstrated in the actions of the organisations (e.g., Red Cross, the Federal Emergency Management Agency) responding to Hurricane Andrew. Two factors are considered in the groundwork for this analysis: 1) the interrelationship between disasters and organisational learning; and, 2) what was and was not learned from recent major disasters (Hurricane Hugo and the Loma Prieta earthquake). Then, a series of theoretical propositions concerning organisational learning is examined. Finally, the actual role of learning in disaster settings is discussed. Analysis revealed that organisational learning in theory and in practice were somewhat different. Planning was not a panacea and plans tended to be laid aside. In cases where objective performance feedback enabled organisational learning, disaster response organisations were more likely to receive subjective performance feedback from the media, which decreased their ability to learn.