
The law and economics of feral extermination: Legal and economic answers to eradicating the cane toad

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The cane toad is a major environmental threat, but programs for its eradication/control are fragmented, ad hoc and seriously underfunded. They reflect a legal regime for feral eradication hampered by inefficient coordination and inconsistent legislative regimes, resulting in suboptimal eradication strategies created and managed at departmental level. The threat abatement plan (TAP) initiated by the federal government is hampered by this legal environment. There is no system in use in Australia for valuing biodiversity. As a result there is no accepted method to value biodiversity loss caused by the toad. Until that is rectified the underfunding of feral extermination will probably continue and our biodiversity will continue to decline as a result. Recommendations are made for legal reform of feral extermination laws, which should reflect the scale of the threat determined by a proper system for valuing biodiversity loss.

THE TOAD: THIS IS NOT A LOVE STORY

The cane toad (*Bufo marinus*), referred to herein as “the toad”, represents a major threat to the environment. Yet it is open to question whether the full armoury of legal, scientific and social measures is being used to control, let alone eradicate it. New ideas are urgently needed that result in coordinated eradication programs.

Science has led the way in attempts to control the toad. Recent developments include discovery of a toad tadpole “alarm pheromone” which they produce when alarmed or frightened.¹ Once detected, the tadpoles flee from the site where the pheromone was emitted. The idea here is to expose the toads to the pheromone to “stress” them and hopefully kill them. Tests indicate that those surviving are smaller than normal adult size, making them more vulnerable and less likely to survive. The development of pheromones to control the toad is a key advance in cane toad control research.

Another scientific advance has been made by researcher Georgia Ward-Fear.² Her work has involved identifying the predation of meat ants (*Iridomyrmex reburrus*). Cane toads apparently have not adequately adapted to the environment frequented by the meat ant and are killed by the ants when they emerge from the tadpole stage. The idea is to increase the presence of meat ants at toad sites with the aim of increasing their use as a control mechanism for toads emerging from the tadpole stage, without any negative impact on native species. The research has also extended to identification of other aquatic native insects that can be used to control toad tadpoles.

The real scientific Holy Grail though for toad control probably rests with stopping the toads from reproducing. Recent research from Team Bufo of Sydney University has revealed a chemical that attracts the toad tadpole, but no other species of frog. The chemical is extracted from the parotoid glands of dead toads, so it is a cheap by-product of toads with a big potential impact for reducing toad numbers. The idea is to use this chemical as bait to catch toad tadpoles in high volume and eliminate them. The main downside is that the chemical is poisonous and so should be handled with care. This

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¹ Shine R, “Some of Team Bufo’s Ideas on Cane Toad Control” (2011), <http://www.canetoadsinoz.com/newideoncanetoadcontrol.html>.

² Ward-Fear G, “Meat Ants” (2011), <http://www.canetoadsinoz.com/meatants.html>.

development, along with the advances in pheromones (including the discovery of a “suppression pheromone” – a chemical produced by older toad tadpoles that kills younger ones), is arguably the most promising in toad control.³

Elimination of the cane toad by manual eradication is seen as unviable. A single clutch can contain approximately 30,000 eggs. If you eradicated 99% on the ground, the few remaining could reproduce all that had been manually collected. Manual removal seems almost universally rejected as a serious method in controlling the toad on its own other than locally. While the arithmetic here is compelling it should not prevent manual eradication techniques used in coordination with scientific developments. The suppression and attractant pheromones have proved effective in reducing the toad numbers, so they at least offer some hope for controlling the toad’s spread.

Another new development with great potential in eradicating (instead of just controlling) the toad lies in gene manipulation. Current scientific research includes the release of genetically modified toads that pass on male genes and sterile toads with no breeding capacity. If these projects were successful, the toad would eventually lapse into extinction in Australia.

The main challenge for these scientific advances is to ensure that cane toad chemical traps using the aforementioned developments are placed in sufficient waterholes to control the toad. This is a logistical problem that might be addressed through the many local community groups eager to eradicate the toad (eg the Northern Territory’s Frogwatch Group and the Kimberly Toad Busters).

The foregoing scientific developments in toad control demonstrate that the scientific community is making valuable contributions to toad control. This article looks at the legal and economic factors that must also be employed to eradicate the toad. A combination of scientific thinking, legal/economic thinking and ongoing community involvement might just be the answer to the toad problem.

CURRENT STATUS OF GOVERNMENT POLICY: THE TOAD’S LEGAL STATUS

The impact of the cane toad is listed as a key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). This means that the toad is identified as threatening to local ecology, particularly the northern quoll and the green and golden bell frog. It is subject to a threat abatement plan (TAP) issued pursuant to s 183 of the EPBC Act. The details of that plan will be discussed a little later.

The Commonwealth government considers cane toads to be a national problem since they are dispersed in three Australian States (Queensland, New South Wales and Western Australia) and the Northern Territory. There is concern that the toad will soon be present in South Australia via the river system from the currently affected States.

The government does support research on the toad through the CSIRO and the Australian Research Council. It set up a cane toad advisory group (since disbanded) made up of State and Territory representatives and scientists to keep it up to date on latest developments. There is also some coordination of industry and local government in control activities.

The government considers that the scale of the infestation renders eradication (except locally) not practicable. Focusing on positive biodiversity outcomes through decreasing the impact of toads and containing their spread is seen as offering the best option for the future. Preventing their access to areas of high biodiversity value is an important part of the government’s strategy. Currently, the government provides funding to community projects through the Caring for Our Country initiative and supports information dissemination about the toad to educate local communities.

At a State level the Queensland Government published a pest risk assessment on the cane toad in 2010. This document highlights that the impact on native wildlife from the toad is significant, with anticipated further declines in native predator populations, especially the northern quoll. Current

³ Shine R, “Cane Toad Tadpole Control” (2011), http://www.canetoadsinoz.com/cane_toad_tadpole_control.html.

correlative modelling of the potential range of the toad predicts it could eventually occupy two million square kilometres, including 76% of the coastline.⁴

A numerical risk assessment system developed by Bomford is widely used to assess risk of vertebrate species.⁵ It predicts a species potential distribution using climate modelling computer programs. It then allocates scores for a number of attributes relevant to a species' pest status, including: biology; costs to the economy, the environment and society; and management efficacy. Using this method the toad has been assessed as an "extreme" threat species.

In Queensland the cane toad is considered a significant pest but is not listed as a "declared" pest as defined by the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld). As a non-declared species there is no legal obligation on the owner of land to ensure their land is free of the toad and no restriction on possession and movement. A declared species would place an obligation on every landholder to take control measures but this is considered not practical. The toad is not a protected species under the *Nature Conservation Act 1992* (Qld) so it may be controlled if this is done in a humane manner. Local government does not have an obligation to control the toad, but may do so. The government's priority appears to be to remove it from designated areas, which is demonstrated by the Department of Agriculture, Fisheries and Forests currently working with other agencies to eradicate it from an island in the Torres Strait.

On its face the non-declared status of the cane toad is an admission that the species is so well established that it is not practicable to expect landholders to proactively take measures to eradicate it from their land. Is this policy defensible? To answer that definitively would require an understanding of its spread, estimated numbers and an assessment of the resources required to remove it by landholders and local government. There is an economic factor in addressing eradication.

In contrast to Queensland, the cane toad is a "declared animal" in Western Australia under the *Agriculture and Related Resources Protection Act 1976* (WA). As such, entry of the species into the State or keeping it is prohibited and the species is subject to eradication in the wild through community coordinated and government funded programs. By comparison, in the Northern Territory, the toad is considered a major pest but not a "declared feral species" under the Territory's *Parks and Conservation Act 2001* (NT). In New South Wales it is a "Category 2 Non-Indigenous Animal" under the *Non-Indigenous Animals Regulation 2006* (NSW). A Category 2 species is one with "high pest potential or of significant conservation value".

There is a lack of consistency between States in the legal status of the cane toad which does place into question the effectiveness of holistic and consistent coordination of control measures. Such measures should ideally be overseen by the Commonwealth government in conjunction with the States and Territories. Achieving consistency in the toad's pest status would be a good start in such a coordinated effort.

THREAT ABATEMENT PLAN AND OTHER CONTROL ACTIVITIES: AN EVALUATION

The Commonwealth currently has a threat abatement plan (TAP) in place pursuant to s 270A and s 183 of the EPBC Act. The TAP was instituted in 2011 and contains three stated objects:

1. To identify priority native species and ecological communities at risk from the impact of cane toads.
2. To reduce the impact of cane toads on priority native species and ecological communities.
3. To communicate information about cane toads, their impacts and the threat abatement plan.

The Commonwealth has acknowledged that the total spend for the control of cane toads from 1986 until 2009 was approximately \$11 million, with a further \$9 million spent on other cane toad research and management activities. This amount perhaps reflects the government's rather blunt

⁴ Urban MC, Phillips BL, Skelly DK and Shine R, "The Cane Toad's Increasing Ability to Invade Australia is Revealed by a Dynamically Updated Range Model" (2007) 274 *Proceedings of the Royal Society of Biological Sciences* 1413-1419.

⁵ Bomford M, "Risk Assessment Models for the Establishment of Exotic Vertebrates in Australia and New Zealand: Validating and Refining Risk Assessment Models" (Invasive Animals Cooperative Research Centre, Canberra, 2008).

statement in the TAP that “eradication of cane toads is not currently possible”. Instead, the focus of the TAP is on protection of high priority species or ecological communities vulnerable to the toad.

The TAP outlines how the Invasive Animals Cooperative Research Centre (IACRC) supports a Cane Toad Advisory Group (CTAG). The latter is described in the TAP as a major coordination point for actions taken under the TAP. Unfortunately, the CTAG no longer exists and the IACRC does not have authority to deal with the TAP. Instead, the TAP is administered through the Commonwealth Department of Environment. This makes assessing the effectiveness of the TAP problematic since actions are undertaken at departmental level and the Department is dealing with a number of threat abatement plans. Assessing funding is a forensic exercise based around funding for particular projects, which may not be exclusively directed at toad control. Currently, the feral cat is considered one of the highest threats being dealt with under a TAP and funding is prioritised accordingly.⁶

Objective 1 of the TAP is to identify high native species and ecological communities at risk from the toad. The identification of vulnerable species and ecological communities will then enable allocation of resources to these identified hot spots.⁷

The purpose of Objective 2 is “to promote effective tools that can be used to reduce the impact of cane toads on native species”. The use of these tools is seen as the responsibility of all stakeholders in the priority identified areas. The process is stated to include preparation of guidelines, including codes of practice and standard operating procedures to protect these priority areas.

Objective 3 is about community education and how the TAP is being implemented. This involves web-based information, and communication of management plans to stakeholders.

The progress of the TAP can be evaluated through the TAP performance indicators listed against each objective. Of course the TAP can be evaluated against other independently determined criteria. Assessment of the TAP is somewhat problematic as it is dependent on release of information at departmental level.

For Objective 1 the performance criteria are:

1. Identification of ecological communities and species at risk from cane toads.
2. Scientific evidence for species suspected to suffer high impact from cane toads.
3. Research that supports understanding of impacts of cane toads, improved understanding of recovery measures and improved resourcing agreements between jurisdictions.
4. A prioritisation tool for allocation of resources to ecological communities and species protection for the toad.
5. The prioritisation tool applied at national level.

In relation to Objective 2 the main performance indicators are:

1. Application of the TAP to designated ecological communities and species.
2. Management plans agreed with relevant stakeholders for each of the species impacted by cane toads at a population level within 18 months of the TAP being issued.
3. Preparation of plans across all land tenures for high priority species and ecosystems protection and monitored by the government.

In relation to Objective 3 the main performance indicators are:

1. Reporting of cane toad management actions and monitoring of results.
2. Regular updating of cane toad fact sheets.
3. Threat abatement plan priorities are communicated directly to communities and stakeholders within three months of request.

In relation to the progress of the TAP, the formal review process will be undertaken in 2016 which is the stipulated five-year review period required under regulation. The review will be conducted by the environmental biosecurity section of the federal Department of the Environment.

⁶ Ms Anne Ferguson, officer in the Department of Environment, Canberra.

⁷ This will require a high degree of uniformity of action that will presumably be enhanced by coordination of the cane toad’s legal status under each relevant State Act. Given the current inconsistent legal classification between States on the toad’s pest status this would appear to be one thing that the Threat Abatement Plan must still address.

In terms of current progress, prior to the formal review in 2016, this is difficult to assess. A Department spokesperson indicated that the federal Department of Environment works with States and Territories to control toad impacts, but noted primary responsibility for invasive animal control belongs with the States and Territories. They affirmed that the TAP is not meant to be a vehicle to eradicate feral animals and is a control measure. The federal spokesperson did confirm that, since 1986, the federal government has directed more than \$11 million towards the “broad scale control of cane toads, with limited success”. The emphasis was affirmed to be on reducing the negative impacts of the toad on key natural assets. They confirmed that recent funding included a Caring for Our Country program for the Burnett Mary Regional Group for natural resource management (Fraser Island World Heritage Area program) to undertake a pilot cane toad control on Fraser Island in 2015. It should be also noted that the Queensland Parks and Wildlife Service (QPWS) is supporting a community initiative by the Fraser Island Natural Integrity Alliance (FINIA) to undertake a pilot program with researchers from the University of Sydney to trial a cane toad tadpole trapping technique developed by the university. In January 2015 the federal government announced that it was investing \$500,000 over two years in the Kimberley Cane Toad Clean Up program. Funding will be provided for activities that contribute to the development and promotion of effective tools that align with the cane toad TAP priorities.

In relation to Queensland State government policy to control the toad, the official position is that the toad is not a declared pest under the *Land Protection (Pest and Stock Route Management) Act*. As a result the toad is considered “established” in Queensland and therefore no eradication/control programs are currently being funded by the State government.

What are we to make of the current TAP process for the toad and the combined State and federal eradication/control activities for the toad generally? Assessment is difficult given that the review is still a year away and interim assessments of the TAP are difficult to obtain. What we do know can be summarised as follows:

1. Since 1986 the spend on the eradication/control process for the toad is approximately \$11 million, with another approximate \$9 million on related research and toad management activities.
2. The federal government has stated in writing that eradication is not possible. The Queensland government position is similar when it states that the toad is not a declared species as it is “established” in Queensland (the implication being that eradication activities are pointless for established species).
3. The federal government has had a TAP in place for control of the toad since 2011 and it is up for review in 2016.
4. Funding at a federal level for TAPs is prioritised according to the perceived seriousness of the threat. Currently, the federal government sees the feral cat as a greater threat than the toad.
5. The first objective of the TAP is identify high native species and ecological communities at risk from the toad.
6. The second objective of the TAP is to promote effective tools that can be used to reduce the impact of cane toads on those native species and ecological communities identified in the first objective.
7. The third objective is to educate the community about the toad and the implementation of the TAP.
8. The current priority of federal government policy in relation to the toad is to reduce the impact of the toad on vulnerable native species. It is not clear how many affected species and communities have been identified in response to the first objective.
9. The TAP has a number of performance criteria by which it can be assessed in the review period in 2016.
10. Despite the TAP and a number of funded programs in different regions of Australia (eg the Kimberley), the federal government has confirmed that primary responsibility for control of invasive species lies with the States.
11. The Queensland Government official position is that the toad is not a “declared” species so that currently there is no eradication/control activities underway at Queensland State government level.

It is possible to make some, albeit tentative, and perhaps only interim, observations on current toad control activities. First, given the projected range of the toad invasion, and that estimated toad numbers are in the hundreds of millions, the accumulated spend on toad control activities since 1986 of approximately \$20 million appears manifestly inadequate. Second, there is possibly a misdirection in policy to simply “declare” that eradication is not possible. Leaving aside biological imperatives that may well be fully in support of such a position, this policy effectively “neuters” a more vigorous policy response and possibly leads to underfunded policies on control activities.

The current State/federal divide on invasive animal control powers arguably leads to a policy vacuum in some areas of toad control, dilutes coordination capability and may well hamper a more vigorous policy response. The current TAP is a step in the right direction for toad control, and the policy of protecting vulnerable species and ecological communities is a good one. However, it should be part of a suite of control activities and for this to be the main objective of the TAP is limited in terms of overall threat abatement. It effectively “closes down” a more holistic policy response. As such the overall effectiveness of the TAP is in question.

Given that there are a number of gaps in the current toad control response, there is a manifest need to address two main issues:

1. The cost of the toad in terms of biodiversity loss/damage.
2. Whether a legal and economic assessment can help us identify a more rigorous toad eradication policy response.

IS THERE A BETTER POLICY RESPONSE?

At issue is the question of whether the current policy under the TAP adequately deals with the realities of the toad. On the one hand the government openly acknowledges that the cane toad cannot be eradicated based on current knowledge and believes the TAP is appropriate. On the other hand it is arguable whether the full armoury of eradication and control tools is being used.

The first issue to consider is the legal status of the toad. As its legal status varies between States there is a need for each jurisdiction to agree on the pest status of the toad to ensure coordination of control measures across borders are uniform.

Governance remains a key issue in the implementation of the TAP for the toad. The control of invasive alien species has been described as a multidimensional exercise that engages a variety of participants across all levels of government.⁸ It is argued that the federal regime for the control of invasive species is a “tangle of laws, regulations and policies that traverse a range of environmental and natural resource systems”.⁹ Federally, the main Acts relevant to invasive species are the *Quarantine Act 1908* (Cth) and the EPBC Act. It is under the latter Act pursuant to s 183 that the biological effects of the toad are listed as a key threatening process invoking the operation of the TAP. The fact that the TAP was initiated only in 2005 highlights that controlling the toad was not an urgent federal priority, given that the EPBC Act was passed in 1999.

There are also a number of federal Ministerial Councils and Intergovernmental Agreements that have authority over invasive alien species. There is no single Intergovernmental Agreement relating to invasive species, but there is provision for ad hoc government agreements to be formalised when deemed necessary, such as the Australian Weeds Strategy. The federal government has also initiated bodies such as Caring for Our Country (a successor to the National Heritage Trust) with the role of providing funding for environmental management of natural resources and the protection of the environment.¹⁰

In respect of the States and Territories, they too have a mix of legislation and associated policy instruments to deal with invasive species. Each State has legislation that covers the eradication and/or

⁸ Riley S, “Law is Order, and Good Law is Good Order: The Role of Governance in the Regulation of Alien Species” (2012) 29 EPLJ 16.

⁹ Riley, n 8 at 27.

¹⁰ See Caring for Our Country, <http://www.nrm.gov.au>.

control of declared pest animals. They have also instituted legislative and policy responses to protect threatened species and ecological communities from invasive species.¹¹ However, not all States have legislation allowing for the listing of threatening processes. For example, Queensland's *Nature Conservation Act* does not provide for the listing of threatening processes.

Gaps and inconsistencies in the legislative control of invasive species do exist and the system is seen by some commentators as marred by its "piecemeal approach, jurisdictional inconsistencies and lacklustre governance and coordination mechanisms".¹² There is no national invasive alien species strategy covering invasive species. While the States have adopted various biosecurity measures, they vary in how they deal with associated environmental considerations.¹³

States and Territories manage invasive species within their jurisdictions, leading to a fragmented policy approach at State level. Different pest classifications of the toad apply in different States, and the States differ in the way they deal with the integration of biosecurity and associated environmental considerations. There are also differences in how different jurisdictions deal with the listing of threatening species and the obligations arising upon listing. For example, under the Commonwealth EPBC Act the Minister must prepare a TAP once a species is listed, but only if the plan is a feasible and efficient way of managing the threat. Compare this to Victoria, where the Minister must prepare a TAP for a declared pest.¹⁴

While, for the toad, there is a national TAP authorised by the Minister pursuant to s 183 of the EPBC Act, it would be of assistance if this process could be reflected consistently through State regimes. In particular, if there is a nationally sanctioned TAP then there needs to be a similar legislative response in all States and Territories. This is not to duplicate the processes under the TAP process, but simply to ensure that all State and federal resources are conjoined under a nationally consistent plan, and that the coercive powers, resources and penalty regimes of all jurisdictions are coordinated under one plan.

All available resources, both State and federal, should be coordinated under one body. A unified regulatory system that reflects agreement between States, Territories and the federal government, with one regulator exclusively dedicated to the task of eradication, is urgently needed. This does beg the question of how best to involve the States and Territories under federal government leadership. One regulator covering invasive species such as the toad may require the States to refer their powers in dealing with invasive species to the federal government pursuant to s 51(xxxvii) of the *Constitution*. A TAP should be coordinated through a single regulator and implemented in conjunction with the States and Territories. Until the full armoury of government resources at all levels (federal, State and local) is used in a coordinated manner, it cannot be said that Australia is properly addressing the toad threat.

ALTERNATIVE POLICY RESPONSES: LAW AND ECONOMICS ANALYSIS

Valuing biodiversity: An assessment of different methods

The current TAP is an attempt to deal with a problem of long standing. It is not suggested that it is misguided in form or intent but it is suggested that the scale of the abatement operation, its resource funding, and its actual impacts, fall well below the scale of the threat. In other words, the response of the TAP is not in proportion to that threat. Part of the problem lies in the failure of government to place a value on the damage done by the toad. Some understanding of the process of valuing natural resources is required in order to do this. By valuing natural resources it becomes possible to place a value on the damage that is being done. Hopefully this in turn can help define a broader-based policy response. Until a value is placed on the damage done by the toad there is a danger that policy responses will remain seriously underfunded.

¹¹ See eg *Threatened Species Conservation Act 1995* (NSW), ss 8 and 13.

¹² Riley, n 8 at 35.

¹³ The Queensland Biosecurity Strategy does seek to integrate biosecurity matters with environmental consequences of invasive species, while New South Wales does not.

¹⁴ *Flora and Fauna Guarantee Act 1988* (Vic), s 19.

Early attempts to value environmental resources have attempted to place value on items that were not subject to any market. Contingent valuation, for example, was a method used by economists to value public goods.¹⁵ This method creates a hypothetical market for an unpriced good and asks individuals to place a dollar value on a proposed change that may occur to either quality, quantity or access. Contingent valuation has been used to estimate the value of wetlands protection.¹⁶ While some may argue that contingent valuation is not appropriate for assigning a monetary value to unpriced environmental goods, it has been frequently used.¹⁷

The problem with contingent valuation is that while people may have strong beliefs and feelings about environmental value, they may not normally think of them in monetary terms. Why people make preferential decisions, or prefer one thing over another, or place greater value on one thing compared to others, makes contingent valuation problematic in its application. The context in which a response on value is being elicited from a respondent will affect their response. People do not always give a value in monetary terms, especially with non-market type items.

The question becomes how to construct a defensible method for obtaining environmental values. The valuation of environmental resources has a multidimensional aspect. Environmental resources have multiple uses so it would follow that some people may value them according to their perceived dominant use and others may look at a variety of values in an environmental good. The application of multi-attribute utility theory was seen as one way to account for the multidimensional value of environmental resources and to provide an intellectually rigorous way to attach numbers to the values that people place on natural resources. It has been described as a set of axiomatic theories of preference.¹⁸ This approach theorised that if people make choices based on their preferences, and these choices satisfy the axiomatic theories of preference, then it is possible to assign numbers to values and then define a rule for combining the numbers into a summarised format. A larger summary measure has a higher value compared to an object with a smaller summary measure. The aim of multi-attribute utility theory is to help decision-makers make choices between alternative plans of action. It could be used with contingent valuation, for example, to provide dollar-based evaluations of identified non-market goods in relation to natural resources.

To illustrate its application consider the basic lifecycle of the toad albeit in a summarised format and mainly projected around its food intake. It is clear that the toad can consume large volumes of invertebrates. Juvenile and adult toads feed on a small variety of small prey, predominantly ground dwelling arthropods. The toad is believed to consume approximately 200 food items per night. While the bulk of the diet is stated to be ants, beetles and termites, the toad can eat anything that fits into its mouth, including a wide variety of insects, frogs, small reptiles, mammals and birds. Cane toads are also considered to have the potential to compete with native species for food and shelter sites. As a result, the toad is considered a key factor in the decline of many native species. Thus it is worthwhile to measure loss of biodiversity as a result of the toad's activities.

The suggested use of contingent valuation and multi-attribute utility theory is based around four steps. First, there is a need to structure assessment by organising information that describes the problem. The aim is to gain a meaningful picture of all factors that contribute to the value of the good, which is the biodiversity loss caused by the toad's activities. Information from ecological experts to gain further insight into the toad's destructive lifestyle attributes is required so that we can structure the problem to enable respondents to place a value on the facts. The type of information needed would

¹⁵ Gregory R, Lichtenstein S and Slovic P, "Valuing Environmental Resources: A Constructive Approach" (1993) 7 *Journal of Risk and Uncertainty* 177.

¹⁶ Loomis J and Kanninen B (1991) "Willingness to Pay to Protect Wetlands and Reduce Wildlife Contamination from Agricultural Drainage" in Dinar A and Zilberman D (eds), *The Economics and Management of Water and Drainage in Agriculture* (Kluwer Academic, Boston MA, 1991).

¹⁷ Phillips C and Zeckhauser R, "Contingent Valuation of Damage to Natural Resources: How Accurate? How Appropriate?" (1989) 4 *Toxic Law Reporter* 520.

¹⁸ Keeney R and Raiffa H, *Decisions with Multiple Objectives* (Riley, New York, 1976).

include: the native species that are potential prey of the toad; species affected by toxic ingestion of the toad (given its toxicity when ingested); and how it may compete with and contribute to the decline of native species.

The value attributes are made explicit from the start to those whose opinion is sought. They would also be asked to explain why they place a value on the activity to the level they choose (eg damage to native wildlife, etc). Careful selection is required to obtain a diverse range of stakeholder respondents. The aim is to ensure that a full range of views is covered by the process. The goal is to find a single hierarchy of values that all of the diverse stakeholders can agree upon. As the aim is to do a study on the monetary value of damage resulting from the toad's lifestyle it is essential that technical experts describe the position both before and after the presence of the toad. These descriptions are then presented to the representatives of the people that are affected by the damage to identify the value attributes. Admittedly, this may be difficult to do since people may not volunteer that they are affected by the toad's activities. However, this should not deter from the reality that native species are lost, resulting in a loss or decrease in genetic diversity with a consequent flow-on effect on ecological integrity for the affected region. Losses might be structured around loss of ecological integrity, biological diversity, human health effects and possible commercial impacts (eg decrease in use of tourist regions in areas affected by the toad). Such losses indicate the attributes that stakeholders are being asked to place a value on.

The second stage involves an assessment of utilities or values from the stakeholder groups. This assessment requires valuation of the lowest level value scale. This is effectively a process to determine the lowest common denominator in order to then assess the range from the lowest to highest value score. It is important that this range remains fixed for the whole process. Trade-offs may be factored in using weights or multiplicative factors designed to recalibrate the values, recognising that not all attributes of value are equally important.

It is then necessary to calculate the total value for a particular scenario. This total utility value is expressed using a single arbitrary "utile" unit of measurement, which under contingent valuation would be converted into dollars.

The final requirement is to perform a "sensitivity analysis". This requires a recalculation of the final value using variations in the utilities being reviewed and any trade-offs that might need to be made. The type of trade-off that might arise may require additional elicitations from stakeholders based on comparative results from different stakeholders. The different stakeholder groups would be expected to produce different utilities and trade-offs. The aim of sensitivity analysis is to reveal the reason for the different assessments of value. The review process would allow for each stakeholder group to assess whether trade-offs or changes to their valuation would be acceptable to the group.

The foregoing analysis is not designed to represent a detailed outline of contingent valuation or multi-attribute utility preference theory. It is an outline designed to illustrate a process that can be undertaken to place value on natural resources. To assess a dollar value of loss of ecological diversity as a result of the toad's activities gives a context by which current policy and associated expenditure can be assessed.

Environmental decisions could also be assessed using a cost benefit analysis. This has gained acceptance as a methodology for decision-making with respect to environmental policy in some quarters of the United States and the United Kingdom in the past.¹⁹ It is not possible to do a cost benefit analysis for toad evaluation, however, unless there is some accepted method of valuing protection of biodiversity. The way that biodiversity impacts natural and economic systems is complex. The average person is likely to be uninformed about the costs and benefits of biodiversity protection. Therefore, the way they may allocate preferences in any valuation study is highly problematic.

¹⁹ Andrews R, "Economics and Environmental Decisions" in Smith VK (ed), *Environmental Policy Under Reagan's Executive Order* (University of North Carolina Press, Chapel Hill NC, 1984).

People need to understand basic information, such as an accepted definition of biodiversity, in order to place a value on its protection.²⁰ Then comes issues such as the area of the biodiversity affected, thereby raising definitional issues at a global or local level. There is also the question of quantifying the optimal distribution of diversity across localities. How do we value biodiversity protection when it is conducted in conjunction with other activities such as production of goods or services? The fact is that the extent of biodiversity is only one measure of the condition of an ecosystem. The reasons given to protect biodiversity will also vary and so the weighting will vary as well. So, at an empirical level, it is difficult to measure the economic benefits of biodiversity compared to other services.

The economic question relating to biodiversity valuation relates to the economic value as determined by people's preferences. These preferences are not necessarily easily reconciled with standard cost benefit analysis. Cost benefit analysis historically has been based around the Kaldor-Hicks Compensation Test, which states that resource allocations are efficient if they allow those who gain to compensate the losers and still be better off. So a main aspect of the Kaldor-Hicks test is to allow for compensation, which means a willingness to give up certain benefits in return for offsetting gains in income. The least amount of compensation the losers will accept in order to approve the resource allocation is their minimum willingness to accept compensation, compared with the maximum willingness to pay of the gainers for their allocation.

From an historical perspective there was some early empirical evidence of a refusal by some people to allow a trade-off of losses in environmental quality against increases in income.²¹ Such people have been described as holding a rights-based ethic in respect of environmental quality.²² They will be less inclined to make the trade-off since they believe there is a moral duty to protect certain ecological communities regardless of price. They would argue that protecting the environment has an intrinsic value which has been defined as being a value that exists independent of the utility of the object being valued to the valuer.²³ The cost benefit analysis process is at odds with the views espoused by rights-based ethicists since they do not embrace the view that value is based on outcomes, such as the changes in utility based on losses from biodiversity. It is through utilitarian value systems that cost benefit analysis is based. So, in order to use cost benefit analysis it would necessarily require understanding the extent of rights-based beliefs for biodiversity protection. This would be as relevant for contingent valuation as it would for a cost benefit analysis.

Although there are problems in conducting cost benefit analysis based around a utilitarian trade-off, this should not necessarily prevent a utilitarian value for biodiversity protection being assessed.

Failure to place a value on biodiversity protection is a major policy mistake resulting in serious underfunding of environmental protection programs such as the TAP for the cane toad. The processes of government should extend to information dissemination about biodiversity conservation. This would seem to be a necessary requirement in order to enable contingent valuation to be successfully used in valuation of non-market benefits of biodiversity conservation. There is evidence that an increased level of information about biodiversity protection will significantly raise the willingness to pay responses for individuals.²⁴

²⁰ The definition in the *Convention on Biological Diversity* signed by 154 nations at the Rio Summit 1992 defined it as: "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems", see <http://www.cbd.int/>.

²¹ Spash CL and Hanley N, "Preferences Information and Biodiversity Preservation" (Discussion paper in *Ecological Economics* 94/1, University of Stirling, 1994).

²² Hanley N, Spash C and Walker L, "Problems in Valuing the Benefits of Biodiversity Protection" (1995) 5(3) *Environmental and Resource Economics* 249.

²³ Callicot JB, "On the Intrinsic Value of Non Human Species" in Norton BG (ed), *The Preservation of Species* (Princeton University Press, 1986).

²⁴ Hanley, Spash and Walker, n 22 at 261.

The foregoing discussion is not designed to be an in-depth critical analysis of cost benefit analysis methodology or contingent valuation of the non-market benefits of biodiversity conservation. The aim is to introduce, from an historical perspective, a process for valuation of natural resources.

RECENT VALUING BIODIVERSITY STUDIES: A CRITICAL REVIEW

The reality that must be faced in considering a value system for plants, animals and ecosystems generally is the difficulty of establishing an intrinsic value for them independent of any valuers' subjective ideas of value. Even if it were possible it remains problematic to reconcile such valuations against the variation of individuals' preferences. It is not obvious that we must prefer an objective value system over our subjective preferences of value when it comes to valuing nature.

In response to this apparent dilemma some would argue that a pragmatic approach is preferable.²⁵ Where, in a particular line of inquiry, facts are produced which enable values to be adopted in response to those facts we can have a pragmatic valuation. It is argued that pragmatism in the valuation process allows for no distinction between facts and values.²⁶ In the process, natural ecosystems could be seen as a public good, but environmental goods do not strictly accord with the criteria for a public good.

To be a public good the thing in question must be jointly consumable (additional consumers can enjoy the good without lessening the amount left for others). It would also need to be non-excludable, which would be the case if the producer cannot exclude non-payers from consuming the good. In this context natural ecosystems are not public goods in a strict economic sense as they are neither jointly consumable nor non-excludable. However, this does not mean we cannot classify them as a category of public good outside of this definitional limitation.

Natural ecosystems are not a good like something we buy from a shop. This confuses us and confounds ideas of how to value them. It is only when we are denied access to the benefits of nature do we begin to see a recognised value. If natural ecosystems are seen as a system of inherently fungible raw materials that people need to gain in order to receive certain benefits then we begin to see a clearer concept of value. Natural ecosystems also provide a basis for value derived from recreational, aesthetic and spiritual associations. It is argued that natural ecosystems contain elements of constitutive intrinsic value warranting the preservation of certain parts of ecosystems (at the very least) that are essential constituents of non-inter-substitutable goods.²⁷ Thus, in the context of the toad, species under threat from the toad and ecosystems impacted by the toad are given a valuation based on the net loss they represent to the ecosystem they were part of.

Another more recent development in valuation of ecosystems is through the use of life satisfaction (or happiness) data to give monetary value to non-market goods.²⁸ Ambrey and Fleming use data on self-reported life satisfaction and a spatially disaggregated Simpson's diversity index to provide a value on ecosystem diversity in South East Queensland.²⁹ The authors note the advantage of the life satisfaction approach is that respondents do not need specific knowledge of the good in question, nor does it require them to place a monetary value on a non-market good.

In their analysis Ambrey and Fleming note that there is some support for the view that natural environments are key drivers to life satisfaction.³⁰ Their approach utilises the inclusion of non-market goods as explanatory variables within microeconomic analysis of life satisfaction variants, along with income and other covariates. The estimated coefficient for non-market goods delivers a direct

²⁵ Norton B, *Sustainability: A Philosophy of Adaptive Ecosystem Management* (Chicago University Press, Chicago, 2005).

²⁶ Welchman J, "Norton and Passmore on Valuing Nature" (2007) *Journal of Agricultural and Environmental Ethics* 353

²⁷ Welchman, n 26 at 359.

²⁸ Ambrey CL and Fleming CM, "Valuing Ecosystem Diversity in South East Queensland: A Life Satisfaction Approach" (2014) 115 *Soc Indic Res* 45.

²⁹ Simson E, "Measurement of Diversity" (1949) 163(1) *Nature* 688.

³⁰ Cunado J and Perez de Gracia F, "Environment and Happiness: New Evidence for Spain" (2012) *Soc Indic Res*, Accepted Article, DOI: 101007/s11205-012-0038-4.

valuation of life satisfaction and a figure for the implicit willingness to pay for non-market goods in monetary terms.³¹ This method does not ask respondents to directly value the non-market goods in question as required in contingent valuation. It does not ask respondents to make explicit trade-offs between market and non-market goods, which is the case in choice modelling. The evaluation is in relation to general life satisfaction. It avoids the problem of lexicographic preferences where respondents to contingent valuation show an unwillingness to trade off non-market goods for income.³²

It is noted by Ambrey and Fleming that the life satisfaction approach has its limitations.³³ Here the authors are somewhat ambiguous since they indicate the main limitation thus: “self-reported life satisfaction must be regarded as a good proxy for an individual’s utility”.³⁴ Whether they regard self-reported life satisfaction as indicating a bias is not made clear. They note the other limitation as the estimation of the income coefficient.³⁵ In explanation of this they comment:

There is now a large literature showing that individuals compare income with past situations and/or the income of their peers. Therefore, both relative and absolute income matter ... As a result, when absolute income is included as an explanatory variable in life satisfaction regressions, small estimated income coefficients are common. This contributes to large marginal willingness to pay estimates...³⁶

As this might result in larger willingness to pay estimates, presumably some allowances for this must be factored into the conclusions drawn from respondents.

Finally, in terms of limitations, Ambrey and Fleming suggest that there are issues with the relationship between the life satisfaction approach to non-market valuation and hedonic pricing. Hedonic pricing is where price is determined both by the internal characteristics of the good being sold and external factors that affect it. The problem being, if there is a connecting relationship between life satisfaction non-market valuations and variations in the labour and housing markets, this must somehow be taken into account in the use of life satisfaction modelling.

The method and data analysis used by Ambrey and Fleming is beyond the scope of this article.³⁷ What is important is their results, which specified that the average willingness to pay in terms of annual household income for a one unit improvement in ecosystem biodiversity was \$14,28.³⁸ They concluded that, given on average there were 2.5 people living in each household in the sample, that implied a per capita willingness to pay of approximately \$5,700. They found that, in changes to ecosystem diversity, individuals have an increasingly higher willingness to pay in order to avoid further degradation in ecosystem biodiversity. Ambrey and Fleming conclude their study by noting the importance of better understanding the welfare implications of declining biodiversity. They conclude that increases in ecosystem diversity have a positive and economically significant effect on life satisfaction; that, on average, an individual has an implicit willingness to pay of approximately \$14,000 in annual household income for a one unit improvement in ecosystem diversity in their local area, measured in terms of the Simpsons diversity index.

The significance of this finding, for current purposes, is the fact that a figure has been derived at all. In a serious academic study a dollar value has been determined which is the starting point for a potential inclusion in national accounts for the value of biodiversity and a point of comparison and evaluation for current spend on eradicating/controlling the toad. The authors of the study have made a

³¹ Frey B, Luechinger S and Stutzer A, “The Life Satisfaction Approach to Environmental Valuation” (2010) 2(1) *Annual Review of Resource Economics* 139.

³² Spash and Hanley, n 21.

³³ Ambrey and Fleming, n 28 at 47.

³⁴ Ambrey and Fleming, n 28 at 47.

³⁵ Ambrey and Fleming, n 28 at 48.

³⁶ Ambrey and Fleming, n 28 at 48.

³⁷ It is covered in Ambrey and Fleming, n 28 at 48-53.

³⁸ This is in Australian dollars, which at the time of writing (October 2012) was 1 AUD = 1.04 USD.

significant advance in adducing a figure based around a credible evaluation using carefully designed and structured questions and evaluation techniques.

Despite this advance, does the life enhancement method represent the best option for valuing biodiversity? One of the key identified threats under the TAP for the toad is the impact it has on native quoll populations. Is it possible to focus on value adhering in specific endangered species as the key determinant of valuing natural ecosystems? One study has concluded that using “iconised” species for valuing biodiversity may lead to high, potentially overestimated values of species preservation.³⁹ That study aimed to separate the value of the landscape of the chosen site from the value of biodiversity protection within it. The point being that value in one can be separated from the value of the other and should, at least in theory, be considered separately while acknowledging that studies have previously tended to link them.⁴⁰ Separation of valuation in this context becomes relevant in management actions dealing with a targeted regime for protection directed to one endangered species and so, practically speaking, it is better to separate out the valuation for that species from a costing point of view.

In the separation study two methods of valuation were used for the purposes of comparison. In one survey specific focus was given to two species (hence being an “iconised” survey). In the other survey a quantitative listing of all species in the surveyed region was used. In each case the study used “choice experiments” which is a departure from the use of contingent valuation methods discussed earlier. The use of choice experiments is stated to allow better analyses of trade-offs among attributes at various levels and explore their potential interaction. The method relies on McFadden’s random utility model.⁴¹ Here the utility of a good is described as a function of its attributes, so choice is made by evaluating those attributes.⁴²

Respondents received a questionnaire and a separate fact sheet, describing the current status and likely future of the subject area, plus information on endangered species including their likely fate in certain scenarios. In addition, respondents were told about possible initiatives to preserve the endangered species, with one survey distinguishing the iconised species and the other providing a general list of species. The surveys included a description of the attributes for the choice experiment. This consisted of:

- area preserved;
- the degree of species preservation;
- the extent of public access;
- recreational facilities;
- the payment vehicle.

The payment vehicle was an “extra yearly income tax earmarked for that and only that purpose”. A note was added before the choice stating “please bear in mind that the amount of money in extra yearly income tax would be taken from your normal budget and consequently you would have less available for other things”. After the choice sets the respondents were then asked to rank the attributes and indicate what their “ideal” scenario was. The respondents were asked to make a choice between a status quo position and one alternative.

The aim of the study was to analyse whether respondents could distinguish between habitat preservation and endangered species preservation and whether they express different willingness to pay for each. For the attributes “access” and “facilities” the willingness to pay estimates were near identical in the two surveys. Between the two surveys there was a big difference, though, in the

³⁹ Jacobsen JB, Boiesen JH, Thorsen JT and Strange N, “What’s in a Name? The Use of Quantitative Measures Versus ‘Iconised’ Species When Valuing Biodiversity” (2008) 39 *Environ Resource Econ* 247.

⁴⁰ For example, a representative example of this more common trend is in Loomis JB and Gonzalez-Caban A, “A Willingness to Pay Function for Protecting Acres of Spotted Owl Habitat from Fire” (1998) 25 *Ecological Economics* 315.

⁴¹ McFadden D, “Conditional Logit Analysis of Qualitative Choice Behaviour” in Zarembka P (ed), *Frontiers in Econometrics* (Academic Press, New York, 1974) p 105.

⁴² It is instructive at this point to note that, in generally describing the methodology of valuation, no attempt is being made to rank or prioritise one methodology over another. The aim is to highlight the existence of different methods of valuation rather than judge them for their inherent benefits for valuing natural ecosystems.

willingness to pay for the protection of endangered species. With iconised species being listed there was an increase in the willingness to pay for their protection. There was general support for the fact that more information provided in the questionnaire on an environmental good tended to increase the willingness to pay. The higher willingness to pay for the iconised species was explained by the “break the existing anonymity” effect of the endangered species. The perception of the more intangible term “biodiversity” was changed to something more specific and increased the feeling of responsibility in the respondents. Finally, the study highlighted that protection of the subject area had value to the public, derived from the protection and enlargement of the habitat. It highlighted that while biodiversity protection is the chief policy motivation, value can be found in other areas, such as access. To the main question of how to assess the value of biodiversity conservation there was wide differences in willingness to pay between the iconised survey and the quantitative survey, thereby making it important that recognition of this difference be factored in when structuring such surveys.

These methods of valuing biodiversity are of little practical use unless they are appropriated and acted on by government, which must be given a reason to see value in biodiversity and for that value to be recognised in national accounts. There needs to be a more rigorous intellectual and ethical platform on biodiversity valuation presented in order to do this.

The cane toad is responsible for loss of biodiversity, with threats to native species (eg the northern quoll) that might be recognised with a value as in the previous studies. The practical issue is whether the cost of biodiversity loss caused by the toad motivates greater biodiversity protection. Does the value of biodiversity loss caused by the toad represent enough value to motivate a greater spend?

To address this question it is necessary to consider what market failure may arise that might encourage government to appropriate a value for biodiversity loss. The market here being loosely defined as the people in the regions affected by the toad and government which is responsible for such regions. Local people may not recognise the value of biodiversity loss in the affected region. As a result they will be unable or unwilling to “charge” their neighbours for the value of goods and services this loss might represent. There is also institutional/government failure where it fails to provide appropriate incentives for the realisation of value.

There is a strong need to somehow demonstrate value and here the contribution of the economist David Pearce is important.⁴³ In his analysis of value for biodiversity, Pearce starts by arguing why value must be placed on biodiversity at all. The answer? – It is necessary in order to convince government to incur the opportunity cost of its protection. To Pearce there is value in biodiversity but he felt it best to not overstate that value through misapplication of economic value methods. The process of valuation, perhaps, needed to specially adapt for biodiversity and he made serious attempts to do that.⁴⁴ Despite considerable literature since Pearce’s text on valuing biodiversity there is still little consensus on methods to determine what biodiversity is worth. The need for valuation is not universally embraced by all economists, with some arguing that it is impracticable and morally suspect.⁴⁵ Others argue that it is not so much about valuing biodiversity but more about generating incentives for its valuation.⁴⁶ Valuation remains necessary, to Pearce, as it is the only way to understand the opportunity cost of its conservation. It may be that willingness to pay (WTP) and willingness to be compensated (WTBC) remain the only way this can be done within established economic paradigms, but there is no consensus on this.

There is also a need to factor in environmental ethics. The ethical dilemma is between the potential intrinsic rights that environmental assets have against the rights of people economically affected by restrictions placed on economic development or the cost to engage in conservation. This ethical dimension does not remove the economic argument for valuation but can be used in

⁴³ Simpson RD, “David Pearce and the Economic Valuation of Biodiversity” (2007) 37 *Environ Resource Econ* 91.

⁴⁴ See in particular Pearce DW and Moran D, *Economic Value of Biodiversity* (Earthscan, London, 1994).

⁴⁵ Vatn A and Bromley DW, “Choices Without Prices Without Apologies” (1994) 29(2) *Journal of Environmental Economic Management* 129.

⁴⁶ Heal GM, “Valuing Ecosystem Services” (Paine Webber working paper series in money, economics and finance PW 98 – 12, Columbia Business School).

conjunction with it. If conservation prevails there is both ethical and economic arguments for compensation to people that lose out through thwarted economic development, or else a need to provide incentives for them to participate in conservation. There is no economic development being thwarted through cane toad control activities. The only basis for intervention by local communities (apart from dedicated community groups) is through economic incentives, which are still based around a value being given to biodiversity loss through toad activities. Pearce recognised the importance of incentives when he wrote of the necessity to provide incentives designed to modify land-use decisions.⁴⁷

We still need a value in order to determine the level of incentive (if that is what is used) to be offered landholders. The traditional willingness to be compensated methodology that arises in contingent valuation might be appropriate here but there are other views. Pearce used the idea of total economic value (TEV), being an aggregate of different categories of value. This is a measure of the economy-wide consequences of incremental change in biodiversity which supports the economy. He arrives at TEV through several categories of value. The first is use values made up of direct, indirect and option values. The other is non-use values made up of bequest and existence values. An example of a direct-use value is hunting and ecotourism. An example of an existence value is the moral satisfaction people might have for the survival of an endangered species. An option value is represented by maintaining natural forests which means the benefits you have by maintaining them over the cost of other options you would need in their absence.

To Pearce the role of government is to “intervene in the bargain to lower transactions cost, establish property rights, deal with public goods issues, or act on behalf of disadvantaged groups”.⁴⁸ So the real challenge is to get to a point where the government is prepared to address the issue of public intervention for compensation and incentives to achieve a desired conservation outcome on a large scale.

The foregoing discussion is designed to progress two things. First to outline different methods of biodiversity valuation, but in the process make no specific recommendation as to a ranking of them. Second, to highlight that biodiversity valuation (of whatever kind) is not being addressed in any capacity and therefore is not being used for environmental policy formulation for cane toad control. In the failure to accord a value to biodiversity loss and damage as a result of toad activities there is a risk of serious underfunding for eradication policy. It also ensures that there is little incentive to explore other policy options, particularly those relating to incentives for landholders.

ERADICATING THE TOAD: SOME GENERAL RECOMMENDATIONS PLUS SPECIFIC RECOMMENDATIONS FOR REGULATORY REFORM

The current legal regime for the control of invasive species with the current State/federal sharing of authority should be replaced by one federal body with full authority to instigate national programs for the eradication and control of feral species. Ideally, the States should refer power to the Commonwealth over invasive species should there be any doubt about the extent of Commonwealth powers. The aim of such a federal body would be to have nationally consistent classifications of the pest status of feral species and coordinate national eradication/control programs that are rolled out across all affected States and Territories.

There is a failure by government to account for natural capital and biodiversity loss. A number of valuation methods have been discussed for biodiversity. It is recommended that the government make an assessment of biodiversity loss, with each TAP using one, or a combination of these methods. It is suggested that there should be an amendment to the EPBC Act mandating a valuation of biodiversity loss associated with species identified under a TAP. This would allow a more measured and proportionate assessment of the policy response, the amount spent on eradication/control programs and utilisation of available resources in invasive species control.

⁴⁷ Pearce and Moran, n 44 p 83.

⁴⁸ Pearce DW (2004) “Environmental Market Creation: Saviour or Oversell?” (2004) 3(2) *Portugese Economic Journal* 115.

In making a policy response, which in part would be reacting to the value of biodiversity loss identified as above, the government should look at the problem from a legal/economic perspective. Until an economic assessment has been made it is not really possible to properly evaluate the policy from an implementation phase perspective. After a proper valuation of biodiversity loss, it may be possible to determine a more holistic response to feral extermination. For example, utilising the full range of responses that address the willingness to pay and willingness to be compensated paradigm. In that respect a policy response that addresses incentives at the landholder level is possibly warranted for the cane toad. An example of an incentive might be an expansion of the deduction provisions under the *Income Tax Assessment Act 1997* (Cth). Currently, s 40-755(1) of that Act allows a deduction for expenditure incurred for the sole or dominant purpose of carrying on environmental protection activity. The current definition of environmental protection activities is limited to pollution and waste prevention and/or control on land. This could usefully be extended to include the eradication of feral species on the land of a taxpayer. It could even be amended to target proclaimed species from time to time.

A proper valuation of biodiversity loss caused by feral species will also enable a clearer assessment of the level of research funding. An assessment of funding should be made against the value of biodiversity loss and given a relative weighting. Funding should be directed against that weighting. A blue sky scenario, no doubt, but if we acknowledge the value of the loss, it will be seen as money well spent.

CONCLUSIONS

This article seeks to raise awareness about the current regulatory landscape governing the control of invasive species. In doing so it is apparent that regulatory control in this sphere needs to be centralised in order to introduce nationally consistent feral species eradication/control programs. The regulatory regimes for invasive species in different jurisdictions urgently needs to be centralised. The current federal/State divide in regulatory control over invasive species is at risk of creating a retardant effect on aggressive policy development over invasive species.

The federal government must instigate measures to place a value on biodiversity. It is recommended that a pragmatic approach be taken on valuation methods enabling room for change over time to reflect developments in the economic modelling for biodiversity valuation. Once a value has been determined for areas affected within each TAP, funding should be in proportion to the identified value. In other words, the determination of value should become a recognised part of the TAP process. The government should be prepared to recognise a value in biodiversity and address a full range of policy initiatives that are in proportion to the value recognised under the TAP. These should include incentives for landholders to engage in feral species eradication and control. This will enable a proportionate and targeted response that embraces both eradication and control and utilises the full armoury of measures that is available. The integrity of precious ecological communities and endangered species are too valuable to not do this.