10. Exclusion as a conservation strategy

Exclusion of threatening processes from areas of habitat for species of special concern is a well-established and critical conservation tool. The general approach has been applied to a range of influences, including endemic or exotic zoonotic or other animal disease, exclusion of fire, management of legal or illegal harvest, or invasion of exotic animals and plants additional to the cane toad. Methods can be equally diverse, encompassing destruction of the hosts or vectors of disease agents, removal of habitat features critical for invasive organisms or fostering other conditions that make habitat less favourable, direct killing of invaders, or biological control through predators or parasites.

In the case of the cane toad, densities obtained may be so high and distribution sufficiently wide as to make direct killing problematic (PJ Whitehead, unpublished data). Biological control is also challenging and is at least a decade away from proof of a system that has a reasonable chance of being accepted by a sceptical public (A. Robinson, pers. comm.). Habitat modification to reduce suitability for toads might include such steps as maintaining or encouraging the development of dense ground cover in riparian fringes that interfere with the movement and other behaviours of toads (e.g. Freeland and Kerin 1991). Unfortunately, the dominant land use (grazing) is associated with disturbance of the ground layer. Regular removal of low vegetation by fire over much of the landscape, including riparian fringes (Russell-Smith et al. 2003) is also at odds with maintenance of densely vegetated habitats.

However, exclusion has served Australia well for millennia. The physical isolation of the great southern land favoured evolution of unique and mega-diverse assemblages of flora and fauna. Settlers learned some harsh lessons about the potential impacts of introducing animals like the rabbit, and subsequently bolstered our natural defences against invasion with rigorous quarantine systems that have mostly served the agricultural community well.

Within the nation, exclusion of "pests" has been practised on a physical scale rarely seen. The dingo fence, constructed in the 19th Century, stretches for more than 5000 km, and was designed to protect the eastern Australian grazing lands from the wild dogs of the interior, which were probably introduced to Australia by Aboriginal people, thousands of years before settlement. The extraordinary and often successful efforts made by the Western Australian Government to exclude agricultural pests like starlings *Turdus turdus* and house sparrows *Passer domesticus* by relying principally on the natural barriers of the Nullabor Plain and arid interior supplemented by ruthless destruction of intruders, are now the stuff of Australian legend.

Given this history, it is perhaps worth reflecting on the reasons for the much more passive stance in regard to the creeping invasion of the toad. First, the species does not damage agriculture or otherwise significantly threaten the mainstream economy. Impacts on economic interests are mostly confined to the Aboriginal customary economy, which depends heavily on wildlife threatened by toads for high quality food (Altman et al. 2003). Maintenance of the customary economy has never been treated as a serious issue by wildlife or pest management authorities. Second, the invasion of the Australian mainland has been gradual. During the long period of range expansion, no more than anecdotes were gathered about its effects on conservation values (see Freeland 1984; Burnett 1997). Animals affected by the presence of toads apparently declined abruptly in abundance but then mostly recovered to varying degrees. No species was shown to have become extinct due to toads during a period when extinctions of arid zone mammals were rife (Morton 1990), so there was no conservation imperative to halt the invasion, even were it considered possible to intervene effectively. Finally, although toads were seen as an inconvenience, such as a threat to the health of pets (Freeland 1984), the inconvenience caused to non-Indigenous Australians was too minor to warrant large public investments in control.

However, the fact that this report, among others, was commissioned is testament to increased public discomfort when it became obvious that Australia had done little or nothing to protect the values of the World Heritage Kakadu National Park from the effects of toads. Their intrusion threatened both the natural and cultural heritage values for which the park had been listed. The work stimulated by that recognition has provided the first rigorous quantitative demonstration of the impact of toads on Australian fauna (M. Oakwood, unpublished; D. Holland unpublished). That work has confirmed the severity of the initial increases on mortality of northern quolls and some goannas in the presence of toads, but suggested no plausible responses.

11. Options for Toad Exclusion

During 2003, the Sessional Committee of the Environment and Sustainable Development of the Northern Territory Legislative Assembly inquired into issues associated with the entry of cane toads into the Northern Territory. A number of submissions to the Committee dealt with the issue of exclusion. Proposals and related argument covered two very different scales.

First, there was material on steps that householders could take to keep their yards toad free. As these sorts of measures are unlikely to contribute significantly to the protection of viable populations of the native fauna known to be at greatest risk from toads, they are not considered further here.

Second, there were proposals for erecting a barrier to exclude toads from Cobourg Peninsula, the site of Garig Banuk Barlu National Park. This proposal was supported by the Garig Board, and was under active consideration by the Parks and Wildlife Service (PWS) of the Northern Territory. As a consequence some work was done by the PWS and the Department of Infrastructure, Planning and Environment to explore the feasibility of such a barrier. This report draws on that material to explore a wider range of options.

The treatment is based fundamentally on recognition that principal determinants of the nature and scale of the response to cane toads will be assessment of the costs, likely effectiveness and putative benefits of such barriers over the long term. Our goal is therefore to provide realistic comparisons of capital and recurring costs of barriers protecting areas large enough to contain populations of vulnerable fauna large enough to be viable over the long term.

Sites for cane toad exclusion

We consider that to illustrate the implications of our data in a heuristically useful way, it is important to provide context and relate the results to genuine proposals or options that provide compelling illustrations of particular aspects of the problem. We have therefore chosen to relate our estimates of MVP and areas of habitat needed to sustain those populations to:

(1) The construction of a cane toad barrier across the neck of the Cobourg Peninsula designed to exclude toads from Garig Banuk Barlu National Park, the first site listed under the Ramsar Convention on Wetlands of International Importance.

(2) Quarantining of islands, (excluding the Tiwi Islands, which have already been invaded by toads), including islands used to establish populations of northern quolls using wild stock taken from Kakadu National Park and closer to Darwin.

(3) The construction of barriers on the mainland to enclose areas of habitat favourable for one or more of the species considered here, including consideration of options based on one large area or a number of smaller sites.

Design of cane toad barriers

Estimates of costs of barriers capable of excluding toads are based on designs made by the Department of Infrastructure, Planning and Environment in Darwin (Lyle Campbell, personal communication). The proposed barriers are to be constructed of sheets of compressed fibre panel, 12 mm thick and 1.2 m wide, linked by metal angle and capped with metal flashing. The panels are to be placed in 30 cm deep trenches, refilled with rammed earth or concrete. The panels would thus stand 90 cm above the substrate, high enough to prevent adult toads jumping over them, with their surface being sufficiently smooth to prevent climbing. The panels are likely to be resistant to minor impacts, but will crack or shatter under impacts from larger falling branches or trees, vehicles or large feral animals like buffalo or horses.

Animals that dig deeply, like feral pigs, or burrow like a range of native species (goannas, small mammals) may undermine or tunnel under panels. Toads may use or enlarge such excavations. As a consequence, barriers will require regular and relatively close, fine-scale monitoring to maintain their integrity. Estimates have been made of the cost of such monitoring based on stated assumptions.

Cost estimates for all structures were based on use of new materials and full commercial costs for fabrication and erection. In order to expand the range of plausible options considered, we also provide estimates assuming that costs could be halved by use of second hand materials and some voluntary labour. For exclusion options such as small islands that may appear to be too small to maintain vulnerable fauna over the long term, we have also provided some preliminary estimates of the cost of maintaining separate populations of relevant fauna in captive breeding colonies, which might be used to supplement island populations as required. The range of variables considered is summarised in Table 3.

Table 3: Variables considered in estimates of the costs of cane toad exclusion.

Variable	Issue	Sources of variation in cost
Construction of barriers	To limit probability of incursion and the number of toads gaining access to sites warranting protection	Materials and construction methods Durability Human and vehicle access (gates) Drainage lines and hence additional constructions costs and increased risk of failure Maintenance of associated fire and treefall breaks Interest rate on capital requirements
Maintenance of structures	To minimise periods of vulnerability through failure of barriers	Regular clearing of firebreaks Frequency of inspection Range of sources of damage, including accident (vehicles), tree-fall, feral animals, erosion, flood, other washout
Surveillance	To detect incursions quickly To demonstrate that exclosure is effective in terms of species requiring protection	Frequency of inspection of habitats favourable to toads Total area and range of habitats subject to inspection Design of surveys (precision) required to detect change in abundance of vulnerable fauna
Response to incursions	To respond effectively to real incursions and to false alarms	Intensity and duration of response Spatial extent of response Response measures
Maintaining captive populations	To reduce risk in event of catastrophic failure (e.g. cyclone) and to support use of smaller than optimal sites (especially islands)	Size of captive populations Number of captive populations

12. Key assumptions underpinning cost estimates

In the absence of reliable information about cane toad impacts on our candidate native species, generating estimates of area required and resultant costs of exclusion require a number of key assumptions. The most important are:

(1) habitats capable of sustaining fauna vary markedly in quality and hence the densities they can support but, for most species, the prospects of locating large tracts of uniformly optimal habitat are low;

(2) our estimates of minimum habitat area (MHA) are best treated as requirements for habitat of "average" quality (usually containing areas of high quality habitat separated by a matrix of lesser quality and sometimes marginal habitat) and so may be considerably larger than required in optimal habitat;

(3) sustained or intermittent increase in mortality of any level above the "background" embedded in the population viability analysis and estimates of minimum viable population size will result in a probability of extinction above the 10% threshold we have set as acceptable over the time horizon of 100 years;

(4) presence of toads within the target area, in any numbers, at any stage of the life cycle, for any substantial period will result in relevant increases in mortality;

(5) management authorities therefore adopt a "zero tolerance" approach, treating any increase in mortality as unacceptable (in fundamental conflict with the management goal) and so design exclusion and associated surveillance and response regimes to minimise probability of intrusions, discover minor intrusions promptly and eradicate them quickly;

(6) effective exclusion demands a combination of physical barriers to cane toad dispersal and regular monitoring of sites for the presence of toads using methods best suited to the physical location; and

(7) chosen sites lack toads at the time of construction, so no costs of cane toad removal are incurred. This option is rapidly being foreclosed for many of the more bio-diverse regions of the Northern Territory but remains realistic for parts of the NT and Western Australia.

It should be noted that in the case of artificial barriers to movement of toads, movements of many other animals will be inhibited and that this may have undesirable consequences for wildlife enclosed within those barriers. We do not provide estimates of the "cost" of such losses.

13. Results – the cost of exclusion

Estimates of the costs of exclusion are given in Tables 4 and 5.

Cobourg Peninsula

Table 4 shows the elements of the estimates of the total annual cost of excluding toads from the Cobourg Peninsula, and area large enough to support viable populations of most of the fauna we considered. It is important to understand the assumptions underlying those estimates. Important decisions regarding items requiring consideration that have substantial impact on the scale of those estimates are:

(1) Interest rate: An annual rate of 5% was applied to the cost of construction as an estimate of the cost of capital and to acknowledge that such an investment will divert funds from other conservation activity of potentially equivalent or greater benefit. Inclusion of this factor effectively doubled the cost of construction averaged over 15 years.

(2) Lifetime of structures: We have limited information on the life of the materials used for this barrier under the conditions they will experience. We have assumed that damage from tree fall, fire, storm damage, erosion, feral and burrowing animals will be frequent and that rapid repair will see a long term incremental degradation of the barrier that will be better managed by replacement than ongoing and increasing expensive repairs. We have assumed that barriers will last longer when footings of concrete are used and increased the estimated lifetime from 15 to 20 years.

(3) Monitoring: Any barrier capable of excluding toads and placed in the challenging north Australian environment is likely to suffer frequent damage that compromises its effectiveness. Close monitoring of the integrity of the barrier will be essential, and the frequency of examination will determine the costs and prospects of achieving control should intrusions occur following damage. We do not have the information needed to assess the relative costs of different monitoring schedules *versus* the costs of achieving and demonstrating control given various delays between intrusion and detection. It is therefore impossible to determine an optimal schedule and choices become essentially arbitrary. We have specified and based our calculations on twice weekly checks during the wet season - when damage is both more probable and likely to coincide with greater mobility of toads - and weekly in the dry season.

(4) Response: There have been no carefully documented and costed responses to control cane toad intrusions capable of achieving total eradication in a reasonably short period. We have assumed that a team of 10 people working for a minimum of 10 days will be necessary to actually achieve removal of all intruding toads and satisfy both management authorities and public that this result has actually been achieved. We have assumed that the probability of a real intrusion is quite low (at 10% per annum), but that a need to check reports of intrusions that prove unfounded will be more frequent at 5 event per year, and require 7 days (FTE) of staff time. We have assumed that methods will be based on manual capture plus some trapping and be focused on waterbodies in the region of suspected intrusion.

All of the variables used in calculations are included in annotated spreadsheets that are available from the authors on request.

The cost of constructing the 6 km barrier, averaged over the specified lifetime, is about 60% of the total annual cost. The balance covers maintaining, monitoring and responding to intrusions through. The estimated requirement of about $410,000 pa considerably exceeds the existing routine operational budget of Garig Banuk Barlu National Park, which meets all other conservation objectives. Nonetheless, the cost is a tiny fraction of the expenses involved in enclosing and protecting equivalent or smaller areas that require constructions and maintenance of a complete exclosure (Table 5).

Other terrestrial situations

Costs of exclosures for a range of fauna under a number of different assumptions regarding habitat quality are illustrated in Table 5. The estimates for enclosing an area large enough to maintain the northern quoll (a 59 km perimeter if an approximately square layout is assumed) are up to $3.2 million annually. In calculating this figure, costs similar to the Garig fence have been assumed, but reduced to take account of simpler gates and uniformly favourable terrain (e.g. no coastal margin). A 20% reduction in maintenance costs has been assumed to take account of economies of scale in securing the larger structure. Moreover, and despite the much larger perimeter, no increase in the probability of penetration of the barrier is assumed. We therefore regard the estimate as a conservative one.

We also examined the costs of providing equivalent protection to a quoll population occupying highly favourable habitat such that the area was capable of supporting 4 times the density of female territories found in typical habitat. Because the ratio of perimeter to area is higher for smaller areas (Figure 2), the cost is reduced to about half ($1.78 million pa). The estimate is slightly higher than half because it is assumed that costs of construction in the rocky areas that appear to provide superior quoll habitat will be 20% higher than in less rocky savanna.

We have also examined the costs of a completely artificial exclosure, namely maintenance of captive populations in the equivalent of a wildlife park. We estimate costs at about $510,000 pa for a population of 475 quolls, the number needed to avoid genetic problems (Frankham et al. 2002).

Costs of maintaining medium size lizards are considerably lower (Table 5), but still more expensive than the Garig barrier. Moreover, it is probable that a site selected to protect quolls would also protect a viable population of frill-necked lizards and some monitors.

Costs of enclosing and maintaining viable populations of the 2 snakes we considered are very high (around $6 million pa). It should be recalled that these estimates assume no increase in the risk of cane toad intrusion or costs of eradicating intruding populations. This is probably unrealistic for such large perimeters (exceeding 100 km) and hence we regard the estimates as very conservative especially as we have assumed a 40% reduction in maintenance costs for these longer fences.

Given that the risk of failure of exclosures is presently unspecifiable, we have also considered the costs of "mixed" strategies that include "insurance" through intensively maintained captive populations. Captive populations can also fail – for example through a disease outbreak - but in general will be organised as a number of sub-populations maintained in widely separated locations, so that the risk of complete failure through catastrophe or otherwise is extremely low. Maintaining substantial and hence secure captive populations costs very much less than well-maintained exclosures in remote sites, irrespective of optimistic assumptions of low risk of failure of barriers around "natural" habitats.

Islands

We have limited direct experience of the costs of maintaining islands free of toads because formal and explicitly resourced "quarantine" arrangements have never been implemented. A number of the larger islands with substantial human populations and regular access by boat and air (Groote Eylandt and Bathurst Island) have already been invaded by toads. Other islands of substantial size close to major estuaries have also been invaded, such as the Edward Pellews group adjacent to the MacArthur River.

The estimates we have provided relate to middle-sized islands (see Figure 3), often in very isolated sites, and requiring access by a mix of road travel, boats and less frequently by light aircraft using bush airstrips. They are necessarily approximate because there are no data about frequency of access by land owners (mostly Aboriginal) other users of the coastal region (e.g. commercial fishermen) or recreational access (fishers or pleasure boaters).

We envisaged 9 visits per year by groups who would survey for toads, plus additional work interviewing the region's boat users to assess risks and promote awareness.

We generated an estimate of about $60,000 pa per island. However, there would obviously be scope to reduce this cost by linking visits to neighbouring islands if included in an exclusion exercise. Whilst this cost appears relatively modest compared with construction and maintenance of barriers in terrestrial settings, effectiveness is presently unknown, and most NT islands are too small to maintain viable populations of one or more relevant species over the long term (Figure 3). By definition, islands used for introductions of mainland "stock" to provide protected populations will lack resident populations of the species of concern, and their absence under natural conditions will occur probably because they are too small. This means that an island strategy would probably need to be associated with maintenance of viable captive populations, at a cost (for quolls) of several hundred thousand dollars per annum.

Captive populations

Providing estimates of the cost of maintaining captive breeding populations was not part of the project brief, but given the ambiguity inherent in estimates of the cost of untested systems of exclosure, inspection and response, we thought it useful to provide at least a crude comparison with this more conventional approach. Our estimates are based on modules sufficiently large to maintain groups of 9-12 animals and assume placement within existing wildlife parks or similar facilities. Thus they represent a conservative estimate of total costs, but include provision for staff salaries, food, veterinary care and connection to infrastructure carrying utilities like water and power supply, and drainage. They are best treated as broad indicators of costs rather definitive estimates for particular species, for which costs will be highly context dependent, depending, for example, on availability or otherwise of skills for maintenance of that taxonomic group among existing staff.

Costs for maintaining populations large enough to maintain genetic variation are far from trivial, but are nonetheless cheaper than semi-natural exclosures.

Table 4: Costs of exclusion of cane toads from an area (Garig Gunak Barlu National Park, Cobourg Peninsula) large enough to support populations of the Northern Quoll and other co-occurring vulnerable species with equivalent or lower area needs (northern sand goanna, black headed python, mangrove monitor, blue winged kookaburra, frill neck lizard and northern death adders). For instance, the minimum area of savanna required to support a viable population of quolls and at a probability of persistence of 90% over 100 years, without supplementation from other populations, is 220 km^2 (Table 2), where as the total area of Garig is 2207 km^2. Total costs are calculated over 15 years (for options 1 and 3) or 20 years (option 2). Option 4 is a cheaper structure based partially on second hand materials and using some volunteer labour. An interest rate of 5% is applied to the capital cost over the life of the project and incorporated in estimates of average annual cost.

Situation	Area (km^2)	Item	Quantity	Description	Total cost (of structure)	Annual cost
Peninsula (Garig Gunak Barlu National Park)	2207	Construction of fence Including labour)	6 km	Based on structure of compressed fibre board on steel supports and with metal capping, with 15-20 year life (before total replacement required) and 5% interest rate. Costs include initial clearing of line. Option 1 involves trenching to bury panels to 30 cm and repacking with earth. Option 2 uses concrete footings throughout. Option 3 uses concrete in vulnerable areas and rammed earth over most of length	(1) $3.45 million (2) $5.86 million (3) $3.64 million (4) $1.81 million	(1) $229,700 (2) $292,900 (3) $242,400 (4) $121,200
		Construction of gates	2	Double gate and associated structures over main access road to permit vehicle entry but limit toad access, plus gates over separate access track.		

Situation	Area (km^2)	Item	Quantity	Description	Total cost (of structure)	Annual cost
		Tidal zone protection	2	Barrier for tidal zone at both northern and southern margins of the peninsula		
		Maintenance of firebreaks	12 km	Annual maintenance of firebreaks to limit damage by tree fall or fire		$4,800
		Repairs and maintenance of structures	6 km	Repairs to major and minor damage from floods, vehicle damage, feral animal damage and tree fall.		$54,741
		Inspection and surveillance of structures and surrounds	6 km	Regular inspection to promptly detect breaks and mobilise repairs, as well as identify and intervene in potential sources of damage (e.g. developing drainage changes)		$28,141
		Surveys for detection of toads inside barrier, including in the absence of known breaches in barrier	weekly	Inspections of entire fenceline using pitfalls and other traps and inspections of all known waterbodies persisting during dry within 2 km of fenceline. More frequent (twice weekly) inspections during wet season. Also includes ad hoc inspections and interviews with visiting boats, commercial and recreation users of the park		$39,854
		Responses to entry of toads	As necessary	Includes aggressive interventions to control intruding toads, plus comprehensive investigation of all reports. Methods to include hand capture at waterbodies plus trapping.		$28,006

Situation	**Area (km^2)**	**Item**	**Quantity**	**Description**	**Total cost (of structure)**	**Annual cost**
				Assumes probability of significant and well established entry is low, and figures average high cost responses over long periods.		
		Surveys of populations of vulnerable fauna	Annual	Surveys to provide assurance that populations of fauna of concern are actually being maintained		$11,196
		Maintaining captive populations	Ongoing	Maintaining captive populations of relevant provenance as "insurance"	$1.69 million	$510,127 for quolls
TOTAL				without "insurance" with "insurance" for one (most vulnerable) species	~$3.6 million ~$5.70 million	~ $410,000 ~ $920,000

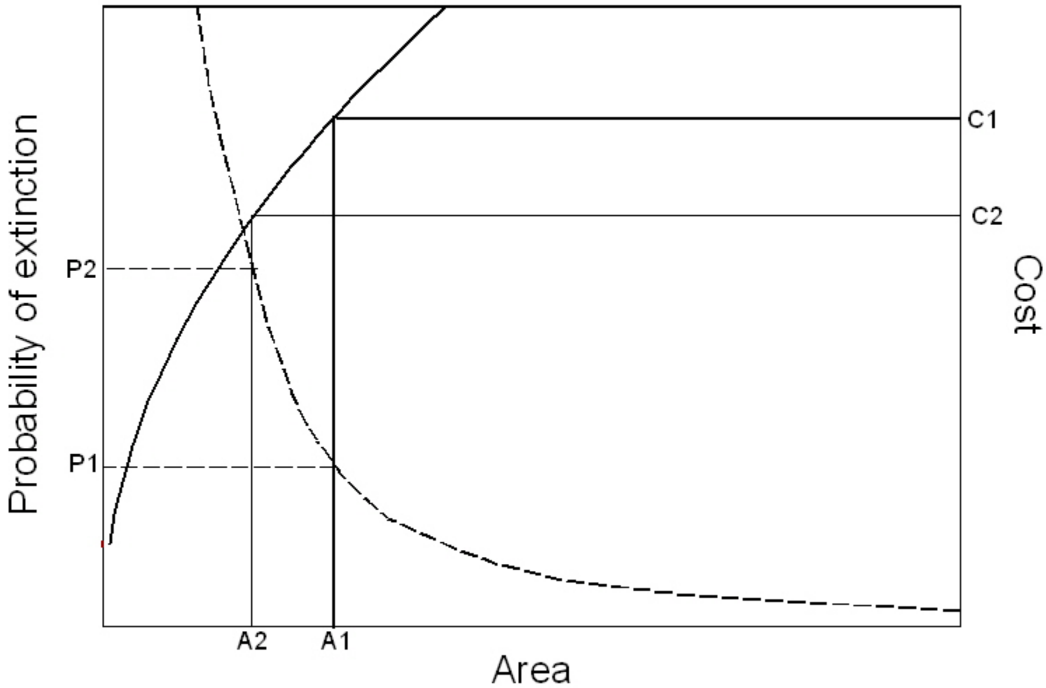

Figure 2. Illustration of the asymmetry of impacts of reduced area (A1-A2) on costs of maintaining a perimeter (continuous heavy line) and probability of extinction (dashed line). Relatively modest reductions in cost (C1-C2) are associated with very substantial increases in risks of extinction (P2-P1). The lines are based on a hypothetical "average" vertebrate with a home range of 5 ha. The probability of extinction axis is from zero to 40%.

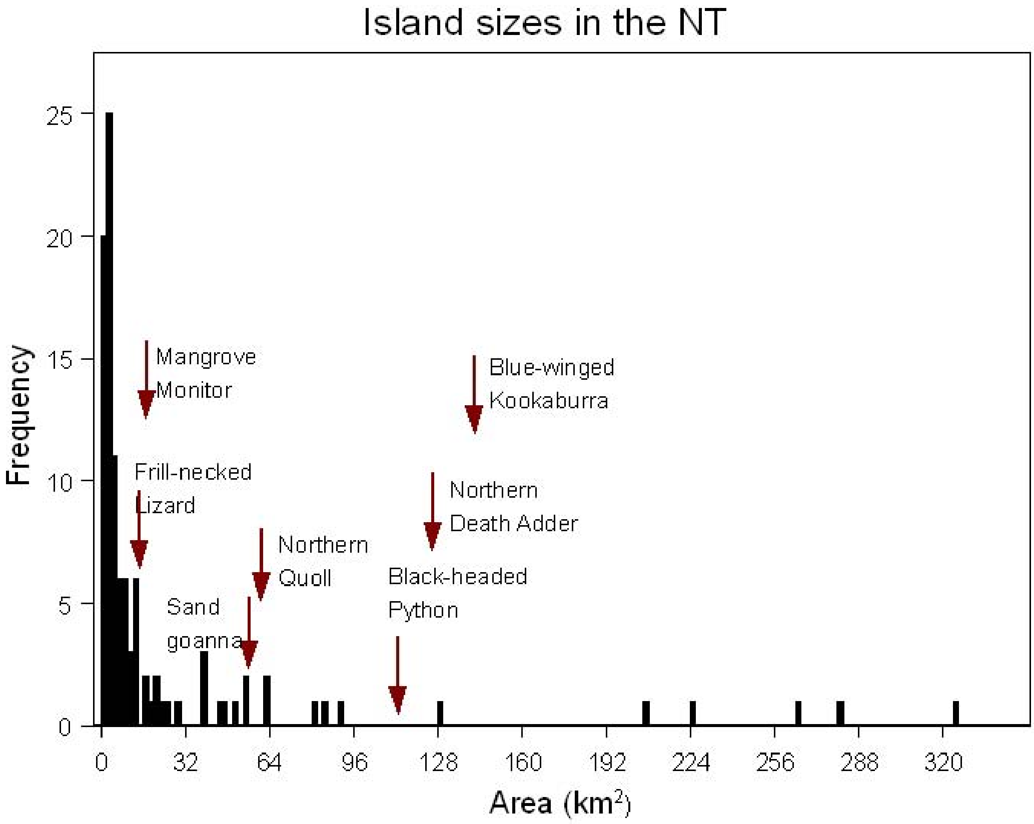

Figure 3. Island sizes in the Northern Territory in relation to MHAs (<20% probability of extinction in a period of 20 years) for a number of fauna. Neither the largest islands (Bathurst = 1707 km^2; Melville = 5821 km^2; Groote Eylandt = 2285 km^2) nor very small islands less than 2 km from the mainland are included. Very small islands (<1 km^2) are also excluded. Clearly there are very few NT islands capable of sustaining a fauna similar to the mainland and few that can sustain viable populations of common vulnerable fauna unless active population management, including supplementation, is undertaken and maintained.

Table 5: Comparison of annual costs for a number of exclusion scenarios for a range of vulnerable species in northern Australia.

Situation	Vulnerable species	Annual costs ($000)	Issues
Peninsula	Northern quoll and varanids, snakes and frill-necked lizards, non-migratory birds	410	Probability of higher rates of toad entry, by both sea and land, than some alternatives. Considerable uncertainty regarding ability to effectively "close" coastal margins of cross-peninsula barrier If exclusion is successful, such sites likely to be large enough to be confident of protecting many species In the example used, costs are contained by access to existing infrastructure and staffing in an existing national park. This will not always be the case, and costs could be considerably higher in other situation.
Non-estuarine island	Northern quoll (introduced)	198	Difficult to institutionalise inspections of boats because of lack of facilities in remote locations, so heavy dependence on regular on-site surveys for toads Frequency of use or residence on islands increases with size, so larger islands face greater risk of cane toad introductions Island selected should be isolated from major rivers so that risk of toads reaching them in wet season floods is low Small uninhabited islands face lower risk of cane toad establishment (e.g. Astell Island at 12.7 km^2) as example, but un likely to support populations of wildlife viable over the long term, therefore requiring insurance of captive population
Mainland exclosures of "average" habitat	Northern Quoll Varanids Snakes	3,121 860-1023 5902-6424	Calculations of area required for MVPs (e.g. northern quoll 220 km^2) are based on average habitat which will mostly be made up of patches of favourable habitat in a matrix of marginal or even hostile habitat. Hence costs of enclosing a single block of typical savanna habitat for quolls may be high.

Situation	Vulnerable species	Annual costs ($000)	Issues
	Non-migratory birds	7364	Yet even exclosures of this size may fail to enclose viable populations of other affected species even if site also contains habitat favourable for those species
Mainland exclosures of high quality habitat	Northern Quoll	1,775	Areas required for MVPs may be greatly reduced in areas of highly favourable habitat in which high densities may be attained, including rocky areas for quolls. A need to take account of higher costs of both construction and maintenance in some favourable habitat types (rocky areas, wetlands, mangroves).
Captive populations alone	Northern Quoll Reptiles	510 104	For comparison with costs and benefits of exclosure strategies, and to permit exploration of "hybrid" strategies (below). Captive population large enough to avoid significant genetic risks.
Mixed strategy – exclosures plus captive breeding insurance	Northern Quoll	1,782	Tradeoffs between robustness of exclosure populations and costs of protecting their integrity may warrant consideration of mixed strategies that take advantage of lower cost options. For purpose of calculations assume an area of the most favourable habitat half that required if no supplementation from captive populations

Table 6: Risks and collateral benefits associated with different "exclusion" tactics for management of cane toad impacts. Categories are necessarily somewhat arbitrary, but are thought to provide a useful summary. The “impact of exclusion failure” column assumes that strategy is the sole or dominant strategy.

Dominant Response	**Conservation benefit for vulnerable species**	**Costs**	**Collateral conservation benefits**	**Risks of exclusion failure**	**Impact of exclusion failure**
Large (MVP+) mainland exclosure with high intensity maintenance	High	Very High	High	Low	Very major
Large (MVP++) peninsular exclosure with high intensity maintenance	Very high	High	Very high	Low	Very major
Large (MVP++) islands with high intensity quarantine	Very high	Moderate	Very high	Low	Very major
Small (MVP-) non-estuarine islands with moderate intensity quarantine	Time limited	Low	High	Substantial	Very major
Small (MVP-) non-estuarine islands with moderate intensity quarantine and large captive populations as "insurance"	High	Moderate	High	Substantial	Low
Small (MVP) mainland "focus" sites of unusually high quality habitat for one or more species and high intensity monitoring	High	High	Substantial	Low	Major
Small (MVP) mainland "focus" sites of unusually high quality habitat with captive breeding "insurance"	High	High	High	Low	Major
Captive breeding only for a range of vulnerable species	Moderate	Moderate	Low	Low	na