Management of dingoes on the NSW National Parks and Wildlife Service estate

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ABSTRACT

Relationships between the abundance of dingoes and their major prey species suggest that dingoes have a functional role in ecosystems. Thus, both the dingo and its function need to be conserved. If dingo hybrids are functionally similar to dingoes, they may need to be maintained in areas where there are no pure dingoes. There is little evidence to support the widely-held belief that dingoes or other wild dogs limit the distribution or abundance of foxes in NSW.

In 1995–96, dingoes and other wild dogs occurred in 133 of NPWS national parks and nature reserves (2.32 million ha), most of which are east of the Great Dividing Range. NPWS has the responsibility of conserving remaining dingo populations on these parks and reserves. However, it also recognises that dingoes and other wild dogs may affect livestock on adjoining properties and accepts the need for management to minimise attacks on stock. The NPWS policy for the management of wild dogs (including dingoes) balances these conflicting aims. Where it is necessary to protect livestock on adjoining properties, NPWS carries out both strategic and reactive control of wild dogs. In 1995–96, control was necessary on 57 (43%) of the parks and reserves with wild dogs. The majority (83%) of this control was in cooperation with adjoining landholders. The most common method was ground baiting with 1080, followed by aerial baiting, trapping, shooting and barrier fencing. Most ground baits are now deployed in bait mounds to minimise non-target take. Since 1995–96, aerial baiting has been significantly reduced; in 1998 it occurred on only two reserves. NPWS policy and practices of wild dog management will respond to increasing knowledge about dingoes and other wild dogs, and to proposed changes to the *Rural Lands Protection Act 1989*, in a manner consistent with both its conservation responsibilities and the need to protect the livestock of neighbours.

Introduction

The first part of this paper continues the discussion of relationships between dingoes and other species begun by Newsome, and comments are made on the relationship between wild dogs and foxes. The second deals with the management of wild dogs by NSW National Parks and Wildlife Service (NPWS).

Relationships between dingoes and other species

Interactions between dingoes and macropods in north-eastern NSW

NPWS carried out a long term study of the ecology of the dingo at a site on the escarpment east of Armidale in northern NSW. Parts of the study relevant to interactions between dingoes

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and macropods, and the functions of dingoes in ecosystems, are briefly summarised here from Robertshaw and Harden (1985a, b, 1986).

The study area had a high diversity of native mammals (30 species). Of the seven macropods, the eastern grey kangaroo *Macropus giganteus,* red-necked wallaby *M. rufogriseus*, swamp wallaby *Wallabia bicolor*, parma wallaby *M. parma* and the red-necked paddymelon *Thylogale thetis* were common while the wallaroo *M. robustus* and long-nosed potoroo *Potorous tridactylus* occurred in some areas in limited numbers.

Swamp wallaby was the most common prey species taken by the dingoes. Compared with the other two large macropods (eastern grey kangaroo and red-necked wallaby), the swamp wallaby occurred more frequently in the diet than would have been expected from the relative abundance of the three species. In part of the study area, the number of dingoes increased significantly during the study. As a consequence, the relative prey abundance per dingo declined markedly (more dingoes had to share the same number of prey). Dingoes responded by hunting more in groups and concentrating on the larger species (particularly swamp wallaby). Group hunting also resulted in wallaby kills being more completely utilised. This suggested that dingoes may mediate the effect of decreases in prey abundance by changes in sociality.

Ultimately, the increase in dingo numbers resulted in a decrease in swamp wallaby abundance. Additionally, areas with low numbers of dingoes had higher macropod densities than those with high numbers of dingoes. This suggested that dingoes exert some control on wallaby numbers, although it could not be concluded that they regulate them.

The response of the swamp wallabies to dingo predation was also interesting. In the areas of low dingo and high swamp wallaby abundance, swamp wallabies bred seasonally with a peak of births in the spring–summer period. However, in the area with high dingo and low swamp wallaby abundance, births occurred throughout the year and females had a greater turnover of pregnancies, suggesting a higher rate of pouch young mortality. We believe this increased mortality was due to dingo predation of young-at-foot and of pouch young evicted by the mother when pursued by dingoes. Thus, increased dingo predation resulted in a disruption of the seasonal breeding pattern of the swamp wallaby and a reduction in the recruitment rate of young wallabies to the population.

A number of studies of dingoes throughout Australia have shown that there are relationships between the abundances of dingoes and their major prey species. While these relationships are complex and poorly understood, they suggest that dingoes have a functional role in ecosystems. The maintenance of this function in conservation areas may have wider importance than just the conservation of the dingo as a species. Thus, conservation authorities need to conserve both the dingo and its function. This will be particularly challenging in areas with a high proportion of dingo hybrids, as these probably perform the same function as dingoes.

Interactions between dingoes and foxes

While an inverse relationship between wild dog and fox *Vulpes vulpes* abundance has been observed (Jarman 1986; Newsome 2000), it remains to be demonstrated that wild dogs cause a reduction in fox abundance. Despite the lack of demonstrated causality, these observations have often been popularly interpreted to mean that wild dogs limit the distribution and abundance of foxes. Foxes are known to have a significant impact on a number of small to medium sized native mammals (Saunders *et al.* 1995), consequently it is a common belief that reducing or ceasing wild dog control would reduce the distribution of foxes and hence their impact on native fauna.

In areas of eastern NSW where wild dogs have not been excluded by human management, wild dogs and foxes commonly co-exist (for example, Newsome *et al.* 1983; Triggs *et al.* 1984; Robertshaw and Harden 1985a and unpublished data; Catling and Burt 1995; Fleming 1996). Harden (1997) also reported that foxes were present in at least 89% of the 133 NPWS parks and reserves with wild dogs. Thus, there is little evidence that wild dogs actually exclude foxes. Catling and Burt (1995), working in forest areas in northern and southern NSW, have also suggested that populations of foxes in south-eastern Australia are more likely to be limited by factors other than the presence of wild dogs.

While far from conclusive, this evidence is contrary to the view that wild dogs limit the distribution and abundance of foxes. The suggestion that reducing or ceasing wild dog control will significantly reduce the distribution or abundance of foxes should then be treated

with considerable caution. In fact, the reverse may be true when controlling wild dogs with 1080 baits because these programs also result in significant reductions in fox populations (McIlroy *et al*. 1986; Fleming 1996).

Past NPWS management of wild dogs

The NPWS policy for the management of wild dogs (including dingoes)

NPWS management of wild dogs is governed by various provisions of the *Rural Lands Protection Act 1989, National Parks and Wildlife Act 1974, Environmental Planning and Assessment Act 1979, Threatened Species Conservation Act 1995, Agricultural and Veterinary Chemicals Code Act 1994* and the *Pesticides Act 1978*.

The NPWS position on wild dogs and their management is articulated in its policy *The Management of Wild Dogs*. The following summary of parts of that policy is particularly germane to this forum on the dingo.

- The NPWS considers that the dingo is part of the native fauna of NSW and as such it has a responsibility to conserve remaining populations in areas it manages. Such conservation measures are restricted to NPWS areas because the dingo is a declared noxious species outside those areas (*Rural Lands Protection Act 1989*). (Note that under proposed changes to the *Rural Lands Protection Act* dingoes will have to be controlled on Crown lands, including the NPWS estate.)
- The conservation status of dingoes is unclear. The distribution of the species has been greatly reduced and it is not known what proportion of wild dogs are pure dingo. In the absence of a reliable field method for separating dingoes from their hybrids, the majority of the wild dog population on NPWS lands are assumed to be dingoes unless it is clear they are feral dogs.
- Remaining dingo populations are threatened by habitat clearing, and the requirement for their control outside NPWS areas as well as their genetic swamping through hybridisation with domestic and feral dogs. The NPWS has no control over these first two threats and its ability to reduce hybridisation is limited because control techniques generally do not discriminate between feral dogs and dingoes.
- The NPWS recognises that wild dogs from NPWS areas sometimes impact on livestock on adjacent areas, and accepts the need for management to minimise these attacks on stock.
- The NPWS will undertake wild dog control on its lands to reduce the impact to livestock on adjacent land when all of the following criteria are met: there is adequate evidence that the wild dogs are coming from NPWS lands; any existing, properly maintained barrier fences have failed to prevent the movement of wild dogs off NPWS lands; wild dog control on the adjacent land has failed to solve the problem; the impact on the dingo population will not threaten its viability on the NPWS estate; and there are cost effective methods of control that will not have significant deleterious effects on populations of protected fauna (see below).
- Where wild dog control is necessary in NPWS areas, it must minimise the impact on remaining dingo populations and non-target species of native fauna. Except when urgent action is required in response to a particular wild dog attack on stock, a Review of Environmental Factors (REF) must be prepared before any control program is implemented. If species listed as threatened on Schedule 1 or 2 of the *Threatened Species Conservation Act 1995* are identified in the REF, control techniques are to be used in such a way as to minimise their impacts on these species. If there is likely to be an impact on a threatened species, then a Species Impact Statement (SIS) has to be prepared.
- To facilitate the management of wild dogs when stock losses are occurring, the NPWS encourages liaison with its neighbours, local Wild Dog Control Associations and Rural Lands Protection Boards. Where control is necessary, it encourages the development and implementation of cooperative management programs with these groups.

Wild dogs in the NPWS estate

In a questionnaire survey of vertebrate pests in NPWS areas in 1996, wild dogs were reported to be present in 133 (39%) of the 358 national parks or nature reserves at that time (Harden 1997). The total area of parks and reserves with wild dogs was 3.43 million hectares, ie. 80% of the NPWS estate. However, wild dogs were not present through all of each park or reserve, and the actual area with wild dogs was estimated at 2.32 million ha (55% of the estate). All but nine of these parks and reserves were east of the Great Dividing Range. Domestic dogs were reported to roam into a further six reserves.

NPWS staff were asked to specify the type of wild dog in each park or reserve. Their perceptions were that in 6% of the reserves the wild dogs were dingoes, in 59% they were a mix of dingoes and hybrids, in 24% they were feral dogs and, in the remaining 11%, they were unknown.

Management of wild dogs

Broadly, there are two types of wild dog management. The first is reactive management, which is control in response to current problems caused by wild dogs. When stock are being lost, it is essential that control actions begin immediately, and the NPWS has mechanisms to ensure an immediate and effective response when it is clear the offending wild dog(s) are from the NPWS estate. Ground baiting, shooting and trapping are the most commonly used methods of reactive control (Harden and Robertshaw 1987). Historically, trapping has proved the most effective method for controlling wild dogs that are killing stock, as these dogs are difficult to bait and shooting is very opportunistic.

The second is strategic management which aims at preventing wild dog problems before they occur, and is appropriate on NPWS lands where there is a recent and regular history of stock losses on adjoining properties. Strategic management can be achieved by separating wild dogs from stock by a physical barrier (barrier fencing). This is effective provided the fence is well maintained. Alternatively, wild dog numbers can be reduced in a buffer strip adjacent to stock, reducing the tendency for the remaining wild dogs to move out onto agricultural land. Wild dog numbers are usually reduced by aerial or ground baiting in coordinated programs covering significant lengths of the interface between agricultural and non-agricultural lands (for example, the annual NSW Agriculture strategic management program).

Management of wild dogs on NPWS areas is a much more difficult task than on agricultural land. First, the NPWS must balance the conflicting objectives of ensuring the conservation of dingoes on its lands and minimising the impact that wild dogs from NPWS lands have on stock on adjoining areas. Second, the NPWS must also ensure that wild dog control measures have the minimum impact on non-target species of native fauna. It must prepare an REF for all control operations (except those requiring urgent action) and may also have to prepare an SIS. These actions are not necessary for control on agricultural lands; there are generally less non-target species at risk and NSW Agriculture has been granted a Section 120 licence for all wild dog control on agricultural lands in the state.

Control methods

The methods used to control wild dogs on NPWS lands, along with the conditions for their use, are described below. The frequency of use of each method during the 1995–96 financial year (Harden 1997) is shown in Table 1. These data were used in preference to the NPWS's annual reporting on control because the latter does not include information about parks and reserves where there was no control.

During the 1995–96 financial year, wild dog control was necessary to protect adjoining livestock on 57 (43%) of the parks and reserves with wild dogs. On 83% of these parks and reserves control was a cooperative effort between landholders and the NPWS; NPWS was solely responsible for control on only 13% of parks and reserves. These figures indicate that a high level of cooperation has been achieved between the NPWS and its neighbours.

Because a single method of wild dog control is rarely completely effective (particularly against wild dogs killing stock), a number of methods may need to be deployed. In 1995–96, a single method was used in 74%, two methods in 21% and 3 methods in 5% of the parks and reserves with control. The methods are outlined below.

1. Barrier fencing

The NPWS has carried out considerable research into the effectiveness of barrier fencing in north-eastern NSW with funds provided by the B.H.P. Community Trust through the (then) National Parks and Wildlife Foundation. The result has been an improved, lower maintenance fence design based on 1.8 m high prefabricated deer fencing with an electrified outrigger wire. However, the cost remains high ($5,000 per km for materials).

The NPWS has limited funds each year to improve the fencing of park and reserve boundaries. This is usually used on a cost sharing basis, with NPWS providing the materials and the adjoining landholder providing the labour and equipment to erect the fence. Barrier fencing was erected on part of the boundary of one reserve (Table 1) in 1995–96. Since 1995–96, barrier fencing has been erected on a number of parks and reserves.

2. Trapping

Table 1. Wild dog control methods used in the 57 reserves with wild dog control during 1995–96. Because more than one method was used in some reserves, the total for the number of parks and reserves using the different methods is greater than the number of parks and reserves with wild dog control.

Control method	Number of parks and reserves using method	Relative frequency of use (%)
Barrier fencing	1	1.3
Trapping	10	13.3
Shooting	5	6.7
1080 poison — aerial baiting	15	20.0
— ground baiting	44	58.7
Total	**75**	**100.0**

Trapping must be approved on a case by case basis by the Regional Manager. Only the more humane, offset, padded-jawed traps or treadle snares may be used. Trapping must also be carried out in accordance with NSW Agriculture's *Code of Practice for use of Traps to Capture Wild Dogs* which requires, among other things, that all traps be serviced at least once every 24 hours. Trapping occurred in 10 parks and reserves in 1995–96 (Table 1).

3. Shooting

Shooting is an extremely opportunistic method of wild dog control that is usually only used in reactive management. Wild dogs were shot on 5 parks and reserves (Table 1).

4. Poisoning

Sodium fluoroacetate (known as 1080) is the only poison that can be legally used to control wild dogs in eastern NSW. It is metabolised within the animal to fluoroacetate and then converted to fluorocitrate which competitively blocks the energy producing cycle (the tricarboxylic acid cycle), depriving the cells of energy and resulting in death. Because these metabolic processes take time, there is always a latent period between the ingestion of 1080 and the onset of the symptoms of poisoning. While there is no antidote for a lethal dose of 1080, these metabolic processes also mean that sub-lethal doses are excreted by the body so there is no accumulation of the toxin in the body.

The toxicity of 1080 to both native and introduced animals in Australia has been extensively studied (for example, see papers by McIlroy, King or Twigg). As a generalisation, warm blooded carnivores (particularly canids) are highly susceptible, herbivores are less sensitive and birds and reptiles are the least sensitive. On a per kilogram bodyweight basis, dingoes are much more susceptible to 1080 than any other native species. The environmental fate of 1080 has also been extensively studied (for example, see Eason *et al.* 1998). It is detoxified by microrganisms in soil and water and neither persists nor accumulates in the environment. There is also a rapid decline in its toxicity in fresh meat baits (McIlroy *et al.* 1988; Fleming and Parker 1991).

The use of 1080 is closely regulated under various pieces of legislation and their accompanying regulations. For wild dogs, each bait is 230 g of boneless meat injected with 6 mg of 1080 in solution. Injecting this relatively small amount of 1080 into the centre of a large bait minimises the risk to non-target species.

a) *Ground baiting:* Baits are placed singly on the ground under grass tussocks or buried in specially prepared baiting mounds. Bait mounds minimise non-target bait take; initially, non-toxic bait is placed in the mounds and the species taking the bait is determined from tracks on the mound over a number of days. The non-toxic bait is then re-placed with toxic bait at all mounds except those that had been visited by non-target species that might be at risk from wild dog baits. Although bait mounds are significantly more expensive to deploy and maintain, the method is preferred by NPWS where it is practical because it has the potential to reduce non-target bait take. The use of either method must be approved by the Regional Manager.

Ground baiting with 1080 was the most commonly used method of wild dog control in 1995–96 (44 parks and reserves; Table 1). NPWS prefers to use bait mounds to minimise the risk to non-target species, and most 1080 programs use this technique; placing baits under tussocks is generally confined to situations where stock are being killed and there is an urgent need for wild dog control.

b) *Aerial baiting:* The use of aerial baiting on NPWS lands is subject to considerable restrictions. It may only be used when all of the following criteria are met: difficult access makes ground control impractical; it is part of

an integrated, properly planned and executed program; the potential environmental impacts on native non-target species are considered; it will not substantially threaten dingo numbers in the area; and it is the most cost effective means of control. Aerial baiting may only be carried out from a helicopter and each program requires the approval of the Director-General of NPWS.

Aerial baiting occurred on 15 parks and reserves (Table 1) in 1995–96. However, since then aerial baiting has been phased out in most parks and reserves because of potential non-target impacts; in 1998 it occurred in only two reserves. To compensate for this reduction, NPWS has increased its use of ground baiting mounds. However, in very inaccessible terrain, ground-based operations are often not possible. In these situations, where stock losses are occurring and provided all necessary environmental impact procedures are completed, aerial baiting may still be possible on the NPWS estate.

The future

Proposed changes to the *Rural Lands Protection Act* will soon affect the management of wild dogs. Knowledge about dingoes and other wild dogs will also increase in the future. Particularly exciting is the possibility that DNA technology may make it possible to determine the actual status of the dingo in wild dog populations (Wilton 2000). The NPWS policy for the management of wild dogs will be responsive to changes in legislation and knowledge in a manner consistent with both its conservation responsibilities and the need to protect the livestock of neighbours.

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QUESTIONS & ANSWERS

CHRIS BANFFY: I was just wondering about predator-predator relationships. Basically, I know that Alan is doing a lot of work with cats and foxes there with the CRC process. What is actually being done with foxes and dingoes? What studies have actually been undertaken in that area? Also, I just question the remark that you threw up: "Let's dismiss this myth".

BOB HARDEN: No, the myth is about distribution, not about whether there is a difference in relative abundance. I think Peter has been working in this area.

PETER CATLING: The key to it all is disturbance. What Bob has said about changes in abundance is correct; when the abundance of dingoes is high, abundance of foxes is low, as Alan Newsome has shown. This has been misinterpreted to mean "to the point of exclusion", which is not correct and is the point that Bob is making. There are many other factors that influence the distribution of the fox. The distribution or abundance of dingoes is quite an insignificant factor in that really. The distribution of foxes mainly coincides with the distribution of the rabbit. Also, disturbance is a very significant factor. If we take examples within the forest estate, then proximity to freehold land and inappropriate fire regimes have a much greater influence than dingoes on fox abundance and distribution. The point is, don't get tied up with the relationship leading to the exclusion of foxes.

DAN LUNNEY: Do you think that we should be undertaking studies that look at the relationship between the density of foxes with dingoes and the native fauna?

BOB HARDEN: Yes, I agree, it would be very nice to do the study, but I think that you would need about half the NHT funding for one year to do it. It would be something that you would have to do experimentally, and would be very, very expensive and quite difficult to do.

KEITH ALLISON: Bob, you have the unenviable task of protection of a lot of species. I remember several years ago the National Parks and Wildlife Service spent a lot of money and entertained a lot of us in conducting a workshop on how to manage some of the species. One subject that stuck in my mind for a long, long time was the management of the dingo on some parks and in areas where you have the quoll. To what degree do you govern one to protect the other? Currently, out in our country, they're trying the reintroduction of the yellow-footed rock wallaby. You can spend a lot of money on one predator, but then you have a protected predator that knocks you back further again. You realise that over in South Australia, and the Broken Hill area, the eagle hawk, which is a protected species, is the biggest killer of the yellow-footed rock wallaby. You can spend all the money on foxes, and likewise the quoll. Has the Service got any preferential management figures or population densities since the workshop of populations of the dog in order to safeguard populations of the quoll?

BOB HARDEN: I would modify the question: "what is the relationship between quolls and dingoes?" to: "what is the relationship between quolls and dingo control?" Quolls and dingoes have coexisted in Australia for a very long time, and there is no real reason to think that, unless there has been some major disturbance in the ecosystem, there would be any major change between them. The issue of contention is: "what is the effect of dingo control

on quoll populations?" There is concern that use of 1080 will reduce quoll populations. The Service has just started a large research project to answer some of those questions. I am not going to buy into the debate by giving my personal view, I would rather wait and see, say 18 months down the track, when my staff have collected some results.

CREG CLANCY: Peter didn't really answer the question as to what research has been carried out to determine that there is no relationship with dingoes displacing foxes? Anecdotal information is only anecdotal information, but Gibraltar Range is a very interesting area. Dingoes are common, foxes are generally absent, parma wallabies are abundant. I think we shouldn't dismiss it too soon, I think the research should include such species as the quoll, the parma wallaby, foxes and dingoes. I think Peter might have all the answers but he hasn't given us the references or what research has been done. So I would ask Peter, if he has got that information, to put it forward. Other than that, let's look at those four species, I think they are all linked. I do tend to agree with what a long-term worker in Gibraltar Range observed, anecdotally, and that was, when they baited all the dingoes out, the foxes got into Gibraltar Range, and you rarely see them there now. Thank you.

PETER CATLING: No, and Alan and people from the CRC might correct me here, but I am sure that there is no work going on directly on fox and dingo. I repeat what I said before, I think there are other factors. I am not sure that I am answering your question, except to say that I can only reinforce what I said earlier, that there are a lot of other factors to do with the distribution of foxes that are not necessarily tied in with the dingo. I repeat, I do not believe that a high abundance of dingoes will limit, or completely exclude foxes, if that is what you are asking.

GREG CLANCY: I'm asking for references.

PETER CATLING: I will send them to you.

GREG CLANCY: That would be great.

DAN LUNNEY: Thank you very much, Bob, that was great.