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Lethal wild dog management: application of the precautionary principle to the development of public policy

Abstract

The wild dog population of Australia nominally comprises dingoes (*Canis lupus dingo*), feral dogs introduced since European settlement (*C. l. familiaris*), and hybrids of the two subspecies. However, the inability to operationally differentiate between dingoes, feral dogs and hybrids ensures that managing wild dogs in Australia is both complex and contentious, with public policy challenged to address competing imperatives to both control and conserve. The problematic nature of wild dog management in Australia is reflected in a maze of legislative contradictions and policy insufficiencies. Disturbingly, the lethal control strategies generally advocated across Australia for the management of wild dogs appear to have been designed with neglect of significant scientific evidence. As a top predator, the wild dog has a crucial role in ecosystems, regardless of considerations such as genetic purity. Moreover, lethal control of wild dogs may in fact not only exacerbate some of the problems experienced by the agricultural and grazing sectors, but through a cascade effect have a potentially disastrous impact on native wildlife. Accordingly, the policies of lethal wild dog management presently endorsed across Australia must be evaluated with regard to scientific evidence. The precautionary principle, which is increasingly discussed in scientific and legal debates over appropriate measures to address complex and uncertain risks, such as lethal predator control, provides wildlife managers with an effective mechanism for assessing scientific evidence along with present and alternative policies for wild dog management.

Introduction

The wild dog population of Australia nominally comprises dingoes (*Canis lupus dingo*), feral dogs introduced since European settlement (*C. l. familiaris*), and hybrids of the two subspecies (Fleming et al. 2001). However, while it is commonly accepted that the dingo was introduced to Australia some 4000 years ago (Corbett 2001) interbreeding with feral dogs post-European settlement has occurred to such an extent that it is now not generally practical or feasible to distinguish between dingoes and feral dogs in the wild (May and Norton 1996). The inability to operationally differentiate between dingoes, feral dogs and hybrids ensures that managing wild dogs in Australia is both complex and contentious, with public policy challenged to address imperatives to both control and conserve.

Wild dog control

Since the rapid expansion of agricultural and pastoral industries in the mid 1800's there has been conflict between rural landholders and wild dogs. In Australia wild dog-related losses emanate not only from attacks on and harassment of livestock, but also costs associated with control programs and decisions to leave empty vulnerable areas that would otherwise be suitable for grazing (McLeod 2004). Although cattle, sheep and other

livestock often constitute only a small proportion of wild dogs' diet (Coman 1972; Brunner et al. 1976; Newsome et al. 1983; Fleming et al. 2001), wild dogs cause substantial economic losses in the agricultural and grazing sectors (McLeod 2004). It has been suggested that if wild dogs killed livestock only to satisfy their nutritional requirements, these animals would not be regarded as such a debilitating problem (Fleming 2001). However, being a canid, wild dogs can exhibit surplus killing (Kruuk 1972); and because sheep are more susceptible to predation by wild dogs than are cattle, the interaction between wild dogs and sheep production is significantly more problematic (Fleming and Korn 1989). In fact, no research to date has documented a significant impact on beef cattle – there is more evidence to suggest that wild dogs have a greater positive role in controlling potential pests (Corbett and Newsome 1987; Caughley et al. 1980; Thompson 1992; Hrdina 1997) than a negative impact on calf production (Allen and Gonzales 1998).

As a result of the behavioural ecology of wild dogs the damage experienced by sheep producers is not necessarily related to the density of these species (Fleming 2001). However, as a consequence of their deleterious impact, the presence of wild dogs has largely determined the distribution of sheep, and to a lesser extent cattle, production in Australia (Newsome and Coman 1989); conversely, human control since European settlement has effectively shaped the geographic distribution and concentration of wild dogs (McLeod 2004).

The management of wild dogs in Australia has evolved little over the past 150 years: with the exception of the toxin sodium monofluroacetate (1080) the principal methods and strategies for wild dog control – poisoning, trapping and shooting – have changed little since the 1880's (Allen and Sparkes 2001). Recent research has, however, demonstrated that the quantifiable evidence of wild dog related livestock loss and the economic interpretation of these impacts are not consistently compiled and, as a consequence, the majority of wild dog control is based on perceived impacts and entrenched practices (Meek and Shields 2001).

Wild dog conservation

The desire to conserve wild dogs, particularly dingoes, is largely a consequence of the perception that dingoes are native fauna, despite their relatively recent introduction (Fleming et al. 2001). Definition of what constitutes native fauna is uncertain and problematic, and can encompass both ecological and cultural considerations (Corbett 2001). Culturally, there is evidence that dingoes have an important role in Aboriginal life (Breckwoldt 1988); moreover, dingoes are regarded by many Australians as iconic animals of aesthetic and intrinsic value (Daniels and Corbett 2003). Dingoes are, in addition, formally recognised as native animals in some Australian States (Fleming et al. 2001). Ecologically, however, both dingoes and other wild dogs appear to have significant functional value (Daniels and Corbett 2003) despite apparent differences in ecology, morphology, behaviour, and physiology (Fleming et al. 2001).

While habitat fragmentation and modification associated with agricultural systems, along with hybridisation with feral dogs have been identified as the principal threats to remaining pure dingo populations (Davis and Leys 2001), it is evidently not generally realistic or reasonable to conserve only pure dingoes. Traditional methods of assessing dingo purity are predominantly based on skull measurements or physical appearance (Newsome et al. 1980; Newsome and Corbett 1982, 1985) – techniques that are impractical or unreliable for

field assessment – and while modern DNA techniques have also been applied to assessing the purity of populations as well as individual animals (Wilton et al. 1999; Wilton 2001); there are some significant questions as to the quality of the dingo genetic material on which comparisons are based and the time taken to complete assessments (Fleming et al. 2001).

Public policy

The competing and conflicting imperatives for wild dog management in Australia are reflected in a maze of legislative contradictions and policy insufficiencies. Disturbingly, the lethal control strategies generally advocated for the management of wild dogs appear to have been designed with neglect of significant scientific evidence. Unfortunately, the inherently political nature of science, combined with its inability to provide surety, has allowed scientific uncertainty issues to be used as a tool to argue for or against certain policies depending on the political priorities of the parties involved (Heazle 2004). This paper addresses the policies of wild dog management and considers the application of the precautionary principle to the development of alternative public policies for the effective management of wild dogs in Australia.

A problem with the law

The legal status of dingoes and wild dogs varies significantly between the Commonwealth, States and Territories, affecting the control and conservation measures that are applied and the level of cooperation between individuals and groups. Following is a summary of the Australian legislation relating to wild dog management.

Commonwealth

The dingo is regarded as a regulated native species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, and therefore is protected in Commonwealth national parks and reserves, World Heritage and other protected areas. However, the *Environment Protection and Biodiversity Conservation Act 1999* provides for dingoes to be controlled in areas where they are having a demonstrated impact on native ecological communities.

Australian Capital Territory

The Australian Capital Territory *Nature Conservation Act 1980* defines protected species in the Territory and includes the dingo on this schedule. Control of wild dogs, including dingoes, on private lands is however permitted subject to a permit authorising the killing of a protected species being issued by Environment ACT.

New South Wales

As a consequence of their impact on the agricultural and grazing sectors the legal status of wild dogs, and particularly dingoes, in NSW is complicated. Under the NSW *Threatened Species Conservation Act 1995* a species is considered indigenous if it was established in NSW prior to European settlement (Dickman and Lunney 2001). Accordingly the legal status of the dingo as a native animal, and therefore a protected species, appears clear. However, the dingo is unprotected under Schedule 11 of the *National Parks and Wildlife Act 1974* and the *Rural Lands Protection Act 1998* requires pest animals declared under the Act, which includes feral dogs and dingoes, to be controlled on Crown lands to the extent necessary to minimise the risk of the pest causing damage on any land.

The legal position of the dingo in NSW has the potential to be further complicated – the Scientific Committee, which is responsible for listings under the *Threatened Species Conservation Act 1995*, has deferred a decision to list dingoes as a threatened species pending further research to determine the genetic purity and distribution of dingoes in NSW and an examination of the impacts of current wild dog management practices employed by the Department of Environment and Conservation (NSW) and other public land managers (Dickman and Lunney 2001). Fauna listed under Schedule 1 or 2 of the *Threatened Species Conservation Act 1995* cannot be declared as pests.

Northern Territory

In view of their ecological importance, dingoes are regarded under Northern Territory legislation as native wildlife (Northern Territory Parks and Wildlife Service 2004). This status affords the dingo full legal protection, making it an offence to posses, interfere with or kill dingoes unless authorised to do so under the *Territory Parks and Wildlife Conservation Act 2000*. Lethal management of such protected wildlife is possible in the Northern Territory through programs approved under the *Territory Parks and Wildlife Conservation Act 2000*. Hybrids and feral dogs are not protected in the Northern Territory. Where it is considered necessary to conduct control operations on Aboriginal lands in the Northern Territory, under the *Aboriginal Land Rights (Northern Territory) Act 1976* such operations are only to be undertaken with the approval of landowners.

Queensland

Under the *Nature Conservation Act 1992* the dingo is a species declared indigenous to Australia. Sections 17 and 62 of the *Nature Conservation Act 1992* provide for the legal protection of the dingo as a natural resource in protected areas such as national parks. Consequently a dingo cannot be interfered with on a protected area unless the chief executive of the Queensland Parks and Wildlife Service has granted a permit or authority. Elsewhere in Queensland dingoes, and other wild dogs, are declared pest species under the *Rural Lands Protection Act 1985.* The responsibility for wild dog control in Queensland lies with landholders and is administered by the Land Protection Branch of the Department of Natural Resources and local governments.

South Australia

Dingoes and hybrids are 'proclaimed' pests and must be controlled under the *Animal and Plant Control Board (Agricultural Protection and Other Purposes) Act 1986* in the sheep zone south of the dog fence. North of the dog fence the dingo is regarded as a legitimate wildlife species and although unprotected is afforded a level of protection by the South Australian Dingo Policy (Animal and Plant Control Commission 1993). Beyond a 35 kilometre-wide baited buffer zone north of the dog fence, conservation of dingoes is enhanced by restrictions to ground baiting, prohibition of aerial baiting and phasing out of bounties. The Dog Fence Board, under the *Dog Fence Act 1946*, administers maintenance of the 2178 kilometre dog fence. Funding is shared equally between the Government and landholders receiving protection of the fence.

Victoria

In Victoria dingoes are offered some protection within the lands administered under the *National Parks Act 1975* through the Wild Dog Policy of the National Parks and Conservation Reserves. Elsewhere in Victoria under the *Catchment and Land Protection Act 1994* landholders have an obligation to prevent the spread of and as far as possible eradicate species declared an Established Pest Animal, including feral dogs, dogs run wild and dingoes and their hybrids, on land they own or occupy.

Western Australia

Dingoes, feral dogs and hybrids are declared pests of agriculture under the provisions of the *Agriculture and Related Resources Protection Act 1976* and are placed into categories A4, A5, A6 and A7. Although category A5 requires that populations should be controlled throughout the State, it is recognised that dingoes pose no threat in vast areas beyond the limits of pastoral or agricultural land and Agriculture Protection Board policy restricts control activities to stocked land and its immediate environs. Under category A7 dingoes are identified as animals native to Western Australia that should, in the opinion of the Agriculture Protection Board, have a program for their management approved, published and implemented. Such management plans are drawn up in consultation with the Department of Conservation and Land Management as this department administers the *Wildlife Conservation Act 1950* under which dingoes are listed as unprotected fauna, although they are not subject to control in fauna reserves and national parks.

Policy and planning: the wild dog management solution?

In an effort to address not only the maze of contradictions established by the legislation, but the publicly controversial task of managing wild dogs, State and Territory Governments have developed somewhat placatory management policies and approaches.

In New South Wales (NSW) the Government has developed a particularly conservative strategy which has been endorsed by various government agencies, Rural Lands Protection Boards and the NSW Pest Animal Council. This approach has, moreover, been

incorporated into the *Rural Lands Protection Act 1998* through the Wild Dog Pest Control Order. This Order allows for the general destruction obligation for selected publicly managed lands to be satisfied through a Rural Lands Protection Board approved wild dog management plan, which will purportedly encompass both control and conservation objectives. To this end the NSW Government has touted documents such as the 2002 *Brindabella and Wee Jasper Valleys Co-operative Wild Dog/Fox Control Plan* (Hunt et al. 2002) as a model panacea for managing and resolving wild dog issues across the state. This, and other wild dog management plans in NSW, advocates both strategic and reactive wild dog control programs based solely on the establishment of bait stations and the trapping of bait-shy individuals (Hunt et al. 2002).

In contrast, the Northern Territory, Western Australian, South Australian, Victorian and Queensland Governments have endorsed a range of strategies, policies and programs for the management of wild dogs that also embrace alternative control and management techniques.

The document *A Management Program for the Dingo (Canis lupus dingo) in the Northern Territory of Australia* (Northern Territory Parks and Wildlife Service 2004) states that the principle technique for dingo control in the NT – where there is significant damage to livestock by dingoes – is 1080 baiting. However, this strategy also suggests that landholders experiencing minor livestock damage will be encouraged to apply for a relevant permit and undertake control through the use of dog-proof fencing or shooting (Northern Territory Parks and Wildlife Service 2004). The *Western Australian Wild Dog Management Strategy 2004* (State Wild Dog Management Advisory Committee 2004) also advocates a range of techniques including trapping, baiting, shooting, barrier and electric fencing. The stated objective of this Strategy is not to eliminate wild dogs from the State, but to control their impact on domestic stock. The Strategy's goal is articulated thus:

'to minimise the impact of wild dogs on economic and community values through the implementation of a community supported strategic approach to wild dog management on both private and public land that contributes to the protection of livestock while supporting the conservation of pure dingoes in other areas of the State.'

The Victorian *Wild Dog Management Strategy* (Department of Natural Resources and Environment 2002) is another plan that advocates a coordinated approach to wild dog management and affirms that to be effective, strategies such as trapping, baiting and electric fencing must be carried out at a high level of efficiency and be closely integrated with each other. The *Queensland Wild Dog Management Strategy* (Queensland Department of Natural Resources and Mines 2002) and the South Australian *Policy on the Management of Dingo Populations in South Australia* (Animal and Plant Control Commission South Australia 1993) encompass a range of strategies for wild dog management both inside and outside the dog-proof fence. The *Queensland Wild Dog Management Strategy* states that effective wild dog control necessarily involves a combination of techniques including trapping, shooting, fencing, baiting and aversion. While the South Australian policy identifies a range of strategies for protecting the livestock industry including continuing, effective maintenance of a dog-proof fence around the sheep country and the destruction of dingoes only in the vicinity of the dog-proof fence.

However, despite the alternative techniques advocated by some State and Territory wild dog management plans and policies, across Australia the central dogma of wild dog

management remains baiting with 1080. This is despite research results indicating that the effectiveness of wild dog poisoning campaigns can vary considerably and rarely achieve the critical threshold level necessary for sustained control (McIlroy et al. 1986; Fleming et al. 1996). More ominously, however, the lethal management strategies advocated in wild dog management plans, strategies and policies appear to have been designed with neglect of scientific evidence – however uncertain – that the wild dog has a significant functional role in many ecosystems and that lethal control of wild dogs may in fact not only exacerbate some of the problems experienced by the agricultural and grazing sectors, but through a cascade effect have a potentially disastrous impact on native wildlife.

So what about the science?

During the 4000 years that dingoes, and now feral dogs and hybrids, have been present in Australia they have unquestionably helped to shape and maintain ecosystems (Daniels and Corbett 2003). Historically, wild dogs have been linked to the demise of the thylacine (*Thylacinus cynocephalus*), Tasmanian devil (*Sarcophilus harrisii*) and native-hen (*Gallinula mortierii*); and moreover may have played a role in the extinction of nine species of bandicoots, macropods and rat-kangaroos in central Australia since the 1930's (Hope 1984; Baird 1991; Corbett 2001). More recently it has been suggested that predation by wild dogs may have a detrimental impact on the continuing survival of certain remnant populations of endangered fauna (Fleming et al. 2001). Significantly, however there is also evidence that wild dogs have an important role in both limiting and regulating populations of macropods (Caughley et al. 1980; Newsome et al. 1983; Corbett and Newsome 1987; Robertshaw and Harden 1989; Thomson 1992; Pople et al. 2000), emus (*Dromaius novaehollandiae*) (Caughley et al. 1980; Pople et al. 2000), feral goats (*Capra hircus*) (Parkes et al. 1996) and feral pigs (*Sus scrofa*) (Woodall 1983; Choquenot et al. 1996).

Despite the considerable body of research relating to dingoes, feral dogs and hybrids, the ecological role of wild dogs remains unclear. Predators such as the wild dog can have highly variable effects on local biodiversity (Sih et al. 1985; Schoener and Spiller 1996; Gough and Grace 1998; Proulx and Mazumder 1998; Siemann 1998; Carson and Root 2000). Wild dogs suppress and regulate some prey species through direct trophic interactions; however, the consequences of this suppression are undefined, but may include indirectly facilitating other species, either by release from competitors (keystone predation) or intermediate predators (trophic cascades) (Paine 1966; Vance 1974; Hunter and Price 1992; Holt et al. 1994; Leibold 1996; Henke and Bryant, 1999). Nevertheless, the net effects of predators such as wild dogs on local biodiversity depend on the number of species that are excluded versus facilitated within a patch (Schoener and Spiller 1996). Notwithstanding the lack of scientific certainty it seems reasonable to suggest that wild dogs may influence faunal community structure and that the disruption of functional predator-prey relationships as a consequence of lethal wild dog management may lead to unforseen impacts on biodiversity and ecosystem processes and may additionally play a role in disabling social behaviours that limit wild dog populations.

Mesopredator release

Aside from the fact that lethal control measures such as poisoning may have a direct impact on non-target native species; reducing wild dog density may result in an increase in other predators with overlapping diets, creating a conservation conundrum through mesopredator release (Soulé et al. 1988; Palomares et al. 1995 Estes 1996; Chourchamp et al. 1999; Crooks and Soulé 1999).

Many lethal wild dog control techniques, such as mound or aerial baiting, reduce the number of both foxes (*Vulpes vulpes*) and wild dogs (Fleming et al. 2001). However, post-control foxes have the potential to recover more quickly and replace wild dogs in the ecosystem – it is considered likely that any management practice that promotes the abundance of foxes relative to that of wild dogs will have a significant adverse impact on endangered critical body weight range (CWR) marsupials (Smith et al. 1992). Additionally, recent research has demonstrated that broad area control of foxes and wild dogs, while highly effective in controlling these species for a period of time, resulted in an appreciable increase in the number of feral cats (*Felis catus*) (Burrows et al. 2003).

Removing wild dogs from a system where foxes and cats also occur can demonstrably result in an increase in fox and/or cat numbers, with consequent increased predation on small native mammals (Fleming et al. 2001). While wild dogs, and in particular dingoes, have been linked to the extinction of a range of native species (Hope 1984; Baird 1991; Corbett 2001), the severity of the impact of wild dogs on the native fauna is considered to be minimal, at least in comparison with the impact that cats and foxes can have on populations (Burbidge and McKenzie 1989; Dickman 1993, 1996). The introduction of the fox, for example, is believed to have played a major role in the extinction of many native ground-dwelling species in the last 130 years (Jones 1923-1925; Le Souef 1923; Short and Smith 1994; Smith and Quin 1996; Short 1998). The role of the feral cat in mammalian extinctions is poorly understood and somewhat controversial; however, the feral cat has been increasingly implicated in the extinction of species of less than 1 kilogram during the first 100 years of European settlement (Dickman 1993; Short and Smith 1994). In contrast, the wild dog is not considered a threat to CWR mammals in undisturbed environments (Smith et al. 1992). CWR species appear to persist in moist, high quality forests (Burbidge and McKenzie 1989) and other areas from which foxes are absent and in which predators such as wild dogs and quolls (*Dasyurus spp.*) are abundant (Smith et al. 1992). Moreover, there are no examples of wild dogs surplus killing medium sized mammals suggesting that these animals have a lesser overall impact on native fauna when compared to foxes (Short et al. 2002). The outcome of replacing wild dogs with foxes and/or cats could be more ecologically disastrous and costly than is currently understood (Saunders et al. 1995; Dickman 1996; Reynolds and Tapper 1996).

Social factors limit population growth

The lethal control of wild dogs may also play a role in disabling social behaviours that limit the growth of wild dog populations. Corbett (2001) has suggested that throughout the majority of mainland Australia wild dogs, and in particular dingoes, have overcome pastoralists principally because control techniques have fractured packs and thereby dampened natural population regulation whereby breeding is confined to the dominant pack female. For example, trapping has been found to merely harvest the surplus population and thereby allow the remaining wild dogs to multiply faster and accordingly

negate attempts at control (Newsome et al. 1973). Indications are that lethal control also affects the age structure of wild dog populations and results in pack formation and prey switching from macropods to livestock (Allen and Gonzales 1998). Research in Queensland has, moreover, suggested that wild dog control has not been effective in reducing livestock loss and in some situations has resulted in increased calf loss as the wild dog population recovered (Allen and Gonzales 1998).

Dispersal sinks

Finally it is significant that wild dog control has rarely been considered successful in the long term due to the dispersal sink effect, which describes the recolonisation of vacant individual territories following the removal of the incumbent individuals (Lidicker 1975). Where conditions are favourable, wild dogs generally form stable packs that maintain distinct territories that overlap little with neighbouring packs (Thompson 1992), although territories may shift in response to changes in food availability or social organisation (Fleming et al. 2001). The territoriality of wild dogs, by definition, implies defence of an area and denotes that the resident animals will stop intruding animals from settling in that area (Thompson 2003).

Thompson et al. (1992) determined that the incidence of dispersal was greatest when the density of the wild dog population was high and the food supply low, and was facilitated by the availability of nearby vacant areas. That is, when food becomes scarce for a large population of wild dogs in a nominally safe area, they may disperse singly or in groups to areas where there are fewer wild dogs – often the resource-rich pastoral and agricultural areas where human control measures are intense (Fleming et al. 2001). Wild dogs are subsequently poisoned, trapped or shot in these zones, creating vacant areas or sinks and perpetuating the dispersal-mortality cycle (Fleming et al. 2001)

The precautionary principle

The complex and contentious nature of wild dog management in Australia is clearly reflected in and compounded by a maze of legislative and policy contradictions. The universal panacea advocated across Australia for managing the detrimental impacts of wild dogs and, seemingly for the conservation of the dingo, is lethal control. However, given the evidence, however uncertain, to suggest that wild dogs are a functional part of predator-prey relationships in numerous natural systems and that lethal control of wild dogs may in fact not only exacerbate some of the problems experienced by the agricultural and grazing sectors, but have a potentially detrimental impact on native wildlife, Governments and agencies responsible for the management of wildlife have clearly failed to deliver effective solutions. The development of a constructive and encompassing solution to wild dog management issues across the continent is undeniably dependent on politics; however, in formulating management decisions it is the assertion of this paper that Governments and their agencies have an obligation to employ the precautionary principle.

The precautionary principle is increasingly discussed in scientific and legal debates over appropriate measures to address complex and uncertain risks, such as lethal predator

control (Tickner and Geiser 2004). Moreover, the principle provides an appropriate framework, which is familiar to wildlife managers. It argues that:

'Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by: (i) careful evaluation to avoid, wherever practicable, serious irreversible damage to the environment; and, (ii) an assessment of the risk-weighted consequences of various options.' (The Intergovernmental Agreement on the Environment, May 1992, Quoted in Deville and Harding 1997, pp. 13).

The precautionary principle is a direction to prevent foreseeable environmental degradation even if foundations of fact and circumstance are unclear (Spry 1997) and applies in situations where risk is suspected but is to a greater or lesser extent unknown (Grayson and Calver 2004). In short, the precautionary principle states that where the scientific evidence is ambiguous, decision-makers should take action to limit continued environmental damage and should err on the side of caution when evaluating proposals that may seriously or irreversibly impact on the environment (Fisher 2003), such as eliminating a top predator from ecosystems.

Although the precautionary principle is not specifically articulated in any Australian legislation, there is legal precedent for its application to wildlife management, particularly in NSW. The most extensive curial discussion of the precautionary principle is that of Stein J of the NSW Land and Environment Court in *Leatch v National Parks and Wildlife Service and Shoalhaven City Council* (cited in Spry 1997). Stein J noted that pursuant to the *National Parks and Wildlife Act 1974* and the *Land and Environment Court Act 1979* he was required to take into account various matters including those which the Court considers relevant as well as the *'circumstances of the case and the public interest'.* In this instance Stein J described the precautionary principle as a '*statement of commonsense'.* He continued:

'It is directed towards the prevention of serious or irreversible harm to the environment in situations of scientific uncertainty. Its premise is that where uncertainty exists concerning the nature or scope of environmental harm (whether this follows from policies, decisions or activities), decision makers should be cautious.'

His Honour then considered the nature of Part 7 of the *National Parks and Wildlife Act 1974* and concluded that it was aimed at the preservation and protection of fauna. He observed that although the precautionary principle is not expressly stated, the cautious approach it suggests is '*clearly consistent with the subject matter, scope and purpose of the Act.'* His Honour therefore concluded:

'Application of the precautionary principle appears to me to be most apt in a situation of a scarcity of scientific knowledge of species population, habitat and impacts. Indeed, one permissible approach is to conclude that the state of knowledge is such that one should not grant a licence to 'take or kill' the species until much more is known.'

Given that wild dogs cause economic losses to the powerful agricultural and grazing sectors (McLeod 2004), it is clear that Governments must act to control wild dogs in the absence of scientific certainty and adequate knowledge. However, the absence of fact or certainty does not preclude the application of the precautionary principle to wild dog management. Recent statements of the precautionary principle have suggested an

additional component that is critical to the effective implementation of this principle: assessment of alternatives (Tickner and Geiser 2004). With regard to wild dog management Governments undoubtedly have an obligation to evaluate alternative, non-lethal strategies in order to prevent serious or irreversible harm to the environment.

Alternatives to lethal management

While some State and Territory Governments have identified in their wild dog management strategies and policies a range of alternative, non-lethal techniques, across Australia the central dogma of wild dog management remains poisoning with 1080. Nevertheless, a range of alternatives to the traditional lethal predator management strategies of poisoning, trapping and shooting have been investigated, both in Australia and overseas, including adversive conditioning (Burns 1983; Gustavson et al. 1983; Tauchmann 1998), the use of sheep-guarding dogs or llamas (Botkin and Taylor 1985; Timm and Schmidt 1990; Balderstone 1992; Green et al. 1994;), fencing (Bird et al. 1997; Allen and Sparkes 2001) and damage compensation schemes (Wagner et al. 1997). Of particular interest is the conclusion of Allen and Sparkes (2001) that where properties are smaller, in rough forested terrain, where alternative prey species are more abundant, where there is mixed support for coordinated baiting campaigns, or where a contiguous buffer cannot be maintained a physical barrier is more effective than a chemical buffer for protecting sheep, the livestock principally affected by wild dogs (Allen and Gonzales 1998). In combination with an effective and targeted compensation scheme, barrier fencing may provide a viable alternative to lethal wild dog management that also satisfies the premise of the precautionary principle – that decision-makers should take action to limit continued environmental damage and should err on the side of caution when evaluating proposals that may seriously or irreversibly impact on the environment.

Alternatives in action?

Through the development and implementation of wild dog management plans the NSW Government has an opportunity to evaluate the effectiveness of an alternative, non-lethal wild dog management strategy such as that described above.

Although the *Dividing Fences Act 1991* does not bind the Crown, NSW Government agencies such as the Department of Environment and Conservation (DEC) recognise that there will often be a mutual benefit to both the agency and its neighbours in erecting and maintaining suitable fencing. Accordingly, the Department of Environment and Conservation presently contributes to boundary fencing where '*necessary and appropriate'* (DEC 2004). In most circumstances the DEC contributes to boundary fencing by suppling materials, while affected neighbouring landholders take responsibility for fence construction and maintenance. The Department of Environment and Conservation's *Boundary Fencing Policy* states:

'The Department may contribute to the cost of boundary fencing if the fencing will:

(a) assist in the protection and conservation of natural values in a park;

(b) mitigate cross-boundary irregularities associated with differing land uses and the management objectives between the Department and adjoining landholders; and

(c) control the movement of pest animals onto, or off, a park.'

The erection of wild dog-proof boundary fencing clearly meets the requirements of the DEC's *Boundary Fencing Policy* outlined above. While the cost of constructing and maintaining wild dog-proof fencing is significant (Bird et al. 1997), the Department of Environment and Conservation presently directs a large percentage of its feral animal resources to control programs targeting wild dogs (English and Chapple 2002). For example, in 2000-2001 more than half of the DEC's feral animal budget was spent on control programs targeting foxes and wild dogs – 25% on foxes and 29% on wild dogs (English and Chapple 2002).

As an alternative to the lethal management strategies presently advocated by the NSW Government, agencies such as the Department of Environment and Conservation should investigate, through the wild dog management plans, directing a percentage of their feral animal control budgets to the erection of wild-dog proof boundary fencing and the implementation of a compensation scheme. For instance, where physical wild dog barriers are erected and adequately maintained and wild dog related livestock losses are confirmed, the Government could then pay landholders compensation at market rates for the lost stock. Such a scheme would not only address the threat of serious or irreversible harm to the environment as a consequence of lethal wild dog management, but probably result in significant savings to the NSW Government and alleviate some of the financial burden landholders suffer as a consequence of wild dog attacks.

Conclusions

McKnight (1976) first raised the question of whether or not pest control should be conducted where it could be demonstrated that an introduced species had merely replaced an extinct native species, thereby occupying the niche as a surrogate guild member. Feral dogs and hybrids have successfully replaced dingoes as a top level predator in many ecosystems, much as dingoes replaced the thylacine and Tasmanian devil on mainland Australia some 4000 years ago. As a top predator, the wild dog has a crucial role in ecosystems, regardless of considerations such as genetic purity (Daniels and Corbett 2003). Moreover, lethal control of wild dogs may in fact not only exacerbate some of the problems experienced by the agricultural and grazing sectors, but through a cascade effect have a potentially disastrous impact on native wildlife. Governments and their agencies relentlessly promote 'best practice' management – in this instance the focus of such 'best practice' must be primarily to prevent attacks on livestock by wild dogs, rather than concentrating on the number of wild dogs killed. Accordingly the policies of lethal wild dog management presently endorsed across Australia must be evaluated with regard to scientific evidence and the precautionary principle and where practicable alternatives assessed.

References

Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

Nature Conservation Act 1980 (Australian Capital Territory)

Dividing Fences Act 1991 (New South Wales)

National Parks and Wildlife Act 1974 (New South Wales)

Rural Lands Protection Act 1998 (New South Wales)

Threatened Species Conservation Act 1995 (New South Wales)

Aboriginal Land Rights (Northern Territory) Act 1976 (Northern Territory)

Territory Parks and Wildlife Conservation Act 2000 (Northern Territory)

Nature Conservation Act 1992 (Queensland)

Rural Lands Protection Act 1985 (Queensland)

Animal and Plant Control Board (Agricultural Protection and Other Purposes) Act 1986 (South Australia)

Dog Fence Act 1946 (South Australia)

Catchment and Land Protection Act 1994 (Victoria)

National Parks Act 1975 (Victoria)

Agriculture and Related Resources Protection Act 1976 (Western Australia)

Wildlife Conservation Act 1950 (Western Australia)

Allen, L. and Gonzales, T. (1998). Baiting reduces dingo numbers, changes age structure yet often increases calf losses. In: *Proceedings of the 11th Australian Vertebrate Pest Conference, Bunbury, Western Australia*.

Allen, L. R. and Sparkes, E. C. (2001). The effect of dingo control on sheep and beef cattle in Queensland. *Journal of Applied Ecology* **38:** 76-87.

Animal and Plant Control Commission South Australia (1993). *Policy on the Management of Dingo Populations in South Australia*. Animal and Plant Control Commission South Australia: Adelaide.

Baird, R. F. (1991). The dingo as a possible factor in the disappearance of *Gallinula mortierii* from the Australian mainland. *Emu* **91:** 121-122.

Balderstone, E. (1992). Maremma guard dogs beat lamb predators. *Australian Farm Journal*, February: 61.

Bird, P.; Lock, B. and Cook, J. (1997). *The Muloorina Cell: a long-term trial to assess electric dingo fence designs*. Unpublished report to the South Australian Dog Fence Board: Adelaide.

Botkin, M. P. and Taylor, N. (1985). Llamas may or may not be the solution to sheep predation. *National Sheep Grower* July: 7-8.

Breckwoldt, R. (1988). *A Very Elegant Animal: The Dingo*. Angus and Robertson: Sydney.

Brunner, H.; Amor, R. L. and Stevens, P. L. (1976). The use of predator scat analysis in a survey at Dartmouth in north-eastern Victoria. *Australian Wildlife Research* **3:** 85-90.

Burbidge, A. A. and McKenzie, N. L. (1989) Patterns in the modern decline of Western Australia's vertebrate fauna: causes and conservation implications. *Biological Conservation* **50:** 143–198.

Burns, R. J. (1983). Coyote predation aversion with lithium chloride: management implications and comments. *Wildlife Society Bulletin* **11:** 128-132.

Burrows, N. D.; Algar, D.; Robinson, A. D.; Sinagra, J.; Ward, B. and Liddelow, G. (2003). Controlling introduced predators in the Gibson Desert of Western Australia. *Journal of Arid Environments* **55:** 691-713.

Caughley, G.; Grigg, G. C.; Caughley, J. and G. J. E. Hill. (1980). Does dingo predation control the densities of kangaroos and emus? *Australian Wildlife Research* **7:** 1-12.

Carson, W. P. and Root, R. B. (2000). Herbivory and plant species coexistence: community regulation by an out-breaking phytophagous insect. *Ecological Monographs* **70:** 73-99.

Choquenot, D.; McIlroy, J. and Korn, T. (1996). *Managing Vertebrate Pests: Feral Pigs*. Bureau of Rural Sciences and Australian Government Publishing Service: Canberra.

Chourchamp, F.; Langlais, M. and Sugihara, G. (1999). Cats protecting birds: modelling the mesopredator release effect. *Journal of Animal Ecology* **68:** 282-292.

Coman, B. J. (1972). Helminth parasites of the dingo and feral dog in Victoria with some notes on the diet of the host. *Australian Veterinary Journal* **48:** 456-461.

Corbett, L. (2001). *The Dingo in Australia and Asia*. JB Books Pty Ltd: Adelaide.

Corbett, L, and Newsome, A. E. (1987). The feeding ecology of the dingo. III. Dietary relationships with widely fluctuating prey populations in arid Australia: an hypothesis of alternate predation. *Oecologia* **74:** 215-227.

Crooks, K. R. and Soulé, M. E. (1999). Mesopredator release and avifaunal extinctions in a fragmented system. *Nature* **400:** 563-566.

Daniels, M. J. and Corbett, L. (2003). Redefining introgressed protected mammals: when is a wildcat a wild cat and a dingo a wild dog? *Wildlife Research* **30:** 213-218.

Davis, E. O. and Leys, A. R. (2001). Reconciling wild dog control and dingo conservation under New South Wales legislation. In: *A Symposium on the Dingo*. C. R. Dickman and D. Lunney (Eds.). Royal Zoological Society of New South Wales: Mosman.

Department of Environment and Conservation (DEC). (2004). *Boundary Fencing Policy*. Department of Environment and Conservation (NSW): Sydney.

Department of Natural Resources and Environment (2002). *Victorian Pest Management: A Framework for Action – Wild Dog Management Strategy*. Department of Natural Resources and Environment: Melbourne.

Deville, A. and Harding, R. (Eds.) (1997). *Applying the Precautionary Principle*. The Federation Press: Sydney.

Dickman, C. R. (1993). Raiders of the last ark: cats in island Australia. *Australian Natural History* **24:** 44-53.

Dickman, C. R. (1996). *Overview of the impacts of feral cats on Australian native fauna*. Australian Nature Conservation Agency: Canberra.

Dickman, C. R. and Lunney, D. (2001). Last howl of the dingo: the legislative, ecological and practical issues arising from the kill-or-conserve dilemma. In: *A Symposium on the Dingo*. C. R. Dickman and D. Lunney (Eds.). Royal Zoological Society of New South Wales: Mosman.

English, A. W. and Chapple, R. S. (2002). *A report on the management of feral animals by the New South Wales National Parks and Wildlife Service*. NSW National Parks and Wildlife Service: Sydney.

Estes, J. A. (1996). Predators and ecosystem management. *Wildlife Society Bulletin* **24:** 390-396.

Fisher, D. E. (2003). *Australian Environmental Law*. Lawbook Co.: Sydney.

Fleming, P. J. S. (2001). Legislative issues relating to control of dingoes and other wild dogs in New South Wales. II. Historical and technical justifications for current policy. In: *A Symposium on the Dingo*. C. R. Dickman and D. Lunney (Eds.). Royal Zoological Society of New South Wales: Mosman.

Fleming, P.; Corbett, L.; Harden, R. and Thomson, P. (2001). *Managing the Impacts of Dingoes and Other Wild Dogs*. Bureau of Rural Sciences: Canberra.

Fleming, P. J. S. and Korn, T. J. (1989). Predation of livestock by wild dogs in eastern New South Wales. *Australian Rangelands Journal* **11:** 61-66.

Fleming, P. J. S.; Thompson, J. A. and Nichol, H. I. (1996). Indices for measuring the efficacy of aerial baiting for wild dog control in north-eastern New South Wales. *Wildlife Research* **23:** 665-674.

Grayson, J. and Calver, M. (2004). Regulation of domestic cat ownership to protect urban wildlife: a justification based on the precautionary principle. In: D. Lunney and S. Burgin (Eds.) *Urban wildlife: more than meets the eye*. Royal Zoological Society of New South Wales: Mosman.

Green, J. S.; Woodruff, R. A. and Andelt, W. F. (1994). Do livestock guarding dogs lose their effectiveness over time? *Vertebrate Pest Conference* (California) **16:** 41-44.

Gough, L. and Grace, J. B. (1998). Herbivore effects on plant species density at varying productivity levels. *Ecology* **79:** 1586-1594.

Gustavson, C. R.; Gustavson, J. C. and Holzer, G. A. (1983). Thiabendazole-based taste aversions in dingoes (*Canis familiaris dingo*) and New Guinea wild dogs (*Canis familiaris hallstromi*). *Applied Animal Ethology* **10:** 385-388.

Heazle, M. (2004). Scientific uncertainty and the International Whaling Commission: an alternative perspective of the use of science in policy making. *Marine Policy* **28:** 361-374.

Henke, S. E. and Bryant, F. C. (1999). Effects of coyote removal on the faunal community in western Texas. *Journal of Wildlife Management* **63(4):** 1066-1081.

Holt, R. D.; Grover, J. and Tilman, D. (1994). Simple rules for interspecific dominance in systems with exploitative and apparent competition. *American Naturalist* **144:** 741-771.

Hope, J. (1984). The Australian Quaternary. In: M. Archer and G. Clayton (Eds.) *Vertebrate Zoogeography and Evolution in Australasia*. Hesperian Press: Carlisle, Western Australia.

Hrdina, F. (1997). Marsupial destruction in Queensland 1877-1930. *Australian Zoologist* **30:** 272-286.

Hunt, R. and Brindabella and Wee Jasper valley wild dog/fox working group. (2002). *Brindabella and Wee Jasper Valleys Co-operative Wild Dog/Fox Control Plan*. NSW Rural Lands Protection Board, NSW National Parks and Wildlife Service and NSW State Forests: Queanbeyan.

Hunter, M. D. and Price, P. W. (1992). Playing chutes and ladders: heterogeneity and the relative roles of bottom-up and top-down forces in natural communities. *Ecology* **73:** 724-732.

Jones, F. W. (1923-1925). *The Mammals of South Australia*. A. B. James: Adelaide.

Kruuk, H. (1972). *The Spotted Hyaena: A Study of Predation and Social Behaviour*. Chicago University Press: Chicago.

Le Souef, A. S. (1923). The Australian native animals. *Australian Zoologist* **3:** 108-111.

Lidicker, W. Z. (1975). The role of dispersal in the demography of small mammals. In: F. B. Golley (Ed.) *Small Mammals: Their Productivity and Population Dynamics*. Cambridge University Press: Cambridge.

Leibold, M. A. (1996). A graphical model of keystone predators in food webs: trophic regulation of abundance, incidence, and diversity patterns in communities. *American Naturalist* **147:** 784-812.

McIlroy, J. C.; Cooper, R. J.; Gifford, E. J.; Green, B. F. and Newgrain, K. W. (1986). The effect on wild dogs, *Canis f. familiaris*, of 1080-poisoning campaigns in Kosciusko National Park, NSW. *Australian Wildlife Research* **13:** 535-544.

McKnight, T. L. (1976). *Friendly Vermin: a survey of feral livestock in Australia*. University of California Press: Berkley.

McLeod, R. (2004). *Counting the Cost: Impact of Invasive Animals in Australia 2004*. Cooperative Research Centre for Pest Animal Control: Canberra.

May, S. A. and Norton, T. W. (1996). Influence of fragmentation and disturbance on the potential impact of feral predators on native fauna in Australian forest ecosystems. *Wildlife Research* **23:** 387-400.

Meek, P. D. and Shields, J. (2001). Positive Dingo Management: how not to throw out the baby with the bath water. In: *A Symposium on the Dingo*. C. R. Dickman and D. Lunney (Eds.). Royal Zoological Society of New South Wales: Mosman.

Newsome, A. E. and Coman, B. J. (1989). Canidae. In: D. W. Walton and B. J. Richardson (Eds.) *Fauna of Australia. Volume 1B, Mammalia*. Australian Government Publishing Service: Canberra.

Newsome, A. E. and Corbett, L. K. (1982). The identity of the dingo. II. Hybridisation with domestic dogs in captivity and in the wild. *Australian Journal of Zoology* **30:** 365-374.

Newsome, A. E. and Corbett, L. K. (1985). The identity of the dingo. III. The incidence of hybrids and their coat colours in remote and settled regions of Australia. *Australian Journal of Zoology* **33:** 363-375.

Newsome, A. E.; Corbett, L. K.; Best, L. W. and Green, B. (1973). The dingo. *Australian Meat Research Committee Review* **14:** 1-11.

Newsome, A. E.; Corbett, L. K. and Carpenter, S. M. (1980). The identity of the dingo. I. Morphological discrimination of the dingo and dog skulls. *Australian Journal of Zoology* **28:** 615-625.

Newsome, A. E.; Corbett, L. K.; Catling, P. C. and Burt, R. J. (1983). The feeding ecology of the dingo. I. Stomach contents from trapping in south-eastern Australia, and the non-target wildlife also caught in dingo traps. *Australian Wildlife Research* **10:** 477-486.

Northern Territory Parks and Wildlife Service (2004). *A Management Program for the Dingo* (Canis lupus dingo) *in the Northern Territory of Australia*. Department of Infrastructure, Planning and Environment: Darwin.

Paine, R. T. (1966). Food web complexity and species diversity. *American Naturalist* **100:** 65-75.

Parkes, J.; Henzell, R. and Pickles, G. (1996). *Managing Vertebrate Pests: Feral Goats*. Bureau of Rural Sciences and Australian Government Publishing Service: Canberra.

Palomares, F.; Gaona, P.; Ferreras, P. and Delibes, M. (1995). Positive effects on game species of top predators by controlling smaller predator populations: an example with lynx, mongooses and rabbits. *Conservation Biology* **9:** 295-305.

Pople, A. R.; Grigg, G. C.; Cairns, S. C.; Beard, L. A. and Alexander, P. (2000). Trends in the numbers of red kangaroos and emus on either side of the South Australian dingo fence: evidence for predator regulation? *Wildlife Research* **27:** 269-276.

Proulx, M. and Mazumder, A. (1998). Reversal of grazing impact on plant species richness in nutrient-poor vs. nutrient-rich ecosystems. *Ecology* **79:** 2581-2592.

Queensland Department of Natural Resources and Mines (2002). *Queensland Wild Dog Management Strategy*. Queensland Government: Brisbane.

Queensland Parks and Wildlife Service (2001). *Fraser Island dingo management strategy*. Queensland Government: Brisbane.

Reynolds, J. C. and Tapper, S. C. (1996). Control of mammalian predators in game management and conservation. *Mammal Review* **26:** 127-156.

Robertshaw, J. D. and Harden, R. H. (1989). Macropodoidea: a review. In: *Kangaroos, Wallabies and Rat-kangaroos*. G. Grigg, P. Jarman and I. Hume (Eds.). Surrey Beatty: Sydney.

Saunders, G. (1999). *Wildlife and Exotic Disease Preparedness in Australia – Rabies*. Wildlife and Exotic Disease Preparedness Program, Department of Agriculture, Fisheries and Forestry: Canberra.

Schoener, T. W. and Spiller, D. A. (1996). Devastation of prey diversity by experimentally introduced predators in the field. *Nature* **381:** 691-694.

Short, J. (1998). The extinction of rat-kangaroos (Marsupialia: Potoroidae) in New South Wales, Australia. *Biological Conservation* **86:** 365-377.

Short, J.; Kinnear, J. E. and Robley, A. (2002). Surplus killing by introduced predators in Australia – evidence for ineffective anti-predator adaptations in native prey species? *Biological Conservation* **103:** 283-301.

Short, J. and Smith, A. P. (1994). Mammal decline and recovery in Australia. *Journal of Mammalogy* **75:** 288-297.

Siemann, E. (1998). Experimental tests of effects of plant productivity and diversity on grassland arthropod diversity. *Ecology* **79:** 2057-2070.

Sih, A.; Crowley, P.; McPeek, M.; Petranka, J. and Strohmeier, K. (1985). Predation, competition, and prey communities: a review of field experiments. *Annual Review of Ecology and Systematics* **16:** 269-311.

Smith, A. P.; Moore, D. M. and Andrews, S. P. (1992). *Proposed Forestry Operations in the Glen Innes Forest Management Area: Fauna Impact Statement*. Austeco Pty Ltd and the Forestry Commission of New South Wales: Australia.

Smith, A. P and Quin, D. G. (1996). Patterns and causes of extinction and decline in Australian conilurine rodents. *Biological Conservation* **77:** 243-267.

Soulé, M. E.; Bolger, D. T.; Alberts, A. C.; Wright, J. M. S. and Hill, S. (1988). Reconstructed dynamics of rapid extinctions of chaparral-requiring birds in urban habitat islands. *Conservation Biology* **2:** 75-92.

Spry, M. (1997). *Hinchinbrook Island and the Precautionary Principle in Australian Environmental Law*. Research Note 4 1997-98, Parliamentary Library, Parliament of Australia. http://www.aph.gov.au/library/pubs/rn/1997-98/98rn04.htm

State Wild Dog Management Advisory Committee (2004). *Western Australian Wild Dog Management Strategy 2004.* Agriculture Protection Board of WA and Western Australia Department of Agriculture, Miscellaneous Publication 22/2004.

Tauchmann, A. (1998). *Aversive conditioning trial on dingoes using lithium chloride and thiabendazole.* Unpublished report to the Queensland Department of Environment: Brisbane.

Thompson, P. C. (1992). The behavioural ecology of dingoes in north-western Australia. III. Hunting and feeding behaviour, and diet. *Wildlife Research* **19:** 531-541.

Thompson, P. (2003). *Wild Dog Control: Facts behind the strategies*. Western Australia Department of Agriculture, Miscellaneous Publication 23/2003.

Thompson, P. C.; Rose, K. and Kok, N. E. (1992). The behavioural ecology of dingoes in north-western Australia. VI. Temporary extra-territorial movements and dispersal. *Wildlife Research* **19:** 585-596.

Tickner, J. A. and Geiser, K. (2004). The precautionary principle stimulus for solutions-and alternatives-based environmental policy. *Environmental Impact Assessment Review* **24:** 801-824.

Timm, R. M. and Schmidt, R. H. (1990). Management problems encountered with livestock guarding dogs on the University of California Hopland Field Station. In: *Predator Management in North Coastal California*, Hopland Field Station Publication 101.

Vance, R. R. (1974). Predation and resource partitioning in one predator–two prey model communities. *American Naturalist* **112:** 797-813.

Wagner, K. K.; Schmidt, R. H. and Conover, M. R. (1997). Compensation programs for wildlife damage in North America. *Wildlife Society Bulletin* **25:** 312-319.

Wilton, A. N. (2001). DNA methods of assessing dingo purity. In: *A Symposium on the Dingo*. C. R. Dickman and D. Lunney (Eds.). Royal Zoological Society of New South Wales: Mosman.

Wilton, A, N.; Steward, D. J. and Zafiris, K. (1999). Microsatellite variation in the Australian dingo. *The Journal of Heredity* **99(1):** 108-111.

Woodall, P. F. (1983). Distribution and population dynamics of dingoes (*Canis familiaris*) and feral pigs (*Sus scrofa*) in Queensland 1945-1976. *Journal of Applied Ecology* **20:** 85-95.