Action Statement No. 248

Dingo *Canis lupus* subsp. *dingo*

Flora and Fauna Guarantee Act 1988

Department of Environment and Primary Industries

State Government Victoria

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Dingo *Canis lupus* subsp. *dingo*

Description

The Dingo (*Canis lupus* subsp. *dingo* Meyer 1793) is the largest terrestrial predator in Australia (Menkhorst 1995). It is both culturally important to Indigenous people as they believe people, place, flora and fauna are intrinsically intertwined, and is aesthetically valued as an iconic Australian species (Elledge *et al.* 2006; Fleming *et al.* 2001). The Dingo arrived in Australia approximately 5,000 (to 10,000) years ago (Savolainen *et al.* 2004), potentially accompanying Austronesian sea-faring people expanding through south-east Asia. The Dingo subspecies is thought to have descended from semi-domesticated dogs in East Asia (Savolainen *et al.* 2004), where the Dingo still remains (Corbett 2003).

An average adult Dingo is 1,230 mm long, 570 mm tall and weighs between 9.6 to 19.4 kg (Van Dyke and Strahan 2008), an average of 15kg (Menkhorst 1995), with females slightly smaller than males (Corbett 2003; Jones 1990). Distinguishing traits include erect pointed ears, a bushy tail, no dewclaws on their back feet and, occasionally, dark facial features (Corbett 2003; Corbett 2004). The Dingo has a narrow muzzle, large canine and carnassial teeth, and large auditory bullae compared to domestic dogs (Corbett 2003; Newsome *et al.* 1980). Most Dingoes have a short ginger coat with white patches on their feet, chest and tail tips (Corbett 2003). Less common are the black and tan, black, and white Dingoes (Corbett 2001; Newsome and Corbett 1985). In contrast to most domestic dog breeds which breed twice per year, the Dingo has an annual breeding cycle (Van Dyke and Strahan 2008).

European settlement has led to the hybridisation of Dingo populations, resulting in reduced genetic integrity of the Dingo and different morphological, behavioural and reproductive traits (Elledge *et al.* 2006). Such hybrids are difficult to distinguish from pure Dingoes due to an overlap in phenotypic and genetic characteristics (Elledge *et al.* 2006).

However, Dingo-dog hybrids are listed as pest animals under the *Catchment and Land Protection Act 1994* and are not considered Dingos for the purposes of this Action Statement or the provisions of the *Flora and Fauna Guarantee Act 1988*, irrespective of the level of hybridisation.

Also, for the purposes of this document, the term 'wild dogs' is defined as feral dogs, wild-living domestic dogs and Dingo-dog hybrids. The term canid is used collectively to refer to both Dingoes and wild dogs. It should also be recognised that a number of the references used in this document do not distinguish between Dingoes and wild dogs and have been used in a general sense to describe the ecology of and threats to Dingoes in Victoria.

Distribution

Following the arrival in Australia, the Dingo extended its range to occupy the entire mainland (Breckwoldt 2001), potentially aided by Indigenous peoples who kept Dingoes as pets or hunting companions (Corbett 2001; Corbett 2003). Dingo density throughout Australia was likely to be quite low in pre-European times, but habitat changes such as artificial watering points would have benefitted Dingoes during droughts, while the introduction of prey species (e.g. rabbits, house mice, livestock, etc) also facilitated increased ranges and abundance (Corbett 2001; Corbett 2003). However, control programs for wild dogs in response to livestock predation have reduced Dingo populations in some pastoral areas due to the difficulties of distinguishing wild dogs from Dingoes (Johnson *et al.* 2007).

The contemporary distribution of the Dingo in Victoria is unclear due to hybridisation (Corbett 2004). Wild dog populations with Dingo representation are found in forest tracts in the Eastern Highlands and East Gippsland (Menkhorst 1995), including the Alpine, Burrowa-Pine, Coopracambra, Mt Buffalo, Baw Baw and Croajingolong National Parks (Corbett 2004; SAC 2007). Dingoes also occur within parts of Wyperfeld National Park and other portions of the Big Desert in north-west Victoria.

Figure 2 below shows where Dingos have been recorded in Victoria until 2007. The records in the south west represent sightings made in the pre-1900s and the Dingo is thought to now be regionally extinct in this part of Victoria.

*Figure 1: Dingo (*Canis lupus *subsp.* dingo*)*
Photo: Angus McNab

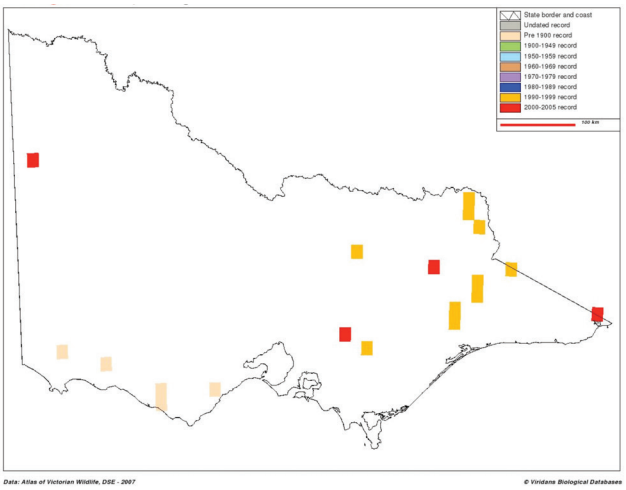

Figure 2: Distribution in Victoria (Victorian Fauna Database, DSE 2007)

Habitat

The Dingo inhabits a diversity of Australian landscapes, from arid and tropical environments to alpine snowfields (Corbett 2003). Prior to European arrival, the Dingo probably occupied most habitats throughout Victoria, but it is now restricted to dry and wet forest ecosystems, sub-alpine woodland, coastal heath or scrub and some Mallee scrub and woodland (Menkhorst 1995).

Life history and ecology

Limited research has been conducted on the life history and ecology of the Dingo in Victoria. Therefore, the following section refers to research largely conducted throughout the rest of Australia. Care should be taken when attributing the findings of arid zones studies to Dingo ecology in eastern Victoria, although it is recognised that these studies may be relevant to Dingo ecology in western Victoria.

The Dingo often lives in a stable pack with a communal territory and strict hierarchy enforced by a dominant alpha pair (Corbett 2003). Pack members frequently live alone, but come together to cooperatively hunt large prey or raise pups (Corbett 2003). Solitary Dingoes may be dispersing juveniles (Allen and Byrne 2008), subordinate animals or those without a pack (Corbett 2003). The Dingo communicates using both olfactory and auditory cues. Scent marking with urine, faeces or gland extracts is ubiquitous, and may signal territory boundaries, use of shared resources such as water points or hunting areas, or reproductive status (Corbett 2003). The Dingo howls to alert other packs to its presence, or to summon the pack together over long distances (Corbett 2003). Differences in howl type may communicate a range of information including pack size, composition and behaviour (Corbett 2003). The Dingo does not bark, but uses moans and 'snuffs' in close-range interactions (Corbett 2003). In temperate highland environments, wild dogs appear to associate in smaller packs of one to three animals; the reason for this is unclear, but may be due to the effects of hybridisation or the abundance of small to medium-sized prey (Corbett 2003).

Female Dingoes come into oestrous annually following sexual maturity at two years of age (Corbett 2003). In Victoria, the Dingo mates in May and June and whelps litters of two to nine pups (average five) in July and August (Catling *et al.* 1992; Corbett 2003). Pups are raised by the pack in a secluded den, such as a wombat burrow or cave (Corbett 2003). They become independent in October or November but may remain with the pack until the following breeding season (Allen and Byrne 2007; Corbett 2003). Only the litter of the dominant female is raised to maturity (Corbett 2003). Subordinate animals may copulate and give birth, but their pups are killed and sometimes eaten by the dominant female and other pack members (Corbett 2003). The lactating subordinate then helps to raise the dominant pair's litter (Corbett 2003). Dingo movement peaks during the mating season and subsequently decreases as Dingoes retreat to isolated areas to give birth and raise young, reducing both home range dimensions and activity until pups mature (Allen and Byrne 2007).

Territory size is dependent upon prey availability and habitat (Corbett 2003). Wild dog studies in Queensland found that the territory of an established pack appears to be seasonally stable and occupies optimal habitat, while newly-independent solitary animals have less stable, elliptical home ranges between the packs, in lower quality habitat (Allen and Byrne 2008). These wild dogs may make long-distance forays out of their home ranges, sometimes exceeding 200 km in more open areas (Allen and Byrne 2007; Allen and Byrne 2008; Claridge *et al.* 2009). Satellite-tracking studies in south-eastern Australia found that wild dog home ranges in areas free of predator control were larger than previously estimated (McIlroy *et al.* 1986), averaging approximately 10,000 ha but reaching up to 55,000 ha (Claridge *et al.* 2009). Home range size did not vary between sexes or age classes but tended to be smaller in areas of estimated high prey abundance (Claridge *et al.* 2009). Most wild dogs within national parks appear to restrict their movements to public land and long-distance movements or dispersals are rare (Claridge *et al.* 2009; McIlroy *et al.* 1986). Satellite tracking of nine wild dogs in eastern Victoria found that the average home range size was three times higher for male wild dogs (12,430 ha) than for females (4,150 ha) (Robley *et al.* 2010).

Dietary studies in Gippsland and north-eastern Victoria found that large and medium-sized mammals form the majority of Dingo prey, in particular species such as the Swamp Wallaby (*Wallabia bicolor*), Common Ringtail Possum (*Pseudocheirus peregrinus*) and European Rabbit (*Oryctolagus cuniculus*) (Newsome *et al.* 1983; Triggs *et al.* 1984). The Dingo also consumes birds, reptiles, arthropods and vegetation in smaller quantities (Triggs *et al.* 1984). Sheep (*Ovis aries*) or cattle (*Bos taurus*) were rarely detected in dietary analysis (Newsome *et al.* 1983). Although the Dingo has been shown to consume threatened species, such as the Long-nosed Potoroo (*Potorous tridactylus*), its predatory impact on these populations appears to be negligible (Claridge and Hunt 2008; Lunney *et al.* 1990; Vernes 2000).

It is difficult to make generalisations regarding Dingo diet as preference changes depending on the circumstance (through time and between sites) (Robertshaw and Harden 1986). Studies have shown that the Dingo hunts alone or cooperatively (Thomson 1992). A Dingo pack can successfully hunt large prey, such as kangaroos, usually by targeting juvenile or female animals (Shepherd 1981) and will continue to hunt native prey despite the presence of livestock (Thomson 1992). Lone Dingoes are more proficient at catching smaller prey species but can also prey upon sheep (Marsack and Campbell 1990; Thomson 1992). The Dingo may kill both native herbivores and livestock in surplus of its food requirements (Thomson 1992). Hunting tactics such as ambush, coursing or harassment of prey may depend on habitat type or capture success (Corbett 2003; Marsack and Campbell 1990; Robertshaw and Harden 1986).

It has been proposed that the Dingo is an opportunistic hunter, because abundant species are usually the major component of its diet (Vernes *et al.* 2001), but alternative prey species may be targeted as abundant prey decline (Thomson 1992). However, in forested environments the Dingo may be a selective hunter, continuing to target preferred prey even if their numbers decrease (Robertshaw and Harden 1986).

In eastern Victoria, hybridisation has probably been underway since European settlement in the mid-1800s (Jones 1990). It is thought that hybridisation is less likely to occur in remote areas, as behavioural differences prevent Dingo packs accepting domestic dogs (Corbett 2003). Corbett (2003) also proposes that as hybrids increase in the population due to persistent contact with feral dogs, behavioural differences diminish and further hybridisation

ensues. In Dingo populations with a prolonged history of hybridisation, the process of hybridisation is probably being driven more by hybrids themselves than feral domestic dogs (Jones 2009). However, it should be noted that the genetic status of remote dingo populations in Victoria remains unknown, although they are likely to be relatively pure.

The level of hybridisation is the subject of some debate and several methodologies have been used to try to quantify Dingo purity. For example, studies in Victoria in the 1960s using skull measurements found that 49 per cent of wild dogs were pure Dingoes (Newsome and Corbett 1985) due to a long history of contact with domestic dogs (Corbett 2001). In contrast, Jones (1990) concluded that physical changes which had occurred due to hybridisation were relatively minor and that the gene pool was predominantly Dingo in composition. Then, using tissue samples from 514 canids killed by professional wild dog controllers around pastoral and public land boundaries, as contracted by the Department of Primary Industries over 2009/2010, only about 1% of individuals were considered to be genetically pure Dingoes (Stephens 2011). Jones (2009) reviewed studies using the canonical variate equation developed by Newsome and Corbett (1982), and concluded that the skull morphology of canids could not be used as a reliable method to distinguish between Dingoes, feral dogs and hybrids in the Victorian eastern highlands.

The Dingo occupies the role of the top-order mammalian predator on the Australian mainland following the disappearance of the Thylacine (*Thylacinus cynocephalus*) and the Tasmanian Devil (*Sarcophilus harrisii*) (Johnson 2006). The Dingo may have initially altered Australian ecosystem dynamics, but is now thought it could provide an overall benefit to biodiversity and ecosystem function (Levy 2009). Top-order predators are important in maintaining diverse ecosystems through their interactive roles with numerous trophic guilds, such as medium-sized or 'mesopredators' like Red Foxes (*Vulpes vulpes*), large herbivores and small prey species (Ritchie and Johnson 2009; Soule *et al.* 2005). When top order predators no longer exist in the environment the mesopredators can increase in numbers and negatively impact populations of their smaller prey species (Crooks and Soule 1999; Ritchie and Johnson 2009).

The Dingo may suppress populations of introduced mesopredators through direct predation or increased predation risk, harassment and competition for resources (Creel and Christianson 2008; Dickman *et al.* 2009; Glen and Dickman 2005; Glen *et al.* 2007; Johnson *et al.* 2007). The Dingo can consume Red Foxes and feral cats (*Felis catus*), albeit rarely (Marsack and Campbell 1990; Newsome *et al.* 1983; Thomson 1992). In addition, Dingoes, cats and foxes overlap in diet, particularly with respect to small and medium-sized mammals (Corbett 2003; Mitchell and Banks 2005). In temperate forested environments, the Dingo and wild dogs appear to exclude foxes at a microhabitat scale (Mitchell and Banks 2005) and, where the Dingo is abundant, appear to restrict the growth of fox populations (Johnson and VanDerWal 2009).

The following studies conducted in arid zones have found a relationship between the presence of the Dingo and marsupial populations. After the arrival of the Red Fox and feral cat, 18 native marsupials and rodents have become extinct (Johnson 2006) and this process may have been aided by the removal of Dingoes (Johnson *et al.* 2007). Today, small marsupials persist in areas where Dingo abundance remains high (Johnson *et al.* 2007). Small mammal diversity may also be positively associated with Dingo presence (Letnic *et al.* 2009b). The Dingo coexists or may even indirectly promote populations of threatened species such as the Malleefowl *(Leipoa ocellata*), Bilby (*Macrotis lagotis*) and Dusky Hopping Mouse (*Notomys fuscus*) (Letnic *et al.* 2009a; Southgate *et al.* 2007; Wallach *et al.* 2009a), by maintaining introduced carnivore and herbivore populations at low, stable numbers (Wallach *et al.* 2009a).

However, despite the intuitive appeal of the mesopredator release theory (Crooks and Soule 1999) in justifying the conservation of the Dingo and the growing body of literature investigating this ecological role, a recent review cautioned that the evidence is still inconclusive (Allen *et al.* 2011). This critique found that fifteen of twenty studies reviewed had serious design and/or methodological flaws (e.g. Corbett 1995; Johnson and VanDerWal 2009; Letnic *et al.* 2009a; Letnic *et al.* 2009b; Wallach *et al.* 2009a). The weaknesses identified included a lack of consideration of seasonal and habitat differences in activity levels, unsupported assumptions about activity/ population indices, issues around sampling design and intensity, as well as using binary data rather than continuous data; all of which could lead to erroneous inferences and results. Allen *et al.* (2011) also present an appropriate experimental design that would be able to demonstrate whether Dingoes suppress mesopredators and benefit biodiversity.

The Dingo may also limit populations of herbivores, such as kangaroos and rabbits (Caughley *et al.* 1980; Pople *et al.* 2000; Shepherd 1981), thereby preventing overgrazing of vegetation (Glen *et al.* 2007). Dingo absence has been associated with higher kangaroo abundance and increased overall grazing intensity (Letnic *et al.* 2009b). The combination of altered fire regimes and eradication of Dingo from Wilsons Promontory is hypothesised as a link to overabundant native and pest animal grazer populations selectively grazing, resulting in coastal tea-tree invasion of the endangered Coastal Grassy Woodland Ecological Vegetation Class (Holland and Williams 2005).

It has been suggested that a Dingo should be defined by its ecosystem function (Daniels and Corbett 2003). However, the behavioural, ecological and reproductive differences between the Dingo, hybrids and domestic dogs may affect their functional role (Elledge *et al.* 2006). For instance, Spencer *et al.* (2008) report that hybridisation over the last four decades has caused a 20% increase in the average body weight of wild dogs in south eastern Australia, with subsequent increases in metabolic demands and efficiency in killing major prey. Further research is required to understand canid interactions within Victorian ecosystems (Claridge and Hunt 2008; Glen *et al.* 2007; Allen *et al.* 2011).

Management rationale

This Action Statement outlines what has been done in the past and what will be done over the next five years for the conservation of Dingoes in Victoria. Its intention is to enable the continued survival of pure dingo populations on more remote areas of public land while continuing to allow control of hybrid dingo-dog populations around pastoral area/public land boundaries.

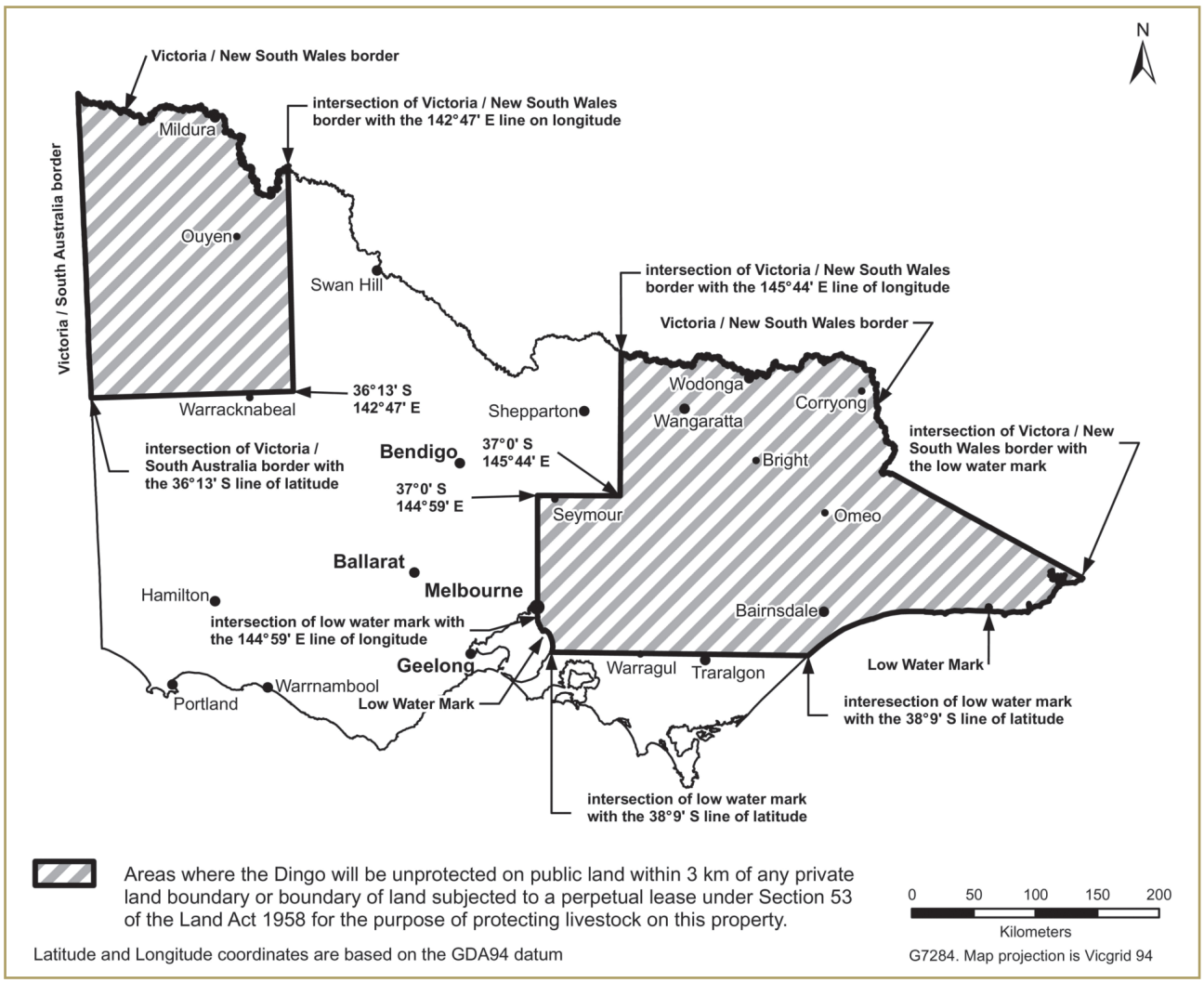

Figure 3: Areas where the Dingo is unprotected on public land within three kilometres of the private land boundary, including land subject to a perpetual lease.

Conservation status

Victorian conservation status

The Dingo (*Canis lupus* subsp. *dingo*) has been listed as 'threatened' under the *Flora and Fauna Guarantee Act 1988* (FFG Act). The Dingo is protected under the *Wildlife Act 1975*. However, it is declared unprotected on:

- all private land in Victoria; and
- public land within 3 km of any private land boundary in the land shown hatched in Figure 3; and
- public land within 3 km of a boundary of any land subject to a perpetual lease under section 53 of the *Lands Act 1958* in the land shown hatched in Figure 3.

The Dingo may also be kept in captivity in Victoria by appropriately licensed persons.

International conservation status

The Dingo (*Canis lupus* subsp. *Dingo*) is recognised as vulnerable on the International Union for Conservation of Nature (IUCN) *Red List of Threatened Species* (International Union for Conservation of Nature 2009)

Threats

While once widespread in Victoria, the Dingo has been affected by a combination of threats, including habitat loss and fragmentation and pest animal control programs, and is now restricted to the east and north-west of Victoria where suitable tracts of forested habitat remain (Menkhorst 1995). Hybridisation with domestic dogs (e.g. lost or abandoned hunting dogs, unrestrained farm dogs) is also a serious on-going threat which is reducing the genetic integrity of the Dingo as a subspecies (Corbett 2003; Wilton 2001). If hybridisation continues, pure Dingoes may not exist in Australia by the end of the 21st century (Corbett 2001).

The impact of timber harvesting practices on the Dingo is unknown, but is not considered to be a major threat. This Action Statement does not include any forestry management prescriptions that would prevent timber harvesting from occurring.

Wild dogs and Dingoes are considered as a pest by some sections of the community and have been estimated to cause more than $13.2 million in annual losses to agriculture in Victoria (Lightfoot 2010).

In other areas of Australia, Dingo control may have lead to disintegration of stable packs and subsequent increased breeding among subordinate animals, which was previously restricted to the alpha female (Corbett 2003). Wallach *et al.* (2009b) speculated that a breakdown in pack structure in arid environments may potentially lead to a higher rate of hybridisation, by increasing the number of dispersing individuals which are more likely to breed with dogs. The maintenance of a stable Dingo pack structure is also inherent to the Dingo's role as a trophic regulator (Glen *et al.* 2007).

Dingo conservation strategies are complicated by the inherent uncertainties of current purity-testing techniques. Skull morphology has traditionally been used to distinguish hybrids and wild dogs from Dingoes by measuring features such as the length of auditory bullae or muzzle (Newsome and Corbett 1985). However, skull assessment requires dead adult specimens (Corbett 2001) and does not indicate the level of hybridisation or back-crossing (Elledge *et al.* 2006; Wilton 2001). Furthermore, the reliability of the skull morphology for identifying Dingo-dog hybrids, particularly those from south eastern Australia, has been questioned by Jones (2009). Coat colour and body shape are equally ambiguous as determinants of purity, as they vary considerably within pure Dingo populations (Jones 1990) and hybrids may exhibit typical Dingo coat colours (e.g. ginger) depending on domestic breed ancestry (Elledge *et al.* 2006). Hybrids may also exhibit a high number of Dingo characteristics due to selection for these traits in the wild (Jones 1990).

Molecular techniques can estimate levels of hybridisation in individuals or populations of wild dogs (Wilton 2001, Stephens 2011). Twelve microsatellite loci on canine chromosomes have been identified where the allele frequencies differ between the Dingo and domestic dogs (Wilton 2001). The most likely ancestry of an unknown wild dog, including the level of hybridisation, can be estimated from the frequency of domestic and Dingo loci in a genetic sample (Wilton 2001). However, this technique may not be completely reliable, due to uncertainty over the purity and representativeness of captive Dingoes used as reference specimens, and the fact that some domestic breeds, such as Blue Heelers, were bred from the Dingo (Elledge *et al.* 2006; Wilton 2001). Stephens (2011) refined the Wilton-type microsatellite approach using a statistical clustering method to distinguish dingoes and dogs, developing a model from which the likely percentage of Dingo ancestry could be determined for individual tissue samples. Using genetic analysis to identify hybrids in the field is not currently practical, as it requires transport to a laboratory for processing and holding of the test individuals until results are known (Elledge *et al.* 2006).

There has been limited research completed on threats to the Dingo in Victoria. The information below has been collated from studies completed on the Dingo in Australia.

Standard threat	Source of Threat	Explanation
Genetic decline	Hybridisation Loss of genetic diversity	Hybridisation between the Dingo and domestic dogs is leading to a decline in pure Dingo populations throughout Australia (Corbett 2004). It is unclear at what point hybrids stop having Dingo traits (Claridge *et al.* 2009). For example, domestic dogs and some hybrids do not have the annual breeding cycle of the Dingo and in good conditions can produce larger litters and may raise two in a year (Catling *et al.* 1992).
Taking by Humans	Poison baiting Shooting Trapping	Since European arrival, the Dingo has preyed upon introduced livestock, leading to Dingo trapping, shooting and baiting (Corbett 2003; Fleming *et al.* 2001). As there is no method of control that distinguishes between feral dogs and Dingoes, wild dog control is largely restricted to the 3km buffer zone adjoining public land by law. These arrangements allow for ongoing control of Dingoes and wild dogs on private land, and on public land adjacent to private land, while providing protection for pure Dingoes in large tracts of public land. A study by McIlroy et al (1986) in New South Wales found that of two successive trail-baiting campaigns with 1080 poison in March and April of 1982, only two (22%) of nine wild dogs carrying radio transmitters were killed by baits in forested environments. This was thought to be due to a preference for live prey, the bait being taken by other species such as foxes, or a post-distribution loss of bait toxicity (McIlroy *et al.* 1986). However, canids are highly susceptible to 1080 baits (Fleming *et al.* 2001). There may also be a small risk to the Dingo through secondary poisoning, for example consuming rabbits poisoned by 1080 in other pest management programs (McIlroy and Gifford 1992). Baiting and trapping programs may also impact on Dingo populations by causing the stable pack structure to break down (Wallach *et al.* 2009b).
Habitat loss/ Habitat Fragmentation	Land use changes – cultivation, agricultural intensification Past vegetation clearance	The Dingo has a large home range (Claridge *et al.* 2009) and as such requires extensive tracts of non-pastoral land without control programs to sustain populations. Habitat loss across Victoria has reduced the amount of suitable land available to the Dingo and has contributed to most Dingo populations in south-eastern Australia declining or becoming locally extinct (Corbett 2004). Clearing of land in Victoria has caused forested areas to become highly fragmented. This may have impacted Dingo populations by restricting their ability to migrate and limiting genetic flow between populations. Contraction and fragmentation of habitat may also have impacted on the Dingo by increasing the exposure of Dingoes to private land where access to domestic dogs is more likely (Corbett 2003). The lack of stable territory may also break down pack structures, resulting in increased reproductive rates and immigration and populations dominated by juveniles (Wallach *et al.* 2010).
Inappropriate fire regimes	Fire – wildfire	Dingo populations in the forests of eastern Victoria may be impacted by high intensity and extensive bushfires. However, there is a lack of research on the impacts of wildfire on Dingo populations. Large scale bushfires may reduce Dingo populations by limiting prey availability and by the direct loss of individuals. Extensive fire may also have a secondary impact on the Dingo by increasing the distance a Dingo has to travel to locate sufficient prey and this may expose some individual Dingoes to pest animal control operations. Alternatively, it's possible that mosaics created by fire may enhance Dingo survival by creating a range of habitats for different prey species.

Important populations

The Dingo occurs in north east Victoria and in parts of Gippsland and north-west Victoria. However, important Dingo populations in Victoria are yet to be identified. The intended management actions address the lack of knowledge about important populations.

Past and current management actions

Action	Result explanation
Develop or amend legislation.	In 2008, the Dingo was listed as a threatened species in Victoria under the *Flora and Fauna Guarantee Act 1988*. This listing resulted in the Dingo being a protected species under the *Wildlife Act 1975* on the greater part of public land within Victoria and removed from the established pest animal list under the *Catchment and Land Protection Act 1994*.
Maintain captive populations for research / display	A number of private individuals have maintained captive populations of the Dingo. Many of these individuals have been actively involved with displaying and educating the public on the cultural and ecological importance of the Dingo. One aim of these captive populations is to maintain a gene pool for possible reintroduction in the wild, although no reintroductions have occurred to date. There are also 77 Dingoes held in institutions belonging to the Australian Zoo and Aquarium Association (ZAA). However, these Dingoes are kept for display and conservation awareness purposes only; at present there is no active breeding program among ZAA institutions.
Involve community groups and volunteers in recovery actions	A number of non-government organisations have been established to promote and conserve the Dingo. These organisations are involved with community education, scientific research and managing the private captive Dingo populations.
Undertake genetic research	In 2009/10, wild dog controllers contracted by the Department of Primary Industries (DPI) took 514 DNA samples from canids within the 3km buffer zone of the public-private land boundary. According to the methodology used, only 1% of these animals were considered to be “pure” Dingoes (Stephens 2011).
Undertake research to identify key biological functions	Limited research has been conducted on the Dingo in Victoria. Corbett (1974) investigated the biology of the Dingo in Victoria. Subsequent research has been limited to investigating the diet (Newsome *et al.* 1983; Brown and Triggs 1990), reproduction (Jones and Stevens 1988) and physical characteristics (Jones 1990) of wild canids in eastern Victoria. More recently, research has focused on determining the effectiveness of various methods of wild dog control (Arthur Rylah Insitute, DSE) and information on their genetics, movement, home range and habitat use (A. Robley pers. comm., 2009).
Control introduced animals	In protecting livestock from wild dog and fox predation, the Victorian Wild Dog Control Program and other control programs may have negatively affected the Dingo through the targeted destruction of canids and fracturing of stable Dingo packs (e.g. Wallach *et al.* 2010). Current policy directs wild dog control efforts to the perimeter of public land, therefore potentially reducing the number of feral dogs with which the Dingo may hybridise. Further research is required to determine the impacts or benefits of wild dog control on the Dingo.

Conservation objectives

Long-term objective

To maintain a viable wild Dingo population that will function as meta-populations across Victoria, which can survive, flourish and retain its potential for evolutionary development.

To provide the general community with a greater understanding and appreciation of the ecological and cultural role and economic value of the Dingo in Victoria.

Objectives of this Action Statement

- To increase the number of populations and individuals within populations.
- To secure populations or habitat from potentially incompatible land use or catastrophic loss.
- To increase knowledge of biology, ecology or management requirements.
- To increase community awareness and supportIntended management actions.

Note: The intended management actions listed below are further elaborated in DSE's Actions for Biodiversity Conservation (ABC) system. Detailed information about the actions and locations, including priorities, is held in this system and will be provided annually to land managers and other authorities. The targets specified below are intended to be met within the 5 year life of this Action Statement.

Intended management actions

These management actions focus on research to identify functional Dingo populations and to understand the ecology and habitat requirements of the Dingo. This information is needed to inform longer-term actions to address key threats, such as habitat loss and degradation and hybridisation and extinction of meta-populations. Such longer-term actions are beyond the scope of this five-year plan. The Department of Environment and Primary Industries will review this Action Statement in five years. The Department is aware that some actions in the Action Statement are dependent on funding, research findings and support of stakeholders and may not be completed before the five-year review. If actions are not completed, but still deemed necessary, they will be incorporated into the next version of the Action Statement.

Standard objective	Targets
To increase knowledge of biology, ecology or management requirements	• Dingo ecology and population trends in Victoria are understood. • The effect of pest animal control on the Dingo is understood. • Identify the "ecosystem function" of the Dingo in mesopredator and overabundant grazer suppression in Victorian ecosystems.

Action	Details	Responsible agents	Priority
Undertake detailed population monitoring and collect demographic information	Conduct detailed phenotypic and genetic surveys of Victorian wild canid populations to identify functional and intact populations of pure Dingos, particularly in remote areas. This information will clarify the abundance and distribution of the Dingo in Victoria and inform future conservation actions and on-ground management.	DEPI (lead), Universities and Parks Victoria	H
Conduct priority research projects as specified	Research aspects of the Dingo's biology, ecology and ecosystem function in Victoria to help inform future conservation actions and on-ground management. The current research priorities for the Dingo in Victoria are: • home range • size of area needed to sustain a functional pack • habitat use • diet • the Dingo's ecological role in Victoria and its interactions with other species, particularly prey and mesopredator populations • potential threats to the Dingo • Dingo predation on domestic livestock.	DEPI (lead) and Universities	H
Undertake research into management requirements	Develop a suitable checklist of phenotypic characters to be used as a preliminary field identification tool.	DEPI (lead) and Universities	H
Undertake research into management requirements	Investigate the effect of pest animal control on Dingo populations.	DEPI and Universities	H
Undertake genetic research	Improve the current genetic definition of the Dingo. To achieve this action, the current reference sample needs to be improved and expanded, including tissue samples, hair from the pelage and/or scats. Investigate the Dingo genetic profile and the relatedness of populations across Victoria.	DEPI (lead) and Universities	H
Assess impacts of bushfires	Investigate the affect and threat that fire (wild and controlled burns) poses to Dingo populations.	DEPI (lead) and Universities	L

Standard objective	Targets
To secure populations or habitat from potentially incompatible land use or catastrophic loss	Suitable habitat is identified and maintained on public land for Dingo populations in a number of geographical areas across Victoria. Regional plans and strategies incorporate management practices that are compatible with the Dingo's biology and ecology.

Action	Details	Responsible agents	Priority
Identify core areas	Core areas for recovery actions on public land need to be identified. The identification of core areas should include a set of Dingo habitat criteria. Actions can then be developed to protect and enhance areas that meet the Dingo habitat criteria.	DEPI, Parks Victoria	H
Review policy and management	Investigate and implement suitable management arrangements in the event that genetically pure Dingo populations are discovered in locations outside core protected areas of public land.	DEPI	M
Establish/Maintain Recovery Team	Establish a Dingo recovery team to oversee the recovery of the Dingo and implementation of the Action Statement for Victoria. The recovery team may include relevant scientists, government staff, public land managers and representatives from conservation and landholder groups.	DEPI, Parks Victoria	M
Provide input into regional fire management and operations plans	Consider the Dingo's habitat requirements during fire operations planning.	DEPI, Parks Victoria	M

Standard objective	Targets
To increase community awareness and support	The Victorian community values the Dingo's ecological and cultural role and economic value. The Victorian community acknowledges and understands the recent changes (the listing as a threatened species) in legislation relating to the Dingo.

Action	Details	Responsible agents	Priority
Develop, publish and distribute educational, technical or publicity material and/or displays	Develop and implement a communications and engagement strategy for the Dingo. The strategy will engage with local and state government, non-government organisations, Victorian Farmers Federation, local landholders, public land managers, hunting associations, Indigenous communities, Wild Dog Management Groups, other target groups and the general community about the Dingo. The focus of the strategy will be an information campaign. The campaign will inform stakeholders on: • the Dingo's threatened species status and the changes in legislation • what these changes mean to stakeholder groups and the general community (including Traditional Owners) • the difference between the Dingo and wild dogs • the roles and responsibilities of State Government • the major threats and requirements for the management of the Dingo • the role and economic value of the Dingo in Victorian ecosystems.	DEPI	M
Develop, publish and distribute educational, technical or publicity material and/or displays	Update visitor information in national parks across within the known distribution of the Dingo about the Dingo's new status, where the Dingo is protected and the penalties for the interfering with or destroying a Dingo.	DEPI and Parks Victoria	M

Action	Details	Responsible agents	Priority
Undertake socio-economic evaluation	Conduct a survey, before and after the implementation of the communications and engagement strategy, to ascertain the community's attitude towards the Dingo.	DEPI	M
Investigate the cultural importance of Dingoes to Indigenous communities	Understand and document the cultural values and associations of Dingoes to relevant Traditional Owners throughout Victoria.	DEPI	M

Standard objective	Targets
To increase the number of populations or individuals	Maintain a population of Dingoes in captivity and a viable population in the wild in Victoria.

Action	Details	Responsible agents	Priority
Following population monitoring, investigate whether the supplementation of existing Dingo populations in high conservation areas is a useful tool for the conservation and genetic integrity of the species, and of localised populations.	The assessment must include, but is not limited to an assessment of risks such as likely survival rates, impacts on other species, impacts on surrounding land holders, users and livestock and risk of disease transfer. The supplementation of Dingoes adjacent (i.e. within 3km) to agricultural areas or areas where wild dog management is planned or being conducted will not be considered.	DEPI	M
Develop or amend legislation	Investigate the compulsory neutering of domestically kept Dingo-dog hybrids in certain areas. This action would require amendments to the Domestic Animals Act 1994. It is intended to reduce the risk of escaped or abandoned Dingo-dog hybrids polluting the wild Dingo gene pool.	DEPI (lead)	L
Review captive breeding and domestic breeding programs	Review the current methodologies of different captive and domestic breeding programs.	DEPI, Zoos Victoria, ZAA, and dingo conservation organisations	L
Store reproductive material as a safeguard against catastrophic loss	Establish a gene bank from pure Dingoes to be stored at a cryogenic facility.	Universities	H

Personal Communications

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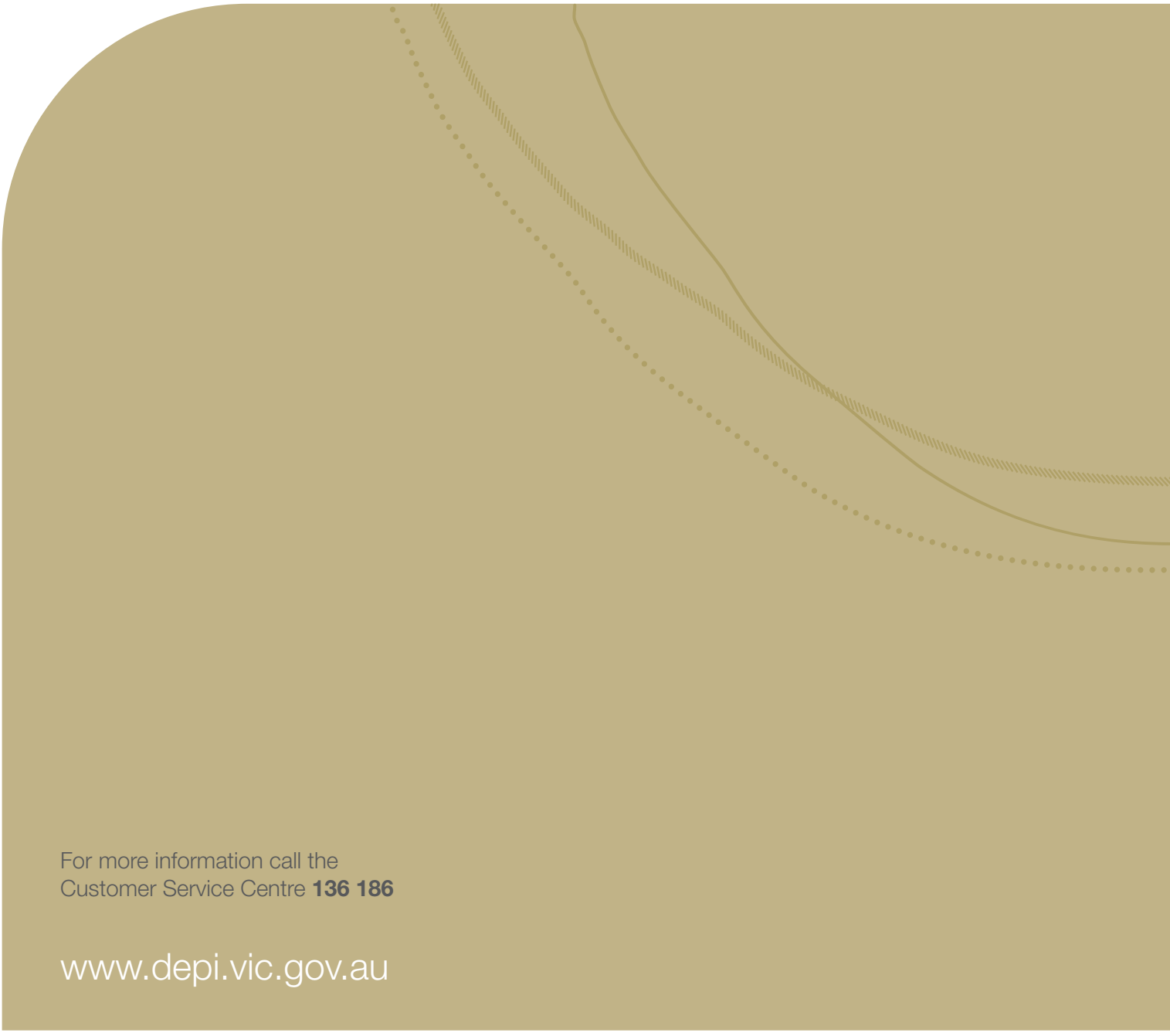

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