

# IMPACTS AND IMPLICATIONS OF RECREATIONAL DEER HUNTING IN QUEENSLAND STATE FORESTS

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## EXECUTIVE SUMMARY

A recent parliamentary petition proposing a trial of recreational hunting in Queensland's state forests was rejected on the grounds that recreational hunting opportunities in Queensland are not limited, and the government has a duty of care to ensure the safety of other state forest users. Hunting on public lands is permitted in five out of Australia's eight states and territories, and is considered an important component in the balance of recreational uses of these lands, as well as providing cost-effective pest animal control and significant economic benefits. This review objectively outlines the implications, both positive and negative, of allowing access to Queensland's state forests for recreational hunting.

There is a growing recognition that introduced deer are an emerging environmental, economic, and social pest in Australia. Since their introduction from the mid-1800s onwards, six species have established self-sustaining populations, including four which occur in various parts of Queensland. While the impacts of deer remain poorly studied in Australia, international studies indicate that deer can have serious negative effects on environmental values, agricultural and forestry production, human and livestock health, and are commonly involved in deer-vehicle collisions. There is evidence that the abundance and geographic distribution of deer in many parts of Australia is increasing, and they have the potential to rival other introduced pests such as goats, pigs, and camels in terms of environmental and economic damage.

In sufficient numbers, deer are able to modify ecosystem structure and function at the landscape scale. Deer alter the structure, composition, and diversity of native vegetation communities through over browsing and trampling of the understorey and seedlings, facilitate the spread of weed seeds, cause localised erosion, and foul water sources. They are known to ingest threatened flora species, reducing population viability, and alter fauna habitat by simplifying the complexity of the shrub and ground layers. Deer impact agricultural production and profitability by feeding on and trampling crops, damaging fences and infrastructure, competing with livestock for pasture, and spreading parasites and disease. Wild deer are responsible for numerous vehicle collisions, and have caused the closure of major roads in Queensland to facilitate deer removal.

Recreational hunting is a popular pastime in Queensland and Australia, with estimated participation levels of between one and five percent of the national population. Access to public lands for recreational hunting in New South Wales and Victoria has seen substantial increases in the hunting population in those states, resulting in a significant expansion to the economic contribution attributable to hunting, much of which is directed to regional areas. Recreational hunting is widely used as a tool for pest management in developed countries around the world, however this potential remains largely underutilised in Queensland. International studies show that when conducted appropriately, recreational hunting can result in significant reductions to deer populations and the level of damage they cause. Encouraging recreational hunters to target pest animals also results in considerable cost savings for government, as it negates the need to employ paid personnel to undertake pest control, and can supplement existing pest management strategies.

Queensland's three million hectares of state forests offer a variety of opportunities for recreational users, and there is little justification for excluding recreational hunting from this mix. It is likely that facilitating access to Queensland's state forests for recreational hunting would see an increase in hunting participants in the state, bringing a range of benefits. These include reductions in deer population and distribution, with concurrent decreases in environmental and agricultural damage. Increased hunting participation is also likely to stimulate regional economies and create employment opportunities, which is particularly

relevant given the recent bushfires and Covid-19 epidemic which have affected many regional areas. Recreational hunting also contributes to avoided health costs and increased social wellbeing, with hunting participants reporting consistently higher levels of mental wellbeing than the average person in Australia.

Despite these benefits, recreational hunting remains controversial with some sectors of society, predominantly due to animal welfare and human safety concerns. Recommendations to increase the pest control value and social acceptance of hunting include the promotion of recreational hunting as an effective pest management implement through the use of scientific evidence, provision of training and education to encourage hunters to undertake population control of deer rather than focusing on trophy hunting, promoting the positive benefits of hunting to the wider community, and advocating the economic and social benefits of hunting. If conducted appropriately, recreational hunting in Queensland's state forests has the potential to confer significant benefits to the environment, economy and social wellbeing of Queensland and its residents.

## INTRODUCTION

The Australian Deer Association Inc (ADA) was formed in 1969 and has branches in each Australian state. The organisation plays a leading role in implementing deer research and actively campaigns to increase hunting opportunities, particularly regarding broader access to public lands within Australia for recreational hunting. The ADA aims to conduct constructive and considered action that benefits deer, recreational hunting and the wider community. A recent petition in Queensland requesting a trial of recreational hunting in Queensland's state forests had gathered over 13,500 signatures when it was tabled in the Queensland Parliament in February 2019. The petition was rejected on the grounds that recreational hunting opportunities are not limited in Queensland, and that the Department of Environment and Science (DES), which has jurisdiction over Queensland's state forests, has a duty of care to ensure the safety of other visitors to these public lands. This is despite the success of similar programs in New South Wales and Victoria, which have seen an increase in recreational hunter numbers, generated considerable economic stimulus for regional areas, and removed a significant number of introduced pest species from public lands in those states.

More than 80 animal species that have been introduced to Australia have established significant wild populations, and many of these have become pests to some degree (Hart 2002). The term 'pest', as used in this report, describes populations of wildlife, either native or introduced, that occur at densities that have the potential to pose a threat to human economic or health values, are capable of adversely affecting populations of native species, are too numerous to maintain desirable densities, or cause environmental damage and disrupt ecological functions (Caughley 1981). Several species of deer meet this definition in Australia, and have become an emerging pest in all Australian states and territories, particularly in the relatively densely populated south east of the country. While deer have historically formed a minor component of the Australian biota, they are currently in the process of becoming more widespread (Moriarty 2004). In many countries around the world, and to an increasing extent in Australia, overabundant deer are considered serious agricultural and environmental pests, traffic hazards, and potential vectors of livestock and wildlife diseases (Moriarty 2004).

As an introduced species to Australia, deer play a dual role. They impose costs on society including damage to property and sites managed for agriculture, forestry and conservation, as well as acting to increase the transmission of disease and frequency of road traffic incidents, but they also provide a source of revenue through sport, hunting and tourism (Austin et al. 2013). Because of the contested policy and legislative positions which place deer somewhere on a spectrum between resource and pest, deer create a wide variety of divergent views within the broader community. This is reflected in the management of wild deer in Australia, with diverse and complex approaches which variously seek to manage deer as 'game', control them as 'pests' or some combination of the two (Davis et al. 2016). There is no cohesive national strategy for the management of deer, which are managed for different outcomes in each state or territory, and variously classified by the individual state governments as pests, game animals, or even protected wildlife species.

Throughout most of the developed world, the management of deer has predominantly utilised regulated recreational hunting as the main method for deer population control (Hall & Gill 2005). However, in Australia, recreational hunters have not been widely engaged by wildlife managers as a tool for controlling deer populations (Finch et al. 2014), despite the fact that annual recreational deer harvests are substantial. For example, it was estimated that recreational deer hunting in Victoria removed around 121,600 deer from the state in 2018 (Moloney & Powell 2019). While natural areas management agencies in many parts of the world allow – and in some cases expend considerable resources to facilitate – recreational

hunting on public lands in order to reduce the damage caused by overabundant mammal populations, this is a relatively new concept in Australia (Bengsen et al. 2016). In recent years though, there has been an increasing shift towards making public lands in Australia available for recreational hunters to target introduced mammals such as wild deer, as well as pigs, goats and canids. This transition has been facilitated by the increasing recognition of introduced animals as a threat to Australia's unique biodiversity, and an awareness that recreational hunting, when conducted appropriately, can play an important role in pest management and population reduction. In other countries such as New Zealand, a key factor in the success of deer management has been the recognition of the negative environmental and social impacts directly or indirectly attributable to deer, and their value as a resource for recreational hunters (Moriarty 2005).

Regardless of whether they hunt on public or private lands, recreational hunters are active participants in wildlife management. There may be as many as one million recreational hunters, and like many countries in the developed world, this hunting community is active and willing to spend large amounts of money on the sport (Finch et al. 2014). Recent estimates suggest that the Australian economy is \$335 million and 3,000 jobs larger as a result of the contribution of recreational hunting and sports shooting (RM Consulting Group [RMCG] 2019). For example, a 2013 survey of Victorian game licence holders found that the estimated expenditure on hunting game animals was \$282 million, with a further \$135 million spent on hunting pest animals. This expenditure generated an estimated 1,115 jobs (full time equivalent), with a further 1,268 jobs stemming from flow-on employment, highlighting the significant economic benefits created by recreational hunting (Department of Environment and Primary Industries [DEPI] 2014). Of all the potential target species for recreational hunters, deer are seen as having particularly high commercial value, a point demonstrated by the continued economic viability of a number of commercial safari operators targeting deer species in southern Queensland, generating considerable financial and employment benefits. However, despite the established economic and social benefits of deer hunting, it remains a controversial activity in Australia, particularly in peri-urban areas, primarily due to public attitudes and safety concerns.

The state of Queensland maintains over 400 state forests, covering more than three million hectares (see Figure 1). These public areas are operated as a multi-use tenure allowing for a range of commercial and recreational activities. They offer a diverse resource for recreational uses including mountain biking, horse riding, bushwalking and four-wheel driving. Recreational hunting is not currently permitted on any public lands in Queensland, with the exception of occasional priority pest control initiatives in which members of the Sporting Shooters' Association Australia are able to participate. This is in contrast to New South Wales, which allows suitably licensed recreational hunters access to more than two million hectares of state forest, and considers hunting in these public areas a mutually beneficial component of the recreational activities undertaken within these forests (New South Wales Department of Primary Industries 2020). Queensland's state forests are managed by the Queensland Parks and Wildlife Service (QPWS) within the Department of Environment and Science, which has an obligation to manage pest animals under both Commonwealth and state legislation.

This report is designed to provide an objective overview of the implication of permitting recreational hunting for deer within state forests in Queensland. There is a strong focus on the environmental and pest management aspects of recreational hunting, as well as the potential economic and social implications. The report is structured into four sections. Part A provides a comprehensive overview of the current knowledge of deer impacts in a state, national and international context, and outlines the potential for recreational hunting to play a role in pest

management, as well as providing a summary of the legislation governing recreational hunting and deer in Queensland. Part B focuses on the possible environmental, economic and social implications of allowing hunting in state forests, while Part C provides an assessment of the potential issues arising from permitting hunting on public lands. Finally, Part D includes a series of recommendations that will provide a focus point for ongoing advocacy for recreational hunting in Queensland.



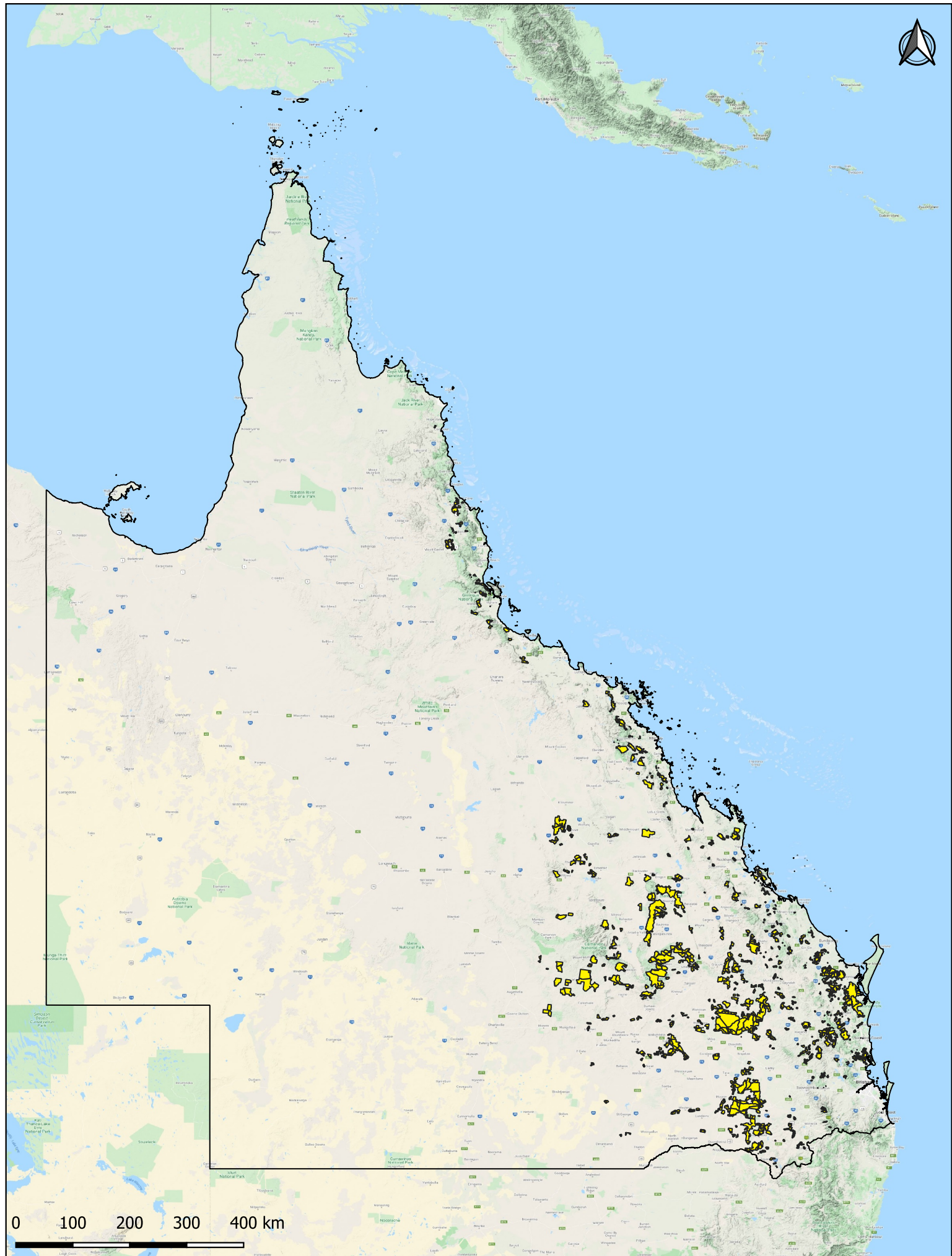


Figure 1. Location and extent of state forests in Queensland (Basemap source: Google, n.d.)

# PART A: BACKGROUND AND CONTEXT

## History of Deer in Queensland and Australia

Various species of deer (members of the family Cervidae) are among the world's most successful and widespread invasive mammals, and can have significant negative implications for natural and agricultural ecosystems (Davis et al. 2016). Six different deer species have established wild, self-sustaining populations in Australia, with at least one species occurring in every state or territory (Moriarty 2004). Within Australia, deer occupy a broad range of habitats ranging from temperate forests to alpine woodlands, arid scrublands, tropical and temperate grasslands, tropical savanna, and rainforest (Davis et al. 2016). The establishment of Australia's wild deer herds commenced in the mid-19<sup>th</sup> century when acclimatisation societies imported deer as a hunting resource (Bentley 1998). For most of their period of occupancy in Australia, deer have been common throughout relatively restricted areas around the sites of their initial introduction (Department of Agriculture, Fisheries and Forestry [DAFF] 2013). However, since the 1970s, escapes from commercial deer farms and deliberate translocations with a variety of motivations have seen the distribution and population size of deer herds increase significantly (DAFF 2013).

In Queensland, several deer species originating from Europe and Asia were released into the wild by the Queensland Acclimatisation Society and various private individuals throughout the late 19<sup>th</sup> and early 20<sup>th</sup> centuries (DAFF 2013). Four species – chital (*Axis axis*), red deer (*Cervus elaphus*), rusa deer (*Cervus timorensis*), and fallow deer (*Dama dama*) have become established in Queensland as a result of these releases. Until recently, rusa deer were considered to be restricted to islands in the Torres Strait, but have now become established in continental Queensland. Fallow deer are primarily found in the Granite Belt region of southern Queensland around Stanthorpe, red deer occur in the Brisbane and Mary Valleys in South East Queensland, and chital are established in the Charters Towers region and other areas in the central Queensland (see Figure 2). Across Australia in 2005 there were an estimated 218 wild deer herds, predominantly established by deer farm escapes or deliberate releases and translocations, numbering in the vicinity of 200,000 individual animals (McLeod 2016). While these numbers are small in comparison to other exotic mammals, the continued increase of deer populations in southern and eastern Australia, where the density of other herbivore pests is typically low, is of increasing concern to land managers (Moriarty 2004). If current trends of population growth and range expansion continue, deer have the potential to rival feral pigs and goats in distribution, abundance and impacts in the near future (Moriarty 2005).

## Impacts of Deer

Despite a comprehensive body of international literature detailing the negative impacts caused by deer species, and a growing recognition of deer as a national problem, they are one of the least studied mammal species in Australia (McLeod 2016). Compounding this paucity of knowledge is the lack of effective legislation governing the management of wild deer in Australia, which indicates that the concept of deer as a pest species is relatively new in the Australian context. As a result, there is a general shortfall of understanding of the ecology, impacts and effective management strategies among land managers (Moriarty 2004). In North America, Europe, New Zealand, and parts of Asia, managers have quantified the environmental, agricultural and social impacts caused by deer, and have developed a suite of techniques to manage and mitigate these impacts (Moriarty 2004). In the USA, deer are cited

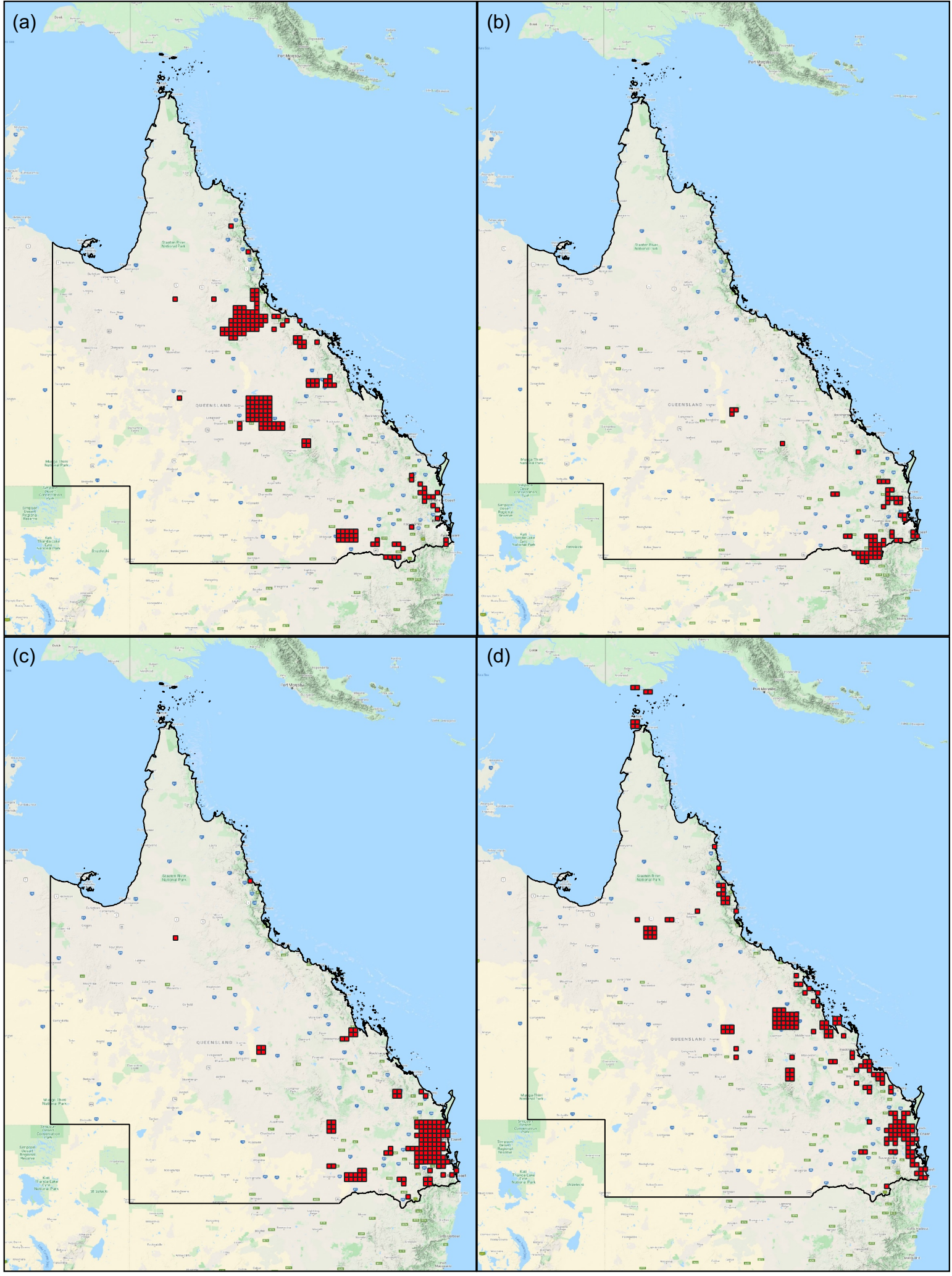


Figure 2. Current Queensland distribution of (a) chital, (b) fallow deer, (c) red deer, and (d) rusa deer (source: Queensland Department of Primary Industry and Fisheries 2014, basemap from Google, n.d.)

by agricultural producers as the single species most likely to cause wildlife-related damage, while in Scotland, deer populations are responsible for an escalating cost of damage to agricultural and forestry crops, increase incidence of road traffic accidents, and browsing and trampling damage to nature conservation areas (MacMillan & Leitch 2008).

Despite the relative paucity of information on the negative impacts caused by deer in Australia, there is a growing recognition of the increasing agricultural, environmental and social impacts of deer species (Centre for Invasive Species Solutions [CISS] 2020). Deer have been implicated in the spread of livestock disease, reduced agricultural livestock productivity due to competition for food resources, crop damage and motor vehicle accidents (McLeod 2016). Australian land managers have reported a range of problems associated with deer, including browsing of native plant species and commercial crops, damage to fences and gardens, competition for food with both native animals and livestock, dispersal of weeds, degradation of water quality, spread of stock disease, and increased erosion (Moriarty 2004). Within Queensland, community reports suggest that some or all of these impacts are becoming significant in parts of the state, particularly those areas where deer abundance is high (DAFF 2013). To address the scarcity of information on deer impacts, the Centre of Invasive Species Solutions is currently undertaking a five year project to provide land managers in Australia with the tools and expertise to cost-effectively manage wild deer, providing an indication of the growing seriousness of deer-related problems.

### Environmental Impacts

Deer act as a keystone species and perform the role of environmental engineers that are able to modify ecosystem functions at the landscape scale (Rooney & Waller 2003). Above certain densities, deer have the potential to cause ecosystem-level consequences, particularly in sensitive habitats. The ecological impacts of overabundant deer are well established in international literature, and include reduced diversity of herbaceous understorey plants as well as changes to the structure, composition and successional patterns of woody vegetation communities (Van Heelen et al. 2010). In the USA, high deer numbers can destroy the structure and function of temperate forests through selective browsing of favoured native plant species, and by dispersing the seeds of invasive weeds into deep forest habitats (Johnson & Horowitz 2014). One particular concern is the ability of deer to reduce plant biomass in the shrub layer, impede vertical growth of shrubs and tree saplings, and permanently alter community composition through selective browsing of favoured species. Aside from modifying the structure, composition and diversity of native vegetation communities, deer also compete either directly or indirectly with native fauna for food, and can have negative effects on soil values and water quality (Fraser 2000).

Specific impacts of deer on vegetation include defoliation of trees, shrubs, vines, herbaceous plants and grasses, removal of shoots and seedlings, bark stripping, and the destruction of plant reproductive material in the form of flowers and fruits, all of which may result in a reduction in plant population viability (Keith & Pellow 2005). While few studies have been conducted into the environmental impacts of deer in Australia, those that have conclude there are potential negative impacts on a variety of plant species. In the Royal National Park in New South Wales, Clarke et al. (2000) found that deer negatively affected 69 different plant species through overgrazing, browsing, trampling, ring-barking and antler rubbing, as well as spreading weed seeds and causing localised erosion. In Victoria, Peel et al. (2005) suggested that prolonged grazing by deer could cause the loss of entire plant communities in some areas. The potential direct and indirect impacts of deer have resulted in environmental degradation caused by deer to be listed as key threatening process under the New South Wales *Threatened Species Conservation Act 1995*.

Deer may also have serious negative impacts on endangered plants and communities, with dietary analysis demonstrating that they ingest rare and threatened plants (DAFF 2013). Analysis of rusa deer stomach contents from Royal National Park showed that deer consumed more than 150 native plant species, including two endangered species, nine vulnerable species, and 13 regionally uncommon species (Moriarty 2005). Enclosure experiments within the national park showed that deer at high densities could be particularly damaging in certain habitats, including areas of littoral rainforest, sandstone gully forest, and sandstone heath, all of which supported significantly less understorey species when deer occurred at higher densities (Moriarty 2005). While similar studies have not been conducted in Queensland, deer are known to feed on the nuts of the bunya pine (*Araucaria bidwillii*), an iconic Queensland conifer tree, and pose a threat to bunya seedling recruitment and population viability (Smith et al. 2007). Growing evidence that deer distribution is increasing in Queensland suggests that, in the future, deer will have serious and widespread effects on natural vegetation communities (Davis et al. 2016).

Evidence from the international literature, and anecdotal data from Australia, suggests that modification of vegetation communities by deer can have negative impacts on native fauna through habitat alteration (Davis et al. 2016). In the USA deer are known to alter or destroy habitat for a range of native birds, small mammals and invertebrates by reducing the structural diversity and complexity of vegetation in the understorey and shrub layers (Johnson & Horowitz 2014). This is particularly relevant for small mammals and ground- or shrub-nesting birds in Australia, who are vulnerable to predation by feral cats, foxes and introduced rodents in simplified understorey environments. Bartlett (2012) found that, in Victoria, sites with high sambar deer densities were associated with a decrease in species richness and abundance of small mammals and reptiles due to reductions in the availability of shelter, food and nesting sites caused by deer browsing. Larger native species may also be negatively impacted by deer through food competition, given the significant overlap in diet between deer and many native herbivores. Those species most at risk of food competition are those that overlap in body mass, such as wombats and various macropods (Davis et al. 2016). In the Granite Belt in southern Queensland, common wombats (*Vombatus ursinus*), which are listed as Near Threatened, may be impacted by growing populations of fallow deer, threatening their ongoing persistence in the state. This competition may be particularly detrimental after the adverse environmental conditions caused by a combination of recent bushfire and drought.

### Economic and Social Impacts

The economic impacts of deer take a variety of forms, including loss of agricultural productivity, damage to property and infrastructure, and the costs of management undertaken to minimise impacts. Lindeman and Forsyth (2008) assessed the impacts of deer on agricultural producers in Victoria, and found that the most commonly reported impacts were eating trees, damaging fences and competition with livestock for pasture. Less frequent impacts included eating fruit and vegetable crops, trampling of crops and fouling of pasture or water (Lindeman & Forsyth 2008). Deer are known to browse foliage in commercially managed forests, reducing growth and productivity of trees in both native eucalypt and exotic pine plantations (Davis et al. 2016).

In the USA, the total cost of deer-related impacts was estimated in 1997 to be over \$US2 billion annually (Conover 1997). While populations of deer are presumably much lower in Australia, the cost to agricultural and primary producers is still significant. In a survey of 15 landowners in New South Wales, McLeod (2016) found that the average financial losses due to deer were \$4,600 per property, with a range of between \$200 and \$20,000. While difficult to quantify, competition between deer and cattle for pasture resources and supplementary feed may be significant, particularly in dry seasons (DAFF 2013), which has the potential to

result in slower growth and lower sale prices for cattle. In Queensland, landowners and managers have reported that deer cause damage to forestry seedlings, horticultural and agricultural crops, commercial flower harvests, orchards, fences and irrigation systems (DAFF 2013). Though it has not been studied in Australia, forest degradation caused by deer may also have indirect economic and social impacts through increased erosion and flooding (Côté et al. 2004).

Wild deer are potentially susceptible to diseases and parasites that may spread to other animals and humans. Transmission may occur when deer use improved pastures, livestock water resources, or when infected deer come in contact with hunting dogs (Davis et al. 2016). Jesser (2005) noted that deer in Australia either carried, or could potentially carry, screw-worm fly (*Chrysomya bezziana*), leptospirosis (*Leptospira* spp.), surra (*Trypanosoma evansi*), Johne's disease (*Mycobacterium avium* ssp. *paratuberculosis*), brucellosis (*Brucella abortus*), ovine Johne's disease (OJD), bovine Johne's disease (BJD), bovine tuberculosis (*Mycobacterium bovis*), Yersinia (*Yersinia pseudotuberculosis*), tissue worm (*Elaphostrongylus cervi*), malignant catarrhal fever, and Louping ill. Feral deer in Queensland are known to carry cattle ticks and may transport them into tick-free areas, transferring them to cattle (DAFF 2013). A CSIRO report on Australia's biodiversity future stated that increasing deer numbers would increase the risk of foot-and-mouth and bluetongue disease in Australia. In the USA, deer carry and spread Lyme disease, the most common vector-borne disease in that country, but which is generally considered to be absent from Australia (Johnson & Horowitz 2014).

Deer also pose a serious economic and human health costs through collisions with motor vehicles. Direct and indirect impacts from these road accidents include damage to vehicles, treatment of human injuries, loss of productivity as a result of injuries, and in extreme cases, the loss of human life. The National Road and Motorists' Association in Australia (NRMA) estimates that vehicle damage from collisions with wildlife and stock costs an average of \$3,000 per incident (NRMA 2003). While only a small fraction of these incidents are likely to involve deer, similar costs have been recorded for deer-related crashes in the USA (McLeod 2016), and the ongoing increase in abundance and distribution of deer is likely to bring vehicles and deer into contact more frequently. In the USA, more than 1.5 million deer-car collisions occur annually, resulting in over \$AU1 billion damage to vehicles, more than 200 human fatalities, and over 16,000 human injuries (Conover 2001). Similarly, in England, vehicle accidents caused by deer are estimated to cause between 750 and 3,200 human injuries annually (Wilson 2003). Deer regularly pose a traffic hazard in several areas in Queensland and occasionally necessitate the closure of major roads to facilitate deer removal, while residents living near deer populations have reported numerous collisions and near misses (DAFF 2013).

## Recreational Deer Hunting

The term 'recreational hunting' describes a broad variety of hunting activities practiced by a diverse range of individuals with different motives and objectives (Bengsen et al. 2016). Recreational hunting is a popular pastime in Australia, and is widely practiced in all Australian states and territories (Finch et al. 2014). Estimates of the total number of hunters in Australia vary widely, from one percent to five percent of the Australian population (Finch et al. 2014, Bauer & Giles 2002). Regardless of which figures are used, it is clear that recreational hunting is practiced by substantial numbers of people, with a broad range of goals, around the country. This large population of hunters supports more than 50 recreational hunting organisations within Australia, with the largest shooting club, the Sporting Shooters Association of Australia (which is a federation of multiple shooting interests, not just recreational hunting), representing

more than 130,000 members (Adams 2013). Membership of these organisations is increasing, suggesting that despite opposition from certain segments of society, recreational hunting plays an integral role in the lives of many Australians.

In many parts of the world, the practice of recreational hunting is considered an important wildlife management tool, yet this potential remains largely untested in Australia. Until recently, recreational hunting was largely restricted to private lands, despite the apparent desire of many hunters to actively participate in pest animal control (Bengsen & Sparkes 2016). Recreational hunting has not generally been seen as an important tool for managing invasive species on public lands, and in the few instances where recreational hunting has been incorporated into strategic pest animal control programs have been tightly controlled and aligned with specific management objectives in limited locations (Bengsen & Sparkes 2016). However, five out of Australia's eight states and territories now permit some form of hunting on public lands (Bengsen et al. 2016) (see Table 1). This increased access to hunting opportunities has seen a rise in the number of people participating in hunting, as entry to public lands negates the need to establish and maintain good relations with private landholders. The number of licenced hunters in Victoria tripled between 2000 and 2015, while in New South Wales, licenced hunter numbers have increased steadily since the establishment of hunting on public lands (Bengsen & Sparkes 2016). To date, there has been little strategic management of recreational hunting on public lands, which contrasts with other countries such as New Zealand, where ground-based shooting has significantly reduced deer populations at large spatial scales (Davis et al. 2016).

**Table 1. Current status of hunting on public lands in Australia's eight states and territories**

State	Hunting Permitted on Public Lands	Brief Description
Australian Capital Territory	No	Hunting is limited to feral animals on private property with landowners' permission
New South Wales	Yes	There are 350 state forests declared as public hunting lands
Northern Territory	Yes	Currently allows the hunting of feral pigs and waterfowl on public game reserves and designated crown lands under a permit system
Queensland	No	Hunting is limited to feral animals on private property with landowners' permission
South Australia	Yes	Open seasons under certain conditions permit the hunting of certain species of game animals on public game reserves
Tasmania	Yes	Pest or feral animals can be taken any time on private land, state forest and crown land
Victoria	Yes	All pest or feral animals, as well as a variety of game species, can be taken on both state forest and private land
Western Australia	No	Hunting is limited to feral animals on private property with landowners' permission

Any proposed increase in access to public lands for recreational hunting is likely to encounter strong, vocal opposition from some segments of society. Proposing lethal management measures to counter increasing invasive animal populations can be distasteful to local residents, and other members of the community, based on the perceived efficacy of recreational hunting, animal welfare and ethical concerns, the issue of public safety, and other concerns about hunting (Johnson & Horowitz 2014). Any proposal to allow hunting in

Queensland's state forests will need to take into account societal attitudes towards deer, which vary from viewing deer as an undesirable pest to seeing deer as an integral part of the Australian landscape and providing increased scenic amenity. An illustration of the varying public feelings towards deer is provided by Finch and Baxter (2008), who found that more than half of the landowners surveyed in Queensland wanted deer to either stay at present levels or increase. As public support is critically important when advocating for the necessary legislative change that would allow recreational hunting in Queensland's state forests, it is important that deer are portrayed (accurately) as an invasive pest species that cause numerous negative impacts. This is supported by evidence that people are more likely to describe deer as 'overabundant' when they either perceive, or have personally experienced, negative impacts (Arnett & Southwick 2015).

There is currently little evidence to either support or disprove the argument that recreational hunting in Australia provides a useful pest animal control tool (Bengsen & Sparkes 2016). However, a limited number of experimental studies and anecdotal reports suggest that well-directed recreational hunting efforts can make useful contributions towards pest management, particularly when combined with other control actions (Bengsen & Sparkes 2016). In addition, hunting can provide a significant pathway to developing strong connections to nature, in the context of modern society which has seen a shift away from an understanding of the natural world and its intrinsic values (Adams 2013). On the other hand, recreational hunting can also impact negatively on conservation objectives, as some hunters have been shown to actively attempt to maintain high populations of introduced and potentially destructive introduced species (Adams 2013). During the 1990s in Australia, deliberate translocations of deer have been a key factor in the spread of deer herds throughout Australia, and have seen the geographic range and population numbers of deer increase significantly (DAFF 2013). For hunting on public lands to be widely accepted, there needs to be a strong focus on the potential pest animal benefits that recreational hunting can achieve.

## **The Role of Recreational Hunting in Pest Management**

The strongest argument for allowing deer hunting in Queensland's state forests revolves around the contribution of recreational hunting towards pest management. If unmanaged, wild deer have the potential to establish significant populations and high densities in many parts of Australia, with concurrent environmental, economic and social impacts (Moriarty 2004). Strategic pest management, as a process, aims to reduce pest populations to densities where the negative impacts they cause is acceptable, and, importantly, is not outweighed by the costs of control (Bengsen & Sparkes 2016). Much of the current pest management activity in Australia is based on a sustained strategic approach with the objective of holding pest animal populations below what they could potentially reach, given that the conditions necessary for complete eradications are rarely realised.

In order to be an effective pest control tool, recreational hunting must provide sufficient pressure on the population of the target species to cause a reduction in the overall population to some point where negative impacts are minimised, or at least decreased (Bengsen & Sparkes 2016). In the case of hunting, this pressure is driven by a combination of the number of hunters, the effort applied per hunter, and the efficiency of individuals. While the national deer harvest by recreational hunters in Australia is relatively high – over 120,000 deer were harvested in Victoria alone in 2018 – management targets should be a reduction in density rather than a set harvest figure (Moloney & Powell 2019, Sharp and Wollscheid 2009). For introduced deer on public lands such as state forests, where the conservation of biodiversity and the mitigation of damage in surrounding agricultural lands is the management priority, the



focus should therefore be on how many deer are left, rather than on how many deer are killed (Nugent et al. 2011).

The success of any pest animal management depends on the extent to which the population dynamics of the target species is considered (Booth 2010). All wildlife populations are constrained by a limiting factor, or series of factors. Many populations are food-limited, whereby populations increase until food resources become scarce, causing the population to decline through some combination of increased juvenile or adult mortality, disease, delayed sexual maturity, or a decrease in birth rates (Conover 2001). The point where the population reaches an equilibrium with the capacity of the land to sustain it is called the environmental carrying capacity (Conover 2001). Successful pest management programs are able to maintain population below the carrying capacity, thereby limiting the environmental, economic and social impacts of the pest animal. For most wildlife species, hunting is compensatory up to a certain threshold, and losses are compensated for by increases in birth or survival rates or decreases in mortality rates to maintain a stable population despite hunting pressure. This process of compensation is why, in Australia, killing even 50 percent of a fox, rabbit or pig population is unlikely to seriously impact population abundance the following year. However, once hunting pressure is increased past the compensatory threshold, hunting becomes an additive process and the target population declines, which is the goal of pest management.

It is critically important that the population dynamics of the target species are thoroughly understood in order to define the compensatory threshold. Hone et al. (2010) used modelling techniques to estimate the percentage of the population of various deer species that must be removed annually to prevent population increase, which is synonymous with the compensatory threshold. They found that the proportion of the population that needs to be removed each year was 34 percent for fallow deer, 46 percent for rusa deer, and 49 percent for chital. While their study did not assess red deer, other studies suggest that the figure for this species is around 27 percent. This is supported by evidence from the international scientific literature. For example, in the Southern Black Forest in Germany, Hagen et al. (2018) found that annual red deer harvests above 38 percent of the population total increased the likelihood of population decline.

In the case of deer, any consideration of population dynamics driving population growth and decline must also examine the sex ratio of the population. Historically, the recreational harvest of most deer species has typically been biased towards stags or bucks (male deer), with a significant proportion of hunters having a strong trophy focus (Fraser 1996). Removal of stags alone is unlikely to suppress deer population growth, and an increased focus on the harvest of does or hinds (female deer) is required in order for recreational hunting to constitute a useful population management tool, despite the fact that this may conflict with hunting traditions (Hagen et al. 2018). The implementation of female-biased hunting, in combination with annual harvest levels of between 30 and 50 percent of the population, is likely to be required to stabilise or reduce the high density deer populations which currently occur in many parts of Queensland and Australia. This cultural shift away from traditional stag-focused hunting has proved effective in the control of wild deer in the USA, where management strategies have shifted towards harvesting antlerless deer to constrain population growth and achieve desired reductions in deer abundance (Brown et al. 2000). This change in recreational hunting culture has been facilitated through regulation and education, causing hunters to identify as important components, and proponents, of pest management. There is evidence from Victoria that the traditional male-biased harvests may be giving way to a more equal sex ratio, or even harvests favouring females (Moloney & Powell 2019), indicating that the cultural shift required for hunters to implement meaningful population reductions is already underway.

There is much potential for recreational hunting to contribute to the strategic control of introduced mammals in Australia, providing mutual benefits to both hunters and land managers (Bengsen & Sparkes 2016). Ground-based shooting is a convenient and inexpensive means of reducing wildlife population densities, and in many cases provides the only viable control option (Bengsen et al. 2020). In some cases, as in particularly sensitive ecosystems or as part of recovery programs for single or entire assemblages of threatened native species, ground-shooting can be used to complement other control tools such as aerial shooting, trapping or poison baiting (Parkes et al. 2010). Regulated hunting of wild deer on public lands can reduce management costs for government agencies, decrease the incidence of translocated deer through the provision of hunting opportunities, and could potentially increase funding for research on deer distribution, abundance and impacts through the prudent use of license and hunting fees (Moriarty 2004). In their global review of ground-based shooting to control overabundant mammal populations, Bengsen et al. (2020) found that a large proportion of programs used unpaid recreational hunters as their main type of shooter. Recreational hunters were the commonest control agent in all regions except Australasia, where government-employed marksmen were more frequent, presumably incurring much greater costs (Bengsen et al. 2020).

## Hunting and Pest Animal Legislation in Queensland

Within Australia, the regulation of hunting activities on public land is predominantly the responsibility of individual states, with access requirements varying amongst the different jurisdictions. Hunting for recreation in Queensland is currently limited to pest animals on private property, and there are no declared game species in the state. There are no permits required for hunting pest animals, however if using a firearm, hunters must be licenced as required under the *Firearms Act 1996*. In other states, various bodies administer hunter licensing, education and compliance. For example, in New South Wales the Game Licensing Unit manages permits and compliance in that state, while administering hunting programs such as hunting on public lands, and various education and accreditation programs. Similarly, in Victoria the Game Management Authority oversees game licensing (as well as undertaking educational programs and research), with various licenses available depending on the requirements of the individual hunter.

Several pieces of legislation govern the management of pest management in Queensland. The *Land Protection (Pest and Stock Route Management) Act 2002* provides a framework for improved management of weeds and pest animals, while the *Biosecurity Act 2014* is designed to ensure a consistent, modern, risk-based approach to biosecurity in Queensland. Both of these acts specifically mention wild deer as a pest animal (see Table 2). Under the *Land Protection (Pest and Stock Route Management) Act 2002*, Class 1 pests are those species that do not currently occur in Queensland, and are subject to eradication. Landowners must take all reasonable measures to keep land free of deer that are declared as Class 2 pests. Class 3 is the least severe category, and places restrictions on the introduction, feeding, supply and release of deer in this group.

**Table 2. Legislation pertaining to deer as pest animals in Queensland**

Legislation	Species	Class/Category	Details
<i>Land Protection (Pest and Stock Route Management) Act 2002</i>	Sambar and hog deer	Class 1 pest	Priority for eradication because not currently established
	Chital and rusa deer	Class 2 pest	Private land managers are required to control

	Red and fallow deer	Class 3 pest	Private land managers are only required to control where their land adjoins protected environmental assets
<i>Biosecurity Act 2014</i>	Sambar and hog deer	Categories 2, 3, 4, 5, and 6	The invasive animal must be reported within 24 hours. All reasonable and practical steps must be taken to minimise the risk of the animal escaping
	Red and fallow deer	Categories 3, 4, 5, and 6	The invasive animal must not be distributed, released into the environment, moved, kept or fed
	Chital and rusa deer	Categories 3, 4, and 6	The invasive animal must not be distributed, released into the environment, moved or fed.

Like other landholders, the Queensland Parks and Wildlife Service is subject to the general biosecurity obligations under the *Biosecurity Act 2014*, and must take all reasonable and practical steps to minimise populations and mitigate impacts of declared pest species on lands under their control, including state forests. The pest management objectives of the QPWS include:

- Protecting natural and cultural values by eradicating pests or significantly reducing their impacts.
- Preventing the introduction or spread of any declared pest plant or animal on the QPWS estate.
- Use contemporary pest management techniques to reduce environmental, economic and social impacts.
- Ensure that pest management is properly planned and executed to produce tangible and long-term outcomes.
- Improve the effectiveness of its pest management through investigating innovations and new technologies.

Given that ground-based shooting is commonly practiced in an international context for pest management of introduced herbivores, and that destruction using firearms is an endorsed pest species management method for deer in Australia (Department of Environment and Science 2015), the concept of allowing recreational hunting as part of an integrated pest management strategy in Queensland's state forests conforms to the goals and priorities for pest management outlined by QPWS, providing it is practiced for the primary purpose of reducing populations of pest animals.

## **PART B: IMPLICATIONS OF PERMITTING RECREATIONAL HUNTING IN STATE FORESTS IN QUEENSLAND**

The previous sections provided a comprehensive background into the issue of deer in Australia, including their history, populations, potential impacts and the current legislative positions towards deer and recreational hunting. The following sections outline the implications, both positive and negative, of allowing recreational hunters to access state forests in Queensland to target deer. These sections have been broadly divided into environmental, economic, and social categories.

### **Environmental Implications**

Given the abundant evidence globally that deer modify and damage natural ecosystems, it can be argued that the management of deer in Australia can be justified under the precautionary principle, whereby control measures should be undertaken despite the general lack of local evidence into the negative impacts of deer. Overabundance of exotic deer in protected areas, including Queensland's state forests, can occur even when the density of deer is low relative to the environmental carrying capacity if ecological damage is occurring. Australian studies of deer impacts indicate that the negative environmental consequences of deer include damage to threatened species and communities, modification of the floristic and structural composition of vegetation, and alteration of habitat for fauna, as well as potentially increased erosion risk and degradation of water quality.

As eradication of deer is not feasible in many parts of Queensland, the management of deer should be focused on a reduction in population density to meet wider biodiversity goals (Booth 2010). In other countries, providing access to recreational hunters has proved effective in reducing deer densities to low levels, circumventing the need for state-funded control programs (Nugent et al. 2011). In Australia, volunteer hunters have successfully contributed to specific conservation initiatives such as South Australia's Operation Bounceback (Booth 2010), but in Queensland, recreational hunting remains largely untested as a means of pest population reduction on public lands. Hunters whose primary motivation is to reduce pest animal populations or the damage they cause have been shown to have a greater impact on pest populations than those motivated purely by consumptive or trophy hunting objectives (Ward et al. 2008). This conservation-oriented motivation is already evident in Australian recreational hunters, with Finch et al. (2014) finding a clear impetus amongst hunters to assist landholders in controlling pests. Over half of the participants in their survey also took part in other forms of natural resource management such as tree planting or weed control, indicating that conservation is a major driver for many recreational hunters (Finch et al. 2014).

Evidence from international sources indicates that recreational hunting can be effective in reducing deer density, with consequent decreases of the ecological damage caused by deer. In the Waikato Conservancy in New Zealand, significant vegetation recovery has been observed in reserves where recreational deer hunters have been encouraged to hunt (Fraser 2000). Without recreational hunting in New Zealand, Fraser (2000) suggests that deer densities in some places would be considerably higher. The conservation benefits achieved were primarily caused by reduced browsing pressure as a result of maintaining deer densities below the environmental carrying capacity (Fraser 2000). In the Blue Mountains region of New Zealand, deer density, as estimated by faecal pellet frequency, consistently declined after the introduction of ground-based shooting, even when commercial hunting ceased and recreational hunting was the only form of population control (Nugent 1988). In the Gettysburg National Military Park in the USA where white-tailed deer are protected, Conover (2001) found

deer densities to be three and a half times higher (28 per km<sup>2</sup>) than surrounding areas where recreational hunting is permitted (8 per km<sup>2</sup>). These examples demonstrate the potential pest management objectives that could be achieved by permitting recreational hunting in Queensland's state forests.

When conducted appropriately, recreational hunting clearly has the potential to reduce deer populations and the damage they cause, however there are also several risks to allowing hunting on public lands that bear consideration. Hunting in an ad hoc fashion is unlikely to lead to reductions in deer density, and may compromise professional control programs or undermine conservation policy (Booth 2010). Recreational hunting risks becoming counterproductive if the values sought by hunters become the reason for deer management, as opposed to management for conservation (Nugent et al. 2011). There is a risk of hunters moving feral animals around in order to increase hunting opportunities, with a New South Wales survey in 2000 finding that an estimated 58 percent of deer populations had been established by illegal translocations for the purposes of hunting, with many translocations occurring in recent decades (Moriarty 2004). In addition, many hunters are unwilling to recognise that overabundance of deer is a problem in areas where they hunt, and are therefore disinclined to participate fully in management actions they perceive as a threat to their hunting activities (Van Deelen et al. 2010).

Recreational hunting may provide food resources for other pest animals such as foxes and wild dogs where carcasses, or parts thereof, are left in situ (Bengsen & Sparkes 2016). In Victoria, deer hunters have been responsible for leaving hundreds of tonnes of sambar deer remains in public forests because they desire only the trophy antlers (Peel et al. 2005). These surplus food resources have the potential to bolster populations of feral predators including pigs, dogs and foxes, whose increased populations pose a threat both to environmental values and to agricultural productivity. There are also questions over whether recreational hunting conducted at single, isolated sites can be effective in reducing ecological impacts. Recreational hunting will provide the greatest environmental benefits when it is conducted collaboratively at the landscape level, ideally in combination with other control methods as part of a strategic pest management program at large spatial scales (Austin et al. 2013). Most, if not all, of these risks can be mitigated by appropriate training aimed at encouraging hunters to view themselves as implements of conservation and pest management.

## **Economic Implications**

Recreational hunting provides significant economic and financial benefits, both within Australia and in other western countries where recreational hunting is a popular pastime. The economic impacts of hunting can be broken into several categories, including the direct and indirect contribution to the economy made by hunting, reduction of impacts to agricultural production, and a decrease in government-funded pest animal management costs. In the USA, more than 13 million recreational hunters create thousands of jobs directly involved in the manufacture, sale and provision of hunting products and services (Arnett & Southwick 2015). These direct impacts are dwarfed by the indirect contributions that hunters make to supporting hundreds of thousands of jobs at local stores, restaurants, hotels and other businesses that benefit from hunting activity (Arnett & Southwick 2015). As of 2011, deer hunting in the USA created almost \$US40 billion in economic activity annually, including retail sales, salaries and wages, and state and federal taxes (Arnett & Southwick 2015). In the state of Mississippi, approximately one third of white-tailed deer hunters were from out of state, generating substantial tourism activity and contributing around 17 percent of the overall economic impact of hunting (Whiteside 2007).

In Australia, a National Hunting Policy Working Group in 1997 estimated there may be as many as one million people participating in recreational hunting in Australia, generating expenditure in excess of \$1 billion annually. The primary contributions to this activity were purchase of vehicles and equipment, access fees and licenses, and downstream-related employment (Sharp & Wollscheid 2009). By 2018, the gross contribution to gross domestic product (GDP) had risen to an estimated \$2.4 billion, comprising \$0.8 billion in direct contributions and \$1.6 billion as a result of flow-on economic activity (RMCG 2019). Recreational hunting is a significant generator of employment, with approximately 3,300 full time equivalent jobs attributed to hunting – around 2,000 directly and a further 1,300 as a result of flow-on economic activity (RMCG 2019). Finch et al. (2014) found that recreational hunters in Australia spent on average \$5,880 annually on hunting goods and services, with a small proportion spending over \$10,000 per year directly. A significant proportion of the total contribution to economic activity and employment is directed at regional communities where hunting takes place, providing regional jobs and injecting much-needed funds to rural economies (Sharp & Wollscheid 2009).

Several recent reports have assessed the economic impacts of recreational hunting in New South Wales and Victoria. As of 2016, there were 19,000 recreational game hunting license holders in New South Wales, with a further 167,000 people holding a firearms license (RMCG 2017). For game license holders, hunting expenditure was estimated to be \$119 million, while the non-game license holders were estimated to spend somewhere between \$446 million and \$1,366 million annually. The employment directly attributable to hunters with New South Wales game hunting licenses was estimated to be 860 jobs. An analysis of the share between hunting on public and private lands indicated that approximately \$34 million (28 percent of the total expenditure) and 247 full time jobs (29 percent of the total) could be attributed to the ability to hunt on public lands (RMCG 2017), giving some idea of the potential economic benefits of allowing hunting in Queensland's state forests. In Victoria, the total expenditure on hunting game and pest animals by game license holders was estimated at \$417 million per annum (when taking into account pest hunting by game licence holders), which generated direct employment of 1,115 full time equivalent jobs, and a further 1,268 jobs stemming from flow-on employment (DEPI 2014). 58 percent of the total expenditure by game license holders was attributed to on-trip expenses, with 60 percent of the overall total expended in regional Victoria, indicating the importance of recreational hunting for regional economies. Deer were the most popular game species in Victoria (excluding general pest animal hunting), and generated an estimated \$57 million alone towards Gross State Product (GSP).

A national audit published in 2019 estimated that the population of recreational hunters in Queensland is around 78,000 (RMCG 2019). Government policy is the primary tool to influence the expenditure of recreational hunters, and the introduction of hunting on public lands is one such measure the Queensland government could take to increase the contribution of recreational hunting to the state economy, which is particularly relevant given the recent economic crisis, and the ongoing state government focus on boosting regional economies and employment. Given the increased participation in hunting in New South Wales and Victoria, the former directly attributable to permitting hunting on public lands, it is likely that recreational hunting participation would increase in Queensland if hunting in state forests was allowed, bringing consequent benefits to regional communities and the state economy as a whole. Tables 3 and 4 below outline the contribution of recreational hunting to GSP and employment in each state and territory in Australia.

**Table 3. Estimated gross contribution of recreational hunting and sports shooting to GDP of Australia and gross state product (GSP) (\$m) of each state and territory, 2018. (Reproduced from RMCg 2019)**

Region	Direct	Flow-on (Intrastate)	Flow-on (Interstate)	Flow-on (Sub-total)	Total
NSW	243	406	197	603	847
VIC	207	304	127	430	638
QLD	115	153	109	262	377
SA	62	86	28	115	177
WA	54	58	66	124	179
TAS	39	45	12	57	97
NT	22	32	8	40	62
ACT	11	12	14	25	37
<b>Australia</b>	<b>757</b>	<b>1,095</b>	<b>561</b>	<b>1,656</b>	<b>2,413</b>

**Table 4. Estimated gross contribution of recreational hunting and sports shooting to employment (FTE) in Australia and each state and territory, 2018. (Reproduced from RMCg 2019)**

Region	Direct	Flow-on (Intrastate)	Flow-on (Interstate)	Flow-on (Sub-total)	Total
NSW	2,727	2,648	1,141	3,789	6,516
VIC	2,479	2,284	916	3,200	5,679
QLD	1,359	1,080	495	1,575	2,934
SA	825	646	193	839	1,665
WA	580	352	223	576	1,155
TAS	465	324	67	391	856
NT	294	167	17	183	478
ACT	93	56	72	128	221
<b>Australia</b>	<b>8,822</b>	<b>7,558</b>	<b>3,124</b>	<b>10,681</b>	<b>19,503</b>

### Agricultural and Pest Management Costs

The agricultural impact of pest animals can be calculated by combining production losses, the expenditure – at the farm and government levels – on pest animal management, and the cost of administration. In the USA, Conover (1997) estimated that deer cause over \$US500 million in damage to agricultural crops, with at least this much in lost productivity in the forestry industry. In Australia, McLeod (2004) calculated the average nationwide annual production losses attributable to all pest animals to be around \$AU336 million. These costs are not disaggregated to assess the impacts of individual species, but where deer are overabundant it can be assumed that they contribute to these financial losses, and given observations that deer populations are increasing in many areas, these impacts are likely to grow in the absence of effective population management. McLeod (2016) found that some \$768 million was spent in pest management over 0.15 million Australian farms in 2006–2007, at an average cost of \$325 per farm. While recreational hunting should not be viewed as a panacea for reducing the agricultural impacts of pest animals, a reduction of deer density on public lands in Queensland is likely to result in a concurrent decrease in agricultural impacts in the surrounding areas. Against this, the potential cost of administration and licensing must be considered. In New Zealand, the cost of issuing permits and administering recreational hunting activities is in excess of \$NZ705,000 annually, but this represents only a small fraction of what state-funded

pest management would cost to remove a similar number of animals from the same areas (Fraser 2000).

Recreational hunting is one of the most cost-effective methods currently available to society to manage some pest animal populations, particularly medium to large mammalian species. If the government were to employ paid personnel to undertake deer management, either directly as government employees or by contract, the cost would likely be prohibitive (Conover 2001). The recreational hunting community in Australia is large, active, and willing to travel to rural and regional areas, and does not have to be paid to undertake pest management. On the contrary, recreational hunters pay for the privilege of hunting through the purchase of firearms or game hunting licenses. In the US state of Ohio, it was estimated that it cost \$US133 to translocate a problem deer, \$US207 to kill it using a government shooter or contracted pest control agent, or \$US45 to kill it using recreational hunters, indicating the cost savings that can be made by involving recreational hunters in pest management (Peck & Stahl 1997). Given the current funding constraints and the range of other urgent conservation problems faced by environmental departments in Australia, the official expenditure for the control of deer is unlikely to increase significantly in the near future. Unless pest management becomes a much higher government priority, recreational hunting is likely to represent the only significant control mechanism for large introduced mammal species, such as deer, on public lands.

Even when the success rate of hunting, as measured by actual deer kills, is low compared to hunting effort, changes in behaviour can reduce the agricultural damage caused by deer. When exposed to intensive hunting, deer may alter their behaviour by becoming more wary, shifting home ranges, becoming increasingly nocturnal, and spending more time in dense cover or other areas where hunting effectiveness is low (Conover 2001). These behavioural changes reduce the vulnerability of deer to hunters, and while they may not lead to a reduction in deer populations directly, they can reduce the impact of deer damage to open areas adjacent to refugia because deer are less willing to venture from cover. This is particularly relevant for deer in Queensland's state forests, which are typically surrounded by properties where agricultural production is the principle land use. If hunting causes deer to reduce activity in these adjacent agricultural areas, economic impacts of deer are likely to be reduced, leading to a more favourable perception of recreational hunting on public lands by rural landholders.

## **Social Implications**

Hunting and gathering has characterised human behaviour throughout our evolution, even in agrarian cultures, so it is unsurprising that hunting remains an integral part of society, even in the western world where the need for subsistence has all but ceased. Modern hunting provides an important avenue for social interactions and the maintenance of cultural traditions, and fosters connections within families and communities (Arnett & Southwick 2015). Recreational hunters are known to seek and foster social relationships with other hunters, often connecting at profound levels (Arnett & Southwick 2015). Hunting traditions are often passed down within families, and there is a substantial level of skill transfer from older to younger generations, providing intrinsic social value. Hunting also instils a sense of connection with nature, and many modern-day hunters volunteer for participation with a wide range of other environmental activities, such as habitat improvement projects, wildlife surveys, and other conservation-related activities (Heffelfinger et al. 2013). Participating in hunting and other nature-based activities not only provides positive social interaction among participants, but also provides the opportunity to connect with government-employed and other professional wildlife managers, which serves to strengthen conservation knowledge, ethics and motivations (Arnett & Southwick 2015).



Hunting also provides significant health benefits, and is potentially a large contributor to avoided health costs amongst the hunting fraternity. There is an increasing body of research which supports the wide range of benefits attributable to outdoor recreation in the fields of individual and community health, environmental and education (Austin et al. 2013). For some people, hunting may constitute an activity that has similar benefits to others they engage in, and which could be substituted to achieve similar health benefits. For others though, recreational hunting is unique and provides benefits that may not be readily achieved by engaging in other activities. Hunting may have incomparable health benefits given that many participants are older males, who are at greater risk of health problems related to physical inactivity compared to younger people (RMCG 2019). Recreational hunting can contribute to physical activity, as well as the mental health benefits ascribable to connecting with nature and growing meaningful social networks, all of which support wellbeing (RMCG 2019). Hunting may play a significant role in avoiding health costs, given the increasing growth in health expenditure in Queensland and Australia.

Recreational hunting may play a substantial role in improving and maintaining mental health, particularly as many hunters are male, with a consequently greater risk of health issues from social isolation compared to women (RMCG 2019). A survey by RM Consulting (2019) found that recreational hunters consistently reported higher subjective wellbeing compared to the adult population in Australia, regardless of age or gender. Spending time outdoors and connecting with nature was rated as being very important to more than three quarters of recreational hunters according to a recent survey (RMCG 2019), and it is likely that the connection with nature and the outdoors engendered by participating in hunting contributes positively to wellbeing. In addition, hunting also encourages participants to learn new skills, experience challenges and feel achievement, fostering a strong sense of self-efficacy (RMCG 2019). People who feel more confident in their ability to meet challenges and achieve tasks typically have higher wellbeing and mental resilience, and this is an important mechanism through which recreational hunting can contribute to wellbeing.

Societal perceptions of hunting are a key social aspect of recreational hunting, as public support is critically important if hunting is to be sustained in the future (Arnett & Southwick 2015). Social perceptions of deer are directly related to the perceived negative impacts caused by deer, which may be environmental, economic or social. Leong (2010) found that people described deer as “overabundant” when they had experienced negative impacts. Where local residents are aware of deer impacts on biodiversity and see these as being important, or have experienced damage to their property or livelihood as a direct result of deer, they have a lower acceptance of deer and express greater support for lethal control measures such as hunting (Johnson & Horowitz 2014). The consequences and perceived effectiveness of hunting also play a key role in support for hunting, and can directly enable aid in shaping community attitudes towards recreational deer hunting (Johnson & Horowitz 2014). Johnson & Horowitz (2014) found that local residents’ fundamental objectives for wildlife management reflected a desire both to protect their households and livelihoods, and to conserve what they perceived as high local environmental values.

In North America, public attitude surveys have consistently indicating that the most acceptable rationale for recreational hunting is for meat (Arnett & Southwick 2015). In many places in the world, wild game remains an important source of subsistence meat, but even in western countries hunting is more publicly acceptable when it is aimed at obtaining meat (Arnett & Southwick 2015). Recently, there has been an increased focus on procuring local, natural and humanely sourced meat, which may be responsible for rising participation in hunting within population segments that are not traditionally engaged in this activity (Arnett & Southwick

2015). This new trend promotes the idea of taking responsibility for sourcing your own food, and the ethical issues raised by livestock production (Gamborg & Jensen 2017). Recreational hunting, when it involves hunting for meat, may be more socially acceptable than intensive livestock production (Thulin et al. 2015). Conversely, recreational trophy hunting may be less acceptable to many elements of society given animal welfare issues and the perceived waste of a valuable resource. Positioning recreational hunting as an activity that humanely sources food while both reducing pest animal populations and decreasing the need for livestock production is likely to result in hunting being viewed more positively by much of the non-hunting portion of society.

There is likely to be opposition to allowing hunting in Queensland's state forests from certain segments of society due to real or perceived negative social impacts. Opponents of recreational hunting on public land argue that it reduces the social value of the land for other users (Bengsen & Sparkes 2016). Hunting may be viewed as being incompatible with other outdoor leisure activities on public lands, as it takes place in areas which are utilised for a diverse range of pursuits by other users. Other state forest users may feel that hunting threatens their right to public access to nature and the outdoor recreation it provides. People's willingness to accept hunting as a legitimate activity on public land may be shaped by concerns about stray bullets, perceptions of hunting as inhumane, or concerns about the ecological impacts (Johnson & Horowitz 2014). Recreational hunters share ethical space with non-consuming users of public land through their appreciation for nature and wild places that is generally based on personal experience, and the challenge for the hunting community is to use this shared space to foster positive perceptions towards hunting and its role within society.

## **PART C: POTENTIAL ISSUES TO BE CONSIDERED**

The evidence and discussion outlined above demonstrates that hunting on public lands can have positive environmental, economic and social implications. However, given the Queensland government's current stance against recreational hunting in state forests, there are a number of issues that need to be considered when advocating for access to public lands in Queensland. Careful deliberation on the issues discussed below is required in order to best promote the idea that recreational hunting in state forests can be of benefit to Queensland's environment and human population.

Evidence suggests that the effective management of pest animal populations requires motivating hunters to harvest sufficient animals of prescribed age and sex classes (Van Deelen et al. 2010). The current hunting culture in Australia, which has a strong focus on the harvest of large-antlered 'trophy' males, is unlikely to provide the pressure needed to reduce populations (Nugent et al. 2011). However, systems that promote the harvest both male and female deer, and deer from younger age classes, have the potential to exert a major influence on deer density (Nugent et al. 2011). Brown et al. (2000) found a strong preference for targeting trophy bucks for their antlers amongst sika deer hunters, while Fraser (1996) found that recreational deer harvests in New Zealand were strongly biased towards males. In contrast, commercial meat hunters in New Zealand took considerably younger deer on average than recreational hunters, resulting in commercial kills being of higher conservation value (Fraser 1996). Fraser (1996) concluded that recreational hunting as a management tool would be much more effective if hunters could be encouraged to shoot more females. Several jurisdictions in the USA regulate the sex ratio of deer harvests through 'earn-a-buck' programs, where hunters are required to harvest and register an antlerless deer before they are authorised to harvest an antlered buck (Van Deelen et al. 2010). These programs, combined with the introduction of supplementary antlerless-only seasons, have been highly efficient at reducing deer numbers. Advocating for the introduction of similar programs in Queensland state forests may go some way to demonstrating the pest management credentials of recreational hunting bodies and their members.

Previous efforts to use recreational hunters to reduce pest populations have sometimes been ineffective because too few hunters participated, or where too much land is inaccessible to recreational hunting (Conover 2001). Where hunting occurs at appropriate densities, recreational hunters can reduce populations below environmental carrying capacity and reduce damage to native vegetation, flora and fauna species, as has been the case in the USA (Conover 2001), and several parts of New Zealand (Fraser 1996, 2000). Populations of pest animals that already exist at or close to carrying capacity are more likely to be able to compensate for hunting mortality through increased reproductive output or survival (Bengsen et al. 2020). While comprehensive studies into the environmental carrying capacity of deer have not been conducted in Australia, the fact that populations are purportedly increasing indicates that carrying capacity has not been reached in most populations. Encouraging hunting within these populations is likely to produce population reductions as long as sufficient hunting pressure is maintained.

For hunting to both achieve conservation objectives and garner support from the public, there is a need for the recreational hunter population to become more knowledgeable about, and dedicated to, the role of hunting in managing deer numbers. If the hunting population can view themselves as implementors of deer management, more hunters are likely to vary their methods and expend extra effort to achieve pest management objectives (Brown et al. 2000). Braysher (2017) identified using operators who were trained in population management methods as one of seven elements for best practice for overabundant animal management.

Increased knowledge of the fundamentals of population management is likely to see greater harvest of female deer and younger age classes, which will have a greater impact on deer populations. Currently, deer are often selectively hunted to maintain viable populations and ongoing hunting opportunities, and some deer hunters in Australia have been reluctant to kill females due to their perceived importance as breeding stock (Bengsen & Sparkes 2016). A shift in hunting ethic which places greater focus on conservation and pest population management is more likely to result in the achievement of meaningful management objectives, promoting greater acceptance of recreational hunting as an integral tool for the management of pest animals on public lands.

An additional threat to the ability of recreational hunting to achieve effective population control is the use of an inconsistent pool of hunters with varying levels of skill and motivation (Bengsen et al. 2020). Not all recreational hunters are equally effective at contributing towards management objectives, and variability in the effort and effectiveness of individual hunters is likely to be an important factor in determining the number of deer killed, and consequently the overall effect on the population (Bengsen & Sparkes 2016). In the Otago region of New Zealand, Nugent (1988) found that only 15 percent of hunters reported killing one or more deer in the Blue Mountains Recreational Hunting Area in 1984-85. Of these, 3.5 percent of the total population of hunters were responsible for killing more than half of the total number of deer harvested (Nugent 1988). These hunters were among the most frequent users of the Recreational Hunting Area, and their success was attributed to greater hunting effort and a higher efficiency in finding and killing deer (Nugent 1988). This emphasises the importance of maintaining a core cadre of recreational hunters with both local experience and a proven commitment to operational objectives (Williams et al. 2013).

Studies from outside Australia suggest that distance and accessibility are important determinants of hunting pressure. Sites closer to relatively large population centres, or that have lower travel costs to access, tend to experience greater hunting pressure than more remote sites or those with limited or difficult access (Bengsen & Sparkes 2016). While hunters are generally willing to travel considerable distances for hunting opportunities, accessibility and the proximity of major roads are important factors contributing to the hunting pressure that can be brought to bear on species such as deer which inhabit vast, sparsely populated rural areas. Generally speaking, Queensland's state forests are well serviced by roads, due to the requirements to haul commercial timber harvests, which may facilitate access by recreational hunters. In addition, the vast majority of state forests occur within a few hours' drive of the coast, where the human population is concentrated, and are generally within a short driving distance of towns providing services such as fuel, accommodation and food.

Hunting pressure is also directly influenced by the level of hunter satisfaction obtained while hunting. Hunters tend to focus their efforts where deer numbers, and the potential for a successful hunt, are greatest (Fraser 2000). Harvest-oriented hunters generally seek either meat or trophies, and if the effort required to harvest an animal increases to the point where it is unrewarding due to decreased numbers of the target species, then hunting becomes unappealing (Bengsen et al. 2020). The result is that, when deer drop below a certain threshold, many hunters will either cease hunting until numbers increase, or focus their efforts on other areas (Fraser 2000). This pattern may undermine the role of hunting as a pest management tool, as maintaining at least some level of hunting intensity is required to maintain deer populations at low densities, and to prevent population recovery. Training and education that encourage hunters to self-identify as pest management agents may assist in maintaining satisfaction levels in areas where deer density and hunting success have fallen below what would normally constitute a defining threshold for hunter satisfaction.

## PART D: CONCLUSIONS AND RECOMMENDATIONS

The Queensland government's current stance, as evidenced by the Environment Minister's reply to a parliamentary petition tabled in 2019 to allow a trial of recreational hunting of deer in state forests, does not favour the introduction of recreational hunting on public lands. This contrasts markedly with the present situation in a number of other states in Australia, where recreational hunting is considered an integral component of the various potential uses for public lands, and an important tool for pest animal management. In an international context, recreational hunting is seen as a low-cost, effective strategy for reducing pest deer populations and the environmental, economic, and social damage they cause. The following paragraphs summarise the present state of knowledge of the implications of recreational hunting on public lands, and the potential impacts of allowing deer hunting in Queensland's state forests.

Deer populations in Queensland, and throughout Australia, are increasing in both number and geographical range. Deer have the potential to become a major pest in Australia through their impacts to the environment, agricultural productivity, households, and vehicle collisions, rivalling the negative impacts caused by feral pigs and goats. Current deer control measures have thus far been largely ineffective at stemming the spread of deer, and recreational hunting offers an economical alternative to other pest control measures. Several Australian studies have documented the environmental damage attributable to deer, which includes changes to the structure and diversity of vegetation communities, damage to plant species at the individual and population levels, a reduction in the quality of fauna habitat, increased erosion risk, and degradation of water sources. Given that Queensland's state forest network encompasses over three million hectares, which is for the most part remnant native vegetation, it is critical that the environmental impacts of deer are limited in these areas. Studies from abroad indicate that recreational hunting can play an important role in reducing the ecological effects of deer at the local to regional scale, but the potentially powerful population control mechanism of recreational hunting remains underutilised on Queensland's public lands.

While the negative economic impacts of deer in Queensland can be considered relatively low, it is uncertain what level this may reach if deer populations continue to spread and grow. Data from the USA suggests that deer have the potential to be major agricultural and forestry pests, contributing to approximately \$US1 billion dollars in damage and lost productivity in these sectors annually. Studies show that the cost of removing an individual deer using recreational hunters is less than a quarter of the expenditure of control by a government shooter or contracted hunter, which indicates that recreational hunting is a cost-efficient method of pest management. In addition, recreational hunting stimulates economic activity and licensing fees can potentially be used to combine recreational hunting with other forms of pest control for more effective population reduction, or to fund research into the ecology and impacts of deer, which remain poorly known in Australia. The economic contribution of recreational hunting on public lands contributes approximately 30 percent of the total economic value of hunting in New South Wales, and much of the economic activity generated by hunting is directed at regional communities, which historically have above average unemployment rates and lower than average economic growth in Queensland. The growth in hunter numbers, and consequently the contribution to the economy, has grown significantly in New South Wales and Victoria as a direct result of allowing hunting on public lands, suggesting that a similar pattern would result from recreational hunting in state forests in Queensland.

Recreational hunting promotes social interactions between members of the hunting fraternity, and fosters family and community cohesion. As hunting is conducted in the outdoors, it encourages a deeper connection with nature, which contributes to social wellbeing. Hunters typically report higher levels of wellbeing than non-hunters, and hunting has been

demonstrated to inspire participants to learn new skills, creating a sense of achievement and fostering mental resilience which can be transferred to other aspects of a participants' life. In many cases, hunting constitutes an activity which provides physical and health benefits that individuals may be unable to achieve by engaging in other pursuits. Hunting has particular health benefits for older males, who are prone to health-related risks associated with inactivity, as well as mental health issues ascribed to social isolation. Overall, hunting contributes significantly to avoided health costs among the hunting fraternity. Any increase in the hunting population, which would be promoted by allowing hunting in state forests, is likely to contribute significantly to the overall health and wellbeing of the Queensland community.

Despite the benefits of permitting hunting on public land, recreational hunting is likely to always face resistance from certain segments of the community. In Queensland, it appears that this attitude permeates to the highest echelons of government. Given the present government stance against recreational hunting in state forests, advocating for a change in legislation is likely to face numerous challenges. Based on the information outlined throughout this report, the following recommendations have been drafted to provide a series of focal points for the Australian Deer Association while advocating for access to Queensland's state forests for recreational deer hunters.

#### Recommendation 1: Promote recreational hunting as an effective form of pest management

The prevailing view of hunting is of an ad hoc exercise that may have little real impact on pest animal populations. However, when conducted appropriately and with suitable objectives, recreational hunting is a legitimate tool for pest population control. Studies demonstrate that with the right regulations and incentives, recreational hunting has the potential to reduce overabundant deer populations, allowing ecological recovery and decreasing negative economic and social impacts. Integral to this concept is a shift in hunting culture whereby recreational hunters begin to self-identify as pest managers, rather than trophy or meat hunters. By targeting more female deer, as well as deer in younger age classes, recreational deer harvests can exert sufficient pressure on deer populations to cause a lasting reduction in population size and density.

#### Recommendation 2: Provide education and training that focuses on population control

Training and education can facilitate the cultural shift required for recreational hunters to identify as pest management agents. Evidence shows that recreational hunters in Australia already have a strong conservation focus, and an increased knowledge of the basic principles of population dynamics is likely to improve hunter satisfaction, and thereby maintain hunting pressure, in situations where deer densities drop below levels that would normally see a decrease in hunting effort. The Australian Deer Association and other hunting organisations already provide a number of training courses for individuals or groups, and it would be a simple matter to expand this education to include pest management strategies. Any move allowing recreational hunting in Queensland's state forests is likely to require additional licensing, and this training could form a component of the licensing process.

#### Recommendation 3: Promote the positive benefits of hunting to the wider community

Community support is vital to the ongoing viability of hunting in Queensland and Australia. Case studies support the claim that local residents and the broader community are more likely to be accepting towards hunting when they perceive a threat to the environment, their health, or their livelihood from the pest species in question. The impacts of deer remain little studied in Australia, although data from overseas provides unequivocal proof of detrimental effects to the environment and agricultural production, as well as negative social and health impacts. Further studies into the local impacts of deer are likely to raise public awareness and shift

community perceptions of deer from a harmless component of Australia's fauna to an undesirable invasive species that causes damage to lives, livelihoods, and the environment. There is potential for this future research to be funded by licensing fees related to hunting on public lands, a strategy that has proved successful overseas.

#### Recommendation 4: Focus on the positive economic and social impacts of hunting

Recreational hunting is practiced by a large number of people in Australia, and contributes significantly to national, state and regional economies. Regional development is a key priority for the current Queensland government, given the growing unemployment rates in rural and regional areas throughout the state (2019-20). This is likely to have been exacerbated by recent events including bushfires and the Covid-19 epidemic, which have had serious impacts on economies of all scales throughout Australia. Permitting access to public lands in other states has resulted in an ongoing increase in the recreational hunting population, with concurrent increases in the positive economic impacts of the sport. A large portion of the economic contribution of recreational hunting on public lands in New South Wales and Victoria is directed at regional areas, and allowing recreational hunting in Queensland's state forests is likely to stimulate economic growth and employment opportunities in several regional areas within the state. In addition, increased recreational hunting opportunities will increase the positive social and health impacts of hunting, which permeate through families and communities. Recreational hunters exhibit high social wellbeing, form strong connections to nature, and participate in a range of conservation-focused activities, having a positive overall impact on their social networks and communities.

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