

# Conservation Hunting and its role in game and feral animal management: A response to papers by the Invasive Species Council of Australia

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## Introduction

Recent articles by the Invasive Species Council of Australia (ISC) through their policy officer Dr Carol Booth have raised doubts about game management and Conservation Hunting as a legitimate tool for the management of game and feral animals in Australia. Dr Booth, (who has a Humanities-based doctorate) appears to be prosecuting the ISC's agenda with an emotive mix of anti-gun fervour and green politics with little focus on science, common-sense, or basic wildlife management principles. This paper in contrast aims to present a scientifically-based and balanced view on game and feral animal management and the legitimate role that Conservation Hunters play in this area of expertise both in Australia and overseas. The authors of this paper are well qualified to present this view having a combined experience in the animal production, veterinary science, and wildlife management fields of some 70 years including over 80 peer reviewed scientific publications.

This paper will first address the ISC's paper titled "A Deer Mistake" and debunk the ISC's unrealistic and unscientific view on deer management in Australia. It will next focus on the ISC's papers titled "Is recreational hunting effective for feral animal control?" and "Is Hunting Conservation?" and provide examples of Conservation Hunters at the forefront of conservation both in Australia and internationally.

## The great deer debate

A deer is not a deer according to the ISC in its critique titled "A deer mistake". In this document, there seems to be much confusion about what type of deer are wild in Australia as well as their impacts and management. The title page of this report depicts a White-tailed deer (*Odocoileus virginianus*) (a common species in North America but not present in Australia). The offending white-tailed deer makes another appearance on page seven of the original report incorrectly described as a red deer (*Cervus elaphus*) (an oversight eventually recognised by the ISC and corrected in later versions). This confusion appears to have spread throughout much of the rest of the document, particularly with regard to deer impacts relative to other introduced animal species and the role of Conservation Hunters in deer management.

### ***Deer impacts in context***

Deer, like any herbivore, can impact environmental, agricultural or community values when their populations increase to unsustainable levels (Caughley 1977; Chaplin 1977; deNahlik 1987; McShea *et. al* 1998; Augustine 1998; Nugent *et. al* 2001). Several studies have provided evidence that deer can impact native and agricultural systems in Australia (Moriarty 2004a, b; Peel *et. al* 2005; Lindeman and Forsyth 2008). There is, however, no evidence that “deer wreak as much harm as feral goats or feral pigs” in Australia as claimed by the ISC. This type of emotive generalisation clearly demonstrates the ISC’s lack of understanding of game and feral animal impacts in Australia and their lack of knowledge of the literature. All animal impacts are relative to the environments they inhabit, the species they affect and the land area they occupy. In a recent Invasive Animal CRC report titled “Assessing Invasive Animals in Australia” (Anon 2008) it was estimated that feral pigs occupy 45% of the Australian landmass and caused \$106.5 million worth of damage to agriculture and the environment. Similarly, feral goats occupy 28% of Australia and cause \$7.7 million worth of damage each year. Deer species were reported to occupy 8.8% of the continent however their impacts were not quantified. In a similar report on the cost of invasive animals in Australia, deer were not even included in the top 11 pest animals estimated to impact agricultural production and the environment in Australia (McLeod 2004).

The scientific evidence put forward by the ISC on deer impacts also needs to be interpreted cautiously. It is generally accepted that in order to obtain viable scientific evidence of ecosystem changes attributed to deer, long-term fenced enclosure studies are required (Jane and Pracy 1974; Mills 1983; Allen *et al.* 1984; Smale *et al.* 1995). This is particularly the case in Australia where the presence of numerous sympatric herbivores in most areas confounds any other type of study and limits them to draw conclusions about potential causal associations between deer and the environment (see Bennett and Coulson 2008). For example, in the study most cited by the ISC as evidence of deer impacts (Peel *et. al* 2005), it is confidently reported that “Threatening processes instigated or maintained by Sambar include: loss of individual taxa, altered vegetation structure and massive widespread removal and prevention of regeneration, which is now resulting in the loss of plant communities in some areas”. Let us now examine the evidence for these serious claims. The methodology used by Peel *et. al* (2005) is described as an observational rationale whereby the authors observed deer sign in the same location as supposed deer damage at different height classes. The limitations of such a technique are quite obvious. The authors show that hog and sambar deer are the likely causal agents of damage above a height that was recorded for other sympatric native herbivores (mainly swamp wallabies). However, what is the rate of the damage caused by deer and how does this compare to damage caused by native herbivores? Processes within ecosystems are never as simple as they seem. Even if deer are removing plant material from an area, does this situation equate to catastrophic damage as reported by Peel *et al.* (2005)? Australian plant species have evolved with browsing animals and therefore have evolved strategies to cope with herbivory (Recher *et. al* 1986, Augustine 1998). The focus of deer impact studies in Australia should concentrate on changes in the density of deer and associated changes in ecosystems over time (see Jane and Pracy 1974; Mills 1983; Allen *et al.* 1984; Smale *et al.* 1995) and not rely on the over-interpretation of simple observational data.

Peel *et. al* (2005) fail to provide a balanced and realistic context for the damage they observed. The observational information collected during this study was not gathered in a rigorous scientific manner and conclusions drawn by the authors were dramatically overstated and did not reflect the limitations of the methodology used, but instead highlight the author’s obvious interpretational bias. Of greater concern is the fact that much of the information contained in Peel *et. al* (2005) was used as the basis for listing sambar deer (*Cervus unicolor*) as a threat to biodiversity in Victoria under the *Flora and Fauna Guarantee Act 1988*.

### ***Can Conservation Hunters help to effectively manage new and established deer populations?***

Much of the ISC's rhetoric regarding Conservation Hunters and deer management appears to be based on perception rather than common-sense and fact. Hunting has never professed to be a silver bullet in the management of deer populations. However, when used as part of a strategic program to control new deer populations or as part of a coordinated approach to managing larger established deer herds, Conservation Hunters can and do make a significant contribution.

New deer populations are a challenging issue for land managers in Australia (Moriarty 2004). The introduction of standards and legislation to effectively combat this issue has been developed in some States (for instance the NSW *Game and Feral Animal Control Act 2002* and *Deer Act 2006*). Pro-active detection and control strategies have also been adopted, similar to those in New Zealand (Fraser *et. al* 2003). In NSW, Conservation Hunting Groups (CHGs) organised by the Game Council have been used to effectively manage the impacts of localised deer populations. For example, in 2008 a CHG removed 49 out of a suspected 50 animals that were impacting areas around the Cowra Japanese Gardens and hospital. All deer were removed humanely with marksmen involved in the program having to meet stringent accuracy and welfare standards. The Conservation Hunters involved in this program were given an award by the local Council for their efforts and praised for the safe and professional outcome of the project. This situation shows that the management of deer and other wild animals does not need to be solely the domain of paid professionals. Organised and structured groups of volunteer Conservation Hunters under the direction of Government agencies like the Game Council NSW are making a professional, safe and positive contribution.

The management of larger existing deer populations presents a different set of challenges for land managers. Conservation Hunting in the context of managing established deer herds should be looked upon as a tool among several others that can be used to help manage deer populations. This was acknowledged in a NSW Parliamentary inquiry into feral animals in 2002 (Anon. 2002). Strategies which rely on hunting as a stand-alone management technique should set achievable management targets within this context. Hunting has been shown to be a very effective secondary management strategy to help contain deer populations and maintain them to moderate population density. For example, in the Kaimanawa Recreational Hunting Area in New Zealand, it was concluded that "hunting pressure was sufficient to contain the deer population and maintain a forest canopy" (Fraser and Speedy 1997).

As described above, studies reporting deer impacts do not indicate that deer have impacts in every area of Australia where they occur. What they do show is that deer populations in sensitive areas need to be carefully managed to reduce their impacts to an acceptable level. In the case of native ecosystems, a risk analysis of where deer are most likely to impact threatened species and ecological communities can be completed relatively quickly and provide governments with a strategic and cost-effective model to start to manage deer in these areas (Moriarty in press). This type of approach needs to be supported by credible and long-term monitoring of deer impacts to assess the effectiveness of management programs. Where deer impacts are the greatest, intensive Government-funded control programs may be warranted in these areas (see Nugent and Choquenot 2004).

In less sensitive areas such as well-conserved habitats in conservation reserves, a more modest investment in deer control may be required to reduce their impacts to an acceptable level. In these areas, a combination of Conservation Hunters and Government funded control programs may be used in conjunction with each other to achieve management objectives. In other areas where deer are present in melded agricultural landscapes on private land, deer can be managed as a game resource. If deer impacts on the environment, agriculture, or public safety in these

areas becomes unacceptable, then the harvest of deer in these areas can be altered to mitigate these impacts.

In summary, deer like other herbivores in Australia, can have negative impacts on the environment, agriculture and community values. However, their impacts in Australia compared to other introduced animals are relatively insignificant. Where deer populations have a high-risk of impacting threatened species and ecological communities, Government-funded control operations may be required to mitigate these impacts. Where deer are present in well-conserved native habitats and melded agricultural landscapes, an opportunity exists to manage deer in these areas as a game resource within an adaptive framework which allows for harvest strategies to be altered to mitigate any deer impacts.

## **The role of Conservation Hunting in game and feral animal management**

Conservation Hunting is not a new concept in the fields of wildlife management and conservation biology. Aldo Leopold, described as “the father of conservation” was an avid hunter. Leopold authored two of the most influential books on hunting (Game Management) and conservation (A Sand County Almanac) (Leopold 1937; 1949). In both publications, the efforts of hunters as conservationists are well-documented. Even the ISC’s Dr Carol Booth acknowledges Leopold’s significant contribution to conservation, citing his work numerous times in her PhD thesis. However she also conveniently ignores the fact that Leopold was a committed and fervent hunter. Leopold’s dictum of wildlife management was based on a scientific approach of wise and sustainable use of wildlife resources, a sentiment echoed by many of the world’s eminent wildlife scientists for more than half a century (Frith 1972; Krebs 1985; Caughley and Sinclair 1994) and recognised by the world conservation union (IUCN 2008).

More recently, the concept of “wise use” has been embraced by wildlife scientists in Australasia (Ramsay 1994; Aslin and Norton 1995; Webb 1996; English 2008) Wise use encompassing game management is now an accepted alternative to protectionist policies and management strategies (English 2008). Game management utilising the efforts of Conservation Hunters to help manage the impacts of both game and feral animal species has now been implemented in three States in Australia and is at the forefront of efforts to promote the sustainable use of wildlife resources (Hall 1999; Hall and Gill 2005; English 2008).

The ISC have failed to embrace the concepts of wise use, game management, Conservation Hunting or common-sense in their recent essay projects and critiques titled “Is recreational hunting effective for feral animal control?” and “Is Hunting Conservation?”. In both publications, emotive and sweeping generalisations about hunting, feral animal control and conservation are common. In particular, the ISC fails to understand the contribution of hunting to conservation and the management of game and feral animals, the role of Conservation Hunting in strategic cooperative game and feral animal management programs, and the motivations of hunters as conservationists. Other advantages of hunting ignored by the ISC, like the economic, emergency disease management and animal welfare benefits of hunting will also be discussed.

### ***The contribution of hunting to conservation and game and feral animal management***

Internationally, hunting is recognised as a key component of many conservation initiatives in many different countries. So important in fact that it was the focus of a large international conference titled “Recreational Hunting, Conservation and Rural Livelihoods: Science and Practice” held in London in October 2006 (Dickson *et. al* 2009). This conference brought together the world’s top conservation biologists, environmental economists, environmental

planners and wildlife ecologists. A central theme of the conference was the contribution of regulated hunting to conservation of endangered species, alternative income streams for rural and third world economies, and sustainable wildlife utilisation.

Hunters making a difference in conservation projects is not limited to international examples. In Australia, Conservation Hunters have also made significant contributions to game and feral animal management and conservation. The most prolific example of this is the role of Conservation Hunters in Operation Bounceback in South Australia's Flinders Ranges. A program also acknowledged by the ISC as successfully utilising hunters in conservation (an acknowledgment in contradiction to many of their previous claims about hunting and its effectiveness). Operation Bounceback has successfully seen the restoration of many of the degraded ecosystems of the Flinders Ranges through an integrated approach, based on community and government partnerships, including Conservation Hunters. One of the program's most important achievements has seen populations of the endangered Yellow-footed Rock Wallaby stabilise after the removal of foxes, feral cats, and feral goats (Norris *et. al* 2005). In addition, this cooperative community-based approach to conservation, involving Conservation Hunters is recognised in the consultation draft of Australia's Biodiversity Conservation Strategy 2010-2020 (Anon. 2009).

In the essay project titled "Is recreational hunting effective for feral animal control?" the ISC postulates that feral animal numbers are quickly replaced by higher reproductive rates and emigration. This situation may arise in sporadic one-off control campaigns, like those conducted by many Government agencies (see Reddiex *et. al* 2006). However, most feral animal control operations conducted by Conservation Hunters are sustained over long periods of time. This sustained hunting provides limited opportunities for game or feral animal populations to maintain or expand their numbers. For example, in New Zealand more than two-thirds of that country's 70,000 red deer harvest was attributed to hunters and in many locations it was shown that hunters reduced fallow deer numbers to acceptable levels and maintained these low levels over extended periods of time (Nugent 1988; Nugent and Fraser 1993). In a similar situation, hunters successfully limited the expansion of four introduced ungulate species in New Mexico (Morrison 1985).

### ***Conservation Hunting as part of a cooperative and coordinated approach to game and feral animal management in Australia***

In the document titled "Is recreational hunting effective feral animal control?" the ISC cleverly plays hunting off against professional feral animal control. However should the focus of the debate be about the best control method and their relative strengths and weaknesses? Or should it be about how both Government and private feral animal control operators and Conservation Hunters can work together to mitigate the impacts of game and feral animals on agriculture, the environment and community values? As discussed previously, Conservation Hunting should be used as part of a number of strategies to manage game and feral animal populations (see Braysher 1993; Anon. 2009).

The ISC's focus on the costs associated with hunting is yet another example of how this group chooses to focus on specific examples and then blows them out of proportion without putting them into context (see section "Deer impacts in context" above). In the ISC's critique titled "Is hunting Conservation?" they single out the Game Council's costs as a taxpayer expense which could be recycled into feral animal management. However, they also fail to produce figures on the cost of taxpayer-funded Government and professional control operations and compare these costs to those of the Game Council. For example, for the year 2006–07, The NSW Department of Environment and Climate Change (DECC) spent \$4.5 million of taxpayer's money on pest

animal control in National Parks, not including salaries (Anon. 2006). For the equivalent year, the Game Council's total Government funding was \$250,000.

The ISC has also singled-out the uncoordinated nature of Conservation Hunting as a game and feral animal management tool to be of concern. In many instances, more strategic channelling of Conservation Hunters towards areas where game and feral animal impacts are greatest is required. However, many Government and professional game and feral animal control operations are guilty of the same mistake. For example, in a review of how feral animal control operations were conducted in Australia, it was shown that of 1306 pest control operations undertaken by Government agencies in Australia between 1990 and 2003 the majority (67.5%) consisted of a single treatment without monitoring of either the pest or biodiversity (Reddiex *et. al* 2006).

### ***The motivations of hunters as conservationists***

Conservation Hunters contribute to conservation in two main ways. Firstly, through the direct funding and involvement in conservation projects. Funding by hunting groups like the Safari Club International (SCI) contributes significant resources to conservation projects around the world. SCI currently funds 57 conservation projects to the tune of \$US2 million (SCI 2009). Some of these projects include the re-introduction of moose to areas of mainland USA, the breeding and reintroduction of Andean condors in Argentina, and the funding of anti-poaching initiatives in Zambia. A similar but smaller scale arrangement is evident in Australia with organisations like Field and Game Australia organising, funding, and carrying-out projects to restore wetlands and grasslands for game bird species and carrying-out fox control operations in and around threatened species habitat (Field and Game Australia 2009).

The second major contribution of hunting to conservation is by providing an economic basis for rural and under-developed communities to conserve and value wildlife. For example, in Northern Pakistan, hunting has been critical to the recovery of two endangered mountain ungulates (Suleiman Markhor, Afghan Urial). Frisia *et. al* (2009) concluded that hunting has been critical to the recovery of these two species through support for a game guard program and by impressing upon the local people that their economic well-being is directly tied to the abundance of Markhor and Urial. In a similar example in Uganda, hunters have been successful in establishing several National Parks and game reserves to allow the reintroduction of hunting and more protection for dwindling wildlife populations from poachers. Other significant benefits reported include the enriching of local communities from hunting revenues, which have been used to undertake community projects (Lamprey and Mugisha 2009).

These are only a few examples that show that hunters in general are committed conservationists, a fact that the ISC fails to consider in their various critiques and essay projects attacking Conservation Hunting. In the paper titled "Is Hunting Conservation?" the ISC bases its arguments around unfounded generalisations of how hunters and conservation have conflicting motivations. Specifically, the ISC claims that Hunters have vested interests in maintaining and spreading feral animals and hunters cause collateral damage and worsen feral animal problems.

As with all groups, there is a minority which choose to flout the law, hunters are no different. Green groups and animal liberation groups have similar issues with a lawless element who prefer to chain themselves to bulldozers, ram ships on the high seas, or break into private farms under the pretences of animal freedom. In NSW, legislation aimed at regulating hunting has provided the framework for Game Council Game Managers and Police to enforce standards on those hunters who wish to continue to do the wrong thing. Initial indications show that this approach is successful in NSW with several high-profile prosecutions completed and numerous

penalty infringements issued for illegal hunting. Similar legislation in other States will likely result in similar successes.

The ISC's notion of collateral damage caused by hunting in its essay project titled "Is recreational hunting effective feral animal control?" are consistent with the narrow and unsubstantiated claims in its other critiques and essays. Several statements border on discrimination, for example the claim that "Other damage occurs when hunters fail to exercise care for the environment ... if they dump rubbish, drive off road, damage fences, leave carcasses or shoot native species". Once again the ISC needs to produce evidence of this collateral damage and report it in the context of such damage caused by other outdoor recreation users and the general public.

### ***Hunting economics***

Hunting not only contributes to conservation in Australian and internationally, but it is also a critical component of many economies, especially in under-developed and regional areas. For example, in poorer rural areas of Botswana, hunting tourism allowed 14 community-based safari hunting enterprises to make more than \$8.45 million in 2002 and has also created employment opportunities for many local people (Mbaiwa 2004). In the United States, hunting generates more than \$67 billion in economic output and more than one million jobs (IAFWA 2002). In New Zealand, hunters were estimated to contribute more than 4.4 million hunter days, harvesting around 6.5 million game and feral animals, and spent more than \$100 million annually on hunting (Nugent 1992). In NSW, conservation hunting is estimated to contribute \$40 million annually to regional economies (Game Council 2008). In 1990, a Master's thesis by Myron Cause showed that deer hunters alone in Australia spent more than \$75 million annually on travel, equipment and accommodation related to this pastime (Cause 1990).

### ***Hunting, emergency disease management and animal welfare***

Conservation Hunters can also make a major contribution to the community through animal disease surveillance and control activities and by helping to relieve the suffering of animals, particularly during natural disasters. For example, in the US, hunters are heavily involved in the detection and management of Chronic Wasting Disease in native deer populations (DEP 2009). At the United Nations Environment Program Convention on Migratory species, it was acknowledged that "Hunters and their national and local organisations have an important role to play in detecting and reporting any new disease outbreaks as well as supporting Governments and conservation organisations in the additional research and monitoring likely to be required over an extended period" (Kanstrup and Walscheid 2005).

In Australia, it is acknowledged that Conservation Hunters could play a major role in the event of an exotic disease outbreak like Foot and Mouth Disease (Game Council 2007). A situation also recognised by The Victorian Department of Sustainability and Environment which states that "Duck hunters can play an important role in the surveillance and reporting significant wildlife diseases, including the Avian Influenza H5N1 virus (DSE 2007).

Conservation Hunters in Australia are also a significant animal welfare resource, particularly after natural disasters like floods, drought and fires. For example, hunters were involved in the relief of animal suffering in the aftermath of the recent Victorian Bushfires. In this instance Sporting Shooters Association of Australia hunters humanely euthanased over 100 suffering native animals including kangaroos, wallabies and wombats (Cusick 2009).

## Conclusion

The ISC's attempts to discredit hunting as a legitimate form of conservation and wild animal management in Australia has failed to provide a logical, balanced or scientific context for their claims. Instead the ISC has highlighted to the greater scientific community their lack of knowledge of game and feral animal management and their obvious prejudice against hunting and hunters in this country. The ISC would be far better to invest its time and energy into developing a more constructive, common sense and cooperative approach towards Conservation Hunters for the betterment of Australia environmentally, socially and economically.

This paper has shown that when examined in a balanced and scientific manner, the role of hunters as conservationists and managers of game and feral animals in Australia and overseas is well established. Specifically hunters can play a major role in the management of new deer populations and contribute through a cooperative approach with landholders and Government agencies to help manage larger deer herds sustainably. As shown by Operation Bounceback and other examples, Conservation Hunters can be a major conservation asset in the management of game and feral animals in Australia, particularly when deployed in a strategic manner and as part of a whole of community approach. Conservation Hunters also contribute significant funds to rural communities in Australia and also have the potential to provide valuable services to the community in the form of animal welfare related assistance during natural disasters and animal disease outbreaks. Internationally hunters contribute significantly to conservation by committing resources and funds to a wide range of projects involving threatened species, habitat restoration and the education of rural and remote communities about the value of wildlife and wild places. Without this contribution, conservation and wildlife management globally would be far worse off.

## References

- Allen, R., Payton, I.J. and Knowlton, J.E. (1984) Effects of ungulates on structure and species composition in the Urewera forests as shown by exclosures. *New Zealand Journal of Ecology*, 7: 119-130.
- Anon. (2002) *NSW Legislative Council Inquiry into Feral Animals*. New South Wales Parliament. Legislative Council. General Purpose Standing Committee No. 5. Sydney NSW.
- Anon. (2006) *Protecting Our Parks from Pest and Weeds*. Department of Environment and Climate Change, NSW, Hurstville NSW.
- Anon. (2008) *Assessing Invasive Animals in Australia 2008*, National Land & Water Resources Audit (NLWRA) and Invasive Animals Cooperative Research Centre, Canberra.
- Anon. (2009) *Australia's Biodiversity Conservation Strategy 2010-2020* (National Biodiversity Strategy Review Task Group 2009), Canberra ACT.
- Aslin, HJ and Norton, TW (1995). No one answer – sustainable use of wildlife in a multicultural society. In *Conservation Through Sustainable Use of Wildlife*, Grigg, G, Hale, P and Lunney, D (Eds.). The University of Queensland Press, Brisbane Qld 4067.
- Augustine, D.M.S. (1998) Ungulate effects on the functional species composition of plant communities: Herbivore selectivity and plant tolerance: *Journal of Wildlife Management*, 62: 1165-1183.

- Bennett, A. and Coulson, G. (2008). Evaluation of an exclusion plot design for determining the impacts of native and exotic herbivores on forest understoreys. *Australian Mammalogy* 30: 83–87.
- Braysher, M. (1993). *Managing Vertebrate Pests: Principles and Strategies*. Bureau of Resource Sciences, Canberra.
- Chaplin, R.E. (1977) *Deer*. Blandford Press, Dorset, UK.
- Caughley, G. (1977) *Analysis of Vertebrate Populations*. John Wiley and Sons, London, New York, Sydney, Toronto.
- Caughley, G. and Sinclair, A. R. E. (1994). *Wildlife Ecology and Management*. Cambridge, Mass., Blackwell Scientific.
- Cause, M. (1990) *Economic Values of Recreational Deer Hunting in Australia*. MSc thesis, Griffith University Brisbane Qld.
- Cusick, S. (2009) *Hunters brought in for bushfire cull*. Website accessed 6.6.09.  
<http://news.ninemsn.com.au/national/bushfires/759594/hunters-brought-in-to-destroy-injured-animals>
- de Nahlik, A.J. (1987) *Wild Deer Culling, Conservation and Management*. Ashford Press Publishing. South Hampton, UK.
- Department of Environment (DEP) (2009) *CWD Not Found in Pa. Hunter-Killed Deer Samples. Department of Environment, Pennsylvania Update*. Website accessed 9.06.09.  
<http://www.depweb.state.pa.us/news/cwp/view.asp?Q=502995>.
- Dickson, B., Hutton, J., Adams, W.M. (2009) *Recreational Hunting, conservation and rural livelihoods*. Wiley-Blackwell Publishers, London, UK..
- DSE (2007) *Game Hunting in Victoria: What hunters need to know about Avian Influenza*. Department of Sustainability and Environment, Victoria.
- Ehrlich, P.R and Erlich, A.H. (1981) *Extinction: the causes and consequences of the disappearance of species*. Random House, NY.
- English, A.W (2008) *Conservation Biology and the utilisation of wildlife in Australia*. University of Sydney, Camden, NSW.
- Field and Game Australia (2009) Field and Game Australia Website. <http://www.fga.net.au/>. Website accessed 11.06.09.
- Fraser, K.W. and Speedy, C.J. (1997) *Hunting pressure, deer populations and vegetation impacts in the Kaimanawa ranges hunting area*. Department of Conservation Report, NZ.
- Fraser, K.W., Parkes, J.P. and Thomson C. (2003). Management of new deer populations in Northland and Taranaki. *Science for Conservation* 212 Department of Conservation NZ.
- Fresina, M.R. and Tareen, S.N.A. (2009) Exploitation prevents extinction: A case study of Himalayan sheep and goats. In Dickson, B, Hutton, J, Adams, W.M. (Eds.) *Recreational Hunting, Conservation and Rural Livelihoods*. Wiley-Blackwell Publishers, London, UK.

- Frith, H.J. (1973) *Wildlife Conservation*. Angus and Robertson, Sydney.
- Game Council NSW (2007) *Hunter Education Handbook*. Game Council NSW, Orange NSW.
- Game Council NSW (2008) *Public Benefit Analysis*. Unpublished report, Game Council NSW Orange, NSW.
- Hall, G (1999) *Introduction to Quality Deer Management*. DPIWE Launceston, Tasmania.
- Hall, G. and Gill, K.P. (2005) Management of wild deer in Australia. *Journal of Wildlife Management* 69 (3) 837-844.
- IAFWA (2002) *Economic Importance of Hunting in America*. International Association of Fish and Wildlife Agencies. Report, Washington, DC.
- IUCN (2008) A 2020 vision for IUCN: *A Global Union for Sustainability*. International Union for the Conservation of Nature. Bonn Germany.
- Jane, G.T. and Pracey, L.T. (1974) Observations on two animal enclosures in Haurangi forest over a period of 20 years. *New Zealand Journal of Forestry* 19: 102-13.
- Kanstrup, N. and Wollscheid, K. (2005) The role of hunters and hunting in management of diseases spread by wildlife. In: *Proceedings of the UNEP-CMS Roundtable on Wildlife Diseases*, Nairobi, 19th November 2005.
- Krebs, C.J. (1985) *Ecology: The experimental analysis of distribution and abundance*. Third Edition. Harper Collins, New York, USA, 800p.
- Lamprey, R.H. and Mugisha, A. (2009) The re-introduction of recreational hunting in Uganda. In: Dickson, B, Hutton, J, Adams, W.M. (Eds.) *Recreational Hunting, Conservation and Rural Livelihoods*. Wiley-Blackwell Publishers, London, NSW.
- Leopold, A. (1933) *Game Management*. Natraj Publishers, New Delhi.
- Leopold, A. (1948) *A Sand County Almanac*. Oxford University Press. Oxford, London, New York.
- Lindeman, M.J. and Forsyth, D.M. 2008. *Agricultural Impacts of Wild Deer in Victoria*. Arthur Rylah Institute for Environmental Research, Department of Sustainability, Victoria.
- Mbaiwa, J.E. (2004) The socio-economic benefits and challenges of a community- based safari hunting tourism in the Okavango Delta, Botswana. *The Journal of Tourism Studies* Vol. 15, No. 2, 37-50.
- McLeod R (2004). *Counting the Cost: Impact of Invasive Animals in Australia 2004*. Cooperative Research Centre for Pest Animal Control, Canberra.
- McShea, W.J., Underwood, H.B. and Rappole J.H. (1997) *The Science of Overabundance: Deer Ecology and Population Management*. Smithsonian Institute Press, London.
- Mills, J.N. (1983). Herbivory and seedling establishment in post fire southern California. *Oecologia* 60: 267-70.

Moriarty, A.J (2004)a. Liberation, distribution, abundance and management of wild deer in Australia. *Wildlife Research*, 31:291-299.

---. (2004)b. *Ecology and Environmental Impact of Javan Rusa Deer (Cervus timorensis) in the Royal National Park*. PhD Thesis University of Western Sydney, Richmond, NSW, Australia.

Moriarty, A.J. (in press) A review of the ecology of wild deer species in Australia. *Australian Zoologist*. 00: 00-00.

Morrison, B. (1985) Harvest strategies to control exotic ungulate populations in New Mexico. In: S.R.S. Beasome (Ed.) *Game Harvest Management: Proceedings of the 3rd International Symposium of the Caesar Kleberg Wildlife Research Institute, Texas A and M University*. Caesar Kleberg Wildlife Research Institute, Texas. Pp 261-267.

Murray, M. G. and Brown, D. (1993). Niche separation in the Serengeti: an experimental test. *Journal of Animal Ecology* 62: 380-389.

Myers JH, Simberloff D, Kuris AM, Carey JR (2000). Eradication revisited: dealing with exotic species. *Trends in Ecology and Evolution* 15:316-320.

Norris, A., Low, T., Gordon, I. Saunders, G. Lapidge, S., Lapidge K. Peacock, T. and Pech, R.P. (2005) *Review of the Management of Feral Animals and Their Impact on Biodiversity in the Rangelands*. A resource to aid NRM Planning. Pest Animal Control CRC, Canberra.

Nugent, G. (1988) Successful control of fallow deer by recreational hunters in the Blue Mountains, Ottago. *New Zealand Journal of Forestry Science* 18: 239-51.

Nugent, G. (1992) Big game, small game, and game bird hunting in NZ: Hunting effort, harvest and expenditure in 1988. *New Zealand Journal of Zoology*. 19:75-90.

Nugent, G. and Fraser, K.W. (1993) Pests or valued resource? Conflicts in deer management. *New Zealand Journal of Zoology*. 20:361-366.

Nugent, G., Fraser, W. and Sweetapple, P. (2001) Top down or bottom up? Comparing the impacts of introduced arboreal possums and terrestrial ruminants on native forests in New Zealand. *Biological Conservation* 99: 65-79.

Nugent, G. and Choquenot, D. (2004) Comparative cost-effectiveness of commercial recreational and state funded deer hunting for conservation purposes. *Wildlife Society Bulletin*, 32(2) 481-492.

Peel, B., Bilney, R. J., and Bilney, R. J. (2005) Observations of the ecological impacts of Sambar *Cervus unicolor* in East Gippsland, Victoria, with reference to destruction of rainforest communities. *Victorian Naturalist* 122, 189–200.

Ramsay, B.J. (1994) *Commercial Use of Wild Animals*. Bureau of Resource Sciences, Australian Government Publishing Service, Canberra.

Recher, H., Lunney, D. and Dunn, I. (1986) *A Natural Legacy: Ecology in Australia*. Singapore National Printers, Singapore.

Reddiex, B., Forsyth, D.M., McDonald-Madden, E., Einoder, L.D., Griffin, P.A., Chick, R.R. and Robley, A.J. (2006) Control of pest mammals for biodiversity protection in Australia. I. Patterns

of control and monitoring. *Wildlife Research*, 33, 691–709.

Safari Club International (SCI) (2009) Safari Club International website.  
<http://www.safariclub.org/>. Website accessed 11/6/09.

Smale, M.C., Hall, G.M.J. and Gardner R.O. (1995) Dynamics of Kanuka (*Kunzea ericoides*) forest on South Kaipara spit, NZ, and the impact of Fallow deer (*Dama dama*). *New Zealand Journal of Ecology*. 19 (2):131-141.

West, P. and Saunders, G. (2007) *Pest Animal Survey 2004-06. An analysis of Pest Animal Distribution and Abundance Across NSW and the ACT*. NSW Agriculture, Orange.

Webb, Grahame J.W. (1996). Sustainable use of wildlife. In *Exploiting Our Native Fauna-Culling, Harvesting, Farming?* Symposium of the Australian Institute of Biology Inc., Adelaide September 1996, pp. 3-11.