

Management Program for the Magpie Goose (*Anseranas semipalmata*)



in the Northern Territory of Australia, 2009–2014



Management Program for the Magpie Goose (*Anseranas semipalmata*) in the Northern Territory of Australia, 2009–2014

Parks and Wildlife Service of the Northern Territory

Department of Natural Resources, Environment, The Arts and Sport

PO Box 496

Palmerston NT 0831

© Northern Territory of Australia, 2009

This work is copyright. It may be reproduced for study, research or training purposes subject to an acknowledgment of the sources and no commercial usage or sale. Requests and enquires concerning reproduction and rights should be addressed to Senior Scientist, Parks and Wildlife Service, PO Box 496, Palmerston, Northern Territory, 0831, Australia.

Citation

Delaney R., Fukuda Y. and Saalfeld, K. (2009). Management Program for the Magpie Goose (*Anseranas semipalmata*) in the Northern Territory of Australia, 2009–2014. Northern Territory Department of Natural Resources, Environment, the Arts and Sport, Darwin.

A management program prepared under the *Territory Parks and Wildlife Conservation Act*.

Acknowledgments

Peter Whitehead, Tony Bowland and Tony Griffiths provided invaluable comments on drafts of this program.

ISBN 978 1 921519 06 2

Front cover: Magpie Geese by Peter Whitehead

Executive summary

The four principal objectives of the Management Program are to:

1. Maintain viable wild populations of the Magpie Goose.
2. Promote the long-term protection of the wetland habitats on which Magpie Geese and other wetland fauna depend.
3. Facilitate, where appropriate, the sustainable use of Magpie Goose populations.
4. Provide ongoing refinement of Magpie Goose management through timely evaluation of management prescriptions and performance.

This five-year Management Program is designed to manage the wild population of Magpie Goose as required under the Territory Parks and Wildlife Act, and broadly includes managing sustainable hunting and harvesting. The Management Program is not designed to deal with the detailed issues associated with permits, hunting and hunting reserves. To address this discrepancy, NRETAS will develop and implement a Waterfowl Hunting Plan, that addresses both on-and off-reserve waterfowl hunting. In addition to the core action of the declaration of the waterfowl hunting season, the Waterfowl Hunting Plan will also address the issue of access to public land for waterfowl hunting, the interaction of waterfowl hunters and the residents of rural areas where waterfowl hunting occurs, and any commercial activities associated with waterfowl hunting. The Hunting Plan will be developed by the end of 2011 in association with stakeholders and will be consistent with the current Management Program.

The Magpie Goose (*Anseranas semipalmata*) is found in Australia and the southern lowlands of West Papua and Papua New Guinea. Its range has contracted from the south-east since European settlement in Australia. Magpie Geese are most abundant in the Top End of the Northern Territory with population estimates ranging from 1 million to more than 2 million birds. High rates of recruitment are possible with nesting success closely tied to rainfall conditions.

Numbers are highest in the floodplains of the western Top End. Approximately 30% or about 1,400 km² of key Magpie Goose floodplain habitat lies within existing parks and reserves, most notably the proposed Mary River National Park and Kakadu National Park.

The *Territory Parks and Wildlife Conservation Act* protects the Magpie Goose. The species is similarly protected in all other jurisdictions in Australia and is listed as a marine protected species at the Federal level.

Magpie Geese have very high socio-economic values in the Top End with an iconic value for residents and visitors alike. It is a totemic animal for Aboriginal people as well as an important seasonal source of food. Other sections of the community see hunting as important with a tradition of such harvest since the early 1900's.

A maximum of 60,000 birds per annum is estimated to be harvested by Aboriginal people as a traditional food source and a further 20,000 – 40,000 are estimated to be taken by non-Aboriginal hunters. There is currently no substantial commercial use of Magpie Geese.

Existing land use patterns in the Territory are generally consistent with retaining large wetland areas and their dependent waterfowl populations. The current potential major threats are habitat modification or loss (such as by weeds and feral animals) and harvest (including issues of lead poisoning of humans, wildlife and habitats). The impact of climate change through changes in sea levels, hydrology and saltwater intrusion is an increasingly important threat to Magpie Geese habitat.

The primary aim of this management program is to ensure the long-term conservation of wild populations of the Magpie Goose and its habitats in the Northern Territory. The program incorporates both Aboriginal traditional and non-Aboriginal use of Magpie Goose populations and encourages management practices that favour all waterfowl, particularly the Magpie Goose, and that protect wetland habitats beyond the boundaries of parks and reserves.

Performance criteria, key actions, estimated costs and timelines for each objective are given. An action table and an annual milestone matrix are provided for responsible managers and staff. Priority actions include reviewing the population monitoring program; instigating processes to promote non-toxic shot for any waterfowl hunting; and ensuring monitoring of, and compliance with harvest quotas.

Details are also given on management practices, including habitat management and values; and Aboriginal traditional and non-Aboriginal harvesting. In particular, the following harvest limits apply:

- Combined Aboriginal traditional and non-Aboriginal harvesting, including both non-commercial and commercial harvest: a mean maximum in any 3 year period of 10% and a maximum in any single year of 14% of the minimum estimated Magpie Goose population for the Top End of the Northern Territory; and
- Agricultural protection: a maximum of 1% of the minimum estimated Magpie Goose population for the Top End of the Northern Territory.

Auditing and detailed monitoring as outlined in the program will ensure that the Magpie Goose will remain a conservation icon into the future.

Contents

<i>Citation</i>	<i>ii</i>
<i>Acknowledgments</i>	<i>ii</i>
Executive summary	iii
Contents	v
List of Tables	vii
List of Figures	vii
1. Introduction	1
1.1 Aim and Objectives	1
1.2 Species	1
1.3 Distribution	1
1.4 Responsible authority	2
1.5 Legislation and international obligations	2
1.5.1 Northern Territory	2
1.5.2 Other States and Territories	3
1.5.3 Commonwealth	3
1.5.4 International	4
2. Management Context	5
2.1 Socio-economic Values	5
2.1.1 Social	5
2.1.2 Cultural	5
2.1.3 Health	5
2.1.4 Economic	6
2.2 Population Estimates	6
2.3 Magpie Goose Habitat	8
2.3.1 Protected areas	8
2.3.2 Significant wetlands outside reserves	9
2.4 History of use	9
2.4.1 Aboriginal traditional harvest	9
2.4.2 Non-Aboriginal harvest	10
2.4.3 Commercial use	11
3. Threats and Impacts	12
3.1 Harvest	12
3.2 Climate change and saltwater intrusion	13
3.3 Shot toxicity and bioaccumulation	13
3.4 Hydrology and water quality	14
3.5 Weeds and introduced plants	14
3.5.1 <i>Mimosa pigra</i>	14
3.5.2 Introduced pasture species	15
3.6 Feral animals and domestic stock	15
3.7 Other threats	16
3.7.1 Interaction with horticulture	16
3.7.2 Disease outbreaks	16

4. Objectives, Performance Criteria and Actions.....	17
4.1 Performance Criteria and Actions.....	17
4.3 Management Practices.....	20
4.3.1 <i>Habitat management</i>	20
4.3.2 <i>Promoting the values of natural wetland environments</i>	20
4.3.3 <i>Harvesting and use</i>	21
4.3.4 <i>Aboriginal traditional harvest</i>	21
4.3.5 <i>Non-Aboriginal harvest</i>	22
4.3.6 <i>Waterfowl Hunting Plan</i>	22
4.3.7 <i>Commercial use</i>	23
4.3.8 <i>Control of Magpie Geese as a horticultural pest</i>	23
4.3.9 <i>Summary of Harvest quotas</i>	23
5. Monitoring	25
5.1 Population estimates	25
5.2 Harvest estimates.....	25
5.2.1 <i>Non-Aboriginal harvest</i>	25
5.2.2 <i>Aboriginal traditional harvest estimates</i>	25
5.3 Habitat monitoring	26
5.4 Review of program	26
6. Required Resources	27
6.1 Costs	27
6.2 Resource allocation.....	27
7. Definitions	28
8. References	29
Appendix 1: Magpie Goose background information	32
Conservation status	32
<i>Australia</i>	32
<i>Northern Territory</i>	32
Conservation in reserves	32
Ecology	33
<i>Habitat requirements and availability</i>	34
References	34
Appendix 2: Monitoring and Evaluation.....	36
Pre-2009 Population Monitoring	36
Proposed Population Monitoring.....	37
Traditional Aboriginal Harvest.....	37
Non-Aboriginal Harvest.....	37
Permits to Destroy	38
Habitats.....	38
Review of Program	38
References	38

Appendix 3: Communications Plan for 2009–2014 Program	39
A. Overarching Communications Plan for the life of Management Program.	39
B. Proposed timeline and communications plan for the annual Declaration of the Waterfowl Hunting Season	43
Appendix 4: Annual Milestone Matrix for 2009–2014 Program	44
Appendix 5: Review of 2003–2007 Management Program	48

List of Tables

Table 1: Estimated Dry season goose population (000's) in three key areas (all within Kakadu National Park) and estimated overall abundance.	9
Table 2: Estimated harvest of Magpie Goose from the permits returns received (2002-8).....	11
Table 3: Performance criteria, key actions and their associated costs ⁴ and timelines to meet the aims and objectives of the Magpie Goose Management Program 2009–2014.	17
Table 4: Harvest limits proposed under the management program (limits are expressed as a proportion of the minimum estimated NT Top End Magpie Goose population and based on information provided in Brooks and Whitehead 2005a,b).....	24
Table 5: Indicative implementation and cost schedule for the management of Magpie Geese. Costs are expressed in \$'000s.	27

List of Figures

Figure 1: Current distribution of Magpie Geese in Australia and southern Papua New Guinea and West Papua (modified from Barrett et. al. 2003 and Coates 1990).....	3
Figure 2: Mean population estimates (\pm SE) for the western Top End of the Northern Territory of adult Magpie Geese based on Wet season surveys from 1983 to 2007.	7
Figure 3: Mean estimates (\pm SE) for the western Top End of Magpie Goose nests based on Wet season surveys from 1984 to 2007.	7
Figure 4: Distribution and density of Magpie Goose populations in relation to Parks and Reserves in the western Top end of the Northern Territory based on wet season surveys in 2000 and 2006.	8

1. Introduction

1.1 Aim and Objectives

The aim of this management program is to:

“Ensure the long-term conservation of the Magpie Goose and its habitats in the Northern Territory”.

The program acknowledges the socio-economic value of the annual harvest to the Northern Territory by continuing to support Aboriginal traditional and non-Aboriginal use of Magpie Goose populations. The program aims to encourage management practices that favour all waterfowl, particularly the Magpie Goose, and protect wetland habitats beyond the boundaries of parks and reserves.

The program has four principal objectives:

1. To maintain viable wild populations of the Magpie Goose.
2. To promote the long-term protection of the wetland habitats on which the Magpie Goose and other wetland fauna depend.
3. To facilitate, where appropriate, the sustainable use of Magpie Goose populations.
4. To provide ongoing refinement of Magpie Goose management through timely evaluation of management prescriptions and performance.

1.2 Species

The Magpie Goose is the sole member of the family Anseranatidae (Sibley *et al.* 1988). The species has closer affinities to the South American screamers (Family Anhimidae) than to ducks, true geese and swans (Family Anatidae). Subspecies or races have not been described. Further details on the status and ecology of the Magpie Goose are provided in Appendix 1.

1.3 Distribution

At the time of European settlement in Australia in 1788, Magpie Geese (*Anseranas semipalmata*) were abundant across northern Australia and were also common on swamps and on coastal and inland river floodplains in south-eastern Australia (Nye *et al.* 2007). By the early 1900s there was a serious contraction of range from the southeast primarily from loss of wetland habitat, with hunting, poisoning, drought and predation also contributing to this population decline (Nye *et al.* 2007).

The species is currently recorded from Australia and the trans-Fly River lowlands of southern Papua New Guinea and West Papua. Major breeding areas are in the wetlands of northern Australia as well as the trans-Fly lowlands. The nomadic range in Australia extends well outside breeding areas (Figure 1).

The Magpie Goose is abundant with the Northern Territory supporting the world's largest population and major breeding areas (Frith and Davies 1961; Tulloch and McKean 1983; Bayliss and Yeomans 1990). Significant resident populations also exist in tropical northern Queensland and Western Australia. Since protection of the species from hunting in the 1930s in eastern and southern states and successful reintroductions in Victoria, New South Wales and South Australia, the species has returned to parts of its former range (Nye *et al.* 2007), although in relatively small numbers compared with the 'core' population areas of northern Australia. The most important component of this extension has been the sustained expansion of the Magpie Goose into south-eastern Queensland, with the current continuous resident and breeding distributional boundary being the northern coast of New South Wales (Nye *et al.* 2007).

There is no evidence to suggest that either the range or mean abundance of Magpie Geese in the Northern Territory has altered significantly since European settlement (Frith 1967, Nye *et al.* 2007).

1.4 Responsible authority

The Northern Territory Department of Natural Resources, Environment, The Arts and Sport (NRETAS) is obliged under the *Territory Parks and Wildlife Conservation (TPWC) Act* to manage wildlife in the Northern Territory.

1.5 Legislation and international obligations

1.5.1 Northern Territory

The *TPWC Act* contains provisions for the management and conservation of native animals including Magpie Geese.

The Magpie Goose is classified as protected wildlife under Section 43 of the *TPWC Act*. Section 66(1) of the *TPWC Act* prohibits the taking or destruction of protected wildlife. However, the Minister may declare that it is lawful to kill specified numbers of a protected animal during specified times, at specified places, and using specified means (Section 45). These provisions are used to declare an annual waterfowl hunting season and the conditions to which waterfowl hunting is subject. All persons hunting waterfowl in accordance with the declared waterfowl hunting season must obtain a permit to take protected wildlife.

It is an offence to possess live Magpie Geese or their eggs except in accordance with a permit issued under Section 43 of the *TPWC Act*.

The taking of wildlife by Aboriginal people for traditional purposes, including food, is provided for under Section 122 of the *TPWC Act*. Aboriginal people are not bound by hunting regulations or seasons when taking wildlife, including Magpie Geese, for food or other traditional purposes.

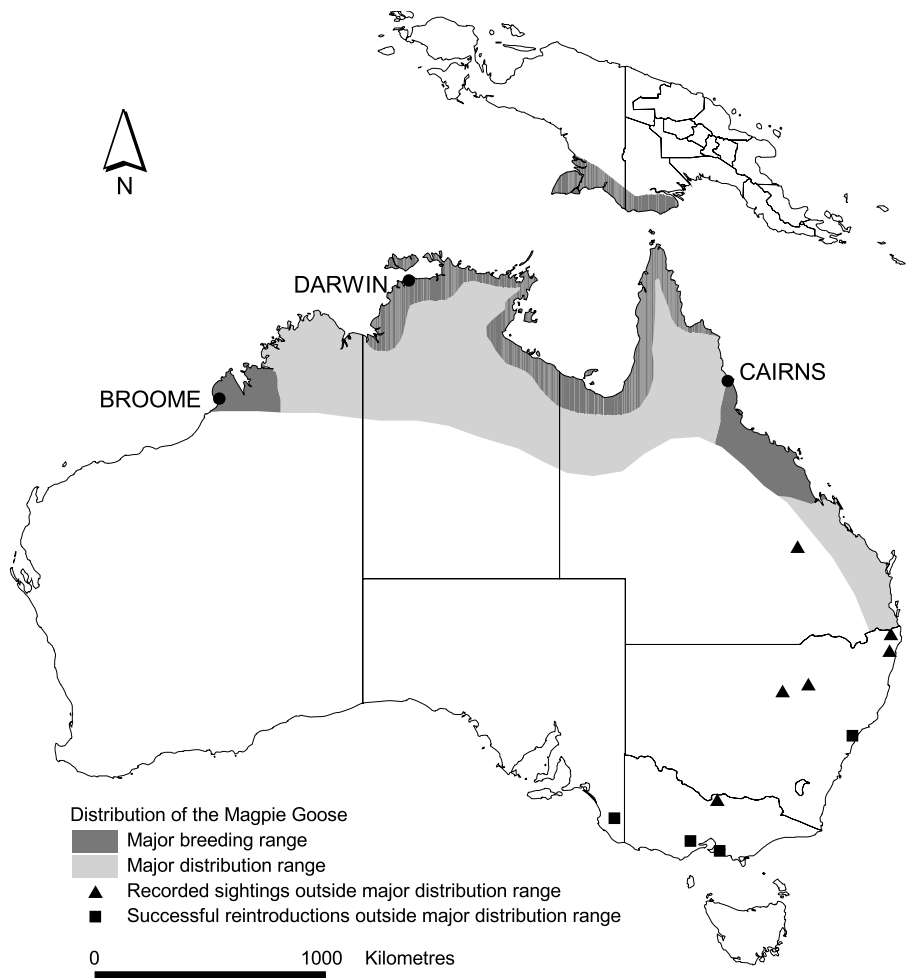


Figure 1: Current distribution of Magpie Geese in Australia and southern Papua New Guinea and West Papua (modified from Barrett et. al. 2003 and Coates 1990).

1.5.2 Other States and Territories

The Magpie Goose is protected in all Australian States and Territories. It is listed as vulnerable in New South Wales (*Threatened Species Conservation Act 1995*), threatened in Victoria (*Flora and Fauna Guarantee Act 1988*) and endangered in South Australia (*National Parks and Wildlife Act 1972*).

1.5.3 Commonwealth

The Magpie Goose is a listed marine species under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. This means that the species has additional levels of protection on Commonwealth lands and limits the circumstances under which birds may be taken.

Export from Australia of any Australian native animal or its parts, requires a permit issued under the *EPBC Act 1999*. Permits may only be issued where the specimens are derived from captive-bred animals or taken in accordance with a management program declared in a notice published in a Commonwealth Gazette to be an approved management program. Officers of the Australian Customs Service and the Australian Federal Police enforce the *EPBC Act 1999* in the Northern Territory.

1.5.4 International

The Magpie Goose is not currently listed under the Convention on International Trade in Endangered Species (CITES) or the Convention on Migratory Species (Bonn Convention). Australia is a signatory to the Convention on Wetlands of International Importance (Ramsar Convention). There are plans of management for two of the three Ramsar-listed areas of the Northern Territory (Stages one and two of Kakadu National Park) which protect wetlands and their dependent fauna, including Magpie Goose. NRETAS is currently developing a plan of management for Cobourg Peninsula (Garig Gunak Barlu National Park).

2. Management Context

2.1 Socio-economic Values

People in the Top End of the Northern Territory identify strongly with the Magpie Goose, and these interactions make an important contribution to the socio-economic fabric of the Northern Territory.

2.1.1 Social

Hunting makes a significant contribution to the lives of many people in the Top End. On Aboriginal lands hunting trips usually involve large family groups for several days or weeks and the social interactions on country are an important aspect of the annual harvest. Similarly, hunting of waterfowl is an important part of the local lifestyle for some sections of the non-Aboriginal community. Some of the enjoyment experienced by hunters includes the camaraderie and the strengthening of relationships as a result of waterfowl hunting and participating in the harvest together.

2.1.2 Cultural

For Aboriginal people in the Top End, the Magpie Goose is a key species in their culture. It is often represented in paintings and ceremonies because it is a totemic species. Hunting Magpie Geese also assists the transfer of skills and knowledge from one generation to the next amongst Aboriginal people (Altman 1987). Sharing the returns from hunting is also a way of fulfilling kinship obligations (Altman 1987).

For Traditional Owners hunting trips are part of a broader context of 'looking after country' enabling them to increase their monitoring of environmental threats and maintain traditional burning practices around floodplains. Hunting Magpie Geese takes people to places that they may not otherwise travel to, where they may come across threats to the environment such as new outbreaks of weeds. This is particularly important in remote areas where there are limited resources to monitor environmental conditions and to mitigate against such threats. There are strong flow-on benefits of maintaining and strengthening culture through this connection to country.

Many non-Aboriginal hunters have a personal or generational culture of harvesting from the land. Hunting waterfowl fosters this tradition. For visitors and Territorians, the vast flocks of Magpie Geese on the floodplains are part of their iconic image of the Top End.

2.1.3 Health

Magpie Geese contribute to a healthy lifestyle in the Territory. Magpie Geese are a nutritious source of food (Miller *et al.* 1993). Hunting Magpie Geese is an active outdoors pursuit and there are strong links between physical exercise and an individual's health. This is particularly evident in Indigenous communities where health and well-being are intimately linked with their relationship to the land (Burgess *et al.* 2005).

2.1.4 Economic

The economic costs and benefits of using the waterfowl resource have not been accurately measured in the Northern Territory, but are thought to be considerable.

For hunters there is significant outlay on guns, ammunition and other equipment such as clothing and refrigeration, as well as fuel and vehicle costs.

The harvest of Magpie Geese contributes to the local economy, particularly in many remote Aboriginal communities in the Top End. One Magpie Goose is large enough to be a meal for one or more people, and up to 60,000 Magpie Geese are harvested annually by Aboriginal people (A. Griffiths, NRETAS unpublished data). Based on a market replacement value of \$20 per bird, the harvest of Magpie Geese may contribute as much as \$1.2 million a year to the Northern Territory economy. This represents a significant amount of food that does not have to be transported to remote communities or purchased by people that generally have little disposable income. The smaller estimated harvest of 20,000–40,000 Magpie Geese taken by non-Aboriginal hunters contributes a correspondingly smaller replacement value of foods, directly contributing some \$400,000–\$800,000 to the economy.

An indirect economic benefit provided by Magpie Geese is their contribution to the tourism industry. The vast Top End wetlands contain an abundance of waterfowl and crocodiles. Most visitors want to experience these dramatic landscapes and animals, including the enormous flocks of water birds.

2.2 Population Estimates

Spatial and temporal variation in the dynamics of Magpie Geese populations have been measured using aerial survey techniques in important Magpie Goose habitat since 1983. The first systematic survey designed to estimate absolute abundance was undertaken in the 1984 wet season. At that time the goose population in the Top End of the Northern Territory was estimated at approximately 2.7 million (Bayliss and Yeomans 1990a).

Wet season surveys in 1984 and 1985 indicated that greater than 95% of the estimated total Top End Magpie Goose population occurred in the western Top End region (Bayliss and Yeomans 1990a). From this observation the estimated Magpie Goose population abundance for the western Top End is taken as close to the absolute index of total Top End population abundance.

Wet season surveys (1984–1993, 1999–2000, 2006–2007) gave estimates of between 1 million to 2.6 million birds (Figure 2) for the western Top End of the Northern Territory. There is some evidence of decline over the period to 1993, but this does not appear to have continued through to 2007. Also, marked, rainfall-driven fluctuations of recruitment rates are common. Populations respond rapidly to variation in rainfall (Bayliss 1989; Whitehead and Saalfeld 2000) and deteriorating environmental conditions associated with periods of below average rainfall.

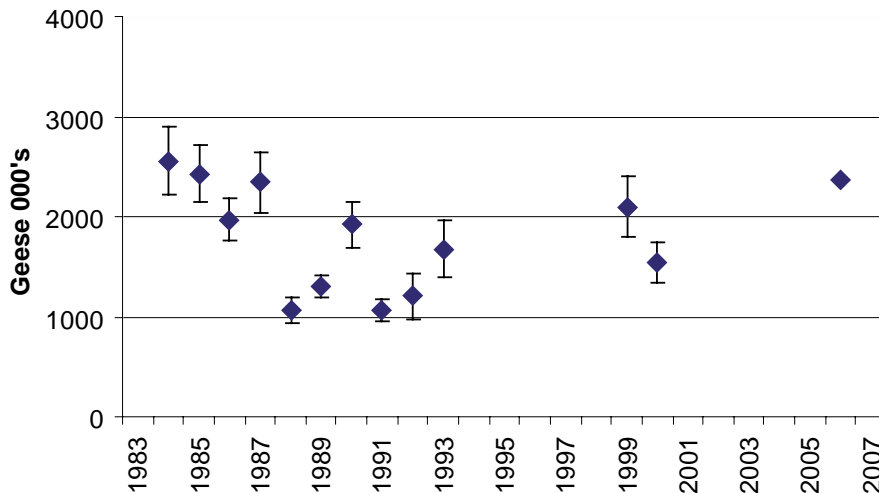


Figure 2: Mean population estimates (\pm SE) for the western Top End of the Northern Territory of adult Magpie Geese based on Wet season surveys from 1983 to 2007.

The more recent estimates are within this previously recorded range. The numbers of nests estimated showed similar patterns to the number of birds with variation between 50,000 and 238,000 nests (Figure 3). Nest numbers fluctuate markedly in response to the timing and amount of rainfall and there is no evidence of a decline in the proportion of the population nesting in the core areas.

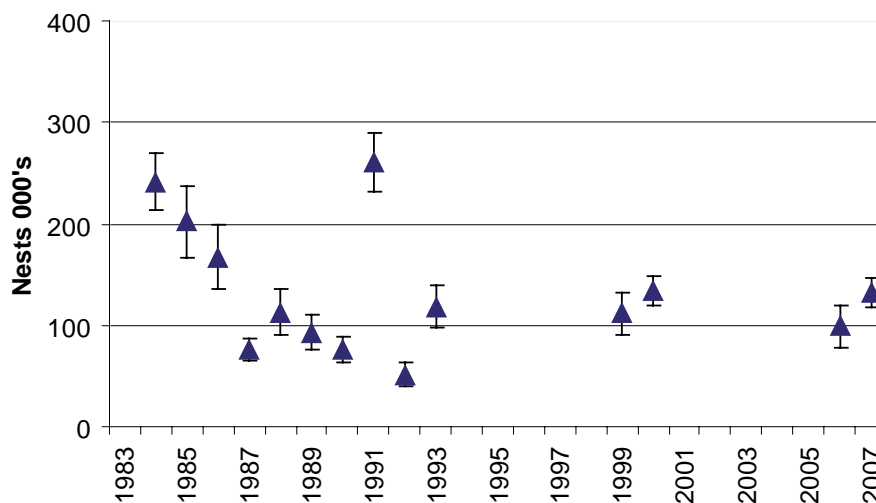


Figure 3: Mean estimates (\pm SE) for the western Top End of Magpie Goose nests based on Wet season surveys from 1984 to 2007.

Nesting trends varied across the Top End. In 1987, nesting was reduced to insignificant levels on each of the Mary, Adelaide and South Alligator floodplains, while the number of nests seen on the Moyle River floodplain increased dramatically over previous years. These changes are likely to have been influenced by regional variation in the extent and timing of Wet season rainfall (Corbett 1988; Tulloch *et al.* 1988; Whitehead and Saalfeld 2000). The widespread failure of nesting in 1990 across all floodplains is attributable to a late transition to Wet season conditions (Whitehead and Saalfeld 2000), and low subsequent rainfall (Corbett 1988). Available information suggests that Magpie Goose populations have the potential to achieve high rates of recruitment under favourable conditions.

Population estimates derived from aerial surveys underestimate absolute abundance (Caughley 1977, Bayliss and Yeomans 1990a & b). The size of this negative bias in aerial surveys of Magpie Goose populations is only poorly known and is thought to be substantial (Bayliss and Yeomans 1990b, Saalfeld 1990). Population estimates provided here are corrected for this bias (Bayliss and Yeomans 1990b, Saalfeld 1990) using best available correction factors, but they are still likely to be conservative and must be taken as minimum population estimates.

2.3 Magpie Goose Habitat

2.3.1 Protected areas

Recent Wet season aerial surveys of the western floodplains (2000 and 2006) determined that approximately 31% or 1,376 km² of key Magpie Goose floodplain habitat in the western Top End lies within existing parks and reserves, most notably the proposed Mary River National Park and Kakadu National Park (Figure 4).

Best available Dry season survey data indicates that most populations also use key floodplain areas in the western Top End (Figure 4). Of these, the key Dry season areas of Boggy Plain and Nourlangie Creek on the South Alligator River, and Magella Plain on the East Alligator River have been identified as especially significant, supporting two-thirds of the estimated total goose population during the Dry season (Table 1).

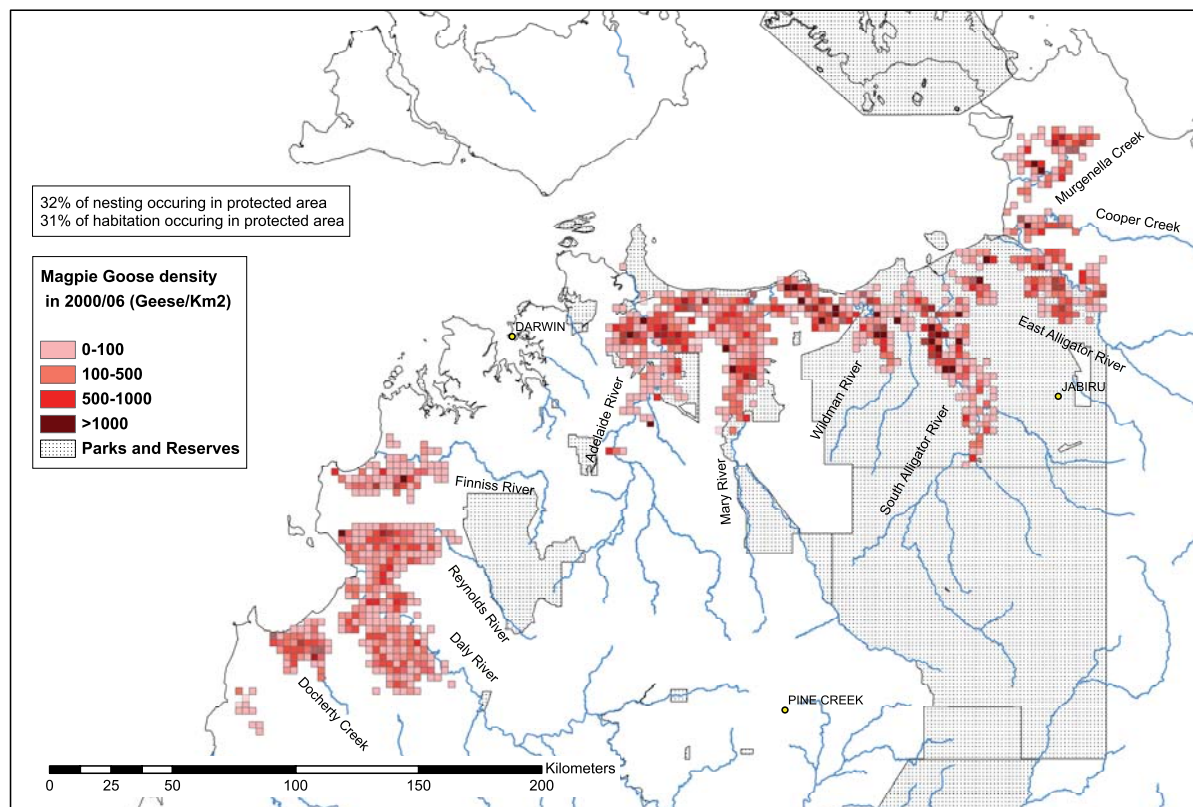


Figure 4: Distribution and density of Magpie Goose populations in relation to Parks and Reserves in the western Top end of the Northern Territory based on wet season surveys in 2000 and 2006.

Table 1: Estimated Dry season goose population (000's) in three key areas (all within Kakadu National Park) and estimated overall abundance.

Area	1983	1984	1995
Boggy Plain	110	660	680
Nourlangie Creek	1,770	1,640	580
Magella Plain	160	240	70
Total	2,040	2,540	1,330
Overall abundance	2,970	3,870	1,950
Proportion	69%	66%	68%

2.3.2 Significant wetlands outside reserves

The conservation value of designated National Parks and Reserves is supplemented by large areas of habitat on Aboriginal lands where access by non-Aboriginal people is by permit only. Local communities and/or their legal representatives control activities likely to affect habitats, or which may be detrimental to the long-term conservation of waterfowl. These protocols and restrictions offer significant protection of wetland areas.

Most remaining habitat is on Pastoral leases, where access is restricted, providing some degree of protection to Magpie Goose populations from harvesting.

2.4 History of use

2.4.1 Aboriginal traditional harvest

Current information on Aboriginal traditional harvest of Magpie Geese suggests that the off-take may be as much as 60,000 birds per annum (A. Griffiths, NRETAS, unpublished data 2009), but it is likely to be less than this level. This estimate is based on work carried out in the Maningrida area of Arnhem Land (A. Griffiths, NRETAS, unpublished data 2009), which gave an estimated local annual harvest of 9,000 Magpie Geese in a good season. Additionally, this work provided an estimate of the number of shot shells fired by hunters per bird harvested of two (2) shot shells per bird.

Extrapolation of this harvest estimate from the Maningrida area to the other two major areas of Aboriginal traditional harvest, the Kakadu and Finnis/Daly floodplains, based on regional Aboriginal population, gives a minimum estimated harvest of 30,000 geese. This estimate is considered a minimum as it only covers three main regional areas of Aboriginal habitation in the Top End, not the entire Top End.

Alternatively, a maximum Aboriginal traditional harvest of 60,000 Magpie Geese was derived using the estimated average of two shot shells per bird for Aboriginal hunters (above) and conservatively assuming that non-Aboriginal hunters exclusively use steel shot whilst Aboriginal hunters use all the lead shot sold in the NT (119,250 shot shells in 2008) in the size range for waterfowl hunting (size range #4 to BBB) (G. Hennessy, NT Field & Game, pers. comm. 2009). This is considered an overestimate since lead shot is also used by non-Aboriginal hunters.

This level of Aboriginal traditional harvest is considered sustainable. An unknown number of eggs are also harvested by Aboriginal people.

Anecdotal evidence suggests that an informal market exists for the sale or barter of birds taken as part of the Aboriginal traditional harvest. Aboriginal people may include parts of the Magpie Goose (particularly feathers) in artefacts manufactured for sale.

Eggs experience high rates of natural mortality, and geese may lay again if the clutch is lost early in the incubation period (Whitehead 1998). Egg harvests may therefore have a limited impact on wild populations. Eggs are harvested by Aboriginal people, chiefly for immediate consumption. Trade in eggs occurred during the late 1960s and early 1970s but this appears to have ceased.

2.4.2 Non-Aboriginal harvest

Magpie Geese have been harvested for consumption by non-Aboriginal people since early settlement (Nye *et al.* 2007). Non-Aboriginal harvest is managed in the Northern Territory through the declaration of an annual Waterfowl Hunting Season and regulated by varying the duration of the hunting season, bag limits, and firearm and ammunition restrictions. Hunting permits allow permit holders to hunt on any land with landholder permission.

Non-Aboriginal hunting effort and off-take are currently assessed from the permits issued and data submitted on permit returns (Table 2). The number of permits issued has stayed relatively constant at around 1000 permits each year from 2002 to 2006, although the corresponding proportion of returns submitted by recreational hunters fell substantially from 73% in 2002 to a low of 14% in 2005. Based on these returns, recreational hunters shot 15 to 26 birds each during a season. Estimates suggest the total recreational harvest over these five years averaged 27,000 birds (range 18,500–38,900). However, the low proportion of returns in 2005 and 2006 suggests these figures are unlikely to be robust and are likely to underestimate the total number of magpie geese harvested.

In 2007 there was a substantial increase in the number of permits issued (to almost 1,400), and a higher proportion of returns (40%), providing some robustness to the estimates. On average each hunter shot 25 geese in 2007. The total estimated number of Magpie Goose shot was on a par with previous years at 34,100 birds. In 2008 the trend of increasing numbers of permits issued continued, with almost 1,600 permits issued. However the very low proportion of returns received (only 13%) means that there can be little confidence in any harvest estimate for 2008 and the provided estimate should be treated with caution.

Table 2: Estimated harvest of Magpie Goose from the permits returns received (2002-8).

Year	# Permits issued	# Permit returns (%)	Average # Geese per shooter	# Magpie Geese declared	Estimated harvest
2002	967	710 (73%)	15.0	10,660	34,100
2003	854	347 (41%)	25.9	8,999	22,100
2004	948	479 (51%)	23.0	11,017	38,900
2005	1,033	142 (14%)	18.7*	2,655	19,300*
2006	1,087	341 (31%)	16.1	5,484	18,500
2007	1,387	561 (40%)	24.6	13,782	34,100
2008	1561	202 (13%)	24.7*	5,000	38,600*

* Proportion of returns too small to estimate harvest with accuracy.

2.4.3 Commercial use

Prior to 2002, three permits were issued for minor commercial use of Magpie Geese taken from the wild. No permits were issued during the life of the previous management program (2002 to 2007). Although there appears to be a strong market for Magpie Goose meat, the high health requirements for handling field-killed game currently makes commercial harvesting uneconomical. The cost of raising birds from eggs also appears to inhibit development of 'ranching' projects similar to those existing for crocodiles.

3. Threats and Impacts

Existing patterns of land use (chiefly pastoral, reserves and Aboriginal lands) in areas where Magpie Goose live are generally passive and allow for the retention of large wetland areas and their dependent waterfowl populations. Major potential threats include habitat loss or modification (including by weeds and feral animals) and harvest for human consumption. The impact of climate change through changes in sea levels, hydrology and saltwater intrusion is an increasingly important threat to Magpie Geese habitat. Other lesser threats include adverse interactions with agriculture and horticulture and disease.

3.1 Harvest

With further growth of the human population in the Northern Territory, harvest by both Aboriginal and non-Aboriginal hunters has the potential to influence the dynamics of local Magpie Goose populations. The extent to which harvest mortality reduces overall survival rates is unknown.

The Magpie Goose is a preferred food species in many Aboriginal communities and may be eaten by up to 60% of Aboriginal people living in Magpie Goose territory with early estimates of 288,000 birds taken each year (Vardon *et al.* 1996). Other information on Aboriginal harvests of Magpie Geese suggests that the off-take is substantially less than this, with up to 60,000 birds harvested per annum (A. Griffiths NRETA, unpublished data). This inconsistency may be due to the methods used by Vardon *et al.*, where there is a risk that the average harvest level and frequency of hunting etc has been overstated and that double counting may have occurred when related people were interviewed

Estimates of non-Aboriginal harvest mortality can be derived from hunting returns associated with permits issued during the annual Waterfowl Hunting Season. These indicate that the annual harvest of Magpie Geese associated with the hunting season is currently less than 2% of the total population, and a maximum of about 10% of the regional population in the area in which non-Aboriginal hunting is most concentrated.

Whitehead (1998) and Brook and Whitehead (2005) indicate that a maximum sustainable harvest of 5 to 14% over the long-term is viable. Using an Aboriginal traditional harvest of 60,000 and a non-Aboriginal harvest of 40,000 (rounded maximum estimated harvest from Table 2) then the estimated total annual harvest is 100,000 Magpie Goose. With a total population estimate of 1,800,000 based on the mid-point of the population range from aerial survey (Section 2.2 & Figure 2), the proposed total annual harvest would be less than 6% of total population with a range of 4% to 10%. This falls well within the range proposed by Brook and Whitehead (2005) and is interpreted as indicating that current harvest levels are sustainable.

The regulatory framework associated with the declaration of the annual Waterfowl Hunting Season enables NRETAS to manage non-Aboriginal harvest if required. However, there is no existing structure for regulation of Aboriginal traditional harvests. Should the combined harvest level approach unsustainable levels in the future, NRETAS will pursue a co-management arrangement with relevant groups and their organisations.

3.2 Climate change and saltwater intrusion

One of the major effects of climate change is an anticipated rise in sea level (Hennessy *et al.* 2004). Magpie Geese are vulnerable to such rises with some 70% of the population in the Territory using dry season habitat that is less than 1 metre above current sea level. These calculations do not take into account other anticipated and compounding changes such as further saltwater intrusion or changes in hydrology and in the distribution and impacts of weed and feral animals. Under these conditions the current total harvest may be unsustainable.

Experience in Kakadu National Park has shown that it is possible to reverse or check the effects of saltwater intrusion by constructing relatively minor earthworks. Similar steps are being taken on the Mary River floodplain with the longer-term aim to improve techniques to slow or contain the potentially devastating effects of sea level rises on freshwater systems. Current climate change predictions for sea-level rises over the long-term are probably greater than can be controlled though such minor earthworks.

3.3 Shot toxicity and bioaccumulation

Lead derived from spent 'lead shot' is a toxic substance that can harm humans, wildlife and the environment, and can contribute significantly to the deaths of many waterbirds. The build-up of lead in the tissues of birds, and the leaching of lead into the soil can affect other fauna by accumulating in animals higher in the food chain (Thomas 1997, Fisher *et al.* 2006).

The most common lead poisoning in birds is a result of ingestion of spent toxic shot used during waterfowl hunting.

These animals experience considerable suffering prior to death, including anaemia, kidney and heart damage, increased susceptibility to infectious diseases and starvation. Predators (including humans) are also vulnerable to lead poisoning if they eat birds that have consumed lead shot (Beintema (date unknown), Burger *et al.* 1998). Other studies indicate that humans who consume birds that have been hunted with lead shot pellets also show increased concentrations of lead in their tissues (Thomas 1997). Even when toxic shot is banned, wetlands will continue to be polluted into the future as these areas will still be affected by toxic shot because of leaching of lead into the surface water, soil and groundwater.

High levels of lead poisoning at Howard Springs Hunting Reserve (Whitehead and Tschirner 1991) resulted in a prohibition of the use of toxic shot at all Northern Territory hunting reserves. While the amount of lead that has accumulated in wetlands in the NT is not known, substantial accumulations have been shown at a number of regularly hunted sites (Whitehead and Tschirner 1991, Saalfeld 1991), and problems are also likely to develop or increase at other sites used repeatedly by recreational or Indigenous hunters.

The Northern Territory was the first Australian jurisdiction to prohibit the use of lead shot for waterfowl hunting. However this prohibition is limited to the four government managed hunting reserves. Other jurisdictions have prohibited the use of lead shot for waterfowl hunting across all tenures. Extending the ban on the use of lead shot for waterfowl hunting to all tenures in the NT has been identified as a management objective in previous versions of the Magpie Goose Management Program.

Issues associated with the introduction of such a ban in a fair and equitable manner that would encompass both Aboriginal and non-Aboriginal hunters has prevented it from being realised.

Before any prohibition on the use of lead shot it was estimated that hunters contributed approximately 350 tonnes of lead to wetlands in Australia each year (Whitehead and Tschirner 1991). While this is expected to have decreased considerably since the introduction of non-toxic shot there is still some input of lead shot into wetlands across Australia. The mandatory use of non-toxic shot in all wetlands has been actively promoted across Australia based on recommendations by the Australian and New Zealand Environment and Conservation Council (ANZECC 1996).

3.4 Hydrology and water quality

Wetland vegetation is sensitive to changes in hydrological regimes including the rate, timing and depth of flooding (Bowman and Wilson 1986; Whitehead et al. 1990) and floodplain environments also act as “sinks” that may accumulate pollutants such as heavy metals (Hart et al. 1987) and herbicides and pesticides. Thus, Magpie Goose habitat may be affected by activities that influence water flows on either the floodplain itself, or elsewhere in the catchment.

The potential impact of changed hydrology and effluents or pollutants on water bird habitat is considered in assessments of proposals to extract water or to manage water quality under the *Water Act* and in Water Allocation Plans which have processes for including environmental flows. Heavy metal pollutants to floodplains originate principally from current mining operations. Their discharge is regulated through a license under the *Water Act* that includes water quality monitoring, and in some cases monitoring the load (mass) of metal contaminants to rivers and streams.

3.5 Weeds and introduced plants

3.5.1 *Mimosa pigra*

Mimosa or the Giant Sensitive Plant, *Mimosa pigra*, is an ongoing threat to Magpie Goose habitats in the Top End. It has already invaded over 140,000 hectares with further invasion halted by containment efforts in recent years (S. Wingrave NRETA pers. comm. 2007). It produces impenetrable thickets, displacing grasses and sedges used by the Magpie Goose for food and nesting.

Mimosa is controlled through integrated management tools including bio-control agents, herbicides and grazing management. Continuing the effort to contain and reduce the spread of Mimosa is a critical element of waterfowl conservation programs. NRETAS has initiated a program of Mimosa control on Territory Parks and Reserves and similar programs have operated in Kakadu National Park and on pastoral and Aboriginal land for some years. Control of noxious plants is the responsibility of the landholder. The NRETAS Weed Management Branch provides extension services to landholders to control Mimosa and other invasive plants.

3.5.2 Introduced pasture species

Replacement of native floodplain pastures by exotic grasses (especially Para Grass, Aleman Grass and Olive Hymenachne) presents a significant long-term threat to Magpie Goose populations. Mature birds and goslings are heavily dependent on seeds of native annual plants especially during the breeding season, and these may be displaced by exotics (Ferdinands *et al.* 2005).

The increasing use of invasive exotic grasses on pastoral properties and their frequent escape into neighbouring sites (including the public conservation estate) is likely to substantially degrade wetland habitat values for Magpie Geese over the mid to long-term (Clarkson 1995, Whitehead and Dawson 2000).

3.6 Feral animals and domestic stock

Feral buffalo have caused substantial environmental change in the seasonal wetlands of the Northern Territory through reducing vegetation cover, accelerating erosion, increasing rates of drainage and subsequent premature drying of swamps, and causing saltwater intrusion into previously freshwater areas (Mulrennan and Woodroffe 1998). Infilling of billabongs due to processes of sedimentation unleashed by feral buffalo has also occurred.

The level of impact of these changes on Magpie Goose populations is unknown. It appears unlikely that the impact of feral buffalo has substantially limited (or is currently limiting) Magpie Goose populations, although geese may have been displaced locally from severely degraded areas, especially during the late Dry season when competition for remaining water bodies and pasture may have been most severe.

Feral buffalo populations were substantially reduced under the Brucellosis and Tuberculosis Eradication Campaign (Freeland and Bolton 1990). Populations are recovering in some areas, including Arnhem Land (NRETA unpublished data) and will present an increasing problem in the future.

Pigs are common on the western floodplains and may compete with geese for some foods like bulbs of the sedge *Eleocharis dulcis* during the dry season. There is currently no evidence that feral pigs have adversely affected Magpie Goose populations. Other feral animals do not occur at densities that are likely to threaten wetland habitats.

There are currently no studies aimed at determining whether pigs, buffalo or cattle grazing on wetlands threaten their suitability as Magpie Goose habitat over the long-term. Improved understanding of the interaction between pastoralism on floodplains and goose ecology is desirable.

3.7 Other threats

3.7.1 Interaction with horticulture

During the late Dry season geese may visit fruit farms in large numbers and damage horticultural crops by trampling, grazing, uprooting plants or consuming fruits (e.g. melons and mangoes) (Whitehead 1991). NRETAS encourages the use of non-destructive control methods, such as birdfrite (a pyrotechnic device), other techniques aimed at scaring rather than killing, and crop netting. Occasionally permits to destroy birds are issued.

Detrimental interactions between geese and horticulture may increase as floodplain habitats are altered by farming practices such as introduction of exotic pastures. If the quality of preferred floodplain habitat declines, the geese may become more dependent on other sites.

3.7.2 Disease outbreaks

Magpie Geese populations are currently monitored for virulent strains of Avian Influenza by the Australian Quarantine Inspection Service (AQIS). Harvesting may be curtailed or stopped should such a disease outbreak reduce Magpie Goose populations.

4. Objectives, Performance Criteria and Actions

4.1 Performance Criteria and Actions

Performance criteria, key actions, total estimated program costs* and timelines for each of these actions are summarised in Table 3. The key actions are also summarised with their action officer and timelines in Appendix 2.

Table 3: Performance criteria, key actions and their associated costs* and timelines to meet the aims and objectives of the Magpie Goose Management Program 2009–2014.

Aim: To ensure the long-term conservation of the Magpie Goose and its habitats in the Northern Territory.

Objective 1 – To maintain viable populations of the Magpie Goose.
(Indicative program cost \$220 000*)

Performance Criteria	Key Actions	Timeline
1. The estimated regional populations of Magpie Geese will not decline by more than 10% above that which can be explained by normal climate fluctuations between surveys; nor will there be an anomalous trend of decline over multiple years.	Review and re-design monitoring program for Magpie Goose surveys.	2009/10
	Implement survey monitoring program.	Commence in 2010/11
	Review existing models of Magpie Goose population dynamics in relation to rainfall and refine to permit robust identification of anomalous change.	Commence in 2009/10
2. Existing available population and habitat data for Magpie Geese will be analysed by 2010.	Maintain a watching brief on minor threats and instigate adaptive management actions should their impacts appear to increase.	Ongoing; review annually
	Encourage the use of non-destructive methods to mitigate any horticultural or agricultural impacts.	Ongoing, review annually
3. Permits to mitigate the detrimental impacts on horticulture will not exceed taking more than 1% of the (regional) population in any one year.	Monitor permit applications and approvals to ensure performance criterion is met.	Ongoing; review annually

* see Table 5

Objective 2 – To promote the long-term protection of the wetland habitats on which Magpie Geese and other wetland fauna depend. (Indicative program cost \$70 000*)

Performance Criteria	Key Actions	Timeline
<p>1. The use of toxic shot for waterfowl hunting by non-Aboriginal hunters across all tenures will be prohibited.</p> <p>2. Promote the use of non-toxic shot by Aboriginal hunters engaged in traditional harvest of Magpie Geese.</p> <p>3. The development of predictive models to measure and estimate the potential impacts of key threats on Magpie Goose wetlands for management decisions will be initiated by 2011.</p> <p>4. The quality of key Magpie Goose habitat will be benchmarked by 2010 and adverse impacts will be mitigated where feasible.</p>	Prohibit the use of toxic shot for waterfowl hunting across all land tenures in the Northern Territory as a condition of the declaration of the annual Waterfowl Hunting Season.	Commence in 2009
	Negotiate with representatives of Aboriginal landowners and other Aboriginal people to promote the use of non-toxic shot when harvesting waterfowl.	Commence in 2009/10
	Develop and implement a public awareness campaign to explain and promote the need for, and benefits of, using non-toxic shot, with particular emphasis in reaching Aboriginal hunters.	Commence in 2009/10
	Explore options to assist hunters to become more skilled shooters, more proficient users of non-toxic shot and therefore more efficient hunters.	Commence in 2009/10
	Collaborate with researchers to help develop predictive models for potential changes in habitat due to climate change, weeds and feral animals.	Commence in 2009
	Establish benchmarks by which to measure any future large-scale changes in key Magpie Goose habitat.	Commence in 2009/10
	Work with landholders and other key stakeholders to mitigate the impacts of weeds and feral animals.	Ongoing, review annually
	Work with land managers to monitor and control any new outbreaks of Mimosa and Para Grass in the western floodplains.	Commence in 2010/11
	Manage weeds and feral animals on National Parks and reserves in accordance with Management programs.	Ongoing, review annually
	Maintain a watching brief on any major changes in extent and quality of key Magpie Goose floodplain habitat.	Ongoing; review annually

* see Table 5

Objective 3 – To facilitate, where appropriate, the sustainable use of Magpie Goose populations. (Indicative program cost \$150 000*)

Performance Criteria	Key Actions	Timeline
<p>1. The Aboriginal traditional and non-Aboriginal harvest of Magpie Geese shall not exceed an average of 10% of the population in any three year period and shall not exceed a maximum of 14% of the population in any single year.</p> <p>2. Any commercial harvest of wild birds will not take total (non-commercial and commercial) off-take over the above limits and off-take of eggs will not exceed 25% in the specified areas.</p> <p>3. An improved model to estimate the impacts of total harvest on Magpie Geese populations which will link to an improved model for determining anomalous change will be available for management use by 2011.</p>	Review hunting effort and take and, should harvest approach or exceed the stated 10% or 14% levels, consult with both Aboriginal and non-Aboriginal hunters to reduce harvest to sustainable levels.	Annually in March
	Hold an annual public meeting for stakeholders with interests in non-Aboriginal hunting management to discuss the waterfowl-hunting season.	June each year
	Annually declare waterfowl hunting season with seasonally-specific conditions as appropriate.	July each year
	Monitor compliance with permit conditions through on-ground patrols throughout the season and via surveying hunters during the season.	Annually during hunting season
	Investigate ways to improve quantity and quality of waterfowl hunting season permit returns.	Commence in June 2009
	Develop and implement a Waterfowl Hunting Plan that addresses both on- and off-reserve waterfowl hunting, including annual declaration and conditions of the waterfowl hunting season.	Completed by end 2011
	Develop and implement a monitoring system to measure the Aboriginal traditional harvest of Magpie Geese after consultation with the Northern Land Council, traditional owners and other Aboriginal people.	Commence in 2010/11
	Ensure that any evidence of local impacts is investigated and appropriate action taken.	Ongoing, review annually
	Ensure any egg collections are timed to minimise natural pre-harvest losses from predation and flooding.	Ongoing
	Ensure any commercial harvests avoid areas where there is other significant harvest.	Ongoing
	Encourage ranching to reduce impacts on the wild population.	Ongoing
	Collaborate with researchers to gather information on the impacts of harvest and use it to refine the model for estimating the impact of Magpie Goose harvesting on populations.	Commence in 2009/10

* see Table 5

Objective 4 – To provide ongoing refinement of Magpie Goose management through timely evaluation of this Management program. (Indicative program cost \$45 000*)

Performance Criteria	Key Actions	Timeline
1. Monitoring and evaluation of the Magpie Goose Management program shall be in accordance with the above objectives, performance criteria, actions and milestones.	Annually audit the progress of the Management program against each of the performance criteria and adjust management practices as necessary.	March each year
	Annually review and update the Communications Plan (Appendix 3).	March each year.
	Review and update the Management program by 2014.	Commence in 2013

* see Table 5

4.3 Management Practices

4.3.1 Habitat management

The effective conservation of Magpie Geese requires strategies for protecting and managing important wetland habitat. The mobility of this species, as well as seasonal changes in habitat requirements and environmentally mediated changes in the location and extent of suitable habitat require that the management program operates across all land tenures.

Should it be deemed necessary or desirable, NRETAS will seek to be involved in managing significant wetlands through:

- agreements with landholders under Section 73 and 74 of the *TPWC Act*;
- declaration of areas as essential habitat under Section 37 of the *TPWC Act*;
- provision of technical advice; or
- land acquisition.

In wetland areas declared as essential habitat, management measures required for the protection of Magpie Goose habitat will involve commitments to control and/or eradicate exotic plant species detrimental to Magpie Goose habitat. Landholders will be required to maintain existing native vegetation and not introduce exotic pastures. Where land use proposals require consideration under the *Environmental Assessment Act* and have the potential to damage important waterfowl habitat, approvals may be conditional on the introduction of management practices which protect wetlands.

4.3.2 Promoting the values of natural wetland environments

Recent recognition of the conservation, aesthetic, recreational, and economic values of wetlands in Australia has encouraged more sensitive management of these systems. NRETAS seeks to further promote public awareness of the need for wetland protection in the Northern Territory. These and other actions are set out in the Integrated Natural Resource Management Plan for the Northern Territory (LCNT 2005). NRETAS will seek to increase options available for landholders to derive an income from natural wetlands, thereby encouraging retaining natural wetlands as a viable land use option. The sustainable commercial use of Magpie Geese is one of those options.

4.3.3 Harvesting and use

The management strategy for Magpie Goose populations will necessarily be adaptive; management actions will be conservative, populations will be monitored, and regulatory provisions will remain flexible to permit a quick response to any evidence of adverse trends. Brook and Whitehead (2005b) suggested a maximum harvest rate of from 5–14 % to avoid risk of substantial population decline, and Peter Whitehead (NRETA, pers. comm. 2009) has suggested that a mean maximum sustainable yield at the mid-point of this range would be realistic. A mean maximum sustainable yield of 10% in any three year period, or 14% in any single year, of total population, has been set as the maximum sustainable harvest limit. This is similar to the thresholds prescribed for other large waterfowl species which are hunted recreationally such as the North American Tundra swans, where the maximum harvest rate is set to 10% (Ad Hoc Eastern Population Tundra Swan Committee 2007). In addition to the maximum harvest limits above, based on Brook and Whitehead's work (2005b) statistically significant population declines of greater than 10% which cannot be explained by normal climatic fluctuations should invoke investigation with possible management intervention, as should anomalous decline trends over multiple years in adjusted population estimates. However, the capacity to measure such a trigger point must first be developed.

Management actions relating to reducing harvest may include:

- consultation with stakeholders to reduce or cease harvesting for a specified period;
- consultation with stakeholders to restrict harvest areas; and
- consultation with stakeholders to change harvest practices.

4.3.4 Aboriginal traditional harvest

Permits issued to allow sale of artefacts will require that only parts from animals taken for food, ceremonial purposes, or otherwise in accordance with this program may be incorporated into artefacts.

There are currently no restrictions on the use of lead shot for Aboriginal traditional harvesting on Aboriginal Lands in the NT. Aboriginal harvest includes the use of guns and accounts for a substantial proportion of the off-take of Magpie Geese each year. Negotiations with representatives of Aboriginal landowners and other Aboriginal people will be initiated to promote the use of non-toxic shot when harvesting waterfowl.

The extent of current adult bird and egg harvests is not accurately known and efforts will be made to gather additional information on the extent of use. The Northern Land Council will be consulted on ways to monitor Aboriginal traditional harvesting of Magpie Geese. Should it be found that Aboriginal traditional harvesting is detrimental to the sustainable status of goose populations, NRETAS will seek to negotiate appropriate co-management agreements. It is not possible to actively regulate Aboriginal traditional harvest under the TPWC Act and any management of Aboriginal traditional harvest is only possible through negotiated co-management agreements.

4.3.5 Non-Aboriginal harvest

The annual waterfowl hunting season is declared after analysing the results of population surveys, hunting returns, the extent of breeding, and the likely impact of recent climatic conditions on environmental condition and predicted mortality rates. Recommendations to the Minister specify the duration of the season, bag limits, methods of take and locations. Prior to any changes to the conditions of the waterfowl hunting season being implemented, consultation with stakeholders would be undertaken.

All non-Aboriginal waterfowl hunters are required to obtain a permit to take protected wildlife. Returns are requested at the close of the season as the basis for monitoring the off-take. NRETAS consults with stakeholders with interests in management of the non-Aboriginal component of waterfowl harvest in the Northern Territory, through the Northern Territory Firearms Council and others, on waterfowl hunting issues.

The use of lead shot for waterfowl hunting by non-Aboriginal hunters is prohibited on all Northern Territory Hunting Reserves. NRETAS will implement a complete ban on the use of lead shot for waterfowl hunting by non-Aboriginal hunters on all lands as a matter of priority. This was recommended in a discussion paper prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC) Task Force on Alternatives to the Use of Lead Shot in Duck Hunting (1996). Steel and Bismuth shot are available alternatives to lead shot.

4.3.6 Waterfowl Hunting Plan

This five-year Management program is designed to manage the wild population of Magpie Goose as required under the TPWC Act and broadly includes managing sustainable hunting and harvesting. The Management Program is not designed to deal with the detailed issues associated with permits, hunting and hunting reserves and has never satisfactorily fulfilled this role in the past. To address this discrepancy NRETAS will develop and implement a Waterfowl Hunting Plan, that addresses both on- and off-reserve waterfowl hunting, including the annual declaration of the waterfowl hunting season and the associated permit conditions. This Hunting Plan will be developed by the end of 2011 in consultation with stakeholders and will be consistent with the current Management Program. The Hunting Plan is required to help separate the management of waterfowl hunting activity as part of the sustainable use of Magpie Geese from the management of the wild population and its habitats.

The specific conditions associated with declaring the waterfowl hunting season that will be dealt with in the Waterfowl Hunting Plan include:

- Species subject to harvest
- Commencement and finish date of the season
- Daily opening and closing time
- Daily bag limits and possession limits
- Firearm and ammunition types and sizes

In addition to these specifics, the Waterfowl Hunting Plan will also address the issue of access to public land for waterfowl hunting, the interaction of waterfowl hunters and the residents of rural areas where waterfowl hunting occurs, and any commercial activities associated with waterfowl hunting.

4.3.7 Commercial use

Currently there is no demand for the commercial use of either birds or eggs. Any future applications for the commercial use of birds or eggs will be assessed on a case by case basis and issued after ensuring the viability and sustainability of each proposal.

Egg harvests will be restricted to a maximum of 25% of nests produced within defined harvesting areas and will concentrate on nests most likely to fail under natural conditions. Collections will be timed to coincide with the peak of nesting (usually late February/March) to minimise pre-harvest mortality through predation or flooding and entire clutches will be harvested to increase the probability of re-laying. Only parties holding appropriate permits will be permitted to carry out egg collection, incubation and raising geese.

Any commercial operations established will be individually licensed and will be regulated under Section 55 of the TPWC Act and subject to review under the *Environmental Assessment Act*. The commercial provision of food products will be regulated by the *Food Act*. Packaging will be labelled to identify the contents as coming from an approved management program.

It is anticipated that, in the longer term, any such commercial demands will be met primarily by farming Magpie Geese under permit.

4.3.8 Control of Magpie Geese as a horticultural pest

Magpie Geese can damage agricultural and horticultural crops, either by feeding directly on the crops or by damaging the crop while taking other foods. NRETAS will encourage affected landholders to use non-destructive control methods, such as crop netting. However, the impacts of Magpie Geese on crops are occasionally managed by issuing permits to take specified numbers of birds. To date, this mortality has been negligible in comparison with other forms of off-take.

4.3.9 Summary of Harvest quotas

Given rapidly fluctuating populations in a variable environment, harvest strategies must be flexible. Upper limits will be imposed as a proportion of populations rather than an absolute numerical limit. Limits for the duration of the program are summarised in Table 4.

Table 4: Harvest limits proposed under the management program (limits are expressed as a proportion of the minimum estimated NT Top End Magpie Goose population and based on information provided in Brooks and Whitehead 2005a,b).

Population segment	Harvest	Limit
Wild (adult) birds	(i) Non-commercial and commercial harvest	Mean off-take in any 3 year period – 10% Maximum off-take in any single year – 14%
	(ii) Horticultural protection	1%
Eggs	(i) Aboriginal traditional harvest	No limits proposed
	(ii) Commercial harvest of eggs for artificial incubation and ranching	25% of nests in any specified harvest areas.

5. Monitoring

5.1 Population estimates

Monitoring of Magpie Goose populations is required to assess whether the aims of the management program are being achieved (i.e. whether annual harvests are sustainable), and to inform future limits on the size of subsequent harvests. However, inconsistencies in time of year, intensity and location of past surveys currently make it difficult to make long-term comparisons. Wet season surveys are timed to occur during the peak of the breeding season of Magpie Geese so estimate populations prior to the hunting season are not in the same areas in which hunting occurs, and may include slightly different components of the populations. Dry season surveys (most recently undertaken to trial remote survey techniques) occur during the hunting season and so can more closely estimate the hunted populations but occur too late to influence the determination of the timing of the hunting season. Some targeted pre-hunting season surveys (April) have also been undertaken to help determine the length and timing of the annual waterfowl hunting season.

A national waterbird survey conducted in 2008 (R. Kingsford, UNSW *pers. comm.*) will help benchmark waterfowl and Magpie Goose populations at a landscape scale across their Australian range. A review of the population monitoring program and the methods employed is required in 2009/10 (see Section 4) which would then be implemented in future years (Appendix 4).

5.2 Harvest estimates

Brook and Whitehead (2005b) suggested a maximum harvest rate of 5–14 % to avoid risk of substantial population decline, and a mean maximum sustainable yield of 10% in any three year period, or 14% in any single year, of total population, has been set as the maximum sustainable harvest limit.

5.2.1 Non-Aboriginal harvest

The only efficient and effective tool for measuring the non-Aboriginal hunting effort is information provided by shooters on number of geese taken. Efforts will be made to improve harvest returns, including seeking greater collaboration from the shooters to provide this information.

In addition, random hunting surveys during the season will record the numbers of hunts and birds taken by each surveyed hunter and can be used to more confidently predict the total number of birds harvested.

5.2.2 Aboriginal traditional harvest estimates

Regular estimates of the size and distribution of this Aboriginal traditional harvest are necessary to ensure the long-term sustainability of magpie geese populations. Key stakeholders including the Northern Land Council will be consulted on ways to monitor Aboriginal harvesting of Magpie Geese.

5.3 Habitat monitoring

NRETAS will maintain a broad overview of the current extent and quality of Magpie Goose habitat on all tenures of land. Information sources will include records made during Magpie Goose aerial surveys, records of weed distribution and pastoral land monitoring reports. Changes in the extent and quality of Magpie Goose habitat will be monitored. On Parks and Reserves, NRETAS will continue to undertake surveys to monitor and control the extent of exotic plant species that are detrimental to Magpie Goose habitat.

Collaboration with Parks Australia North and Government Departments charged with weed monitoring and control is required. Within NRETAS, the Weed Management Branch coordinates strategic control of Mimosa across all NT land tenures through implementing the draft Mimosa management strategy. NRETAS is also reviewing the declared plant list through a weed risk assessment process.

NRETAS will cooperate with the Northern Land Council and participate with Indigenous Community Ranger programs to promote awareness, monitoring and control of exotic plant species on floodplains on Aboriginal land.

5.4 Review of program

The actions in the 2002–2007 Management Program for the Magpie Goose have been reviewed (Appendix 5). The 2009–2014 Program will be fully reviewed at the end of five years from the date of approval of the program as required under section 32(2) of the *TPWC Act*.

6. Required Resources

6.1 Costs

The estimated costs for each objective for each year of the program are outlined in below (Table 5) and in Appendix 4.

Table 5: Indicative implementation and cost schedule for the management of Magpie Geese. Costs are expressed in \$'000s.

Objective	Year					Total
	09/10	10/11	11/12	12/13	13/14	
To maintain viable populations of the Magpie Goose	42	47	47	42	42	220
To promote the long-term protection of the wetland habitats on which Magpie Geese and other wetland fauna depend.	20	15	15	10	10	70
To facilitate, where appropriate, the sustainable use of Magpie Goose populations.	30	30	30	30	30	150
To provide ongoing refinement of Magpie Goose management through timely evaluation of this Management program.	5	5	5	15	15	45
Total	97	97	97	97	97	485

6.2 Resource allocation

The actions proposed in this management program build on previous Magpie Goose survey work undertaken by NRETAS and others. The proposed actions involve collaboration with recreational hunters, pastoralists, Aboriginal landholders and the Northern Land Council. The involvement of the above groups in implementing the management program will assist complementary actions and the efficient use of funds to address management of the species.

7. Definitions

Aboriginal traditional harvest	<i>harvest carried out by Aboriginal people in accordance with Section 122 of the Territory Parks and Wildlife Conservation Act</i>
ANZECC	<i>Australian and New Zealand Environment and Conservation Council</i>
CITES	<i>Convention on International Trade in Endangered Species</i>
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
NLC	<i>Northern Land Council</i>
NRETAS	<i>Department of Natural Resources, Environment, the Arts and Sport</i>
Non-Aboriginal harvest	<i>harvest carried out by either Aboriginal or non-Aboriginal people in accordance with a declared Waterfowl Hunting Season</i>
NT	<i>Northern Territory</i>
Top End	<i>Northern Territory north of 15°S latitude</i>
TPWC Act	<i>Territory Parks and Wildlife Conservation Act</i>
Western Top End	<i>that area of the Top End to the west of 133°E longitude</i>

8. References

- Ad Hoc Eastern Population Tundra Swan Committee (2007). A management plan for the eastern population of tundra swans. The Atlantic, Mississippi, Central and Pacific Flyway Councils.
- Altman J.C. (1987). *Hunter-gatherers today: an Aboriginal economy in north Australia*. Australian Institute for Aboriginal Studies, Canberra.
- ANZECC (1996). Alternatives to the use of lead shot in duck hunting in Australia. ANZECC Task Force on Alternatives to the Use of Lead Shot in Duck Hunting.
- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003) *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Australia.
- Bayliss, P.G. (1989). Population dynamics of Magpie Geese in relation to rainfall and density: implications for harvest models in a fluctuating environment. *J. Appl. Ecol.* **26**, 925-934.
- Bayliss, P.G. and Yeomans, K. (1990a). Seasonal distribution and abundance of Magpie Goose, *Anseranas semipalmata* Latham, in the Northern Territory and their relationship to habitat, 1983-1986. *Aust. Wildl. Res.* **17**: 15-38.
- Bayliss, P.G. and Yeomans, K. (1990b). Use of low-level aerial photography to correct bias in aerial survey estimates of magpie goose and whistling duck density in the Northern Territory. *Aust. Wildl. Res.* **17**: 1-10.
- Beintema, N. (date unknown). Non-toxic shot: a path towards sustainable use of the waterbird resource. Africa-Eurasian Migratory Waterbird Agreement, http://www.unep-aewa.org/publications/technical_series.htm, Technical Series No. 3 report prepared for UNEP/AEWA Secretariat.
- Bowman, D.J.S. and Wilson, B., (1986). Wetland vegetation pattern on the Adelaide River floodplain, Northern Territory, Australia. *Proc. R. Soc. Qld.* **97**.
- Brook, B.W, and Whitehead, P.J. (2005a). Sustainable harvest regimes for magpie geese (*Anseranas semipalmata*) under spatial and temporal heterogeneity. *CSIRO Wildlife Research*, 2005, **32**: 459-464.
- Brook, B.W, and Whitehead, P.J. (2005b). Plausible bounds for maximum rate of increase in magpie geese (*Anseranas semipalmata*): implications for harvest. *CSIRO Wildlife Research*, 2005, **32**: 465-471.
- Burger, J., Kennamer, R.A., Brisbin, I.L. and Gochfield M. (1998). A risk assessment for consumers of Mourning Doves. *Risk Analysis*, **18**(5): 563-573.
- Burgess, C., Johnston F., Bowman, D. and Whitehead P. 2005. Healthy Country: Healthy People? Exploring the health benefits of Indigenous natural resource management. *Australian and New Zealand Journal of Public Health* **29**:117-122.
- Caughley, G. 1977. *Analysis of Vertebrate Populations*. Wiley, London.
- Clarkson, J. (1995). Poned pastures: a threat to wetland biodiversity. In '*Proceedings of Wetland research in the wet-dry tropics of Australia*', (Eds C. M. Finlayson) pp. 206-211. (Environmental Research Institute of the Supervising Scientist, Jabiru).

- Coates, B.J. (1990). *The birds of Papua New Guinea: including the Bismarck Archipelago and Bougainville*. Dove Publications, Alderley, Queensland.
- Corbett, L.K. (1988). Fluctuations in the yearly numbers of magpie goose (*Anseranas semipalmata*) nests at Kapalga in Kakadu National Park with emphasis on the effects of feral buffalo and rainfall. Report to the Australian National Parks and Wildlife Service, CSIRO. Division of Wildlife and Ecology; Darwin
- Ferdinands K., K. Beggs and P. Whitehead (2005). Biodiversity and invasive grass species: multiple-use or monoculture? *Wildlife Research*, **32**(5):447-457.
- Fisher, I.J., D.J. Pain and V.G. Thomas (2006). A review of lead poisoning from ammunition sources in terrestrial birds. *Biol. Cons.* **131**:421-432.
- Freeland, W.J. and Bolton, W.J. (1990). Feral water buffalo (*Bubalus bubalus*) in the major floodplains of the 'Top End', Northern Territory, Australia: Population growth and the Brucellosis and Tuberculosis Eradication Campaign. *Aust. Wildl. Res.* **17**(4), 411-421.
- Frith, H.J. (1967). *Waterfowl in Australia*. Angus and Robertson, Sydney.
- Frith, H.J. and S.J.J.F. Davies (1961). Ecology of the Magpie Goose *Anseranas semipalmata* Latham. *CSIRO Wildl. Res.* **6**, 91-141.
- Hart, B.T., E.M. Ottaway and B.N. Nollu (1987). Magella Creek system, northern Australia. II Material budget for the floodplain. *Aust. J. Mar. Freshw. Res.* **38**, 861-876.
- Hennessy K., C. Page, J. Bathols, K. McInnes, B. Pittock, R. Suppiah and K. Walsh (2004). *Climate change in the Northern Territory*. CSIRO report for the Northern Territory Department of Infrastructure, Planning and Environment. March 2004. <http://www.nt.gov.au/nreta/environment/greenhouse/pdf/ntclimatechange.pdf>
- LCNT (2005). *Integrated Natural Resource Management Plan for the Northern Territory: sustaining our resources – people, country and enterprises*. Landcare Council of the Northern Territory, March 2005.
- Miller, J., James, K. and Maggiore, P. 1993. *Tables of Composition of Australian Aboriginal Foods*. Aboriginal Studies Press.
- Mulrennan, M.E. and C.D. Woodroffe (1998). Saltwater intrusion into the coastal plains of the Lower Mary River, Northern Territory, Australia. *J. Environ. Mgt.* **54**:169-188.
- Nye, E. R., Chris R. Dickman, and Richard T. Kingsford. (2007). A wild goose chase – temporal and spatial variation in the distribution of the Magpie Goose (*Anseranas semipalmata*) in Australia. *Emu* **107**(1) 28–37.
- Saalfeld, WK. 1990. *Aerial survey of magpie goose populations and nesting in the Top End of the Northern Territory - Wet season 1990*. Technical Report Number 50, Conservation Commission of the Northern Territory.
- Saalfeld, W Keith. 1991. *Notes on lead shot load in the substrate of Lambells Lagoon Reserve, Top End, Northern Territory*. Technical Memorandum, Conservation Commission of the Northern Territory.
- Sibley, C.G., Ahlquist, J.E. and Monroe B.L. (1988). A classification of the living birds of the world based on DNA-DNA hybridization studies. *Auk* **105**, 409-423.

- Thomas, V.G. (1997). The environmental and ethical implications of lead shot contamination in rural lands in North America. *J. Agric. Environ. Ethics*, **10**:41-54.
- Tulloch, D.G. and McKean, J.L. (1983). Magpie goose populations on the coastal plains of the Northern Territory (1958-1980). *Corella*, **7(2)**, 32-6.
- Tulloch, D.G., Cellier, K.M. and Hertog, A.L. (1988). The distribution of the nests of the Magpie Goose (*Anseranas semipalmata* Latham) at Kapalga, N.T.: A four-year study. *Aust. Wildl. Res.* **15(2)**: 211-221.
- Vardon, M.J., Missi, C., Cleary, M. and Webb, G.J.W. (1996). Aboriginal use and conservation of wildlife in northern Australia: a cultural necessity. In 'Conservation Outside Nature Reserves' Proceedings.
- Whitehead, P.J. (1998a). *Dynamics of habitat use by the Magpie Goose Anseranas semipalmata: implications for conservation management*. Unpublished Ph.D. thesis, Northern Territory University, Darwin
- Whitehead, P.J. and Dawson, T.E. (2000). Let them eat grass! Nature Australia Summer 2000, 46-55.
- Whitehead, P.J. and Saalfeld, W.K. (2000). Nesting phenology of magpie geese (*Anseranas semipalmata*) in monsoonal northern Australia: responses to antecedent rainfall. *Journal of Zoology (London)* **251**, 494-508.
- Whitehead, P.J. and Tschirner K. (1991). Lead shot ingestion and lead poisoning of Magpie Geese, *Anseranas semipalmata*, foraging in a northern Australian hunting reserve. *Biol. Conserv.* **58(1)**, 99-118.
- Whitehead, P.J., Wilson, B. and Bowman, D.M.J.S. (1990b). Conservation of Northern Territory coastal wetlands: The Mary River floodplain. *Biol. Conserv.* **52**, 85-111.

Appendix 1: Magpie Goose background information

Anseranas semipalmata Latham

Conservation status

Australia

(*Environment Protection and Biodiversity Conservation Act 1999*): Marine protected species.

Northern Territory

(*Territory Parks and Wildlife Conservation Act*): Protected species.

Conservation in reserves

Significant areas of Magpie Goose habitat are contained in the following reserves:

Kakadu National Park	19,804 km ²
Gurig National Park	2,207 km ²
Mary River National Park	1,217 km ²
Djukbinj National Park	552 km ²
Black Jungle/Lambells Lagoon	41 km ²
Harrison Dam	38 km ²
Melacca Swamp	23 km ²
Howard Springs Hunting Reserve	16 km ²
Fogg Dam	15 km ²

Other smaller reserves provide habitat for large flocks of geese at certain times of year e.g. Knuckey's Lagoon and Leaning Tree Lagoon Nature Park.

Aerial surveys in 2000 and 2006 showed that 32% of the 4,300 km² used by Magpie Geese to breed at substantial densities was within protected areas and that 31% of the key dry season floodplain habitat was within protected areas.

Ecology

Key life history and ecological parameters for the magpie goose are summarised below.

Breeding	Concentrated in the wet season with the timing of breeding apparently depending on the progress and extent of flooding and the resultant growth of wetland vegetation. Substantial rainfalls in the dry-wet transition (October-December) increase the proportion of the population breeding and promote early nesting (Whitehead and Saalfeld 2000). The birds aggregate in large breeding colonies in swamps which offer abundant nest sites, together with a supply of food for the young and adults (Frith and Davies 1961; Bayliss and Yeomans 1990; Tulloch <i>et al.</i> 1988)
Clutch size	Varies regionally, from year to year and during nesting seasons (Dexter 1988; Whitehead and Tschirner 1990a; Whitehead and Saalfeld 2000) with a mean clutch size of 8.7 eggs per nest (Whitehead and Saalfeld 2000).
Sexual maturity	Not well known. Whitehead (1998b) suggests that males reach breeding age at four to five years and females after two years.
Egg mortality	Up to 72% of eggs are lost to predation by birds of prey, dingoes, water rats, and goannas (Frith and Davies 1961), water pythons (Whitehead 1998a) and people (Dexter 1988). Flooding may cause significant egg mortality, especially following late heavy rainfall associated with cyclones or severe rain depressions occurring after the peak of nesting (Whitehead and Tschirner 1990b). Magpie Geese can re-lay following complete destruction of a clutch, particularly if it is lost early in the incubation period (Whitehead and Saalfeld 2000).
Gosling mortality	High mortality between hatching and fledging. Dexter (1988) observed Whistling Kites and White-breasted Sea-Eagles taking goslings from a nesting colony on the Adelaide River floodplain. Dingos are also important predators (Corbett 1989). Unfledged geese may perish in large numbers when swamps dry before they are able to fly to suitable alternative habitat (Frith and Davies 1961). Older Magpie Geese also have fewer eggs (Whitehead 1998a).
Post-fledging mortality	Age-specific mortalities after fledging are unknown. Wild Magpie Geese may live for more than 27 years (Tulloch 1985) with mortality rates probably falling considerably after the first year as adult and sub-adult (fledged) birds survive poor seasons and local habitat deterioration by dispersal to more favourable areas.
Movement / dispersal	During the late dry season (October-November) geese concentrate in large flocks around remaining water bodies, but disperse widely following significant wet season rains (Whitehead 1998a). As the frequency and amount of rainfall increases toward the middle of the wet season mature birds again aggregate at floodplain breeding colonies. Wider ranging movements in search of food are probably most common during the dry-wet transition (Frith and Davies 1961; Whitehead 1998a), and post-breeding when family groups seek out large Water Chestnut (<i>Eleocharis dulcis</i>) swamps.

Both recruitment and mortality are closely dependent on erratic rainfall patterns (see Taylor and Tulloch 1985). Persistence of large and relatively stable populations in such circumstances may depend on strong dispersal powers combined with the availability of a wide range of available dry season refuge or breeding areas that differ in the rainfall conditions under which they provide favourable habitat. This notion is consistent with the strong correlation between local population estimates and regional rainfall (Bayliss 1989).

Habitat requirements and availability

The Magpie Goose is a bird of the sub-coastal floodplains. Within these regions, the bird has specialised, but seasonally variable, habitat requirements (Bayliss and Yeomans 1990; Whitehead 1998a). In the Dry season the important habitat requirements for Magpie Geese are:

- Reliable access to areas of shallow water. As ephemeral waters dry, birds become increasingly concentrated and dependent on permanent or semi-permanent water bodies.
- Adjacent areas of floodplain supporting *Eleocharis* spp. and low pasture.
- Roosting sites adjacent to water and feeding areas. Birds may roost on the ground or, more commonly, in trees, especially *Melaleuca* spp. fringing the floodplains.

In the transition between the Dry and Wet seasons, Magpie Geese use open grassed areas which provide patchily distributed grazing following local rainfall. Then, during the wet season and wet-dry transition, they require:

- Ephemeral freshwater over floodplains together with flooding regimes that produce plant communities (chiefly dense stands of *Hymenachne acutigluma*, *Eleocharis* spp. and *Oryza* spp) for breeding. Immature birds may aggregate on the periphery of some breeding colonies in areas dominated by *Fimbristylis* spp.
- Water depths between 30 and 90 cm at nest sites.
- Conditions favouring abundant growth and seeding of *Oryza rufipogon* at the peak of hatching and immediately afterwards.

The availability of suitable habitat is highly variable among regions and years, and broadly reflects variation in the extent and timing of rainfall (Whitehead et al. 1990b). Mortality rises and recruitment declines when below average falls occur. The magnitude of these changes may be related to the proportion of suitable habitat that receives adequate rainfall (Whitehead et al. 1992). Suitable habitat is unlikely to be limiting during favourable seasons given current land use patterns. However, it may become more limiting during sequences of unusually dry years and with sea level rises associated with climate change.

References

- Bayliss, P.G. (1989). Population dynamics of Magpie Geese in relation to rainfall and density: implications for harvest models in a fluctuating environment. *J. Appl. Ecol.* **26**, 925-934.
- Bayliss, P.G. and Yeomans, K. (1990) Seasonal distribution and abundance of Magpie Goose, *Anseranas semipalmata* Latham, in the Northern Territory and their relationship to habitat, 1983-1986. *Aust. Wildl. Res.* **17**, 15-38.
- Corbett, L.K. (1989). Assessing the diet of dingos from faeces: a comparison of three methods. *J. Wildl. Manage.* **53**: 343-346.
- Dexter, N. (1988). *The effect of experimental clutch harvest on Magpie Geese Anseranas semipalmata in sub-coastal Northern Territory, Australia*. Unpubl. M. Appl. Sci. Res. Manage. thesis, Canberra College of Advanced Education.
- Frith, H.J. (1967). *Waterfowl in Australia*. Angus and Robertson, Sydney.
- Frith, H.J. and S.J.J.F. Davies (1961). Ecology of the Magpie Goose *Anseranas semipalmata* Latham. *CSIRO Wildl. Res.* **6**, 91-141.
- Taylor, J.A. and Tulloch, D.G. (1985). Rainfall in the wet-dry tropics: Extreme events at Darwin and similarities between years during the period 1870-1983 inclusive. *Aust. J. Ecol* **10**, 29.
- Tulloch, D.G. (1985). The Magpie Goose (*Anseranas semipalmata*) and the black soil plains: A biological case history of waterbirds in coastal north Australia. Pp. 285-94 in K.N. Bardsley, J.D.S. Davie and C.D. Woodroffe (eds.) *Coasts and Tidal Wetlands of the Australian Monsoon Region*. Australian National University, Mangrove Monograph No. 1.
- Tulloch, D.G., Cellier, K.M. and Hertog, A.L. (1988). The distribution of the nests of the Magpie Goose (*Anseranas semipalmata* Latham) at Kapalga, N.T.: A four-year study. *Aust. Wildl. Res.* **15**(2), 211-221.
- Whitehead, P.J. (1998a). *Dynamics of habitat use by the Magpie Goose Anseranas semipalmata: implications for conservation management*. Unpublished Ph.D. thesis, Northern Territory University, Darwin.
- Whitehead, P.J. (1998b). Boofheads with deep voices: sexual dimorphism in the Magpie Goose *Anseranas semipalmata*. *Wildfowl* **49**, 75 – 91.
- Whitehead, P.J. and Saalfeld, W.K. (2000). Nesting phenology of magpie geese (*Anseranas semipalmata*) in monsoonal northern Australia: responses to antecedent rainfall. *Journal of Zoology (London)* **251**, 494-508.
- Whitehead, P.J. and Tschirner K. (1990a). Eggs and hatchlings of the Magpie Goose, *Anseranas semipalmata*. *Emu* **90**(3), 154-160.
- Whitehead, P.J. and Tschirner K. (1990b). Magpie goose, *Anseranas semipalmata*, nesting on the Mary river floodplain. Extent and frequency of flooding losses. *Aust. Wildl. Res.* **17**, 147-157.
- Whitehead, P.J., Wilson, B. and Bowman, D.M.J.S. (1990b). Conservation of Northern Territory coastal wetlands: The Mary River floodplain. *Biol. Conserv.* **52**, 85-111.
- Whitehead, P.J., Wilson, B. and Saalfeld, K. (1992). Managing the Magpie Goose in the Northern Territory: Approaches to management of mobile fauna in a patchy environment. In “*Conservation and Development Issues in Northern Australia*”. Moffat, I and Webb, A (Eds.). North Australia Research Unit, Australian National University.

Appendix 2: Monitoring and Evaluation

Pre-2009 Population Monitoring

Since 1983 four different broad scale aerial surveys methods have been used to monitor Magpie Goose populations in the Northern Territory (Figure 5). Each survey method provides a different index of the size of the Magpie geese population or suits a different purpose.

1. Wet season surveys: These broad-scale aerial surveys of all of the coastal and sub-coastal wetlands between the Fitzmaurice River and the Arnhem Land escarpment (the index areas) cover approximately 19,000 km² and an estimated 95% of the Magpie Goose population. These western floodplain areas were surveyed annually 1983 - 1993 (Bayliss and Yeomans 1990, Saalfeld 1990), with additional surveys in 1999 and 2000. The previous management program recommended that such surveys be undertaken every four years (see Appendix 5). These wet season surveys currently provide the best and most consistent population distribution and density information for the last 25 years and are generally undertaken in late March/early April.
2. In the 1984, 1985 and 1986 wet seasons, these waterfowl surveys were expanded across the Top End. The previous management program stated that these major Top End wetland surveys for waterfowl should be undertaken every 12 years, or sooner should wet season surveys show a significant decline in Magpie Goose populations (see Appendix 5).
3. During the pre-hunting season small-scale aerial surveys specifically target high density Magpie Goose population and nesting areas (as previously determined). These sample surveys have helped to determine the length of the annual waterfowl hunting season and are conducted in late March/April. Most recently these pre-hunting surveys were undertaken in 2006 and 2007 by helicopter.
4. Dry season survey (October/November): Magpie Geese populations were surveyed in the dry seasons of 1983, 1984 and annually from 1994 to 1997. Only in 1984 can the data be directly compared with a corresponding wet season survey. Analysis of Dry season data from 1983, 1984 and 1995 indicates that 68% of the estimated Magpie Goose populations are restricted to Boggy Plain, Nourlangie Creek on the South Alligator River, and Magella Plain on the East Alligator River. The Dry Season surveys in 1994-1997 were undertaken to trial the use of remote sensing systems to estimate goose populations and were undertaken in conjunction with collecting aerial survey photos. They were not intended to replace the standard wet season surveys.

The methods used for the wet season surveys from 1983 – 1994 are detailed in Bayliss and Yeomans (1990). This technique formed the basis for later surveys with some modifications as influenced by Saalfeld (1998) and Marsh and Sinclair (1989) and is as published by Edwards, Saalfeld and Clifford (2004) for the aerial survey of camels.

Aerial counts of waterfowl are negatively biased (i.e. under estimates of population abundance). Observer saturation precludes the use of the tandem team mark-recapture technique of Marsh and Sinclair (1989) to derive sighting correction factors for observers. Currently published environmental correction factors have been determined across a range of environmental conditions (Bayliss and Yeomans 1990).

Proposed Population Monitoring

The variation in survey methods and timing used since 1983 presents difficulties in understanding the long-term trend in goose populations and of comparing estimates of Magpie Goose populations across years as the underlying conditions and assumptions vary. Neither has there been a regular cycle of surveys since 1993, and few surveys have been undertaken or published since then.

There is therefore a strong need to review previous data and survey methods and to plan a consistent program for monitoring Magpie Geese populations to ensure their long-term sustainability. Questions to be addressed include:

- How can the best use be made of existing data?
- What level of anomalous change (where fluctuations can't be explained by the known effects of weather) should be used to trigger a management response?
- When and how often should surveys be undertaken?
- What are the relative merits of different methods and should some previously unexplored techniques be trialled?
- What survey method(s) should be used?
- Are the current environmental correction factors still adequate?

This review is of the highest priority for the management program and will be initiated in 2009. Relevant experts and stakeholders will be consulted during the process. The revised monitoring program will be appended to this management program when finalised. Until this review is complete, it should be assumed that standard wet season surveys are most appropriate and should be undertaken at least every four years for the area between Fitzmaurice River and Arnhem Land.

Traditional Aboriginal Harvest

Currently there is no systematic monitoring of the Aboriginal traditional harvest. A system to measure the Aboriginal traditional harvest of both birds and eggs will be developed and implemented in collaboration with the Northern Land Council and other indigenous interests. Documentation of this monitoring system will be appended to this management program when complete.

Non-Aboriginal Harvest

The size and extent of the non-Aboriginal harvest will be monitored annually by:

- Conservation Officers patrolling magpie geese hunting areas to measure compliance by hunters of permit conditions
- analysing permit returns to estimate harvest levels
- randomly surveying hunters during the season to help correct for bias in permit returns.

Permits to Destroy

The number of permits issued to destroy birds to mitigate their impacts on agriculture and horticulture will be monitored to ensure take is less than 1%.

Habitats

Much key Magpie Goose habitat is within National Parks, reserves and Aboriginal land. The quality of key Magpie Goose habitat firstly needs to be benchmarked by which to measure any future large-scale changes in key Magpie Goose habitat. The need for regular habitat monitoring will then be reviewed and the details worked out. Some level of broad-scale monitoring may need to be undertaken, either in conjunction with population surveys or independently.

NRETAS will cooperate with the Northern Land Council and Indigenous Community Rangers to monitor exotic plants and feral animals on floodplains on Aboriginal lands.

Review of Program

The actions and performance criteria outlined in this program will be monitored annually to ensure compliance.

References

- Bayliss, P.G. and K. Yeomans (1990). Seasonal distribution and abundance of Magpie Goose, *Anseranas semipalmata* Latham, in the Northern Territory and their relationship to habitat, 1983-1986. *Aust. Wildl. Res.* **17**, 15-38.
- Edwards. G.E., W.K. Saalfeld and B. Clifford (2004). Population trends in the feral camel in the Northern Territory, Australia. *Wildlife Research*, **31**(5):509-517.
- Marsh, H and D.F. Sinclair (1989). Correcting for visibility bias in strip transect aerial surveys of aquatic fauna. *J. Wildl. Manage.* **53**(4), 1017-1024.
- Saalfeld, WK. 1990. *Aerial survey of magpie goose populations and nesting in the Top End of the Northern Territory - Wet season 1990*. Technical Report Number 50, Conservation Commission of the Northern Territory.
- Saalfeld, W.K. (1998). *Aerial survey of donkey and horse populations in the Victoria River District 1996*. Technical Report. Parks and Wildlife Commission of the Northern Territory.

Appendix 3: Communications Plan for 2009–2014 Program

A. Overarching Communications Plan for the life of Management Program.

Objective 1 – To maintain viable populations of the Magpie Goose.

Action	Communication of outcomes
Review and re-design monitoring program for Magpie Geese surveys.	Provide as updated attachment to program on website and disseminate through existing stakeholder interactions
Implement survey monitoring program	Web, NT Firearms Council, general media
Review existing models of Magpie Goose population dynamics in relation to rainfall and refine to permit robust identification of anomalous change	Peer-reviewed journals and on web.
Maintain a watching brief on minor threats and instigate adaptive management actions should their impacts appear to increase.	General media and existing stakeholder interactions
Encourage the use of non-destructive methods to mitigate any horticultural or agricultural impacts.	Individual applicants and general media opportunistically
Monitor permit applications and approvals to ensure performance criterion is met.	Internal reporting

Objective 2 – To promote the long-term protection of the wetland habitats on which Magpie Geese and other wetland fauna depend.

Action	Communication of outcomes
Prohibit the use of toxic shot for waterfowl hunting across all land tenures in the Northern Territory as a condition of the declaration of the annual Waterfowl Hunting Season.	Public meetings and advertising of annual Waterfowl Hunting Season
Negotiate with representatives of Aboriginal landowners and other Aboriginal people to promote the use of non-toxic shot when harvesting waterfowl	Northern Land Council for dissemination to traditional owners and other Aboriginal people
Develop and implement a public awareness campaign to explain and promote the need for, and benefits of, using non-toxic shot, with particular emphasis in reaching Aboriginal hunters.	Public and community meetings and workshops, media advertising and information presentations, brochures and pamphlets.
Explore options to assist hunters to become more skilled shooters, more proficient users of non-toxic shot and therefore more efficient hunters.	To be developed as part of Action
Collaborate with researchers to develop predictive models for potential changes in habitat due to climate change, weeds and feral animals.	Peer-reviewed journals, web and existing stakeholder interactions
Establish benchmarks by which to measure any future large-scale changes in key Magpie Goose habitat.	
Work with landholders and other key stakeholders to mitigate the impacts of weeds and feral animals.	Landholder and stakeholder interactions
Work with land managers to monitor and control any new outbreaks of Mimosa and Para Grass in the western floodplains.	General media and existing stakeholder interactions
Manage weeds and feral animals on National Parks and reserves in accordance with Management programs.	Internal reporting
Maintain a watching brief on any major changes in extent and quality of key Magpie Goose floodplain habitat.	Disseminate any changes through existing stakeholder interactions

Objective 3 – To facilitate, where appropriate, the sustainable use of Magpie Goose populations.

Action	Communication of outcomes
Review hunting effort and take and, should harvest approach or exceed the stated 10 or 14% levels, consult with both Aboriginal and non-Aboriginal hunters to reduce harvest to sustainable levels.	General media, web and see separate table below)
Hold an annual public meeting for stakeholders with interests in recreational hunting management to discuss the waterfowl hunting season.	(see separate table below)
Annually declare waterfowl hunting season with seasonally-specific conditions as appropriate.	(see separate table below)
Monitor compliance with permit conditions through on-ground patrols throughout the season and via surveying hunters during the season.	Internal reporting, NT Firearms Council for dissemination to member organisations
Investigate ways to improve quantity and quality of waterfowl hunting season permit returns.	NT Firearms Council for dissemination to member organisations (and dependent on outcomes of Action)
Develop and implement a Waterfowl Hunting Plan that addresses both on- and off-reserve waterfowl hunting, including annual declaration and conditions of the waterfowl hunting season.	NRETAS and other government agencies, Northern Land Council for dissemination to traditional owners and other Aboriginal people, NT Firearms Council for dissemination to member organisations, and the general public
Develop and implement a monitoring system to measure the Aboriginal traditional harvest of Magpie Geese after consultation with the Northern Land Council, traditional owners and other Aboriginal people.	Northern Land Council for dissemination to traditional owners and other Aboriginal people, NT Firearms Council for dissemination to member organisations (and dependent on outcomes of Action)
Ensure that any evidence of local impacts is investigated and appropriate action taken.	Disseminate any changes through existing stakeholder interactions
Ensure any egg collections are timed to minimise natural pre-harvest losses from predation and flooding.	
Ensure any requests for commercial harvests avoid areas where there is other significant harvest.	
Encourage ranching to reduce impacts on the wild population.	
Collaborate with researchers to gather information on the impacts of harvest and use it to refine the model for estimating the impact of Magpie Goose harvesting on populations	Peer-reviewed journals as appropriate, and any changes through web and existing stakeholder interactions

Objective 4 – To provide ongoing refinement of Magpie Goose management through timely evaluation of this Management program.

Action	Communication of outcomes
Annually audit the progress of the Management program against each of the performance criteria and adjust management practices as necessary.	Internal reporting
Annually review and update the Communications Plan.	Internal reporting
Review and update the Management Program by 2014.	2014-2019 Management Program

B. Proposed timeline and communications plan for the annual Declaration of the Waterfowl Hunting Season

WK	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1	Permit returns submitted from Hunters.	Meet with NT Firearms Council to discuss hunting season.		Brief to Minister with recommendations for Hunting season, Instrument for signature and Gazettal.	Advertise season opening (Saturday) and issue Permits (following Monday) two months prior to opening of Season	Advertise Waterfowl Hunting Season	Mid-week, earliest opening of Hunting Season
2		Public meeting to discuss hunting season	Meet with NT Firearms Council to discuss hunting season.	Print Permits and associated maps and information. Develop media releases for the Hunting Season			
3		Analyse population / nesting survey data / information and permit returns.	Apply to Parliamentary Council for Hunting Season Instrument.			Advertise Waterfowl Hunting Season	
4	Nesting survey (if undertaken) to coincide with peak nesting (approx. late March to late April).	Organise new Permits and stickers.		Parks to organise Joint Patrols with Police for Hunting Season.			

Appendix 4: Annual Milestone Matrix for 2009–2014 Program

Milestone matrix for each objective in the Magpie Goose 2009–2014 management program.

Aim: To ensure the long-term conservation of the Magpie Goose and its habitats in the Northern Territory.

Objective 1 – To maintain viable populations of the Magpie Goose.

Milestone	Action Officer	2009-10	2010-11	2011-12	2012-13	2013-14
Review and re-design monitoring program for Magpie Geese surveys.	Director, Wildlife Use	2009-10				
Implement survey monitoring program	Director, Wildlife Use		Commence in 2010-11			
Review existing models of Magpie Goose population dynamics in relation to rainfall and refine to permit robust identification of anomalous change	Director, Wildlife Use	Commence in 2009-10				
Maintain a watching brief on minor threats and instigate adaptive management actions should their impacts appear to increase.	Director, Wildlife Use	Ongoing; review annually	Ongoing; review annually	Ongoing; review annually	Ongoing; review annually	Ongoing; review annually
Encourage the use of non-destructive methods to mitigate any horticultural or agricultural impacts.	Director, Wildlife Use	Ongoing; review annually	Ongoing; review annually	Ongoing; review annually	Ongoing; review annually	Ongoing; review annually
Monitor permit applications and approvals to ensure performance criterion is met.	Director, Wildlife Use	Ongoing; review annually	Ongoing; review annually	Ongoing; review annually	Ongoing; review annually	Ongoing; review annually

Objective 2 – To promote the long-term protection of the wetland habitats on which Magpie Geese and other wetland fauna depend.

Milestone	Action Officer	2009-10	2010-11	2011-12	2012-13	2013-14
Prohibit the use of toxic shot for waterfowl hunting across all land tenures in the Northern Territory as a condition of the declaration of the annual Waterfowl Hunting Season.	Executive Director, Collections, Biodiversity and Biological Parks	Commence in 2009-10				
Negotiate with representatives of Aboriginal landowners and other Aboriginal people to promote the use of non-toxic shot when harvesting waterfowl	Director, Conservation and Wildlife	Commence in 2009-10	ongoing	ongoing	ongoing	ongoing
Develop and implement a public awareness campaign to explain and promote the need for, and benefits of, using non-toxic shot, with particular emphasis in reaching Aboriginal hunters	Director, Conservation and Wildlife	Commence in 2009-10	ongoing	ongoing	ongoing	ongoing
Explore options to assist hunters to become more skilled shooters, more proficient users of non-toxic shot and therefore more efficient hunters.	Director, Conservation and Wildlife	Commence in 2009-10	ongoing	ongoing	ongoing	ongoing
Collaborate with researchers to develop predictive models for potential changes in habitat due to climate change, weeds and feral animals.	Director, Wildlife Use	Commence in 2009-10	ongoing	ongoing	ongoing	ongoing
Establish benchmarks by which to measure any future large-scale changes in key Magpie Goose habitat.	Director, Wildlife Use		Commence in 2010-11			
Work with landholders and other key stakeholders to mitigate the impacts of weeds and feral animals.	NRM Division and Parks Division	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually
Work with land managers to monitor and control any new outbreaks of Mimosa and Para Grass in the western floodplains.	NRM Division	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually
Manage weeds and feral animals on National Parks and reserves in accordance with Management programs.	Parks Division	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually
Maintain a watching brief on any major changes in extent and quality of key Magpie Goose floodplain habitat.	Director, Wildlife Use	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually

Objective 3 – To facilitate, where appropriate, the sustainable use of Magpie Goose populations.

Milestone	Action Officer	2009-10	2010-11	2011-12	2012-13	2013-14
Review hunting effort and take and, should harvest approach or exceed the stated 10% or 14% levels, consult with both Aboriginal and non-Aboriginal hunters to reduce harvest to sustainable levels.	Director, Wildlife Use	Annually in March	Annually in March	Annually in March	Annually in March	Annually in March
Hold an annual public meeting for stakeholders with interests in recreational hunting management to discuss the waterfowl hunting season.	Director, Conservation and Wildlife	June each year	June each year	June each year	June each year	June each year
Annually declare waterfowl hunting season with seasonally-specific conditions as appropriate.	Director, Conservation and Wildlife	July each year	July each year	July each year	July each year	July each year
Monitor compliance with permit conditions through on-ground patrols throughout the season and via surveying hunters during the season.	Director, Conservation and Wildlife	Annually during hunting season	Annually during hunting season	Annually during hunting season	Annually during hunting season	Annually during hunting season
Investigate ways to improve quantity and quality of waterfowl hunting season permit returns.	Director, Conservation and Wildlife	Commence in 2009-10				
Develop and implement a Waterfowl Hunting Plan that addresses both on- and off-reserve waterfowl hunting, including annual declaration and conditions of the waterfowl hunting season.	Director, Conservation and Wildlife	Commence in 2009-10	Ongoing	Completed in 2011-12		
Develop and implement a monitoring system to measure the Aboriginal traditional harvest of Magpie Geese after consultation with the Northern Land Council, traditional owners and other Aboriginal people.	Director, Wildlife Use	Commence in 2009-10				
Ensure that any evidence of local impacts is investigated and appropriate action taken.	Director, Wildlife Use and Director, Conservation and Wildlife	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually	Ongoing, review annually

Objective 3 – To facilitate, where appropriate, the sustainable use of Magpie Goose populations.

Milestone	Action Officer	2009-10	2010-11	2011-12	2012-13	2013-14
Ensure any egg collections are timed to minimise natural pre-harvest losses from predation and flooding.	Director, Wildlife Use	ongoing	ongoing	ongoing	ongoing	ongoing
Ensure any requests for commercial harvests avoid areas where there is other significant harvest.	Director, Wildlife Use	ongoing	ongoing	ongoing	ongoing	ongoing
Encourage ranching to reduce impacts on the wild population.	Director, Wildlife Use	ongoing	ongoing	ongoing	ongoing	ongoing
Collaborate with researchers to gather information on the impacts of harvest and use it to refine the model for estimating the impact of Magpie Goose harvesting on populations	Director, Wildlife Use	Commence in 2009-10				

Objective 4 – To provide ongoing refinement of Magpie Goose management through timely evaluation of this Management program.

Milestone	Action Officer	2009-10	2010-11	2011-12	2012-13	2013-14
Annually audit the progress of the Management program against each of the performance criteria and adjust management practices as necessary.	Director, Wildlife Use	March each year	March each year	March each year	March each year	March each year
Annually review and update the Communications Plan.	Director, Wildlife Use	March each year	March each year	March each year	March each year	March each year
Review and update the Management program by 2014.	Director, Wildlife Use				Commence in 2013	

Appendix 5: Review of 2003–2007 Management Program

Report on the Previous Magpie Goose Management Program (2003 – 2007) Milestone Matrix.

2003–2007 Milestone Matrix	Year						Report on Milestone Achievements as per August 2007
	2003/4	2004/5	2005/6	2006/7	2007/8		
Declaration of annual waterfowl hunting season.	Jul 04	Jul 05	Jul 06	Jul 07	Jul 08		Hunting seasons were declared each year and successfully managed.
Monitoring of wet season Magpie Goose populations index areas and core nesting areas (1 survey every 4 years).				April 06			The wet season index areas were surveyed in 2006.
Monitoring of dry season Magpie Goose population index areas (1 survey every 4 years).		Dec 04					There was no 2004 dry season survey due to financial constraints.
Investigate feasibility of monitoring Magpie Goose habitat health using remote sensing technology.			Dec 05				Not undertaken due to unreliable results from goose population and nest monitoring analysis using videography.
Major Magpie Goose population survey of all Top End wetlands (1 survey every 12 years).					Jun 08		No major Magpie Goose survey was undertaken during the life of the program due to index areas showing stable Magpie Goose populations. The last survey of all Top End wetlands was undertaken in 1986.
Assess use of videography to monitor Magpie Goose nesting and feeding habitat in index areas.		Dec 04					Remote sensing technology, both videography and aerial photography, was trialled. Initial results were not accurate enough to warrant replacing conventional field surveys at this stage.
Prohibit the use of lead shot for recreational waterfowl hunting across NT.		Aug 04					The use of lead shot for recreational waterfowl hunting is banned on NT Parks and Reserves. No progress was made in relation to expanding this to all NT lands due to legislative complexities.

2003–2007 Milestone Matrix	Year					Report on Milestone Achievements as per August 2007
	2003/4	2004/5	2005/6	2006/7	2007/8	
Attend annual public meeting with recreational waterfowl hunters to discuss waterfowl hunting season.	Jun 04	Jun 05	Jun 06	Jun 07	Jun 08	Meetings were held annually with Waterfowl Hunters. Input from these meetings was considered in the management and timing of hunting seasons.
Negotiate with Indigenous landowner organisations for a phase-out of the use of lead shot on Aboriginal freehold lands.	Timeframe variable, commence in 2003/04					No progress was made on this during the life of the program.
Negotiate with landholders to manage significant wetlands to achieve conservation outcomes in relation to Magpie Goose habitat.	Timeframe variable, commence in 2003/04					No progress was made on this during the life of the program.
Refine model of Magpie Goose harvest impact on populations.	Dec 03	Dec 04	Dec 05	Dec 06	Dec 07	Model completed (Brook & Whitehead, 2005).
Review of program.					Dec 07	Completed.
Encourage control of exotic plant species on Aboriginal communities.						Weeds Management Branch coordinated control programs for Mimosa and other weed species.
Consider declaring important habitat as “Essential Habitat” under the Territory Parks and Wildlife Conservation Act 2006. E.g. Mary River and Djukbinj NP (page ii, and page 5).						No habitat was declared as Essential during the life of the program.
Issue permits to take birds up to 1% of the local population to limit detrimental impact on agriculture (page iv).						Permits have been issued during life of program with numbers of birds taken below 1% local population.
Within National Parks and Reserves, prevent large infestations of Mimosa and Para grass from spreading and eradicating any new infestations.						Efforts to contain Mimosa have been reasonably successful on Parks and Reserves and containment efforts continue.
NRETAS will seek to increase options available for landholders to derive an income from natural wetlands (page 5).						No permits for commercial use of Magpie Geese were issued during the term of the previous program.

2003–2007 Milestone Matrix	Year					Report on Milestone Achievements as per August 2007
	2003/4	2004/5	2005/6	2006/7	2007/8	
Encourage Aboriginal Communities to apply for permits to sell Magpie Geese and artefacts derived from Magpie Geese.						Attempts to encourage establishment of Indigenous commercial use of Magpie Goose were unsuccessful due to significant initial capital costs associated with Health Department requirements for human consumption.
A model examining the impact of harvest off-takes (commercial and non-commercial) on Magpie Goose populations will be used, in conjunction with population monitoring, to guide the setting of harvest levels.						Brook & Whitehead (2005) modelling addressed this. There is no commercial harvest yet to model.
Co-operate with the Northern Land Council and participation with Indigenous Community Ranger programs to promote awareness, monitoring and control of exotic plant species on floodplains on Aboriginal land.						Weeds Management Branch is continuing to coordinate control programs for Mimosa and other weed species.
In protected areas existing large infestations of Mimosa, Para Grass and Olive Hymenachne will be prevented from expanding and any new populations found will be monitored and controlled.						Annual Weed action plans on Parks have addressed weed control on Parks and Reserves.