NSW **National Parks and Wildlife Service**

Mid North Coast Region

Pest Management Strategy

2008-2011

Department of **Environment & Climate Change** NSW

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The NSW National Parks and Wildlife Service (NPWS) is part of the Department of Environment and Climate Change (DECC). Throughout this strategy, references to "NPWS" should be taken to mean the Parks and Wildlife Group carrying out functions on behalf of the Director General and the Minister of DECC.

Cover photographs: clockwise from top left

Feral cat ***control*** *– Kumbatine National Park* (A. Marshall)
Dingo ***dna/tagging/tracking*** *– Limeburners Creek Nature Reserve* (J. Baldwin)
Fox ***control*** *– Crowdy Bay NP* (A. Marshall)
Bitou bush ***monitoring*** *- control transect – Hat Head National Park* (M. Dodkin)
Cane toad ***musters*** *– Port Macquarie* (NPWS)
Aerial bitou bush ***spraying*** *– Sea Acres Nature Reserve* (B. Marchant)
Water lettuce ***infestation*** *– Crowdy Bay National Park* (M. Dodkin)
Wild deer ***road accidents*** *– Lake Innes Nature Reserve* (B. Laut)

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Common Terms and Acronyms

Acronym	Term	Definition
BMAD	Bell Minor Associated Dieback	
CAMBA	China – Australia Migratory Bird Agreement	Agreement between the Government of Australia and the Government of the People's Republic of China for the protection of migratory birds and their environment.
CMA	Catchment Management Authority	CMAs are regional bodies that work in partnership with farmers, local groups, Aboriginal communities, local government, industry and State Government agencies to develop the best policies and programs for natural resource management at a catchment level.
CDEP	Community Development Employment Projects	The CDEP program is an Australian Government funded initiative for unemployed Indigenous people in selected locations.
DECC	Department of Environment and Climate Change	The State Government Department that brings together a range of conservation and natural resources science and programs, including native vegetation, biodiversity and environmental water recovery to provide an integrated approach to natural resource management. DECC includes the Parks and Wildlife Group, whose 'public' name is NPWS.
DPI	Department of Primary Industries	NSW Department of Primary Industries (DPI) acts in partnership with industry and other public sector organisations to foster profitable and sustainable development of primary industries in NSW. The department was formed in July 2004, with the amalgamation of Mineral Resources NSW, NSW Agriculture, NSW Fisheries and State Forests NSW.
EEC	Endangered Ecological Community	Schedule 1 of the TSC Act lists threatened species, populations and ecological communities and species that are endangered or presumed extinct. The TSC Act defines 'endangered' as a species, population or ecological community that is likely to become extinct or is in immediate danger of extinction.
EPBC Act	Environment Protection and Biodiversity Conservation Act 2000	
FAWNA	For Australian Wildlife Needing Aid	FAWNA is a volunteer wildlife rescue and rehabilitation service for injured and orphaned native wildlife. FAWNA operates on the mid north coast of NSW and is licensed by NSW National Parks and Wildlife Service (NPWS).
Game Act	Game and Feral Animal Control Act 2002	
GIS	Geographic Information System	
HS	Historic Site	
JAMBA	Japan – Australia Migratory Bird Agreement	Agreement between the government of Australia and the government of Japan for the protection of migratory birds and birds in danger of extinction and their environment.
KTP	Key Threatening Process	
LGA	Local Government Area	

MNCR	Mid North Coast Region	NSW NPWS Mid North Coast Region
NP	National Park	
NPW Act	National Parks and Wildlife Act	
NPWS	NSW National Parks and Wildlife Service	The 'public' name of Parks and Wildlife Group within DECC.
NR	Nature Reserve	
NSW	New South Wales	
OSCU	Operations Support and Coordination Unit	NPWS MNCR OSCU
PAS	Priorities Action Statement	The PAS provides an overview of recovery actions for all NSW threatened species, populations and ecological communities. It establishes relative priorities and timetables for carrying out recovery actions, and will establish performance indicators to monitor the progress of each species' recovery.
RAMSAR	The Convention on Wetlands of International Importance	The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those that remain.
RLPB	Rural Lands Protection Board	Statutory bodies under the Rural Lands Protection Act 1998 that deliver essential services to ratepayers and others in each district as the frontline in the management of animal health, pest animal and insect control, travelling stock reserves, stock movement, stock identification and drought relief. There are currently 47 RLPB's which cover NSW.
RLP Act	Rural Lands Protection Act 1998	
ROKAMBA	Republic of Korea – Australia Migratory Bird Agreement	The ROKAMBA formalises Australia's relationship with the Republic of Korea in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat.
RPMS	Regional Pest Management Strategy	This document.
RSPCA	Royal Society for Protection of Cruelty to Animals	
SCA	State Conservation Area	
SEPP 14	State Environmental Planning Policy 14 - Coastal Wetlands	State Environmental Planning Policy No. 14 aims to preserve and protect coastal wetlands in the environmental and economic interest of NSW.
State Plan	NSW State Government Plan	The State Plan sets outs the goals the community wants the Government to work towards. It identifies priorities for Government action over the next 10 years.
TAP	Threat Abatement Plan	Comprehensive plans to tackle the state's 'Key Threatening Processes' - from foxes and feral cats to land clearing and firewood collection. The plans outline actions to manage these threats, and explain how the actions can be put into effect.
TSC Act	Threatened Species Conservation Act	
WDCA	Wild Dog Control Association	

1 Introduction

Pest species are animals (including invertebrates) and plants that have negative environmental, economic and social impacts. In this document they are collectively referred to as pests. Pests are most commonly introduced species, though native species can become pests. In parks, pests may have impacts across the range of park values, including impacts on biodiversity, cultural heritage, catchment and scenic values.

Pests are among the greatest threats to biodiversity throughout Australia. In New South Wales, they have been identified as a threat to 657 of 945 (70%) species, populations and communities listed under the *Threatened Species Conservation Act 1995* (TSC Act); more than any other process except the destruction and disturbance of native vegetation. Minimising the impacts of pests on biodiversity is thus the main objective of National Parks and Wildlife Service (NPWS) pest management.

Pests can also have significant impacts on economic values of neighbouring lands. The NPWS seeks to address these impacts when setting management priorities and significant resources are committed towards landscape wide pest programs, including wild dogs. The control of pests outside of parks is the responsibility of private landholders and other agencies such as Rural Lands Protection Boards (RLPB's), local Councils, the Department of Primary Industries (DPI) and the Department of Lands. The NSW Invasive Species Plan provides the framework for the coordinated management of weeds and pests that occur over varying land tenure. NPWS is a committed partner to the implementation of this plan.

Many pests are distributed widely across Australia and eradication is not possible in the foreseeable future. They occur in most environments and across all land tenures. Pests often spread quickly and have high reproductive rates, allowing them to re-establish rapidly following control programs. In recognising that eradication of widespread pests across large areas is an unrealistic goal, NPWS prioritises effort to focus on areas where outcomes/control potential is greatest. Resources can then be directed to ensure that the resultant control programs are effective in reducing these impacts. It is the responsibility of all land managers to work together to control pests where significant impacts have been identified.

In NSW, the main pest management priorities for the conservation of biodiversity are focussed on threatened species and endangered ecological communities, and are identified in the Threatened Species Priorities Action Statement (PAS), individual threat abatement plans (TAP's) and reserve plans of management. Pest programs are also integrated with other park management programs such as fire management.

2 Purpose of the Strategy

The development of Regional Pest Management Strategies (RPMS's) provides NPWS with a strategic approach to pest management across NSW. The strategy developed for each region provides a tool to broadly identify pest distribution and their associated impacts across the park system. It details priorities for each Region, including actions listed in the PAS and TAP's. It also details actions to protect neighbours from pests such as wild dog, pig, and site based weed control and allows resources to be allocated to high priority programs. The RPMS also identifies the requirement for other plans or strategies, such as wild dog plans or bush regeneration plans, which provide a more detailed approach.

New pest species continue to establish in the environment either through the importation of new species into Australia or the escape of domestic plants and animals. Prevention and early detection followed by eradication is the most cost-effective way to minimise the impacts of new pests. The NPWS works with other agencies to prevent the introduction of new pests into the wild and to respond rapidly when new incursions occur. The response of NSW government agencies to new pests will be coordinated through the NSW Invasive Species Plan.

This strategy has a four (4) year life span. In the final year of the strategy, it is intended that the strategy will be reviewed and updated.

3 Legislation and Policy

The NPWS has a number of statutory responsibilities in relation to pest management.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) vests the care, control and management of national parks, nature reserves, historic sites and Aboriginal areas with the Director-General of the NPWS. Key management objectives include conservation, provision of appropriate scientific and educational opportunities, and management of fire and pest species. These are achieved through the preparation and implementation of plans of management for each reserve, which identify pest species present, control strategies and priorities for that reserve.

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) lists threatened species, endangered populations and endangered ecological communities. The TSC Act also lists key threatening processes (KTPs), which are identified as having significant impacts on the conservation of native flora and fauna. As of August 2006, 18 pests have been listed as KTPs e.g. *Predation by the Red Fox*, *Invasion of Native Plant Communities by Bitou Bush and Boneseed*. The NSW Threatened Species Priorities Action Statement (PAS) outlines the strategies for ameliorating threats listed under the TSC Act including the preparation of TAP's. For each of these strategies the PAS lists one or more detailed actions which aim to protect threatened species by reducing the impact of listed threats.

Rural Lands Protection Act 1998

The pest animal provisions of the *Rural Lands Protection Act 1998* (RLP Act) outline the conditions under which animals, birds and insects are "declared" pests and provides for the control of such pest species. Gazettal of pest species occurs through Pest Control Orders that allow the Minister for Primary Industries to specify pest species on a state wide or local basis and the conditions or factors that apply to the control of each pest. Rabbits, wild dogs and feral pigs have been declared pest animals throughout NSW.

The RLP Act binds the Crown for the control of pest animals declared under the Act. Public land managers such as the NPWS are required to eradicate (continuously suppress and destroy) pest animals "…to the extent necessary to minimise the risk of the pest causing damage to any land" using any lawful method or, if the Order specifies a method to be used, by the method specified.

An approach to balance the conservation of dingoes with the need for wild dog control has been incorporated into the RLP Act through the Pest Control Order for Wild Dogs. This order allows for the general destruction obligation for lands listed in Schedule 2 of the order to be satisfied through wild dog management plans with both control and conservation objectives.

Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* provides for the identification, classification and control of noxious weeds in New South Wales. The Act aims to identify noxious weeds and their respective control measures, as well as the roles and responsibilities for their control for both public and private land managers/owners.

Amendments to the Noxious Weeds Act in 2005 repealed the NSW *Seeds Act 1982* and introduced a new classification system of weed control classes based on the degree of threat and the distribution of the introduced plant within the state. These new control classes are:
Control Class 1 – State Prohibited Weeds
Control Class 2 – Regionally Prohibited Weeds
Control Class 3 – Regionally Controlled Weeds
Control Class 4 – Locally Controlled Weeds
Control Class 5 – Restricted Plants.

Under this new classification system, Control Classes 1, 2 and 5 noxious weeds are referred to as notifiable weeds.

Pesticides Act 1999

The *Pesticides Act 1999* and the Pesticides Regulation 1995, regulate the use of all pesticides in NSW, after point of sale, and includes specific provisions for record keeping, training and notification of use. Specific requirements have been included under the Pesticides Regulation in relation the following.

Pesticide Record Keeping: Records must be kept by all people who use pesticides for commercial or occupational purposes such as on farm or as part of their occupation or business. There are also specific record keeping provisions for persons who aerially apply pesticides under both the Act and regulations.

Pesticides Training: People who use pesticides in their business or as part of their occupation must be trained how to use these pesticides. Any person employed or engaged (e.g. volunteers) by NPWS to use pesticides must also be trained.

Pesticide Notification: Notification requirements apply to pesticide applications by public authorities in public places (including NPWS estate). The NPWS Pesticide Use Notification Plan sets out how the Department will notify the community about pesticide applications it makes to public places. (The plan can be located on the NPWS web site).

Pesticide Control Orders are orders that: prohibit or control the use of a pesticide or a class of pesticide, or authorise the use or possession of a restricted pesticide e.g. 1080. Use of a pesticide must be in accordance with the Control Order where such exists. Current Control Orders can be found at:
www.environment.nsw.gov.au/pesticides/pco.htm.

Game and Feral Animal Control Act 2002

The major aim of the *Game and Feral Animal Control Act 2002* (Game Act) is to promote responsible and orderly hunting of game animals and certain pest animals. The public lands that are covered by this Act do not include any NPWS estate.

Other Relevant Legislation

- *Environment Protection and Biodiversity Conservation Act 2000* (Australian)
- *Agricultural and Veterinary Chemicals Code Act 1994*
- *Environmental Planning and Assessment Act 1979*
- *Firearms Act 1996*
- *Heritage Act 1977*
- *Prevention of Cruelty to Animals Act 1979*
- *Occupational Health and Safety Act 2000*
- *Wilderness Act 1987*
- *Protection of the Environment Operations Act 1997*

Park Management Program and Policies

The Park Management Program is a series of guides which are being developed to define the values and objectives for park management and to integrate park policy, planning, operations, monitoring, evaluation and reporting. The aims of the guides are to improve the way we go about park management by:

- providing clear and consistent management objectives and operational procedures; and
- introducing a system to achieve consistent standards in park management and reporting on performance.

The Park Management Program comprises a Policy Guide, a Planning Guide, an Operating Procedures Guide and a Monitoring and Evaluation Guide. The Policy Guide describes the goals and objectives for park management and the key principles which are applied to guide the achievement of these objectives. Some specific policies relating to the management of weeds and pest animals are mentioned below. Figure 1 contains a flow chart of the pest species management process and highlights the linkages between legislation, policy, planning, implementation, and reporting.

Policy 2.6 Wild Dogs acknowledges the complexities inherent in the need to conserve native dingoes (and their hybrids) together with the need to control wild dogs.

The NPWS Firearms Management Manual brings together the policy, procedural and technical information required for staff regarding the safety, security and legal procedures for keeping and using firearms. The manual replaced the *NPWS Firearms Policy* and provides policy and procedures for all aspects of firearms use and management including:

- possession and use of firearms by NPWS staff and other approved users;
- firearms administration and record keeping;
- location and storage of firearms;
- planning and risk management for firearms operations;
- maintenance and modification of firearms;
- animal welfare issues related to shooting pest animals and euthanasing native animals; and
- firearms training.

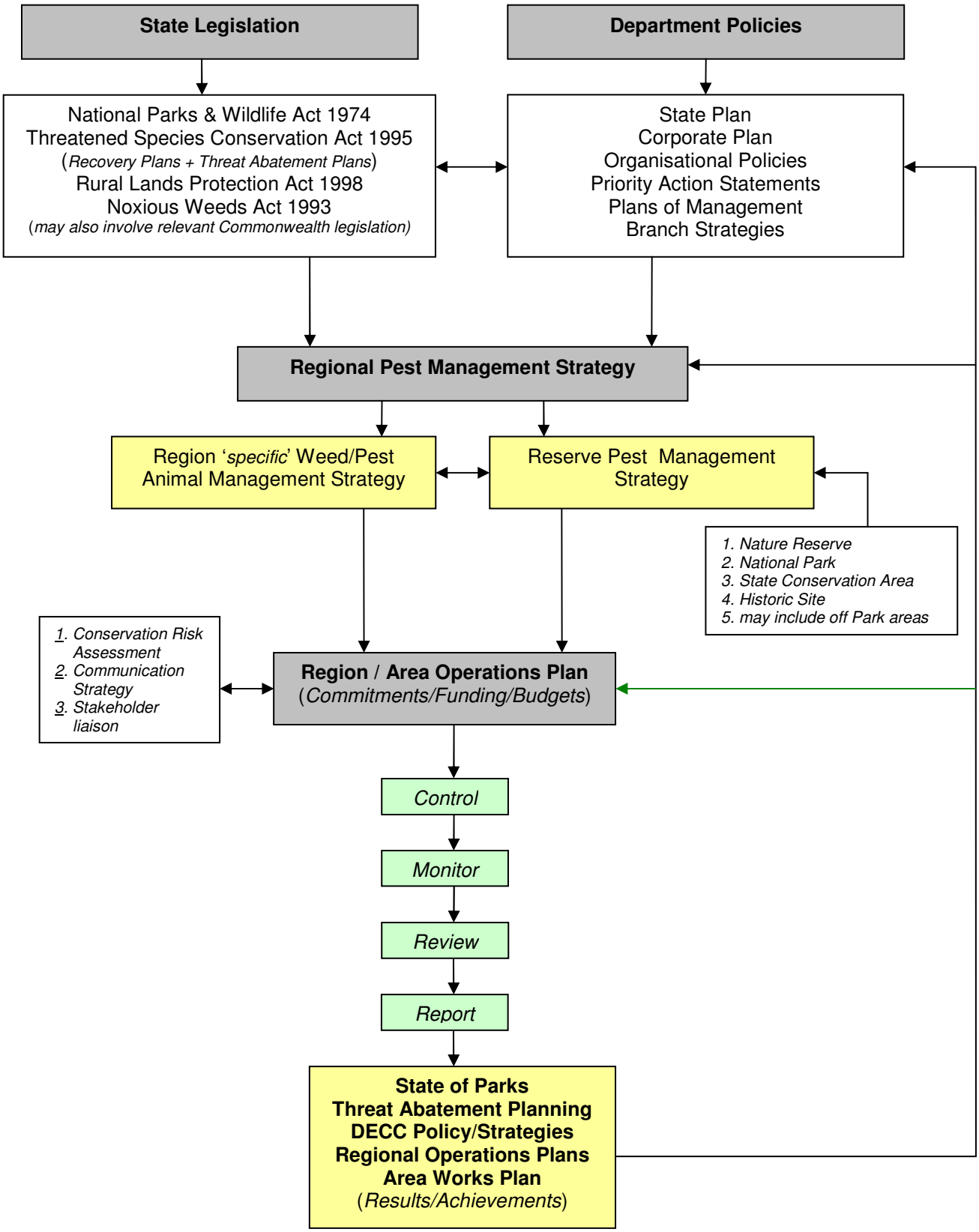

Figure 1. Pest Species Planning and Management Process

A statewide policy directive requires conservation risk assessments for the application of pesticides on park to ensure that an appropriate level of environmental assessment is carried out prior to application.

Other Plans

Other plans that help direct pest management may include Catchment Action Plans for each of the 13 Catchment Management Authorities, regional weed plans, state and national strategies, and reserve Plans of Management.

This RPMS satisfies several State Plan targets:

- *E4: Better environmental outcomes for native vegetation, biodiversity, land, rivers and coastal waterway:*
- This Strategy contains a number of actions to help achieve priority E4, through the implementation of feral animal and weed control programs to reduce impacts on biodiversity.
- *P6: Increased business investment in rural and regional NSW:*
- This Strategy contains actions that will reduce potential and actual economic impacts of pests to neighbouring enterprises.
- *E1: A secure and sustainable water supply for all users:*
- This Strategy includes actions that will enhance water catchment values through the control of weeds and feral animals in catchment areas.

4 Regional Overview

The Mid North Coast Region (MNCR) covers the Manning, Hastings and Macleay valleys. The MNCR extends from Wang Wauk/Nabiac in the south to Stuarts Point in the north and extends inland to the Great Dividing Range. The MNCR includes the City of Taree, and the major towns of Port Macquarie, Kempsey and Wauchope. The coastal parts of the MNCR are the most populated and receive heavy visitation, particularly during holiday periods.

The MNCR manages 197,555 hectares of land in 70 protected areas, including 18 national parks (NP's), 40 nature reserves (NR's), 11 state conservation areas (SCA's) and 2 historic sites (HS's) (see Figure 2). The MNCR also manages the Lord Howe Island Marine Park which covers an area of 47,205 hectares.

The MNCR is divided into three management areas, Manning, Hastings and Macleay. The Areas are primarily responsible for implementation of works and activities within their Areas. The Operations Support and Coordination Unit (OSCU) provide professional support to the Areas and coordinates Region-wide functions and responsibilities. There are three local government areas in MNCR: Greater Taree; Kempsey; and Port Macquarie – Hastings (see Figure 3).

A range of pests occur due to the complex nature of the natural environment. The MNCR is characterised by major and minor valleys cleared for agricultural purposes with a backdrop of steep ridges and ranges running from the coast to the Great Divide. A wide range of plants and animals have been introduced. In addition to land use changes, the geology, the altitudinal range from the coast to sub-alpine, and the variation in land use including rural, semi-rural, urban and natural areas, all contribute to their being a wide variety of pest management issues.

The area of NPWS estate managed by MNCR has nearly tripled in the past decade from 22 reserves covering 69,742 ha in 1997 to 70 reserves covering 197,555 ha, mainly due to outcome of the Upper North East Regional Forest Agreement. As such, the number of Regional pest control programs has increased significantly. The MNCR has worked with neighbours to increase the number of collaborative programs, implemented a number of control programs to protect threatened species, and increased the involvement of community bush regeneration groups in coastal reserves. The involvement of volunteers in coastal reserves has been integral to the success of weed control programs in all coastal reserves. A number of research programs are also being undertaken in collaboration with universities and the Weeds and Invasive Animals Cooperative Research Centres.

The MNCR also undertakes co-operative aerial and ground vertebrate pest control programs with the Kempsey and Gloucester RLPB's. Figure 3 shows the areas covered by the Kempsey and Gloucester RLPB's. The emerging wild deer issue in the mid north coast has seen the formation of the Mid North Coast Wild Deer Working Group, which now includes the NSW Game Council as one of the critical stakeholders to enable population control. The MNCR also implements programs under the Bitou Bush and Fox TAP's.

Some reserves are jointly managed between two Areas in MNCR and others are jointly managed between MNCR and other Regions. Biriwal Bulga NP and Crowdy Bay NP are jointly managed by Hastings and Manning Areas. Werrikimbe NP/SCA and Cottan-Bimbang NP are jointly managed by Hastings Area and Walcha Area (Northern Tablelands Region). Carrai NP/SCA is jointly managed by Macleay Area and Walcha Area (Northern Tablelands Region). New England NP is jointly managed by Macleay Area and Dorrigo Area (North Coast Region).

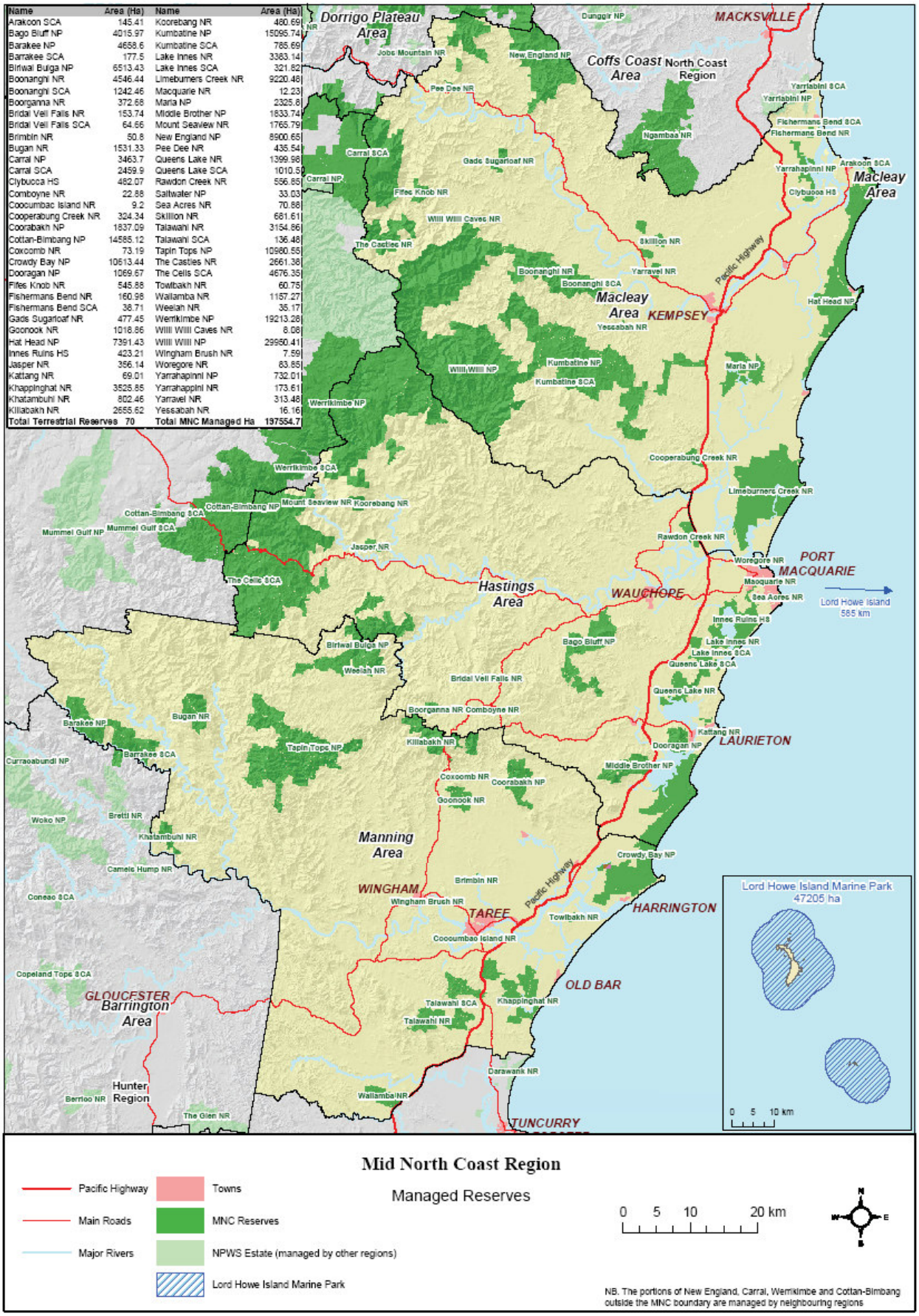

Figure 2. Map of Mid North Coast Region

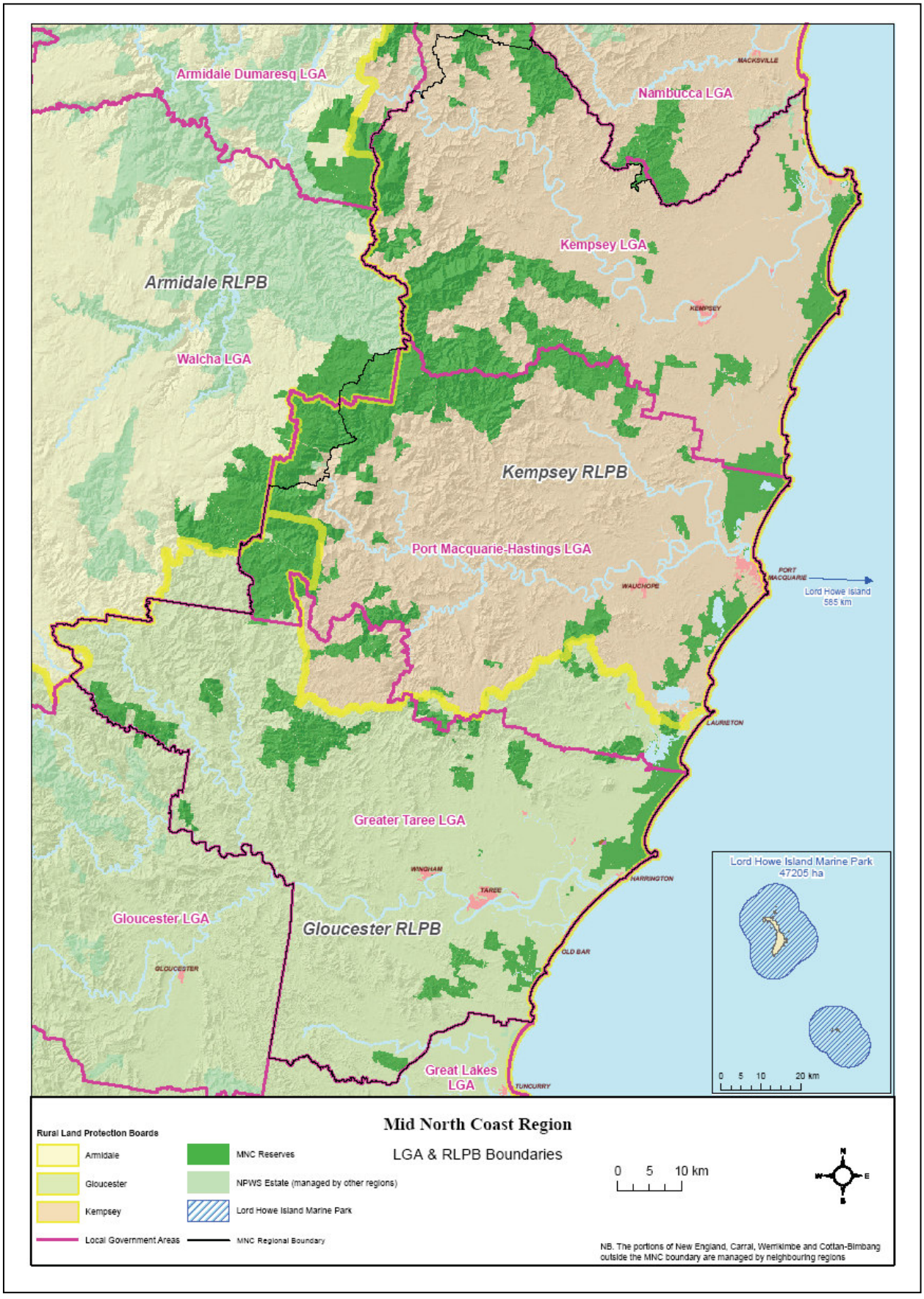

Figure 3. LGA and RLPB boundaries in MNCR

5 Pest Distribution Tables

The following pest distribution tables give an overview of priority pest species for each reserve within MNCR. The data is derived from a combination of systematic surveys, consultation with staff and other agencies and through planning processes. The tables are not comprehensive lists of all pest species within MNCR. To date no pest species have been recorded in Lord Howe Island Marine Park, however monitoring programs are in place to ensure early detection of pest species (Kerr, pers. comm., 2008).

5.1 Weed Species

Table 1: Hastings Area Weed Distribution

● Denotes established widespread populations throughout a reserve
○ Denotes scattered populations throughout a reserve
⊙ Denotes isolated populations restricted to a small geographic area of a reserve
# Denotes likely or predicted to occur

Reserve	Bitou Bush	Lantana	Mysore Thorn	Groundsel Bush	Glory Lily	Bushland Weeds	Rainforest Weeds	Exotic Pine	Eoxtic Grasses	Exotic Vines	Aquatic Weeds
Bago Bluff NP		●				#	⊙		○	#	
Boorganna NR		⊙				⊙	○			#	
Bridal Veil Falls NR/SCA		○				⊙	#		⊙		
Biriwal Bulga NP		○				⊙	#		⊙		
Comboyne NR		⊙				⊙	○				
Cottan-Bimbang NP		⊙					⊙	⊙	⊙		
Crowdy Bay NP	●	●		⊙		#	⊙	⊙	○		⊙
Dooragan NP	⊙	●				⊙	#		#		
Innes Ruins HS	#	⊙	⊙				⊙				
Jasper NR		●					⊙				
Kattang NR	○	⊙				⊙	⊙		○	#	
Koorebang NR		●					⊙		#		
Lake Innes NR/SCA	●	⊙	⊙			⊙			○		⊙
Macquarie NR	⊙	⊙			#	●	○		○	○	#
Middle Brother NP	⊙	⊙				⊙	#		⊙		
Mount Seaview NR		⊙					⊙		⊙		
Queens Lake NR/SCA	⊙	●				⊙			⊙		
Rawdon Creek NR	#	●				⊙			●		⊙
Sea Acres NR	●	⊙				⊙	○		○	⊙	
The Cells SCA		⊙				⊙	○	⊙	⊙		
Werrikimbe NP/SCA		⊙				⊙	#	⊙	#		
Woregore NR	●	⊙				⊙			⊙	#	

Table 2: Macleay Area Weed Distribution

- ● Denotes established widespread populations throughout a reserve
- ○ Denotes scattered populations throughout a reserve
- ⊙ Denotes isolated populations restricted to a small geographic area of a reserve
- **#** Denotes likely or predicted to occur

Reserve	Bitou Bush	Lantana	Mysore Thorn	Groundsel Bush	Glory Lily	Bushland Weeds	Rainforest Weeds	Exotic Pine	Eoxtic Grasses	Exotic Vines	Aquatic Weeds
Arakoon SCA	⊙	⊙			⊙	⊙	⊙		⊙		
Boonanghi NR/SCA		●							⊙		
Carrai NP/SCA		⊙				⊙			⊙		
Clybucca HS	#	●		●					⊙	⊙	
Cooperabung Creek NR	#	⊙				⊙			⊙		
Fifes Knob NR		⊙									
Fishermans Bend NR/SCA	#	⊙		⊙		⊙	#		⊙		
Gads Sugarloaf NR		●									
Hat Head NP	●	⊙		⊙	⊙	⊙	⊙		⊙	⊙	⊙
Kumbatine NP/SCA		●		⊙		⊙			⊙		
Limeburners Creek NR	●	⊙				⊙	⊙		⊙		
Maria NP	#	○		#				⊙	⊙		
New England NP		●							⊙		
Pee Dee NR		⊙									
Skillion NR		●				○			⊙		
The Castles NR		⊙									
Willi Willi Caves NR		●									
Willi Willi NP		○				⊙		⊙	⊙		
Yarrahappinni NP/NR		●							⊙		
Yarravel NR		○				○			⊙		
Yessabah NR		●				⊙	⊙		⊙		

Table 3: Manning Area Weed Distribution

- ● Denotes established widespread populations throughout a reserve
- ○ Denotes scattered populations throughout a reserve
- ⊙ Denotes isolated populations restricted to a small geographic area of a reserve
- **#** Denotes likely or predicted to occur

Reserve	Bitou Bush	Lantana	Mysore Thorn	Groundsel Bush	Glory Lily	Bushland Weeds	Rainforest Weeds	Exotic Pine	Eoxtic Grasses	Exotic Vines	Aquatic Weeds
Barakee NP/SCA		○				⊙			⊙		
Biriwal Bulga NP		○				⊙		⊙	⊙		
Bretti NR		○							⊙		
Brimbin NR		○				⊙			⊙		
Bugan NR		⊙							⊙		
Coocumbac Island NR		○					⊙		⊙	⊙	
Coorabakh NP		○				⊙			⊙		
Coxcomb NR		#									
Crowdy Bay NP	●	⊙		⊙		⊙	⊙		○	#	⊙
Goonook NR		○				⊙			⊙		
Khappinghat NR	●	⊙			#	#		⊙	○		⊙
Khatambuhl NR		⊙							⊙		
Killabakh NR		●				⊙			⊙		
Saltwater NP	⊙	○				#	●		⊙	#	#
Talawahl NR/SCA		●							○		
Tapin Tops NP		○				⊙		⊙	⊙		
Towibakh NR	⊙	●							⊙		
Wallamba NR	#	○							⊙		
Weelah NR		⊙				⊙			⊙		
Wingham Brush NR		⊙					⊙			⊙	

5.2 Pest Animal Species

Table 4: Hastings Area Pest Animal Distribution

- ● Denotes established widespread populations throughout a reserve
- ○ Denotes scattered populations throughout a reserve
- ⊙ Denotes isolated populations restricted to a small geographic area of a reserve
- **#** Denotes likely or predicted to occur
- * Schedule 2 lands under the RLPB Wild Dog Pest Control Order

Reserve	Fox	Wild Dog	Wild Deer	Feral Cat	Feral Pig	Feral Horses	Feral Goat	Feral Rabbit/Hare	Introduced Rodents	Feral Birds	Feral Honeybees	Cane Toad	Feral Fish
Bago Bluff NP	●	○		●							#		
Boorganna NR	○	○		○									
Bridal Veil Falls NR/SCA	⊙	⊙		#				#	⊙		#		
Biriwal Bulga NP*	⊙	●	#	⊙									
Comboyne NR	○	○		○									
Cottan-Bimbang NP*	○	○	#	○							#		
Crowdy Bay NP	○	⊙	⊙	○	⊙			⊙	○	⊙	●		⊙
Dooragan NP	⊙	⊙		⊙			⊙		○	⊙	○		
Innes Ruins HS	#			#	#								
Jasper NR	○	⊙											
Kattang NR	●			●					⊙	⊙	○		
Koorebang NR	○	⊙											
Lake Innes NR/SCA	○	○	○	○	⊙				○	⊙	○	⊙	●
Macquarie NR	○		⊙	○				⊙	○		#		⊙
Middle Brother NP	○	⊙	#	○							#		
Mount Seaview NR	○	⊙											
Queens Lake NR	○	○	⊙	○			⊙		○	⊙	○		#
Rawdon Creek NR	○	⊙		○					○	⊙	●		#
Sea Acres NR	⊙		⊙	○					⊙	⊙	#		
The Cells SCA	⊙	○	#	○					⊙				
Werrikimbe NP/SCA*	⊙	●	#	○	⊙		#	⊙	○		⊙		⊙
Woregore NR	⊙			⊙					●	⊙	⊙	#	

Table 5: Macleay Area Pest Animal Distribution

- ● Denotes established widespread populations throughout a reserve
- ○ Denotes scattered populations throughout a reserve
- ⊙ Denotes isolated populations restricted to a small geographic area of a reserve
- **#** Denotes likely or predicted to occur
- ***** Schedule 2 lands under the RLPB Wild Dog Pest Control Order

Reserve	Fox	Wild Dog	Wild Deer	Feral Cat	Feral Pig	Feral Horses	Feral Goat	Feral Rabbit/Hare	Introduced Rodents	Feral Birds	Feral Honeybees	Cane Toad	Feral Fish
Arakoon SCA	●	⊙		○					⊙		⊙		#
Boonanghi NR/SCA	○	⊙		⊙									
Carrai NP/SCA*	⊙	○	#										
Clybucca HS	●	⊙	#	○									
Cooperabung Creek NR	●	⊙		○									
Fifes Knob NR	⊙	⊙	#										
Fishermans Bend NR/SCA	●	⊙		○					○	⊙	⊙		
Gads Sugarloaf NR	⊙	○	#										
Hat Head NP	●	●	⊙	○					⊙		⊙		⊙
Kumbatine NP/SCA*	○	⊙		○					⊙				
Limeburners Creek NR*	●	●	⊙	○	○		#	⊙	⊙		⊙		⊙
Maria NP	●	○		○	⊙				⊙				
New England NP*	⊙	○	#										
Pee Dee NR	⊙	○	#										
Skillion NR	●	○		○				○		⊙	⊙		
The Castles NR*	⊙	⊙											
Willi Willi Caves NR	⊙	⊙											
Willi Willi NP*	○	⊙			○		#						
Yarrahapinni NP/NR	●	⊙	#	○									#
Yarravel NR	●	⊙	#	○				⊙		⊙	⊙		
Yessabah NR	⊙	#		○					⊙		⊙		

Table 6: Manning Area Pest Animal Distribution

- ● Denotes established widespread populations throughout a reserve
- ○ Denotes scattered populations throughout a reserve
- ⊙ Denotes isolated populations restricted to a small geographic area of a reserve
- **#** Denotes likely or predicted to occur
- ***** Schedule 2 lands under the RLPB Wild Dog Pest Control Order

Reserve	Fox	Wild Dog	Wild Deer	Feral Cat	Feral Pig	Feral Horses	Feral Goat	Feral Rabbit/Hare	Introduced Rodents	Feral Birds	Feral Honeybees	Cane Toad	Feral Fish
Barakee NP/SCA	⊙	●	#	⊙		⊙	#						
Biriwal Bulga NP*	⊙	●	⊙	⊙									
Brimbin NR	○	○		○	⊙				⊙		⊙		
Bugan NR	⊙	●		○									
Coocumbac Is NR	○								○		⊙		
Coorabakh NP	⊙	○		⊙							#		
Coxcomb NR	⊙	○		⊙									
Crowdy Bay NP	●	●		●				⊙	○	⊙	⊙		⊙
Goonook NR	○	○		○	⊙						#		
Khappinghat NR	●	○	⊙	●			⊙	○	○	⊙	⊙		
Khatambuhl NR	⊙	○		○									
Killabakh NR	⊙	○		○									
Saltwater NP	●	⊙	#	⊙			⊙	○	○	⊙	⊙		
Talawahl NR/SCA	○	○	#	○					⊙		#		
Tapin Tops NP*	⊙	○		●									
Towibakh NR	○	○		○					⊙	⊙	#		
Wallamba NR	●	○	#	○	#						#		
Weelah NR	⊙	○		○									
Wingham Brush NR	○			○					○	⊙	⊙		

6 Pest Management Objectives

The overriding objective of NPWS's pest management programs is to minimise adverse impacts of pests on biodiversity and other park values whilst complying with legislative responsibilities.

Programs also aim to:

- manage pest populations to minimise their impact on neighbours;
- increase community understanding of the adverse impacts of pests on biodiversity and Aboriginal and historic cultural heritage; and
- support cooperative approaches and participation in pest management programs with the community and other agencies.

7 Pest Management Principles

Wherever possible, NPWS adopts an integrated approach to pest management, where more than one control technique is used, across the landscape. Integrated pest management is likely to be more effective because it avoids selecting for herbicide resistant weed biotypes or bait-smart/trap-shy animals. Targeting more than one pest species is important as the control of one species may benefit another (e.g. control of foxes may benefit rabbits, control of bitou bush often leads to an increase in other weeds). Also, control is usually undertaken at particular times of the year when pests are most vulnerable (e.g. translocation of herbicides to growing points is usually greater when weeds are flowering).

So that pest management undertaken by the NPWS is carried out effectively and efficiently, the following principles are generally applied.

- Pest control is targeted to species/locations where benefits will be greatest.
- Development of control priorities are set by clearly defining the problem to be addressed e.g. specific impacts are identified so that the purpose of control is clear.
- Where relevant, pest control is collaborative and across tenure, that is, undertaken on a landscape approach.
- Early detection of new incursions and rapid response is considered a high priority as this is the most cost-effective form of pest control.
- Priority is given to mitigating the impacts on biodiversity of a pest that has cultural significance (e.g. feral horses), whilst minimising impacts on cultural values.
- The aim of most pest control programs is to minimise the adverse impacts of pests, as many exotic pests are already widespread (e.g. foxes, blackberries) and for these species eradication is generally not possible, except for isolated occurrences.
- The focus of control programs is directed towards the values to be protected, because killing pests, by itself, does not necessarily minimise their impacts due to the fact that ecological processes are complex and can be affected by a range of factors.
- Risk assessments are undertaken prior to pest control, where required.
- Pest management strives for a balance between cost efficiency, target specificity and animal welfare.
- Where appropriate, pest control employs a combination of control methods and strategies (integrated pest management).
- Pest control programs usually take a 'holistic' approach, to control all significant pest threats at a site. This will vary according to factors such as appropriate time for control, availability of funding and other control resources.
- Pesticide use complies with relevant legislation and is employed in a manner that minimises impacts on the environment.

- Pest management programs are often integrated with other land management activities such as fire, asset and recreation management.
- Monitoring is implemented, at varying levels, to demonstrate and improve the ongoing effectiveness of control programs.

8 Pest Program Priorities

NPWS prioritises its pest control programs to focus on those areas where the impacts of pests are likely to be greatest. Resources can then be directed to ensure that the resultant control programs are effective in reducing these impacts. The availability of suitable control techniques and resources (both financial and physical), as well as the practicality and cost effectiveness of control, also influence which programs can be implemented.

Where new pest incursions occur, early detection and eradication is the most cost-effective way to minimise the impacts. The NPWS will work with other agencies and community groups to prevent the introduction of new pests and to respond rapidly when new incursions occur.

The following key factors are considered when determining priorities for pest management within MNCR.

Critical Priority

- *Threatened Species/Communities*: Programs targeting pests which are, or are likely to be, significantly impacting on biodiversity, as largely identified in the PAS (e.g. undertake fox control at the Manning River Harrington/Farquhar spits priority site for little terns as identified in the Fox TAP). Also includes obligations under international treaty agreements of JAMBA, CAMBA, RAMSAR, and ROKAMA.

- *Human Health/Human Risk*: Programs that target pests which impact significantly on human health or are part of a declared national emergency (e.g. outbreak of foot and mouth disease or control of feral pigs in the catchment area of a domestic water supply reservoir); also includes pests that potentially pose a risk to human heath or safety (e.g. feral deer causing road accidents or toxic effect of ingestion of any part of the glory lily plant) – whilst these pests can often be of minimal risk, any escalation will see prioritisation to a critical level for implementation of control.

- *Impacts on Agriculture*: Programs targeting pests that impact significantly on agricultural production (e.g. wild dog control where there is potential for significant stock losses as identified in Wild Dog Management Plans); programs to control State Prohibited or Regionally Prohibited Noxious Weeds (Control Class 1 and 2 weeds).

- *New Incursions*: Programs addressing new occurrences of highly invasive pest species with potential for significant impacts on park values, subject to risk/feasibility assessment (e.g. riparian vine weeds such as madiera and cat's claw vines in rainforest communities previously free of these weeds).

High Priority

- World Heritage: Programs that target pests that impact significantly on world heritage or international heritage values (e.g. control of lantana impacting on Gondwana World Heritage values of Werrikimbe NP or Willi Willi NP).

- Cultural Heritage: Programs targeting pests that impact significantly on important cultural heritage values (e.g. control of mysore thorn and other weeds within the historic fabric of the Innes Ruins HS, Trial Bay Goal in Arakoon SCA and the Limestone Kilns within Kumbatine NP).

Medium Priority

- Wilderness/Wild Rivers: Programs that target pests that impact significantly on Wilderness, Wild Rivers, national heritage values or other important listed values (e.g. control of lantana or bitou bush along a declared Wild River or within a Wilderness area such as Limeburners Creek NR).

- Recreation/Aesthetic: Programs that target pests that impact significantly on recreation, landscape or aesthetic values (e.g. control of bitou bush/lantana on the margins of camping areas; control of weeds in an areas of natural beauty that are visited frequently, such as coastal headlands at Diamond Head in Crowdy Bay NP and Point Perpendicular in Kattang NR).

- Community Co-operative Program: Community or cooperative programs targeting pests that impact significantly on park values or agricultural production and that have ongoing, proven effectiveness and participation (e.g. control of winter senna with the assistance of an established community group); control of Regionally Controlled Noxious Weeds (Control Class 3 weeds).

- Regional Plan: Community or cooperative programs that are implemented as part of an endorsed state or regional plan (e.g. control of bitou bush across boundaries as part of a regional control plan prepared by a regional weeds advisory committee and supported by NPWS).

Lower Priority

- Community Program/Local Impacts: Community programs targeting pests that have localised impacts on natural ecosystems or agricultural lands and that promote community education and involvement with parks (e.g. participation in a new bush regeneration project with a local community group; control of Locally Controlled and Restricted Noxious Weeds (Control Class 4 and 5 weeds).

- Existing Programs: Previous programs targeting pests that have localised impacts on native species and ecosystems, and that can be efficiently implemented to maintain program benefits, (e.g. the maintenance of areas treated previously for whisky grass to continue keeping them weed free).

In some circumstances, new programs may be introduced, or priority programs extended to target pests where a control "window of opportunity" is identified:
- where burnt areas become more accessible for ground control of weeds;
- where drought makes control of pest animals more efficient because they congregate in areas where water is available (e.g. pigs, goats and deer); or
- when a new biocontrol agent becomes available.

This "window of opportunity" can exist for all priority pests and should be part of a planned approach to any pest management.

The pest control priorities listed in Table 7 should be considered in conjunction with the pest distribution tables in Section 5 and the pest program overviews in Section 12. Table 7 reflects the current status of threatened species, populations and communities known to be impacted, or potentially impacted, by these pest species as described/listed in the PAS.

Table 7: Summary of Pest Control Priorities in MNCR

PEST PROGRAMS	Critical				High		Medium				Low		
	Threatened Species/Communities	Human Health/Human Risk	Impacts on Agriculture	New Incursions	World Heritage	Cultural Heritage	Wilderness/Wild Rivers	Recreation/Aesthetic	Community Co-operative program	Regional Plan	Community Programs/Local Impacts	Existing Programs	Window of Opportunity
WEEDS:													
Bitou Bush	●					●	●	●	●	●	●	●	●
Lantana	●		●		●	●	●	●	●	●	●	●	●
Mysore Thorn		●				●			●	●	●	●	●
Groundsel Bush	●		●	●						●		●	●
Glory Lily	●	●		●					●	●		●	●
Bushland Weeds	●					●	●	●	●	●	●	●	●
Rainforest Weeds	●						●	●	●	●	●	●	●
Exotic Pines					●		●	●				●	●
Exotic Grasses	●		●	●			●	●		●		●	●
Exotic Vines	●						●		●	●		●	●
Aquatic Weeds		●		●				●		●		●	●
PEST ANIMALS:													
European Fox	●	●	●		●		●	●	●		●	●	●
Wild Dog		●	●		●		●	●	●	●	●	●	●
Wild Deer	●	●	●	●	●		●	●	●	●	●	●	●
Feral Cat	●	●	●		●		●	●				●	●
Feral Pig	●	●	●		●	●	●	●					●
Feral Horses								●		●		●	●
Feral Goat	●	●	●					●				●	●
Feral Rabbit/Hare	●		●					●				●	●
Introduced Rodents	●	●						●				●	●
Feral Birds	●	●		●				●	●		●	●	●
Feral Honeybees	●	●	●					●					●
Cane Toad	●	●						●	●	●	●	●	●
Feral Fish	●			●				●				●	●

The management programs for the above pest species are reported in the '2007 SoP' which summarises program effectiveness and the MNCR Operations Plan which details actions/funding – currently 2007/08.

Both “proactive” and “reactive” programs will occur depending on the circumstances, urgency and requirements of a planned and strategic approach. Consideration is also given to partnerships established with relevant agencies LGA’s, RLPB’s, CMA’s, neighbours, community groups (Landcare, Dunecare, etc) and other relevant stakeholders.

Future priorities for pest control will need to reflect changes in the distribution, abundance or impacts of pests that may occur in response to environmental changes including climate change. This is consistent with the key objectives for invasive species in the NSW Biodiversity and Climate Change Adaptation Framework. NPWS is supporting research to understand the interaction between climate change, pests and biodiversity.

8.1 Climate Change

Climate change has been listed as a KTP under TSC Act. Projections of future changes in climate for NSW include higher temperatures, increasing sea levels and water temperatures, elevated CO_2, more intense but possibly reduced annual average rainfall, increased temperature extremes and higher evaporation.

These changes are likely to lead to greater intensity and frequency of fires, more severe droughts, reduced river runoff and water availability, regional flooding, increased erosion and ocean acidification.

The direct impacts of climate change on species and ecosystems may include:
- range shifts and species movement towards cooler latitudes or higher elevations or in response to changed rainfall frequencies and/or distributions;
- extinctions of local populations along range boundaries;
- changes in productivity and nutrient cycling within ecosystems, due to a combination of climate change and increasing carbon dioxide levels;
- increasing invasion by opportunistic, weedy or highly mobile species, especially into sites where local populations of existing species are declining;
- increasing threat to freshwater ecosystems through decreasing water flows and changes in water temperature and chemistry; and
- progressive decoupling of species interactions (for example plants and pollinators).

The greatest detrimental impact is believed to be on the cover and diversity of woody species (Bradstock, 2007). The warm to cool temperate sclerophyll forests and woodlands typical of this region will see an increased fire risk resulting from more droughts with a decline in shrub species and potentially an increase in invasive grasses (Bradstock, 2007).

Adjusting NPWS management of the environment through programs to reduce the pressures arising from other threats such as habitat fragmentation, invasive pest species, bushfires, pollution and urban expansion, will hopefully reduce the severity of the effects of climate change.

9 Pest Program Recording and Monitoring

Measuring the response of biodiversity (or other values) to pest control is necessary in order to:
- demonstrate the degree of impacts and hence justify priorities for management; and
- measure the effectiveness of ongoing control and direct resources to those programs with the greatest effect.

Measuring the response of biodiversity can be difficult because populations of native species can vary in space and time for many reasons so that differentiating the effects of pest control from other sources of variation is often complex. Where populations cannot be counted directly, measurement is dependent on using indices of abundance. Rigorous attempts to measure population responses need to consider experimental design (e.g. treatment and non-treatment sites, replication, time scale for measurable responses to occur), sampling design (because the entire population can rarely be measured) and standardisation of population measures to allow data to be collated (across sites, times and land tenure where appropriate). As a result, measuring the response to pest control is expensive.

The monitoring of response of pest species distribution and abundance provides an interim measure of effectiveness essential:

- to aid comparison between control effort and biodiversity response;
- to provide useful data where biodiversity, other park values or agricultural responses are too difficult to measure or there are insufficient resources to make measurements; and
- to provide an interim measure where native species may take some time to respond to pest control.

Where pest incursions have occurred recently, or where their distribution is otherwise limited, the objectives of control are usually to eradicate the incursion completely or to contain its spread. In these situations, monitoring is required to confirm eradication or containment and should focus on the pest species rather than the response of native species to control. Such an approach may require methods that are capable of detecting populations at very low densities and prolonged monitoring will be required to ensure that containment or eradication has been achieved.

Monitoring programs should also include measures to verify the results of research to gain a better understanding of the interaction between pests and climate change.

Systems and databases are being developed for the consistent and systematic collection, collation, storage and analysis of data as part of the Monitoring and Evaluation component of the Park Management Program. In MNCR standardised data record sheets have been developed for the recording of vertebrate pest control programs. This data is downloaded into, and analysed by the Arcview Geographic Information System (GIS).

All pesticide use is identified and recorded on an 'intended pesticide use notification' form by both staff and contractors to communicate the intended use of a pesticide on park. Staff and contractors are also required to complete the 'daily chemical records' sheet for all weed and insecticide use, and baiting sheets for other pesticide use in accordance with the *Pesticides Act 1999*.

A statewide strategy for monitoring NSW natural resources has been adopted by the State Government. The NSW Natural Resources Monitoring, Evaluation and Reporting Strategy seeks to measure long-term trends in natural resources in NSW and the effectiveness of specific management actions to sustain them. It is based on 13 statewide targets which define broadly the natural resources of interest including a specific target for invasive species (weeds and pest animals). The target is a reduction in the impact of invasive species by 2015 (NSW State Plan: Priority E4). To assess progress towards this target, three indicators have been developed for invasive species:

- number of new invasive species established (all new species whose impacts are likely to be significant);
- distribution and abundance of emerging invasive species (selected species only); and

- success of control programs for widespread invasive species (selected species only) as measured by a reduction in impacts (e.g. a reduction in the impacts of foxes on biodiversity).

NPWS has committed to providing information for the third indicator. This commitment is currently limited to biodiversity responses to fox control and bitou bush control at priority sites identified in the respective TAPs. Monitoring protocols for both TAPs have been developed and these will be used to guide the collection and analysis of data for these species. In the future, reporting on other pests may be provided if additional resources become available.

10 Regional Coordination and Support of Pest Control Programs

Pest control programs are coordinated by the local NPWS Area and Region in order to ensure that resources are utilised to achieve the best possible outcomes. Area and Regional assistance is required to efficiently work with neighbours, community groups and other agencies. Education of staff and the broader community are essential requirements in integrated pest management.

At the Regional level staff participate in coordinated pest programs, are represented on joint committees, and attend meetings with various land managers and stakeholders to ensure integrated management. These include local government (Great Lakes, Greater Taree City, Port Macquarie-Hastings, Kempsey and Nambucca Councils), Lands Department, RLPB's (Gloucester, Kempsey and Armidale) and the Mid North Coast Weeds Advisory Committee.

MNCR work with a range of community and Aboriginal groups on pest management projects. Aboriginal liaison occurs throughout MNCR. For example, the native nursery and regeneration project by the "Pandanus People" and the Dhunghutti group in Arakoon SCA, the South West Rocks area and Limeburners Creek NR. A combined lantana / giant Parramatta grass/ groundsel bush control project to protect the ancient middens in the Clybucca HS continues as a training and restoration project by the combined Dhunghutti-Gumbainggir group. An educational program on edible rainforest plants and the impact of weeds in the Sea Acres NR is undertaken by the Biripi Land Council, while an additional CDEP program is assisting lantana and asparagus fern removal from the understorey in the rainforest and sclerophyll swamp forest communities of Saltwater NP, near Taree.

Universities associates (Newcastle, New England, New South Wales, Macquarie and Southern Cross) are also involved, and encouraged to undertake academic and research activities for post and under graduate projects. Staff provide support and assistance to students undertaking work experience. This has been particularly relevant to pest species such as bitou bush, wild deer, cane toads, mysore thorn and salvinia.

Volunteers continue to provide valuable assistance in pest management in MNCR. Groups undertake bush regeneration programs in a number of coastal and near coastal reserves. They involve both community groups and individuals, and include Point Plomer Malibu Club, Port Macquarie Landcare, Mid North Coast National Parks Association, DuneCare and local Progress Associations.

An excellent example of the Region working with the community is the long standing Diamond Head "Bitou Bush Bashes" with the Mid North Coast National Parks Association in Crowdy Bay NP. This program, which began in 1978, now stands as one of the longest-running volunteer weed programs in Australia. Figure 4 shows a summary of the number and timeframe of programs that have been initiated and continue in MNCR.

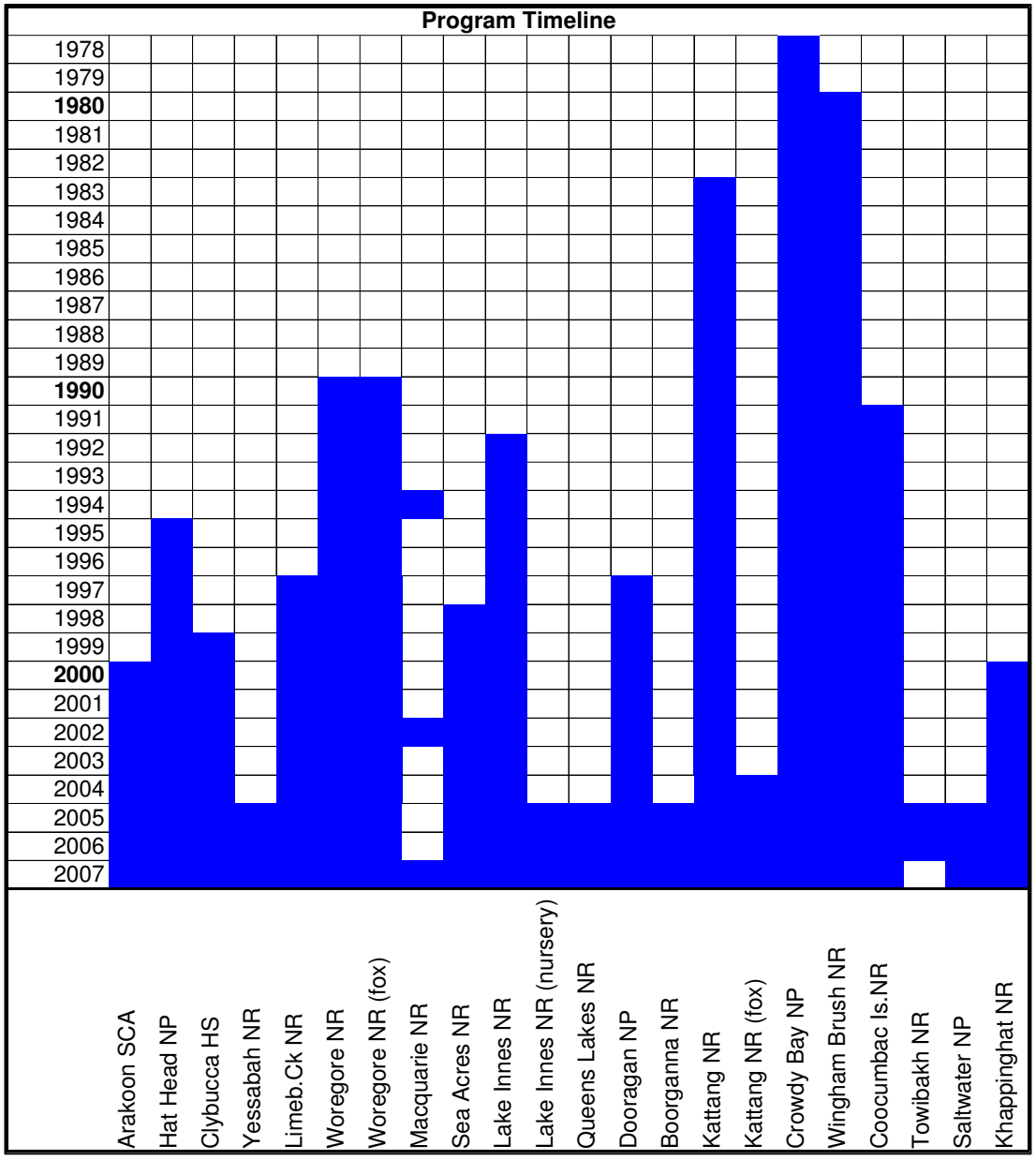

Figure 4. Number and timeframe of programs in MNCR

These groups have an important positive impact and in some instances have been critical to the current level of achievement in a number of the Region's weed control and bush regeneration programs. Important inroads have been made with coastal vegetation communities, with major efforts directed towards the removal of coastal weeds (eg. bitou bush, lantana and cassia/winter senna).

All groups work in areas which have been identified as high priority sites in the Bitou Bush TAP. Other programs have involved dedicated groups and individuals working in the Region's rainforest reserves at Wingham Brush NR, Coocumbac Island NR and at Gap Beach, Hat Head NP. The amount of time has varied depending on the project, some being time consuming "one-off" projects, while others involve annual ½ to 1 day programs highlighted in Figure 5 below.

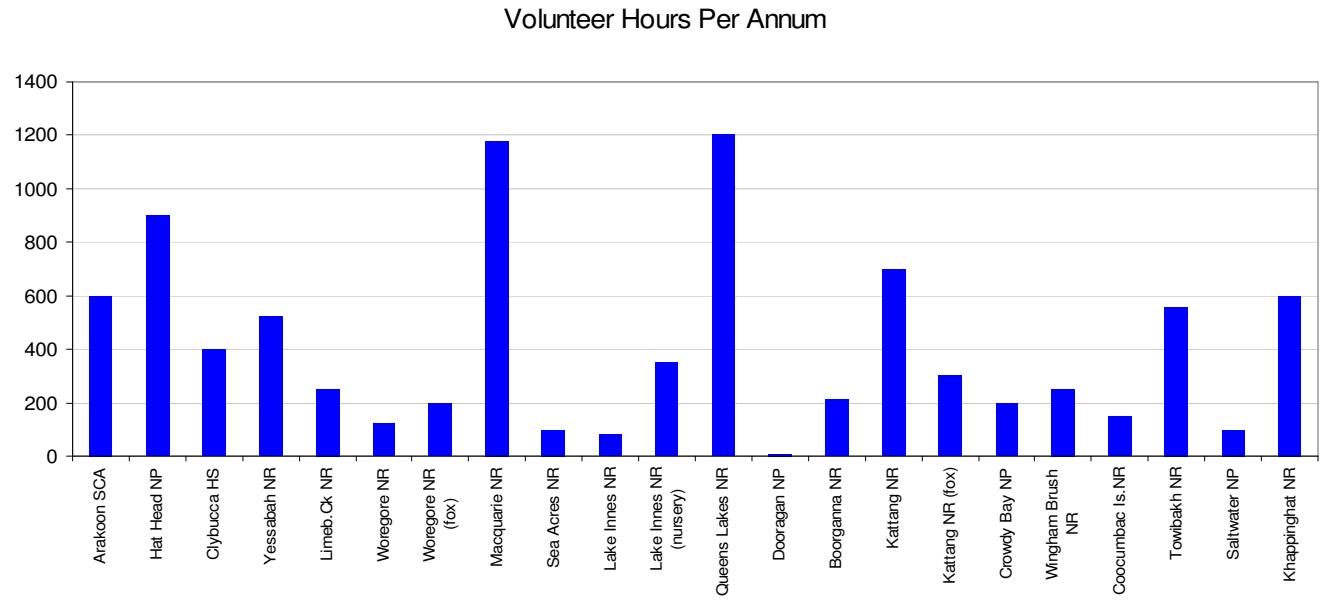

Figure 5. Volunteer hours spent on weed control programs in MNCR

Work plans are developed, where appropriate, with these groups to ensure priorities are consistent with reserve plans of management and the RPMS. Support is provided to the groups through the provision of:

- training - including occupational health and safety, safe herbicide use, weed and native plant identification;
- equipment – including bush regeneration tools, personal protective equipment, identification manuals, etc; and
- supervision – an appropriate level of supervision for new members or new groups.

New community groups will be encouraged and supported at sites identified as a high priority in the RPMS.

11 Pest Program Overviews

11.1 Weed Species

11.1.1 Bitou Bush

Distribution and abundance

Bitou bush (*Chrysanthemoides monilifera ssp. rotundata*) is widespread in all coastal reserves in MNCR. Most fore dunes and hind dunes are or have been heavily infested. It has also established in coastal heath and woodlands, littoral rainforest and grassy headlands. The western spread of bitou bush is being monitored by the Region, as it has been recorded several kilometres inland (e.g. western slopes of North Brother Mountain). The extent of bitou bush has been reduced dramatically in some reserves as a result of control programs that have been implemented for many years (e.g. Crowdy Bay NP, Kattang NR and Sea Acres NR).

Impacts

Bitou bush is a highly competitive weed that smothers native plant communities and destroys natural habitat and food sources for native animals. It threatens over 180 native plant species, populations and ecological communities in NSW. Bitou bush invades dunes, coastal heathlands, grasslands, woodlands and forests (DEC, 2006). Bitou bush can also disturb cultural heritage sites by destroying the fabric of the site. It can provide food and shelter to feral animals, such as the red fox.

Bitou bush is a Weed of National Significance, and is declared Class 4 under the *Noxious Weeds Act 1993* in the three coastal councils in MNCR (Greater Taree, Kempsey, and Port Macquarie-Hastings). National, state and regional strategies have been prepared. The invasion of native plant communities by bitou bush is listed as a KTP under the TSC Act (NSW Scientific Committee, 1999a) and a TAP (DEC, 2006) has been prepared.

Bitou bush infestations threaten the conservation values of endangered ecological communities (EECs) such as Littoral Rainforest and Themeda Grassland on Seacliffs and Coastal Headlands. Although not adequately researched, it is considered that the dominance of bitou bush can alter the composition of native birds in dunal and headland systems, by favouring seed-eaters at the expense of nectar-feeding, heath species.

Priorities for control

The Bitou Bush TAP (DEC, 2006) identifies 21 priority sites for control in MNCR:

- Arakoon SCA;
- Hat Head NP – Big Smoky, Conners-Hat Head, East of Town and Headland, O'Connor's Beach, Cresent Head, South;
- Crowdy Bay NP – North, South, Diamond Head, The Gap, Harrington – Crowdy Head Road;
- Sea Acres NR - Tacking Point, Miner's Beach;
- Kattang NR;
- Limeburners Creek NR;
- Saltwater NP / Khappinghat NP – Wallabi Point Headland;
- Dooragan NP; and
- Clybucca HS.

Site management plans have been prepared for Hat Head NP, Limeburners Creek NR and Sea Acres NR; site plans will be developed for the remaining priority sites.

Control

Bitou bush is controlled using an integrated approach. A number of different techniques are utilised including physical removal, cut-and-paint, and herbicide treatment from backpack, vehicle and helicopter. Two biocontrol agents, tip moth (*Comostolopsis germana*) and seed fly (*Mesoclanis polana*) have established in all coastal reserves.

There are a large number of control programs undertaken by volunteers that have been in place since 1978 using manual removal and cut-and-paint techniques. Volunteers contribute significantly to bitou bush control in MNCR.

Monitoring

Bitou bush density and distribution mapping has been undertaken in all coastal reserves, with selective mapping at Bitou Bush TAP priority sites. Transects have been established in most coastal reserves. Aerial and ground photography has also been undertaken.

The Region will monitor the success of bitou bush control programs at selected TAP sites using the methods outlined in the Bitou Bush TAP monitoring guidelines.

11.1.2 Lantana

Distribution and abundance

Lantana (*Lantana camara*) has the widest distribution and highest rate of occurrence across the parks and reserves managed by MNCR. Lantana favours disturbance and hence is particularly common in previously logged / cleared areas and along drainage lines and roadsides. Heavy lantana infestations occur in Kumbatine NP/SCA, Queens Lake NR/SCA, Willi Willi Caves NR, Yessabah NR and parts of Crowdy Bay NP. However, the extent of lantana has been reduced in Wingham Brush NR, Macquarie NR, Coocumbac Island NR, Sea Acres NR and Clybucca HS following implementation of control programs invoving staff, volunteers and contractors.

Impacts

Lantana has significant adverse effects on biodiversity. It typically forms dense thickets, suppressing native vegetation and seedlings through shading, nutrient competition, smothering and chemical suppression of the germination and/or growth of other plant species (allelopathy). Lantana readily invades disturbed sites and communities, including edges and canopy breaks in dense forest communities. In open forests and woodlands lantana often becomes a dominant understorey species. Lantana can dramatically alter forest structure and fauna habitat, and restrict the movement of native fauna and people. Lantana thickets can increase the intensity of wildfires. Lantana is toxic to both humans and animals.

Lantana is listed as one of 20 Weeds of National Significance, a KTP under the TSC Act (NSW Scientific Committee, 2006a) and is declared Class 4 under the *Noxious Weeds Act 1993* in the three councils in MNCR (Greater Taree, Kempsey, and Port Macquarie-Hastings).

A secondary impact from lantana is Bell Miner Associated Dieback (BMAD), The dieback, generally associated with a lantana invasion of the understorey, involves the defoliation of eucalypts crowns which ultimately leads to the death of standing trees. It is currently spreading rapidly through sclerophyll forests in NSW and is thought to be occurring in several reserves in MNCR. BMAD is associated with the native bell miner or bellbird (*Manoria melanophrys*) and is strongly associated with sap feeding insects called psyllids. Bell miners are a natural part of eucalypt ecosystems and normally have minor and positive impacts on forests. However, increases in bell miner populations and their distribution, in addition to other factors such as tree stress, psyllid infestation, dense forest understoreys, weed invasion (particularly lantana), drought, logging, road construction, pasture improvement, bio-diversity loss, soil nutrient changes, and changing fire and grazing regimes have all been implicated in the spread of BMAD (Bell Miner Associated Dieback Working Group, 2004). In MNCR a trial is underway to burn parts of Kumbatine NP to reduce the extent of lantana and monitor the impact this has on BMAD.

Priorities for control

- Endangered Ecological Communities (EECs) – Littoral Rainforest, Lowland Rainforest on Floodplain, Swamp-oak Floodplain Forest.
- Kumbatine BMAD Lantana Control Trial.
- Yessabah Dry Rainforest.
- Existing programs

A statewide Lantana TAP is being prepared which will identify the biodiversity most at risk from lantana and priority locations for control of lantana, including within MNCR.

Control

Integrated control techniques are required, where a range of techniques are used in combination, depending on the individual situation. Specific techniques include; foliar spraying with herbicide (by back pack, quad bike, tractor or vehicle mounted quick spray unit or by splatter gun), cut-and-paint, hand removal and release of biological control agents. Mechanical techniques can be effective at controlling lantana and encouraging native regeneration, however, great care must be taken to minimise impacts on existing native vegetation, and significant follow-up control is required due to increased soil disturbance.

Effective herbicide or biological control is made more difficult by the plant's habit of temporarily "shutting down" during dry periods or after frost. Effective herbicide applications require the plant to be actively growing.

Note: recent anecdotal evidence indicates that a low volume – high concentration application of herbicide through a splatter gun is much more target specific and caused less off target damage than conventional foliar spraying techniques. Further trials and monitoring will be undertaken in MNCR.

Monitoring

Programs focussed in EECs or adjacent to threatened species are monitored through mapping and in some cases photo points and/or transects. This is particularly the case where lantana is being controlled at Bitou Bush TAP sites.

11.1.3 Mysore Thorn

Distribution and abundance

Mysore thorn (*Caesalpinia decapetala*), also known as thorny poinciana, is a climbing shrub from Indonesia. It has a limited distribution in MNCR, with a major infestation that occurred in and around the Innes Ruins HS. Here it originated as a garden cultivar and ornamental shrub planted by Major Innes' wife in the 1830's as part of the Innes Homestead gardens. There are a number of smaller infestations in the Johns River area and near Taree.

Impacts

Mysore thorn is a vigorous growing thorny plant capable of climbing and engulfing native vegetation, fences, road signs, sheds, bridges and other infrastructure. It especially favours creek lines where it forms dense thickets restricting water flows, access and downstream movement of flood debris; leading to increased flood damage (NCWAC, 2004).

Mysore thorn severely impacts on biodiversity through restricting germination, reducing forest biomass through smothering, and severely restricting movement of native animals. The sharp barbs on its branches can also injure native wildlife and humans. The sprawling thickets provide habitat for foxes, cats and rabbits. Mysore thorn is known to have carcinogenic properties and therefore care needs to be taken when disposing of and/or burning plant material.

Priorities for control

- Innes Ruins HS and any other detected occurrences on NPWS estate.

Control

Mysore thorn has been the target of an intensive control program within the "Ruins" area since late 1980's, with subsequent follow-up programs undertaken to trial various techniques. Mysore thorn will continue to be contained and/or eradicated within the grounds of the "Ruins".

Metsulfuron methyl-based herbicides are currently registered for control of mysore thorn in Australia. A permit has been approved for the use of glyphosate-based herbicides on the plant. These herbicides have shown some success controlling the plant (NCWAC, 2004).

Monitoring

The infestation at Innes Ruins HS has been surveyed into field plots to monitor recruitment, seedling establishment and control techniques.

11.1.4 Groundsel Bush

Distribution and abundance

Groundsel bush (*Baccharis halimifolia*) occurs as small infestations in Crowdy Bay, Hat Head and Kumbatine NP's, while the largest infestation is known from Clybucca HS.

Impacts

Groundsel bush is an aggressive invader of disturbed areas and readily invades and proliferates in undisturbed low-lying areas. It has a rapid growth rate and produces vast quantities of windborne seed, which readily germinates. It successfully out-competes and shades native species, prohibiting natural regeneration, and often forms dense thickets that grossly alter the structure and floristic composition of native plant communities (including some SEPP 14 wetlands).

Groundsel bush is declared Class 3 under the *Noxious Weeds Act 1993* in the LGAs of MNCR. Groundsel bush is reported as toxic to cattle, sheep, horses and chickens. The ability of groundsel bush to colonise after fire and flood events can lead to rapid invasion of an area, particularly within paperbark swamps, coastal heath and coastal eucalypt forests.

Priorities for control

- Continue and expand control programs in Clybucca HS where ongoing effort is required for program maintenance..
- Isolated and/or new occurrences - Crowdy Bay, Hat Head and Kumbatine NP's.
- Infestations near neighbouring properties.

Control

Groundsel bush has been the subject of an intensive biological control program and several agents are currently active in the field. These include the gall fly (*Rhopalomyia californica*), a stem boring beetle (*Megacyllene mellyi*) and a stem boring moth (*Oidaematophorus balanotes*). Neither of the latter two species are achieving any effective control at present. The gall fly, released over 10 years ago, which deforms the growing tips reducing seed production, is widespread but its effectiveness is again questionable - it is present in the Clybucca HS infestations.

Groundsel bush has been actively controlled within the three reserves where it currently is located, but will require ongoing maintenance and resources to enable some success. The infestation in Clybucca HS is the focus of a more regular program to protect both the archaeological and environmental values of the site and assist neighbouring farming properties to curb the potential level of infestation.

Assistance and support for biological control agents will continue.

Monitoring

NPWS will continue to record and map all occurrences and treatments of groundsel bush. Bio-control agents will be monitored and reported as required by DPI.

11.1.5 Glory Lily

Distribution and abundance

Glory lily (*Gloriosa superba*) occurs in dunal areas and headlands. The highest densities are found in disturbed areas and/or where bitou bush control has been undertaken. There are small infestations in Hat Head NP and Arakoon SCA and it has been found adjacent to the southern boundary of Khappinghat NR.

Impacts

Glory lily is an aggressive perennial scrambler or climber that spreads by seed and vegetative means. It is suspected of heavy competition for water and nutrients, and contains harmful alkaloids that can cause fatal poisoning of mammals, including humans. It invades coastal plant communities from the fore dune to littoral rainforest.

All parts of the glory lily plant are highly toxic if eaten and it has been responsible for the poisoning of humans, native wildlife and livestock.

Priorities for control

- Isolated and new infestations in Hat Head NP, Arakoon SCA and other coastal reserves.
- Where populations are likely to increase in response to other weed control.

Control

Thorough manual control of isolated plants with few stems is the most effective control option but is of limited practicality for any larger infestations. Herbicide application has shown variable success with the most effective option currently a mixture of glyphosate and metsulfuron methyl (used in accordance with Permit 9907) and applied early in the growing season with a follow up treatment late summer/early autumn. A problem with herbicide application is the potential for off target damage, particularly in heavy infestations, and careful application is needed. Alternate herbicide control options should continue to be investigated. The use of the herbicide picloram is being trialled with some success

Monitoring

Existing infestations are treated as required. New infestations are recorded and are to be treated within that growing season where possible.

11.1.6 Bushland Weeds

Bushland weeds are comprised of a variety of species, often originating as ornamental garden plants disposed as refuse within bushland reserves, or spread by animals (especially birds) or by wind and water dispersal. There is often overlap and commonality of weeds in bushland and rainforest communities. However, each require modified control techniques and management approaches due to the differing environmental gradients that operate in these communities, in particular light penetration, soil richness, moisture availability and the degree of disturbance. Typically bushland environments include the following weed species:

Woody Weeds
Cotoneaster (*Cotoneaster species*), pepper tree (*Schinus areira*), large-leaved privet (*Ligustrum lucidium*), small-leaved privet (*L. sinense*), tree of heaven (*Ailanthus altissima*), sweet briar (*Rosa rubiginosa*), camphor laurel (*Cinnamomum camphora*), cassia (*Senna pendula*), mickey mouse plant (*Ochna serrulata*), polygala (*Polygala myrtifolia*), umbrella tree (*Schefflera actinophylla*) and wild tobacco tree (*Solanum mauritianum*).

Exotic Herbs
Mother-of-millions (*Bryophyllum delagoense*), noogoora burr (*Xanthium occidentale*), nodding thistle (*Carduus nutans*), spear thistle (*Cirsium vulgare*), St Johns wort (*Hypericum perforatum*), and formosan lily (*Lilium formosanum*).

Distribution and abundance

In MNCR bushland weeds are generally relevant to the smaller reserves which have an interface with the urban or asset protection zones involving infrastructure such as historic buildings or near development areas such as campgrounds. The majority of reserves in MNCR have bushland weeds of varying degrees. The main reserves however include Macquarie, Kattang, Lake Innes and Queens Lake NR's, Hat Head and Crowdy Bay NP's. To a lesser extent, but linked to rainforest regeneration programs, are Sea Acres, Wingham Brush, Coocumbac Island, Yessabah NR's and Saltwater NP. Their presence in areas of disturbance within larger parks and reserves is sometimes due to proximity with pastoral and/or agricultural situations.

Impacts

Bushland weeds as a collective group constitute a serious environmental threat to the conservation of MNCR's parks and reserves, particularly those smaller reserves bordered by urban areas.

The impacts of bushland weeds can be exacerbated by the introduction and establishment of other major weed species such as lantana and bitou bush. Dense thickets can form as bitou and lantana grow over the established bushland weeds. Additionally, some bushland weeds, such as creepers and vines (see Section 11.1.10) are capable of reaching into the canopy layer.

Priorities for control

Bushland weeds are targeted where biodiversity values are impacted, but also in areas of high public profile with educational programs. This especially applies to the smaller remnant reserves that have high visitation. These include those reserves mentioned above where some programs have been in place for 25 year or more (e.g. Diamond Head in Crowdy Bay NP and Wingham Brush NR).

Control

A range of control techniques are used to control the various bushland lands weeds. This may include manual, chemical and biological control, or a combination of these techniques.

Public education programs are undertaken with reserve neighbours to encourage the proper disposal and/or compost of garden refuse, and to alert neighbours to the environmental impacts posed by bushland weeds (e.g. Kattang, Macquarie, Queens Lake and Wingham Brush NR's).

Where needed and where there is a strong enough community support, community action groups, such as the "Friends of Kattang NR", shall be formed with NPWS assistance and staff involvement to initiate bushland weed eradication/control programs.

Monitoring

This will include the mapping and recording of weeds (both noxious and environmental). Also control and eradication programs will be recorded, including voluntary participation and external grants to assist these programs e.g. Coastcare grants for Point Perpendicular (Kattang NR) and Gap Beach (Hat Head NP).

11.1.7 Rainforest Weeds

Rainforest weeds are comprised of a variety of species which have often originated as ornamental 'escapees' and spread by either accidental or intentional dumping of refuse, or via dispersal through fauna (especially birds), wind and water. They appear, in the majority, to originate from South Africa or South America. The exotic vines (see Section 11.1.10) are particularly adapted and vigorous weeds to deal with in rainforest communities. Weeds in this category are management issues in many floodplain and coastal areas statewide, but particularly in northern NSW. There is often overlap and commonality of weeds in rainforest and bushland communities. Each requires modified control techniques and management approaches due to the differing environmental gradients that operate in these communities, in particular light penetration, soil richness, moisture availability and the degree of disturbance.

Typically rainforest environments include the following weed species:

Woody Weeds
Large-leaved privet (*Ligustrum lucidium*), small-leaved privet (*L. sinense*), tree of heaven (*Ailanthus altissima*), camphor laurel (*Cinnamomum camphora*), mickey mouse plant (*Ochna serrulata*), umbrella tree (*Schefflera actinophylla*) and wild tobacco tree (*Solanum mauritianum*).

Exotic Herbs
Wandering jew (*Tradescantia albiflora*)and formosan lily (*Lilium formosanum*).

Distribution and abundance

In MNCR major weed problems effecting rainforest reserves occur in Sea Acres, Yessabah, Wingham Brush and Coocumbac Island NR's and at Gap Beach (Hat Head NP). Rainforest weeds are controlled as part of regeneration projects within these reserves.

Impacts

Rainforest weeds, particularly those adapted to establishing rapidly within areas of disturbance, can seriously threaten the conservation values of rainforest reserves and impede natural regeneration of sites. Rapid growing climbers and vines can quickly swamp a rainforest canopy, and out-compete native rainforest species. Certain rainforest weeds in particular, such as the umbrella tree, can be spread via native birds into rainforest areas and establish within staghorns and elkhorns, robbing these of nutrients and ultimately encasing the host tree as an exotic version of the strangler fig.

Priorities for control

- Gap Beach in Hat Head NP, and Sea Acres, Kattang, Coocumbac Island, Yessabah, and Wingham Brush NR's.
- Rainforest regeneration will be extended to cover other reserves where weeds occur but programs have not been implemented so far.
- Rainforest regeneration projects conducted within the Region have proved effective in controlling rainforest weeds, and will continue to be the focus of control programs in the future.

Control

Rainforest regeneration requires a specialised approach which considers the successional stages of rainforest ecology and the life habit of rainforest weeds. Bush

regeneration techniques and the use of herbicides have been specifically developed for working in rainforest environments to minimise non-target impacts and to maximise regeneration.

Programs to restore and regenerate rainforest remnants have been in existence for close to 20 years and efforts have pioneered relevant strategies in order to correctly monitor progress and techniques employed. Many of these were developed at Wingham Brush prior to its dedication as a NR. Volunteers have made a significant contribution to the control of rainforest weeds over many years (e.g. Coocumbac Island, Wingham Brush and Sea Acres NR's, and Hat Head NP).

Monitoring

Existing programs will continue to be monitored by worksheets of activities undertaken and these ultimately summarised. Photographic evidence of before and after effects is a major tool in the monitoring process. Educational and promotional programs will continue as part of the Region's focus on rainforest protection - in the Manning valley there has been a major emphasis in this respect on the work and success of the regeneration program at the Wingham Brush, which has both national and international recognition.

11.1.8 Exotic Pines

Radiata Pine (*Pinus radiate*) and Slash Pine (*P. elliottii*)

Distribution and abundance

Exotic pine plantations occur in Biriwal Bulga NP, Cottan-Bimbang NP/The Cells SCA, Crowdy Bay NP, Khappinghat NR, Maria NP, Tapin Tops NP, Werrikimbe NP/SCA and Willi Willi NP. Most plantations were part of the Forests NSW trials which aimed to examine the growth rates and viability of pine plantations within a range of climate and environmental areas. The plantation in Crowdy Bay NP was part of a post sand mining regeneration planting to trial their growth.

Impacts

Biodiversity values can be significantly impacted where pine monocultures exist. A limited number of native bird and mammal species are found where former plantations exist in reserved lands. Exotic pines also impact the recreation, landscape and aesthetic values of NPWS reserves. Exotic pines inhibit the growth of native vegetation due to light exclusion and growth inhibitors in needles and bark.

Seeds are spread by wind, water and birds with seedlings (pine wildlings) spreading out from plantations. Wildlings grow rapidly, eventually forming dense canopies which prevent regeneration of native species and increase the fire hazard.

Priorities for control

- Contain or control significant known infestations, particularly the pine plantations in Willi Willi NP (excluding the arboretum at Mount Banda Banda) to reduce impacts on Wilderness values.
- Eradicate isolated or newly detected infestations and individual wildlings.

Control

Exotic pines will be controlled using manual, mechanical and chemical control techniques. The main method for large trees will be stem injection with undiluted Tordon ® during active growing months.

Manual methods include felling and ringbarking larger trees and hand pulling of seedlings. Cones of mature fruiting trees once felled should be bagged and removed. Application of fire may also be used to kill large infestations. Hot burning is required to kill seeds in soil to reduce pine regeneration.

Note. Existing exotic pine plantations will be assessed in relation to the viability of harvesting their timber in an environmentally sensitive manner. Where it is not viable to harvest timber from existing exotic pine plantations, control will be undertaken as described above.

Monitoring

Monitor all exotic pine plantations to safeguard spread into adjoining areas. Monitor regrowth at all sites following control/removal of mature exotic pines (e.g. Crowdy Bay NP).

11.1.9 Exotic Grasses

Giant paspalum (*Paspalum urvillei*), giant Parramatta grass (*Sporobolus fertilis*), spiny burrgrass (non native *Cenchrus* spp.), pigeon grasses (*Setaria* spp.), kikuyu (*Pennisetum clandestinum*), whisky grass (*Andropogon virginicus*), broad-leafed paspalum (*P. wettsteinii*), Coolatai grass (*Hyparrhenia hirta*), buffalo grass (*Stenotaphrum secundatum*), molasses grass (*Melinis minutiflora*), African lovegrass (*Eragrostis curvula*), pampass grass (*Cortaderia sellona*), giant reed (*Arundo donax*), carpet grass (*Axonopus affinis*) and Rhode's grass (*Chloris gayana*).

Distribution and abundance

Infestations of most exotic grass species occur along roads, tracks and trails and previously disturbed areas within many reserves in MNCR. Giant Parramatta grass is present almost exclusively along roadsides, often growing in dense swards (e.g. Clybucca HS and Limeburners Creek NR). Kikuyu and buffalo grass is present on headlands in Hat Head NP, Saltwater NP and Sea Acres NR. Infestations of whisky and carpet grass occur along roadsides in a number of reserves, although it is particularly abundant in Crowdy Bay NP on roads, trails and sites previously disturbed by sand mining operations. Broad-leafed paspalum is an emerging problem in smaller lowland reserves and Coolatai grass has recently been detected along roadsides at a number of sites within MNCR.

Molasses grass was introduced post sand mining operations and is present in disturbed areas in Crowdy Bay NP, with scattered infestations in Saltwater NP. In addition, there are known localised infestations of other grasses, such as giant reed on Coocumbac Island NR.

A number of temperate climate grasses such as African lovegrass occur along roadsides in various parks and reserves, while pampas grass has been found on the rainforest edge in Sea Acres NR and wetlands in Crowdy Bay NP. Coolatai grass has been discovered along the walking track at Green Island Point in Hat Head NP, and on the roadside at Sea Acres and Lake Innes NR's. It appears to be spreading rapidly throughout MNCR.

Impacts

Exotic grasses are vigorous, persistent and invasive weeds in disturbed areas. Once established they can displace low vegetation and native grasses, and provide a seed source for dispersal by vehicular and pedestrian traffic.

Some grasses become invasive and others dominate ground cover layers in full sun to shade (e.g. buffalo grass can dominate ground cover layers in the Coastal Saltmarsh, Swamp Oak Floodplain Forest and Themada Grassland on Seacliffs and Coastal Headlands EECs). Whisky grass is a threat to swamp sclerophyll forest and heath/sedge lands. Coolatai grass has proven very invasive in open woodlands on the slopes and tablelands and is a threat to heathlands, especially graminoid clay heaths on headlands. Invasion of native plant communities by exotic perennial grasses is listed as a KTP under the TSC Act (NSW Scientific Committee, 2003).

Priorities for control

- EECs including: Littoral Rainforest; Themada Grassland on Seacliffs and Coastal Headlands; and Swamp Oak Floodplain Forest.
- Isolated and new infestations in all reserves.
- Where control of grasses is required as part of a bush regeneration program.

Control

A variety of control techniques can be utilised for controlling grasses, including physical removal of isolated clumps or herbicide spot-spraying, from a vehicle-mounted spray unit or rope wick applicators. The risk of using herbicides is the potential impact to native grasses. The creation of bare patches following herbicide application allows exotic grasses to rapidly re-establish. Follow-up is critical in the control of exotic grasses.

Monitoring

NPWS will continue to record and map all occurrences and treatments of exotic grasses. Treatments will be assessed for their effectiveness, but success can only be guaranteed with repeated treatments and persistent surveillance where programs are implemented.

11.1.10 Exotic Vines

Cats claw creeper (*Macfadyena unguis-cati*), madeira vine (*Anredera cordifolia*), introduced morning glory (*Ipomoea* spp.), balloon vine (*Cardiospermum grandiflorum*), moth vine (*Araujia sericifera*), asparagus ferns (*Asparagus* spp.), and Japanese honeysuckle (*Lonicera japonica*).

Distribution and abundance

Exotic vine infestations occur in all major catchments within MNCR. As most exotic vines are readily spread by water movement, riparian zones are particularly threatened.

Cats claw creeper, madeira and balloon vines are widespread within the Macleay, Hastings and Manning catchments, infesting extensive areas of all river systems, as well as many tributaries. Ongoing control programs are current in all 3 valleys, as well as targeted programs at Wingham Brush and Coocumbac Island NR's. Elsewhere in the region they have an isolated occurrence and any infestations are a high priority for control, particularly around old settlements and historic buildings.

Asparagus ferns are common garden escapes that readily invade many coastal reserves. Significant asparagus fern infestations are continuing to be controlled in Wingham Brush and Sea Acres NR's, and a major control program has been implemented in Saltwater NP.

Japanese honeysuckle can be a significant weed in reserves within urban environments or around historic building sites such as Smoky Cape Lighthouse in Hat Head NP, Roto House in Macquarie NR and Innes Ruins HS. Moth vine has an isolated occurrence in some coastal reserves generally associated with rainforest communities.

Impacts

Exotic vines have been ranked by the NSW Mid North Coast Weeds Advisory Committee as having the most impact on biodiversity of all weeds species present in the region. Exotic vines are easily transported, grow quickly and many are capable of climbing to the top of trees and stripping branches due to their weight. This leads to mass germination of exotic vines and other weeds with the increased sunlight reaching the forest floor and hence the destruction of floristic and structural diversity and fauna habitat. Heavy infestations result in trees being transformed to poles, often falling down in future flood events.

Substantial asparagus infestations often create impenetrable thickets of thorny vine between the ground and 4m in height. Morning glory commonly occurs in coastal heaths, woodlands and swamp forests where it out competes, smothers and displaces native species.

Exotic vines reduce human access and can impact on physical infrastructure such as fencelines and picnic facilities. Invasion and establishment of exotic vines and scramblers is listed as a KTP under the TSC Act (NSW Scientific Committee, 2006b).

Priorities for control

- EECs including: Coastal Saltmarsh; Littoral Rainforest; Lowland Rainforest on Floodplain; Subtropical Coastal Floodplain Forest; Swamp Oak Floodplain Forest; and Swamp Sclerophyll Forest on Coastal Floodplains.

- Near threatened species and known threatened species habitat including flying fox camps.
- New and isolated infestations.
- Bush regeneration programs targeting the most upstream infestations.
- Maintenance of existing long-term control programs, particularly following a window of opportunity such after flood events.

Control

The first priority for control in most exotic vine infestations is to control the vine in the upper canopy. This is generally achieved through cutting and painting or scraping and painting, depending on the species, with herbicide. Aerial tubers / seed pods should be bagged and composted for madeira vine and balloon vine infestations.

Follow up control generally involves foliar spraying seedlings and regrowth with glyphosate or hand removal of isolated plants. In heavy Asparagus infestations there may be a need for physically clearing away stems tangled in trees before foliar spraying the remaining plants with herbicide. Light infestations can be controlled through crowning.

Monitoring

Exotic vine infestations need to be controlled at least 3 times per year to ensure that native regeneration is not adversely affected, and for madeira / balloon vine, that tubers / seed pods are not produced within that time. Isolated infestations are controlled immediately where possible, however it is important that their location is mapped to ensure adequate follow up control occurs.

Monitoring the effectiveness of key exotic vine control programs is undertaken through mapping the size and density of infestations, and establishing photo points. In some locations, quadrats are used to record the number and diversity of native and introduced plants.

11.1.11 Aquatic Weeds

Water lettuce (*Pistia stratiotes*), salvinia (*Salvinia molesta*), cabomba (*Cabomba caroliniana*), parrots feather (*Myriophyllum aquaticum*), water hyacinth (*Eichhornia crassipes*), and sharp rush (*Juncus acutus*).

Distribution and abundance

Water lettuce – occurs together with salvinia in a relic sandmining pond in Crowdy Bay NP.

Salvinia – there is a heavy infestation in Harrington Lagoon, and also in the relic sandmining pond in Crowdy Bay NP; a heavy infestation once occurred in the Swanpool wetland within Hat Head NP; a small infestation is recorded in a dam within Rawdon Creek NR. Infestations have also been recorded in several off-park storm water drains and creek lines which flow into Lake Innes NR. This weed also occurs at several off-park locations within the three major floodplain catchments (Manning, Hastings, and Macleay) of MNCR.

Cabomba – heavy infestation in stormwater drain (Cabomba Drain) in Lake Innes NR. Additional infestations occur in off-park stormwater drains and creek lines which flow into Lake Innes NR.

Parrots feather – occurs together with cabomba in Cabomba Drain in Lake Innes NR and is also present in off-park stormwater drains and creek lines which flow into Lake Innes NR.

Water hyacinth – occurs as a medium to heavy infestation in the Swanpool within Hat Head NP. Also occurs at several off-park locations within the three major floodplain catchments (Manning, Hastings, and Macleay) of MNCR.

Sharp rush – infestations are recorded along the foreshore of Khappinghat Creek adjacent to Khappinghat NR and Saltwater NP.

Impacts

Water lettuce can produce abundant growth, expand rapidly and form obstructive mats. These large dense floating mats can have negative impacts on native aquatic plants and animals. They can interfere with irrigation, boating and water sport activities. Thick mats of water lettuce are also known to harbour mosquitoes. Water lettuce is declared Class 1 under the *Noxious Weeds Act 1993* in all LGAs in MNCR.

Salvinia disrupts aquatic ecosystems, seriously affecting native animals and plant life; decreases the quality of water by causing odours, accumulation of organic matter and stagnation of streams; degrades the aesthetic values of waterways; reduces or prevents the use of waterways for recreation and transport; and interferes with the functioning of river control structures, especially during flooding (DPI, 2006). Salvinia is declared Class 3 under the *Noxious Weeds Act 1993* in all LGAs in MNCR. Salvinia is listed as a Weed of National Significance in Australia.

Cabomba is an aggressive invader of freshwater systems, particularly if they are nutrient rich. It is a fully submerged aquatic plant that out-competes native freshwater plants and has similar impacts to salvinia. It can impede aquatic recreational activities and drowning is a risk for entangled swimmers. Cabomba is declared Class 5 under the *Noxious Weeds Act 1993* in all LGAs in MNCR. Cabomba is listed as a Weed of National Significance in Australia.

Parrots feather forms dense stands and is capable of totally choking water ways, excluding all other flora and fauna.

Water hyacinth can form a dense, impenetrable mat over the water surface. Specific damage includes: destroying natural wetlands; eliminating native aquatic plants; reduced infiltration of sunlight; changing the temperature, pH and oxygen levels of water; reducing gas exchange at the water surface; increasing water loss through transpiration; altering the habitats of aquatic plants and animals; reducing aesthetic values of waterways; and reducing water quality (DPI, 2005). Water hyacinth is declared Class 3 under the *Noxious Weeds Act 1993* in all LGAs in MNCR.

Sharp rush displaces native rushes and sedges. It can rapidly spread through wetlands, river systems and creeks. Recreational quality of habitat is greatly reduced due to sharply pointed leaves and stems. *Juncus acutus* is closely related to the native *J. kraussii* and there documented cases that where the two are growing together that they have hybridised. The hybrid is potentially more dangerous than the straight *J. acutus*.

Priorities for control

- Water lettuce - relic sandmining pond in Crowdy Bay NP.
- Salvinia - Harrington Lagoon and the relic sandmining pond in Crowdy Bay NP; Swanpool wetland in Hat Head NP; and dam in Rawdon Creek NR.
- Cabomba - Cabomba Drain in Lake Innes NR.
- Parrots feather - Cabomba Drain in Lake Innes NR.
- Water hyacinth - Swanpool wetland in Hat Head NP.
- Sharp rush – Khappinghat Creek foreshore in Khappinghat NR and Saltwater NP.

Control

Aquatic weed control is problematic due to rapid growth of aquatic weeds and the impact dead and decaying material can have on water quality. A permit may be required from the Climate Change and Environment Protection Group (DECC) for any herbicide applications applied over or near water. As new biological control agents become available for aquatic weeds these will be incorporated into the integrated aquatic weed control program.

Water lettuce – physical removal is effective for small infestations. Water lettuce plants cannot survive for long out of the water and can be removed by either raking or being pulled to the bank with an encircling rope. Once removed, plants must be allowed to dry out and break down. It is important to make sure that all plants removed are placed above the flood line. If possible, place on plastic to prevent them from taking root in the mud. Water weed harvesting craft may be suitable for larger infestations although these can be quite expensive. Herbicides may be necessary to control large infestations of water lettuce. Currently, biological control is not considered an effective method for this weed. However, the weevil (*Neohydrnomu pulchellus*) has been successful in clearing a dam of water lettuce in Queensland within seven months of its release and has significantly reduced other infestations near Brisbane. In the longer term, biological control may be considered appropriate as part of an integrated control approach following further research into combatants suited to this climate.

Salvinia – successful management of salvinia relies on early detection, action and implementation of an integrated control program. Varying infestations may require a different method or a combination of biological, mechanical or herbicide control techniques (DPI, 2006a). Detailed information on integrated control is available in the

NSW DPI's 'Salvinia Control Manual' (DPI, 2006b). An ant-sized weevil (*Cyrtobagous salviniae*) has been released in the Swanpool wetland in Hat Head NP.

Cabomba – once established it is extremely difficult to control. Mechanical removal of small infestations can be attempted, if practical. All fragments of the weed must be removed and disposed of carefully. Excavators may be used to remove larger infestations. Draining or "draw down" of a water body can also be effective. There are no herbicides registered for cabomba control in NSW.

Parrots feather – physical removal of isolated plants, removing all plant material. Dry out all material on the ground in the sun. Never dispose of any parrots feather in ditches, creeks etc.

Water hyacinth – integrated control (mechanical, biological and chemical). Physical removal of isolated seedlings/plants.

Sharp rush – mechanical removal in areas already disturbed or invaded with weeds. Physical removal of isolated infestations. Due to hybridisation, successful programs are potentially limited at this stage.

Monitoring

NPWS will continue to record and map all aquatic weed infestations in MNCR. The effectiveness of control techniques will be monitored together with various water quality parameters. NPWS will liaise with relevant councils prior to undertaking aquatic weed control programs.

11.2 Pest Animal Species

11.2.1 European Fox

Distribution and abundance

Foxes (*Vulpes vulpes*) occur in most environments in Australia, however, they are probably most abundant in agricultural areas with patches of uncleared vegetation, because these areas provide abundant food, cover and denning sites. In contrast, foxes appear to be rare in closed forest distant from cleared land.

Foxes occur throughout MNCR, in both urban areas and bushland reserves.

Impacts

The introduction of foxes into Australia has had a devastating impact upon native fauna, particularly among medium-sized (450-5000 g) ground-dwelling and semi-arboreal mammals, ground-nesting birds and freshwater turtles. Recent studies have shown that predation by foxes continues to suppress remnant populations of many such species. Foxes have caused the failure of several attempts to reintroduce native fauna into areas of their former range. Predation by foxes was the first KTP to be listed under the TSC Act (NSW Scientific Committee, 1998). Foxes are also significant predators of domestic stock including poultry and lambs with the potential to reduce lambing rates significantly.

Native species most likely to be impacted at the population level in MNCR include little terns, beach stone curlew, pied oystercatcher, bush stone curlew, brolga, rufous bettong, brush-tailed rock wallaby, and freshwater turtles. A range of other species including bandicoots, brush turkeys and brush-tailed possums are also impacted.

Priorities for control

The Fox TAP (NPWS, 2001a) identifies the Manning River Harrington/Farquhar beach spits as a high priority site for fox control in MNCR to protect little terns and beach stone-curlews. This site has been identified as one of the most successful breeding sites for little terns on the east coast of Australia.

Targeted fox control is also undertaken in Clybucca HS, Coocumbac Island NR, Crowdy Bay NP, Kattang NR and Woregore NR. Foxes are controlled as part of targeted wild dog control programs in Limeburners Creek NR, Hat Head NP and Kumbatine NP/SCA.

Due to the strong scavenging nature of foxes, garbage depots within camping and rest areas shall be managed to prevent or reduce the likelihood of fox scavenging.

Control

Regular systematic baiting using 1080 is the preferred method of fox control and is used throughout MNCR. This is supplemented by soft-jaw trapping, den fumigation and shooting.

To protect the little tern colony baiting for foxes is undertaken prior to the commencement of the little tern breeding season. Subsequent baiting is undertaken if there is further evidence of fox activity on the Harrington/Farquhar spits during the breeding season.

Monitoring

The impact of fox predation on the priority species and conversely, the effectiveness of the control program are being assessed through long-term monitoring of priority species at the sites and fox populations.

An annual program is undertaken at the Harrington/Farquhar spits to monitor the number of little tern/beach stone-curlew eggs versus the number of successful fledglings. The number of baits taken by foxes is also measured along with presence /absence of foxes via sand pad monitoring. Data is analysed and published periodically as part of the review of the Fox TAP.

Fox populations are monitored at all sites where targeted fox control programs are undertaken. This includes the monitoring of mound bait stations and sand pads to determine presence/absence.

11.2.2 Wild Dog

Distribution and abundance

Wild dogs (*Canis lupus familiaris* and *C. l. dingo*) can be divided into three groups. Dingoes, which arrived in Australia about 4000 years ago, feral dogs – domestic dogs living in the wild, and hybrids - the result of crossbreeding between dingoes and feral dogs. Wild dogs have a distribution across Australia, particularly in nearby/adjacent areas to major towns, rural settlements and outlying properties.

Dingoes originally occurred throughout NSW but today populations of wild dogs, including dingoes occur mainly in the east of the state on public and private lands along the Great Dividing Range and coastal hinterlands.

Wild dogs are present in low to medium densities in most of the larger reserves in MNCR, particularly abutting the rural landscape. Many of these reserves are identified Dingo Management Areas under Schedule 2 of the RLPB Wild Dog Pest Control Order. Pest Animal Distribution Tables in this strategy provide a full list of reserves where wild dogs are known to occur within MNCR.

An assessment of wild dog DNA samples (total 247) collected throughout the NPWS Northern Branch indicate that more than 70% of those trapped and DNA sampled are dingoes (varying from 100% to 50% pure). Pure dingoes comprised approximately 20% and feral dogs 8%.

DNA analysis of wild dog populations in North Coast Region show a significant proportion of wild dogs in the larger reserves of New England NP and Cathedral Rock NP are either pure or greater than 75% pure dingo. A core population of pure dogs continues to breed in the Limeburners Creek NR, while pure dingoes have been recorded in various locations across the landscape in MNCR, as well as further south in the Myall Lakes NP in the Hunter Region.

Impacts

Wild dogs, including dingoes, can cause significant livestock losses to the pastoral industry. Livestock affected include goat, sheep and cattle. Significant impacts occur where forested and gorge areas interface with fine wool sheep country. Impacts on cattle operations are most pronounced during calving.

Breeding between dingoes and feral dogs is one of the biggest threats to remaining native dingo populations. Maintenance of dingo pack structure within identified Dingo Management Areas (Schedule 2 lands) is seen as important to minimise further hybridisation and reduce predation impacts on neighbouring livestock operations.

Wild dogs do suppress populations of pest species such as feral goats, pigs and foxes. This means the positive management of wild dog populations is an important element of biodiversity conservation and pest management.

Wild dogs, including dingoes, are declared as a pest animal throughout NSW under the RLP Act on lands other than NPWS estate. NPWS seeks to find a balance between conserving and controlling dingoes and other wild dogs in areas where they impact on livestock.

Priorities for control

Wild dogs, including dingoes, have been declared as a pest animal under the RLP Act and they must be controlled on Crown lands. Although the dingo is unprotected

under Schedule 11 of the NPW Act, it is considered a native animal, and there is a requirement for it to be conserved both on NPWS managed lands and within NSW generally.

Wild dog management plans are prepared in conjunction with the local RLPB's and Wild Dog Control Associations (WDCAs). The plans must include the dual aims of minimising livestock predation and the conservation of the dingo in the core areas of all reserves listed under Schedule 2 of the Wild Dog Pest Control Order. While the overarching management plans are developed by the RLPB's, operational plans are negotiated with individual WDCAs on an Association area basis.

Priorities for wild dog control on reserves in MNCR are based primarily on the level of livestock predation reported by adjoining landholders, in accord with the relevant wild dog management plans. Wild dog control measures will be focused on areas of reserves where there are current and/or historic records demonstrating significant impact on livestock from wild dogs emanating from the reserves. There will be close liaison with the local WDCA and landholders when developing control programs.

NPWS will continue to work with RLPB's to develop and review wild dog management plans. NPWS commitments in these plans include implementing cooperative 1080 baiting programs in conjunction with neighbours in problem areas. Contract wild dog trapping occurs on an annual or biannual basis to monitor effectiveness of baiting programs and in cases where reactive control of wild dogs is required due to livestock and other neighbour impacts (e.g. attacks to domestic animals). The Kempsey RLPB have prepared a draft Wild Dog Management Plan (Kempsey RLPB, 2007). Interestingly, the results of questionnaires attached to annual Land and Stock Returns indicate that a 1/3 of the wild dog/stock impacts can be attributed to domestic dogs.

Control

A range of control techniques will be used to manage wild dogs within MNCR. Strategic control programs are undertaken in partnership with the local RLPB's, WDCA's and individual landholders, and may be either proactive or reactive in accordance with the NPWS Wild Dog Policy (NPWS, 2005).

Proactive control options aimed at minimising the impact of wild dogs on livestock include:

- ground/mound baiting and trapping in accessible areas using either NPWS staff or contract trappers; and
- aerial baiting in the rugged inaccessible areas where other control techniques may not be suitable.

Note - free-feeding may be undertaken prior to the use of lethal baits in order to monitor the presence of, and to minimise impacts on, non-target species.

Reactive control occurs in response to new reports of livestock predation or dog activity. Control will be implemented as soon as practicable using one or other of the above methods, or a combination thereof.

MNCR together with RLPB's will liaise with local government and encourage them to enforce controls on straying domestic dogs as per the NPWS Wild Dog Policy and the draft Kempsey Wild Dog Management Plan.

Dingo Risk Management

Dingo habituation and aggression towards park visitors has been identified as a potential risk in popular camp grounds in Limeburners Creek NR, Crowdy Bay and Hat Head NP's. As well as direct risk to human safety posed by habituated and therefore potentially aggressive dingoes, accidental absorption of the hydatid parasite (which can be carried in dingo faeces) can cause disease or death in humans.

To manage these issues in a strategic and consistent manner the NPWS have prepared a draft policy and procedures for the control of risks to humans from dingoes (DECC, 2008). MNCR has also prepared a draft dingo management strategy for Limeburners Creek NR. Key elements of the strategy include: a review of campground waste management; appropriate signage; visitor education; and marking of dogs for identification.

Monitoring

Liaise with neighbours and other stakeholders (RLPB's and Wild Dog Associations) about wild dog issues.

Samples of all wild dogs trapped by NPWS staff or contractors will be sent for DNA analysis. A Geographic Information System (GIS) database of stock loss reports, wild dog activity and DNA results will be maintained for MNCR. MNCR will regularly review the database and generate GIS maps to assist in the annual review of NPWS MNCR wild dog management programs. An additional database has been established for scats to determine prey species (e.g. native wildlife, domestic stock, feral animal etc).

NPWS will monitor dingoes in high visitor use areas such as Limeburners Creek NR, Crowdy Bay and Hat Head NP's and if required will remove aggressive dingoes. Preventative monitoring will also be undertaken (e.g. Colour ear-tagging dingoes frequenting camping areas).

11.2.3 Wild Deer

Distribution and abundance

Four deer species are known to have formed wild populations in MNCR. These are rusa deer (*Cervus timorensis*), fallow deer (*Dama dama*), red deer (*Cervus elaphus*), and chital deer (*Axis axis*). Other species that may occur in MNCR are sambar deer (*Cervus unicolour*) and hog deer (*Axis porcinus*).

It is estimated that several hundred wild deer are dispersed across MNCR with populations escalating (NPWS, 2006). Localised wild herds occur around the Port Macquarie area and in Queens Lake and Lake Innes NR's. Deer are regularly reported along the Pacific and Oxley Highways. They are potentially present in a number of escarpment reserves such as Carrai, Werrikimbe and New England NP's and Fifes Knob, Gads Sugarloaf, Mount Seaview and Pee Dee NR's.

Impacts

Herbivory and environmental degradation caused by feral deer has been declared a KTP under the TSC Act (NSW Scientific Committee, 2004a).

Wild deer can have major impacts in parks and reserves, by:
- destroying native plants. Deer can trample plants; graze on them, and ring-bark young trees. Deer can have a major impact on the variety and abundance of plant species where populations are high;
- fouling waterholes;
- causing soil erosion;
- transmitting diseases such as foot-and-mouth disease; and
- spreading weeds.

High densities of wild deer have been found to reduce understorey plant species in the endangered ecological community Littoral Rainforest by as much as 70%. Deer have been found to browse on lantana, crofton weed, mistflower and mother of millions (Moriarty et al, 2000). The dietary overlap between rusa deer and the swamp wallaby (*Wallabia bicolour*) is estimated to be 15 – 50%, with one deer eating approximately the same amount of vegetation as three swamp wallabies (DEC, 2005).

Wild deer on roads have caused several major car accidents in NSW in recent years. Wild deer within MNCR present a public safety hazard, particularly with the small, highly mobile populations recorded in and adjacent to Lake Innes NR. Car accidents continue to cause significant damage near Port Macquarie. Given the proximity of major arterial roads in the area where wild deer have been observed to range, there is a continual risk for ongoing and potentially fatal accidents.

Priorities for control

- Develop proactive strategic and collaborative wild deer control programs in conjunction with the Mid North Coast Region Wild Deer Working Group, targeting areas in and around Lake Innes NR and Queens Lake NR/SCA.
- Implement reactive control programs for wild deer in response to a significant impact on a reserve's values or neighbours.

Control

NPWS MNCR has prepared a Wild Deer Pest Management Strategy (NPWS, 2006) and works cooperatively with other stakeholders in the region through the Mid North Coast Region Wild Deer Working Group which formed in 2001. Other stakeholders include RLPB's, Forests NSW, NSW Police, local government, RSPCA, NSW Game Council, Deer Farmers Association, FAWNA, local veterinarian/s and recreational shooters. In recent times the game council has organised the formation of the Port Macquarie - Hastings Hunting Group who undertake culling of nuisance wild deer in consultation with NSW Police and local RSPCA officers.

A number of techniques are available for the control of wild deer including shooting, fencing, trapping using feed based lures, oral sedation, mustering, and 'Judas' control. However, in remote areas and difficult habitat (e.g. wetlands), there are few viable cost-effective options available. Shooting is the most preferred humane option.

Given the current population level of wild deer, there is a 'window of opportunity' to control the current population before it expands. However, as the population is widely dispersed, control programs will be labour intensive and require adequate funding and resources.

Monitoring

The occurrence and distribution of feral deer shall continue to be monitored within the Region as detailed in the MNCR Wild Deer Pest Management Strategy. The Port Macquarie - Hastings Hunting Group will continue report control efforts. The recording of incidence will be undertaken cooperatively by stakeholder members of the MNC wild deer working group.

11.2.4 Feral Cat

Distribution and abundance

Cats (*Felix domesticus*) have been present in Australia at least since European settlement, and may have arrived as early as the 17th century. Feral cats are now found throughout Australia. There are estimated to be 400,000 feral cats in NSW and around 12 million across Australia.

Feral cats are solitary and predominantly nocturnal. Studies in western NSW have shown that males usually occupy a home range of 280 hectares, while females had smaller ranges of about 150 hectares but this may be larger if food supplies are scarce. They are less common in closed forests, preferring open, dryer habitats such as grasslands. Although no specific systematic surveys have been undertaken for feral cats in MNCR, opportunistic surveys, anecdotal reports and sand pad surveys indicate that they are present to varying degrees in all reserves. They are particularly abundant near urban centres and townships. This includes the distribution of urbanised domestic cats which occur within reserves such as Macquarie, Lake Innes, Sea Acres and Wingham Brush NR's, and which constitute a threat to the native fauna of these reserves.

Impacts

Feral cats are carnivores and can survive with limited access to water. They generally eat small mammals, but also catch birds, reptiles, amphibians, fish and insects, taking prey up to the size of a brush-tail possum. There is clear evidence that feral cats have had a significant impact on island fauna. On the mainland, they contributed to the extinction of many small to medium sized mammals and ground-nesting birds; particularly in the arid zone. In some instances, feral cats have directly threatened the success of recovery programs for endangered species. Threatened species recorded in MNCR that are known to be predated on by feral cats include Hastings River mouse (*Pseudomys oralis*), ground parrots (*Pezoporus wallicus*), grass owls (*Tyto capensis*), and the little tern (*Sterna albifrons*). Feral cats also carry infectious diseases such as toxoplasmosis and sarcosporidiosis, which can be transmitted to native animals, domestic livestock and humans.

Predation by feral cats is listed as a KTP under the EPBC Act and the TSC Act (NSW Scientific Committee, 2000a).

Priorities for control

A TAP for predation by feral cats has been produced under the EPBC Act and is currently being produced under the TSC Act. The Cat TAP will identify high priority locations for control of feral cats along with appropriate control techniques. MNCR will continue to implement opportunistic control and cooperative programs with concerned neighbours and undertake trapping in identified problem areas including Kattang, Macquarie, and Sea Acres NR's.

MNCR will continue to support research into feral cat control and utilise any appropriate new control techniques.

Control

Control of feral cats is problematic as they are hard to trap, do not readily take baits unless during periods of food shortage, and generally difficult to shoot as they avoid human contact. Even if cats are removed from an area, it is quickly re-colonised (DEH, 2004).

Registration of the vertebrate pesticide sodium fluoroacetate (1080) is currently being sought for the control of feral cats where conditions for its use are suitable. Audible recorded lures for feral cats and other predators are available through a number of sources. Night shooting is assisted by the cat's distinctive, green eyeshine. Rubber-jawed, leg-hold traps can be laid in the same manner as they are laid for wild dogs and foxes. Cats can also be trapped in wire 'treadle-type' box traps although this method is most practical for semi-feral urban cats (NRW, 2006).

Monitoring

Sand pads across forest tracks can provide some indication of feral cat numbers in remote locations and will continue to be recorded as part of the implementation of the Fox TAP and targeted regional wild dog and fox control programs. A coordinated and standardised reporting system will be developed as part of the implementation of the TAP for predation by feral cats.

11.2.5 Feral Pig

Distribution and abundance

Domestic pigs (*Sus scrofa*) were introduced to Australia at the time of European settlement as a food source, and by the 1880's were regarded as a pest in several areas of western NSW and Victoria. Today there are estimated to be between 13 million and 23 million pigs in Australia. Significant populations occur in all states and territories except Tasmania.

Feral pigs occur across eastern Australia and into tropical areas of the NT. WA also has populations of feral pigs. Feral pig local distribution is limited to areas of available food, access to water and reasonably undisturbed shelter. Arid areas do not provide adequate requirements of daily water and hence is a limiting factor for feral pig distribution.

Feral pigs are mainly found along watercourses and floodplains and in hot weather they are usually found within two kilometres of water. Densities vary depending on conditions, with about one feral pig per square kilometre in eucalypt woodland, forest and grazing land, and as many as 10–20 in wetlands and seasonally inundated floodplains. Feral pigs are active from late afternoon to early morning. They eat a wide range of foods including plants and small animals, and they will scavenge on dead animals. Adult male feral pigs (boars) generally roam alone over an area of up to 43 square kilometres, while females (sows) range over areas smaller than 20 square kilometres (DEH, 2005).

Within MNCR feral pigs are known to occur within Brimbin NR, Goonook NR, Crowdy Bay NP, Lake Innes NR, Werrikimbe NP, Limeburners Creek NR, Maria NP, and Willi Willi NP.

Impacts

Feral pigs are a serious environmental and agricultural pest. Predation, habitat degradation, competition and disease transmission by feral pigs is listed as a KTP under the EPBC Act and TSC Act (NSW Scientific Committee, 2004b). Feral pigs are listed as a declared pest under the RLP Act.

Feral pigs have significant impacts on the environment, including:

- Eating or destroying native plants and animals;
- Wallowing in, fouling and disturbing soils in dams, waterholes and other moist or swampy areas.
- Creating drainage channels in swamps;
- Digging for food. This can have major impacts on vegetation and forest litter, particularly along drainage lines and around swamps and lagoons, or after rain when the ground is softer. These actions destabilise stream banks and accelerate erosion;
- Eating frogs, reptiles, birds and small mammals, and;
- Spreading weeds and possibly disease.
- Spread of the soil borne pathogen *Phytophthora cinnamomi* belonging to the water mould group (*Oomycetes*). *P. cinnamomi* has been recorded Werrikimbe NP and is thought to be present in areas of Willi Willi NP. Infection of native plants by *P. cinnamomi* is listed as a KTP under the TSC Act (NSW Scientific Committee, 2002a) and the EPBC Act. *P. cinnamomi* may contribute to plant death where there are other stresses present such as waterlogging, drought, and perhaps wildfire (NSW Scientific Committee, 2002a).

Feral pigs can be a serious agricultural pest. They eat and destroy grain crops, improved pastures, and damage fences. They have been known to kill and eat up to 40% of newborn lambs. Feral pigs carry endemic diseases such as leptospirosis, brucellosis and meliodosis (DEH, 2005).

Priorities for control

Cooperative control programs with park neighbours and the RLPB will continue to be supported by NPWS. Control programs focus on trapping and baiting in areas of current activity. Traps have been built by NPWS staff and are available to assist park neighbours with control programs.

A Feral Pig TAP is being prepared which will identify the biodiversity most at risk and priority locations for control of feral pigs, including MNCR.

Feral pig control will be undertaken within Werrikimbe and Willi Willi NP's when required to complement programs undertaken by Northern Tablelands Region on the western section of Werrikimbe NP and in Oxley Wild Rivers NP. Other pig control programs will be reactive in association with local RLPB's.

Control

A number of techniques are available to control feral pigs including shooting, trapping and baiting. Traps built near areas where pigs are active, such as watering holes can be successful when baited with grain. 1080 baiting is also used in some areas. The maintenance of native dingo populations is likely to assist in controlling feral pigs populations in MNCR reserves.

Illegal hunting of pigs on NPWS lands is discouraged as it can result in escape of pig dogs, release of domestic pigs by shooters, damage to traps being used by NPWS and safety concerns to the general public. Extended drought can provide a window of opportunity for control of wild pigs due to their need for regular water.

The 'Judas pig' technique has been utilised in other Regions, where their gregarious nature enables pigs fitted with radio collars to guide shooters to the location of other feral pigs. Feral pig control programs shall involve the Judas Program. Pigs are initially free-fed, then trapped in a mesh cage. One individual animal is then tagged with a radio collar and released. The "Judas" pig is followed over a period of weeks to determine where active pig sites are located. Finally, an ambush is arranged where feral pigs are either shot or trapped/shot/ or poisoned.

Monitoring

The number of pigs trapped or shot is recorded during control programs. Wild pig sightings and evidence of rooting behaviour is recorded by NPWS staff. Reports from park neighbours are also recorded.

11.2.6 Feral Horse

Distribution and abundance

In NSW, feral horses (*Equus caballus*) are a significant problem within a number of conservation reserves along the Great Dividing Range and eastern seaboard. English (2001a) estimated the population of feral horses in NSW as between 5000 and 8000 horses. Conservation reserves in NSW where horses are a significant problem include Guy Fawkes River, Kosciusko, Oxley Wild Rivers, Yuraygir, Barrington Tops, Blue Mountains, and Kanangra-Boyd NP's and Yerranderie SCA. Feral horses are also present on lands adjoining most of these reserves.

Currently, feral horses have only been recorded in one reserve in MNCR, Barakee NP/SCA.

Impacts

Feral horses accelerate erosion through trampling, compaction and grazing. They also impact on native vegetation and ground-nesting birds, foul water holes and contribute to the spread of weeds. In high altitude alpine herb fields trampling and grazing of bog and fen communities creates gully lines along horse trails that drain these sensitive communities. In water catchment areas, feral horse impacts accelerate soil erosion that increases sedimentation and potential transference of dangerous pathogens into water supplies. As horse density within conservation reserves increase their impacts on the environment become more significant.

Priorities for control

The removal of feral horse from Barakee NP/SCA to reduce damage to threatened species, endangered ecological communities and reduce risk to vehicular traffic.

Control

Different horse control techniques are required depending on factors such as season, feed availability, site accessibility, and horse density. A fully integrated suite of control techniques have been considered and combinations of different techniques have been assessed and are used to control feral horses. In Barakee NP/SCA the initial control method will be the use of feed based lures to draw horses into portable trap yards. Captured horses will then transported from the park and made available to identified horse interest groups for re-homing. Other control techniques may be developed and utilised later in the program as required. All feral horse control will be carried out in accordance with the appropriate Code of Practice and Standard Operating Procedures.

Monitoring

The effectiveness of horse removal programs will be assessed by measuring the reduction over time of the horse population in the park and preventing increases in local density and expansion of horse distribution. Monitor the number and movements of mobs in Barakee NP/SCA.

11.2.7 Feral Goat

Distribution and abundance

Goats (*Capra hirtus*) occur through the Great Dividing Range, in the semi-arid rangelands of NSW, QLD, Victoria and WA, and highlands of Tasmania. Their distribution appears is limited by adequate water supplies, and where the dingo is absent or uncommon.

In MNCR limited sightings of feral goats have been made in the Crowdy Bay, Dooragan, Hat Head and Saltwater NP's, and Limeburners Creek, Khappinghat and Queens Lake NR's. They are recorded in the Comboyne plateau area near Boorganna NR. There is potential for feral goats to occur in other reserves in MNCR.

Impacts

Feral goats compete with fauna and livestock for fodder, water and shelter, as well as cause damage to heritage sites, and are potential vectors of livestock diseases (e.g. internal parasites and diseases such as "foot and mouth" and foot-rot).

Grazing and browsing by feral goats has significant impacts on native vegetation. It can lead to changes in species composition as more palatable species are eaten, as well as changes in vegetation structure. Grazing can lead to a decrease in overall cover and an increase in bare ground, which, combined with trampling and soil surface damage which may result in significant increases in soil erosion. These habitat changes in turn affect native fauna through competition for food and shelter.

Competition and habitat degradation by feral goats is listed as a KTP under the TSC Act (NSW Scientific Committee, 2004c).

Priorities for control

- Feral goat numbers will be monitored to assess the population level and any impact on reserves in MNCR.
- Following indication of a significant population size and environmental impact, control programs will be employed.
- Harvesting of feral goats has become an important income source for some landholders and needs to be taken into consideration when conducting control programs.

Control

Effective control of feral goats requires an integrated approach using several complementary control techniques. The main control techniques in MNCR will be ground shooting and trapping programs. In addition, if adjoining landholders adjacent to reserve boundaries have feral goats they will be encouraged to reduce feral goat numbers through shooting, mustering and/or trapping. The maintenance of native dingo populations is likely to assist in controlling feral goat populations in NPWS reserves. The potential 'window of opportunity' will be implemented should drought conditions see an aggregation of goat herds.

Monitoring

Sightings to be monitored and strategies implemented as appropriate. Maintain liaison with neighbours and RLPB's.

11.2.8 Feral Rabbit and Brown Hare

Feral rabbits (*Oryctolagus cuniculus*) and brown hare (*Lepus capensis*).

Distribution and abundance

The rabbit has the widest distribution of any vertebrate pest species within Australia, found across the continent except for the tropical area of northern Australia. It occurs in a variety of habitats, but predominately occurs within the semi-arid rangelands and agricultural areas.

In MNCR rabbits are mainly confined to the hinterland agricultural areas which border Werrikimbe and Willi Willi NP's. Rabbits have also been recorded in Crowdy Bay and Saltwater NP's, and Macquarie, Limeburners Creek, Skillion, Yarravel and Khappinghat NR's. Hares are recorded in Khappinghat NR.

Impacts

Rabbits are a declared pest animal under the RLP Act and are listed as a KTP under the EPBC Act and TSC Act (NSW Scientific Committee, 2001) due to competition for habitat and food resources with endangered native fauna.

Feral rabbits occupy a wide range of habitats, including native and modified grasslands, woodland, heath and forest. Rabbits impact on native species due to competition for resources, alteration to the structure and composition of vegetation, and land degradation.

Rabbits also impact on development sites in Saltwater NP by removing ground cover.

Priorities for control

- Current programs will continue in Saltwater NP and Khappinghat NR.
- Control programs will be implemented with stakeholders as required or where identified under a TAP.

Control

Rabbit control uses a combination of techniques including baiting, fencing, fumigations, trapping, shooting, warren ripping and biological controls.

Monitoring

The numbers of rabbits reported within and adjacent to NPWS estate shall be monitored and programs implemented as appropriate.

11.2.9 Introduced Rodents

Black rat (*Rattus rattus*), brown rat (*R. norvegicus*), and house mouse (*Mus musculus*).

Distribution and abundance

Two species of introduced rodents are recorded in MNCR, the black rat (*Rattus rattus*) and house mouse (*Mus musculus*). The black rat and house mouse are widely distributed across all of MNCR, and are particularly abundant in semi-urban and urban reserves. The brown rat (*R. norvegicus*) is also likely to present along coastal break walls on major rivers in MNCR.

Impacts

Introduced rodents prey on many native animals including birds, reptiles and insects. They also compete with native wildlife for food, and can prevent plant regeneration by consuming seeds and damaging seedlings. Predation by *Rattus rattus* on Lord Howe Island is listed as a KTP under the TSC Act (NSW Scientific Committee, 2000b) where it has already been responsible for the extinction of five species of birds and numerous invertebrates. These rats also cause substantial economic loss to the island's palm seed industry. On Mutton Bird Island NR at Coffs Harbour, black rats are affecting the breeding of wedge-tailed shearwaters (*Puffinus pacificus*). The black rat is a known carrier of several diseases, including leptospirosis and salmonellosis, transmitted to humans through its urine and faeces.

In MNCR introduced rodents can have an impact on shorebird breeding success on Pelican Island (Woregore NR) and at the little tern breeding colony on Manning River Harrington/Farquhar spits. The populations of black rats in campgrounds in Arakoon SCA and Crowdy Bay NP can pose a public health risk to visitors as well as causing damage to property. At Sea Acres Rainforest Centre (Sea Acres NR) infestations of black rats are an ongoing issue.

Priorities for control

- Arakoon SCA, Crowdy Bay NP, Sea Acres NR

Control

An Integrated Management Plan for the control of the black rat in Trial Bay Camp Ground in Arakoon SCA (NPWS, 2001b) has been prepared to minimise the potential impacts of any control programs on the brush-tailed phascogale (*Phascogale tapoatafa*) which also occurs at this location.

Introduced rodent control programs will be implemented at Crowdy Bay NP and Sea Acres NR, and as required in other reserves and off-park situations (e.g. little tern roosting sites). All programs will be implemented in an environmentally responsible manner to minimise potential non-target impacts.

Monitoring

Monitoring will be undertaken for all introduced rodent control programs, to determine population levels (reduction of numbers) and impacts. Potential non-target impacts will also be monitored.

11.2.10 Feral Birds

Indian myna (*Acridotheres tristis*), common starling (*Sturnus vularis*), sparrow (*Passer domesticus*), and spotted turtle-dove (*Streptopelia chinensis)*.

Distribution and abundance

Feral birds are generally found in association with human habitation with medium to high densities in urban and rural areas, and those fringing reserves. It appears that Indian mynas and common starlings have increased and expanded their habitat to include open pasture lands and open forest.

Feral birds are now distributed throughout MNCR, particularly in the coastal areas adjoining major towns and cities. Indian mynas are a relatively new incursion in MNCR. They have only been recorded in MNCR in the past eight years, but have rapidly expanded and are now present in most towns within the MNCR.

Impacts

Impacts of feral birds include competition for hollow nesting sites of birds, bats and mammals, spread of weed species and competition for food resources. Indian mynas are very intelligent and aggressive birds that are known to evict native birds: parrots, kookaburras and pee wee's from their nests, dump their eggs, chase them away from their nests, and drive them from the area. In urban habitats they are considered to be a threat to the long term survival of native birds. Common starlings additionally contaminate nesting sites by filling hollows with deep linings that attract parasites and become unusable for other species that use little lining. Both Indian mynas and starlings are well known for their impact on human habitation where serious infestations of bird lice can occur.

Priorities for control

- Control programs will be implemented where feral birds are impacting on significant species and/or EEC's.
- Control programs may also be implemented where feral birds are impacting on recreation and aesthetic values at high profile public visitor areas.
- The MNCR will encourage community groups through their local Landcare groups and council to undertake control programs of any known occurrences to reduce the spread of the birds in their areas.

Control

A trapping system developed at the Australian National University is currently being trialled by a number of community groups and local councils along coastal NSW. Trapping has been successful in cities such as Canberra in reducing localised populations of Indian mynas. Traps are currently held at the local NPWS Hastings Area depot and Port Macquarie Landcare.

An off-park culling program is also being undertaken by the Port Macquarie-Hastings Hunting Group in association with the Game Council of NSW and the local Port Macquarie Landcare.

Monitoring

MNCR will record feral bird sightings, monitor population spread, and liaise with relevant stakeholders. The effectiveness of control programs on NPWS estate will be monitored.

11.2.11 Feral Honeybees

Distribution and abundance

Feral honeybees (*Apis mellifera*) are known to exist in many reserves across MNCR, however their distribution has not been accurately mapped. Anecdotal evidence suggests that they are more abundant in urban and coastal reserves. There are 93 registered bee sites within 14 reserves in MNCR.

Impacts

Honeybees impact on biodiversity in two broad ways, firstly via competition for tree hollows, and secondly via competition for floral resources, such as pollen and nectar. The loss of tree hollows via occupation by feral honey bees reduces the number of hollows available for native animals to breed and shelter. This is of particular concern for species which are threatened. Hollows are an extremely important resource for many Australian animals, particularly birds and mammals.

Threatened species which are likely to be affected by competition from honeybees for hollows include the brush-tailed phascogale (*Phascogale tapoatafa*), squirrel glider (*Petaurus norfolcensis*), yellow-bellied glider (*Petaurus australis*), major Mitchell's cockatoo (*Cacatua leadbeateri*), glossy black cockatoo (*Calyptorhynchus lathami*), superb parrot (*Polytelis swainsonii*), and regent parrot (*Polytelis anthopeplus*). Populations of protected species that may become threatened include the common brushtail possum (*Trichosurus vulpecular*), greater glider (*Petauroides volans*), and sugar glider (*Petaurus breviceps*) (NSW Scientific Committee, 2002).

Competition from feral honeybees is listed as a KTP under the TSC Act (NSW Scientific Committee, 2002b).

Priorities for control

Any feral honeybee population inhabiting hollow bearing trees at locations where threatened hollow dependent fauna have been recorded will be a priority for removal.

Control

A professional pest controller will be consulted in most situations with the application of a registered insecticide the most probable control method. In some situations it may be appropriate to engage a local apiarist to remove the feral honeybee population.

Monitoring

Visual inspections will be undertaken following treatments to confirm hive destruction.

11.2.12 Cane Toad

Distribution and abundance

Cane toads (*Bufo marinus*) are currently restricted to the northern region of NSW, with well-established colonies occurring in the Tweed River Valley, Byron and Lismore areas. Their range extends along the coast as far south as Yamba, with isolated colonies around Angourie, Mororo-Ashby, Brooms Head and Port Macquarie. Established colonies of cane toads have been found up to 90km west of Ballina with the western boundary currently situated around Kyogle/Casino. Vagrants are regularly reported in Sydney, Wollongong, Coffs Harbour and the Central Coast area. Vagrant reports are typically only one animal often found near tourist parks or landscape/nursery supplies or along railway or highway corridors. They have also been reported in other states and the ACT.

Cane toads have been recorded around the rural/ urban area fringing Lake Innes NR from late 1995 to 2006. Individual cane toads have also been recorded at various locations within the Region (Taree and Kempsey), and are most likely associated with incidental releases through inter-state nursery transport from QLD. The population around Lake Innes NR is currently the southern most recorded breeding population. An annual cane toad 'muster' is undertaken with NPWS staff, the local community and Landcare. In 2007, MNCR strengthened its campaign to eradicate toads from Port Macquarie with assistance from Hastings Landcare, the Frog and Tadpole Study Group (FATS) and the Port Macquarie-Hastings Council. The campaign included a major residential information mail out, intensive trapping at known breeding sites, a large community muster, the assistance of the Western Australia Cane Toad Detection Dog and an extensive media campaign. For the first time in a decade no toads were detected despite ideal cane toad breeding conditions. A report of a population in the Frederickton area north of Kempsey is yet to be confirmed.

Impacts

The cane toad is poisonous at all stages of its life (eggs, tadpoles, toadlets and adult toads) and they impact on native fauna during all of these stages. Their ability to survive in a range of habitats and wide temperature ranges (5-40^{o}C) increases their breeding capacity and threat to native species. Insects, smaller toads and native frogs, small snakes and the occasional small mammal are all part of the cane toads' diet. Not only do they prey on native fauna, but they also compete for food, shelter and breeding sites. Summers in Northern NSW provide ideal breeding conditions for cane toads. Females lay between 8,000-35,000 eggs at a time and may lay two clutches each year.

The invasion and establishment of cane toads is listed as a KTP under both the TSC Act (NSW Scientific Committee, 2006c) and the EPBC Act. Cane toads taken as prey by native fauna can cause death to both animals.

The native species most likely to be impacted at the population level in MNCR include tiger quoll, goannas, frog eating snakes and certain bird species. Native invertebrates are predated.

Priorities for control

Priorities for control are guided by the DECC Cane Toad Management Policy, the Northern Branch Cane Toad Management Strategy (NPWS, 2007), and the Lake Innes NR and Port Macquarie area Cane Toad Pest Species Strategy (NPWS, 1999).

In MNCR the focus is on minimising the impact on native species by:

- eradicating existing isolated populations on and nearby to Lake Innes NR in the Port Macquarie area and any other areas where cane toads are detected;
- preventing the establishment of new populations; and
- maintaining and developing community interest and awareness in cane toad control.
- early confirmation of the presence/absence of the potential breeding population in the Frederickton area north of Kempsey.

Control

Cane toad management in MNCR is largely undertaken by NPWS staff, discovery rangers, contractors and volunteers (e.g. Port Macquarie Landcare) with assistance from local government. Raising public awareness and encouraging members of the public to hand in suspected live toads minimises the likelihood of native frogs being accidentally killed. Sightings and reports from the public are crucial in providing a quick response to new incursions. Following any confirmed report of toads in a new area, MNCR will, where possible, undertake a mailbox-drop to surrounding residents, conduct spotlight surveys and will set traps to detect and remove any new colony that may have established.

As cane toads are a relatively recent introduction (approximately 10 years ago) into MNCR, community education has been the focus of the cane toad control strategy for this species. Given that initially native frogs were confused for cane toads, there is a need to stress correct identification for cane toads. The guidelines developed from the “Frog and Toad Discovery Program” for community and school education will continue to be implemented.

Monitoring

A database of cane toad sightings will be maintained in MNCR. All control programs (involving trapping and manual collection) will record the location, numbers collected, sex and size (if possible).

11.2.13 Feral Fish

Plague minnow or gambusia (*Gambusia holbrooki*), koi carp (*Cyprinus carpio koi*), rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), redfin perch (*Perca fluviatilis*) and goldfish (*Carassius auratus*).

Distribution and abundance

Many fish species have been introduced into NSW waters over the past 200 years, both intentionally and accidentally. Some species, including plants, animals and seaweeds, have established themselves in NSW and are now regarded as pests. Pest species can threaten native aquatic and terrestrial life directly as predators or competitors for food or indirectly by altering their natural habitat.

In freshwater aquatic habitats the introduction of exotic fish species to areas outside their natural range, have occurred widely for the purposes of recreational fishing enhancement, mosquito control (plague minnow) and aquaculture. There have also been an increasing number of introductions through the intentional or accidental release of aquarium fish.

Four species are currently of concern in MNCR: gambusia; koi carp; rainbow trout; and brown trout. Redfin perch have been recorded in the Macleay Catchment, and goldfish have been recorded in both the Macleay and Manning Catchments, although it is not known whether these species occur on NPWS estate (Kaye, pers. comm., 2008).

Predation by plague minnow is listed as KTP under the TSC Act (NSW Scientific Committee, 1999b). This species is recorded from a number of coastal and near urban reserves (Lake Innes NR, Crowdy Bay NP and Hat Head NP). A survey of relic dams from the post-sandmining era in coastal parks recorded their presence in the majority of dams.

Koi Carp, measuring approximately 35cm in length, has been recorded, trapped and electrofished in the southern reaches of Wrights Creek in Macquarie NR.

Brown trout and rainbow trout are highly likely to be present in the streams of most of the MNCR's escarpment parks from release and restocking programs prior to reserve dedication.

Impacts

Some of these species, most notably trout, are seen as having social and economic benefits for recreational fisheries and have been actively maintained through stocking or other fisheries management actions in the past. However, their impact on aquatic biodiversity in MNCR waterways is currently not fully understood. Further research is required to better understand the terrestrial and aquatic species likely to be at most risk from predation by trout, with a particular emphasis on threatened stream dwelling frogs.

Koi carp and the plague minnow are now considered strictly as pests in the wild, as they alter or degrade the natural environment and compete with native species for food, habitat or spawning grounds.

The plague minnow has been colloquially described as the 'animal weed' of our aquatic environment, because of its ability to rapidly reproduce, disperse widely and occupy diverse habitats, to the detriment of native species. This small fish is highly aggressive and predatory.

Carp were recently listed as a Class 1 Noxious Species in NSW under the noxious species provisions of the Fisheries Management Act 1994. Carp are widely believed to have detrimental effects on native aquatic plants, animals and general river health, particularly through their destructive feeding habits. Some probable impacts of carp include: reducing water quality; increasing the likelihood of algal blooms; causing erosion; impacting on invertebrates and aquatic plants; potential disease outbreaks; and reduction in native fish numbers.

Priorities for control

Koi carp in Macquarie NR are a pest that the community has identified as a high priority for action at the local level and has been identified in the Macquarie NR draft Pest Strategy. Both the Port Macquarie-Hastings Council and NSW Fisheries support a collaborative program.

It is also a pest which threatens the conservation, cultural heritage or recreational values of an area. There existed a window of opportunity and for which continued management is necessary to maintain benefits gained from previous control programs on this species in the Port Macquarie – Wrights Creek environs.

Due to the complexity and difficulty of effectively controlling plague minnows, any control will only be attempted where a potential effective outcome is possible or the site has some priority in relation to threatened species.

Brown trout and rainbow trout, or other associated recreational fish, will only be controlled in line with policy or further direction from within the agency. In some cases it may be necessary to prevent the introduction and reduce populations of non-native fish in streams where vulnerable native animal species occur (Haering, pers. comm., 2008).

Control

There are presently no effective and specific methods to target control plague minnow (draining a waterbody or using the pesticide 'rotenone' will destroy the target species but both methods are non specific). Once established in a waterway it is almost impossible to eradicate them from that environment, particularly from connected waterways such as creeks, rivers and streams, and large permanent water bodies. A number of physical, chemical and biological approaches have been trialled with varying degrees of success and inherent risks. Actions identified in the Plague Minnow TAP (NPWS, 2003) are targeted predominantly towards ameliorating the impacts on frogs, particularly threatened species. In MNCR, this particularly applies to threatened species such as the green & golden bell frog, giant burrowing frog and wallum froglet. There are many other species potentially impacted in MNCR as detailed in the TAP.

Current management strategies for koi carp in Macquarie NR include electrofishing to stun, catch and euthanase. Electrofishing involves passing an electric current through water via electrodes which stuns nearby fish, leading to their disorientation and easy capture. Electrofishing can be dangerous and therefore operators require a high level of training and rigorous safety standards must be followed. NSW Fisheries have used this method in Wrights Creek in the recent past with success.

Carp can be also be opportunistically netted and euthanased in Wrights Creek. This method has also been effective in the recent past, however is very time consuming and not as nearly as effective as electrofishing. Rehabilitation of Wrights Creek is important in order to change the aquatic environment to favour native fish.

Monitoring

MNCR will continue to monitor the distribution and abundance of koi carp in Macquarie NR and the success of management strategies. Water quality and carp abundance will also be monitored in conjunction with NSW DPI. MNCR will produce GIS layers showing the distribution and abundance of these, or other feral fish species, and when management programs are implemented such as the control of koi carp in Macquarie NR. Research will be supported to better understand the terrestrial and aquatic species likely to be at most risk from predation by trout, with a particular emphasis on threatened stream dwelling frogs.

12 Identified Key Threatening Processes in MNCR

Table 8 provides a summary of the KTP's in MNCR.

Table 8: KTP's in MNCR

	Key Threatening Process as at January, 2008	Type	State	National
1	Invasion and establishment of **exotic vines & scramblers**	weed	●	
2	Invasion of native plant communities by **bitou bush & boneseed**	weed	●	
3	Invasion of native plant communities by **exotic perennial grasses**	weed	●	
4	Invasion, establishment and spread of ***Lantana camara***	weed	●	
5	Competition and grazing by the **feral European rabbit**	animal	●	●
6	Competition and habitat degradation by **feral goats**	animal	●	●
7	Competition from **feral honeybees**	animal	●	
8	Herbivory & environmental degradation caused by **feral deer**	animal	●	
9	Predation by **feral cats**	animal	●	●
10	Predation by the **European red fox**	animal	●	●
11	Predation by **plague minnow**	animal		
12	Predation, habitat degradation, competition, disease transmission by **feral pigs**	animal	●	●
13	Infection of native plants by ***Phytophthora cinnamomi***	fungus	●	

13. Noxious Weeds

Table 9: Noxious Weeds

Noxious Weeds See DPI website for current information: http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed		Greater Taree	Port Macquarie - Hastings	Kempsey
Common Name	**Scientific Name**			
African Boxthorn	*Lycium ferocissimum*	-	-	-
African Feather Grass	*Pennisetum macrourum*	5	5	5
African Turnip Weed	*Sisymbrium runcinatum*	5	5	5
African Turnip Weed	*Sisymbrium thellungii*	5	5	5
Alligator Weed *	*Alternanthera philoxeroides*	2	2	2
Anchored Water Hyacinth	*Eichhornia azurea*	1	1	1
Annual Ragweed	*Ambrosia artemisiifolia*	5	5	5
Arrowhead	*Sagittaria montevidensis*	5	5	5
Artichoke Thistle	*Cynara cardunculus*	5	5	5
Athel Tree/Athel Pine *	*Tamarix aphylla*	5	5	5
Bathurst/Noogoora/..Burrs	*Xanthium spp*	4	4	4
Bear-skin Fescue	*Festuca gautieri*	5	5	5
Bitou Bush *	*Chrysanthemoides monilifera ssp rotundata*	4	4	4
Black Knapweed	*Centaurea nigra*	1	1	1
Blackberry *	*Rubus fruticosus agg spp*	4	4	4
Boneseed	*Chrysanthemoides monilifera ssp monilifera*	4	4	4
Bridal Creeper *	*Myrsiphyllum asparagoides*	5	5	5
Broadleaf Pepper Tree	*Schinus terebinthifolius*	3	3	3
Broomrapes	*Orobanche spp* except native species	1	1	1
Burr Ragweed	*Ambrosia confertiflora*	5	5	5
Cabomba *	*Cabomba caroliniana*	5	5	5
Cayenne Snakeweed	*Stachytarpheta cayennensis*	5	5	5
Chilean Needle Grass *	*Nassella neesiana*	4	4	4
Chinese Celtis	*Celtis sinensis*	3	3	3
Chinese Violet	*Asystasia gangetica ssp micrantha*	1	1	1
Clockweed	*Gaura lindheimeri*	5	5	5
Clockweed	*Gaura parviflora*	5	5	5
Columbus Grass	*Sorghum x almum*	4	4	4
Corn Sowthistle	*Sonchus arvensis*	5	5	5
Crofton Weed	*Ageratina adenophora*	4	4	4
Dodder	*Cuscuta spp* except native species	5	5	5
East Indian Hygrophila	*Hygrophila polysperma*	1	1	1
Egeria	*Egeria densa*	5	5	5
Espartillo	*Achnatherum brachychaetum*	5	5	5
Eurasian Water Milfoil	*Myriophyllum spicatum*	1	1	1
Fine-Bristled Burr Grass	*Cenchrus brownii*	5	5	5
Fountain Grass	*Pennisetum setaceum*	5	5	5
Gallon's Curse	*Cenchrus biflorus*	5	5	5
Giant Parramatta Grass	*Sporobolus fertilis*	4	4	4
Giant Rats Tail Grass	*Sporobolus pyramidalis*	3	3	3
Glaucous Starthistle	*Carthamus glaucus*	5	5	5
Golden Dodder	*Cuscuta campestris*	4	4	-
Golden Thistle	*Scolymus hispanicus*	5	5	5
Green Cestrum	*Cestrum parqui*	3	3	3
Groundsel Bush	*Baccharis halimifolia*	3	3	3
Harrisia Cactus	*Eriocereus spp*	4	4	4
Hawkweed	*Hieracium spp*	1	1	1
Horsetail	*Equisetum* species	1	1	1
Hygrophila	*Hygrophila costata*	2	2	2
Hymenachne *	*Hymenachne amplexicaulis*	1	1	1
Johnson Grass	*Sorghum halepense*	4	4	4
Karoo Thorn	*Acacia karroo*	1	1	1
Kochia	*Bassia scoparia / Kochia scoparia*	1	1	1

Noxious Weeds See DPI website for current information: http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed		Greater Taree	Port Macquarie - Hastings	Kempsey
Lagarosiphon	*Lagarosiphon major*	1	1	1
Lantana (All) *	*Lantana spp*	5	5	5
Lantana (Red Flowering) *	*Lantana camara*	4	4	4
Long-Leaf Willow Primrose	*Ludwigia longifolia*	4	4	4
Mexican Feather Grass	*Nassella tenuissima*	1	1	1
Mexican Poppy	*Argemone mexicana*	5	5	5
Miconia	*Miconia spp*	1	1	1
Mimosa *	*Mimosa pigra*	1	1	1
Mossman River Grass	*Cenchrus echinatus*	5	5	5
Mother Of Millions	*Bryophyllum spp*	3	3	3
Nodding Thistle	*Carduus nutans*	4	4	-
Onion Grass	*Romulea spp & vars* except *R. rosea* var. *australis*	5	5	5
Oxalis	All *Oxalis* spp and vars except the natives species	5	5	5
Pampas Grass	*Cortaderia spp*	4	4	4
Parthenium Weed *	*Parthenium hysterophorus*	1	1	1
Paterson's Curse & Bugloss	*Echium spp*	4	4	4
Pond Apple *	*Annona glabra*	1	1	1
Prickly Acacia *	*Acacia nilotica*	1	1	1
Prickly Pear	*Cylindropuntia* species	4	4	4
Prickly Pear	*Opuntia spp* except *O. ficus-indica*	4	4	4
Red Rice	*Oryza rufipogon*	5	5	5
Rhus Tree	*Toxicodendron succedanea*	4	4	4
Rubbervine *	*Cryptostegia grandiflora*	1	1	1
Sagittaria	*Sagittaria platyphylla, Sagittaria graminea*	5	5	5
Salvinia *	*Salvinia molesta*	3	3	3
Sand Oat	*Avena strigosa*	5	5	5
Senegal Tea Plant	*Gymnocoronis spilanthoides*	1	1	1
Serrated Tussock *	*Nassella trichotoma*	4	4	4
Siam Weed	*Chromolaena odorata*	1	1	1
Smooth-Stemmed Turnip	*Brassica barrelieri ssp oxyrrhina & B.oxyrrhina*	5	5	5
Soldier Thistle	*Picnomon acarna*	5	5	5
Spiny Burrgrass	*Cenchrus incertus*	4	4	4
Spiny Burrgrass	*Cenchrus longispinus*	4	4	4
Spotted Knapweed	*Centaurea maculosa*	1	1	1
St. John's Wort	*Hypericum perforatum*	3	3	-
Texas Blueweed	*Helianthus ciliaris*	5	5	5
Water Caltrop	*Trapa spp*	1	1	1
Water Hyacinth	*Eichhornia crassipes*	3	3	3
Water Lettuce	*Pistia stratiotes*	1	1	1
Water Soldier	*Stratiotes aloides*	1	1	1
Willows *	*Salix spp*	5	5	5
Witchweed	*Striga species*	1	1	1
Yellow Burrhead	*Limnocharis flava*	1	1	1
Yellow Nutgrass	*Cyperus esculentus*	5	5	5

Class 1: State Prohibited Weeds - The plant must be eradicated from the land and the land must be kept free of the plant. This is an all of NSW declaration.
Class 2: Regionally Prohibited Weeds - The plant must be eradicated from the land and the land must be kept free of the plant.
Class 3: Regionally Controlled Weeds - The plant must be fully and continuously suppressed and destroyed.
Class 4: Locally Controlled Weeds - The growth and spread of the plant must be controlled according to the measures specified in a management plan.
Class 5: Restricted Plants – The requirements in the *Noxious Weeds Act 1993* for a notifiable weed must be complied with. This is an all of NSW declaration.

Note: All **Class 1, 2** and **5** weeds are prohibited from sale in NSW.

* Denotes Weed of National Significance

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