NSW National Parks and Wildlife Service

South Coast Region

Draft Pest Management Strategy 2008 - 2011

Department of Environment & Climate Change NSW

Published by:
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DECC 2007
ISBN 978 1 74122

www.npws.nsw.gov.au

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Cover photo: Inspection of feral goat damage to Birds Nest Fern (*Asplenium australasicum*) in Kangaroo Valley, NSW.

This plan should be cited as follows:

DECC 2007. South Coast Region Pest Management Strategy 2008 - 2011. DECC, Sydney, NSW

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

Acknowledgements

A number of NPWS staff have provided additional valuable information to this project including Alex Deura, Brian Richardson, David Hunter, Diane Garrood, Les Mitchell, Melinda Norton, Meghan Kempster, Mike Jarman, Phil Craven, Rob Perry and Valda Corrigan. The author wishes to thank these and all other staff who have reviewed and provided input to this strategy.

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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; 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 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, local councils, the Department of Primary Industries 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. In recognising that eradication of widespread pests across large areas is an unrealistic goal, NPWS prioritises control effort to focus on areas where impacts are 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 New South Wales, 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 (TAPs) and reserve plans of management. Pest programs are also integrated with other park management programs such as fire management.

Purpose of the Strategy

The development of Regional Pest Management Strategies (RPMS) 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 TAPs as well as other actions such as wild dog and feral pig control to protect neighbouring properties 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 that 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.

In this strategy, the generic term “parks” is used to refer to any lands managed by NPWS including national park, nature reserve, Aboriginal area, historic site, state conservation area and regional park amongst others. This strategy has a four year life span. In the final year of the strategy, it is intended that the strategy will be reviewed and updated.

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, regional parks, state conservation areas, historic sites and Aboriginal areas with the Director-General of the NPWS. Key management objectives include conservation, provision of appropriate recreational, 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 and control priorities for that reserve.

Threatened Species Conservation Act 1995

The Threatened Species Conservation Act 1995 (TSC Act) provides for the listing of threatened species, endangered populations and endangered ecological communities. The TSC Act also enables the listing of key threatening processes (KTPs), which are identified as having significant impacts on the conservation of native flora and fauna. As of August 2007, 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 threat abatement plans. 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 farms 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 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 managed park lands). 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 (Game) 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 national park estate land.

Deer Act 2006

The objectives of the Deer Act 2006 are to define the ownership of deer, regulate the keeping of captive deer, prevent the release of deer from captivity and control wild deer. The Act is yet to come into force pending drafting of regulations and appointment of authorised officers. The Act is expected to come into force in late 2007.

Other Relevant Legislation

Environment Protection and Biodiversity Conservation Act 1999 (Australia)
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.

Policy 2.6 Wild Dogs acknowledges the complexities inherent in the need to conserve native dingoes 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.

A statewide policy directive requires conservation risk assessments for the application of pesticides on park wherever there may be significant impacts on the environment are possible. This policy ensures that an appropriate level of environmental assessment is carried out prior to use of pesticides.

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.

Regional overview

The South Coast Region covers 1.6 million hectares, extending from Lake Illawarra in the north to Batemans Bay in the south, and west towards but excluding Braidwood and Mittagong. The Region covers a diversity of land systems including coastal fringe, dissected sandstone plateaux and tableland country.

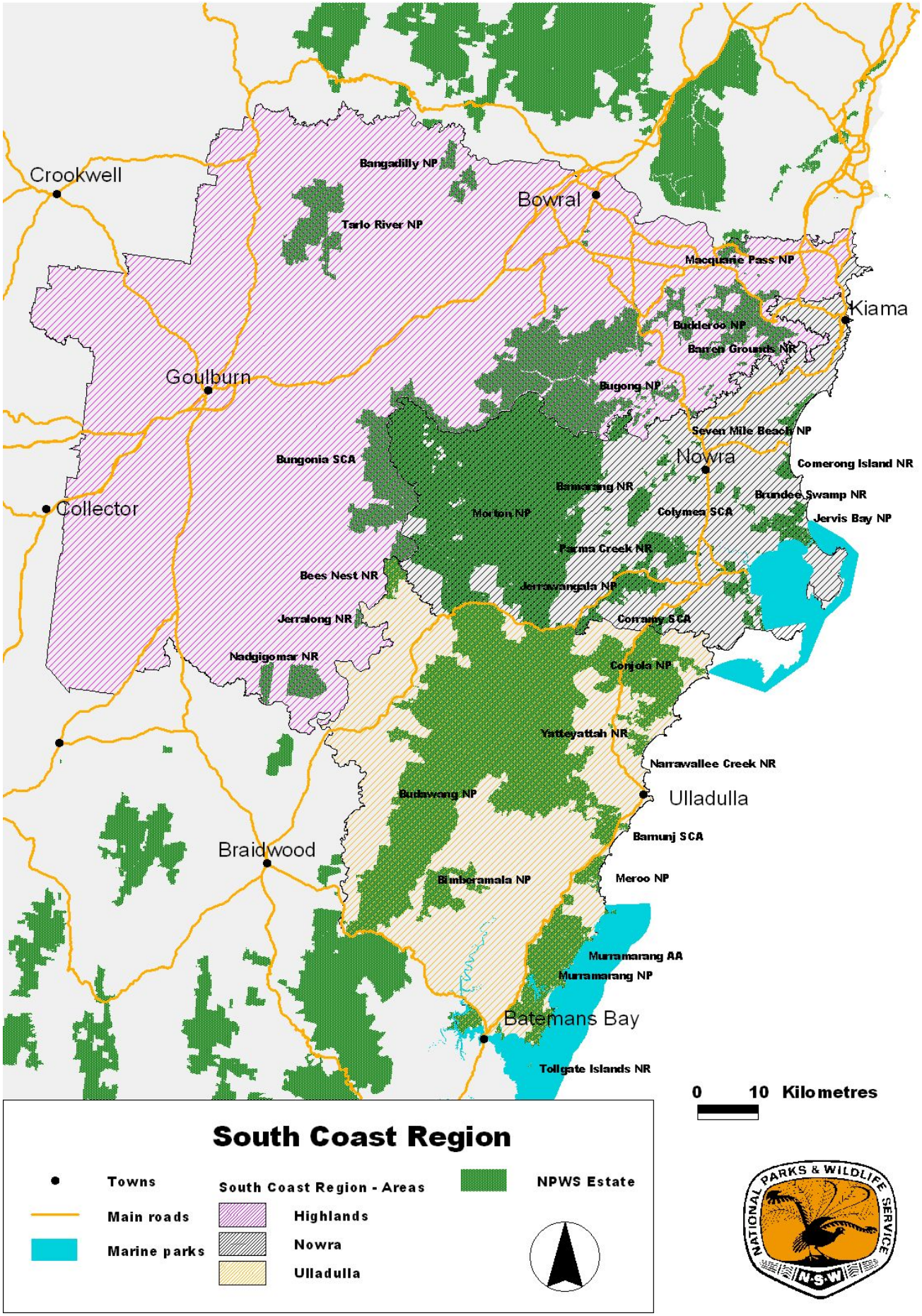
The Region manages 318,937 hectares of terrestrial reserves within 50 protected areas, including 15 National Parks, 26 Nature Reserves, 1 Aboriginal Area, 1 Historic Site, 6 State Conservation Areas and 1 Regional Park. The Region manages Jervis Bay Marine Park and assists with management of the northern part of Batemans Marine Park. It also provides technical input into the management of Sydney Catchment Authority lands in the northern part of the Region. The Region is also involved with some off–park conservation issues in collaboration with the Climate Change and Environmental Protection Group.

The Region is divided into four management areas, Ulladulla, Nowra and Highlands Areas and Jervis Bay Marine Park (see Regional map). The Areas and Marine Park are primarily responsible for implementation of works and activities within their Areas. The Operations and Support Co-ordination Unit provides professional support to the Areas and Marine Park and coordinates Region-wide functions and responsibilities. Also located within the Unit are the Fitzroy Falls and Minnamurra Visitor Centres, as well as the Discovery Program. It includes administration and is responsible for strategic planning and operations and the coordination of asset, fire and pest management.

The operations of the Region are decentralised with 9 discrete work locations. The majority of the Region's 85.2 permanent positions are distributed across 5 main work units: the Regional Office based at Nowra (15), Jervis Bay Marine Park office at Huskisson (5.4) and the Ulladulla (20), Nowra (18) and Highlands (17.8) Areas. The Highlands Area, based at Fitzroy Falls, includes an office and workshop at Bungonia State Conservation Area while Ulladulla Area includes an office at Depot Beach. An additional 9 positions are based at the Fitzroy Falls Visitor Centre (4) and Minnamurra Rainforest Centre (5).

The Region coincides with 7 local government areas; Shoalhaven, Kiama and Shellharbour, and parts of Wingecarribee, Eurobodalla, Goulburn Mulwaree, Palerang and Upper Lachlan. Parts of Jervis Bay NP and Jervis Bay Marine Park share a border with the Commonwealth managed Booderee NP. The Region overlaps with 4 Rural Lands Protection Boards; South Coast, Braidwood, Goulburn and Moss Vale.

Regional Map



Pest Distribution Tables

The following pest distribution tables give an overview of priority pest species for each reserve within the Region. 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 the Region.

● 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

Note:

The following table does not include all species that are regarded as pests or species for which pest program overviews are found later in this strategy. An example is Red-eared Sliders for which no distribution information is available for reserves in the Region and has therefore been left out of the following table.

	Wild Dog	Fox	Feral Pig	Rabbit	Plague Minnow	Feral Goat	Feral Deer	Feral Cat	Feral Honeybee	Amphibian Chytrid
HIGHLANDS AREA										
Bangadilly NP	⊙	○	⊙			○				
Barren Grounds NR	○	○		⊙		○	⊙	⊙		
Barrengarry NR		○						⊙		
Budderoo NP	⊙	●	⊙	⊙		○	○	○		
Bungonia SCA	○	●		●		○		⊙		
Cambewarra Range NR	○	○				⊙	⊙	●		
Cecil Hoskins NR		●		○				○		
Jerralong NR	○	○		○		⊙		⊙		
Kangaroo River NR	⊙	●						○		
Macquarie Pass NP	○	○	⊙				○	○		●
Macquarie Pass SCA	○	○					○	○		
Morton NP (north & west)	●	○	⊙	○		●	○	○		●
Nadgigomar NR	○	○	⊙	●		○		⊙		
Robertson NR		⊙						⊙		
Rodway NR								⊙		
Tarlo River NP	○	○		●		○		⊙		
Throsby Park HS		○		○				⊙		
NOWRA AREA										
Bamarang NR	○	●						○		
Bomaderry Creek RP	⊙	●		⊙				●	○	
Brundee Swamp NR	○	○	○		⊙			⊙		
Bugong NP	○	○	⊙			⊙	⊙	⊙	○	

	Wild Dog	Fox	Feral Pig	Rabbit	Plague Minnow	Feral Goat	Feral Deer	Feral Cat	Feral Honeybee	Amphibian Chytrid
Colymea SCA	○	●				⊙		⊙		
Comerong Island NR	⊙	●		○				○		
Corramy SCA	○	○						○		
Jerrawangala NP	○	○	⊙	○	⊙	⊙	⊙	○	○	●
Jervis Bay NP	●	●		⊙	⊙		○	●		
Morton NP (east)	●	●	⊙	⊙		●	⊙	○	○	●
Morton SCA	○	●		⊙		⊙		○	⊙	
Parma Creek NR	○	○	⊙	○	⊙			○	○	
Saltwater Swamp NR	⊙	○	⊙	⊙	⊙			⊙		
Seven Mile Beach NP	○	●	⊙	⊙	⊙			●		
Tapitallee NR	○	○					⊙	●		
Triplarina NR	●	●						●		
Wogamia NR	○	○				⊙		○		
Woollamia NR	○	○						○		
Worrigee NR	○	○						○		
ULLADULLA AREA										
Barnunj SCA	○	○						**O**	○	
Bees Nest NR	○	○				⊙		⊙	○	
Belowla Island NR										
Bimberamala NP	○	○						○	○	
Brush Island NR										
Budawang NP	●	●				**O**	⊙	**O**	○	
Clyde River NP	**O**	**O**					⊙	**O**	○	
Conjola NP	●	●	⊙	⊙			⊙	●	○	●
Cullendulla Creek NR	⊙	⊙						⊙		
Meroo NP	○	○		⊙			⊙	○	○	
Morton NP (south)	●	●	⊙	⊙		●	⊙	○	○	
Murramarang AA				**O**				⊙		
Murramarang NP	**O**	●	⊙	⊙				●	○	
Narrawallee Creek NR		○						○	○	
Tollgate Islands NR										
Yatteyattah NR		●						○		

The weed species shown in the following table are either Declared Weeds of National Significance (for which there may be a National Priority Action Framework prepared); have been determined as Key Threatening Processes or are weeds or groups of weeds of significant local or regional importance.

● Denotes established widespread infestation throughout a reserve
○ Denotes scattered infestation throughout a reserve
⊙ Denotes isolated infestation restricted to a small geographic area of a reserve (encompassing new weed incursions)

	Asparagus weeds: Note 1	Ageratina spp.	Bitou Bush	Blackberry	Bonseed	Exotic vines: Note 2	Ex. perennial grasses: Note 3	Garden escapees	Lantana	Pinus spp.	Sea Spurge	Spiny Rush	Wetland weeds	Willows
HIGHLANDS AREA														
Bangadilly NP				⊙		⊙	○							
Barren Grounds NR				⊙					⊙					
Barrengarry NR									○					
Budderoo NP		○		⊙		○			○					
Bungonia SCA				○			○							
Cambewarra Range NR		⊙				⊙			○					
Cecil Hoskins NR				⊙		⊙	⊙						●	○
Jerralong NR							○							
Kangaroo River NR		○				○								
Macquarie Pass NP		○				○			○					
Macquarie Pass SCA		○				○			○					
Morton NP (north & west)		○		⊙		○	○		○	⊙				⊙
Nadgigomar NR							○			⊙				
Robertson NR						○								
Rodway NR									⊙					
Tarlo River NP				○			○			⊙				⊙
Throsby Park HS				⊙										
NOWRA AREA														
Bamarang NR		○		○		○			●					
Bomaderry Creek RP	○	○		⊙		○	○		○					○
Brundee Swamp NR			○	○		○	○		○				○	
Bugong NP		○												
Colymea SCA		○		○		○			○					
Comerong Island NR	○		○	⊙		○	○	⊙	○		⊙	○	○	
Corramy SCA														
Jerrawangala NP				⊙					○					
Jervis Bay NP	○		○	⊙		○	○		○					
Morton NP (east)		○		⊙		○	⊙		○					⊙
Morton SCA		○		⊙		○			○					
Parma Creek NR														
Saltwater Swamp NR			○			○								
Seven Mile Beach NP	○	○	●	⊙		○	○		○					
Tapitallee NR														

	Asparagus weeds: Note 1	Ageratina spp.	Bitou Bush	Blackberry	Bonseed	Exotic vines: Note 2	Ex. perennial grasses: Note 3	Garden escapees	Lantana	Pinus spp.	Sea Spurge	Spiny Rush	Wetland weeds	Willows
Triplarina NR			⊙	⊙				○						
Wogamia NR				⊙		⊙			⊙					
Woollamia NR														
Worrigee NR	○	○	⊙	⊙		⊙	⊙	○	⊙					
ULLADULLA AREA														
Barnunj SCA						⊙	○	⊙			○			
Bees Nest NR							○					○		
Belowla Island NR														
Bimberamala NP				⊙										
Brush Island NR				⊙			⊙				⊙	⊙		
Budawang NP						○								
Clyde River NP	○			⊙		○	○		○			○		
Conjola NP	○	○	○	○	○	○	○	⊙	○		○	○	○	
Cullendulla Creek NR	○		○	⊙		○	○	⊙				●	○	
Meroo NP	⊙			⊙		⊙	○			○	○	○		
Morton NP (south)				⊙										
Murramarang AA			○	⊙			●					●	○	
Murramarang NP			○	○		○					○	○	○	
Narrawallee Creek NR			○		○	○			⊙		⊙	○	⊙	
Tollgate Islands NR			○											
Yatteyattah NR	○			⊙		○	○	○						

Notes:

(1) Asparagus weeds known to occur in SCR reserves include Bridal Creeper and Ground Asparagus

(2) Exotic vines known to occur in SCR reserves include Madiera Vine, Dolichos Pea, Ground Asparagus, Bridal Creeper, Cape Ivy, English Ivy, Cat's Claw Creeper, Coast Morning Glory, Morning Glory, Japanese Honeysuckle, Moth Vine (Moth Plant), Passionfruit (*Passiflora spp.*), Turkey Rhubarb (Potato Vine), Black-eyed Susan, *Tradescantia fluminensis* and Periwinkle

(3) Exotic perennial grasses known to occur in SCR reserves include Serrated Tussock, African Lovegrass, Kikuyu, Buffalo Grass, Panic Veldgrass, Pampas Grass, Parramatta Grass and Whiskey Grass.

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.

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-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 i.e. 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, 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 not possible.

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 to strike 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 take a holistic approach, given that the control of one pest may benefit other pests, in that they attempt to control all significant pest threats at a site. 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 management and recreation management. Monitoring is being implemented, at varying levels, to demonstrate and improve the ongoing effectiveness of control programs.

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. Factors that influence which programs can be implemented include the availability of suitable control techniques and resources (both financial and physical) and the practicality and cost effectiveness of control.

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 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 the Region.

Critical Priority

1. Programs targeting pests that have, or are likely to have, significant impacts on biodiversity identified in the NSW Threatened Species Priorities Action Statement (PAS)
2. 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
3. Programs targeting pests that impact significantly on agricultural production
4. Programs addressing new occurrences of highly invasive pest species with potential for significant impacts on park values (subject to risk/feasibility assessment)

High Priority

5. Programs that target pests (other than those covered in priorities above) that impact significantly on World Heritage or international heritage values, e.g. control of rabbits impacting on World Heritage values of Mungo NP; pest control in Ramsar wetlands
6. Programs targeting pests that impact significantly on important cultural heritage values e.g. control of feral goats where they are inhabiting an area containing Aboriginal rock art; control of rabbits undermining an historic building

Medium Priority

7. Programs other than those covered in priorities above that target pests that impact significantly on Wilderness, Wild Rivers, national heritage values or other important listed values e.g. control of willows along a Declared Wild River or within a Wilderness area
8. Programs that target pests that impact significantly on recreation, landscape or aesthetic values, e.g. control of Blackberry on the margins of camping areas; control of weeds in an area of natural beauty that is visited frequently
9. 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 willows with the assistance of an established community group; control of Regionally Controlled Noxious Weeds (Control Class 3 weeds)
10. Community or cooperative programs that are implemented as part of an endorsed state or regional plan (and not covered above in higher priorities), 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

11. 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)
12. 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 Serrated Tussock 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 e.g. where burnt areas become more accessible for ground control of weeds; where drought makes control of feral pigs and feral goats more efficient because they congregate in areas where water is available; or when a new biocontrol agent becomes available.

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. NPWS is supporting research to understand the interaction between climate change, pests and biodiversity.

Pest Program Recording and Monitoring

Measuring the response of biodiversity (or other values) to pest control is necessary 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 NPWS (across sites, times and land tenure where appropriate). As a result, measuring the response to pest control is expensive and can be afforded for only a small sub-set of control programs.

Where native populations are rare, cryptic or dispersed, or where a suite of species is predicted to be affected indicator species, or other indices of relative abundance, can be used to provide an indirect measure of effectiveness. For example, while fox control may benefit a broad range of ground dwelling mammals, monitoring may focus on a particular “indicator” species which may be easy to capture.

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
- provide useful data where biodiversity, other park values or agricultural responses are too difficult to measure or there are insufficient resources to make proper measurement and
- 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 objective of control is 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.

Where appropriate, monitoring programs should also include measures to verify the results of research being undertaken 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.

Strategy review

At the end of four years the Strategy will be completely reviewed. This will include re-surveying and re-mapping weed distributions and densities where necessary in reserves in the Region. Management and treatment strategies should be re-prioritised based on the success of the annual control programs and assessment of monitoring outcomes. Budgets and resourcing considerations will also need to be reviewed. Some minor review and re-prioritisation may also occur on an annual basis through weed mapping updates following treatment works, feedback from monitoring programs or according to availability of resources.

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 also 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 and are also best achieved by centralised coordination.

The Region will continue to implement systems for pest program reporting and monitoring. The Region now has a permanent Regional Pest Management Officer to provide support for Area pest management planning and program implementation. This assistance will include evaluating management plans, disseminating information and major program planning. Part of this evaluation and strategic direction will be underpinned by development of databases that record management effort e.g. FeralBASE and WeediBASE.

An important objective for the Region is to provide support for community-based volunteer groups who carry out pest management activities on reserves under the supervision of NPWS staff and on private property as part of NPWS threatened species conservation programs. Some of these groups include:

- The Friends of the Brush-tailed Rock-wallaby who help to conserve local populations of this threatened species by raising funds, conducting fox control and protecting rock-wallaby habitat on private land
- The Robertson Environment Protection Society (REPS) who work to protect and enhance the natural environment in and around the Robertson area, including Robertson NR
- The Upper Minnamurra Rivercare Group who are local rural residents who work on riparian restoration projects near the Minnamurra rainforest in Budderoo NP
- The Friends of Durras who are volunteers who carry out weed control and monitoring of shorebirds on the Murramarang NP coastline. The main focus of the groups work is control of Bitou Bush, Sea Spurge and Senna
- Shorebird volunteers at Shoalhaven Heads and Lake Wollumboola who assist with shorebird protection works especially during the summer breeding season. Works that the volunteers carry out include erecting and maintaining protective fences and signs around breeding sites, monitoring nesting sites, recording breeding information and talking to the public
- Conservation Volunteers Australia who carry out a regular program of water quality monitoring, tree planting, bush regeneration, seed collection and propagation and photopoint monitoring at Seven Mile Beach NP

Pest Program Overviews

Vertebrates, invertebrates and animal diseases

Chytridiomycosis

Chytridiomycosis is a water-borne disease of amphibians caused by the parasitic chytrid fungus *Batrachochytrium dendrobatidis*. This disease is a global epidemic and infection of frogs by amphibian chytrid causing the disease chytridiomycosis has been determined to be a Key Threatening Process by the NSW Scientific Committee.

Not all frog species are at high risk of becoming infected and not all frogs die from the disease. In certain areas, those species at greatest risk have a strong association with streams (especially those that breed in permanent streams) rather than pond or terrestrial breeders (Kriger and Hero 2007). Transmission of chytrid fungus is associated with frog species that have other biological, habitat or behavioural characteristics. For example, chytridiomycosis could be more common in frogs that aggregate at retreat sites through higher frequency frog-to-frog contact (Rowley and Alford 2007), or in species that fail to produce antimicrobial peptides in their skin that inhibit *B. dendrobatidis* infection (Woodhams et al. 2006). Queensland studies suggest that if frog populations can survive initial episodes of population decline chytrid resistance should build up in the remnant population and it may recover (Berger et al., 1999). It is very likely that the chytrid fungus is ubiquitous throughout frog populations in SCR.

Impacts

Chytridiomycosis is known to kill Green and Golden Bell Frogs (*Litoria aurea*). The Shoalhaven region is a stronghold for this species but populations of these frogs in SCR are considered to be at risk to the disease.

Chytridiomycosis was detected in a remnant population of endangered Stuttering Frogs (*Mixophyes balbus*) at Macquarie Pass NP in 2004 and was believed to cause of the decline in the population. It has been detected in the Heath Frog (*Litoria littlejohni*) populations in Morton and Jerrawangala NPs and Parma Creek NR (P. Craven, pers.comm.)

Other stream breeding threatened frogs that occur in SCR include the Giant Burrowing Frog (*Heleioporus australiacus*) as well as other currently non-threatened species. The Red-crowned Toadlet (*Pseudophryne australis*) may also be susceptible.

Control methods and management strategies are guided by objectives in the National Chytridiomycosis Threat Abatement Plan (DEH 2006)

Control methods

1. Maintain strict adherence to the NPWS Hygiene Protocol for the Control of Disease in Frogs for field researchers to prevent spreading the fungus into new areas

2. Develop an education program to inform the public on the impact of chytridiomycosis on native frogs and reduce the incidence of deliberate or accidental releases of native and exotic pet frogs
3. Inform wildlife rehabilitation groups to ensure that frogs in care are free of the disease before release using CSIRO accepted chytridiomycosis sampling protocols

Management strategy

1. Continue development and implementation of a monitoring program that is underway for Green and Golden Bell Frogs, Heath Frogs, Giant Burrowing Frogs and Stuttering Frogs to determine ongoing population trends for these species in SCR reserves
2. Determine the ecological interactions between the chytrid fungus and amphibian species in continued population decline in SCR reserves, or those threatened due to small population size
3. For species threatened with extinction from chytridiomycosis, implement measures to maintain the species in the wild, and hence maintain the ongoing interaction between host and pathogen to allow the development of resistance

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Feral Cat (*Felis catus*)

Predation by feral cats has been determined to be a Key Threatening Process for a range of small threatened vertebrate species.

Cats may be classed as domestic, stray or feral. Domestic cats are pets or house cats living with people; their ecological requirements are intentionally provided by humans. Stray cats rely only partly on humans for provision of their ecological requirements, and include animals in urban fringe situations, dumped animals, and cats kept on farms for rodent control. Feral cats are free-living; they have minimal or no reliance on humans for their ecological requirements, and survive and reproduce in self-perpetuating populations. Individual cats can shift between classes in their lifetimes (from Scientific Committee determination 2002).

The determination and this program overview only relates to feral cats.

Distribution and abundance

Feral cats are found in most Australian environments, and in rural areas may be most abundant near rural residential and agricultural land. Feral cats are likely to be less common in closed forest types than open woodlands.

Impacts

Predation by feral cats impacts on many fauna species including threatened birds and mammals in SCR reserves. Feral cats threaten Eastern Bristlebird (*Dasyornis brachypterus*) populations at Jervis Bay NP and Barren Grounds NR, Little Terns (*Sterna albifrons*) breeding on coastal reserves and Striated Fieldwrens (*Calamanthus fuliginosus*) at Murramarang and Morton NPs. Feral cats may also predate on Brush-tailed Rock-wallabies (*Petrogale penicillata*)

and Southern Brown Bandicoots (*Isoodon obesulus*) when alternative prey are scarce or absent.

Other small mammals such as rodents, dasyurids, burramyids and ground-nesting birds are at particular risk.

Control methods

Feral cats are generally controlled using cage traps. Cats caught in traps will be humanely destroyed except for domestic cats clearly identifiable by behaviour or those wearing a collar. Domestic cats will be taken to the nearest Council animal shelter.

Priority sites

1. Control cats at locations where threatened birds are nesting
2. Control cats as part of broader feral animal control activity following wildfires
3. Opportunistically control feral cats during fox shooting for shorebird recovery programs
4. Opportunistically control feral cats during goat and deer control programs

Management strategy

1. Participate in the development and trialling of a cat-specific bait designed to minimise the risk to non-target species
2. Encourage research efforts to improve knowledge of feral cat predator-prey interactions
3. Identify the biodiversity most at risk from predation by feral cats in SCR reserves
4. Conduct community education programs and involve community groups in the protection and management of shorebird nesting against cat predation
5. Increase community awareness of the impact of cats on wildlife and ways to reduce these impacts

Monitoring and performance measures

1. Increased effectiveness of control efforts
2. Continue to review evidence of cat impacts at priority control sites

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Feral Deer (family *Cervidae*)

Distribution and abundance

Rusa deer (*Cervus timorensis*), Red deer (*Cervus elaphus*), Chital deer (*Axis axis*) and Fallow deer (*Dama dama*) occur in and adjacent to reserves in SCR. The general distribution of deer is sporadic and numbers are lower than feral goats. However, the range and abundance of some deer species appears to be increasing significantly. New occurrences of feral deer have been reported near all major towns and localities in the Region.

Impacts

Herbivory and environmental degradation by feral deer is a Key Threatening Process. Deer are known to have a significant impact on freshwater wetlands, river flat forests, peatlands, swamplands and rainforests in SCR. Overgrazing, trampling, wallowing, ring-barking, antler rubbing, erosion and dispersal of weeds are documented impacts of feral deer that could alter the composition and structure of these Endangered Ecological Communities.

Deer are also a significant threat to a number of rare plants in SCR reserves including Illawarra Irene (*Irenepharsus trypherus*) in Budderoo NP. Feral deer are known to damage agricultural crops and fences and, like goats, are potential vectors for outbreaks of animal diseases.

Control methods

Ground based shooting is the primary control method available. Trapping efforts at other locations have generally been unsuccessful to date but remains a potential control option during rutting. Deer may be shot opportunistically during aerial goat control programs.

Priority sites

1. Escarpment lands in the northern Shoalhaven catchment to protect rainforest, including Budderoo NP and Barren Grounds NR
2. Bugong NP
3. Macquarie Pass NP
4. Riparian zones of major rivers in Morton NP

Management strategy

1. Ensure that deer control is conducted humanely and is target-specific
2. Promote and participate in an “all tenure feral deer control” approach within SCR to limit distribution and abundance of feral deer
3. Maintain and extend co-operative deer control with the Braidwood, Goulburn, Moss Vale and South Coast RLPBs, CMAs, the Sydney Catchment Authority, NPWS Sydney South Region, park neighbours and Landcare groups.
4. Prepare a pest animal control order under the Rural Lands Protection Act for feral deer (and goats) in areas adjacent to SCR reserves that are impacted by deer

5. Continue the approved deer research and management program in Kangaroo Valley in co-operation with the Upper Kangaroo Valley Landcare group
6. Prepare a Regional deer management plan based on the Kangaroo Valley model for deer management in affected SCR reserves by 2009
7. Closely monitor training requirements for shooters engaged on deer control programs and enhance training opportunities if required

Monitoring and performance measures

As deer are wide ranging and currently in low densities it is difficult to measure the impacts of deer on rainforests and rare plants. However, research is currently being conducted in the region to improve measuring techniques.

A Regional monitoring system will be progressively developed to assess changes in biodiversity values known to be impacted by feral deer (and goats) that will measure:

- Total population range and size using spatial modelling
- Changes in deer numbers by systematic experimental design
- Changes in the impact on browsed vegetation using a habitat index

This system will initially focus on the effect of browsing on rainforest and heathland plants in Budderoo NP and in subtropical rainforest pockets along the Shoalhaven River in Morton NP (Palmer and Jackett 2006).

Feral Goat (*Capra hircus*)

Competition and habitat degradation by feral goats is a Key Threatening Process for several Endangered Ecological Communities and many threatened plant and animal species, including Broad-headed Snakes (*Hoplocephalus bungaroides*) and Brush-tailed Rock-wallabies.

Distribution and abundance

Feral goats range through escarpment, gorge and plateau lands in the northern and northwestern parts of SCR including Bungonia SCA, Bangadilly, Tarlo, Morton and Budderoo NPs and Barren Grounds, Jerralong, Nadgigomar and Bees Nest NRs. Feral goats are believed to be absent from Budawang NP but they may be spreading south through the Shoalhaven gorgelands and tributaries.

Impacts

Feral goats are known to significantly impact biodiversity values, including threatened swamps and rainforests and rare plant and animal populations. Goats are also recognised as potential vectors for spread of disease and may significantly impact on agricultural lands.

Feral goats have been known to damage Aboriginal occupation sites in escarpment caves and degrade wilderness and water catchment values.

Control methods

Aerial shooting is the primary control method used in remote, steep and inaccessible terrain and where sparse vegetation allows good visibility. Ground based shooting is the primary control method used in densely vegetated escarpment country.

Co-operative control programs are undertaken with park neighbours.

Shooting is only carried out by qualified, fully trained and competent shooters in accordance with protocols set out in operational shooting plans.

Priority sites

1. Escarpment lands in the northern Shoalhaven catchment to protect rainforest, including Budderoo and Morton NPs and Barren Grounds NR
2. Upper Shoalhaven River region, including Bungonia SCA
3. In key habitat areas to protect Broad-headed Snakes
4. Rock overhangs and caves in the species range to protect the Large-eared Pied Bat (*Chalinolobus dwyeri*) and Aboriginal cultural values
5. In Ettrema Creek, Bundundah Creek and other major tributaries of the Shoalhaven River where goats are currently in low numbers
6. Towards the lower parts of the Corang River to achieve control on private land to protect the Pygmy Cypress Pine (*Callitris oblonga*)

Management strategy

1. Ensure that goat control is conducted humanely and is target-specific
2. Promote and participate in an “all tenure feral goat control” approach within SCR to limit distribution and abundance of feral goats
3. Maintain and extend co-operative goat control with the Braidwood, Goulburn, Moss Vale and South Coast RLPBs, CMAs, the Sydney Catchment Authority, NPWS Sydney South Region, park neighbours and Landcare groups.
4. Prepare a pest animal control order under the Rural Lands Protection Act for feral goats (and deer) in areas adjacent to SCR reserves that are impacted by goats
5. Maintain and extend aerial goat culling as a key control technique for remote area biodiversity conservation
6. Explore the practicality of introducing a satellite goat tracking system to enhance the effectiveness of finding Judas goats from aircraft using conventional ground based radio telemetry
7. Closely monitor training requirements for shooters engaged on goat control programs and enhance training opportunities if required. Develop staff capabilities in radio tracking techniques.

Monitoring

A Regional monitoring system will be progressively developed to assess changes in biodiversity values known to be impacted by feral goats (and deer) that will measure:

- Total population range and size using spatial modelling

- Changes in goat numbers by systematic experimental design
- Changes in the impact on browsed vegetation using a habitat index

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Feral Honeybee (*Apis mellifera*)

Distribution and abundance

The introduced honeybee is widely but patchily distributed as a feral species in NSW and can be locally abundant, with bees found in many SCR reserves. Competition from feral honeybees is a Key Threatening Process. This determination refers to free-living feral bee colonies in tree hollows outside managed hives.

Impacts

There is evidence that honeybees impact on native fauna through competition for tree hollows and floral resources.

Threatened species which are likely to be affected through displacement and competition for hollows from honeybees include Brush-tailed Phascogales (*Phascogale tapoatafa*), Squirrel Gliders (*Petaurus norfolcensis*), Yellow-bellied Gliders (*Petaurus australis*) and Glossy Black Cockatoos (*Calyptorhynchus lathami*). Removal of pollen by honeybees has been shown to affect seed set in several ROTAP plant species including the Jervis Bay Grevillea (*Grevillea macleayana*).

Feral honeybees have been observed nesting in a tree hollow known to be used by Broad-headed Snakes during summer and may have a potential impact on habitat used by these snakes (B. Gray, pers.comm.)

Management strategy

1. Survey Murramarang NP to gain a better understanding of the extent and severity of the threat from feral honeybees particularly in old growth forest (this may be a suitable project for a tertiary student)
2. After survey information is available, identify the threatened species likely to be affected and assess the severity of the threat from feral honeybees
3. Investigate the feasibility of removing feral honeybee swarms when they are identified on SCR reserves
4. Promote research into the impacts of honeybees where licensed beekeepers use SCR reserves.

Monitoring and performance measures

1. Improved understanding of the impacts of feral honeybees
2. Improved management of licensed beekeeping system

Feral Pig (*Sus scrofa*)

Distribution and abundance

Feral pig populations are generally found in low densities in SCR reserves. Pig numbers are steady in Murramarang NP but there is increasing evidence of pig activity in Morton and Budawang NPs. Pigs are reported to be deliberately released by pig hunters on the south coast and hinterlands. Some of these releases appear to have been successful in establishing wild populations.

Impacts

Predation, habitat degradation, competition and disease transmission by feral pigs is a Key Threatening Process. Box woodland, montane peatland, wetlands and riverflat eucalypt forest Endangered Ecological Communities are degraded by feral pig activity. Feral pigs threaten water catchment values, may impact significantly on agricultural production and act as vectors for the spread of animal diseases. They kill or compete with many threatened bird, mammal and amphibian species. Stream dependent threatened frogs are at particular risk from habitat damage by pigs.

Feral pigs can cause severe localised environmental damage by selective feeding on plant communities, weed dispersal, creation of drainage channels in swamps, soil erosion and fouling of watering points by wallowing and rooting (West and Saunders 2003).

Control Methods

Trapping, shooting and 1080 baiting are the preferred methods of pig control. Feral pigs are opportunistically shot during aerial feral goat control programs.

Priorities for control

1. Continue active trapping programs in Murramarang, Clyde River and Morton NPs
2. Conduct reactive control elsewhere at sites where pig activity is detected

Management strategy

1. Ensure that pig control is conducted humanely and is target-specific
2. Maintain and improve cooperation with neighbours and RLPBs undertaking feral pig control work
3. Progressively survey and record the extent of feral pig distribution and abundance on SCR reserves
4. Increase community awareness of the environmental impacts of feral pigs and the need for pig control
5. Prioritise biodiversity requiring protection from feral pig impacts
6. Prioritise feral pig control based on evidence of the impacts
7. Continue current feral pig control programs until evidence of impacts is reviewed and control programs are prioritised

Monitoring

1. Establish photopoint monitoring at priority sites
2. Regularly monitor pig activity on other SCR reserves and adjacent lands
3. Evaluate effectiveness of current control techniques and adjust as necessary

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European Red Fox (*Vulpes vulpes*)

NPWS fox control is guided by the Fox Threat Abatement Plan. The plan aims to direct fox control to areas where impacts on threatened species are likely to be greatest and to ensure that these fox control programs are effective in reducing such impacts (NPWS 2001). It shows which threatened species are at greatest risk from fox predation and at which sites fox control is most critical for these species.

Distribution and abundance

Foxes are found in most Australian environments, and in rural areas are most abundant near rural residential and agricultural lands. Modified landscapes interspersed with bushland provide ideal habitat for foxes. Foxes are much rarer in remote, closed forest habitats and wilderness. They occur in the vast majority of SCR reserves.

Impacts

Foxes are known to predate on native fauna including threatened Brush-tailed Rock-wallabies, Southern Brown Bandicoots and Long-nosed Potoroos (*Potorous tridactylus*) and the nests of several threatened shorebird species.

Foxes also compete with native carnivores for food and shelter and are known to harbour and spread diseases, including sarcoptic mange and hydatids.

Control methods

Ground baiting with 1080 baits is the primary and most effective control method used to control foxes. Shooting, trapping, exclusion fencing and den fumigation are alternative methods of control.

Management strategies

1. Continue to review and implement best practice guidelines for the control of foxes
2. Manage foxes in co-operation with other agencies and private landholders

For Brush-tailed Rock-wallabies:

3. Undertake intensive fox control at the Kangaroo Valley and Taralga (private property) priority sites
4. Undertake intensive fox control at planned BTRW re-introduction sites
5. Assist with expansion of fox control onto private lands within identified priority sites in collaboration with landholders and CMAs (CMA 2007)

6. Participate in development of a broader, more robust community-wide support base for ongoing predator and competitor control programs

For shore-nesting birds - Little Terns, Pied Oystercatchers and Hooded Plovers:

7. Undertake intensive fox control at Conjola, Jervis Bay, Murramarang and Seven Mile Beach NPs and Comerong Island NR
8. Involve trained community volunteers in survey, monitoring and wardening activities to reduce fox impacts

For Long-nosed Potoroos (non-Fox TAP):

9. Undertake fox control at priority sites in Barren Grounds NR
10. Investigate the response of populations to predator control to gain a better understanding of the level of predator control required for the local survival of the species

For Eastern Bristlebirds (non-Fox TAP):

11. Undertake fox control where bristlebirds are vulnerable to predation, particularly after large scale fire, in Jervis Bay NP and in collaboration with Booderee NP

Monitoring

The Fox TAP outlines monitoring programs which measure the response of threatened species to fox control. For shore-nesting birds the effectiveness of these programs is measured by fledgling success. Changes in fox activity will be monitored using binary counts of footprints on sandpads placed across roads and tracks. At other sites, bait uptake rates will be used as a measure of changes in fox activity.

1. Measure the response of BTRW and fox populations at the Kangaroo Valley priority site
2. Measure the response of fox populations at the Taralga priority site
3. Measure the response of Hooded Plovers and Pied Oystercatcher populations at the Conjola NP and Murramarang NP priority sites
4. Measure the response of the Little Tern population at the Lake Wollumboola (Jervis Bay NP) priority site
5. Measure the response of the Pied Oystercatcher population at the Comerong Island NR priority site
6. Resurvey Tarlo River and Bangadilly NPs, Jones Creek and Parma Creek to assess abundance and threats
7. Undertake annual monitoring of populations of Eastern Bristlebirds at all known sites, including Jervis Bay NP and Barren Grounds NR

Plague Minnow (*Gambusia holbrooki*)

Plague minnows are omnivores that feed on a wide range of insects, aquatic invertebrates, zooplankton and tadpoles. This tiny fish which was originally introduced to control mosquitoes is a Key Threatening Process and a Threat Abatement Plan has been prepared to manage minnow predation on threatened species.

Distribution and abundance

Plague Minnows are now widely distributed in Australia from deliberate human introductions into ponds and streams, flooding and dispersal by birds. The minnows thrive in modified aquatic environments such as farm dams, weirs and drainage channels. It is possible that minnows could be transported into remote and pristine locations during water extraction by firetankers and aircraft at firefighting operations.

While plague minnows have not been detected in Meroo NP (M. Kempster, pers.comm.), they are known to be present in Lake Wollumboola in Jervis Bay NP and in Jerrawangala and Seven Mile Beach NPs and Brundee Swamp, Parma Creek and Saltwater Swamp NRs.

Impacts

In SCR, populations of threatened Green and Golden Bell Frogs (*Litoria aurea*) in Jervis Bay NP and surrounding areas and Coomonderry Swamp in or adjacent to Seven Mile Beach NP have declined substantially in recent decades and plague minnows are one of a number of identified threats (Daly 2007). Plague minnows are likely to be causing adverse impacts on a range of threatened frog species throughout SCR.

Direct evidence linking plague minnows to declines of bellfrog populations is limited but a number of studies have identified negative associations between the presence of plague minnows and frog species. Plague minnows will predate on frog eggs, hatchlings and tadpoles and behave aggressively to tadpoles e.g. tailfin attack (NPWS 2003).

Control methods

There are no known effective, *Gambusia* specific chemical or biological control methods currently available, although biocontrol research is being carried out. The most effective physical control method is to drain and dry wetlands or ponds that are key habitat locations for threatened frog species. A possible control method could be the temporary introduction in cages of large freshwater fish that are known to eat plague minnows.

Indirect control methods such as restoration and revegetation of degraded wetlands, ponds and streambanks may differentially favour native frogs and reduce predation opportunities for plague minnows.

Priority sites

1. Green and Golden Bellfrog habitat in Jervis Bay NP
2. Brundee Swamp NR

3. Coomonderry Swamp in Seven Mile Beach NP

Management strategy

1. Minimise on-going human dispersal by raising public awareness and education of the *Gambusia* threat to native frogs
2. Investigate potential control methods at Brundee Swamp NR
3. Carry out monitored physical control in key threatened frog habitat at Copper Cup Point in Jervis Bay NP (drain and dry 2 small dams)
4. Encourage research on the impacts of plague minnows on frogs, particularly those identified in the threat abatement plan at risk from *Gambusia* predation
5. Participate in any chemical or biological control trials that may be developed following a risk assessment process
6. Assess and map the presence of plague minnows in artificial firefighting water storages, such as helibucketing reservoirs
7. Conduct general surveys of threatened frog habitats for *Gambusia* (and chytridiomycosis).

Monitoring and performance measure

Monitor the response of threatened frog species to the creation of *Gambusia*-free habitat and physical control works.

Red-eared Sliders (*Trachemys scripta*)

Distribution and abundance

Red-eared Sliders, or pet terrapins, are an emerging and potentially serious riparian zone pest in Australia. The species has spread worldwide after accidental and deliberate releases of captive bred pet turtles. In Australia there are breeding populations in the wild including the catchment of Georges River in southern Sydney (A. Stimson, pers.comm).

In SCR, sliders may occur in numerous waterways and the species may have been detected in Wingello Creek in or adjacent to Morton NP (Burgin 2007).

Impacts

Red-eared Sliders are robust, exhibit high fecundity and have similar habitat requirements to the Murray Short-necked Turtle (*Emydura macquarii*) that inhabits river systems in eastern Australia. The sliders are known to displace native turtles elsewhere and, if the Wingello Creek sliders are now extant, have significant potential to spread widely in the Shoalhaven River system.

Control methods

No information has been found on slider control work. Trapping using modified opera house (yabby) traps or fight nets are potential control methods. Meshing of creeklines with fine diameter nets to prevent the downstream movement of eggs and turtles may be an option at some locations.

Management strategy

1. Survey sections of Wingello Creek when information available on known sites
2. Prepare educational material on the species for NPWS staff and the public
3. Develop and trial control methods if sliders detected

European Rabbits (*Oryctolagus cuniculus*)

Competition and grazing by feral European rabbits has been listed as a Key Threatening Process and rabbits are a noxious pest under the Rural Lands Protection Act 1998.

Distribution and abundance

Rabbits occur in low densities in most SCR reserves and use above ground shelter rather than warrens. However, significant rabbit populations occur in the open forests and grasslands of Tarlo River NP, Nadgigomar NR and Bungonia SCA. Sand dune environments in the coastal zone may harbour significant populations from time to time.

Impacts

Grazing by rabbits is known to change the structure and composition of native vegetation communities, compete with native fauna for food and shelter and, where they are found in large numbers, can cause severe erosion.

Brush-tailed Rock-wallabies may be impacted by grazing competition with rabbits in Kangaroo Valley and Taralga and rabbit grazing may impact of the threatened White-flowered Wax plant (*Cynanchum elegans*). Bomaderry Zieria (*Zieria baeuerlenii*) may also be at risk from rabbit grazing (T. Barratt, pers. comm.).

Control methods

Rabbit control methods include shooting and 1080 baiting. Rabbit Haemorrhagic Disease (RHD) (calicivirus) has been released at sites on the south coast with limited success.

Management strategy

1. Prioritise biodiversity at risk from rabbit impacts
2. Continue to implement current control programs on SCR reserves until evidence of impacts is reviewed
3. Monitor known populations and conduct control programs when population size is warranted
4. Rehabilitate disturbed areas
5. Participate in co-operative control programs with park neighbours where rabbits are impacting on the urban interface

Monitoring and performance measures

1. No formal monitoring program is proposed
2. Sites where control is implemented will be recorded and resurveyed at regular intervals

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Wild Dog (*Canis spp.*)

Wild dogs include dingoes (*Canis lupus dingo*), feral dogs (*Canis lupus familiaris*) and their hybrids.

Wild dogs are declared noxious pests except on lands listed on Schedule 2 of the RLPB Pest Control Order for Wild Dogs. On these lands, principally NPWS reserves, wild dogs are managed under wild dog management plans.

Distribution and abundance

Dingoes occurred throughout NSW but populations are now fragmented due to habitat loss and wild dog control and hybridisation. Feral dogs also occur widely in the landscape as a result of irresponsible dog ownership and urban expansion.

Impacts

Predation by wild dogs may pose a risk to remnant populations of threaten native mammals, although foxes present a significantly greater risk to the conservation of fauna in this region (NPWS 2001). Wild dog scat analyses in SCR reserves indicate a strong dietary preference for swamp wallabies and wombats (NPWS 2007). Wild dogs also compete with native carnivores for food and shelter and are known to harbour and spread diseases, including neosporin and hydatids.

Wild dogs attack, maim and kill livestock and have been reported to attack humans. On average, there are about 40 wild dog livestock attacks reported annually in the Goulburn and Moss Vale RLPB areas covered by wild dog management plans (NPWS 2007). These do not necessarily relate to NPWS reserves. However, there has been a recent increase in reported livestock attacks in the Southern Highlands on recently established small sheep and goats flocks.

Control methods

Trapping and 1080 poisoning, including rotary winged aerial baiting, are methods that may be used on SCR reserves in accordance with wild dog management plans or otherwise DECC approved control activities. Shooting and exclusion fencing are target-specific control methods that may also be used as part of an integrated approach with trapping and 1080 poisoning to control wild dogs.

Management strategy

1. Ensure that wild dog control is conducted humanely and is target-specific
2. Where practical, remove feral dogs from SCR reserves
3. Implement approved actions in the Braidwood-South Coast and Shoalhaven wild dog management plans
4. Minimise the impact of wild dog control on non-target native animals
5. Maintain a close working relationship with RLPBs, local Councils and reserve neighbours on wild dog control
6. Continue research activities on the ecology, distribution and diet of wild dogs and participate in trials of innovative control techniques
7. During fox baiting programs, if there are reports of wild dogs or monitoring detects their presence in these reserves, 1080 wild dog meat baits will be placed on known wild dog routes instead of fox baits.
8. Where practical, integrate wild dog and feral pig control activities

Monitoring and performance measures

1. All wild dog control programs will include monitoring and reporting (using wild dog reporting form)
2. Monitor wild dog activity (plus other predator and prey populations) using sand plots on identified trails in Conjola, Morton and Tarlo River NPs. Monitoring may also be established in SCR reserves adjacent to where wild dog attacks on stock appear to be increasing, especially in the Highlands Area.

Weeds

Asparagus weeds including Bridal Creeper

Asparagus weeds known to occur in SCR reserves include Bridal Creeper (*Myrsiphyllum asparagoides*) and Ground Asparagus (*Protasparagus aethiopicus*). Bridal Creeper is a declared Weed of National Significance and a notifiable W5 noxious weed throughout NSW. The invasion and establishment of exotic vines and scramblers (addressed separately later in this strategy) which include Asparagus weeds is a listed Key Threatening Process.

Distribution, abundance and biology

Bridal Creeper occupies a wide range of vegetation types and can invade and dominate undisturbed forest and riparian zones. Infestations are established in the Shoalhaven LGA and the weed is steadily increasing in distribution from the south. Major infestations occur at Abrahams Bosom proposed for inclusion in Jervis Bay NP. Ground Asparagus is most abundant on coastal dunes and there is a large infestation in the Crown land adjacent to the northern end of Seven Mile Beach NP that is spreading into the park.

Impacts

Bridal Creeper is an aggressive tree-climbing weed that smothers native ground vegetation, shrubs and small trees. Although it has not been declared a Key Threatening Process it is a potential threat to rare species as it can colonise in undisturbed ecosystems. Ground Asparagus is a major threat to littoral rainforest in coastal reserves.

Control methods

High intensity fire and grazing have been used successfully for control of asparagus weeds. Conventional physical and chemical control methods are physically difficult and expensive. The CSIRO has successfully developed and implemented a biological control program using the leafhopper *Zygina* species and the rust fungus *Puccinia myrsiphylli*.

CSIRO rust and leafhopper release sites on the south coast include Conjola and Murramarang NPs and Macquarie Pass SCA. There has also been Bridal Creeper dieback at Cullendulla Creek NR attributed to release of rust.

Priority sites

1. Bridal Creeper rust release sites
2. Conjola and Clyde River NPs
3. Narrawallee Creek, Comerong Island and Cullendulla Creek NRs
4. Abrahams Bosom when added to Jervis Bay NP and littoral rainforest in coastal reserves
5. Illaroo Road and Bomaderry Weir in Bomaderry Creek RP
6. Isolated infestations on boundaries of Worrigee NR
7. Littoral rainforest in Seven Mile Beach NP and EECs at Comerong Island NR

Management strategy

1. Contain or control significant existing infestations
2. Eradicate rare, isolated or newly detected infestations
3. Assist with monitoring of leafhopper and rust release sites
4. Conduct a trial burning and tethered grazing project at a selected priority site
5. Allow natural regeneration following treatment at most sites and
6. Consider supplemental planting if natural regeneration is too slow or monitoring indicates active intervention is required
7. If possible, assess adjacent lands for infestations of asparagus weeds and establish co-operative programs with landholders to control any infestations found.

Monitoring and performance measures

1. Inspect high priority sites regularly
2. Record and map all Bridal Creeper and Ground Asparagus infestations

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Ageratina species

Crofton Weed (*A. adenophora*) and Mistflower (*A. riparia*)

Distribution, abundance and biology

These weeds are typically found in warm moist locations on the margins of rainforest and creek banks. The Nowra area is generally at the southern limit of their range and the weeds are found in SCR reserves in the northern Shoalhaven catchment. These weeds can extend into wetlands.

Both species have a profuse display of white flower clusters in spring, crofton weed having sticky white hairs whereas the floral hairs on Mistflower are not sticky.

Impacts

Ageratina spp. impact on rainforest communities and populations of rare plants, including the perennial herb (*Typhonium eliosurum*). These weeds can dominate the ground cover in gullies and streambanks and may spread rapidly in moist, fertile and sheltered locations.

Control methods

Ageratina spp. will be managed using manual and chemical control techniques. SCR will participate in biocontrol establishment if effective biological controls become available.

Priority sites

1. Shoalhaven River tributaries in Morton NP
2. Coonemia Creek, Huskisson and Abrahams Bosom (when added to the park) in Jervis Bay NP

3. Seven Mile Beach NP
4. Macquarie Pass NP
5. Mistflower at Minnamurra rainforest in Budderoo NP
6. Bugong Creek in Bugong NP
7. Nelson Creek in Kangaroo River NR

Management strategy

1. Contain or control infestations in undisturbed or remote sites
2. Eradicate rare, isolated or newly detected infestations
3. Conduct surveys to improve knowledge of distribution as part of routine weed surveys
4. Target sites where weeds are impacting on threatened entities
5. Allow natural regeneration following treatment at most sites and
6. Consider supplemental planting if natural regeneration is too slow or monitoring indicates active intervention is required.

Monitoring and performance measures

1. Inspect high priority sites regularly
2. Record and map all Crofton Weed and Mistflower infestations

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Bitou Bush and Boneseed (*Chrysanthemoides monilifera*)

Bitou Bush is a Weed of National Significance, a Key Threatening Process for a number of threatened entities, a noxious W4 weed and there is an approved Threat Abatement Plan (NPWS 2006) to manage invasion of native plant communities by Bitou Bush and boneseed.

Distribution and abundance

Bitou Bush is found in coastal environments including Jervis Bay, Conjola and Seven Mile Beach NPs and Comerong Island and Cullendulla Creek NRs.

There has been a long history of control in SCR reserves particularly in the Ulladulla Area, where infestations are now isolated and dispersed.

Impacts

Bitou Bush displaces and overgrows rainforest, coastal sclerophyll forests, grasslands, swamp forests and saltmarshes and impacts on threatened shorebirds dependent on these Endangered Ecological Communities. Of particular concern is the impact of Bitou Bush on freshwater wetlands in Jervis Bay NP and on the perennial herb (*Chamaesyce psammogeton*) at Seven Mile Beach NP.

Control methods

Bitou Bush will be controlled using manual, mechanical, chemical and biological control techniques. Aerial herbicide application will continue at DPI approved sites. Biological control will include using approved biological control

agents (moth, beetle and fly species) and establishment of populations of the bitou leaf roller moth (*Tortrix spp*.) will be supported.

Bitou Bush control is generally carried out as part of a co-ordinated program with adjacent landholders and other agencies.

Priority sites

The highest priorities for Bitou Bush control in SCR reserves are sites identified in TAP. These priorities are based on protection of threatened entities as follows:

1. Seven Mile Beach NP, Jervis Bay and Conjola NPs (numerous sites) and Comerong Island NR for protection of littoral rainforest, Bangalay sand forest and swamp oak floodplain forest and SEPP 26 wetlands
2. Seven Mile Beach and Jervis Bay NPs for protection of *Chamaesyce psammogeton*
3. Jervis Bay NP for protection of swamp oak floodplain, freshwater wetlands and *Wilsonia backhousei*

Other sites identified for control in SCR reserves include Murramarang NP (south) and Cullendulla Creek and Tollgate Islands NRs.

Management strategy

1. Eradicate Bitou Bush in SCR reserves south of the Bitou Bush containment line at Sussex Inlet
2. Conduct primary control of all substantial infestations north of the containment line
3. Eradicate rare or isolated infestations in SCR reserves elsewhere
4. Continue to participate and support the implementation of Bitou Bush management in accordance with the Bitou Bush TAP
5. At high priority sites specified in the TAP develop site-specific management plans for Bitou Bush control based on currently available best practice guidelines
6. Coordinate and train volunteers and other stakeholders, including indigenous communities, who wish to participate in control programs at high priority sites
7. Undertake public awareness programs on the impacts of Bitou Bush and the importance of its control
8. Aerial spraying and biocontrol will be carried out in close consultation with DPI
9. Foster co-operative programs across land tenures
10. Allow natural regeneration following treatment at most sites and
11. Consider supplemental planting if natural regeneration is too slow or monitoring indicates active intervention is required

Monitoring and performance measures

1. Maintain matched plot (bitou and native) monitoring system at Seven Mile Beach NP
2. Periodic updating of weed maps
3. Periodic ground checking of high priority weed sites

Exotic perennial grasses, including Serrated Tussock (*Nassella trichotoma*)

Invasion of native plant communities by exotic perennial grasses is a Key Threatening Process. The most significant exotic grass is Serrated Tussock that is also a Weed of National Significance and noxious W4 weed.

Distribution, abundance and biology

Serrated Tussock and/or other exotic perennial grasses occur in many Highlands Area reserves and a wide variety of exotic grasses are found in coastal areas. Some of these weeds are emerging problems for SCR reserves. These grasses include Chilean Needlegrass (*Nassella neesiana*), African Lovegrass (*Eragrostis curvula*), Giant Parramatta Grass (*Sporobolus fertilis*) and Pampas Grasses (*Cortaderia spp*.)

Buffalo Grass (*Buchloe dactyloides*) and Kikuyu (*Pennisetum clandestinum*) overgrow shorebird nesting sites on offshore island reserves, including Brush Island NR.

Impacts

Serrated Tussock was accidentally introduced into Australia and has spread to dominate some native grasslands and woodlands in SCR reserves in the Highlands Area. As it is not favoured by native grazing animals selective grazing of other species results in a rapid increase in less palatable grasses like tussock.

Invasion of native plant communities by exotic perennial grasses is a threat to many Endangered Ecological Communities including box woodland at Bungonia SCA and Tarlo River NP and woodlands, grasslands and wetlands in coastal reserves. Terrestrial orchids, rare plants, birds and reptiles are also likely to be affected.

Control methods

Exotic perennial grasses will be controlled using manual and chemical control techniques. All terrain vehicles and aerial spraying may be used to increase efficiency of control at established, remote and larger infestations, especially for Serrated Tussock.

Priority sites

1. Serrated Tussock wherever it is found but especially at Bungonia SCA, Nadgigomar NR, and McCallums Flat on the Shoalhaven River in Morton NP
2. Exotic perennial grasses generally in Bangadilly, Morton and Tarlo River NPs, Bungonia SCA and Cecil Hoskins and Jerralong NRs
3. Giant Parramatta Grass at Copper Cup Point in Jervis Bay NP and near the coal wharf in Comerong Island NR
4. Pampas Grass east of the old tip in Bomaderry Creek RP where previous control work has occurred but follow-up required
5. Buffalo Grass and Kikuyu in Brush Island NR
6. Newly detected Pampas Grass infestation in Worrigee NR

7. African Lovegrass near Emery's Road in Cambewarra Range NR

Management strategy

1. Contain and control significant established infestations
2. Eradicate rare, isolated or newly detected infestations
3. Conduct grass identification training for bush regenerators to minimise the risk of misidentification with native tussock grasses
4. Eradicate Buffalo Grass and Kikuyu from coastal island reserves
5. Foster partnerships with community and Landcare groups to improve cross tenure control works
6. Prepare weed management plans for high priority sites
7. Map and monitor all weed infestations including Buffalo Grass and Kikuyu at priority sites
8. Confine Buffalo Grass and Kikuyu to existing areas
9. Establish weed monitoring and control as part of Asset Management Zone hazard reduction maintenance program
10. Develop and trial techniques for restoring degraded remnants including grassland ecosystem
11. Allow natural regeneration following treatment at most sites and
12. Consider supplemental planting if natural regeneration is too slow or monitoring indicates active intervention is required

Monitoring and performance measures

1. Assess fire affected sites for new infestations
2. Periodic ground checking of high priority weed sites
3. Maintain follow-up programs with inspections of treated areas and high risk areas
4. Inspect known sites annually

Exotic vines and scramblers

The invasion and establishment of exotic vines and scramblers is a Key Threatening Process for several Endangered Ecological Communities and threatened species in SCR.

Exotic vines known to occur in SCR reserves include Madiera Vine (*Anredera cordifolia*), Dolichos Pea (*Dipogon lignosus*), Cape Ivy (*Delairea odorata*), Cat's Claw Creeper (*Macfadyena unguis-cati*), English Ivy (*Hedera helix*), Coast Morning Glory (*Ipomoea cairica*), Morning Glory (*Ipomoea indica* and *Ipomoea purpurea*), Japanese Honeysuckle (*Lonicera japonica*), Moth Vine (*Araujia sericifera*), Passionfruit (*Passiflora spp*.), Turkey Rhubarb or Potato Vine (*Acetosa sagittata*), Black-eyed Susan (*Thunbergia alata*), Trad (*Tradescantia fluminensis*) and Periwinkle (*Vinca major*).

Distribution, abundance and biology

Exotic vines and scramblers are widespread and locally abundant in natural environments in eastern NSW. The worst weed infestations occur on the margins of riparian zones, rainforest and in other sheltered, fertile and moist locations. These species pose particular threats to remnant or disturbed

rainforest and wet sclerophyll communities. Exotic vines are characterised by the ability to dominate and smother understorey native plants, compete with, and prevent germination by, native plants and disperse widely in fertile and riparian environments.

Impacts

Exotic vines and scramblers threaten rainforests, swamp forests and tall open forests on fertile soils. Invasion and establishment of these weeds also directly threaten:

- *Irenepharsus trypherus* (preliminary) at Minnamurra rainforest and the escarpment of the Upper Kangaroo River in Budderoo NP, on the banks of the Kangaroo River and Jones Creek area in Morton NP and at Bees Nest NR
- *Daphnandra sp "C" Illawarra* at Minnamurra rainforest (preliminary assessment)
- Long-nosed Potoroos (*Potorous tridactylus*) at Budderoo and Conjola NPs and Barren Grounds and Cambewarra Range NRs (preliminary assessment)
- Golden-tipped Bats (*Kerivoula paupuensis*) at Bimberamala NP
- Littoral rainforest in Seven Mile Beach NP
- EECs generally including subtropical rainforest communities and Coastal Swamp Oak Forest

Some exotic vines and scramblers form dense ground cover carpets that suppress native species (e.g. *Tradescantia fluminensis* and *Vinca major*). In sclerophyll communities, exotic vines and scramblers are more mesic than the native species and may change the nature of the fuel and thus alter fire behaviours and regimes. Invasion by exotic vines and scramblers can also alter other biotic aspects of communities such as the abundance and diversity of plant-dwelling invertebrates (Ernst and Cappuccino 2005).

Turkey Rhubarb infestations pose a threat to populations of the perennial herb and ROTAP *Typhonium eliosurum* along the Shoalhaven River downstream of Tallowa Dam and on the Kangaroo River adjacent to Kangaroo River NR (BLS 2002). *Tradescantia* is present in sheltered situations such as the rainforests at Back Run Creek and at the southeastern end of Apple Tree Flat on the Shoalhaven River in Morton NP where it completely dominates the understorey vegetation.

Control methods

Control methods vary for different vines and scramblers. A combination of manual and chemical control techniques will be used.

Priority sites

1. Minnamurra rainforest in Budderoo NP
2. Established long-term control programs on the Shoalhaven River and its close tributaries in Morton NP
3. Yarrunga Creek catchment in Morton NP, especially for Passionfruit.
4. Yatteyattah NR for Madeira Vine

5. Macquarie Pass NP
6. Seven Mile Beach NP and Comerong Island NR
7. Bomaderry Creek RP
8. Kangaroo River NR for Cape Ivy and Trad
9. Tarlo River NP and Barbers Creek in Morton NP for Periwinkle

Management strategy

1. Contain or control significant known infestations
2. Eradicate rare, isolated or newly detected infestations
3. Assist with raising awareness of exotic vine impacts on biodiversity with the general public and the nursery industry
4. Participate in the investigation and testing of effective control methods
5. Assist with collation of baseline information to help determine priority sites for control
6. Conduct surveys to improve knowledge of distribution as part of routine weed surveys
7. Investigate the potential for eradication of exotic vines adjacent to Irenepharsus trypherus sites at Bees Nest NR and Jones Creek in Morton NP
8. Implement measures (fencing, gates, bollards, signs etc) to control and restrict pedestrian and vehicular access where necessary to prevent weed and rubbish dumping
9. Allow natural regeneration following treatment at most sites and
10. Consider supplemental planting if natural regeneration is too slow or monitoring indicates active intervention is required

Monitoring and performance measures

1. Progressively survey, map and monitor all weed infestations
2. Periodic ground checking of high priority weed sites
3. Conduct annual surveys of known exotic vine locations where threatened species occur

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<u>Garden and rural escapees and other emergent and opportunistic weeds</u>

An increasing list of domestic weeds has spread from urban gardens and rural areas into adjoining bushland, drainage lines and along roads and walking tracks. Dispersal of seed is by wind, water, birds, other animals (e.g. horses), human shoes and tyres or by dumping of garden clippings and rubbish. Often hazard reduction fires adjoining urban areas encourage the spread of garden weeds into reserves as well as allowing the emergence of opportunistic weeds (e.g. inkweed) by creating ideal conditions for colonization (exposed soils and reduced competition from natives). Some of these weeds have been declared noxious.

Key domestic and opportunistic weeds identified on or adjacent to SCR reserves include:
Mother-of-millions (*Bryophyllum tubiflorum*), Coral Tree (*Erythryna x sykesii*), Tobacco Bush (*Solanum mauritianum*), Trumpet Lily (*Lilium formusanum*), Arum Lily (*Zantedashia aethiopica*), Agapanthus (*Agapanthus praecox ssp. orientalis*), African Scurfpea (*Psoralea pinnata*), Inkweed (*Phytolacca*

octandra), Shade Crassula (*Crassula multicava*), Monbretia (*Crocosmia x crocosmiiflora*), Wild Watsonia (*Watsonia bulbillifera*), Beach Daisy (*Arctotheca populifolia*), Senna (*Senna pendula* and *Senna septemtrionalis*), Indian Shot (*Canna indica*), Fleabane (*Conzya albida*), Blackberry Nightshade (*Solanum nigrum*), Flat Weed (*Hypochaeris radicata*), *Juncus cognatus* (exotic sedge), Red Hot Pokers (*Kniphofia uvaria*), Coreopsis (*Coreopsis lanceolata*), *Aristea ecklonii* (exotic bulb), Thistles (all species), Impatience (*Impatiens balsmina*) and Spiderplant (*Chlorophytum comosum*).

Distribution and abundance

The above weeds are typically associated with disturbed areas such as the bushland interface with urban and rural areas, road edges and at visitor nodes such as camping areas. Rate of spread into adjoining bushland may be slow but can be significant over time especially in APZs and SFAZs due to regular burning and other disturbances. Drainage lines and lakes may also facilitate significant weed proliferation.

Impacts

Generally the impact of domestic and opportunistic weeds is low due to their slow rates of spread and restriction to disturbed areas. However, the density of infestations may be high in some locations where weed control has not been undertaken regularly, such as in newly acquired reserves. This may be a concern where Endangered Ecological Communities are being impacted. For example, Agapanthus are overgrowing native ground cover in some areas of Bangalay sand forest in Barnunj SCA.

Control methods

Control methods include a variety of chemical and manual techniques depending on the weed type, density and location. Weed control adjoining urban areas may be assisted by local community members at some sites.

Priority sites

1. Wyoming Ave, and Dolphin Point APZs and Burrill Lake SFAZ, Pot Holes car park and Stokes Island, Sunburnt Beach and Termeil Point camping areas and Burrill Lake fringe (especially near urban area) in Meroo NP
2. Lagoon Head cabins, Bush Mission Camp and areas adjoining Crown Land in Barnunj SCA
3. Urban interface in Jervis Bay NP
4. Worrigee and Triplarina NRs (along trails throughout and in APZ).
5. Bomaderry Creek RP (especially adjacent to old tip site) for Mother-of-millions.

Management strategy (developed from BES 2007)

1. Conduct primary control of all known noxious weeds
2. Eradicate rare, isolated or newly detected garden weed infestations
3. Develop and implement a public education program for urban interface weed problems
4. Establish partnerships with community groups to work on the urban interface

5. Map and monitor all weed infestations
6. Target weeds impacting on threatened entities
7. Establish weed monitoring and control as part of APZ hazard reduction maintenance program
8. Implement measures (fencing, gates, bollards, signs etc) to control and restrict pedestrian and vehicular access where necessary to prevent weed and rubbish dumping
9. Allow natural regeneration following treatment at most sites and
10. Consider supplemental planting if natural regeneration is too slow or monitoring indicates active intervention is required.

Monitoring and performance measures

5. Assess fire affected sites for new infestations
6. Periodic updating of weed maps
7. Periodic ground checking of high priority weed sites

Lantana (*Lantana camara*)

Lantana is a noxious weed; a Weed of National Significance and the invasion, establishment and spread of Lantana is a Key Threatening Process.

Distribution, abundance and biology

Lantana is prolific in coastal areas but the eastern escarpment of the Great Dividing Range appears to be a limiting factor in the spread of Lantana to the western areas of SCR under current climatic conditions. It is an aggressive invader of disturbed forest and hind dunes. Lantana is common in wet forest margins in SCR reserves in the northern Shoalhaven catchment and where established it will rapidly dominate sites where the forest canopy has been opened up, such as the foothills and midslopes of the coastal ranges. In many localities in the northern Shoalhaven, Lantana has spread hundreds of metres up steep terrain into reserves from cleared or disturbed land.

Impacts

Lantana is a threat to rainforests, coastal eucalypt forests and swamp forests. Infestations pose a threat to populations of the perennial herb *Typhonium eliosurum* and other threatened plant species including the climber *Cynanchum elegans, Daphnandra sp. 'Illawarra'* trees, Illawarra Irene (*Irenepharsus trypherus*), *Solanum celatum* shrubs and Magenta Lilly Pilly (*Syzygium paniculatum*).

Lantana can rapidly smother ground vegetation and climb into the canopy, suppress natural regeneration at disturbed sites and alter ecological processes including fire regimes.

Control methods

Lantana will be controlled using manual, mechanical, chemical and biological control techniques. Herbicide application is not recommended when the infestation is under environmental stress (e.g. drought).

Priority sites

1. Minnamurra Rainforest in Budderoo NP
2. Macquarie Pass NP
3. Carama Inlet, Copper Cup Point and Cabbage Tree Swamp in Jervis Bay NP
4. Seven Mile Beach NP, Comerong Island NR
5. Bamarang NR
6. Colymea SCA
7. Narang Road area of Bomaderry Creek RP

Management strategy

1. Eradicate infestations in reserves south of Ulladulla
2. Contain spread of Lantana at high priority sites
3. Eradicate rare or isolated infestations in SCR reserves elsewhere
4. Assist the NSW Lantana Bio-control Task Force at established biocontrol sites in SCR reserves
5. Map distribution and abundance of all infestations
6. Participate in research on the use of remote sensing to survey and map Lantana distribution
7. Co-ordinate Lantana and feral animal control works
8. Allow natural regeneration following treatment at most sites and
9. Consider supplemental planting if natural regeneration is too slow or monitoring indicates active intervention is required

Monitoring and performance measures

1. Periodic updating of weed maps and involvement with statewide mapping inventory
2. Periodic ground checking of high priority weed sites
3. Maintain follow-up programs with inspections of treated areas and high risk areas
4. Inspect known sites annually

Pine species (*Pinus spp.,* especially *P. radiata*)

There are a number of pine species grown in plantation forestry that are now causing concern as environmental weeds (*P. radiata, P. elliotti, P. contorta* and *P. ponderosa*). Seeds are spread by wind, water and birds with swards of seedlings (pine wildings) spreading out from plantations. Wildings grow rapidly, eventually forming dense canopies which prevent regeneration of native species and increase the fire hazard (NPWS 2002).

Distribution and abundance

About 75 hectares of pine plantation occurs in Meroo NP. Following the removal of mature trees at plantation sites regrowth has been prolific. Many other pockets of large trees remain around Burrill and Tabourie Lakes. Pines also occur in Tarlo River and Morton (Wingello section) NPs and Nadgigomar NR. Former pine plantations existed in the Corang area and wildings may impact on adjacent areas of Morton and Budawang NPs.

Impacts

Biodiversity values can be significantly impacted where pine monocultures exist. A limited number of native bird and mammal species are found where former pine plantations exist in reserved lands. Pines also impact the recreation, landscape or aesthetic values of some SCR reserves. Pines inhibit the growth of native vegetation due to light exclusion and growth inhibitors in needles and bark (NPWS 2005).

Control methods

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.

Priority sites

1. Former plantations in Meroo NP and Morton (Wingello section) NP

Management strategy

1. Contain or control significant known infestations
2. Eradicate rare, isolated or newly detected infestations and individual wildings
3. Survey reserve areas near boundaries with former pine plantations regularly
4. Priority will be given to control where pines are threatening or adjacent to Endangered Ecological Communities and riparian zones
5. Mature pines may be retained where they are deemed to be part of a cultural or historic landscape but the wildings from these trees will be removed
6. Allow natural regeneration following treatment at most sites and
7. Consider supplemental planting if natural regeneration is too slow or monitoring indicates active intervention is required

Monitoring and performance measures

1. A mapping and photopoint monitoring system has been established at Tarlo River NP. Monitoring will continue at these sites
2. Mapping and photopoint monitoring will be established at other locations where pines are impacting on biodiversity values

Sea Spurge (*Euphorbia paralias*)

Distribution and abundance

Sea Spurge is a recent coloniser of sandy beaches in the Shoalhaven and is now well dispersed along the coast from Lake Wollumboola southwards.

Populations of Sea Spurge occur on numerous beaches in SCR reserves (Mills 1998). In Nowra Area, minor infestations of Sea Spurge occur between Currarong and Culburra beaches in Jervis Bay NP. In Ulladulla Area significant infestations occur on Richmond Beach and North Head beach in Murramarang NP and minor infestations on various beaches including Island Beach, Dawsons Beach and Oakey Beach in the same reserve. In Conjola NP a significant infestation exists on Monument Beach and minor infestations occur on surrounding beaches. Narrawallee Creek NR contains a minor infestation on Buckleys Beach. Elsewhere in the region Sea Spurge occurs on numerous beaches outside reserves.

Impacts

Sea Spurge plants produce small, hard seeds that are tolerant of saltwater and can be spread widely by ocean currents. Several thousand seeds per year can be released by a single plant. Plants are long-lived and can form very extensive and densely growing populations that smother and out-compete local native beach plants. Sea Spurge has the potential to threaten native plant and animal beach communities. Large populations of Sea Spurge may be detrimental to beach nesting shorebirds such as Red-capped Plovers and threatened Hooded Plovers and Pied Oystercatchers. Such densely growing Sea Spurge may also be detrimental to recreational activities on beaches. The toxic milky sap of the plant may be a human health risk.

The spread of Sea Spurge is difficult to predict because beach and dune systems where the weed proliferates are dynamic systems subject to impacts from wind and waves. As a result, seeds can occur at various levels within the dune profile and can be exposed and/or transported in significant volumes over large distances.

Control

Sea Spurge will be controlled by manual and chemical control techniques. Off label permits for other effective chemical controls may be sought if necessary.

Priority sites

The highest priority for control will be beach sites where Sea Spurge is impacting on threatened plant or shorebird protection activities including:

1. Beaches in SCR reserves between Sussex Inlet and Bendalong
2. North and South Monument Beach in Conjola NP
3. Richmond and North Head Beaches in Murramarang NP

Management strategy

1. Eradicate rare, isolated or newly detected infestations
2. Contain and control significant established infestations
3. Develop and implement a targeted information program to improve awareness of the existence, impacts and control techniques of Sea Spurge
4. Establish partnerships with community groups to help identify when Sea Spurge is setting seed so that control can be better targeted
5. Map and monitor infestations
6. Allow natural regeneration following treatment at most sites and
7. Consider supplemental planting if natural regeneration is too slow or monitoring indicates active intervention is required
8. Liaise with other land managers including the Commonwealth (Booderee NP) and local Councils for more effective management of infestations

Monitoring

1. Regular inspections of beaches in SCR reserves
2. Establish photopoint monitoring at known infestations

Spiny Rush (*Juncus acutus*)

Distribution and abundance

Spiny Rush is native to the Mediterranean region, western Europe, South Africa, USA and South America. It is found in all states except Tasmania and the Northern Territory. In SCR it occurs in many waterways and other low-lying areas, particularly in saline areas. It can be found in all coastal reserves in the region. Known locations are in Clyde River, Conjola, Meroo, Murramarang, Jervis Bay and Seven Mile Beach NPs, Cullendulla Creek, Comerong Island and Narrawallee Creek NRs and Barnunj SCA. Other reserves such as Saltwater Swamp and Brundee Swamp NRs may also have infestations.

Spiny Rush is at high densities in some locations and has the potential for further spread into reserve wetlands. Infestations already exist within several Endangered Ecological Communities including freshwater wetlands on coastal floodplains, coastal saltmarshes and swamp oak forests.

Impacts

Once established Spiny Rush covers the area and eliminates almost all other vegetation. Stands can become impenetrable to wildlife and humans, preventing access to water. When growing in creeks and channels it can seriously obstruct water flow and cause local flooding.

The weed displaces native sedges and invades coastal saltmarsh communities and swamp oak forests. At locations such as Comerong Island NR it has the potential to change the vegetation structure leaving the area unsuitable for threatened shorebirds including many migratory species.

Priority sites

1. Comerong Island NR
2. EECs on other SCR reserves

Priorities for controlling particular infestations must be worked out when planning a Spiny Rush management program. Clean areas should be kept free of Spiny Rush and managed to prevent infestation. Extensive infestations are best quarantined and tackled as a land management program.

Control methods and management strategy

1. Conduct weed identification training for relevant SCR staff
2. Survey and map existing infestations with the SCR
3. Eradicate rare, isolated or newly detected infestations
4. Contain and control significant established infestations
5. Conduct experimental trials on best methods of eradication including the use of fire
6. Continue to work co-operatively with reserve neighbours on co-ordinated weed control programs to minimise the risk of weed invasion of wetland areas

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Wetland weeds

Wetland weeds include subsurface plants in coastal estuaries and associated wetlands, such as the saltwater seaweed *Caulerpa taxiflora*; aquatic surface weeds such as *Salvinia molesta* or less specialised weeds at the wetland margins such as Lantana.

Distribution and abundance

The current distribution of wetland weeds in wetlands in SCR reserves is limited. However, there is significant potential for the spread of noxious and environmental weeds into reserve wetlands including several Endangered Ecological Communities. Coastal and Tableland Alluvial Valley Floor Wetlands, Sand-dune Wetlands and South Coast Swamp Forest -*Casuarina glauca* are several that may be impacted by wetland weeds. Bitou Bush is likely to occur in Sand-dune Wetlands in SCR reserves.

The margin of the artificial wetland of Cecil Hoskins NR is a significant weed invasion site. Willows, blackberry, exotic perennial grasses, gorse and some exotic vines are present adjacent to the waterway. The aquatic weed, Parrots Feather (*Myriophyllum aquaticum*) is also a concern in the reserve. Wild Watsonia (*Watsonia bulbillifera*) is found on the foreshores of Jervis Bay NP in moist protected locations. Giant Parramatta Grass (*Sporobolus indicus*) occurs in Comerong Island NR near the coal wharf mangroves. *C. taxifolia* is found in Narrawallee inlet near Narrawallee Creek NR, in Lake Conjola near Conjola NP, in St Georges Basin near Corramy SCA and in Burrill Lake near Meroo NP. It has also recently been detected in Cullendulla Creek near Cullendulla Creek NR and in Durras Lake adjacent to Murramarang NP. Both sites are in Batemans Marine Park sanctuary zones.

Water Hycacinth (*Eichhornia crassipes*) and Brazillian Water Milfoil (*Myriophyllum aquaticum*) have been recorded in many freshwater wetlands on the South Coast.

Impacts

It is yet to be determined what impact *C. taxifolia* will have and it has been observed growing adjacent to native seagrasses and on unvegetated subsurface sediments.

Salvinia and willows pose a considerable risk to Coomonderry Swamp in and adjacent to Seven Mile Beach NP. Salvinia was eradicated from Flat Rock Creek in Triplarina NR but further surveys are needed to confirm eradication.

Parrots Feather creates a thick sponge mat as it progresses. At Cecil Hoskins NR it has now created matted links that foxes and other predators can use to reach former islands where waterbirds rest and breed.

Control methods

Control methods vary for wetland weeds. A combination of manual and chemical control techniques will be applied.

Priority sites

1. Control known infestations of Lantana, Bitou Bush, Moth Vine and Pampas Grass in Brundee Swamp and Saltwater Swamp NRs and in Seven Mile Beach NP adjacent to Coomonderry Swamp
2. Investigate options to progressively reduce Parrots Feather at Cecil Hoskins NR
3. Conduct targeted search for Salvinia at Flat Rock Creek in 2007/2008

Management strategy

1. Conduct weed identification training for relevant SCR staff
2. Regularly monitor reserved wetlands for the presence of weeds
3. Where *C. taxifolia* is reported in NPWS wetlands, report to DPI Fisheries and work in conjunction with them as they have primary responsibility for caulerpa management. Attempt to prevent its spread into reserved wetlands through signage and regulation of boat access
4. Continue working co-operatively with reserve neighbours on co-ordinated weed control programs to minimise the risk of weed invasion of wetland areas

Willows (*Salix spp.*)

Salix species except Weeping and hybrid Pussy Willows (*S. babylonica, S. x reichardtii* and *S. x calodendron*) are noxious and notifiable W5 weeds throughout NSW. Most species of willow are Weeds of National Significance.

Distribution, abundance and biology

All willows are widespread and associated with the gravel beds of rivers. Willows are known to occur in the riparian areas of Cecil Hoskins NR and Tarlo River NP. Willows also occur sporadically along the Shoalhaven River corridor in Morton NP.

Most willow reproduction is vegetative through fragmentation or breaking of twigs and branches that rapidly root in water. However, reproduction by seed is particularly common and is the predominant means of proliferation for several species (particularly *S. cinerea* and *S.nigra*) (Cremer et al 1995).

Impacts

Willows can significantly modify streambank vegetation and hydrology in riparian environments. In streams, willows cause channel diversion, soil or bank erosion, loss of stream capacity, stream obstruction, increased flooding and loss of infrastructure. These impacts lead to degradations of water quality and stream health (Cremer et al 1995).

Willows displace native vegetation and cause modifications to river flow that can lead to major stream bank erosion particularly during flood events and potentially adverse effects on aquatic fauna. If infestations increase they may threaten the conservation value of adjacent rainforest and other vegetation communities (BLS 2002).

Control methods

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

Management strategy

Contain or control significant known infestations
Eradicate rare, isolated or newly detected individual trees
Allow natural regeneration following treatment

Priority sites

1. Shoalhaven River corridor in Morton NP
2. Cecil Hoskins NR
3. Tarlo River NP

Monitoring and performance measure

Map willow locations when detected for future control

Summary of Pest Management Priorities

Regional pest priorities – vertebrates, invertebrates and disease	**CRITICAL**				**HIGH**		**MEDIUM**				**LOWER**			**Priority sites** Note: The information in this column is an abbreviated version of information in each of the relevant Pest Program Overviews.
	1. Threatened species and communities	2. Human Health	3. Impacts on agriculture	4. New incursions	5. World Heritage	6. Cultural heritage	7. Wilderness/Wild Rivers	8. Recreation/Aesthetic	9. Community co-operative program	10. Regional Plan for co-operative programs	11. Community programs/local impacts	12. Existing programs	13. Window of opportunity	
Chytridiomycosis	●			●					●					No specified priority sites
Feral cat	●											●		Threatened shorebird nesting sites in coastal reserves
Feral deer	●	●	●	●			●		●			●		Rainforest escarpment reserves & riparian zones adjacent to major rivers in Morton NP
Feral goat	●	●	●	●		●	●		●			●		Rainforest escarpment reserves & riparian zones adjacent to major rivers in Morton NP; Broad-headed Snake habitat, rock overhangs for Large-eared Pied Bat & Aboriginal cultural values, Corang River private land for Pygmy Cypress Pine
Feral honeybee	●			●										Murramarang NP
Feral pig	●	●	●	●			●				●	●		Murramarang, Clyde River & Morton NPs
European fox	●		●						●			●		Brush-tailed Rock-wallaby sites in Kangaroo Valley & Taralga and planned re-introduction sites. Shorebird nesting sites in coastal reserves & Long-nosed Potoroos and Eastern Bristlebirds habitat
Plague minnow	●			●										Green and Golden Bellfrog habitat in Jervis Bay NP
Red-eared Slider				●									●	Wingello Creek and other Shoalhaven tributaries in Morton NP
Rabbit	●		●									●		Sites when they may be impacting on threatened species or park values or park neighbours
Wild dog	●	●	●							●				Sites approved in wild dog management plans

Regional pest priorities – weeds	CRITICAL				HIGH		MEDIUM				LOWER			Priority sites Note: The information in this column is an abbreviated version of information in each of the relevant Pest Program Overviews.
	1. Threatened species and communities	2. Human Health	3. Impacts on agriculture	4. New incursions	5. World Heritage	6. Cultural heritage	7. Wilderness/Wild Rivers	8. Recreation/Aesthetic	9. Community co-operative program	10. Regional Plan for co-operative programs	11. Community programs/local impacts	12. Existing programs	13. Window of opportunity	
Asparagus weeds	●			●					●					Rust release sites; Cudmirrah, Clyde River & Jervis Bay NPs, Narrawallee, Cullendulla Creek & Worrigee NRs & Bomaderry Creek RP
Ageratina spp.	●													Shoalhaven River tributaries in Morton NP, Budderoo, Bugong, Jervis Bay, Macquarie Pass and Seven Mile Beach NPs
Bitou Bush	●									●	●	●		Seven Mile Beach NP, Jervis Bay and Conjola NPs (numerous sites) and Comerong Island NR
Exotic grasses	●		●	●								●		Serrated Tussock wherever found but especially at Bungonia SCA, Nadgigomar NR & McCallums Flat in Morton NP. Exotic perennial grasses generally in Bangadilly, Morton and Tarlo River NPs, Bungonia SCA & Cecil Hoskins & Jerralong NRs, Giant Parramatta Grass at Copper Cup Point in Jervis Bay NP & Comerong Island NR, Pampas Grass in Bomaderry Creek RP, Buffalo Grass & Kikuyu in Brush Island NR & Pampas Grass in Worrigee NR
Exotic vines	●			●					●			●		Minnamurra rainforest in Budderoo NP, established programs & other sites in Macquarie Pass, Morton, Seven Mile Beach & Tarlo River NPs, Yatteyattah & Comerong Island NRs & Bomaderry Creek RP
Garden escapees	●			●							●		●	Some APZs & Burrill Lake SFAZ & camping areas in Meroo NP, urban interface areas Jervis Bay NP, Worrigee &Triplarina NRs, Bomaderry Creek RP and Barnunj SCA.

Regional pest priorities – weeds	CRITICAL				HIGH		MEDIUM				LOWER			Priority sites Note: The information in this column is an abbreviated version of information in each of the relevant Pest Program Overviews.
	1. Threatened species and communities	2. Human Health	3. Impacts on agriculture	4. New incursions	5. World Heritage	6. Cultural heritage	7. Wilderness/Wild Rivers	8. Recreation/Aesthetic	9. Community co-operative program	10. Regional Plan for co-operative programs	11. Community programs/local impacts	12. Existing programs	13. Window of opportunity	
Lantana	●							●	●			●		Budderoo (Minnamurra rainforest), Jervis Bay, Macquarie Pass & Seven Mile Beach NPs, Bamarang & Comerong Island NRs, Colymea SCA & Bomaderry Creek RP
Pinus spp.								●					●	Former pine plantations in Morton & Meroo NP
Sea Spurge	●										●			Beaches in SCR reserves between Sussex Inlet and Bendalong, certain beaches in Conjola and Murramarang NPs
Spiny Rush	●										●			No specified priority sites
Wetland weeds	●			●										Brundee Swamp, Cecil Hoskins, Saltwater Swamp & Triplarina NRs
Willows	●								●					Morton and Tarlo River NPs and Cecil Hoskins NR

Other emerging pest issues

Potential pest threats

New pest threats may emerge during the life of this strategy that require planning, control and monitoring. These threats may emerge as a result of accidental or deliberate release or escape of exotic animals and plants, adaptation by exotic species to new environments, climate change and habitat modification.

A general increase in mean temperatures and fewer frost days are predicted for the future climate of Australia. All invasive plants can be expected to demonstrate a southward range shift, increased rainfall will spread weeds and temperature sensitive plants may shift into higher altitude areas (CRC 2007). However, climatic change may also assist the spread of some biological control agents and improve their effectiveness.

Some of these pest threats have already been determined to be Key Threatening Processes. Psittacine Circoviral (beak and feather) Disease (PCD) is known to affect endangered psittacine species and populations and may threaten local populations of Gang-Gang Cockatoos (*Callocephalon fimbriatum*), Glossy Black-Cockatoos (*Calyptorhynchus lathami*) and Swift Parrots (*Lathamus discolour*). Cane Toads (*Bufo marinus*) and Red Imported Fire Ants (*Solenopsis invicta*) are other potential serious pest threats that require close monitoring. An increase in the rate of spread of some weed species may result from accidental or deliberate introduction of exotic Large Earth Bumblebees (*Bombus terrestris*) from Tasmania where they are now established.

The Region is aware of the need for monitoring and control activities to be sufficiently flexible to address not only potential new pest threats but also new incursions of existing threats from elsewhere within the Region e.g. the plant pathogen *Phytophthora cinnamomi.*

Existing pest threats

The invasion and establishment of Scotch broom (*Cytisus scoparius*) is a proposed Key Threatening Process pending finalisation. This weed is known to affect NPWS reserves outside SCR.

European Brown Hares (*Lepus capensis*) appear to be increasing in abundance in several Highlands reserves but the current impact of this species is unknown. Domestic farm animals, including cattle, are occasional invaders of native bushland and have been known to establish wild populations. Several small populations of cattle occur in Morton NP, including animals occasionally seen in Danjera Creek.

Existing populations or infestations of other pests that are considered a low threat are currently managed under specific or general control programs e.g. Blackberries.

Operational guidelines

The following operational guidelines and conditions will be applied to all feral animal control programs on SCR reserves.

1. All feral animal control will be humane and target specific
2. An approved shooting operations plan using the standard format will be prepared for all planned shooting programs
3. Shooting will only be undertaken by shooters who are licensed, accredited by the NSW Firearms Safety Awareness Council and have successfully completed the NPWS Firearms Accreditation Level 2
4. Planned shooting programs will not occur during school holidays, public holidays or on Friday or Saturday nights unless the shooting supervisor is satisfied that the relevant sections of the park can be closed to visitors and all potential safety issues can be addressed
5. Police will be contacted by the shooting supervisor prior to each shooting operation.
6. Park neighbours in the immediate vicinity will be notified at the commencement of each planned shooting programs. Police will be notified by the shooters at completion of each shooting operation.
7. Operational briefings on procedures and target areas will occur prior to the commencement of each planned shooting program and there will be regular meetings between the shooting supervisor and shooters during the program
8. A person qualified in first aid will be present in each shooting team
9. Every person participating in chemical control (baiting) operations will be trained and competent in the use of relevant chemicals and methods
10. The program supervisor will comply with requirements for proper record keeping and the provisions of the NPWS Pesticide Use Notification Plan
11. All shooting will comply with the provisions of the NPWS Firearms Policy
12. A Job Safety Analysis will be prepared and a Job Safety Briefing will be conducted by the program supervisor at the commencement of each shooting program and at regular intervals over the program period
13. Following feral animal control, staff and contractors will complete and lodge report forms to Regional PMO for updating of FeralBASE.

The following operational guidelines and conditions will be applied to all weed control programs on SCR reserves.

1. A Job Safety Analysis will be prepared for each weed control program
2. A Job Safety Briefing will be conducted by the program supervisor at the commencement of each weed control program and at regular intervals over the program period
3. Every person participating in weed control operations will be trained and competent in the use of relevant chemicals and methods
4. The program supervisor will comply with requirements for proper record keeping and the provisions of the NPWS Pesticide Use Notification Plan
5. Following weed treatment staff and contractors will complete and lodge weed treatment forms to the Regional Pest Management Officer for updating of WeediBASE

Glossary

AA	Aboriginal Area
APZ	Asset Protection Zone
BTRW	Brush-tailed Rock-wallaby
CMA	Catchment Management Authority
DECC	Department of Environment and Climate Change
DPI	Department of Primary Industries
EEC	Endangered Ecological Community
ESFM	Ecologically Sustainable Forest Management
LGA	Local Government Area
NP	National Park
NPWS	National Parks and Wildlife Service (a part of the Department of Environment and Climate Change)
NR	Nature Reserve
RLPB	Rural Lands Protection Board
ROTAP	Rare or Threatened Australian Plants
RP	Regional Park
SCA	State Conservation Area
SCR	South Coast Region
SFAZ	Strategic Fire Advantage Zone
TAP	Threat Abatement Plan

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List of Noxious Weeds

NOXIOUS WEEDS ACT 1993
WEED CONTROL ORDER No. 20
Order declaring certain plants to be noxious weeds
I, IAN MACDONALD MLC, Minister for Primary Industries, pursuant to sections 7 and 8 of the Noxious Weeds Act 1993, hereby:
revoke all orders made pursuant to section 7 and 8 of the Act and any order revived as a result of this revocation;
declare the plants listed in column 1 of Schedules 1, 2, 3, 4 and 5, and alternatively described in columns 2 and 3 of those Schedules, to be noxious weeds;
3. apply the following weed control classes to these plants:
a. A weed control class of 1 is applied to all plants listed in Schedule 1;
b. A weed control class of 2 is applied to all plants listed in Schedule 2;
c. A weed control class of 3 is applied to all plants listed in Schedule 3;
d. A weed control class of 4 is applied to all plants listed in Schedule 4;
e. A weed control class of 5 is applied to all plants listed in Schedule 5;
specify that, in respect of each plant listed in column 1 of Schedules 1, 2, 3, 4 and 5, the land to which the order applies in respect of each such plant is that land described in column 4 of those Schedules opposite the relevant entry in column 1;
specify that, in respect of each plant listed in column 1 of Schedules 1, 2, 3, 4 and 5, the control measures that are to be applied to each such plant are as described in column 5 of those Schedules opposite the relevant entry in column 1;
6. specify the control objectives for the plants as follows:
a. the control objective for weed control class 1 is to prevent the introduction and establishment of those plants in NSW.
b. the control objective for weed control class 2 is to prevent the introduction and establishment of those plants in parts of NSW.
c. the control objective for weed control class 3 is to reduce the area and the negative impact of those plants in parts of NSW.
d. the control objective for weed control class 4 is to minimise the negative impact of those plants on the economy, community or environment of NSW.
e. the control objective for weed control class 5 is to prevent the introduction of those plants into NSW, the spread of those plants within NSW or from NSW to another jurisdiction.

This order commences on 1 September 2006 and will remain in force for a period of five years unless otherwise amended or revoked.
Dated this 30th day of August 2006.
IAN MACDONALD, M.L.C., Minister for Primary Industries

Schedule 1 – Class 1 Noxious Weeds
Throughout NSW, these plants must be eradicated from the land and the land must be kept free of the plant

Common name	Scientific name
Anchored Water Hyacinth	*Eichhornia azurea*
Black Knapweed	*Centaurea nigra*
Broomrapes	*Orobanche* species except the native *O. cernua var. australiana* and *O. minor*
Chinese Violet	*Asystasia gangetica* subspecies *micrantha*
East Indian Hygrophila	*Hygrophila polysperma*
Eurasian Water Milfoil	*Myriophyllum spicatum*
Hawkweed	*Hieracium* species
Horsetail	*Equisetum* species
Hymenachne	*Hymenachne amplexicaulis*
Karoo Thorn	*Acacia karroo*
Kochia	*Bassia scoparia* except *B. scoparia* subspecies *trichophylla*
Lagarosiphon	*Lagarosiphon major*
Mexican Feather Grass	*Nassella tenuissima*
Miconia	*Miconia* species
Mimosa	*Mimosa pigra*
Parthenium Weed	*Parthenium hysterophorus*
Pond Apple	*Annona glabra*
Prickly Acacia	*Acacia nilotica*
Rubbervine	*Cryptostegia grandiflora*
Senegal Tea Plant	*Gymnocoronis spilanthoides*
Siam Weed	*Chromolaena odorata*
Spotted Knapweed	*Centaurea maculosa*
Water Caltrop	*Trapa* species
Water Lettuce	*Pistia stratiotes*
Water Soldier	*Stratiotes aloides*
Witchweed	*Striga* species except native species and *Striga parviflora*
Yellow Burrhead	*Limnocharis flava*

Schedule 2 - Class 2 Noxious Weeds
The plant must be eradicated from the land and the land must be kept free of the plant

Common name	Scientific name	Area
Alligator Weed	*Alternanthera philoxeroides*	Goulburn Mulwaree Council, The Council of the Municipality of Kiama, Palerang Council, Shellharbour CC, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Cape Broom	*Genista monspessulana*	Eurobodalla SC
Gorse	*Ulex europaeus*	Eurobodalla SC
Mesquite	*Prosopis species*	Upper Lachlan SC
Parkinsonia	*Parkinsonia aculeata*	Upper Lachlan SC
Salvinia	*Salvinia molesta*	Whole of NSW except the local control areas listed in Class 3 for this species
Water Hyacinth	*Eichhornia crassipes*	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Upper Lachlan SC, Wingecarribee SC

Schedule 3 – Class 3 Noxious Weeds
The plant must be fully and continuously suppressed and destroyed

Common name	Scientific name	Area
Giant Parramatta Grass	*Sporobolus fertilis*	Eurobodalla SC, Shellharbour CC, Shoalhaven CC
Gorse	*Ulex europaeus*	Goulburn Mulwaree Council, Palerang Council, Shellharbour CC, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Green Cestrum	*Cestrum parqui*	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Groundsel Bush	*Baccharis halimifolia*	Eurobodalla SC, Shellharbour CC, Shoalhaven CC
Lantana	*Lantana* species	Eurobodalla SC
Mysore Thorn	*Caesalpinia decapetala*	Shellharbour CC
St. John's Wort	*Hypericum perforatum*	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Shellharbour CC, Shoalhaven CC
Water Hyacinth	*Eichhornia crassipes*	The Council of the Municipality of Kiama, Shellharbour CC, Shoalhaven CC

Schedule 4 – Class 4 Noxious Weeds
The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority

Common name	Scientific name	Area
African Boxthorn	*Lycium ferocissimum*	Eurobodalla SC, The Council of the Municipality of Kiama, Palerang Council, Shellharbour CC, Shoalhaven CC, Upper Lachlan SC
African Lovegrass	*Eragrostis curvula*	Eurobodalla SC, Goulburn Mulwaree Council, The Council of the Municipality of Kiama, Palerang Council, Shellharbour CC, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Bathurst/ Noogoora/ Californian/ Cockle burrs	*Xanthium* species	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Bitou Bush	*Chrysanthemoides monilifera* subspecies *rotundata*	Eurobodalla SC, The Council of the Municipality of Kiama, Shellharbour CC, Shoalhaven CC
Blackberry	*Rubus fruticosus aggregate* species except cultivars	Whole of NSW
Boneseed	*Chrysanthemoides monilifera* subspecies *monilifera*	Eurobodalla SC, The Council of the Municipality of Kiama, Shellharbour CC, Shoalhaven CC
Chilean Needle grass	*Nassella neesiana*	Whole of NSW except the local control areas listed in Class 3 for this species
Columbus Grass	*Sorghum x almum*	Upper Lachlan SC
Crofton Weed	*Ageratina adenophora*	Shoalhaven CC
Fireweed	*Senecio madagascariensis*	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Golden Dodder	*Cuscuta campestris*	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Shellharbour CC, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Harrisia Cactus	*Harrisia* species	Whole of NSW
Hemlock	*Conium maculatum*	Eurobodalla SC, Palerang Council, Upper Lachlan SC, Wingecarribee SC
Horehound	*Marrubium vulgare*	Palerang Council
Johnson Grass	*Sorghum halepense*	Upper Lachlan SC

Lantana	*Lantana* species	Shellharbour CC, Shoalhaven CC
Mistflower	*Ageratina riparia*	Shoalhaven CC
Nodding Thistle	*Carduus nutans*	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Pampas Grass	*Cortaderia* species	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Shellharbour CC, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Paterson's Curse, Vipers Bugloss, Italian Bugloss	*Echium* species	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Upper Lachlan SC, Wingecarribee SC
Prickly Pear	*Cylindropuntia* species	Whole of NSW
Prickly Pear	*Opuntia* species except *O. ficus-indica*	Whole of NSW
Privet (Broadleaf)	*Ligustrum lucidum*	Shoalhaven CC
Privet (Narrow-leaf/Chinese)	*Ligustrum sinense*	Shoalhaven CC
Rhus Tree	*Toxicodendron succedaneum*	Whole of NSW
Scotch Broom/English Broom	*Cytisus scoparius*	Eurobodalla SC, Goulburn Mulwaree Council, The Council of the Municipality of Kiama, Palerang Council, Shellharbour CC, Shoalhaven CC, Upper Lachlan SC, Wingecarribee SC
Scotch Thistle, Stemless Thistle, Illyrian Thistle, Taurian Thistle	*Onopordum* species	Eurobodalla SC, Goulburn Mulwaree Council, Palerang Council, Upper Lachlan SC, Wingecarribee SC
Serrated Tussock	*Nassella trichotoma*	Whole of NSW
Sifton Bush	*Cassinia arcuata*	Goulburn Mulwaree Council, Upper Lachlan SC, Wingecarribee SC,
Spanish Broom	*Spartium junceum*	Eurobodalla SC
St. John's Wort	*Hypericum perforatum*	Upper Lachlan SC, Wingecarribee SC
Sweet Briar	*Rosa rubiginosa*	Goulburn Mulwaree Council, Palerang Council, Upper Lachlan SC
Wild Radish	*Raphanus raphanistrum*	Goulburn Mulwaree Council

Schedule 5 - Class 5 Noxious Weeds
Throughout NSW, the requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with

Common name	Scientific name
African Feather Grass	*Pennisetum macrourum*
African Turnip Weed	*Sisymbrium runcinatum*
African Turnip Weed	*Sisymbrium thellungii*
Annual Ragweed	*Ambrosia artemisiifolia*
Arrowhead	*Sagittaria montevidensis*
Artichoke Thistle	*Cynara cardunculus*
Athel Tree/Athel Pine	*Tamarix aphylla*
Bear-skin Fescue	*Festuca gautieri*
Bridal Creeper	*Myrsiphyllum asparagoides*
Burr Ragweed	*Ambrosia confertiflora*
Cabomba	*Cabomba caroliniana*
Cayenne Snakeweed	*Stachytarpheta cayennensis*
Clockweed	*Gaura lindheimeri*
Clockweed	*Gaura parviflora*
Corn Sowthistle	*Sonchus arvensis*
Dodder	All *Cuscuta* species except the native species *C. australis, C. tasmanica* and *C. victoriana*
Espartillo	*Achnatherum brachychaetum*
Fine-bristled Burr grass	*Cenchrus brownii*
Fountain Grass	*Pennisetum setaceum*
Gallon's Curse	*Cenchrus biflorus*
Glaucous Star Thistle	*Carthamus glaucus*
Golden Thistle	*Scolymus hispanicus*
Lantana	*Lantana* species
Long-leaf Willow Primrose	*Ludwigia longifolia*
Mexican Poppy	*Argemone mexicana*
Mossman River Grass	*Cenchrus echinatus*
Onion Grass	All *Romulea* species and varieties except *R. rosea var. australis*
Oxalis	All *Oxalis* species and varieties except the native species *O. chnoodes, O. exilis, O. perennans, O. radicosa, O. rubens,* and *O. thompsoniae*
Red Rice	*Oryza rufipogon*

Sagittaria	*Sagittaria platyphylla*
Sand Oat	*Avena strigosa*
Smooth-stemmed Turnip	*Brassica barrelieri* subspecies *oxyrrhina*
Soldier Thistle	*Picnomon acarna*
Texas Blueweed	*Helianthus ciliaris*
Willows	*Salix* species except *S. babylonica, S. x reichardtii, S. x calodendron*
Yellow Nutgrass	*Cyperus esculentus*

Authorised to be printed
ISSN 0155-6320 ROBERT J. GALLAGHER, Government Printer.

SCR pest management plans

There are a number of current plans that guide pest management on reserves in SCR. This list changes regularly and does not include many other strategies, recovery and threat abatement plans in use in this Region.

Protecting our National Parks from Pests and Weeds, DECC 2006 is a corporate level plan that guides development of Regional level pest and weed management plans. The South Coast Region Operations Plan 2007/2008 is an annual plan that identifies corporate level actions and how they will be implemented in SCR.

The following current Area and reserve level planning documents describe in detail the on-ground works required to implement Regional objectives:

Bomaderry Creek Regional Park Weed Management Plan

Budderoo NP (Minnamurra rainforest and Budderoo plateau) Weed Management Strategy

Budderoo NP (Kelly's Cottage Precinct) Weed Management Strategy

Colymea SCA, Bamarang NR and Wogamia NR Weed Management Plan

Comerong Island NR Weed Management Plan

Cullendulla Creek NR Weed Management Strategy

Morton NP Heritage and Weed Management Assessment (Timealong Precinct)

Morton NP (Shoalhaven River Corridor) Weed Management Plan

Jervis Bay NP and Woollamia NR Weed Management Plan

Murramarang AA and Brush Island NR Weed Management Strategy

Tarlo River NP Weed Management Strategy

Seven Mile Beach Weed Management Plan

Nadgigomar NR Weed Management Strategy

Weed Surveys, Pre-treatment, Monitoring and Prioritising 2002-2003 in NPWS reserves of the Highlands Area