Office of Environment & Heritage
NSW National Parks & Wildlife Service

Draft Regional Pest Management Strategy

Part A: 2012-2015








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The New South Wales National Parks and Wildlife Service (NPWS) is part of the Office of Environment and Heritage (OEH). Throughout this strategy, references to NPWS should be taken to mean the NPWS carrying out functions on behalf of the Director General of the Department of Premier and Cabinet, and the Minister for the Environment.

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Executive summary

The vision for the NPWS Regional Pest Management Strategies is to minimise adverse impacts of pests on biodiversity, protected areas and the community. The strategies achieve this through identifying and focusing on the highest priority programs, ensuring that actions are achievable and delivering measurable outcomes. The Regional Pest Management Strategies are divided into Part A and Part B. This Part A provides the broader planning framework for the management of pests by NPWS. Part B describes the local circumstances within each NPWS Region and applies the Part A framework to prioritise specific management programs.

Pest species are animals, invertebrates and plants that have negative environmental, economic and social impacts. Pests are among the greatest threats to biodiversity throughout Australia. The NSW Invasive Species Plan provides the framework for the coordinated management of pests that occur over varying land tenure. NPWS is responsible for the management of pests on NPWS estate and is a committed partner to the implementation of the Invasive Species Plan.

Pest management actions can be broadly encompassed under one of four categories: prevention, eradication, containment and asset-based protection. These four categories typically correspond to an increase in the spatial distribution of a pest through time. Prevention, eradication and containment relate to pest-led programs, while asset protection relates to site-led programs. Distinguishing between pest-led and site-led programs keeps the focus on why resources are being allocated to manage pests.

The Regional Pest Management Strategies are based on seven principles: 1. Prevention is better than cure; 2. Evidence-based decision making and risk assessments should feature in pest program development; 3. Widespread pest programs should adopt an asset-based management approach; 4. Pest Management should take an integrated approach; 5. Outcomes of pest programs must be clear, demonstrable and measurable; 6. Pest Management requires on-going effort; and 7. A partnership approach should be applied.

Taking these principles into account, the Regional Pest Management Strategies have three broad goals, each with a series of objectives and actions. These three goals are to: 1. Eradicate or contain - Eliminate or prevent the spread of new species; 2. Effectively manage - Reduce the impacts of widespread species; 3. Capacity - Ensure NPWS has the commitment and ability to manage pests.

Ongoing monitoring and evaluation of pest control programs is critical in determining the effectiveness of management and providing information to enable programs to be continually adapted and improved to achieve the defined objectives. Monitoring, evaluation, reporting and implementation are the four components of adaptive management. Adaptive management is a systematic approach that implements, learns and adapts management actions in order to achieve the best possible outcomes.

The broader planning framework for the management of pests by NPWS outlined in this Part A of the Regional Pest Management Strategies has been applied to each of the 14 NPWS regions to produce a regionally specific Part B, which contains the specific prioritised management programs for the region.

Acronyms

The following acronyms are used throughout this document.

Acronym	Expanded Text
AMS	Asset Maintenance System
BPWW	Biodiversity Priorities for Widespread Weeds
CAP	Catchment Action Plan
CMA	Catchment Management Authority
DECCW	NSW Department of Environment, Climate Change & Water
KPI	Key Performance Indicator
KTP	Key Threatening Process under the TSC Act
MER	Natural Resource Management Monitoring, Evaluation and Reporting
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	NSW National Parks and Wildlife Service
NRM	Natural Resource Management
NSW	New South Wales
OEH	Office of Environment and Heritage
PAS	Priorities Action Statement
PMP	Park Management Program
POM	Plan of Management
PWG	Parks and Wildlife Group, the internal name within OEH for NPWS
PWIS	Pest and Weed Information System
RLP Act	*Rural Lands Protection Act 1998*
ROP	Regional Operations Plan
RPMS	Regional Pest Management Strategy
SOP	Standard Operating Procedure
TAP	Threat Abatement Plan
TSC Act	*Threatened Species Conservation Act 1995*

1. Vision

The vision of the NSW Invasive Species Plan is that “the environment, economy and community of NSW are protected from the adverse impacts of invasive species”. Goal 1 of the NPWS Strategic Plan states that there will be a reduction in the impacts of invasive species.

The vision for the Regional Pest Management Strategies (RPMSs) is to minimise adverse impacts of pests on biodiversity, protected areas and the community. The strategies achieve this through

- identifying and focusing on the highest priority programs,
- ensuring that actions are achievable and
- delivering measurable outcomes.

2. Structure and purpose of the strategy

The development of RPMSs provides the National Parks and Wildlife Service (NPWS) with a strategic approach to pest management in parks across NSW. The Regional Pest Management Strategies are divided into Part A and Part B.

Part A provides the broader planning framework for the management of pests by NPWS. It documents the corporate environment, legislation and policy context and describes the logic used for identifying, prioritising and monitoring pest management programs. It also establishes Service-wide pest management goals, objectives and actions

Part B describes the local circumstances within each NPWS Region and applies the Part A framework to prioritise specific pest management programs. These priorities will be included in Regional Operations Plans (ROPs) and implemented through the Asset Maintenance System (AMS). Part B for each Region also broadly identifies pest distribution and associated impacts across the Region.

These strategies have a four year life span. The progress of their implementation will be continuously monitored throughout that period.

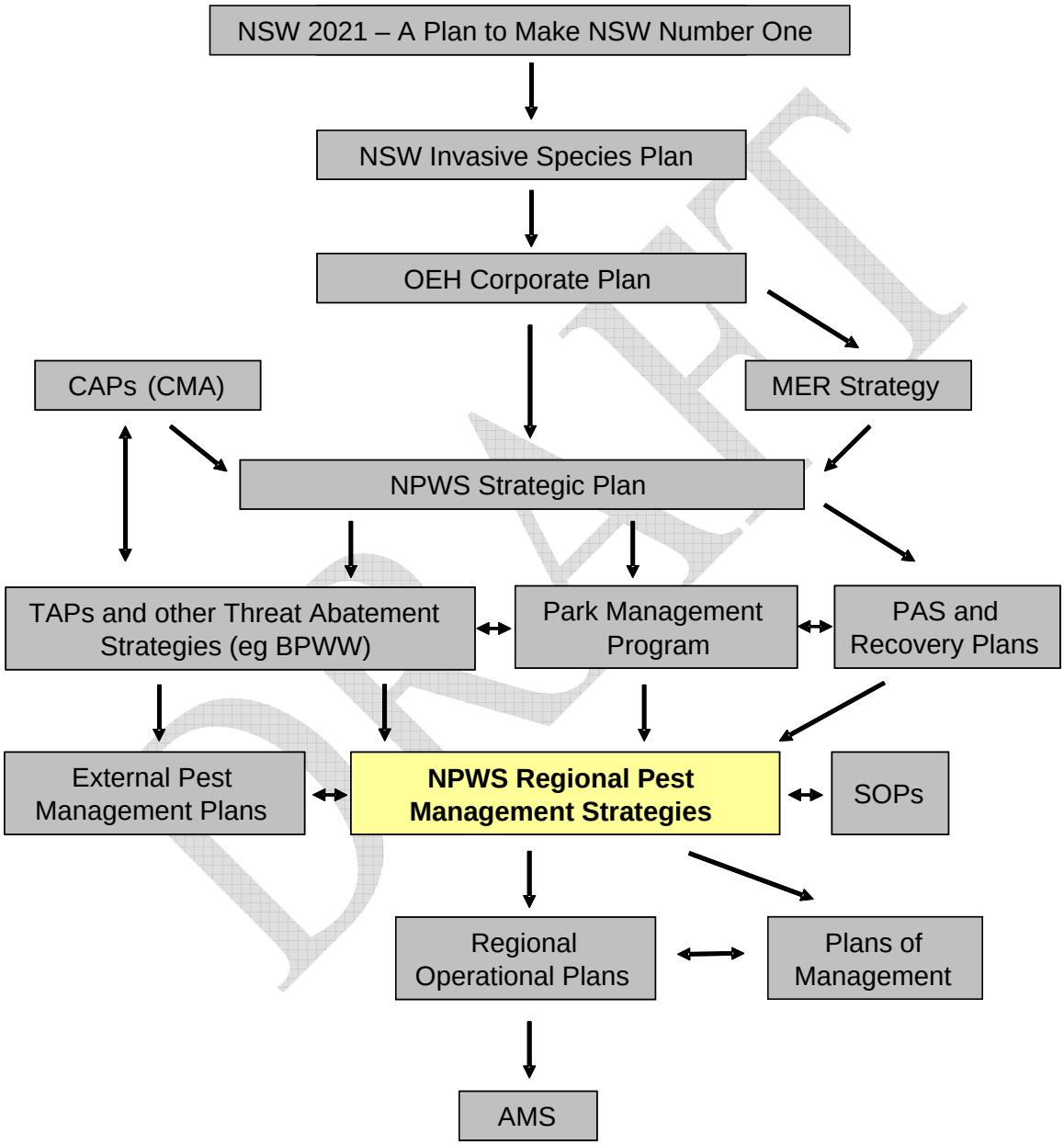
3. Introduction

Pest species are animals, invertebrates and plants that have negative environmental, economic and social impacts. In this document they are collectively referred to as pests. Pests are among the greatest threats to biodiversity throughout Australia.

NPWS currently manage over 850 national parks and reserves, nearly 9 percent of NSW. In this document, the generic term “parks” is used to refer to any lands managed by NPWS under *the National Parks and Wildlife Act 1974.* One of the major management challenges is reducing the impacts from introduced pests and invasive weed species on park values, including impacts on biodiversity, threatened species, endangered ecological communities, cultural and historic heritage, catchment and scenic values.

The control of pests outside of parks is the responsibility of private landholders and other agencies such as Livestock Health and Pest Authorities, local councils and the Department of Primary Industries. The NSW Invasive Species Plan provides the framework for the coordinated management of pests that occur over varying land tenure. NPWS is a committed partner to the implementation of this plan.

4. Context



4.1 State context

At the state level, pest management within the Office of Environment and Heritage (OEH) is guided by two core planning instruments: **NSW 2021 – A Plan to Make NSW Number One** which sets out broad performance goals, and the **NSW Invasive Species Plan** which provides specific goals, objectives and actions in relation to Invasive Species management.

4.2 Corporate environment

OEH Corporate Plan

Working within *NSW 2021 - A Plan to Make NSW Number One* the Office of Environment and Heritage Corporate Plan *(DECCW 2010)* primarily addresses the *Strengthen Our Local Environment and Communities* strategy. For pest management on parks, *Goal 22 Protect Our Natural Environment* has the target to *reduce the impact of invasive species at priority sites on NPWS parks and reserves leading to a positive response of native biodiversity at 50% of these sites by October 2015 (Protect and Restore Priority Land, Vegetation and Water Habitats*: *Manage Weeds and Pests)*. This target has the priority action to *address core pest control in National Parks through the delivery of NPWS Regional Pest Management Strategies and improve educational programs and visitor access*. The OEH Corporate Plan relevant goal is "integrated landscape management for long-term ecological, social and economic sustainability*"* with the objective that "*fire, pest animals and weeds are managed in cooperation with neighbours and other agencies to protect parks and neighbouring lands"*. The Departmental priority is to "*prepare, implement and monitor regional strategies for managing cultural heritage, pests and weeds and fire in parks and reserves"*. Also working within *Goal 22 Protect Our Natural Environment*, the *NSW Invasive Species Plan 2008-2015* provides a framework for the coordinated and cooperative management of invasive species aiming to prevent new incursions, contain existing populations and adaptively manage already widespread species.

Parks and Wildlife Group Strategic Plan

The *Parks and Wildlife Group Strategic Plan* key strategies to achieve the Corporate and State priorities, goals and objectives are:

- Work across land tenures with land managers and landholders to manage threats to biodiversity and native vegetation, including minimising the impacts of pests and weeds;
- Implement actions under the Threatened Species Priorities Action Statement (PAS) to promote the recovery of threatened species, populations and ecological communities and manage Key Threatening Processes (KTPs), including but not limited to identifying PAS actions for inclusion in ROPs;
- Continue to implement and monitor effectiveness of Threat Abatement Plans (TAPs);
- Contribute to research to improve our understanding of the interactions between climate change, native biodiversity and the distribution of pests and weeds; and
- Lead the development and implementation of the NSW Invasive Species Plan and Natural Resource Management Monitoring, Evaluation and Reporting (MER) Strategy as they relate to biodiversity conservation.

Regional Operations Plans

Directly linked to the *Parks and Wildlife Group Strategic Plan, Regional Operational Plans* aim to standardise and align planning throughout Parks and Wildlife Group. The approach consolidates strategies and actions contained in other planning instruments (including the Regional Pest Management Strategy) and is reviewed and updated annually. These plans then set the priorities for work within the PWG Region.

4.3 Legislation

The NPWS has a number of statutory responsibilities in relation to pest management. A list of Acts administered by OEH can be found at: www.environment.nsw.gov.au/legislation

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) vests the care, control and management of national parks, nature reserves, historic sites and Aboriginal areas with the Director-General of the NPWS. The intent of the NPW Act is the conservation of the State's natural and cultural heritage; and fostering public appreciation, understanding and enjoyment of the State's natural and cultural heritage. Plans of management for each reserve must be prepared and implemented under the Act and must consider the protection of park values, including the identification and mitigation of threatening processes such as pests

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) lists threatened species, endangered populations and endangered ecological communities. The *TSC Act* also lists Key Threatening Processes (KTPs), which are identified as having significant impacts on the conservation of native flora and fauna. As of July 2011, 25 pests have been listed as KTPs e.g. *Predation by the Red Fox*, *Invasion of Native Plant Communities by Bitou Bush and Boneseed*. The 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) declared 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.

Under the *Noxious Weeds Act 1993*, weeds are classified 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.

Pesticides Act 1999

The *Pesticides Act 1999* regulates 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 2009 in relation to the following.

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

Pesticides Training: People who use pesticides in their business or as part of their occupation must be trained how to use these pesticides. Any person employed or engaged 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 .

Other relevant legislation

- Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
- Agricultural and Veterinary Chemicals (New South Wales) 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
- Fisheries Management Act 1994
- Western Lands Act 1901

A full list of NSW legislation can be found at : www.legislation.nsw.gov.au

4.4 Park Management Program

The Park Management Program (PMP) was developed by Parks and Wildlife Group in 2004. The PMP aims to coordinate different initiatives and work towards ensuring head office programs are communicating efficiently: between themselves; with the field; and with the Parks and Wildlife Directors Group. In particular, the PMP currently has a strong focus on

delivering for parks and regions to help plan and execute programs through their Regional Operational Plans (ROPs).

The PMP contains guides on Policy, Planning, Operating Procedures, and Monitoring and Evaluation, and comprises a number of statewide strategic projects relating to the management of pests, including the following.

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

The OEH 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 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 Assessment for the application of pesticides on park to ensure that an appropriate level of environmental assessment is carried out prior to application.

Other plans

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

5. Issues, challenges and risks

There is a very large number of pest species in NSW and the number of introduced species becoming established in the natural environment is increasing continually, with around 10 new species being identified each year. They are distributed widely across Australia and many species are increasing in distribution. Pest populations usually have high reproductive capability, and can both colonise new areas rapidly, and recover quickly after control.

This situation is further complicated by environmental changes, including those associated with climate change, which may affect the ability of pest species to grow and reproduce in different areas. In addition, new pest species are continually arising, and it is essential to be able to respond to this. A particular threat is posed by new introduced pathogens, which may require particular and focussed management and hygiene.

The NSW Invasive Species Plan succinctly outlines the key challenges relating to pest management in NSW. These challenges are also relevant to pest management in parks:

- To have the knowledge, skills, resources and systems to address the impact of pests;

- To manage or control widespread pests to reduce their impact where benefits of control are greatest;
- To develop and deploy effective and efficient ways to eradicate or contain a pest before it becomes widespread; and
- To identify potential new pests to the region and parks, thoroughly assess potential invasiveness and implement effective barriers to prevent their establishment.

As indicated in the OEH Corporate Plan and the NSW Invasive Species Plan, potential climate change creates uncertainty when considering the future distribution and abundance of pest species. In order to plan for effective future management of pest species in parks, the interaction between climate change and pest species distribution requires further research.

While NPWS is responsible for pest management on parks, cooperative and landscape scale management is a feature of many NPWS pest programs. In order for this to succeed there is a requirement for excellent relationships with the local community, neighbours, other land management agencies and regulatory authorities. These relationships are influenced by many factors regarding parks management such as bushfire management, recreational management and the history of land use in the area. The challenge is to continue to improve on local community and government agency relationships in order to facilitate the coordination of pest management over the landscape.

6. Pest management logic

6.1 NSW Invasive Species Plan

The NSW Invasive Species Plan reiterates that the most effective way to manage pests is to prevent their initial incursion. Many pests have the ability to establish rapidly in new areas and new incursions require a timely and rapid response. However, many pests are already widely established in New South Wales, and their eradication across large areas is not achievable with existing resources. Priorities for the control of these species must be rigorously determined, and resources focused on areas where the benefits of control will be greatest.

The NSW Invasive Species Plan identifies the above and lists four goals:

Goal 1: Exclude - prevent the establishment of new pests.

Goal 2: Eradicate or contain - eliminate, or prevent the spread of new pests.

Goal 3: Effectively manage - reduce the impacts of widespread pests.

Goal 4: Capacity building - ensure NSW has the ability and commitment to manage pests.

Pest management actions (under Goals 1 to 3) can be broadly encompassed under one of four categories: prevention, eradication, containment and asset-based protection (Figure 1). These four categories typically correspond to an increase in the spatial distribution of a pest through time. Prevention, eradication and containment relate to pest-led programs, while asset protection relates to site-led programs. Distinguishing between pest-led and site-led programs keeps the focus on why resources are being allocated to manage pests.

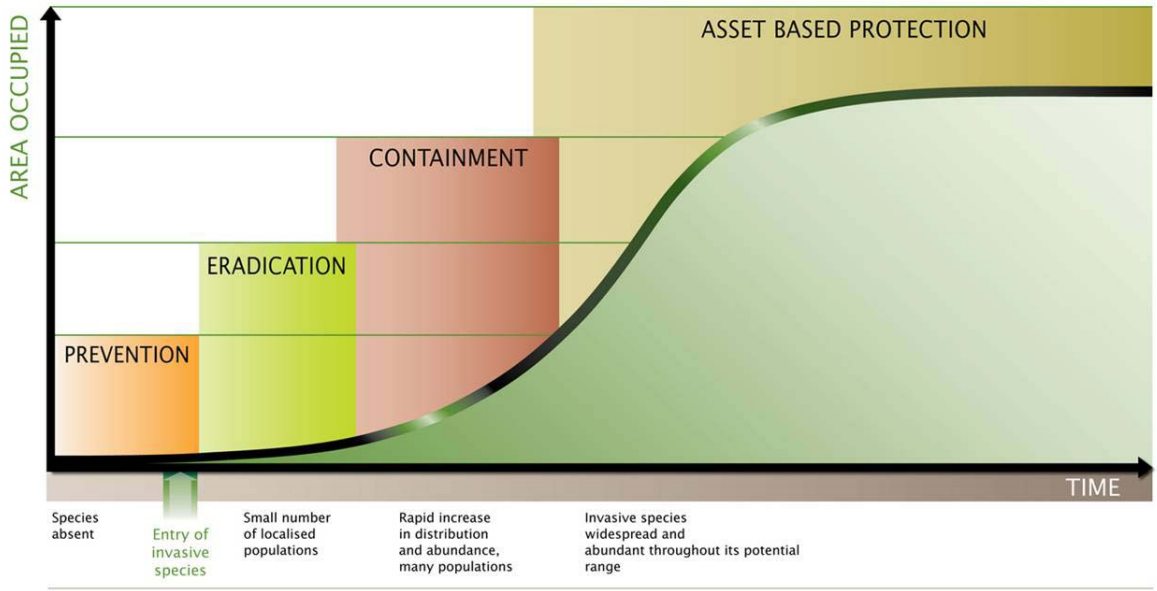


Figure 1 **Generalised invasion curve showing actions appropriate to each stage (DPI Victoria 2009).**

A pest-led program is one which aims to control a new pest that has the potential to greatly increase in numbers, distribution and level of impact. Pest-led programs are proactive approaches to minimise future risks.

A site-led program focuses on specific areas and what is required to protect the values or assets of those places. This asset based approach is usually for widespread pests and programs are defined by what is needed to protect values or assets at specific high priority locations.

6.2 Principles

Principle 1: Prevention is better than cure.

New pest species continue to establish in the natural environment either through the importation of new species into Australia or the escape and establishment of domestic plants and animals. Prevention of both the introduction and spread of pests is a critical priority as it is the most effective means of reducing the impact and cost of management in most instances. Early detection and intervention can thus present an opportunity for total eradication. This principle means that important work may well be done at locations that are currently relatively free of pests and can be given higher protection against invasion with relative ease. It also underlines the importance of investment in surveillance, hygiene, early detection and rapid response mechanisms. The NPWS works in partnership with other agencies to detect and prevent the introduction of new pests into the natural environment and to respond rapidly when new incursions occur.

Principle 2: Evidence-based decision-making and risk assessments should feature in pest program development.

Evidence-based decision-making must be the basis for pest management. It is important to demonstrate that planning and prioritisation is based on the best available scientific and technical information. In addition, risk assessments should be conducted prior to pest control. For example, identification of pests for eradication should be based on an analysis of feasibility of control and risk of impact. Where a high-risk species cannot be eradicated, there can be substantial net benefit gained from containing further spread.

Principle 3: Widespread pest programs should adopt an asset-based risk management approach.

The aim of most pest control programs is to minimise the adverse impacts of widespread pests for which eradication is not possible. Therefore, a site-led approach should be used for widespread species and management should be targeted to sites where benefits will be greatest. Prioritisation should be based on maintaining important assets and optimising outcomes for asset protection and management. In the case of natural and cultural heritage, they should be ranked by their conservation significance. For example, where two ecosystems have similar conservation value, generally intact ecosystems should have priority for management over degraded ecosystems. Similarly ecosystems at higher risk of impact should have priority over those at lower risk.

Principle 4: Pest management should take an integrated approach

Integrated pest management (where more than one control technique is used) is likely to be more effective as it avoids herbicide resistant weeds or bait-shy animals. Furthermore, targeting more than one pest is often important as the control of one species may benefit another.

Principle 5: Outcomes of pest programs must be clear, demonstrable and measurable.

Setting of clear management objectives is vital for planning, monitoring, evaluation and reporting. Monitoring should be implemented, at appropriate levels, to demonstrate and improve the ongoing effectiveness of control programs. Control programs should be based on an adaptive management approach to ensure continuous development and improvement based on a framework incorporating monitoring, evaluation, feedback and change.

Principle 6: Pest management requires on-going effort

For most pests, localised one-off or low frequency control is likely to be ineffective due to the rapid reinvasion or reestablishment of the pest. Therefore, ongoing effort will usually be required for long-term success. Planning for pest programs should consider a realistic assessment of the capacity to maintain adequate effort over the long-term.

Principle 7: A partnership approach should be applied

NPWS is responsible for pest management on parks in NSW. However, pests occur and move across the landscape irrespective of tenure boundaries. Therefore, to be most effective pest management should be collaborative and coordinated across the landscape.

6.3 Goals, objectives and actions

The Goals of these Strategies follow the structure of the relevant goals of the NSW Invasive Species Plan.

Goal 1 Eradicate or contain. Eliminate or prevent the spread of new pest species.

- Objective 1.1: timely detection and response to new incursions
    - Action: Increase the capacity of staff, volunteers and visitors to recognise, detect and report new incursions
        - KPI: Number of recognition workshops that the region has been involved in and alerts circulated to staff and volunteers.
    - Action: Increase capacity to respond rapidly to eradicate or contain
        - KPI: Number of cooperative networks to detect and respond to new incursions that the Region participates in and number of new incursions detected
    - Action: Eradicate or contain new incursions
        - KPI: Number of new incursions eradicated or contained

Goal 2 Effectively manage. Reduce the impacts of widespread pests

- Objective 2.1: identification and prioritisation of management programs where benefits are greatest
    - Action: Use a risk based approach to prioritise management programs based on the impacts and feasibility of control
        - KPI: Tables of programs in RPMS are prioritised using a risk based approach
    - Action: Implement actions to promote the recovery of threatened species, populations and ecological communities and manage key threatening processes related to the impacts of pests (e.g. TAPs, BPWW, PAS)
        - KPI: Number of programs in AMS with completed work orders.
- Objective 2.2: effective and targeted on-ground control
    - Action: Integrate the Regional Pest Management Strategy actions with Regional Operational Plans and Plans of Management
        - KPI: Number of ROPs and POMs including RPMS programs
    - Action: Implement pest management programs as guided by objective 2.1
        - KPI: All implemented pest management programs are from the RPMS
    - Action: Implement and improve established best practice guidelines and Standard Operating Procedures
        - KPI: All programs comply to best practice guidelines and SOPs for the humane destruction of feral animals.
    - Action: Support cooperative planning and operations that use integrated management across tenures.

        - KPI: Number of cooperative programs

Goal 3 Capacity. Ensure NPWS has the commitment and ability to manage pests

- Objective 3.1: commitment to manage identified high priorities
    - Action: Adequately resource priority pest management programs
        - KPI: Proportion of RPMS programs in ROPs
- Objective 3.2: increased community acceptance of and involvement in effective pest management
    - Action: Develop and implement targeted communication to increase community awareness and involvement in pest management
        - KPI: number of community awareness programs participated in
    - Action: Maintain and build on existing volunteer participation
        - KPI: number of volunteer hours
    - Action: Identify further opportunities for community involvement
        - KPI: number of new programs applied and/or achieved
- Objective 3.3: skilled workforce implementing pest management
    - Action: Ensure staff and volunteers involved in pest management are adequately trained
        - KPI: All staff and volunteers adequately trained
- Objective 3.4: ability to measure the effectiveness of pest management
    - Action: Improve capacity to record pest management programs
        - KPI: all pest programs included in AMS
    - Action: improve mapping of pest distribution and abundance
        - KPI: spatial component of PWIS developed
    - Action: Monitor the effectiveness of management programs and adapt as required
        - KPI: Number of pest management programs including monitoring
    - Action: Integrate, evaluate and report State, regional and local monitoring information:
        - KPI: Integrated reporting system in place and used (AMS)

7. Pest program monitoring evaluation and reporting

Monitoring is necessary to evaluate the level of pest impacts, refine priorities for management and target pest control with greatest effect. Ongoing monitoring and evaluation of pest control programs is critical in determining the effectiveness of management and providing information to enable programs to be continually adapted and improved to achieve the defined objectives. Monitoring should allow reporting on

- Inputs
- Processes
- Outputs
- Outcomes

Monitoring may target pest impacts, response of biodiversity, pest distribution or abundance. Where the objective of pest control programs is to reduce the pest impact at a site in order to protect a particular asset, monitoring should include a measure of the response of the asset. Where the objective of the pest control program is to eradicate an incursion or contain its spread, monitoring should focus on the pest.

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, may be used to provide an indirect measure of effectiveness. For example, while fox control may benefit a broad range of native animals, monitoring may focus on a particular “indicator” species which may be easy to capture.

Measuring the response of biodiversity (or other values) 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 measured directly, monitoring is dependent on indirect measures of abundance. Rigorous attempts to measure population responses need to consider

- experimental design (e.g. treatment and non-treatment sites, replication and 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 may be expensive and should be targeted to a selected range of appropriate programs.

Monitoring the response of pest distribution and abundance may also be an important interim measure of effectiveness:

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

Where pest incursions have occurred recently, or where their distribution is otherwise limited, the objective of control is usually to eradicate the incursion or to contain its spread. In these situations, monitoring is required to confirm eradication or containment and should focus on the pest 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.

The PWG Draft Monitoring and Evaluation Guide provides information relating to monitoring techniques and standards for pest species and native flora and fauna. This guide can be found at http://deccnet/parkmgmt/resources/MEG11Aug10LR.pdf

Monitoring, evaluation, reporting and implementation are the four components of adaptive management. Adaptive management should be utilised wherever appropriate to do so, especially where there is uncertainty regarding whether a management action will achieve the desired pest management objective or techniques. Adaptive management is a systematic

approach that implements, learns and adapts management actions in order to achieve set objectives in an uncertain environment.