4

Protection of the natural and cultural heritage

4.1 What's in this chapter?

This chapter reports on the performance of management in protecting the natural and cultural heritage of the Tasmanian Wilderness World Heritage Area. Protection is taken to encompass identifying and taking appropriate action to avert or actively manage impacts, threats and risks so as to avoid the loss or degradation of the natural and cultural heritage and achieve ecologically sustainable management.

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At a glance…key findings of this chapter

Several identified damaging activities or practices that threatened the natural or cultural heritage of the TWWHA were halted or significantly reduced over the 1992–1999 period (see Section 4.5 'Cessation or reduction of damaging activities and practices').

Management of identified threats to the natural and cultural heritage of the TWWHA over the 1992–1999 period was associated with the following results:

Wildfires: There were no 'landscape-scale' fires over the 1992–1999 period and no significant built assets were lost (see Section 4.6 'Wildfires').

Plant diseases and dieback: There was evidence of incremental spread of root rot disease *Phytophthora cinnamomi* along some walking tracks within the TWWHA and a new high altitude dieback at Pine Lake on the Central Plateau caused localised losses in pencil pine communities. (See Section 4.7 'Plant diseases and dieback'.)

Weeds: Some weeds continued to expand their distributions in the TWWHA over the 1992–1999 period and two recent new weed invasions to the area (marram grass and sea spurge) pose a serious threat to the integrity of natural coastal ecosystems. (See Section 4.8 'Weeds and other introduced plants.)

Introduced animals: Feral goats were eradicated from the TWWHA; rabbits have probably been eradicated from the Strathgordon area; and starlings have virtually been eradicated from the breeding ground of the endangered orange-bellied parrot at Melaleuca. There was no known establishment of new introduced animal species in the TWWHA although the distributions of some introduced animals expanded over the period. (See Section 4.9 'Introduced animals'.)

Tourism and visitor activities and use:

RIVERBANK EROSION BY BOATS ON THE LOWER GORDON RIVER significantly decreased following the introduction of cruise boat access and speed restrictions (see Section 4.10.2 'Case study—Riverbank erosion on the lower Gordon River').

WALKER IMPACTS. Many walking tracks in the TWWHA continued to erode; unplanned tracks continued to develop; and backcountry campsites continued to expand and deteriorate, especially in alpine areas. Some alpine and montane plant communities were damaged as a result of walker impacts. However, a sound scientific base of knowledge has been established to guide management towards sustainable environmental management. (See Section 4.10.3 'Case study—Walker impacts'.)

HORSERIDING: Impacts caused by recreational horseriding on the Central Plateau decreased over the 1992–1999 period and the current low levels of recreational horse riding in the Central Plateau Conservation Area and on Patons Road are considered to be ecologically sustainable. (See Section 4.10.4 'Case study—Horseriding on the Central Plateau').

Development of new facilities and other infrastructure: Of the new or upgraded visitor facilities provided in the TWWHA, a small number of developments raised some issues of concern amongst natural and cultural heritage specialists on account of their impacts (see Section 4.11 'Development of new facilities and other infrastructure').

Coastal erosion resulted in the loss of a number of Aboriginal heritage sites on the southwest coast of Tasmania. However, a program of midden stabilisation resulted in the successful conservation of a number of large midden sites. (See Section 4.12 'Coastal erosion of Aboriginal heritage sites'.)

Regulation of the Gordon River's water flow by hydro-electric power generation operations has been associated with extensive ongoing erosion of downstream riverbanks, and degradation of the rare meromictic lakes adjacent to the lower Gordon River. Much of this degradation occurred prior to the 1992–1999 period. (See Section 4.14 'Regulation of river flows by hydroelectric power generating operations')

The Tasmanian public perceives the main threats to the TWWA to be too many visitors; commercial development, and environmental degradation (see Section 4.3.3 'Public perceptions of threats'.)

New or emerging threats to the natural and cultural heritage of the TWWHA include the potential establishment of foxes in Tasmania, the outbreak of Devil Facial Tumour Disease, and increasing levels of tourism and numbers of visitors to the TWWHA (see Section 4.3.2 'New or emerging threats').

4.2 What is the natural and cultural heritage of the TWWHA?

'Heritage is our legacy from the past, what we live with today, and what we pass on to future generations' (Department of the Environment and Heritage website <http://www.deh.gov.au/heritage/html>). What makes the concept of World Heritage exceptional is its universal application. World Heritage sites are deemed to be important to all the peoples of the world, irrespective of the territory in which they are located. It is the universal quality of world heritage sites, transcending national identifies, that makes the Tasmanian Wilderness World Heritage Area so important.

In 1982, the Tasmanian Wilderness World Heritage Area was inscribed on the World Heritage List for both its outstanding natural and cultural universal values. Of the 720 properties on the World Heritage List[25], the TWWHA satisfies the greatest number of criteria for listing of any property[26]. The criteria that were met for acceptance of the TWWHA on the World Heritage List are outlined below.

NATURAL CRITERIA

(i) Is an outstanding example representing the major stages of the earth's evolutionary history.

(ii) Is an outstanding example representing significant ongoing geological processes, biological evolution and humanity's interaction with the natural environment;

(iii) Contains superlative natural phenomena, formations or features, or areas of exceptional natural beauty; and

(iv) Contains the most important and significant natural habitats where threatened species of animals or plants of outstanding universal value still survive.

At the time of initial listing, the above four criteria represented all the criteria for natural heritage.[27]

CULTURAL CRITERIA

(iii) Bears a unique or at least exceptional testimony to a civilisation that has disappeared.

(v) Is an outstanding example of a traditional human settlement which is representative of a culture and which has become vulnerable under the impact of irreversible change; and

(vi) Is directly or tangibly associated with events or with ideas or beliefs of outstanding universal significance.

At the time of initial listing the above criteria represented three of the six criteria for cultural heritage.

In 1989, the TWWHA was expanded by 600,000ha under slightly modified criteria.

Whilst the World Heritage and other significant values of the Tasmanian Wilderness World Heritage Area have not been comprehensively defined to date, examples of the World Heritage values of the TWWHA that Department of the Environment and Heritage has identified as being associated with the criteria are presented in Appendix 5. A project is currently in progress (2003) to update the list of values for the TWWHA.

25 As at December 2001.

26 Mt Taishan in China also meets the same number of criteria.

27 The criteria for World Heritage listing have since been revised. For more information, see the UNESCO website <http://whc.unesco.org/>

4.3 What are the main threats to the natural and cultural heritage?

Key Desired Outcome addressed in this section:

KDO 3.1: Accurate and timely identification and assessment of threats or adverse impacts to the World Heritage and other natural and cultural values of the World Heritage Area.

4.3.1 Existing threats and pressures

Natural and cultural heritage specialists of the managing agency considered that the main threats and pressures that were either causing impacts or were posing an active threat of impact to the natural or cultural values of the TWWHA over the 1992–1999 period were:

- **Illegal activities**, especially the illegal cutting and removal of Huon pine and other valuable timbers; the illegal introduction of trout into trout-free lakes; arson and other unlawful lighting of fires; removal of mineral specimens, and unauthorised track cutting into remote areas.
- **Wildfires**, especially the risk of unmanageable 'landscape-scale fires' and peat fires.
- **Plant diseases and dieback**, especially the root rot disease *Phytophthora cinnamomi*, Pine Lake dieback, and cankers affecting *Diselma*.
- **Weeds**, especially marram grass, sea spurge, Spanish heath, gorse, ragwort, broom, blackberries, Canadian pond weed and holly;
- **Introduced animals**, especially established species including trout, starlings, goats, rabbits, wasps and bumblebees, as well as potential establishments of new introduced species (e.g. red fin perch, carp, Mesopotamia deer etc).
- **Tourism and visitor activities and use**, especially ecologically unsustainable levels or types of use.
- **Development of new facilities and other infrastructure**, especially inappropriate or inappropriately sited facilities and infrastructure which can cause direct and/or indirect impacts to the natural or cultural heritage.
- **Coastal erosion** of Aboriginal heritage sites.
- **Lack of maintenance or active conservation of historic heritage**.
- **Regulation of river flows** by hydroelectric power generating operations, which has been associated with unnatural erosion of lake and river banks, and degradation of the hydrologically significant meromictic lakes adjacent to the Gordon River.

Illegal activities are covered in Chapter 2, Section 2.5.2 'Law enforcement and compliance issues'. Each of the other threats listed above and their management over the 1992–1999 period are examined in the following sections of this chapter.

4.3.2 New or emerging threats

In addition to the above threats, the managing agency considers the following are new, emerging or previously unaddressed threats to the natural and cultural values of the TWWHA.

- **Potential establishment of new introduced species in Tasmania and the TWWHA (especially foxes).** European red foxes have recently been sighted in Tasmania, and a major effort is currently being directed towards their eradication. If foxes were to become established in Tasmania, they would be expected to have very serious consequences for many species of Tasmania's native fauna, in particular for small mammals and bird species that are now either absent or virtually absent from mainland

Australia due to predation by foxes. Whilst there is no evidence that foxes are present within the TWWHA, the potential establishment of foxes in Tasmania poses a very serious threat to the natural heritage of the whole state.

In addition, there is a significant threat of marine weed and pest invasion including the Northern Pacific seastar (*Asterias amurensis*), Rodger's sea urchin *Centrostephanus rodgersii*, and the European shore crab (*Carcinus maenas*). The Northern Pacific seastar is currently known from the Derwent estuary where it is directly competing with native species for space and resources. Rodger's sea urchin is increasing in numbers and distribution down the east coast of Tasmania. It feeds on algae and has radically altered the environment in parts of Bass Strait. The European shore crab occurs in the south of Tasmania and has an adaptable diet and strong invasive tendencies.

There also remains a significant risk of deliberate new introductions of non-native species into the TWWHA becoming established.

- **Recent outbreak of Devil Facial Tumour Disease in Tasmanian devils.** Tasmanian devil populations in the northern and eastern areas of Tasmania and extending as far west as Derwent Bridge have recently exhibited a widespread outbreak of Devil Facial Tumour Disease. Devils affected by the disease grow obvious facial cancers and die within about three to five months. The condition is believed to be associated with the failure of the devil's immune system which normally combats cancers and cancer-causing agents (DPIWE, 2003).
- **Lack of knowledge of fire regimes (and possibly inappropriateness of current regimes) required to establish and maintain the optimal mix of ecological communities for the long-term conservation of biodiversity in the TWWHA and to appropriately manage the risk of major wildfires.** Inappropriate fire regimes (e.g. fires being too frequent, too infrequent, or too hot etc) can cause major long-term changes in the nature and extent of vegetation communities, and can give rise to serious risks to public safety, built assets, and adjoining lands. As yet, knowledge of fire regimes, their consequences, and their management is rudimentary and there are risks associated with both action and inaction. These are important issues with far-reaching consequences.
- **Increasing levels of tourism and numbers of visitors.** The number of visitors to the TWWHA increased by about 30-35% over the 1992–1999 period, and there are expectations for continuing tourism growth in Tasmania. The number of commercial tourism enterprises both within and adjacent to the TWWHA increased in recent years and several proposals are currently under development. Whilst tourism is an important element of the state's economic future, a key emerging issue for the TWWHA is how increasing tourism and visitation can be effectively managed to deliver ecologically sustainable human use of the TWWHA without degrading the area's natural and cultural heritage.
- **Increasing mechanised access to remote areas.** Increasing use of mechanised vehicles to access remote parts of the TWWHA poses threats for the spread of plant diseases and for causing a variety of other impacts to previously undisturbed places. For example, increasing use of all terrain vehicles (ATVs) or quad bikes south of Macquarie Harbour and along coastal regions poses a major risk of the spread of *Phytophthora* root rot disease and of disturbance to Aboriginal heritage sites. Increasing use of boats and aircraft flights to access remote areas of the TWWHA is likely to give rise to a range of visitor impacts, especially in sensitive environments. There is currently little capacity to detect and manage these threats.
- **Cruise ships, boating and diving activities in the Port Davey–Bathurst Harbour region.** During the 1992–1999 period, a previously unknown and significant community of marine invertebrates was discovered in Bathurst Channel. This community of fragile and sensitive species is vulnerable to disturbance from boat anchors, ship motors, and divers, as well as to increased nutrient levels. Careful management of boating and diving activities and visitor use is needed to protect these sensitive marine communities[28]. The potential of allowing cruise boats to operate within the Port Davey region poses a significant threat to these marine communities

The potential establishment of the European red fox (*Vulpes vulpes*) in Tasmania poses a very serious threat to the many small mammals and bird species that are now either absent or virtually absent from mainland Australia due to predation by foxes. This photo (taken on Philip Island, Victoria) shows a fox that has killed a fairy penguin.
Photo by Marjolein van Polanen Petel

A Tasmanian devil affected by the deadly devil facial tumour disease.
Photo by Christo Boars

28 A notesheet has recently been produced for yacht and boat users of the area which identifies recommended anchorages and gives advice on speed limits, effluent disposal and other measures for protecting the natural environment. Protection of these communities will be addressed in the mid-term review of the 1999 TWWHA management plan.

and also increases the risk of introducing marine weeds and pests. There may also be a slight increased risk of an oil spill.

- **Changes to flow regimes in the Gordon River under proposed Basslink hydro power generation operations** have the potential to cause more serious adverse impacts on the ecosystems of outflow rivers e.g. by causing accelerated erosion of the riverbanks. Careful management of operations is required to minimise impacts.
- **Drought and/or global warming**. There was a widespread lack of regeneration of the fire-sensitive endemic pencil pine (*Athrotaxis cupressoides*) within the coniferous woodlands of the Central Plateau. In addition, throughout Tasmania (including the TWWHA) there was a noticeable decline in the health of eucalypt woodlands. Drought and/or global warming are considered to be possible causes for these observations.

  The effects of global warming and sea level rise may be slow and difficult to identify with certainty but potential changes include the degradation and loss of alpine environments and associated communities (alpine communities contain many endemic species) which are limited in distribution in Australia; increased coastal erosion through rising sea levels (with associated loss of significant coastal Aboriginal midden sites); alteration to natural rates and magnitudes of change in the region's drainage system and alteration in the erosive potential of the area's rivers and streams. There appears to be some evidence that coastal dune systems (which are very sensitive to sea level change) are having foredunes truncated for the first time in the last 3,000 years. This may be a result of depleted sediment supply and/or a result of rising sea levels.

4.3.3 Public perceptions of threats

In addition to the managing agency's assessment of threats to the TWWHA, public perceptions of the main threats to the area were sought through a public phone survey conducted by a market research firm[29] on behalf of the Parks and Wildlife Service. Five hundred randomly selected Tasmanian residents were asked *'What do you consider to be the main threats to the Tasmanian Wilderness World Heritage Area?'*

The Tasmanian public identified the following as the main threats to the Tasmanian Wilderness World Heritage Area

- too many visitors (31%)
- commercial development (31%)
- environmental degradation (22%)
- fire (13%)
- poor management (11%)
- weeds, pests and diseases (6%)
- illegal activities (5%)
- lack of funding (4%)

In most cases, there was considerable overlap in the perceptions of threats by the public and the managing agency, although the public gave higher recognition to the threats posed by too many visitors and commercial development while the managing agency gave higher recognition to the significance of wildfires, plant diseases, and the regulation of river flows by hydro-electric power generating operations.

29 The information presented in this section summarises the findings of a phone survey of 500 randomly selected Tasmanian adults undertaken in 1999 by Enterprise Marketing and Research Services (EMRS, 2000a) on behalf of the Parks and Wildlife Service.

4.4 Management of identified threats and adverse impacts, 1992–1999

Key Desired Outcome addressed in this section:

KDO 3.2: Aversion or management of threats or adverse impacts within acceptable, and where necessary defined, limits which do not compromise the achievement of the objectives of World Heritage Area management. Cessation or a significant reduction in identified damaging activities or practices to minimal and ecologically sustainable levels.

During the 1992–1999 period, a range of management activities was undertaken to protect the natural and cultural heritage and to address identified threats and pressures on those values. The following sections detail the evidence of management effectiveness in addressing those threats and pressures. For some programs, monitored information about performance indicators enabled the effectiveness of management to be examined in considerable detail. In other cases there was little or no measured information available that related to the management of threats or pressures on significant values. This was particularly evident in relation to cultural heritage values.

4.5 Cessation or reduction of damaging activities and practices

Over the 1992–1999 period, a number of identified damaging activities or practices that were causing significant impacts or posed an active threat to the natural or cultural heritage of the TWWHA were either halted or significantly reduced. For example:

- A major quarry for limestone at Lune River (Bender's Quarry) that had been shown to be causing damage to the significant limestone karst system at Ida Bay was closed. A major rehabilitation program stabilised the quarry benches and resulted in significant improvements in water quality of cave streams and an increase in the abundance of cave stream fauna (see Section 5.7.1 'Karst system at Lune River').
- Active management of speed and access conditions for commercial cruise boats on the lower Gordon River resulted in a dramatic reduction in serious riverbank erosion (see Section 4.10.2 'Case study—Riverbank erosion on the lower Gordon River'.
- Sheep and cattle grazing on the Central Plateau (which had been linked to erosion and damage to alpine vegetation) ceased in accordance with the provisions of the 1992 TWWHA management plan. During the moratorium research and monitoring of the impacts was conducted. The findings of this research indicated that the combination of fire, rabbits and grazing had resulted in the development of widespread soil erosion on the Central Plateau. These findings led to the conclusion that stock grazing should not be reintroduced to the Central Plateau Conservation Area. This conclusion was enacted in the 1999 management plan.
- Declaration of Fuel Stove Only Areas decreased the use of campfires in sensitive alpine areas of the TWWHA (campfires posed a risk of igniting peat fires and other wildfires).
- A commercial horseriding operation on the boundary of the World Heritage Area at Cradle Mountain, which was shown to be causing significant environmental damage, was relocated to a less sensitive area.
- Small-scale mining operations at Adamsfield ceased.

Fire is arguably the greatest realistic threat that could cause rapid, large-scale, major ecological impacts to the TWWHA.
Photo by Tim Rudman

4.6 WILDFIRES

About the threat

WHAT IS THE THREAT?

Unmanageable wildfires are probably the greatest realistic threat that could cause rapid, large-scale, major ecological impacts to the TWWHA and its World Heritage and other significant values. In addition, unmanageable wildfires pose a serious threat to public safety, built assets and adjacent lands. Two types of wildfires pose extreme threats to the TWWHA—'landscape-scale fires' and peat fires.

Landscape-scale fires are fires that are not stopped by normal fire boundaries such as wet forest or major rivers. These fires have the potential to cause large-scale major ecological impacts to the TWWHA, including destruction of fire-sensitive rainforest and alpine vegetation (including pencil pines, myrtle-beech, King Billy pines and sphagnum moss) along with their associated fauna. These communities can take hundreds to thousands of years to recover following fire.

Peat fires are fires that burn accumulated layers of partially decomposed organic matter that has built up into extensive beds of peat and other organic-rich soils. These organic soils are widely distributed throughout western and southwest Tasmania. When soil conditions are dry, any fire over organic soils is likely to ignite a peat fire. Peat fires are extremely difficult to extinguish because they smoulder in the ground. Consequently, peat fires can burn for many months if there is insufficient rainfall to saturate the soil and extinguish the fire. Peat fires are a major source of ignition for new above-ground wildfires because they can act as a continuous ignition source throughout an entire summer season.

WHAT NATURAL OR CULTURAL VALUES ARE AFFECTED?

Fire-sensitive vegetation (including pencil pines, myrtle-beech, deciduous beech, Huon pines, King Billy pines and sphagnum) are threatened with destruction by wildfires, especially by landscape-scale fires. For example, the PWS Fire Management Section considers that if there were fires of the same magnitude as occurred in the 1850's, 1890's and 1930's, then large areas of fire sensitive vegetation in southwestern Tasmania would be destroyed or severely damaged (see Marsden-Smedley 1998, and Johnson & Marsden-Smedley 2002).

These skeletal stags are all that remain of an ancient stand of pencil pines following a fire. Pencil pines, Huon pines, and King Billy pines are slow growing endemic conifers that are especially vulnerable to fire.
Photo by Nick Sawyer

Background to management

The TWWHA is dominated by fire-adapted and dependent vegetation that has expanded over thousands of years in response to Aboriginal patterns of fire use. Research findings suggest that fires under Aboriginal management were mostly high frequency low intensity fires in buttongrass moorlands, with fewer fires in other vegetation types.

Under early European management, patterns of fire management changed, and some fire-sensitive communities were intentionally burned to increase accessibility. Landscape-scale fires occurred in southwestern Tasmania in 1850, 1897/98, 1933/34 and 1960/61and are believed to have been responsible for major losses of fire sensitive vegetation in what is now the TWWHA.

The 1992 management plan for the TWWHA prohibited management-initiated fires in Wilderness Zones, with the exception of habitat management burns and these could only be undertaken to maintain the habitat of rare or endangered species such as the orange-bellied parrot. In other zones of the TWWHA, and if provided for in an approved fire management plan, management initiated fuel reduction burns were allowed in moorlands, dry sclerophyll forest and woodland, heathlands and grasslands.

CAUSES OF WILDFIRES IN SOUTHWESTERN TASMANIA

Arson is the primary source of ignition for wildfires in southwestern Tasmania (Marsden-Smedley 1998). Over the 1975 to 1996 period, arson accounted for about 65% of wildfires and 46% of the area burnt in southwestern Tasmania. While escaped management-initiated fires only accounted for 2.5% of the number of wildfires, they accounted for 39% of the area burnt. Lightning accounted for about 9% of wildfires and about 2% of the area burnt.

Causes of wildfires in southwestern Tasmanian (between 1975/76 and 1995/96)*

Cause of wildfire	Number and % of wildfires	Area burnt (ha) and % of total area burnt
Arson	106 (65%)	46,705 (46%)
Unknown	21 (13%)	10,514 (10%)
Lightning	15 (9%)	2,152 (2%)
Escaped campfire	13 (8%)	107 (0.1%)
Escaped management	4 (2.5%)	39,550 (39%)
Accident	2 (1%)	1,830 (1.8%)
Other	2 (1%)	100 (0.1%)

* Source: This table has been compiled from data presented in Table 3.1, Marsden-Smedley (1998).

How was the threat averted or managed over the 1992–1999 period?

OVERALL MANAGEMENT GOAL: to manage risk factors so as to avoid the occurrence of unmanageable fires in the TWWHA and to achieve appropriate fire regimes for desired ecological and other outcomes.

MANAGEMENT ACTIONS AND SIGNIFICANT EVENTS

During the 1992–1999 period, a fire prevention policy was implemented for the TWWHA. This included fire management planning, fuel reduction burning, a walker education campaign, the adoption of a Fuel Stove Only Area policy, and an immediate fire suppression policy. Actions included:

- A 'Fuel Stove Only Area' policy was adopted for almost the entire TWWHA to reduce, amongst other things, the risk of accidental camp fire escapes. To coincide with this, an educational program promoting 'Minimal Impact Bushwalking' was implemented to educate walkers about the risks of campfires, particularly on peat soil.
- Fire management plans were prepared for the region.
- A policy of fire suppression was adopted and all detected instances of unplanned fires were suppressed. Where peat fires were located they were extinguished wherever possible and/or monitored until the danger of a further fire escape was considered to be over.
- Fire spotters were employed over the moderate to high fire danger periods to report and investigate any smoke.
- During the summer period, district staff undertook patrols of known 'hot spots' for arson in the TWWHA (especially along the Lyell Highway). In the more remote areas, track rangers provided a greater management presence during the summer period.
- Investigations were carried out in relation to several unlawfully lit fires; however, no formal charges were laid.
- The agency planned for and implemented a small-scale tactical fuel-reduction burning program in areas where there has been a regular history of arson fires. Fuel reduction

Luck plays a significant role in the nature and success of fire management operations in the TWWHA. For example, on Christmas Eve in 1998, lightning started four separate fires in the TWWHA. On the other hand, dousing rain followed all potentially major fires in the TWWHA over the 1992–1999 period.
Photo by PWS Fire Management

burning was concentrated along the Lyell Highway. This program was intended to reduce fuel loads and so decrease the potential fire intensity in the event of a wildfire, and so increase the opportunity for suppression.

- There were 17 approved management burns over the 1992–1999 period (see table below). Sixteen of the 17 management burns were for the purposes of hazard reduction burns all of which were carried out to reduce the age of buttongrass communities, either along the Lyell Highway (14 fires) or at Melaleuca (2 fires)[30].
- One management burn at Birchs Inlet was for the purpose of ecological management to produce the vegetation communities required by the endangered orange-bellied parrot. This fire, at Birchs Inlet, escaped the planned boundaries and burnt a larger area than anticipated (planned size =172ha; actual size=417ha). The unplanned burn is regarded as a wildfire caused by an escaped management burn.
- Field staff were trained in fire fighting, and fire-fighting crews were employed and trained to increase the fire readiness of the managing agency. In addition a cooperative relationship was developed between the state's major land management agencies and the Tasmanian Fire Service to increase the number of trained staff available in emergency situations.
- Methodologies were jointly developed by the Parks and Wildlife Service, University of Tasmania, Forestry Tasmania, and the Tasmanian Fire Service to predict buttongrass moorland fire behaviour over a wide range of conditions for the southern region of the TWWHA. These models take into account the age distribution of buttongrass moorlands.
- In 1994, a study commenced to investigate the impact of fuel reduction burns on small mammals in buttongrass moorlands. In 1998 the investigation was expanded to include the effects of fuel reduction burns on invertebrates. These are long-term studies (longer than 5 years) which are expected to yield important information to management.
- More recently, in 2000, PWS coordinated an international symposium on indigenous fire management ('Native Solutions—fire management') in Hobart.

Jon Marsden-Smedley (Fire Management Officer) recording data during a habitat management burn.
Photo by Dylan Kendall

Results

There were 34 recorded fires in the TWWHA over the 1992–1999 period. Of these, half (17) were approved management-initiated fires ('management burns') and the other half were unplanned fires or 'wildfires'.

Of the 17 approved management burns, only one escaped the planned fire boundaries to become a wildfire. Of the 17 wildfires, lightning caused 9 fires; arson caused 4, the causes of 3 fires are unknown, and an escaped management burn caused one fire.

Figure 9 indicates the location and cause of fires in the TWWHA over the 1992–1999 period. Appendix 6 presents detailed information about the locations and sizes of these fires. The tables below present summaries of: (1) management-initiated fires in the TWWHA over the 1992–1999 period, and (2) wildfires in the TWWHA over the same period.

30 Note that for the purposes of fire management analysis, Melaleuca and Cox Bight which are surrounded by the TWWHA are included with the TWWHA (although technically they are part of the Southwest Conservation Area).

(1) Management-initiated fires in the TWWHA over the 1992–1999 period

Reason for Management Burn	Number of Fires	Area Burnt (ha)	% Area Burnt	Number Escaped
Hazard Reduction Burn	16	2151	84%	0
Ecological Management Burn (for orange-bellied parrot)	1	417	16%	1*
		Total = 2568ha	100%	

* Planned area =172ha; actual area = 417ha (= wildfire of 245ha)

(2) Wildfires in the TWWHA over the 1992–1999 period

Cause of wildfire	Number and % of wildfires	Area burnt (ha) and % of total area burnt
Arson	4 (23%)	675 (38%)
Lightning*	9 (53%)	420 (23%)
Unknown	3 (17%)	442 (25%)
Escaped management burn	1 (6%)	254 (14%)
	Total =17 (100%)	Total = 1,791 (100%)

*Four of these lightning fires ignited on the one day, on Christmas Eve 24 December 1998.

The Parks and Wildlife Service's Seasonal Fire Crew and friends enjoying a Christmas barbecue. The Fire Crew supports the fire management and suppression work of the PWS throughout Tasmania. From left to right: Peter Clarke, Phil Duggan, Andrew Tenniswood, James Bell, Todd Bennetto, Andrew Luttrell, Damien Whitfield, Tim Scott, John Duggan, Owen Taylor, Peter Zammit, Pat Marshall, Bruce Sutton, Peter Medley, Andrew Zeilkinski, Robin Hutchings, Richard Cloudsdale, Mark Whitney, Cung Tran, Jon Marsden-Smedley and Adrian Pyrke. (Absent: Tom Denman and Nolan Alderfox.)
Photo by PWS Fire Management

MONITORED CONDITION INDICATORS

No condition indicators related to the values threatened by wildfire were monitored over the 1992–1999 period. Potential condition indicators include the area and condition of significant fire sensitive vegetation communities or populations.

MONITORED PRESSURE INDICATORS

Pressure indicators (and how they were monitored)	**Targets for pressure indicators** (and how performance is assessed)	**Changes in pressure indicators over the 1992–1999 period**
AGE DISTRIBUTION OF BUTTONGRASS MOORLANDS: Time since the last fire and earlier fire history is determined by assessing sites for evidence of fire history (including tree ring analysis and banksia node counts) and also historical records or references to fires. The percentage of vegetation types burnt over different periods is determined by fire boundaries and vegetation types from historical aerial photographs (from 1940›s onwards).	AGE DISTRIBUTION OF BUTTONGRASS MOORLANDS: Targets yet to be identified	AGE DISTRIBUTION OF BUTTONGRASS MOORLANDS: Over the past 65 years, there has been a progressive increase in the average age of buttongrass moorlands in the southern half of the TWWHA due to a lack of fire. Over the 1992–1999 period, this trend continued. Only a small area was subject to habitat-management and/or hazard-reduction burning. Currently about 75% of the moorlands in the southern half of the TWWHA are old growth (ie more than 35 years since fire); 12% are mature (ie 15 to 35 years since fire) and only 13% are regrowth (i.e. less than 15 years since fire). If current trends continue until 2005, it is estimated that about 79% of these moorlands will be old growth; 21% will be mature and less than 0.1% will be regrowth. (See Marsden-Smedley and Kirkpatrick, 2000.)

Outcomes

- There were no 'landscape-scale' fires over the 1992–1999 period, i.e. there were no fires that could not be stopped by normal fire boundaries such as wet forest or major rivers.
- No significant built assets were lost as a result of wildfires during the 1992–1999 period.
- None of the wildfires within the TWWHA spread into adjacent land holdings over the 1992–1999 period. One fire spread from the Southwest Conservation Area into the TWWHA (from Cox Bight); however no other wildfires on adjoining land holdings spread into the TWWHA over the period.
- Wildfires burnt a total area of 1,791ha over the 1992–1999 period. The largest wildfires were an arson fire at Coates Creek, which burnt 447ha, and the escaped management burn at Birchs Inlet, which burnt 417ha. The escaped management burn burnt only moorland.
- Wildfires within the 1992–1999 period caused degradation and/or loss of 55 hectares of montane or alpine vegetation including some sphagnum peatlands.

Fire research is vital to the development of sound fire management strategies that will deliver desired long-term ecological outcomes. Here, research is being carried out at Harrisons Opening on the Yo-Yo Track, Huon River, following a fire in January 1993.
Photo by Barry Batchelor

Commentary on management performance

The following commentary has been provided by fire management staff within the Parks and Wildlife Service and specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- The key factor contributing to management performance over the 1992–1999 period (ie the absence of unmanageable fires in southwestern Tasmania) has been luck…so far. The PWS Fire Management Section considers that there is a continuing significant risk of major fires in the area due to the existence of extensive areas of 'old-growth' buttongrass (i.e. buttongrass that has not been burnt for more than 35 years) in the southern half of the TWWHA. The exclusion of fire from these fire-adapted communities leads to a build-up of high fuel loads that are a major risk factor for unmanageable 'landscape-scale' fires.
- Research has provided a better understanding of fire behaviour in buttongrass moorlands and this provides important input to models for ongoing fire management.
- The Fuel Stove Only Area has generally worked well in highland areas (where it is easy to demonstrate the lack of firewood and the sensitivity of the environment) and few campfires are now being lit in these areas. However in lowland areas, fires are still being lit but now, instead of fires mostly being lit in old well-established fire places (where a deep bed of ash generally isolates the fire from the underlying peat), the fires are often being lit next to where people camp, regardless of the presence or absence of peat. It is common to see small peat fire dibbles, and this type of fire usage almost certainly increases the risk of campfire escapes.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- The managing agency's capacity to manage fires and its level of fire preparedness progressively decreased over the management period due to changes in management emphasis, a declining base level of funding for fire management, and changes in staffing roles. For example:
  - low levels of recruitment of (young) ranger staff progressively resulted in an aging ranger staff with reduced levels of fitness to carry out fire fighting;
  - changing roles for PWS rangers meant that rangers were decreasingly required to participate in fire fighting and a smaller pool of staff became available to do so;
  - the above factors led to increasing reliance and use of temporary seasonal fire crews employed on project funds.

ADDITIONAL COMMENTS

- There appears to have been some reduction in the overall rate of suspected arson in the TWWHA over the 1992–1999 period. However, outside the TWWHA in the adjoining Southwest Conservation Area, there were numerous arson fires over the 1992–1999 period e.g. there were at least 7 recorded arson fires at Cape Sorell on the northwestern peninsula at the entrance to Macquarie Harbour. The occurrence of arson fires in adjoining areas poses a risk of wildfires spreading into the TWWHA.
- The risk of deliberate and accidental fires associated with the use of coastal areas by fishers and walkers remains relatively high.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of wildfires.

- Appropriate fire management regimes need to be developed and implemented for fire-adapted and fire-dependent vegetation in the TWWHA. Recent research suggests that the most appropriate fire management regime for buttongrass moorlands in the southern half of the TWWHA would be small scale mosaic fires of less than 100ha fires on a 30year interval (range 20–50years) (Marsden-Smedley & Kirkpatrick, 2000.)
- Appropriate fire management regimes also need to be determined for grasslands, dry sclerophyll forest and heathlands.
- Directed research needs to continue to address knowledge gaps and enhance the capacity of management to predict and deliver the appropriate fire regimes to achieve the desired outcomes.
- The principles of adaptive management need to be applied in order to ensure that as new knowledge becomes available it is incorporated into operational fire management to achieve the best outcomes.
- Strategic prescribed burning needs to be implemented to reduce the levels of threat of unmanageable wildfires.
- Effective preventive strategies need to be developed and implemented to decrease the incidence of arson fires, including fires on adjoining lands.
- Greater liaison with Aboriginal groups may lead to better understanding regarding fire management in the TWWHA.
- A high level of wildfire fighting ability needs to be maintained. The Parks and Wildlife Service's level of fire preparedness needs to increase in order to provide adequate protection in the event of a major fire. For this to occur, the level and security of funding for fire management needs to increase.

Among the PWS staff with responsibilities for fire management are, from left to right, Jon Marsden-Smedley (Fire Management Officer), Stuart Hagell (Technical Officer, Equipment), Tony Blanks (Senior Fire Management Officer) and Adrian Pyrke (Fire Management Officer). Mark Whitney (Works Officer) is absent from the photo.

Photo by Sophie Underwood

Aerial view of the burnt swathe left by a fire at Harrisons Opening in 1993.

Photo by Barry Batchelor

SOURCES OF INFORMATION AND COMMENT

Jon Marsden-Smedley (WHA Fire Management Officer, PWS Fire Management Section), Ph: 6233 6767.

Jayne Balmer (Botanist for the southern region of the TWWHA), Ph: 6233 6160.

Figure 9

Prescribed management burns and unplanned fires over the 1992–1999 period

There were no major fires in the TWWHA over the 1992–1999 management period. Of the 34 recorded fires, half (17) were approved management-initiated fires ('management burns') and the other half were unplanned fires ('wildfires').

Notes: 'Escaped management burn' here refers to a prescribed management burn that burnt outside its planned fire boundaries. The burnt area outside the planned boundaries is counted as a wildfire. For the purposes of fire management reporting, fires within the Melaleuca–Cox Bight area of the Southwest Conservation Area are included as part of the TWWHA. Fires in other regions of the Southwest Conservation Area are not included in reports but are shown for information on this map.

4.7 PLANT DISEASES AND DIEBACK

4.7.1 Phytophthora root rot disease

About the threat

WHAT IS THE THREAT?
Phytophthora cinnamomi is an introduced plant pathogen that causes root rot disease in susceptible plant communities below about 700m elevation. *Phytophthora cinnamomi* is spread by water, with human activities often accelerating the spread of the pathogen e.g. through infected mud on walkers' boots or on vehicles. *Phytophthora cinnamomi* has been observed to spread naturally downhill at a rate of more than 50m per year, whilst its unassisted uphill spread is probably in the order of just one metre per year.

WHAT NATURAL OR CULTURAL VALUES ARE AFFECTED?
Buttongrass moorland and scrub communities are the main communities affected by root rot disease, although recently disturbed forest is also vulnerable. The fungus causes the roots of susceptible plant species to rot, thereby killing the plant. Some species, such as the White Waratah (*Agastachys odorata*), silver banksia (*Banksia marginata*) and Christmas bells (*Blandfordia punicea*), may be completely eliminated from infected areas while populations of other species such as *Sprengelia incarnata* are substantially reduced. The threatened species *Lomatia tasmanica* is also at risk if the stand is disturbed by fire.

Phytophthora cinnamomi can lead to major long-term changes in the floristic and structural character of infected moorland vegetation.

Background to management

The *Phytophthora cinnamomi* pathogen was most likely introduced to Southwest Tasmania at the time of the early mining activity. First detected within the area of the TWWHA in the 1970's, *Phytophthora cinnamomi* is now well established in the TWWHA, having infected more than 2,500 hectares of buttongrass moorland. In 1978–1980 some experimental plots were established to investigate the impact of *Phytophthora cinnamomi* on moorlands.

How was the threat averted or managed over the 1992–1999 period?

OVERALL MANAGEMENT GOAL: to minimise the extent and severity of impacts associated with *Phytophthora cinnamomi* on the natural vegetation communities of the TWWHA.

MANAGEMENT ACTIONS AND SIGNIFICANT EVENTS OVER THE 1992–1999 PERIOD
Because there is, as yet, no effective method for the broad-scale control or eradication of *Phytophthora cinnamomi*, management effort over the 1992–1999 period focused on preventing the spread of the disease.

- Baseline mapping of the distribution of root rot disease along the World Heritage Area track system was undertaken in 1992. Since then, some further mapping has been undertaken in response to walking track developments and monitoring.

Phytophthora cinnamomi is an introduced plant pathogen that causes the roots of susceptible plant species to rot, thereby killing the plant. This photo shows plants affected by the disease.

A community affected by the *Phytophthora* root rot disease. The main communities affected by root rot disease are buttongrass moorland and scrub.
Photos by Tim Rudman

- Roads were closed where there was significant risk of vehicles spreading the disease, such as the Jane River Track.
- In 1993 a *Phytophthora cinnamomi* management plan and hygiene manual was prepared. This was subsequently implemented with the following actions:
  - wash down stations were installed along major high risk walking tracks (such as on the Frenchmans Cap Track) to prevent further spread of the disease;
  - enforcement of hygiene procedures for aerial access to all remote area track work, and other management activities and research work;
  - installation of long term monitoring plots to determine the longer term responses of plant species and communities to infection;
  - research to determine susceptibility of the endangered species Lomatia tasmanica; and
  - public education programs were run to reduce the risk of spread by walkers, and information was incorporated into the Minimal Impact Bushwalking program.
- Full baseline plots were established in 1998–2000 to enable comprehensive long-term monitoring of floristic changes associated with *Phytophthora cinnamomi* infection.

Results

MONITORED CONDITION INDICATORS

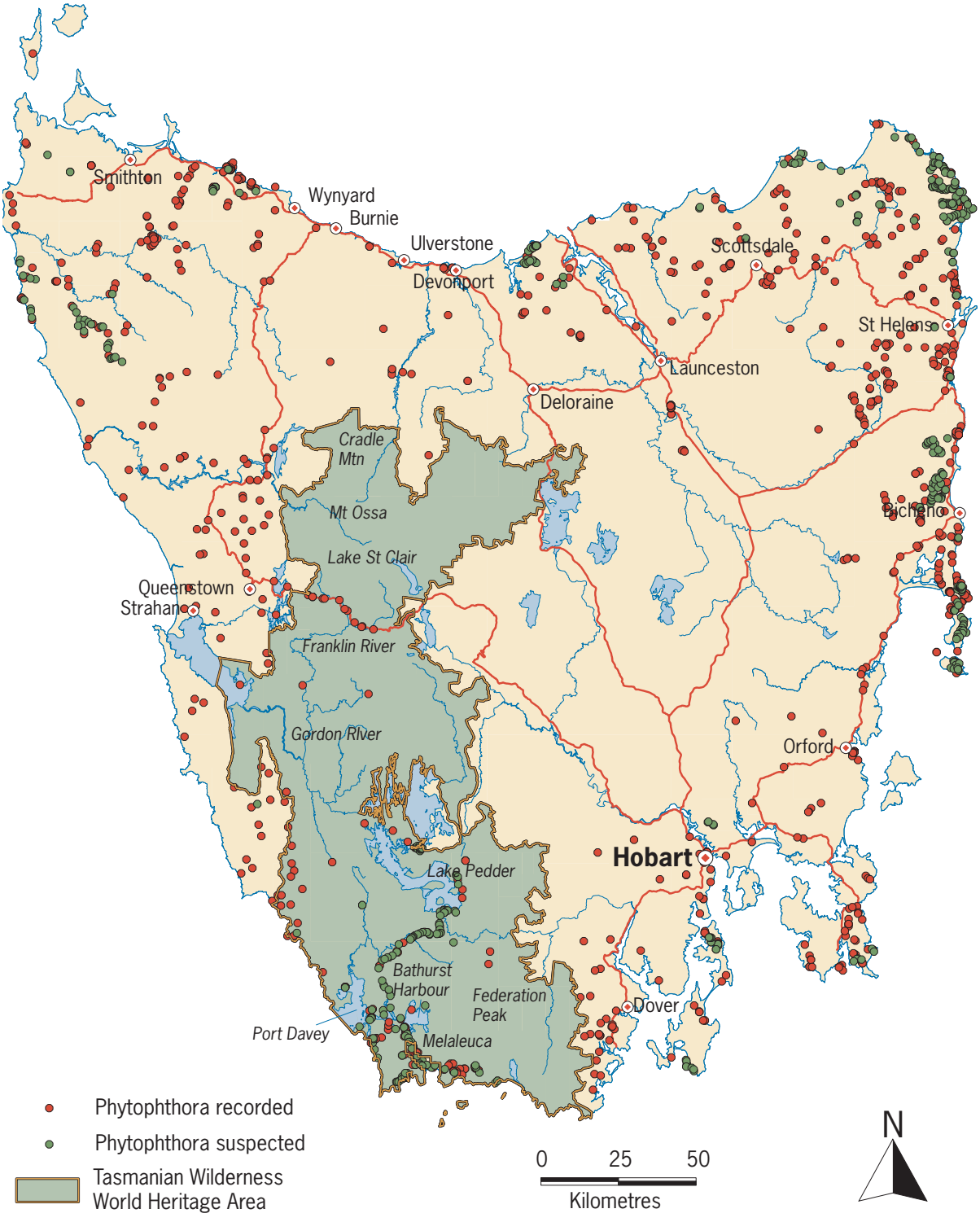
Condition indicators (and how they are monitored)	**Targets for condition indicators** (and how performance is assessed)	**Changes in condition indicators over the 1992–1999 period**
NUMBER OF INFECTED CATCHMENTS: Number of catchments in which *P. cinnamomi* is recorded*.	TARGET FOR NUMBER OF INFECTED CATCHMENTS: No new catchments infected by *P. cinnamomi*.	There is no record of new catchments being infected during the period (i.e. in catchments that were known to be disease-free in recent years).
WALKING TRACKS/ROADS AFFECTED: Number and extent of walking tracks and roads affected by *P. cinnamomi**.	TARGET FOR WALKING TRACKS/ ROADS AFFECTED: No spread of *P. cinnamomi* infection where management actions to control its spread are in place.	There are inadequate measured data to provide documented evidence of the changes in the distribution or impact of *Phytophthora cinnamomi* in the TWWHA over the term of management. However, incremental spread of *P. cinnamomi* on some walking tracks has been noted in 1999. This includes spread along the new track to Cox Bight from Melaleuca, and around the Southwest Cape track route. The disease has probably extended elsewhere but no survey of the areas has been conducted for 10 years. Many areas are still to be surveyed or re-surveyed, and it is likely that the true distribution of the disease will always considerably exceed our knowledge of its extent.
NUMBER OF POPULATIONS OF SUSCEPTIBLE THREATENED PLANT SPECIES AFFECTED BY *P. CINNAMOMI**. *The above 3 indicators are all surveyed periodically and are monitored in an ad hoc fashion.	No new infections affecting populations of susceptible threatened species.	There is no evidence of new populations of susceptible threatened plant species in the TWWHA being affected during the 1992–1999 period.

Figure 10

Distribution of Phytophthora root rot disease

Phytophthora cinnamomi is an introduced plant pathogen that causes root rot disease in plant communities. The extensive distribution of *P. cinnamomi* in the far southwest of Tasmania reflects a long history of the disease in the area. *Phytophthora* root rot is spread by water, wildlife and human activities, which accelerate the spread of the disease e.g. through infected mud on walkers' boots or on vehicles. Roads (such as the Lyell Highway) and walking tracks (such as the Old Port Davey Track, South Coast Track and McKays Track) are major corridors of spread for the pathogen as can be seen on the map. *P. cinnamomi* is mostly absent from high quality wilderness areas.
In this figure, the recorded locations (red dots) represent sites where the presence of *Phytophthora cinnamomi* was positively identified through laboratory isolation of the pathogen. The suspected locations (green dots) represent sites where field observations recorded plant symptoms consistent with *Phytophthora* root rot disease.

Source: DPIWE GTSpot database (data as at April 2002)



MONITORED PRESSURE INDICATORS

Pressure Indicators (and how they are monitored)	Targets for pressure indicators (and how performance is assessed)	Changes in pressure indicators over the 1992–1999 period
EXTENSION OF TRACK SYSTEM OR OTHER ACCESS INTO UNINFECTED CATCHMENTS.	No new tracks (or other access) into uninfected catchments from infected areas.	Some tracks have been extended into *Phytophthora*-free areas over the 1992–1999 period. Illegal track construction for 4WD bikes south of Macquarie harbour is a serious threat to disease-free areas north of Port Davey.

Outcomes

- There is no evidence of *Phytophthora cinnamomi* infection along the walking tracks within most of the catchment areas previously identified as disease-free and being actively managed as *Phytophthora*-free catchment areas (for example between South Cape Rivulet and the Iron Bound Ranges, the Arthur Plains and the Lodden Plains) over the 1992–1999 period. However, an infection has more recently been observed (in 2001) in the previously disease-free catchment of the Cracroft. This infection is possibly related to track maintenance works undertaken during the 1992–1999 period.
- There is evidence of incremental spread of *Phytophthora cinnamomi* along some walking tracks within the TWWHA—most notably along the Southwest Cape circuit and within the Cox Bight area. The disease has probably extended beyond these areas. The true extent of infection of *Phytophthora cinnamomi* is uncertain due to a lack of resources to undertake surveys in wilderness areas; in addition, the complex patchwork of infected areas precludes attempting to map boundaries away from tracks and roads.
- More recently in 2001 there was evidence of a failure in the effectiveness of hygiene measures when *P. cinnamomi* infestations developed on the Arthur Plains beyond the Junction Creek washdown station and at Deadmans Bay.

Commentary on management performance

The following commentary has been provided by specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- Mapping of *P. cinnamomi* on the TWWHA road and track system.
- Identification of susceptible disease-free areas.
- Establishment of wash-down stations on walking tracks which are at risk and also feasible.
- Public education program.
- Introduction of *P. cinnamomi* hygiene measures for management activities considered likely to spread the pathogen.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Limited capacity to manage the pathogen. The problem can realistically only be addressed by limiting the role people play in spreading the pathogen.
- The major threat of spread of the pathogen associated with illegal 4WD bike tracks being extended southwards from Low Rocky Point could be stopped by removing bridges; however, the bridges are not being removed due to community agreements to keep them open.

- Lack of resurveys of the distribution of root rot disease limited knowledge about the spread of the disease.

ADDITIONAL COMMENTS

- Unlimited access by people to disease-free areas will continue to carry with it the risk of long distance translocation of *Phytophthora cinnamomi* and subsequent infection of new areas.
- Increasing access by quad bikes and all-terrain vehicles south of Birchs Inlet poses a significant risk of spreading root rot disease from the heavily infected plains south of Birchs Inlet into uninfected parts of the TWWHA.
- Aerial access by helicopters to previously remote areas is potentially a new risk factor for the spread of *Phytophthora*. Hygiene measures have been implemented to reduce this risk.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of root rot disease.

- Resurvey the TWWHA track system. Report on the number of tracks and extent of *P. cinnamomi* infestation. Re-analyse change in catchments affected by *P. cinnamomi*.
- Undertake further research on the nature of the long-term impacts of *P. cinnamomi*. Identify species at risk and the nature of community changes following infection. Fire assists species to regenerate so results will not flow for a number of fire cycles.
- Identify representative areas of susceptible plant communities and implement high level protection from *P. cinnamomi* for these areas.
- Investigate application of phosphonate to manage the spread of new infestations on walking tracks and reduce disease activity. (Phosphonate is an agent that may retard the spread of *P. cinnamomi*.)
- Encourage or require commercial operators to provide washdown facilities on board their vessels for clients to use when embarking/disembarking within the TWWHA e.g. within Bathurst Harbour.
- Improve public knowledge of the impacts of *P. cinnamomi* on TWWHA values and the measures they can take to reduce the spread of the pathogen.

Tim Rudman (Flora Protection Officer) joined the managing agency in 1990, working initially in fire management and fire training, and more recently, taking responsibility for developing management plans for introduced plant pathogens (including root rot disease) and weeds.

Photo by Sophie Underwood

SOURCES OF INFORMATION AND COMMENT

Tim Rudman (Flora Protection Officer, Vegetation Section, Nature Conservation Branch, DPIWE), Email: tim.rudman@dpiwe.tas.gov.au, Ph. 6233 3912.

4.7.2 High altitude dieback

About the threat

WHAT IS THE THREAT?

A new dieback was discovered at Pine Lake on the Central Plateau. This dieback differed from previous outbreaks of dieback associated with *Phytophthora cinnamomi*, as it occurred at much higher altitudes. While the cause of the dieback is uncertain, it is associated with a new species of *Phytophthora*, warm temperatures and dry conditions.

During the 1992–1999 period, a new dieback was discovered affecting pencil pine communities at Pine Lake on the Central Plateau. Quarantine measures and research were quickly established to address a potentially significant new disease threat. The situation now appears to have stabilised and there is some evidence of recovery in the plant community.

Photo by Nick Sawyer

WHAT NATURAL OR CULTURAL VALUES ARE AFFECTED?

The endemic conifer *Athrotaxis cupressoides* (pencil pine) and five associated understorey plant species are particularly sensitive to the disease—*Richea scoparia, Boronia citriodora, Orites acicularis, O. revoluta* and *Tasmannia lanceolata*.

Dieback can lead to local plant extinction and changes in natural community structure and processes. For example, thinning of the tree overstorey and the shrub understorey brings about changes in the local micro-climatic conditions that may lead to changes in both natural successional processes and plant population dynamics.

Background to management

Pine Lake dieback was first discovered in 1994 at Pine Lake on the Central Plateau. This type of dieback was distinguished from the root rot disease *Phytophthora cinnamomi* because the altitude of Pine Lake is above that tolerated by *Phytophthora cinnamomi*. The *Phytophthora* species isolated from diseased plants at Pine Lake is a species new to Australia.

How was the threat averted or managed over the 1992–1999 period?

OVERALL MANAGEMENT GOAL: to minimise the extent and severity of impacts associated with high altitude dieback on the natural vegetation communities of the TWWHA, and where practicable to achieve recovery of health and community structure of affected communities. In the early years following its discovery, the immediate goal was to control the potential spread of a putative new plant pathogen at Pine Lake while research was conducted to investigate the cause and impact of the dieback.

MANAGEMENT ACTIONS AND SIGNIFICANT EVENTS OVER THE 1992–1999 PERIOD

- Dieback in the pencil pine communities at Pine Lake on the Central Plateau was first observed in 1994.
- A quarantine area at Pine Lake was declared in 1995 to minimise the risk of walkers spreading the disease to new sites.
- Fences and signs were erected to inform the public of the problem and to request that they not enter the area.
- Hunting zones in the TWWHA were relocated so hunters did not enter the area.
- Research and monitoring were then commenced to identify the nature and causes of the dieback.
- A research program to investigate the cause of Pine Lake dieback was developed by the managing agency in partnership with the University of Tasmania. This included attempts to isolate and identify pathogens associated with the dieback.
- The impacts of the dieback on vegetation communities at Pine Lake were monitored by the managing agency.
- A new *Phytophthora* species was found in association with diseased coniferous heath at Pine Lake. The University of Tasmania provided the PWS with preliminary recommendations on the pathogenicity of the new *Phytophthora* species identified from Pine Lake.
- Because the new *Phytophthora* species had not been recorded in Australia before, its management was therefore treated as a potential new plant pathogen incursion into Tasmania.
- A management strategy was put in place that was consistent with national policies for pathogen incursion management.

- Department of Transport sealed the Lake Highway through the affected area to minimise siltation and to halt the ongoing need for gravel to be brought into the area.
- Research identified the presence of several *Phytophthora* species in the area that had not previously been recorded in Tasmania. However no causal relationship between these *Phytophthora* species and the plant death at Pine Lake could be established.
- Surveys of dieback elsewhere were undertaken to determine if the problem was localised or whether it was part of a greater problem. When no direct link could be proven between the presence of the new *Phytophthora* species and the dieback at Pine Lake, and when it was clear the area was recovering from the dieback, quarantine restrictions were lifted and the fences were removed.

Results

MONITORED CONDITION INDICATORS

Condition indicators (and how they are monitored)	**Targets for condition indicators** (and how performance is assessed)	**Changes in condition indicators over the 1992–1999 period**
SPREAD OF SYMPTOMS. Signs of new outbreaks and increased plant mortality (from incidental sightings) are the main indicators of increased severity.	INTERIM TARGET: Containment of spread of disease to currently affected areas. ASSESSMENT OF PERFORMANCE: Documentation of any new outbreaks of the disease.	Monitoring showed that there was limited local spread of dieback at a number of sites at Pine Lake. New sites of dieback developed in the immediate vicinity of the initially identified sites in two areas.
LEVEL/EXTENT OF PLANT MORTALITY. On-ground monitoring of impacts on species (see Whinam et al. 2001).	ABSOLUTE TARGET: Recovery of health and community structure of affected communities. ASSESSMENT OF PERFORMANCE: Re-survey of the current Pine Lake Quarantine Area during the life of the 1999 TWWHA Management Plan to assess improvement/ deterioration in plant health.	The health of the plants at the dieback site showed recovery over time. No new outbreaks of dieback were recorded.

MONITORED PRESSURE INDICATORS

No pressure indicators have been identified for Pine Lake dieback because it has not been possible to determine a definite cause for the dieback.

Outcomes

- A new high altitude dieback was identified in the pencil pine communities at Pine Lake on the Central Plateau. The dieback caused some loss in the pencil pine community.
- The situation appears to have stabilised with no evidence of recent expansion of the affected area, and some evidence of recovery in the plant community.
- The cause of the dieback remains uncertain. A *Phytophthora* species was found in association with coniferous heath but is not considered the primary causal factor.
- Dieback at Pine Lake is thought most likely to have been caused by a combination of climate (drought), disturbance and pathogens.
- No other areas of alpine dieback of this type have been observed.

Commentary on management performance

The following commentary has been provided by specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- Quick and appropriate response to a potentially significant disease threat.
- Cooperation between specialist staff of the Nature Conservation Branch, District staff of the Parks and Wildlife Service, and the Department of Transport to implement the necessary protection and management actions.
- Publication and promotion of information and management actions to user groups led to high compliance with Quarantine Area regulations and support for actions.
- Sealing of Lake Highway near Pine Lake by the Department of Transport minimised the potential of spread of the disease to other alpine areas.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Breaches of Quarantine Area regulations had the potential to spread the pathogens (e.g. some people/person breached the quarantine area and removed sections of boardwalk of an interpretive walk at Pine Lake).
- Difficulties in isolating pathogens from diseased plants have prevented a definitive determination of the cause of the disease to date.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of Pine Lake dieback.

- Review the requirements for a monitoring program at Pine Lake with a view to downgrading the frequency and intensity of monitoring.
- Investigate any new outbreaks of dieback, including pathogenic investigation and ecological monitoring. Any increased plant death in the Quarantine Area should trigger consideration of increased management actions.

SOURCES OF INFORMATION AND COMMENT

Tim Rudman (Protection Officer, Flora Section, Nature Conservation Branch, DPIWE), Pine Lake pathogen management, Email:tim.rudman@dpiwe.tas.gov.au, Ph. 6233 3912.

Jennie Whinam (WHA Botanist, Nature Conservation Branch, DPIWE), Pine Lake ecological monitoring, Email: jenniew@dpiwe.tas.gov.au, Ph. 6233 6160.

4.7.3 Other plant diseases

The native fungal disease myrtle wilt (*Chalara australis*) caused deaths of myrtle-beech (*Nothofagus cunninghamii*) in rainforests that were subjected to disturbance by developments such as walking tracks (for example at the Franklin River picnic area). This impact primarily affects local aesthetic and tourism values.

Observations of dieback in Cheshunt pine *Diselma archeri* across alpine areas within the Walls of Jerusalem National Park and the Cradle Mountain–Lake St Clair National Park were investigated. This led to the identification of a new species of canker-causing fungus (*Pseudophacidium diselmiae*). The widespread distribution of the fungus combined with the localised nature of the dieback suggests that it is likely to be a natural disease event. No further management was undertaken.

4.8 WEEDS AND OTHER INTRODUCED PLANTS

4.8.1 Overview

ABOUT THE THREAT

Few exotic (non-native) plant species are able to flourish in the low nutrient environments that prevail over much of the TWWHA. However, at least 129 of the approximately 740 exotic plant species (including garden plants) known to have established naturalised populations within Tasmania occur within the TWWHA. Most of these species only occur within disturbed environments such as roadsides or in the vicinity of facilities such as campsites and huts. Introduced species generally fall into two categories of threat with respect to the natural values of the TWWHA—low-risk species and high-risk species.

The majority of introduced species in the TWWHA do not pose any significant threat to the integrity of the populations of native species or to native plant communities. Examples of such low-risk introduced species include bearded oats (*Avena barbata*), sticky bartsia (*Parentucellia viscosa*), and dandelion (*Taraxacum officinale*).

Many low-risk introduced species occur at sites where they have been planted (e.g. at historic settlements including the old town sites at Adamsfield, East and West Pillinger) and at various building sites along the Lyell Highway. Because of the association of these plantings with historical use of the area, some of these plantings are considered to have cultural significance.

In contrast to the above low-risk introduced plant species, a relatively small number of introduced plant species in the TWWHA and adjacent areas have the potential to actively invade and expand within native vegetation, so altering the natural ecology of the area. These high-risk weed species include marram grass, sea spurge, Spanish heath, ragwort, broom, blackberries, Canadian pondweed and holly.

Not all introduced plants in the TWWHA pose a threat to native plant communities. These remnant patches of daffodils, in Adamsfield Conservation Area, indicate the presence of a former house site. Because daffodils are not considered to pose an active threat of invasion to the surrounding native vegetation, management provides for them to be retained because of their association with historical use of the area.

Photo by Barry Batchelor

How was the threat averted or managed over the 1992–1999 period?

PWS District staff undertook weed management actions as and when resources were available—weed management was not centrally coordinated.

- Major weed control actions were undertaken for a number of weed species including ragwort, pampas grass, holly, willows, marram grass and blackberries.
- Weed surveys and mapping were undertaken for the roads and tracks of the TWWHA in the early part of the management period. A coastal weed survey was undertaken in the middle part of the period and an aquatic plant weed survey was undertaken in 1999.
- Consideration of possible cultural significance of plantings associated with historical plantings led to the adoption of a policy of not removing exotic species from historical sites unless those species were considered to pose a significant threat to the integrity of surrounding native vegetation.
- Infestations of marram grass (*Ammophila arenaria*) were discovered in 1997 at extremely isolated coastal dune locations along the southwest coast. These infestations were mapped and sprayed. Detailed information about marram grass and its management over the 1992–1999 period is presented in Section 4.8.2, 'Case study—Eradication program for marram grass'.
- An assessment was conducted of the invasive potential of all exotic species known to occur within the TWWHA for which biological and distribution data were available. This assessment produced a risk rating for many of the exotic species within the TWWHA with which to assist decision-making regarding weed management priorities.

- An environmental weed database was developed in electronic format, which replaced the former Weed Management Manual. The database includes biological, ecological and control information.
- More recently, in 2000, an overall Weed Management Strategy for the TWWHA was completed.

Results

The most significant weed threats that have been addressed by the managing agency's weed management programs are listed in the table below.

Management of weeds in the Tasmanian Wilderness World Heritage Area[31]

Common name	Scientific name	Significance of threat to conservation	Distribution	Abundance	Changes over the 1992–1999 period	Active management program?
Marram grass	*Ammophila arenaria*	Alters coastal geomorphology and can establish monocultures	SW Coast	Small populations	Reduced	Eradication underway at all sites
Blackberries	*Rubus fruticosus* sp. agg.	Displaces native plants	Widespread in northern areas, localised in the Southwest	Small to medium populations	Some populations reduced or eradicated	Eradication in remote areas commenced, control along major roads and visitor centres occurring
Sea spurge	*Euphorbia paralias*	Possibly displacing native plants; stabilising active dune systems	Scattered SW beaches	Small populations	Increasing	No action during 1992–1999. Control recently commenced (2001).
Ragwort	*Senecio jacobaea*	Establishes in disturbed areas of the Plateau	Roadsides and throughout the Central Plateau	Small to medium populations	Steady?	Annual control undertaken.
Holly	*Ilex aquifolium*	Displaces native plants	Lyell Highway	Medium population	Increasing	Control commenced in 2000
Pampas Grass	*Cortaderia richardii*	Displaces native plants	Lyell Highway	Small populations	Populations eradicated	Follow up monitoring
Willow	*Salix* spp.	Alters stream ecology	Lyell Highway	Small populations	Eradicated	Annual control undertaken
Canary broom	*Genista monspessulana*	Displaces native plants, alters fire regimes	Roadsides and garden sites	Small populations	Some populations reduced or eradicated	Annual control undertaken.
Cumbungi	*Typha latifolia*	Alters stream ecology	Huon River and Lake Pedder	Small to medium populations	Increasing	Control commenced in 2000

31 Compiled by Tim Rudman (Flora Section, Resource Management and Conservation Division, DPIWE)

Outcomes

- Weed infestations within the TWWHA are still largely limited to roadsides and localised areas adjacent to huts within the Central Plateau Conservation Area.
- Some weeds continued to expand their populations in the TWWHA over the 1992–1999 period. Spanish heath, gorse, blackberries, Canadian pondweed and holly all have strongholds in the TWWHA that expanded during the period. In particular, there have been increases in the populations of Spanish heath and other weeds along the Strathgordon road, and blackberries have established and spread in coastal and riparian areas.

- Weeds were identified in a variety of new places, including species not previously recorded within the TWWHA e.g. orange hawkweed (*Hieraceum aurantiacum*) which occurs along the Lyell Highway.
- Marram grass (*Ammophila arenaria*) and sea spurge (*Euphorbia paralias*) have recently invaded along the western coastline of the TWWHA. These weeds pose a serious threat to the integrity of natural coastal ecosystems.

Commentary on management performance

The following commentary has been provided by specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- Weed surveillance in remote areas.
- Establishment of weed control projects with dedicated staff in the latter years of the period enabled weed control programs to be completed (rather than being interrupted through staff being required to attend to other management needs).

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Summer weed control programs were often disrupted by the need for staff to respond to critical incidents (e.g. wildfires) which affected performance.
- The length and remoteness of the TWWHA coastline imposes high costs for surveillance and control of coastal weeds.
- The capacity for early detection and quick response to any incursion of marine weeds is low.
- While currently relatively restricted in distribution, some high-risk weed species are already beyond the managing agency's ability to eradicate and require ongoing management effort to contain their distribution, eg. blackberries and sea spurge.
- A long-term risk is posed by a few introduced species that are spreading adjacent to the TWWHA, including *Leycesteria formosa* (Elisha's tears), *Thinopyrum junceiforme* (sea wheat-grass), and marine weeds.
- Serious coastal weed threats have recently emerged which may cause serious loss of conservation value to the coastal ecosystems of the TWWHA. The most threatening species are sea spurge and marram grass. Both are able to invade foredune habitats, altering the morphology of dune systems, replacing native plants as dominants and altering the entire ecology of the coastal environment.

ADDITIONAL COMMENTS

- Neither marram grass or sea spurge is believed to have been present in the TWWHA at the commencement of the 1992–1999 period. Recent control programs implemented for marram grass have proved extremely successful but there will have to be a long-term commitment of considerable resources to control this problem. A methodology for sea spurge control is under development but again there will be ongoing pressure from this highly invasive and prolific species. Sea spurge is a rapid invader that may not be feasible to control in the longer term. If there is no ongoing control program, marram grass and sea spurge are likely to become widespread dominants on TWWHA beaches.

Figure 11

Distribution and abundance of introduced plant species

Introduced plant species in the TWWHA are concentrated around areas of natural or human disturbance e.g. rivers, coasts, roads and human residences. Although high numbers of introduced plant species are associated with residences, only a relatively small number of these plants pose a significant risk of becoming environmental weeds. Within the TWWHA, most recorded weed sites in the central wilderness area reflect a single occurrence or a very small number of individual plants. Conversely, weed sites along the coast, in disturbed areas, and in the north of the TWWHA generally reflect larger weed infestations.

Source: DPIWE GTSpot database

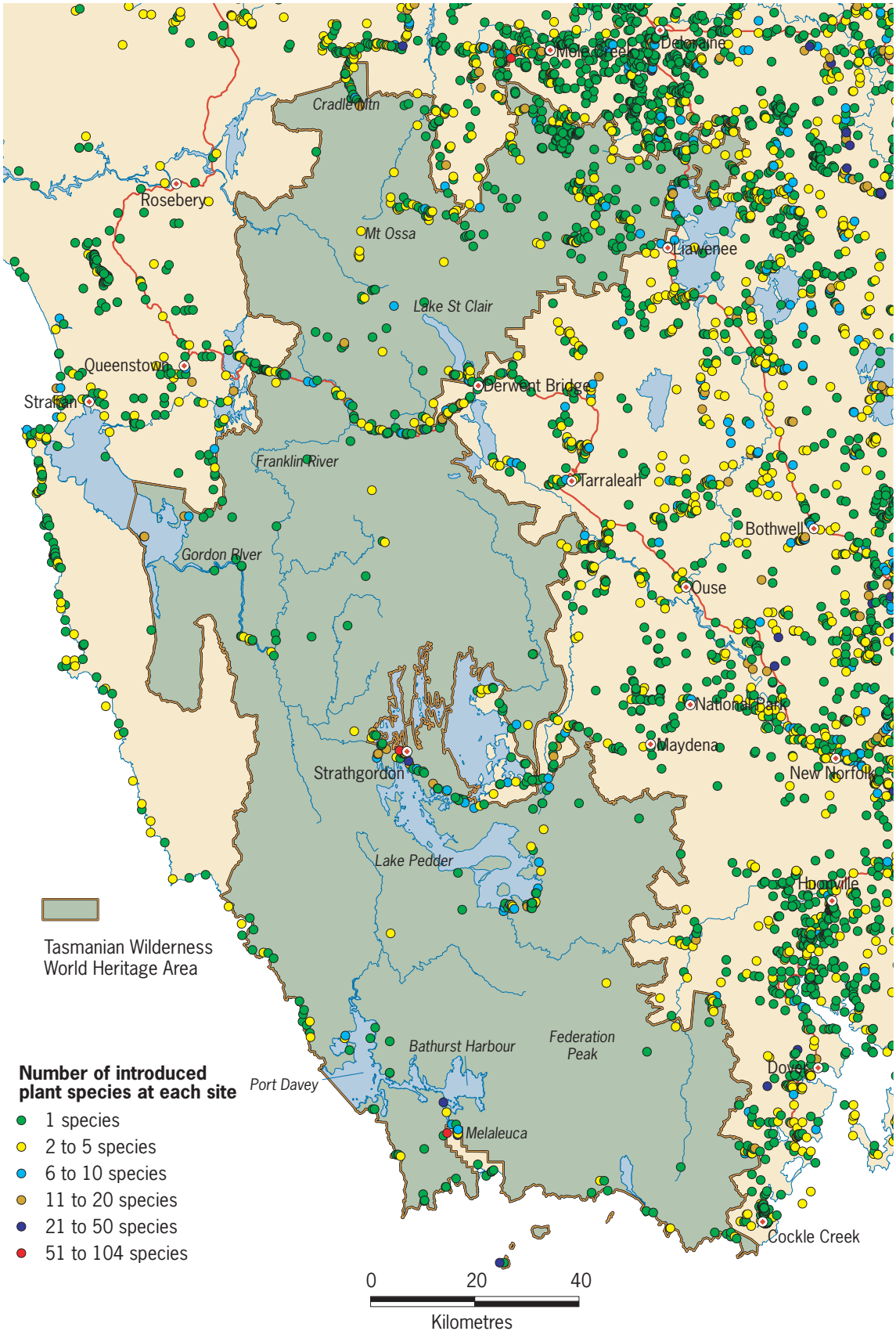
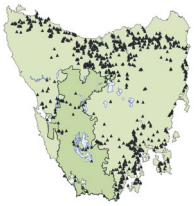


Figure 12 Priority weeds for control in the TWWHA

Site records on GTSpot database

Blackberry (*Rubus fruticosus*)
occurs along the Lyell Highway, Gordon Rd, at Melaleuca, and along coasts and rivers. It is spreading in the southwest.
Photo by Tamar Valley Weed Strategy

Threat: high



Canary Broom (*Genista monspessulana*)
occurs at Strathgordon and Melaleuca. It is spreading in disturbed areas.
Photo by Hans and Annie Wapstra

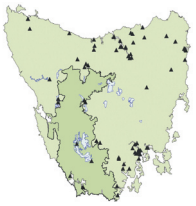
Threat: low

English Broom (*Cytisus scoparius*)
occurs at Strathgordon, Melaleuca and Lake St. Clair. It is spreading in disturbed areas.
Photo by Tim Rudman

Threat: low

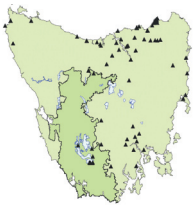
Cotoneasters (*Cotoneaster spp*)
were planted near dwellings at Lake St. Clair, Marakoopa Cave, Strathgordon, Melaleuca, Bond Bay and introduced at Scotts Peak. They have some potential to spread, at least in the northern half of the World Heritage Area.
Photo by Tim Rudman

Threat: medium



Cumbungi (*Typha latifolia*)
is an aquatic plant that occurs at Lakes Pedder and Gordon. It is spreading in lake systems and rivers with low flow, and is usually spread by ducks.
Photo by Tim Rudman

Threat: medium



Elisha's tears (*Leycesteria formosa*)
occurs at Strathgordon township. It is spreading in undisturbed areas adjacent to the World Heritage Area.
Photo by Tim Rudman

Threat: high

English Holly (*Ilex aquifolium*)
occurs at Lake St. Clair, Nelson Creek, Kelly Basin, Mt. McCall, and Strathgordon. All but the Mt. McCall sites are associated with settlements. Holly is spreading in undisturbed areas.
Photo by Tim Rudman

Threat: high

Gorse (*Ulex europaeus*)
occurs along the Lyell Highway near Maydena. It is spreading in disturbed areas.
Photo by Birgit Kruse

Threat: low

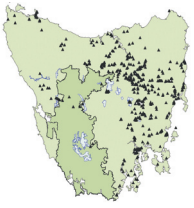


Figure 12 Priority weeds for control in the TWWHA continued

Site records on GTSpot database

Marram Grass (*Ammophila arenaria*) occurs within the World Heritage Area only at Towterer Beach. It is spreading down the west coast from Cape Sorell.

Photo by Tim Rudman

Threat: high

Montbretia (*Crocosmia x crocosmiiflora*) occurs along the Lyell Hwy, at Melaleuca, Lake St. Clair and Nelson Creek. These sites are all near settlements.

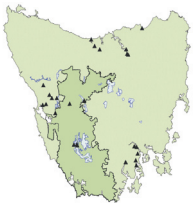
Photo by Tim Rudman

Threat: medium

Pampas grass (*Cortaderia spp*) occurs at Collingwood, Lake St. Clair and Nelson Creek. Spread is limited to disturbed areas.

Photo by Tim Rudman

Threat: low



Pines (*Pinus spp*) are planted near dwellings at Great Lake near Lake Burbury (a small plantation), Strathgordon and Melaleuca. Spread is mainly in disturbed areas.

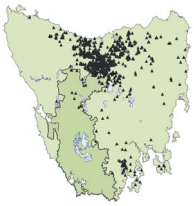
Photo by Tim Rudman

Threat: medium

Ragwort (*Senecio jacobaea*) is invasive on the Central Plateau and is spreading along roadsides.

Photo by Christian Goninon

Threat: high



Spanish heath (*Erica lusitanica*) occurs along the Gordon Road and at Strathgordon. It spreads along roadsides and has the potential to invade recently rehabilitated quarries and tracks

Photo by Tim Rudman

Threat: medium

Willows (*Salix spp*) were planted near dwellings along the Lyell Highway and at Melaleuca. There is little chance of willows spreading at Melaleuca.

Photo by Tamar Valley Weed Strategy

Threat: low to medium

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving the management of weeds.

- Provide additional funding for monitoring and control of high-risk weeds such as marram grass, seaspurge and blackberries from remote areas in the TWWHA.

SOURCES OF INFORMATION AND COMMENT

Tim Rudman (Protection Officer, Flora Section, Nature Conservation Branch, DPIWE). Email:tim.rudman@dpiwe.tas.gov.au, Ph. 6233 3912.

Jennie Whinam (Botanist WHA northern region), Nature Conservation Branch, DPIWE), Email:jenniew@dpiwe.tas.gov.au, Ph. 6233 6160.

Jayne Balmer (Botanist WHA southern region, Nature Conservation Branch, DPIWE), Email: Jayne.Balmer@dpiwe.tas.gov.au, Ph. 6233 6160.

4.8.2 Case study— Eradication program for marram grass (*Ammophila arenaria*)

About the threat

WHAT IS THE THREAT?

The introduced weed marram grass (*Ammophila arenaria*) is spreading down the west coast of Tasmania into the TWWHA from northern Tasmania. Fragments of rhizomes washed ashore are the most likely source of new infestations.

WHAT NATURAL OR CULTURAL VALUES ARE AFFECTED?

Marram grass significantly changes the geomorphic dynamics of natural sand dune systems and displaces the native coastal vegetation. Marram grass is very effective at trapping sand and this leads to the formation of steep foredunes and reduced mobility of naturally active dune systems.

Nesting sites of some shore birds such as the hooded plover may be reduced as a result of the changes brought about by marram grass.

Native dune vegetation on the west coast of Tasmania is dominated by a wide variety of herbs, grasses, sedges and shrubs as seen in this photo.

Photo by Phil Cullen

Marram grass has invaded parts of the TWWHA coastline and is a serious threat to natural coastal ecosystems. Marram displaces native vegetation and changes the shape and dynamics of natural dunes.

Photo by Mike Pemberton

Background to management

Marram grass had been recorded from the southwest of Tasmania in the past but there is no detailed documented history.

How was the threat averted or managed over the 1992–1999 period?

OVERALL MANAGEMENT GOAL: to eliminate marram grass from the TWWHA and adjacent coastlines in order to protect TWWHA beach and dune systems.

MANAGEMENT ACTIONS AND SIGNIFICANT EVENTS OVER THE 1992–1999 PERIOD

- The distribution of marram grass in the TWWHA was mapped in 1997 and the impact of marram grass on natural dune systems was documented (Cullen 1998).
- Control options for marram grass were investigated.
- Spraying of all infestations over approximately 90km of coastline with herbicide was undertaken in 1999 and achieved considerable success.

Results

MONITORED PRESSURE INDICATORS

Pressure indicators (and how they are monitored)	**Targets for pressure indicators** (and how performance is assessed)	**Change in pressure indicators over the 1992–1999 period**
DISTRIBUTION OF MARRAM GRASS: Records of new locations; number and location of beaches with marram grass; extent of marram grass on affected beaches. The distribution of marram grass is mapped by foot, air and boat surveys. Re-surveys are to be conducted periodically.	INTERIM TARGET: All marram infestations in the TWWHA eradicated or under treatment programs by 2003. ABSOLUTE TARGET: All marram grass infestations within the TWWHA removed by 2003. ASSESSMENT OF PERFORMANCE: Monitored reduction in marram infestations with treatment.	There has been no repeat survey of marram grass since the original 1997 baseline mapping, so it is not possible to determine changes in distribution.

Outcomes

- Knowledge has been gained about the distribution and environmental impacts of marram grass in southwest Tasmania.
- Marram grass occurs inside the TWWHA at Towterer Beach and is distributed extensively along the coast of the Southwest Conservation Area north of Low Rocky Point.
- Trials demonstrated that herbicide spraying provides a practical means of eradicating infestations of the weed.
- A control program of herbicide spraying is in progress over approximately 90km of coastline.

Commentary on management performance

The following commentary has been provided by specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- On-staff presence of personnel with relevant professional expertise to recognise and raise awareness of the problem.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Lack of availability of resources for remote area work during peak summer work periods.
- Cost of operations.
- Weather-dependent timing of operations.
- Potential for spread and new colonisations of the weed.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of marram grass.

- Provide additional funding for eradication of marram grass and other high-risk weeds such as seaspurge and blackberries from remote areas in the TWWHA.
- Conduct regular resurveys.

SOURCES OF INFORMATION AND COMMENT
RMC Flora Section and RMC Earth Science Section, Marram grass project:
Mike Pemberton (Ph: 6233 6405), Tim Rudman (Email: tim.rudman@dpiwe.tas.gov.au, Ph. 6233 3912) and Shane Breen (Ph: 6471 7379)

Michael Pemberton (Senior Earth Scientist) joined the Department in 1988 as the first officer appointed in Tasmania to oversee identification and conservation of geodiversity. Mike was responsible for investigating problems of streambank erosion on the Gordon River and for managing investigations into the impact of quarrying on the Exit Cave area. The quarry was eventually closed and the site rehabilitated. Other major projects that Mike has been involved in have included studying the impact of marram grass on the conservation values of the Southwest dunefields, and assessments and rehabilitation of erosion on the Central Plateau. Mike is currently supervising a project investigating fire regimes in TWWHA peatlands over the last 6,000 years—a time period during which there have been relatively minor climatic fluctuations. The aim of this project is to contribute to sustainable fire management in the TWWHA.

Photo by Sophie Underwood

4.9 Introduced animals

4.9.1 Overview

About the threat

The presence of introduced animals in the TWWHA impacts on the natural ecology of the area in a variety of ways e.g. through predation, browsing, competition, disease or direct damage to habitats. The presence of introduced animals may also detract from visitor appreciation and enjoyment of the unspoilt natural qualities of the area.

Compared with the rest of Tasmania, the TWWHA contains relatively few introduced animals, both in terms of species and numbers. This is largely a result of limited human disturbance in the TWWHA and the relatively harsh environment of western and alpine Tasmania.

At least 80 species of introduced animals are known to occur in Tasmania, of which 39 have been recorded from the TWWHA. Eight mammal species, 11 birds, 4 fish, and 16 introduced invertebrates have been recorded. No introduced reptiles or frogs have been recorded from the TWWHA. There are likely to be many more introduced invertebrates in the TWWHA (and Tasmania as a whole) than are currently known.

The existing introduced animals that are considered the highest threats to the natural ecology of the TWWHA are trout (both brown and rainbow), goats, rabbits, starlings, lyrebirds, European wasps and bumblebees.

There is also concern that introduced animals that are currently not present in the TWWHA may potentially be introduced to the area and become established. For example, red fin perch, which are currently limited to Lake Gordon (outside the TWWHA), could potentially make their way through the McPartlan Pass canal and into Lake Pedder (inside the TWWHA) and so further impact on the aquatic ecosystem. Carp, which were discovered in Lakes Crescent and Sorell in 1995, have the potential to cause serious ecological impacts if introduced to the TWWHA

There have also been reported attempts to introduce deer into natural areas of Tasmania. There is particular concern about the potential for the adaptable subspecies of the fallow deer—the Mesopotamia deer (*Dama dama mesopotamica*)—to become established. Other reported attempted introductions include the red deer (*Cervus elaphus*), the Sambar (*Cervus unicolor*), and attempts to relocate fallow deer (which are established in eastern Tasmania) to parts of western Tasmanian where they could become established.

More recently, sightings of foxes in eastern and northern Tasmania are of grave concern to the integrity of the state's native fauna and ecosystems. Should the fox become established, it would be expected to have a severe impact on several Tasmanian endemic species that occur in the TWWHA (including the Tasmanian pademelon and long-tailed mouse) as well as several species that have the majority of their range within the TWWHA (including the broadtooth mouse and ground parrot). Options for controlling foxes within the TWWHA would be likely to be severely limited by the remote and rugged mountainous landscape.

How was the threat averted or managed over the 1992–1999 period?

- Prevention of the introduction of new exotic species to the TWWHA was mainly focused on preventing the spread of exotic fish species and managing the use of live bait by freshwater anglers. For example, the 1999 TWWHA management plan prohibited baitfishing in the TWWHA except at Lakes Augusta and MacKenzie in the Western Lakes region. In relation to the threat of spread of redfin perch, the Inland Fisheries Service (IFS) in conjunction with Hydro Tasmania mounted a major control program to prevent the spread of redfin perch from Lake Gordon to Lake Pedder. This included active management by Hydro Tasmania of waterflows within the McPartlan Pass canal (between Lake Pedder and Lake Gordon) to reduce the likelihood of redfin perch migrating into Lake Pedder. IFS undertook surveys to determine the distribution of redfin perch within the area.
- Two major eradication programs for introduced animal species were undertaken—a statewide feral goat eradication program and a local eradication program for rabbits in the Strathgordon area. Detailed information about goats and their management over the 1992–1999 period is presented in Section 4.9.2 'Case study—Eradication of goats program'.
- A rabbit eradication plan for the town of Strathgordon was developed in consultation with all stakeholders. Following the introduction of myxamatosis in 1998, monitoring revealed that 52% mortality was achieved. This was then followed by a shooting program and the fencing of 25ha to provide a barrier to rabbit movement and to allow for rehabilitation of degraded areas. By the end of spring 1999, no rabbits could be detected using the standard monitoring technique but 1 or 2 rabbits were still known to be present. Through a combination of shooting and rabbit dogs, these rabbits were destroyed, and no rabbits have been detected since January 2001. Monitoring will continue for 2 years before the area is declared rabbit-free. In other areas, rabbits continue to cause significant impacts on the condition of alpine and montane vegetation especially on the Central Plateau.
- A program was implemented to eliminate starlings from the breeding habitat of the orange-bellied parrot at Melaleuca. Starlings were shot and a nest destroyed in orange-bellied parrot breeding areas at Melaleuca and Birchs Inlet.
- Other management actions for feral animals included cat trapping; rat control at public huts; and destroying of wasp nests in response to reported sightings. There was no centrally coordinated approach to introduced animal management within the department during the 1992–1999 management period and districts undertook control actions in response to sightings by the public or departmental staff.
- Methods to control cats using poisoned bait stations were investigated but following trials were deemed unsuitable as no bait dispenser could be devised that prevented other species from accessing the bait. Ad hoc feral cat control is largely ineffective as other cats establishing new territories soon replace any animals removed. Control is only effective in localised areas and eradication is not possible.
- Rat surveys were conducted along the Lyell Highway in areas that were once settled, and some rat control was undertaken at public huts.
- Localised control of wasps occurred at visitor nodes (e.g. Heritage Landing, Hastings Caves). Strategies for control of selected wasp populations were developed and parasitic wasps were released at Hastings Caves and Cockle Creek. However, these have not been effective to date in controlling wasp numbers.
- The managing agency also supported postgraduate research projects investigating the impacts of trout on aquatic communities (Elvey, 2002), and the impact of honeybees on leatherwood forests (Mallick, 2001). These studies have shown that trout can significantly alter the community structure of aquatic systems, and that honeybees have minimal impact on native species in leatherwood forests; however, there may be potential for impacts in some areas where nectar production is low and native insect abundance is high The Inland Fisheries Service conducted surveys to determine the distribution and abundance of native and exotic fish species within the Lower Gordon River and associated tributaries.

Barney Howell (Project Officer, Feral Animal Control) has been involved with the eradication of feral goats statewide, the eradication of starlings from Melaleuca and the eradication of rabbits from Strathgordon.
Photo by Sophie Underwood

Stephen Mallick, PhD student, videotaping leatherwood flowers to record insect visitors. The managing agency contributed funds to Stephen's research project to study the impacts of honeybees on leatherwood in the TWWHA. The study concluded there was very little evidence of impact either on pollination of the plants or on the invertebrate community.
Photo by Mike Driessen

Results

MANAGEMENT OF INTRODUCED ANIMALS IN THE TWWHA[32]

1. Introduced Mammals

Common Name	Scientific Name	Significance of threat to conservation	Distribution	Abundance	Changes over the 1992–1999 period	Active Management Program?
MAMMALS						
Goat	*Capra hircus*	High	Limited mostly to highland areas	Low	Populations now eradicated	Yes, regular shooting of herds over the 1992–1999 period
Rabbit	*Oryctolagus cuniculus*	Medium–high	Central Plateau, Strath-gordon, Breaksea Island	Locally abundant	Population probably eradicated at Strathgordon	Yes, poisoning and shooting at Strathgordon
Cat	*Felis catus*	Medium	Widespread	Low	None	Yes, occasional trapping and shooting
Fallow deer	*Dama dama*	Low	Limited to edge of central highlands	Low	None	Yes, eradicate any incursions into TWWHA
Dog	*Canis familiaris*	Low	Limited	Probably absent	None	No
Black rat	*Rattus rattus*	Low	Limited	Low	None	Yes, some trapping
Sugar glider	*Petaurus breviceps*	Low	Widespread	Common	None	No
House mouse	*Mus musculus*	Low	Limited	Low	None	No

2. Introduced Birds

Common Name	Scientific Name	Significance of threat to conservation	Distribution	Abundance	Changes over the 1992–1999 management period	Active Management Program?
Common starling	*Sturnus vulgaris*	Medium	Limited to coastal areas and human settlements	Locally common	Virtually eradicated from Melaleuca but on-going control will be required. Reduction in numbers at Birchs Inlet	Yes, control in orange-bellied parrot breeding areas
Superb lyrebird	*Menura novaehollandiae*	Medium	Limited but increasing in wet forested areas	Locally common	Increasing in range and abundance	No, but some research on impacts has been undertaken
Common blackbird	*Turdus merula*	Unknown, probably medium	Widespread	Rare	None	No
European greenfinch	*Carduelis chloris*	Unknown, probably low	Limited	Possibly vagrant	None	No

32 Compiled by Michael Driessen (Fauna Section, Resource Management and Conservation Division, DPIWE)

2. Introduced Birds (continued)

Common Name	Scientific Name	Significance of threat to conservation	Distribution	Abundance	Changes over the 1992–1999 management period	Active Management Program?
European goldfinch	*Carduelis carduelis*	Unknown, probably low	Limited	No residents, mostly winter flocks	None	No
Skylark	*Alauda arvensis*	Unknown, probably low	Probably absent	Probably absent	None	No
Laughing kookaburra	*Dacelo novaeguineae*	Unknown, probably low–medium	Limited to eastern and northern margins of the TWWHA	Low	Possibly increasing in range within the TWWHA	no
House sparrow	*Passer domesticus*	Unknown, probably low	Limited to human settlements	Low	None	No
Mallard	*Anas platyrhynchos*	Unknown, probably medium	Limited	Low	None	No
Spotted turtledove	*Streptopelia chinensis*	Low	Probably absent only one record	Probably absent	None	No
Feral pigeon	*Columba livia*	Low	Probably absent, only one record	Probably absent	None	No

3. Introduced Freshwater Fish

Common Name	Scientific Name	Significance of threat to conservation	Distribution	Abundance	Changes over the 1992–1999 period	Active Management Program?
Brown trout	*Salmo trutta*	High	Widespread	Common	Possibly small increase in range due to illegal stocking	Managed for recreational fishing purposes. Study into impacts on native species
Rainbow trout	*Oncorynchus mykiss*	Medium	Limited to various lakes	Locally common	Increase in range due to illegal stocking	Managed for recreational fishing purposes
Redfin perch	*Perca fluviatilis*	High	Lake Gordon only	Locally common	Potential for spread into Lake Pedder	Control of McPartlan Canal to stop spread into lake
Brook trout	*Salvelinus fontinalis*	Low	Clarence Lagoon only	Locally common	None	Managed for recreational fishing purposes
Atlantic salmon	*Salmo salar*	Unknown	Limited to various lakes	Unknown	Possibly increased	No

4. Introduced Terrestrial Invertebrates

Common Name	Scientific Name	Significance of threat to conservation	Distribution	Abundance	Changes over the 1992–1999 period	Active Management Program?
Scarab beetle	*Aphodius fimetarius*	Unknown	Limited	Unknown	None	None
Honeybee	*Apis mellifera*	Low	Widespread	Common	None	Management of Apiary Locations in WHA. Study completed into impacts on native fauna and flora
European wasp	*Vespula germanica*	Medium	Widespread	Common	None	Nests destroyed when located
Bumblebee	*Bombus terrestris*	Medium	Increasing	Increasing	First recorded in 1992 and have since spread to many parts of the state including the TWWHA.	Some research on impacts completed. Other research being undertaken
Millipede	*Cylindroiulus latestriatus*	Unknown	Unknown	Unknown	Unknown	No
Gastropod	*Arion intermedius*	Unknown	Unknown	Unknown	Unknown	No
Gastropod	*Lehmannia nyetelia*	Unknown	Unknown	Unknown	Unknown	No
Gastropod	*Lithobus microps*	Unknown	Unknown	Unknown	Unknown	No
Gastropod	*Oxychrilus cellarius*	Unknown	Unknown	Unknown	Unknown	No
Earthworm	*Lumbricus rubellus*	Unknown	Unknown	Unknown	Unknown	No
Springtail	*Hyporgastrura purpurescens*	Unknown	Unknown	Unknown	Unknown	No
Springtail	*Hyporgastrura (Ceratophy-sella) communis*	Unknown	Unknown	Unknown	Unknown	No
Aphid	Sitobion sp	Unknown	Unknown	Unknown	Unknown	No

5. Introduced Marine Invertebrates

Common Name	Scientific Name	Significance of threat to conservation	Distribution	Abundance	Changes over the 1992–1999 period	Active Management Program?
Crab	*Cancer novaezelan-diae*	Low	Limited	Uncommon	Unknown	No
Pill box crab	*Halicarcinus innominatus*	Low	Limited	Uncommon	Unknown	No
Bryozoan	*Membranipora membranacea*	Unknown	Widespread	Common	Unknown	No

Outcomes

- Goats were eradicated from the TWWHA, and more broadly, significant progress was made towards eradicating feral goats from the state of Tasmania. Within the TWWHA, all 14 known sites for feral goats on the Central Plateau have now been declared inactive. Monitoring is continuing to check for any occurrences.
- Rabbits have probably been eradicated from Strathgordon, although several years of monitoring will be required to confirm this.
- Starlings have virtually been eradicated from the breeding habitat of the endangered orange-bellied parrot at Melaleuca. However, there remains the potential for re-invasion.
- There was no known establishment of new introduced species in the TWWHA.
- A number of introduced animals are known to have extended their distribution and abundance in the TWWHA over the 1992–1999 period, as follows:
  - Trout have been illegally introduced and become established in lakes and rivers in the TWWHA that were previously trout-free (e.g. Lake Bill, Lake Ayr, Lake Myrtle, Lake Louisa). See Section 2.5.2 'Law enforcement and compliance issues'.
  - Lyrebirds (which were introduced[33] to Tasmania from mainland Australia in the 1930's and 40's) have spread further into wet forests within the TWWHA and now occur in wet forest in the vicinity of Tarraleah and the King William Range as well as on the South Coast Track. Lyrebirds are considered likely to continue spreading in the future. Although there is no evidence they are directly threatening native species, lyrebirds may be changing the character of forests by reducing the amount of ground ferns and saplings (Tanner, 2000).
  - Kookaburras (introduced from mainland Australia in 1906) have spread along the northern and eastern margins of the TWWHA.
  - Bumblebees (which were introduced into Tasmania sometime in the early 1990's) have now spread well into the TWWHA. Eradication of bumblebees is no longer considered a practicable option.

Commentary on management performance

The following commentary has been provided by specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- Identification of realistic control or eradication options.
- Development of management plans for control or eradication.
- Securement of funds to undertake control or eradication programs.
- Committed staff to implement the programs.
- Partnerships between DPIWE and University of Tasmania resulted in cost-effective research projects that increased knowledge about the impacts of introduced animals.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Difficulty and expense of controlling or eradicating introduced animals once they have become established.
- Remoteness and difficulty of access of the vast majority of the TWWWHA.
- New introductions of exotic species into Tasmania e.g. bumblebees and the possible introduction of foxes.

33 Lyrebirds were introduced to Tasmania from Victoria for conservation purposes as it was considered the species was at risk of extinction (Tanner, 2000).

- Lack of knowledge about the impacts of most introduced animals on the natural ecosystem hampered the prioritisation of management effort.
- Lack of public awareness about which animals are introduced species and about their ecological impacts e.g. many Tasmanians believe trout are native species.
- For some species, management options for control are limited by high community social values on the species e.g. trout and deer.
- Delays or lag time in the notification of all relevant authorities in the event of the introduction of an exotic animal.

ADDITIONAL COMMENTS

- The key to feral animal management is to prevent exotic (non-native) species from becoming established in Tasmania in the first place. Once an animal has become established, it is notoriously difficult to remove it.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of introduced animals.

- Improve quarantine control measures to prevent introduced animals from establishing in Tasmania.
- Educate public about the risks of introducing exotic animals to Tasmania.
- Increase knowledge about the impacts of introduced animals, particularly with a view to identifying specific values that may be threatened.

SOURCES OF INFORMATION AND COMMENT

Mike Driessen (WHA Zoologist, Nature Conservation Branch, DPIWE,
Email:michael.driessen@dpiwe.tas.gov.au, Ph.6233 3751.

Figure 13

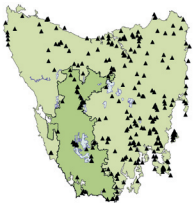
Introduced animals of significance to the TWWHA

(a) Mammals—cat, rabbit and goat

Site records on GTSpot database

Feral cats (*Felis catus*) occur throughout much of the TWWHA. Currently they are not considered a significant threat to the conservation status of native species in the area. However, if feral cats become established at Melaleuca or Birchs Inlet, the endangered orange-bellied parrots may be at greater risk.

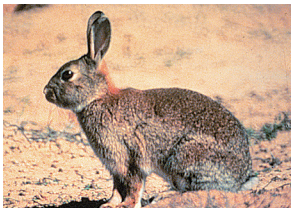
Photo by Trevor Norris, PWS

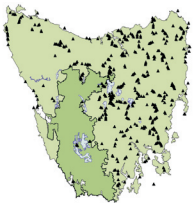


Threat: medium

Rabbits (*Oryctolagus cuniculus*) are common and widespread on the Central Plateau and also occur in isolated populations at Strathgordon and Breaksea Island. Rabbits compete with native animals and cause soil erosion while rabbit grazing also hinders the regeneration of newly planted seedlings of native trees such as pencil pines. An eradication program at Strathgordon is believed to have removed all rabbits from this site. On the Central Plateau eradication is not considered possible. In areas of rehabilitation, grazing exclosures have been established to allow vegetation to regenerate.

Photo by PWS, Interpretation Unit





Threat: medium

Feral goat (*Capra hircus*) were established and increasing in the TWWHA at the commencement of the 1992 management period. An active statewide feral goat eradication program between 1994 and 2001 removed a total of over 2,500 goats and achieved outstanding results. Within the TWWHA, the original 9 herds of goats (consisting of about 230 animals) are now believed to have been removed. A monitoring program is continuing to check for any recurrences.

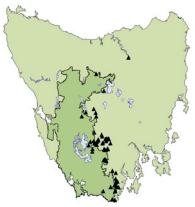
Photo by Hans and Annie Wapstra

Refer to Figure 13(e), page 96

(b) Birds—lyrebird and starling

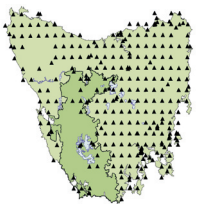
Lyrebirds (*Menura novaehollandiae*) were originally introduced to Mt Field and Hastings Cave Scenic Reserve in the 1930s and 40s. Since then, they have spread to Meander in the north, Butlers Gorge in the west and South East Cape. Little is known about the impact of lyrebirds; however a recent study found that in areas where lyrebirds are present, there are less ferns and saplings. Lyrebirds are spreading throughout wet forests in Tasmania.

Photo by P. Green, NSW National Parks and Wildlife Service



Threat: medium

European starlings (*Sturnus vulgaris*) occur at Melaleuca and Birchs Inlet in the Tasmanian Wilderness WHA. State-wide, starlings occur in locally abundant populations in association with human settlement and along some coastal areas. Starlings can impact on the endangered orange-bellied parrot by taking up their nest sites; however, starling populations at Melaleuca are actively controlled to protect the breeding success of the orange-bellied parrot.



Threat: high

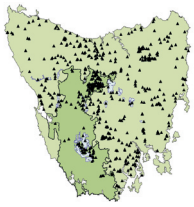
Note: Unlike the other maps in this series, the European starling map displays a regular grid pattern of distribution because the map is based on data from the Birds Australia database which records data in blocks of 280 x 280 km (equivalent to 10 minutes on a map) rather than actual site records (as are recorded in the DPIWE GTSpot database).

(c) Fish—trout and redfin perch

Site records on GTSpot database

Brown trout (*Salmo trutta*) occur throughout much of the TWWHA. Trout threaten several native fish species and significantly impact on freshwater communities.

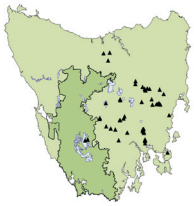
Photo by Inland Fisheries Service



Threat: high

Redfin perch (*Perca fluviatilis*) occur at Lake Gordon, just outside the TWWHA. Redfin perch pose a threat to native galaxid fish species. Hydro Tasmania controls waterflow in the canal between Lake Gordon and Lake Pedder in an attempt to prevent the introduction of Redfin perch into Lake Pedder.

Photo by Inland Fisheries Service



Threat: high

(d) Invertebrates—honeybee, bumble bee and European wasp

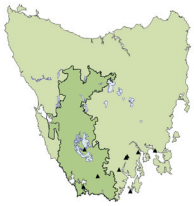
Honey bees (*Apis mellifera*) are widespread throughout the TWWHA. Studies on the ecological impact of commercial honey bees show there is a decrease in the available nectar and pollen in leatherwood forests; however this does not appear to affect native insects due to the superabundance of the nectar.

Photo by Michael Driessen

Threat: low

Bumble bees (*Bombus terristris*) are spreading throughout the TWWHA. Research shows that they compete with native bees in nectar collecting; however the impacts are not yet known.

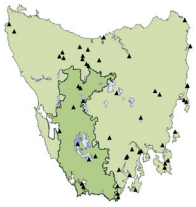
Photo by Roger Buttermore



Threat: unknown

European wasps (*Vespula germanica*) are found throughout the TWWHA but are most common near visitor sites where they are attracted to people's food and drink. Wasps are predatory animals and their prey includes the endangered Ptunnara brown butterfly. Wasps also detract from visitor enjoyment.

Photo by Birgit Kruse



Threat: high

Note: These maps of the distributions of honey bees, bumble bees and European wasps probably underestimate the true extent of distribution of these species due to the low levels of data records in the DPIWE GTSpot database.

4.9.2 Case study—
Eradication of goats program

About the threat

WHAT IS THE THREAT?
Breeding populations of feral goats have become established in many parts of Tasmania, including sites on the Central Plateau within the TWWHA.

WHAT NATURAL OR CULTURAL VALUES ARE AFFECTED?
Goats eat, and significantly degrade, natural vegetation communities, including threatened plant species.

Background to management

A 'Judas goat' ready for release. Judas goats played an important role in the eradication of feral goats from the TWWHA. Judas goats are so named because they are fitted with radio collars and then released into the wild where they join up with feral herds of goats. The radio collars enable the herds to be subsequently located and destroyed.

Photo by Val Dell

Goats have been feral in Tasmania for many years. During the 1980s there was a rapid increase in the farming of goats, which later declined. Many goats in farmland areas adjacent to the TWWHA escaped or were set free, and breeding populations of feral goats became established in the TWWHA.

A survey of feral goats in 1991 found 9 herds in the TWWHA. A feral goat control program commenced in 1991.

How was the threat averted or managed over the 1992–1999 period?

OVERALL MANAGEMENT GOAL: to eradicate feral goats from the TWWHA and the state of Tasmania.

MANAGEMENT ACTIONS AND SIGNIFICANT EVENTS OVER THE 1992–1999 PERIOD

- The feral goat control program in the TWWHA continued. In 1994, the program was extended to become a statewide feral goat eradication program.
- Goats were shot either from on foot or from helicopter. Shooting from helicopters proved to be the more efficient method, particularly in rough terrain.
- 'Judas goats' (i.e. goats fitted with radio transmitter collars) were released in areas where feral goats were relatively numerous. The Judas goats mixed with the feral herds and thereby allowed the feral herds to be located and destroyed.
- Any reported sightings of goats in the TWWHA were investigated by a Wildlife Ranger and, if confirmed, action was immediately taken to control or eradicate the animals. Experience has demonstrated that it is much easier and more effective to eliminate new herds as they are located, rather than after delaying for several years.
- Community liaison and education was undertaken to raise awareness of the problem and encourage good practices.

Results

MONITORED CONDITION INDICATORS

Condition indicators (and how they are monitored)	**Targets for condition indicators** (and how performance is assessed)	**Change in condition indicators over the 1992–1999 period**
RE-GROWTH OF VEGETATION COMMUNITIES DAMAGED BY GOATS: Monitored by direct observation and measurement of vegetation regrowth by photo monitoring and vegetation transect sampling plots.	TARGET: No evidence of browsing damage to vegetation caused by goats.	Monitored plots outside the TWWHA (at Lake Leake, Pawleena, Moorina, Orford, Gunners Quoin and Mt Wellington) demonstrated full recovery of vegetation 2 years after the removal of goats. There is no remaining evidence of browsing damage. Vegetation plots within the TWWHA were monitored in 1997; however direct observation indicates that there has been much regeneration of vegetation in the locations where goats have been eradicated.

MONITORED PRESSURE INDICATORS

Pressure indicators (and how they are monitored)	**Targets for pressure indicators** (and how performance is assessed)	**Change in pressure indicators over the 1992–1999 period**
SIGHTINGS OF GOATS: The number and location of reported sightings of goats.	TARGET: No feral goats in the World Heritage Area by 2003. ASSESSMENT OF PERFORMANCE: No sightings of goats.	Between 1991 and 1994, the number of herds of goats in the World Heritage Area increased from 9 to 15. All fifteen of these herds have since been eradicated. In total, over 200 goats have been removed from the TWWHA. There is no evidence of ongoing recruitment of goats from neighbouring areas.

Outcomes

- Feral goats have been eradicated from the TWWHA.
- There is no evidence of ongoing recruitment of goats to the TWWHA from neighbouring areas, although there remains a potential for incursions.
- The statewide feral goat eradication program, which commenced in 1994, removed 3,100 goats from 153 sites around the state and resulted in the elimination of feral goat populations from many sites (see Figure 13(e), page 96).

A large feral billy goat—a sight no longer likely to be encountered in the TWWHA thanks to the success of the feral goat eradication program in the TWWHA. A statewide feral goat eradication program is continuing.
Photo by Hans and Annie Wapstra

Commentary on management performance

The following commentary has been provided by specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- Securing funding for helicopter use and for employment of a project officer to undertake goat control, investigations of sightings and community liaison.
- Active control programs for feral goats have been very effective in reducing the numbers of goats in the TWWHA and statewide.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Difficulties of accessing and locating goats in remote locations, and weather-related limitations on helicopter use e.g. operations were usually restricted to summer months.

Glenn Atkinson (Wildlife Ranger) is responsible for the on-ground coordination of the feral animal control program. Glenn also deals with matters related to law enforcement in the TWWHA, including fire investigations, the control of recreational vehicles, and investigations into the poaching of Huon pine and other valuable timbers.

Photo by Sophie Underwood

- Lack of funds to maintain intensity of goat eradication programs (for example, NHT funds were secured in 1997 but not again until 2001.)

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of feral goats.

- Monitoring needs to continue for any new sightings of goats in the area, with appropriate eradication response as needed.
- Prevention of recruitment of feral goats from domestic goats on neighbouring properties needs to be continued through ongoing community liaison and education.

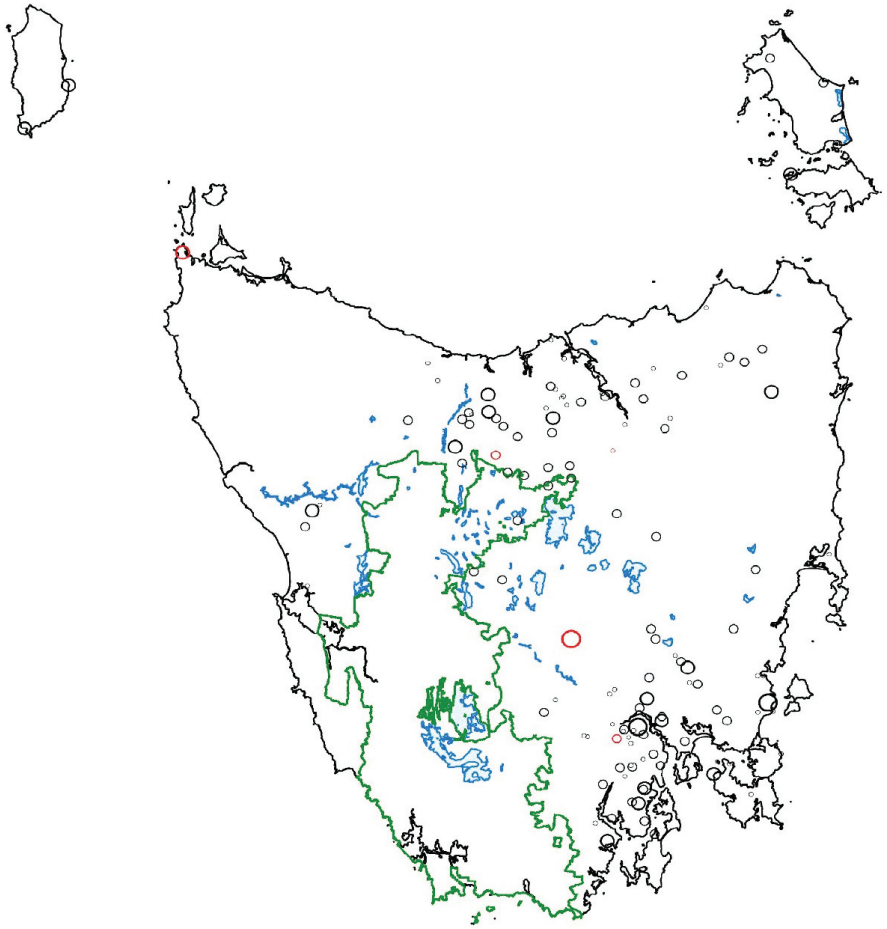
SOURCES OF INFORMATION AND COMMENT

Irynej Skira (Wildlife Biologist, Fauna Section, RMC, DPIWE), Feral Goat Program. Email: Irynej.Skira@dpiwe.tas.gov.au, Ph 6233 6372.

Glenn Atkinson (Wildlife Ranger) Glenn.Atkinson@dpiwe.tas.gov.au, Fax: 6233 3477.

Figure 13(e)

Progress in the eradication of feral goats, 1994–2001



Between 1994 and 2001, the feral goat eradication program removed over 2,500 goats which resulted in the elimination of goats from the Tasmanian Wilderness World Heritage Area and from most other sites statewide. Black circles indicate sites where goats were eradicated. Red circles indicate sites where goats still remain.

Number of goats removed from sites.

<10 11–50 51–100 >100

Note that data are only available for the number of goats removed from sites and not for original population size estimates.

4.10 TOURISM AND VISITOR ACTIVITIES AND USE

4.10.1 Overview

About the threat

In general, tourism and visitor activities and use of the TWWHA are a welcome and desired component of the overall management strategy for the TWWHA. Under some circumstances however, these activities can pose a threat to the natural or cultural values. When adverse impacts do occur, they are generally associated with the following situations:

1. Visitor activity, use or even presence damages, disturbs or disrupts fragile or vulnerable life forms, features, sites, or natural processes. For example cushion plants are damaged when trodden on and are slow to recover; root rot disease can be spread by mud on walkers' boots; cave visitors can accidentally break delicate cave formations or walk mud onto pristine crystalline surfaces which can result in dirt becoming embedded in the limestone; boat wakes and walker activities can initiate or accelerate erosion on susceptible riverbanks and dunes; and Aboriginal sites can be disturbed and damaged by walkers and vehicles.
2. The numbers of people undertaking an activity or use exceeds the ecologically sustainable levels for that activity and/or causes high levels of impact that are not readily reversible. For example the number of campers increases until sustainable thresholds are exceeded; the amounts of human waste in back country areas leads to environmental pollution; human disturbance increases the pressure on already endangered species (such as the orange-bellied parrot); the number of visitors in a cave gives rise to high levels of carbon dioxide, which causes acidic solution of the limestone formations. In practice, many activities that can be undertaken by relatively small numbers of people without causing undue impact become problematic and/or unsustainable as the numbers of people undertaking that activity increases and exceeds the capacity of the system to withstand or readily recover from the pressure.
3. Visitors do things that are contrary to management directions or advice, for example not adhering to Minimal Impact practices; not keeping to formed tracks; feeding wildlife[34] etc.
4. People undertake illegal activities e.g. remove resources, commit arson etc. (Illegal activities are covered in Section 2.5.2 'Law enforcement and compliance issues'.)

How was the threat averted or managed over the 1992–1999 period?

- A number of major management strategies and programs were developed and implemented to promote sustainable visitor use of the TWWHA, including the Walking Track Management Strategy and Minimal Impact programs (see Section 6.4.3 'Management for ecologically sustainable human use').
- Proposals for new activities or significant increases in activity were assessed for potential impacts through the Project Proposal Form system (see Section 4.11 'Development of new facilities and other infrastructure').
- Research was undertaken to determine the sustainable carrying capacities for various activities in different areas of the TWWHA (including horseriding on the Central Plateau (see Section 4.10.4 'Case study—Horseriding on the Central Plateau), and trampling by walkers in alpine areas (see Section 4.10.3 'Case study—Walker impacts').
- Monitoring programs were undertaken for a range of visitor activities and for the condition of selected values.
- The findings of research and monitoring studies were taken into account to inform and guide management strategies and actions.

The Boat Shed at Dove Lake is a familiar landmark for many visitors to Cradle Valley. The Boat Shed was originally designed and constructed by the Park's first ranger, Lionell Connell, in 1939. It is now managed as a fine example of vernacular or "everyday" architecture.
Photo by Glenys Jones

Tracey Diggins (Track Education Officer) at the launch of a range of educational materials for walkers, which included displays, brochures and a video.
Photo by PWS

34 The feeding of wildlife can give rise to animal diseases (such as 'lumpy jaw') and also give rise to animal aggression and/or nuisance factor for visitors.

The wakes from cruise vessels on the lower Gordon River were shown to be responsible for causing serious ongoing riverbank erosion.
Photo © Tourism Tasmania

Case studies

The following case studies detail the management and outcomes for three significant threats associated with tourism and visitor activities and use over the 1992–1999 period:

1. Riverbank erosion by commercial cruise boat operations on the Lower Gordon River;
2. Walker impacts; and
3. Horseriding on the Central Plateau.

4.10.2 Case study— Riverbank erosion on the lower Gordon River

About the threat

WHAT IS THE THREAT?

Research demonstrated that wake waves from vessels (especially commercial cruise boats) were the principal cause of extensive, serious and ongoing erosion of the riverbanks of the lower Gordon River. (Under natural conditions, the alluvial banks of the lower Gordon River would be stable to depositional.) Based on measurement of erosion in an untrafficked control reach of the river, up to 80% of the erosion of the riverbanks was considered to be attributable to the wakes from commercial cruise vessels.

Regulation of river flows by hydro-electric power generation operations, which is associated with serious riverbank erosion of the middle Gordon River, may also be contributing to a minor degree to bank instability of the lower Gordon River.

WHAT NATURAL OR CULTURAL VALUES ARE AFFECTED?

Natural sedimentological processes have been reversed from actively depositional to erosional along many reaches of the lower Gordon River. Maintenance of natural processes is an explicit management objective for the TWWHA and a key responsibility of world heritage management.

Erosion has caused rapid retreat of the river banks in most reaches of the lower Gordon River. Part of the landform assemblage being eroded is of outstanding geoconservation significance at a global level and includes some of the best examples of levee banks in temperate areas of the southern hemisphere. These levee banks protect and hold meromictic lakes which contributed directly to World Heritage listing.

Erosion and collapse of the riverbanks also caused loss of riverine temperate rainforest, including significant numbers of Huon pine.

Heritage Landing on the lower Gordon River is now the limit of navigation for commercial sightseeing cruises on the Gordon River. Visitors can disembark here and wander along a short high quality interpretive nature trail through ancient rainforest.
Photo by Glenys Jones

Background to management

Extensive bank erosion on the lower Gordon River was first identified in the mid 1980s, coincident with the introduction of large, fast commercial cruise vessels. The problem was exacerbated by speed and competition amongst operators (the best reflections were available to the first boat up-river). Erosion monitoring commenced in 1987. A locality map of the lower Gordon River is provided in Figure 14.

Bank retreat in the period prior to 1989 is estimated to have been up to 10 m, with an average of perhaps 3 to 5 m on erosion susceptible bank types (alluvial, estuarine and levee), with associated loss of riparian vegetation.

Significant steps were taken in 1989 to halt erosion and to achieve ecologically sustainable tourism use of the river. These included:

- the most environmentally sensitive area of the river was closed to navigation and new visitor facilities were provided at Heritage Landing—the new limit of navigation for commercial craft; and
- speed limits were introduced for commercial vessels.

These actions led to a reduced erosion rate, especially in reaches now untrafficked by commercial cruise boats.

Geophysical investigations aboard the PWS vessel *Shearwater*, in January 1996. Researchers from James Cook University mapped the bed of the river using side-scan sonar and a precision depth sounder, and the results were integrated with grainsize analysis of grab samples. This work allowed a greater understanding of the sedimentological processes operating in the estuary and its geomorphological evolution since post-glacial sea level rise.

Photo by Jason Bradbury

How was the threat averted or managed over the 1992–1999 period?

OVERALL MANAGEMENT GOALS: The dual goals of management are to re-establish stability to the eroding riverbanks of the lower Gordon River and allow natural recovery of degraded landforms; and to achieve environmentally sensitive and sustainable ongoing tourism on the lower Gordon River.

MANAGEMENT ACTIONS AND SIGNIFICANT EVENTS OVER THE 1992–1999 PERIOD

- Monitoring of bank erosion and revegetation continued over the 1992–1999 period.
- Bingham Inquiry: The Gordon River Tourist Operations Inquiry report was released in 1994. The inquiry examined licensing, environmental conditions and environmental management, and recommended a new licensing regime.
- Lower Gordon River Recreation Zone Plan: The first draft of the plan was released in 1994 to guide management. The plan was formally approved in 1998. The aim of the plan is to provide a management framework that ensures environmental sustainability and a high standard of ecotourism practice in accordance with the nature and significance of the Gordon River environment.
- Speed limits for cruise vessels were further reduced in 1994 from 9 knots to 6 knots.
- Licence conditions were introduced with the aim of reducing bank erosion (e.g. the demonstration of low wake became a requirement for new commercial vessels).
- Research: Geotechnical characterisation of bank sediments was undertaken by consultants as part of the Low Wake Hull Project in 1994. Bedload characterisation and geophysical investigation of channel morphology was undertaken by consultants in 1996. More recently, research has been focussed on fluvio-estuarine sediment dynamics and investigation of the processes involved in erosion of the various banks by wake waves.
- Potential impacts of wash from floatplane landings on erosion rates on the lower Gordon River were also investigated. No impacts were detected.
- Monitoring systems were also established on the Davey, Old, Spring and North rivers as well as Melaleuca Creek and Inlet (all in the Bathurst Harbour–Port Davey area, which is subject to a low level of vessel use for commercial tourism, recreation and commercial fishing) to measure bank stability/erosion.

Rainforest clads the banks of the dark tannin-stained waters of the Gordon River.

Photo by Glenys Jones

Results

MONITORED CONDITION INDICATORS

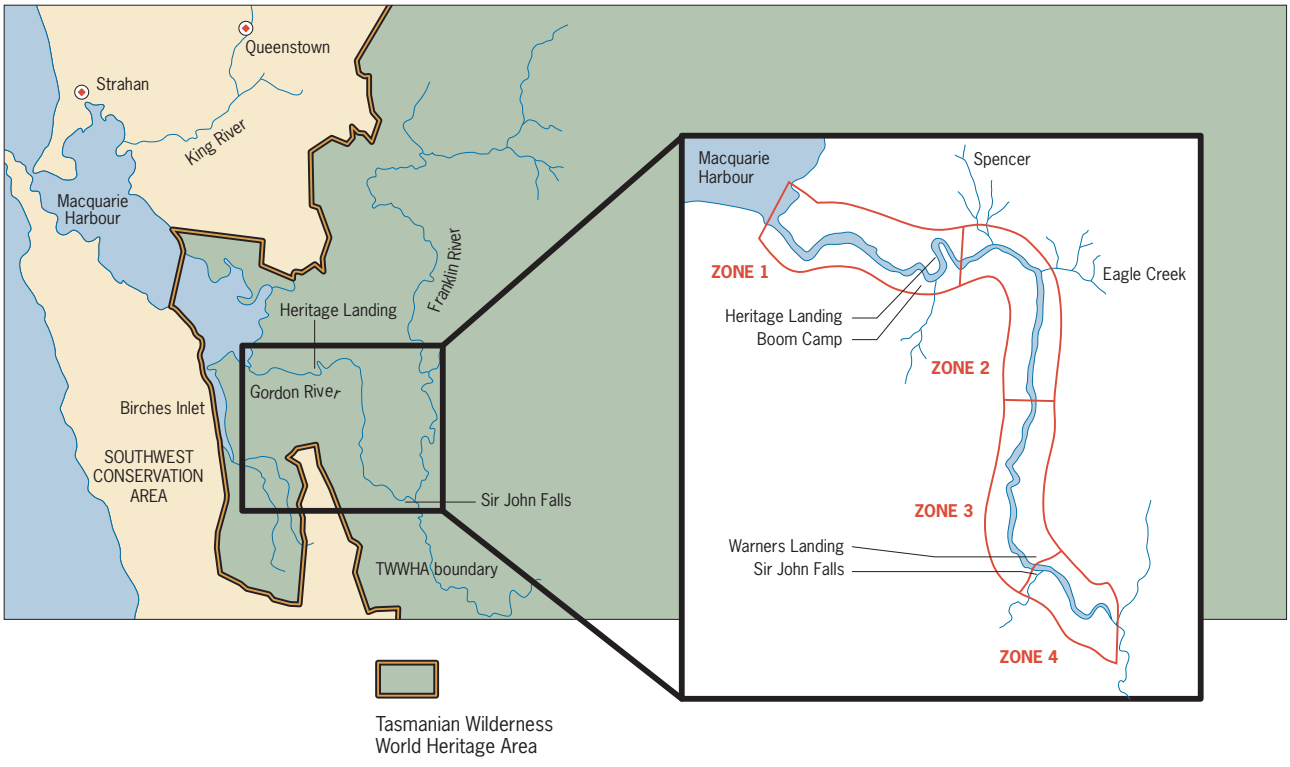
Condition indicators (and how they are monitored)	**Targets for condition indicators** (and how performance is assessed)	**Changes in condition indicators over the 1992–1999 period**
EROSION RATE AND BANK RETREAT/STABILITY: monitored by twice yearly measurement of approximately 250 erosion pins at some 50 sites along the river. Associated monitoring methods include bank profile, plan surveys and a record of landslip activity.	EROSION RATE TARGET: no detectable vessel induced erosion. ASSESSMENT OF PERFORMANCE: Determined by comparing rates of erosion on trafficked alluvial banks downstream from Heritage Landing and very similar untrafficked (but previously disturbed) alluvial banks further upstream. BANK STABILITY TARGET: return of stability or depositional regime to the various banks as appropriate. Natural recovery of degraded landforms. ASSESSMENT OF PERFORMANCE: Determined by erosion monitoring.	EROSION RATE decreased in some areas following a further cruise vessel speed reduction in 1994. However, both naturally depositional and formerly stable areas remain erosional. BANK RETREAT/ STABILITY: Levee bank retreat has essentially halted since removal of cruise traffic above Heritage Landing, although on-going slope adjustments continue. Renewed deposition at the scarp foot is encouraging, particularly in the Sir John Falls camp area.
REVEGETATION OF DESTABILISED BANKS: the natural revegetation of levees and landslips is periodically monitored using quadrats. Subvertical scarps and undercuts on actively eroding alluvial and estuarine banks are not revegetating and are not monitored.	REVEGETATION TARGET: Continued growth and eventual wind-throw of trees on metastable levee scarps producing long term angle of repose stability. Continued litter accumulation and soil formation on landslip scarps. ASSESSMENT OF PERFORMANCE: via irregular monitoring/ survey of revegetation.	REVEGETATION of destabilised levees and landslips is proceeding well. Re-establishment of sediment deposition is required in order for alluvial and estuarine banks to revegetate

Figure 14

Locality map, lower Gordon River

(a) Macquarie Harbour and lower Gordon River

(b) Enlargement, lower Gordon River showing management zones



MONITORED PRESSURE INDICATORS

Pressure indicators (and how they are monitored)	**Targets or limits for pressure indicators** (and how performance is assessed)	**Change in pressure indicators over the 1992–1999 period**
WAKE CHARACTERISTICS—especially maximum and total wake wave power of regular vessels (i.e. cruise boats). Maximum wave height: not to exceed 75mm as measured in deep water 50m from the vessel track.	WAKE CHARACTERISTICS: Target for wake wave height: maximum / total wake wave power to be less than the erosion threshold, presently estimated as 15 watts per metre in zone 1 and 10 w/m in zone 2, but subject to revision according to results of ongoing research. Limits for maximum wave heights are met by measuring vessel wake (either on river or using towing basin model tests) and then setting a speed limit for each vessel as part of the licensing process. POTENTIAL ALTERNATIVE TARGET: Wake waves reduced to resemble the annual time equivalent component of the natural wave climate (would require technically challenging characterisation of natural wave climate).	WAKE CHARACTERISTICS: Wake wave characteristics of all existing (1994, 1995, 1996, 1998, 1999, 2000) commercial vessels were measured. The largest regular wake was reduced when speed limits were reduced in 1994 (see Bradbury 1998).
FREQUENCY OF WAVE DISTURBANCE: Commercial cruise vessel frequency is monitored through licence returns. Private vessel use is technically difficult to monitor without full-time staff presence on the river.	FREQUENCY OF WAVE DISTURBANCE: An adaptive management response is required if condition targets are not achieved through management of wake height i.e. the number of cruise boat trips may need to be limited.	FREQUENCY OF WAVE DISTURBANCE: There has been no significant change in the frequency of wave disturbance over the management period.
EXTENT OF AREA OPEN TO NAVIGATION: nature of relevant restrictions on vessel access/operation.	EXTENT OF AREA OPEN TO NAVIGATION: Requires an adaptive management response as above. Due to the extremely low erosion threshold, zone 3 (between Limekiln and Sir John Falls) is likely to remain closed to most commercial use until banks are stabilised by mature vegetation.	EXTENT OF AREA OPEN TO NAVIGATION: There has been no significant change in the extent of area open to navigation over the 1992–1999 management period. Commercial use is predominantly limited to the area below Heritage Landing; the yacht Stormbreaker has been granted access to Sir John Falls for the sole purpose of transporting Franklin River rafters off-river. Private vessel access remains unrestricted

Outcomes

- Riverbank erosion resulting in levee bank retreat has essentially halted since cruise vessel traffic ceased above Heritage Landing.
- Downstream of Heritage Landing, riverbank erosion is still continuing in both naturally depositional and formerly stable areas of the river. However, erosion rates in these areas significantly decreased following the reduction of speed limits for cruise vessels.
- Tourism operations on the lower Gordon River have become more environmentally sensitive. For example:
  - most older commercial cruise vessels have been replaced with new vessels with improved hull design for reduced wake;
  - tourism operators and managers have a better understanding and awareness of the environmental impacts associated with tourism on the lower Gordon River;
  - tour vessel operations have changed and improved, resulting in more environmentally aware usage of the river and providing more informed interpretation of the TWWHA and its values for their clients.

Commentary on management performance

The following commentary has been provided by specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- Vessel speed and access restrictions.
- Closure of river above Heritage Landing to most commercial vessels since 1989. Reduction of speed limits for larger commercial vessels in 1994.
- Introduction of licence conditions aimed at reducing streambank erosion. Demonstration of low wake is required before licences are issued to new commercial vessels.
- The Bingham Inquiry (Bingham, 1994) resulted in a fairer licensing regime for commercial operators whilst preserving environmental safeguards.
- Lower Gordon River Recreation Zone Plan guided management decisions regarding river traffic.
- Research into bank characteristics and vessel wave-making properties (Low Wake Hull Project, University of Tasmania and Australian Maritime College). Bed-load characterisation and geophysical investigation of channel (by James Cook University) and on-going research into processes of wave erosion (by Nature Conservation Branch) provided a necessary base of knowledge.
- The extent and regularity of the monitoring program established by the Nature Conservation Branch clearly demonstrated the magnitude of the problem and provided an authoritative base for initial and ongoing controls on vessels.

Geomorphological examination of eroding sandy levee. When this photograph was taken in the late 1980s, these formerly stable banks were retreating by about 1m per year. Exclusion of cruise vessels from leveed reaches in 1989 dramatically slowed the rate of erosion, and substantial natural revegetation has since occurred. Vegetation is essential for bank stability, however since the dominant species are slow growing rainforest trees full stabilisation will not be achieved for many decades or longer, and these banks therefore remain very susceptible to erosion by wave wakes.

Photo by Mike Pemberton

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Significant commercial tourist enterprises and investment are linked to the continued operation of Gordon River cruises.
- Engineering uncertainties in low wake cruise vessel design, which are complicated by sea-keeping requirements to traverse Macquarie Harbour.
- Slow rates of streambank rehabilitation due to trapping of sediment behind Gordon River Dam and other hydrological changes.
- Use of private craft on the river is difficult to control, or even monitor, without full-time staff presence on the river. Inappropriate activities in private vessels also have the potential to cause significant damage.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of riverbank erosion of the Gordon River.

- Discourage operation of private vessels at planing speed. (Waves from planing vessels are more erosive than those from vessels operating in displacement mode.) Revise and publicise users' code for private vessels accordingly.
- More extensive cooperation with Hydro Tasmania is required if the effects of river regulation are to be investigated and managed.
- Continue present monitoring and research, and apply findings to decision-making directed towards restoring and maintaining ongoing natural processes.
- Further research is required to confirm wave height power erosion thresholds and examine other wake characteristics influencing erosion; the effects of hullform on wake characteristics and the effects (and possible mitigation) of existing river regulation and future regulation under Basslink.

Jason Bradbury (Geoscientist) has been working on the Gordon River erosion project since 1992. This has involved monitoring and scientific studies to assist in the management of the lower Gordon River.

Photo by Sophie Underwood

SOURCES OF INFORMATION AND COMMENT

Jason Bradbury (Geoscientist, Earth Science Section, Nature Conservation Branch, DPIWE), Gordon River erosion project, Email: j.bradbury@dpiwe.tas.gov.au.

4.10.3 Case study—Walker impacts

About the threat

WHAT IS THE THREAT?

As the number of walkers in the TWWHA increases, a variety of impacts may emerge. Some of these impacts relate to biophysical damage caused by excessive trampling of sensitive areas; others relate to social impacts such as the effect of crowding on the quality of visitors' wilderness recreational experience. This section addresses only the direct biophysical impacts of walkers.

Martin Hawes (Track Monitoring Officer) was the author of the 1994 Walking Track Management Strategy and was responsible for establishing the track monitoring program for the TWWHA.

Excessive trampling by walkers in sensitive areas of the TWWHA is associated with the following direct biophysical impacts:

- track erosion, which is often made worse if water flows along tracks;
- track widening, braiding and quagmire formation;
- broadscale trampling damage to vegetation, especially sensitive alpine vegetation communities;
- the proliferation, expansion and deterioration of back-country campsites; and
- the formation of unplanned tracks and pads in formerly trackless areas.

These impacts mostly affect backcountry areas where tracks are not 'hardened' to withstand walker impacts.

In addition to the above direct impacts, walkers may also pose a risk for a variety of other indirect impacts e.g. of spreading the root rot disease *Phytophthora cinnamomi* and of degrading the water quality of pristine lakes and streams through human waste.

WHAT NATURAL OR CULTURAL VALUES ARE AFFECTED?

Walker impacts can result in ecological damage to vegetation communities and geomorphological systems. In particular, excessive trampling can lead to damage and/or loss of alpine and montane plant communities. These communities are particularly significant in the TWWHA because they contain many endemic species. Once damaged, the recovery time for these communities is very slow.

The formation of unplanned new tracks in previously trackless areas also degrades the biophysical wilderness quality of the TWWHA.

Walker impacts may also degrade the quality of walker's recreational experience itself. For example, walkers will generally be less likely to enjoy their experience if tracks are eroded, braided or muddy, and trackside vegetation is in poor condition. Conversely, visitors' experience can also be altered if 'primitive' tracks in remote areas are replaced by hardened tracks to control walker impacts.

Hardening tracks to avoid impacts associated with increasing numbers of visitors is one option for sustainably managing walking tracks. However, hardened tracks alter the walking experience and to some extent reduce the feeling of being in a wilderness area. This track is in the Walls of Jerusalem National Park.

Photo by Grant Dixon

Background to management

Extensive degradation of the World Heritage Area track system was identified in 1990/91 by the first inventory of the entire World Heritage Area track network (Hawes, 1998). That inventory found that the total length of tracks in the TWWHA is around 1,000km. At least 120km of these tracks were found to be eroded to a depth greater than 25cm, with local erosion substantially deeper in some areas. 100km of tracks were muddy and 85km were braided. 75km of tracks were considered to be subject to a fast rate of erosion, and 300km to a moderate rate of erosion.

Tracks in the Southwest were generally in a worse condition than elsewhere in the TWWHA, while tracks in the Central Plateau/Great Western Tiers/Upper Mersey region tended to be in better than average condition. Bare and eroded campsites were noted in many areas, and there was evidence of apparently active unplanned track formation (i.e. an expanding track network).

Experimental walker impact trials were established to measure the impacts of known numbers of walkers on vegetation, and to determine how long the vegetation took to recover. These experiments demonstrated that the environmental carrying capacity for alpine and montane vegetation communities in the TWWHA is quite low and that recovery following trampling is very slow. Some plants showed little sign of recovery from 500 passes 4 years after trampling.
Photo by PWS

Degraded track, Lake St Clair.

Repaired and upgraded walking track, Lake St Clair.
Photos by Barry Batchelor

The long-term costs of stabilising and maintaining a track network that is actively eroding and/or expanding is of significant management concern.

How was the threat averted or managed over the 1992–1999 period?

OVERALL MANAGEMENT GOAL: to provide a range of recreational walking opportunities whilst managing walker usage of the TWWHA within ecologically sustainable limits.

MANAGEMENT ACTIONS AND SIGNIFICANT EVENTS OVER THE 1992–1999 PERIOD

- During the 1992–1999 period, a major Walking Track Management Strategy for the Tasmanian Wilderness World Heritage Area and linked monitoring system were developed to manage the physical and environmental sustainability of the entire walking track network within the TWWHA (Hawes, 1998). A draft of the Walking Track Management Strategy was produced in 1992; the strategy was completed in 1994, and approved in 1998. The strategy contained a series of approaches combining works, education and regulation which, when integrated, aimed to address the environmental and recreational impacts associated with walking in the TWWHA. A major plank of the strategy was a comprehensive regulatory system for controlling walker numbers as a means of limiting impacts. Other components included a major works program to stabilise tracks, education program, research and monitoring.
- A substantial multi-year funding program under the Natural Heritage Trust allowed extensive track works in the TWWHA to proceed in accordance with the Walking Track Management Strategy.
- In keeping with the Strategy, trackwork focused on arresting track erosion in high priority areas—mostly in alpine areas above 1,000m altitude. (In these areas, vegetation recovery rates are very slow and so action is critically needed to prevent trampling damage leading to the formation of large bare areas.)
- Upgrading works were undertaken in many areas to lessen environmental impacts and work commenced on hardening campsites to reduce high levels of environmental impacts at popular overnight sites.
- Some tracks that were identified as being badly degraded were closed and/or re-routed. Rehabilitation trials were undertaken to determine the most effective way of assisting rehabilitation of these closed tracks. Trials were conducted in locations that represented different types of environments e.g. a site west of New Harbour Range is located on quartzite, in very steep terrain that has lost much of the original organic material; while a site at Cradle Cirque is located on flat, dolerite terrain that has retained peat. These trials are continuing.
- A Track Monitoring System, involving both on-ground measurements and aerial photography, was designed and established during 1992–94 to assess the extent, degree and rates of change of track impacts, including erosion and unplanned track development. The program was further expanded to provide ongoing data on track and campsite condition and impacts. The program provides data that can be linked to the relevant track standard defined in the track classification system of the Walking Track Management Strategy.
- Experimental walker impact trials were established in representative alpine environments on the Central Plateau (1994), Western Arthur Range (1996) and montane Tim Shea (1999) to measure impacts of known numbers of walkers on vegetation, and to determine how long it takes for vegetation to recover. These experiments demonstrated that the environmental carrying capacity for some vegetation types in the TWWHA (especially alpine and montane communities) is quite low and that recovery following disturbance is very slow. Some life forms took up to 1 year to die after trampling and other life forms showed little sign of recovery from 500 passes 4 years after trampling.

The findings of these studies indicate that the annual threshold of walkers for pads to form in Central Plateau shrubland is between 200 and 500 passes, and around 700 passes for the grassland. In the Western Arthur Range, the threshold of walkers for pads to form was between 30 and 100 passes and environmental thresholds were breached at about 200 passes (see Whinam & Chilcott 1999; Whinam & Chilcott 2003).

- Public consultation on track management issues was undertaken on several occasions with comments sought on the Walking Track Management Strategy, and the design of a possible walker regulation system. Consultation included focus group discussions and public forums as well as written comment.
- A Tracks Education Officer was employed to support implementation of the Walking Track Management Strategy. Educational material produced included 'Walking the Fine Line' and 'The Science behind the Strategy' which were both produced as brochures and videos.
- Authors and magazine editors were encouraged to limit publication of descriptions of walking tracks and routes within the TWWHA to those areas considered suitable for promotion. Some meetings with authors occurred; however these were generally of limited success. There was also limited success in restricting information about remote tracks, especially as the availability of information about these routes increased as a result of expanding World Wide Web sources.
- With the exception of the introduction of a permit system to limit the number of walkers in environmentally sensitive areas, all the major recommendations from the Walking Track Management Strategy have been, or are now being, implemented.
- While the 1992 TWWHA management plan provided for the implementation of 'use restrictions to limit environmental impacts and reduce unplanned track formation', there was significant opposition to regulating visitor numbers and/or use from parts of the Tasmanian walking community, and the proposed permit system has not been implemented.

The Track Management Team was responsible for implementing the World Heritage Area Walking Track Management Strategy. From left to right: **Grant Dixon, Phil Wyatt** and **Roger Ling.**
Photo by Sophie Underwood

Walker impacts in the TWWHA commonly result in the formation of widening tracks and muddy quagmires. Mark Errey, who has been a track worker for more than 15 years, is shown here working on a degraded track at Blowhole Valley.
Photo by Parks and Wildlife Service

Results

MONITORED CONDITION INDICATORS

Condition indicators (and how they are monitored)	**Potential targets for condition indicators** (and how performance is assessed)	**Change in condition indicators over the 1992–1999 period**
TRACK CONDITION: The Track Monitoring System involves the re-measurement, at 2–3 year intervals, of more than 450 established monitoring sites located on a range of tracks in various walking areas across the World Heritage Area. Monitoring involves the measurement of track depth and width parameters. Rates of change in track condition can be calculated from ground monitoring data (for track condition) or comparison of aerial photographs (for unplanned track formation).	TARGET: A stable track network (i.e. minimal erosion or excessive widening over the long term); and achievement of the desired or prescribed condition targets for tracks as specified in the Walking Track Management Strategy. ASSESSMENT OF PERFORMANCE: Results of monitoring of track condition and rates of change.	Continuing erosion and deterioration of the existing World Heritage Area track network was documented over the management period. During the 1994–98 period, over tracks of all types and usage categories, depth increased by 11% per year and width increased by 4% per year. Rates of change vary across track types and walking areas, however track widths in some areas increased by 40–50%.
EXTENT OF UNPLANNED TRACK NETWORK AND RATE OF FORMATION: Purpose flown 1: 5,000 scale colour aerial photographs, supplemented by ground inspections of selected areas, are being used to determine the extent and monitor changes in the World Heritage Area track network. Estimates of past changes are necessarily based on qualitative or anecdotal information.	TARGET: No unplanned track extension i.e. the extent and degree of development of the track network is consistent with the Walking Track Management Strategy. ASSESSMENT OF PERFORMANCE: Results of monitoring of extent and rate of formation of unplanned tracks.	It has been estimated that up to 150 km of unplanned track formation may have occurred throughout the TWWHA since 1980, including approximately 50 km of track in previously trackless country. Specific examples include evidence of up to 9km of pad development on routes in the Frankland Range and 4km in the Southwest Cape area (both low use) since about 1990.
CONDITION OF CAMPSITES: The location and condition of all campsites in walking areas encompassed by the Track Monitoring System have been noted. The level of detail recorded during campsite surveys ranges from allocation of a categorical condition class to the detailed mapping of site boundaries. Historic data from surveys during the last 5–10 years is available for many campsites, providing a basis for monitoring. Resurveys are planned at approximately 5-year intervals.	TARGET: An adequate number of stable campsites (i.e. no unplanned expansion in the area or number of campsites) consistent with the track network prescriptions specified in the Walking Track Management Strategy. ASSESSMENT OF PERFORMANCE: Results of monitoring of campsite condition and rates of change.	Active deterioration of campsites (vegetation loss, expansion and/or erosion) has been noted in a number of areas, particularly alpine areas of the Southwest.

MONITORED PRESSURE INDICATORS

Pressure indicators (and how they are monitored)	**Potential targets for pressure indicators** (and how performance is assessed)	**Change in pressure indicators over the 1992–1999 period**
WALKER NUMBERS/USAGE: Log book records and track counters are used to estimate walker usage of various tracks and areas.	TARGET: Environmentally sustainable levels of walker usage (i.e. usage levels that maintain or achieve the above condition indicator targets). The sustainable environmental carrying capacity for alpine environments can be estimated on the basis of experimental trials of repeat usage and recovery data, and historical track monitoring data. An adaptive management response is required if condition targets are not being achieved. ASSESSMENT OF PERFORMANCE: Monitoring of track and campsite conditions and rates of change, and the extent and rate of formation of unplanned tracks (see condition indicators above).	Walker numbers have steadily increased over the management period. For example, usage of the Overland Track (Cradle Mt to Lake St Clair) increased from about 5,400 per year in 1992/93 to about 7,300 in 1999/2000. There were similar increases in the levels of usage of the Walls of Jerusalem tracks (increasing over the same period from about 2,600 to 3,200).

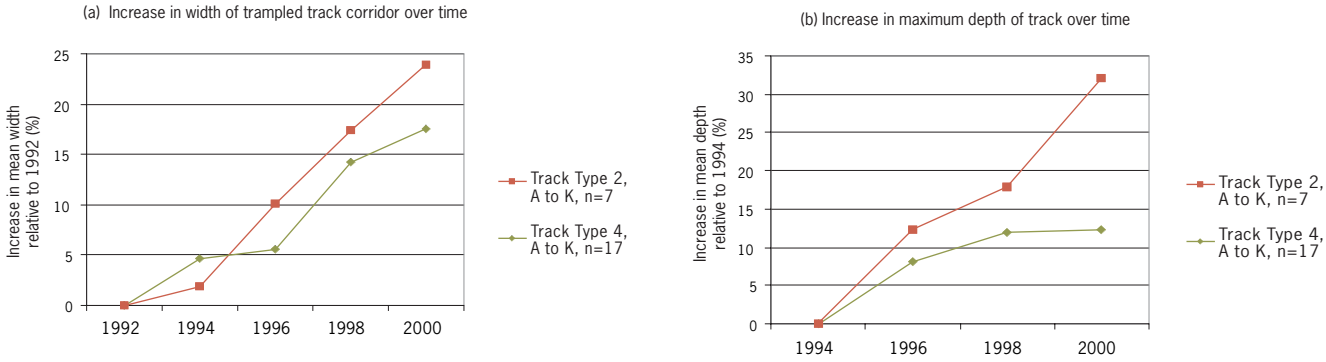


Figure 15

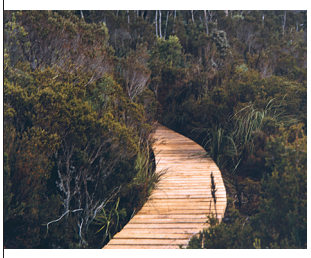
Walker impacts. Track monitoring case study, Western Arthur Range

Over the 1992–1999 period, the number of visitors using walking tracks in the TWWHA increased markedly e.g. by up to 35% in several areas. Scientific monitoring of the walking track network over this period demonstrated widespread continuing erosion and deterioration of the track network. Many walking tracks and overnight campsites were found to be unstable and increasing in area, and there was significant unplanned formation of new tracks. The figures above present representative findings of the Track Monitoring Program for the Western Arthur Range—a 24km long range in the Southwest National Park where visitors generally spend between 3 and 7 days in backcountry walking. Figure (a) shows that the width of trampled track corridor for this section of track increased by 17–24% over an 8 year period. Figure (b) shows that the depth of the walking track increased by 12–32% over a 6 year period. The rate of degradation of the track was related to the type of terrain (e.g steep tracks, or level tracks with poor drainage etc). Similar evidence of track degradation was recorded in many other parts of the TWWHA.

Outcomes

- Many badly degraded and actively eroding walking tracks in the TWWHA have been stabilised as a result of management works.
- Many walking tracks in high-use visitor areas of the TWWHA and some back-country camping sites have been 'hardened' to withstand high levels of visitor use, and these tracks and sites are generally being sustainably managed.
- However, many walking tracks throughout the TWWHA are not currently being sustainably managed. Monitoring of the track network revealed that over the 1992–1999 period, many tracks continued to erode; unplanned tracks continued to develop; and some backcountry campsites continued to expand and deteriorate, especially in alpine areas.
- There is evidence of damage to some alpine and montane plant communities due to the levels of use by walkers resulting in the formation of unplanned walking tracks. As yet trampling damage has only degraded a relatively small proportion of this vegetation. However, trampling trials have demonstrated that the environmental carrying capacity for some vegetation types is quite low. Rates of recovery on sub-alpine and alpine environments are very slow—in the order of decades for 200–500 passes per year. (A 'pass' is one person walking over the site.)
- A sound scientific base has been established for the sustainable environmental management of the entire TWWHA walking track network. For example, the sustainable carrying capacities for walkers in various vegetation types have been determined based on the findings of experimental trials.
- The number of walkers in the TWWHA significantly increased over the 1992–1999 period, thereby increasing pressures on the walking track system (see Section 6.4.2 'Visitor numbers to the TWWHA').
- Due to opposition from parts of the Tasmanian walking community, there has been no regulation or other mechanism put in place for limiting the number of walkers in sensitive environments as a means of limiting impacts.

Greater attention to the aesthetic design of trackwork has resulted in the creation of tracks with special visual appeal such as this track at Lake Osborne, Hartz Mountains National Park. Over the 1992–1999 period, high quality short walking tracks were provided at a variety of convenient access points to the TWWHA to encourage more people to visit and enjoy the TWWHA.



This remote area campsite platform was built in March 1998 at Hanging Lake, near Federation Peak in the Eastern Arthurs. Platforms such as this provide overnight walkers with a relatively comfortable and level base on which to pitch their tents, while also limiting the size and nature of campsite impacts on the environment.

Photos by Parks and Wildlife Service

Commentary on management performance

The following commentary has been provided by track management staff and planning staff within the Parks and Wildlife Service and specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- Development of the Walking Track Management Strategy provided an integrated management strategy to address the problem of unsustainable levels of walker impacts.
- With the exception of the walker regulation system, all the major recommendations of the Walking Track Management Strategy (including walker education, track and campsite hardening, and priority erosion control works) have been, or are now being implemented.
- Appointment of relevant staff to the project and their subsequent contributions e.g. PWS Track Monitoring Officer (temporary appointment in 1990, permanent from 1997) and his subsequent work in identifying the nature and extent of the walker impact problem. Appointment of PWS Track Management Officer (in 1993) to oversee the works program and track management issues generally. Appointment of the PWS Track Education Officer (in 1995) to develop materials to promote minimal impact walker practices and raise awareness of track management issues and preferred walker behaviour (however, this was a temporary position which has not been continued).
- Research into walker impacts and subsequent recovery rates through walker impact trials. This research has provided a quantitative basis from which to model sustainable carrying capacities and recovery rates in different environments.
- Strong minimal impact program over the management period.
- Track Ranger Program, which helped to communicate minimal impact messages to walkers.

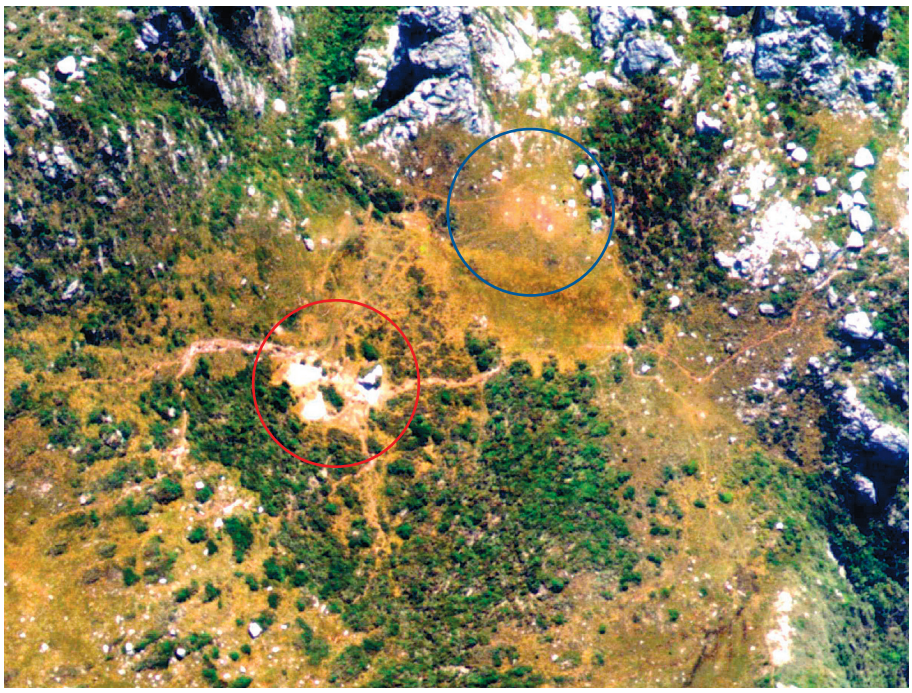
KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Significant opposition from the Tasmanian Federation of Walking Clubs, some individual clubs and individual walkers to the proposed introduction of a walker regulation system has precluded full implementation of the recommendations of the Walking Track Management Strategy.
- There has been a general reluctance to take a precautionary approach to managing sustainable human use in the TWWHA.

Systematic scientific monitoring of the TWWHA track network involves the regular measurement of track depth and width parameters of more than 450 established sites located on a range of tracks in various walking areas across the TWWHA. This work provides a sound basis for determining whether tracks are being sustainably managed or are actively eroding and progressively degrading.
Photo by Tracey Diggins

ADDITIONAL COMMENTS

- Since 1999, alternative approaches to limiting visitor numbers through a permit system have been investigated. Partnership approaches were established between the Parks and Wildlife Service and bushwalkers in an attempt to resolve the impasse surrounding walker regulation and to develop possible ways forward in sustainably managing walker usage. These approaches have included:
  - A Track Assessment Group (TAG) composed of Tasmanian walker representatives and other stakeholders met over a two-year period and produced a report 'A Way through the Wilderness—An approach for a socially, environmentally and economically acceptable solution to problems of environmental degradation in the Tasmanian Wilderness World Heritage Area'. The recommendations of this report included undertaking a review of walking areas in the TWWHA and establishing a management approach based on 'Limits of Acceptable Change' (LAC). These recommendations are currently being implemented through the Bushwalking and Track Review process (BATR).
  - The BATR process involves all stakeholders in thoroughly reviewing the management options for particular walking areas. It provides the opportunity



High Moor is a camping area in the centre of the Western Arthur Range, visited by about 300 people per year. The pale patches (circled in red) in the centre of this aerial photo are bare ground where campsites have resulted in the loss of vegetation and the establishment of ongoing erosion. At the top centre of the photo, the light brown patch (circled in blue) reflects a more recent or less intensively used campsite where vegetation has been damaged and bare soil areas are beginning to develop. Close examination of the photo reveals a network of unplanned tracks and pads traversing this whole area. High Moor is one of the areas where revegetation trials are currently underway.

Photo by Information and Land Services Division, DPIWE

for stakeholders to reach an informed agreed solution to providing walking opportunities and sustainably managing walker impacts. The process is currently publicly reviewing the walking recreation opportunity spectrum for the TWWHA. This will be followed by assessment of two pilot areas (Western Arthurs and Frankland Range).

The effectiveness of the above approaches in delivering sustainable management of walker usage will be reported in future editions of the State of the TWWHA Report.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Planning staff provided the following comment regarding the management of walker impacts.

- Until such time as an acceptable mechanism is agreed and implemented for limiting the impacts of walkers in sensitive areas of the TWWHA, there is likely to be on-going degradation of existing tracks and campsites, and unplanned formation of new tracks in some areas.

SOURCES OF INFORMATION AND COMMENT

Track Monitoring PWS, Track Management Section: Grant Dixon (Track Monitoring Officer), Email: grant.dixon@dpiwe.tas.gov.au, Ph. (03) 62332705.

Walker Impact Trials DPIWE Nature Conservation Branch: Jennie Whinam (Botanist World Heritage Area), Email: jennie.whinam@dpiwe.tas.gov.au, Ph. (03) 6233 6160.

Tim O'Loughlin (Planning Officer, WHA) Track Assessment Group, Ph. (03) 6233 2112.

Bushwalking and Track Review PWS Mark Poll (Visitor Service Research Officer), Ph. (03) 6233 2548.

4.10.4 Case study—Horseriding on the Central Plateau

About the threat

Horseriding causes significant trampling damage to sensitive plant communities, especially alpine and montane vegetation.

Background to management

On the basis of environmental impact considerations, the 1992 TWWHA management plan prescribed that horseriding be limited to the Liffey and Meander Forest Reserves, the Central Plateau Conservation Area and potentially five other areas within Cradle Mountain–Lake St Clair National Park to be determined following investigations and in conjunction with riders.

How was the threat averted or managed over the 1992–1999 period?

OVERALL MANAGEMENT GOAL: to achieve ecologically sustainable management of horseriding in the high country of the TWWHA.

MANAGEMENT ACTIONS AND SIGNIFICANT EVENTS OVER THE 1992–1999 PERIOD

- The impacts of horseriding in alpine and montane areas of and adjacent to the TWWHA were scientifically studied and documented (Whinam et al, 1994).
- A map of areas sensitive to horseriding on the Central Plateau was produced.
- Detailed assessments were undertaken of the impact of horses and the suitability of various locations with riders. This process led to allowing riding in three parts of the Cradle Mountain–Lake St Clair National Park (Patons Road, February Plains and Lone Gum Plain). A route through the Walls of Jerusalem was ruled out as was riding in the Campbell River region of the Cradle Mountain–Lake St Clair National Park. The review process also identified sensitive areas within the Central Plateau Conservation Area that needed to be avoided by riders. A map of these sensitive areas was prepared and presented to riders.
- Riders refused a requirement under the National Parks and Reserved Lands Regulations 1999 to obtain a permit for riding on the Central Plateau Conservation Area. They believed it was not necessary as the area had been ridden for many years without permits being required. A compromise was negotiated which resulted in a change to the Regulations, which allowed riders to register rather than being required to have a permit.
- A code of conduct for recreational horseriding in the high country that promoted measures to minimise environmental impacts was developed in conjunction with riders[35].
- Recreational horseriders on the Central Plateau have generally adopted the code of conduct.
- The environmental impacts associated with a commercial horseriding operation adjacent to the TWWHA at Cradle Mountain were found to be significant. Following extensive negotiations, the operation was relocated to a less vulnerable area with existing hardened tracks.

35 'Horse riding in the high country. A code of practice for riding in Tasmanian highland areas' (PWS, 1997)

Outcomes

- A commercial horseriding operation adjacent to the TWWHA at Cradle Mountain that was demonstrated to be having serious environmental impacts was relocated to a less vulnerable area.
- An agreed system for managing horseriding in the TWWHA is now in place.
- With the development and adoption of a code of practice for high country horseriding, impacts caused by recreational horseriding on the Central Plateau were lessened over the 1992–1999 period.
- The sustainable carrying capacity for horseriding on the Central Plateau has been scientifically determined on the basis of experimental trials.
- Current low levels of recreational horseriding in the Central Plateau Conservation Area and Patons Road are considered to be ecologically sustainable.

Commentary on management performance

The following commentary has been provided by specialist staff within the Nature Conservation Branch of DPIWE.

- Key factors contributing positively to management performance
- Field days with specialist staff of the managing agency and horse riders.
- There was good collaboration between specialist staff and field staff to ensure management outcomes.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Ecological sustainability could be threatened if numbers of recreational horse riders in the high country increased.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff did not identify any suggested actions for improving management of horseriding on the Central Plateau.

SOURCES OF INFORMATION AND COMMENT

Jennie Whinam (Botanist WHA, northern region), Email: jennie.whinam@dpiwe.tas.gov.au, Ph. (03) 6233 6160.

Jennie Whinam (Botanist, World Heritage Area) has been employed as a botanist since she started with the department in 1990. Jennie has been involved in many projects including trampling trials in the Western Arthurs, Tim Shea and Central Plateau; evaluating horseriding impacts on the Central Plateau; and monitoring dieback at Pine Lake. Jennie has also undertaken a major assessment of the reservation and conservation values of Sphagnum peatlands.

Photo by Dan Ralph

4.11 DEVELOPMENT OF NEW FACILITIES AND OTHER INFRASTRUCTURE

About the threat

The development of facilities and other infrastructure can have direct impacts on the natural and cultural values of the TWWHA and also lead to significant indirect impacts on adjacent areas through changing the levels and nature of human use. For example, the construction of a bushwalkers' hut may lead to trampling damage to vegetation around the hut due to the increased traffic of walkers in the area.

How was the threat averted or managed over the 1992–1999 period?

- A general strategy was applied to the TWWHA that where facilities could be located outside the TWWHA, they would not be provided within the TWWHA. This strategy is aimed at preserving wilderness quality within the TWWHA. The management plan also required that any major facilities to be provided within the TWWHA needed to be consistent with the management plan and site plan, and subject to the approval of the TWWHA Ministerial Council.
- For major project proposals (such as for Visitor Centres, tourism developments etc), detailed surveys of the natural and cultural values of the area were undertaken to inform the assessment process and, if in principle approval for the proposal was provided, to assist the further development of more detailed plans for the proposed project. In some cases, plans for projects were modified to take account of, and reduce, potential impacts to identified natural or cultural values in the area (e.g. the proposed tourism development at Pump House Point, and siting of Lake St Clair Visitor Centre).
- In the early years of the 1992–1999 period, all proposals for new infrastructure and activities to be provided in the TWWHA were assessed for potential environmental impacts through a system of 'Project Proposal and Initial Environmental Effects Statement' forms which were reviewed by relevant officers of the managing agency including specialists in natural and cultural heritage. The proposed infrastructure or activity was only approved where the managing agency considered the natural or cultural heritage was not unduly impacted.
- Because of problems associated with the Project Proposal Form system (in particular, the length of time taken between project proposal and final approval or rejection of proposed projects) use of the system was downgraded in the latter phases of the management period, especially for smaller scale projects. Proposals for major infrastructure projects (such as Visitor Centres, major walking tracks etc) continued to require detailed site surveys and consultation processes.
- A New Proposals and Impact Assessment process was incorporated into the 1999 TWWHA management plan to provide a mechanism for assessing proposals that had not been specifically addressed in the management plan. This process was designed to be open, transparent, have clear decision points and provide certainty to proponents in a clear timeframe.

Outcomes

- Many new or upgraded visitor facilities were provided in the TWWHA that benefited visitors without causing undue impacts on the natural or cultural heritage of the area. For example, a variety of high quality short walking tracks and interpretive facilities.
- A number of proposed projects were rejected on the basis of their potential impacts. For example, a proposed new restaurant adjacent to the Cradle Mountain Visitor Centre did not proceed; and a proposal to relocate a boat ramp at Lake Augusta was rejected.
- A small number of infrastructure projects over the 1992–1999 period raised some issues of concern amongst natural and cultural heritage specialists for their adverse impacts on the natural and/or cultural heritage, although the projects were approved in consideration of their broader contribution to management objectives. These concerns included:
  - development of a new hut, toilets and campsites at Waterfall Valley which led to the loss of some significant native grassland vegetation;
  - human developments (construction of radio towers, cairns, tracks, huts etc) have led to further reductions and degradation of alpine and montane vegetation communities and wilderness values;
  - development of the Lake St Clair Visitor Centre, new visitor accommodation cabins, carparks and other facilities led to a reduction in the integrity of highly

significant glacial moraines at Lake St Clair and associated woodland-scrub vegetation;

– construction of the new Pine Valley hut led to the removal of the culturally significant Old Pine Valley hut; and

– sealing and upgrading of the Cradle Mountain Road adjacent to the TWWHA was associated with a significant increase in road kills of native animals that seriously impacted on the local populations of quolls and Tasmanian devils.

- Some pre-existing facilities or infrastructure continued to cause impacts. For example, dams continued to impact on the wilderness values of the TWWHA and to alter natural hydrological processes, in some cases causing ongoing river bank erosion (see Section 4.14 'Regulation of river flows by hydroelectric power generating operations'). Similarly, pre-existing roads and tracks in some cases continued to cause impacts e.g. a 4WD track at Lake Augusta which traverses an Aboriginal site resulted in ongoing damage to the cultural values of the site.

Commentary on management performance

The following commentary has been provided by planning staff of the Parks and Wildlife Service with input from natural and cultural heritage specialists.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

- The TWWHA management plan provided clear guidance regarding the provision of facilities in different zones of the TWWHA, and also set out requirements for public consultation and Ministerial Council approval for major proposals.
- The early involvement of specialist staff with expertise in the natural and cultural heritage of the TWWHA provided information and advice regarding the values of particular areas and opportunities for avoiding or mitigating potential impacts.
- A formal system of assessment for proposed projects ensured that informed decisions were made.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Use of the Project Proposal form system was downgraded in the latter years of the management period to increase processing efficiencies. However this was without an alternative system of assessment being formally adopted.
- Uncertainty as to whether the *Land Use Planning and Approvals Act 1993* (LUPAA) applied to land reserved under the *National Parks and Wildlife Act 1970*.[36]
- There was no clear process for assessing proposals that were not covered by the TWWHA management plan or that required amendment to the management plan[37].
- There was no clear designation of what was a 'major project' (requiring a full environmental impact study) and what was a 'minor project' (requiring only limited internal assessment by staff).
- There was little coordinated documentation of the number of facilities established in the TWWHA in relation to the management plan's provisions; or of the number and type of proposed projects considered and how they were assessed; or of the determinations made for approval or rejection of those proposals.

36 In 2001, an amendment to the *Land Use Planning and Approvals Act 1993* clarified that land reserved under the *National Parks and Wildlife Act 1970* was subject to planning approval by local government. To date, this amendment has not come into force.

37 The 1999 TWWHA management plan has addressed this issue by establishing a clearly defined process for new proposals and impact assessments. The mid-term review of the 1999 TWWHA management plan will integrate this process with Council requirements under LUPAA.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Planning staff provided the following suggested actions for improving the management of new facilities and other infrastructure.

- There is a need for a consistent, practical and formal procedure for assessing proposed projects and activities in the TWWHA. (The 1999 management plan calls for the

development of a successor to the Project Proposal Form system. Work on developing such as system is well advanced. In the meantime, a modified Project Proposal Form system continues to operate.)

- There is a need for coordinated and consistent documentation and recording of the number and nature of proposed developments in the TWHWA, and of the process and outcomes of those assessments.

SOURCES OF INFORMATION AND COMMENT

Tim O'Loughlin (WHA Planning Officer, Planning Section, PWS), Ph. 6233 2112.

This photo shows the former carpark at Cynthia Bay, Lake St Clair, which occupied the prime lakeside location. The carpark was closed and rehabilitated as part of the planned re-development of the site to provide a new Visitor Centre and linked carpark in a less intrusive area further back from the lake. The following photographs show the transition of the site to the current layout of facilities. Note the location of the visitor picnic hut on the left of this photo.

Photo by Glenys Jones

A tranquil scene at the lakeside lookout at Cynthia Bay, Lake St Clair. The new layout of facilities at Cynthia Bay encourages visitors to get out of their car, explore the Visitor Centre, and then wander down to the lake to enjoy the natural scenery. The former lakeside carpark was rehabilitated.

Photo by Glenys Jones

Sensitive environmental design was one of the factors that contributed to the Lake St Clair Visitor Centre being awarded the Royal Australian Institute of Architects State Award for a new public building. The Centre also received an Interpretation Association Australia award.

Photo by Glenys Jones

Rehabilitation of the former lakeside carpark at Lake St Clair in progress. The old picnic hut (in the centre of this photo) which is particularly valued by the local bushwalking community was retained in the redevelopment of the site.

Photo by Barry Batchelor

The new Visitor Centre at Lake St Clair. As well as providing functional areas for park management, information, interpretation displays, a restaurant, general store, public amenities, and walker registration, the building aims to create a memorable experience that enhances visitors' enjoyment of the Tasmanian Wilderness and provide a symbolic transition between 'civilisation' (the end of the road) and the wilderness.

Photo by Glenys Jones

4.12 COASTAL EROSION OF ABORIGINAL HERITAGE SITES

About the threat

Coastal erosion processes (both wind and wave) have caused the loss of significant Aboriginal heritage sites along the coasts of Tasmania. While much of this erosion is due to natural processes, dune blowouts may also be initiated or exacerbated by disturbance associated with a variety of human activities including camping, quad bike use and fires. Erosion associated with dune blowouts can lead to the loss of important Aboriginal sites.

Global warming may also be contributing to increased coastal erosion.

Several large Aboriginal midden sites along the Southwest coast that were at risk of being lost as a result of natural coastal erosion processes were successfully protected and stabilised.
Photo by Parks and Wildlife Service

How was the threat averted or managed over the 1992–1999 period?

- A number of major conservation projects were developed by the managing agency in consultation with the Tasmanian Aboriginal Land Council (TALC) to stabilise eroding midden sites along the southwest coast of Tasmania. The projects were mainly implemented by TALC with assistance from the Aboriginal community.
- There was no specific program to reduce the impacts of human activities on coastal Aboriginal heritage sites.

Outcomes

- The program of midden stabilisation resulted in the successful conservation of a number of large midden sites.
- Some midden sites recorded in 1991 along the South Coast could not be relocated in the late 1990s and it is assumed that these have been lost to erosion.
- Other midden sites were probably lost and/or degraded by coastal erosion; however there was little direct monitoring of sites not included in the stabilisation program and specific examples are anecdotal.
- Stabilisation works for midden sites caused localised degradation of vegetation at the rehabilitation sites but do not pose any long-term threat to flora values.

Commentary on management performance

The following commentary has been provided by specialist cultural heritage staff of the Tasmanian Heritage Office and Aboriginal Heritage Office.

KEY FACTORS CONTRIBUTING POSITIVELY TO MANAGEMENT PERFORMANCE

- Development of the Aboriginal Management program linking the Tasmanian Aboriginal Land Council and PWS operations in managing Aboriginal values;
- Development and implementation of the Southwest Middens Stabilisation program;
- Alignment of protection programs and projects with PWS policy, planning and operational activities;
- Projects identifying and establishing planning documentation for cultural places and issues;
- Projects identifying and establishing protective measures for cultural heritage places;

- Projects increasing awareness of cultural heritage values; and
- Development and implementation of training and education programs for PWS staff.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Lack of a coordinated maintenance program for cultural heritage assets;
- Lack of an ongoing program for the protection and conservation of cultural heritage assets;
- Low priority afforded cultural heritage works in comparison with other PWS priorities (e.g. recreational and infrastructure management);
- Funding constraints limiting regular maintenance and repair works for cultural heritage assets;
- Funding constraints limiting the identification and documentation of works for cultural heritage assets; and
- Uncontrolled visitor activities at cultural heritage places.

Brett Noble (Manager, Cultural Heritage Branch) has been with the managing agency for over ten years, during which time he has undertaken numerous surveys for Aboriginal and historic values and prepared conservation plans for key historic sites. Brett now oversees management of cultural heritage services.

Photo by Sophie Underwood

Angie McGowan (Manager Special Heritage Projects, Tasmanian Heritage Office) is responsible for Aboriginal and historic heritage conservation and management in the TWWHA.

Photo by Tim O'Loughlin

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of coastal erosion of Aboriginal heritage sites.

- Development of Strategic Asset Maintenance Planning program for cultural heritage assets tied to operational requirements of PWS;
- Continuation of Aboriginal management program;
- Continuation of protective projects;
- Development and continuation of research program for cultural heritage assets; and
- Continuation of training and education programs for PWS staff.

SOURCES OF INFORMATION AND COMMENT

Angie McGowan (Manager, Special Heritage Projects, Tasmanian Heritage Office), Ph: (03) 6233 2424.

Brett Noble (Manager, Heritage Policy Development, Tasmanian Heritage Office), Email: Brett.Noble@heritage.tas.gov.au, Ph. (03) 6233 6679.

4.13 LACK OF MAINTENANCE OR ACTIVE CONSERVATION OF HISTORIC HERITAGE

About the threat

Lack of maintenance and/or other active conservation measures for historic huts and other significant cultural values can result in their deterioration, with associated loss of their values. Deterioration can be rapid where visitor impacts exacerbate the deterioration.

How was the threat averted or managed over the 1992–1999 period?

- A number of huts were identified as culturally significant and in need of maintenance, and these needs were addressed according to district and regional funding priorities. Some other maintenance and active conservation of culturally significant places was

implemented according to district and regional priorities. However, there was no overarching program to identify, prioritise and implement maintenance requirements for historic huts or to establish active conservation programs for vulnerable sites to achieve the optimal conservation of cultural values.

- In 1993–1994, the Historic Huts Preservation Project produced 29 conservation reports for historic huts and tracks. Inclusion in this program was based primarily on recreation management considerations and some of the huts involved would not be considered heritage assets.
- Other huts that were considered not to have recreational or management amenity value have from time to time been assessed for cultural value.
- During 1996–98 the Cultural Heritage Branch and Parks and Wildlife Service established the Community Huts Partnership Program. This program provides for and promotes community participation and partnership in the care of historic public huts. Community groups and individuals take an active role in managing selected huts, including carrying out regular maintenance.

Lake Ball Hut, Walls of Jerusalem National Park.

Photo by I. Terry

Brothers Kerry and Neville How are Hut Partners for Lake Ball Hut and are also two of the original builders of the hut. The Community Huts Partnership Program was established to promote community involvement in the care and management of historic and approved public huts in the TWWHA.

Photo by I. Terry

Outcomes

There was significant progress in conserving and maintaining a range of historic huts and places over the management period. For example:

- A number of historic huts were retained following conservation assessments in 1993 and 1994. Historic huts with recreational values were maintained in line with the conservation reports where this coincided with district and regional priorities. In addition, some other huts assessed as being redundant from a recreational perspective have been retained when assessed as having cultural value. Where culturally significant huts had no additional management values, these were usually not maintained or maintenance was delayed, e.g. Derwent Bridge hut, Scotts Peak hut.
- A number of huts identified by community groups and individuals as culturally significant have been maintained through the efforts of the community hut caretakers with the active support of the district staff. Examples of successfully maintained huts in this program include Allisons Hut, Reindeer Lodge, Kitchen Hut and Whiteley's Hut.
- Some vulnerable historic places have been actively conserved where this has coincided with district or regional priorities for recreation management.

However, lack of maintenance of several historic huts has been associated with deterioration in the condition of the huts and the loss of significant fabric and social value as they become unused. For example:

- Some historic huts have not attracted community hut partners and regular maintenance was only undertaken when this coincided with district or regional priorities.
- Some culturally significant places identified as vulnerable and deteriorating have not been actively conserved or maintained because conservation of cultural values was not identified as a district priority if those values were not coupled with other recreational or management amenity values. These places continued to deteriorate over the management period, for example Bramble Cove whaling sites, Cox Bight Hut, and Settlement Point. However specific data are not available, as there was no program to monitor the condition of these sites.

Commentary on management performance

The following commentary has been provided by specialist cultural heritage staff of the Tasmanian Heritage Office.

KEY FACTORS CONTRIBUTING POSITIVELY TO MANAGEMENT PERFORMANCE

- Development and implementation of the Community Huts Partnerships program;
- Alignment of conservation programs and projects with PWS policy, planning and operational activities;
- Projects identifying and establishing planning documentation for cultural places and issues;
- Projects actively conserving and developing key cultural heritage places;
- Projects identifying and establishing sustainable uses for cultural heritage places; and
- Projects developing interpretation and increasing awareness of cultural heritage values.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

- Lack of a coordinated maintenance program for cultural heritage assets;
- Lack of an ongoing program for the protection and conservation of cultural heritage assets;
- Low priority afforded cultural heritage works in comparison with other PWS priorities (e.g. recreational and infrastructure management);
- Funding constraints limiting regular maintenance and repair works for cultural heritage assets;
- Funding constraints limiting the identification and documentation of works for cultural heritage assets; and
- Uncontrolled visitor activities at cultural heritage places.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of historic heritage.

- Development of Strategic Asset Maintenance Planning program for cultural heritage assets tied to operational requirements of PWS;
- Continuation of the Community Huts Partnerships program;
- Development and continuation of research program for cultural heritage assets; and
- Development and implementation of training and education programs for PWS staff.

SOURCES OF INFORMATION AND COMMENT

Angie McGowan (Manager, Special Heritage Projects, Tasmanian Heritage Office), Ph. (03) 6233 2424.

Brett Noble (Manager, Heritage Policy Development, Tasmanian Heritage Office), Email: Brett.Noble@heritage.tas.gov.au, Ph. (03) 6233 6679.

4.14 REGULATION OF RIVER FLOWS BY HYDRO-ELECTRIC POWER GENERATING OPERATIONS

About the threat

WHAT IS THE THREAT?
Regulation of river flows by hydroelectric power generation operations disturbs the natural physical, chemical and biological processes of river systems. Significant hydrological modification of rivers can result in unnatural bank erosion of lakes and downstream rivers, and in some cases, may affect significant hydrological features such as meromixis (see below). The Gordon Dam was established prior to the area being listed as a World Heritage Area.

WHAT NATURAL OR CULTURAL VALUES ARE AFFECTED?
Regulation of the Gordon River's water flow by the Hydro-Electric Corporation has been responsible for considerable erosion of the riverbanks and loss of riverside vegetation downstream of the Gordon Dam, affecting the middle Gordon River between the dam and the Franklin River (i.e. upstream of the area affected by tourist cruise vessels).

Meromictic[38] lakes adjacent to the lower Gordon River are characterised by salinity-induced stratification and abrupt physico-chemical changes with depth. These lakes support diverse and highly specialised communities and species (e.g. more than 200 taxa[39]). Community level biotic characteristics (especially trophic organisation) are believed to be globally unique. Rarity of meromixis contributes to the world heritage values of the TWWHA.

Hydroelectric power generation operations on the Gordon River have been associated with the degradation or loss of meromixis of lakes by reducing the frequency of flow events required to periodically recharge the saline bottom waters and so maintain meromixis. See Hodgson & Tyler 1996 for an explanation of this complex process. Specialised species (such as phototrophic sulphur bacteria and phototrophic micro-aerobic flagellates) are lost when meromixis is destroyed.

Background to management

Meromixis in the lakes associated with the Gordon River was first identified as part of a Hydro Electric Commission scientific survey in the 1970s prior to construction of the then proposed Gordon below Franklin Dam. Limnology and aquatic ecology were subsequently intensively studied. Four meromictic lakes were identified within the TWWHA—Lake Fidler, Lake Morrison and Sulphide Pool and 'Marble Pool'[40] (all lakes alongside the lower Gordon River). These lakes are characterised by salinity-induced stratification and abrupt physico-chemical changes across a shallow chemocline that are associated with a unique micro-biota.

How was the threat averted or managed over the 1992–1999 period?

OVERALL MANAGEMENT GOAL: to protect outstanding natural values (including the meromictic lakes of the Gordon River) and to minimise the environmental impacts of hydroelectric power generation operations.

38 Meromixis arises where incomplete mixing occurs in a water body such that the water mass remains stratified (or layered) throughout the year.

39 Tyler pers. comm

40 'Marble Pool' is an informal name for an unnamed lake.

MANAGEMENT ACTIONS AND SIGNIFICANT EVENTS OVER THE 1992–1999 PERIOD

- Aquatic biodiversity in the meromictic lakes was regularly investigated by external scientists prior to 1994 and occasionally since that time.
- Inland Fisheries Service examined the effects of management of the Gordon Power station on the meromictic status of Lake Fidler and the Lower Gordon River using measurements of water temperature, salinity and dissolved oxygen profile.
- No directed action was taken to prevent or mitigate the impacts of the regulation of the river flow by the Hydro Electric Corporation over the 1992–1999 period.

Results

MONITORED CONDITION INDICATORS

Condition indicators (and how they are monitored)	**Targets for condition indicators** (and how performance is assessed)	**Changes in condition indicators over the 1992–1999 period**
MEROMICTIC STABILITY. Meromictic stability was irregularly monitored by external scientists (e.g. from University of Tasmania, Deakin University and others) prior to 1994 and occasionally since then. DEPTH OF CHEMOCLINE Depth of chemocline was monitored irregularly by external scientists. If there were no external studies in progress, then the depth was estimated twice yearly by staff of the Nature Conservation Branch using submersible pump and tape measure to determine the depth of odiferous water. DEPTH PROFILES OF CONDUCTIVITY, PH, TURBIDITY AND DISSOLVED OXYGEN: may be monitored twice yearly in future.	TARGET: Long-term meromictic stability to be maintained / improved over the next ten years (by 2009).	Meromixis has been lost in Lake Morrison, Sulphide and 'Marble' Pools (Hodgson & Tyler 1996). Meromictic stability has been reduced and the depth of chemocline lowered in Lake Fidler. Some recovery occurred during periods of extended power station shutdown (ibid). Meromictic stability in Lake Fidler is now described as 'precarious' (ibid); however degradation was fortuitously slowed by reduced use of the Gordon power station and occasional total shutdowns, allowing recharge of saline bottom waters.
Biodiversity: Biodiversity of meromictic lakes was irregularly studied by external scientists.	TARGET: Natural biodiversity of meromictic lakes to be maintained.	

MONITORED PRESSURE INDICATORS

Pressure indicators (and how they are monitored)	**Potential targets for pressure indicators** (and how performance is assessed)	**Changes in pressure indicators over the 1992–1999 period**
POWER STATION DISCHARGE, especially high discharge during periods of low natural flow.	TARGET: Targets under development.	Over the 1992–1999 period, use of the Gordon power station reduced due to the commissioning of the Antony and King power schemes. Reduced use of the Gordon power station increases the probability of salt wedge penetration into the estuary and meromictic recharge.

Outcomes

- Regulation of river flows by power station operations has been associated with extensive bank erosion in the middle sections of the Gordon River. River banks of a wide range of ages are eroding at an accelerated rate compared with natural rates. Tea-tree scrub continues to hold the banks in some places, but where high water levels have killed vegetation, further bank collapse and erosion are likely to occur.
- Much of this damage had already taken place prior to the 1992–1999 period and it is not possible to determine the extent of any further changes that may have occurred over this period because there was no systematic monitoring program.
- Regulation of river flows associated with hydroelectric power generation operations has also resulted in the degradation of the rare meromictic lakes adjacent to the lower Gordon River. Meromixis has been lost in Lake Morrison, Sulphide and 'Marble' Pools; and meromictic stability in Lake Fidler has been reduced and the depth of the chemocline lowered. Some recovery of meromixis occurred in at least one lake (Lake Fidler) during periods of extended power station shutdown which allowed for recharge of saline bottom waters.
- More recent research has demonstrated that power station operations continue to cause extensive bank erosion on the Gordon River (Koehnken et al 2001).

Commentary on management performance

The following commentary has been provided by specialist staff within the Nature Conservation Branch of DPIWE.

KEY FACTORS POSITIVELY CONTRIBUTING TO MANAGEMENT PERFORMANCE

Meromixis

- Co-operation and advice from external scientists in demonstrating the problem and causes, and in developing monitoring techniques.

Erosion of riverbanks

There was no active management program related to erosion associated with the regulation of river flows during the 1992–1999 period.

KEY FACTORS LIMITING OR THREATENING MANAGEMENT PERFORMANCE

Meromixis

- Ongoing monitoring of the meromictic lakes by external scientists is dependent upon the level of scientific interest (which in turn is linked to the existence of meromixis).

Erosion of riverbanks

- Lack of hydrological knowledge—for example departures from natural hydrological regimes due to river regulation—are difficult to determine with limited data (both baseline and present).

ADDITIONAL COMMENTS

- Bank erosion on the middle reaches of the Gordon River associated with power station operations is currently considered a more significant threat than that caused by commercial cruise boats on the lower reaches of the Gordon River.

- If not managed carefully, introduction of the proposed trans-Bass Strait power cable (Basslink) and the associated power generation demands and changes to flow regimes in the Gordon River could result in further detrimental changes to the hydrological regime and associated erosion.
- Environmental considerations may compromise the optimisation of power generation.

SUGGESTIONS FOR IMPROVING MANAGEMENT EFFECTIVENESS

Specialist staff provided the following suggested actions for improving management of regulation of river flows.

- More extensive cooperation with Hydro Tasmania is required to resolve processes and mitigate threats, especially through the timing of power station maintenance shutdowns. For example, to maximise the probability of meromictic recharge, planned shutdowns of the power station for maintenance should occur during periods of low flow.
- If meromictic stability continues to decline, occasional shutdowns may be required for environmental reasons[41].
- Further research is required to examine the effects of river regulation and any proposed changes to the present hydrological regime e.g. associated with Basslink. For example, a hydrological regime to recharge the meromictic lakes also needs to consider the effects on other important values such as the Gordon River Banks, instream flora and fauna etc.[42]

SOURCES OF INFORMATION AND COMMENT

Jason Bradbury (Geoscientist, Earth Science Section, Nature Conservation Branch, DPIWE), Email: j.bradbury@dpiwe.tas.gov.au.

41 Hydro Tasmania are currently (2003) considering development of an artificial recharge program.

42 A monitoring and adaptive management plan is being developed.