SOUTH COAST REGION

A PLAN FOR THE PROTECTION OF SOUTH COAST VEGETATION FROM DIEBACK

NUMBER 3
1994–1998

Department of Conservation and Land Management
South Coast Region
44 Serpentine Road
ALBANY WA 6330

CONTENTS

FOREWORD

The Department of Conservation and Land Management (CALM) addressed dieback in the South Coast Region of Western Australia as a priority issue in 1986 and produced a Protection Plan for the period 1986-88. This plan was reviewed in 1988 and a modified plan prepared for 1989 to 1993.

Further modifications to cover the years 1994 to 1998 are presented in this Plan.

Achievements since 1986 have been very significant and are the result of keenness, hard work and expertise of many CALM staff in the South Coast Region and from other branches within the Department.

Effective disease management programmes are essential for the conservation of the important endemic flora of this region.

Syd Shea
EXECUTIVE DIRECTOR

PREFACE

This Plan has been written for the guidance of departmental officers in accord with the requirements of Sections 33(3) and 56(1) of the Conservation and Land Management Act (1984). These sections provide for 'necessary operations' to be undertaken to restore the natural environment, and to protect the indigenous flora and fauna. the Plan will be made available to other instrumentality's, community groups, universities and the general public on request.

The Plan, effective from 1994 to 1998, replaces the South Coast Dieback Protection Plan of 1989-93.

Progress in implementation of the previous plan is reviewed. The Plan then describes:

- the current situation of dieback in the South Coast Region of the Western Australian Department of Conservation and Land Management (CALM), and

- outlines strategies and actions for the protection of the Regions native vegetation against dieback.

South Coast Region

The South Coast Region is one of nine administrative regions of the Western Australian Department of Conservation and Land Management It extends from Irwin Inlet in the west to Eucla on the Western Australian/South Australian border. The region currently encompasses 14 national parks, a considerable number of nature reserves and a small number of timber reserves (Map 1). Relevant information on the features of this region, including proposed new conservation areas, is contained in the South Coast Region Management Plan - 1992-2002, (CALM, 1992)

The South Coast Regional Office and Albany District Office are located in Albany and a District Office is in Esperance. Ranger staff are located in the major national parks and at Two Peoples Bay Nature Reserve.

What is Dieback?

Dieback is the common name given to disease caused by microscopic soil borne fungi of the genus *Phytophthora*. This term is usually applied to the effects of *Phytophthora cinnamomi* but several other species cause similar symptoms in native vegetation.

These fungi produce minute zoospores which are motile in water and larger chlamydospores which are moved with soil and plant material. The spores infect plant roots and as the fungal mycelium moves through the root system it rots the affected tissue. Native plant species vary widely in their susceptibility to these pathogens - some die quickly if infected e.g. Banksia, while less susceptible trees such as jarrah may die more slowly yet others are highly resistant to the fungus.

Phytophthora cinnamomi

In the western parts of the South Coast Region *P. cinnamomi* is widely distributed, particularly in the higher rainfall areas and it is believed to have been active in the landscape for a hundred years or more. Aerial photography of Two Peoples Bay Nature Reserve shows extensive infections well established prior to 1946.

Phytophthora megasperma

In recent years field sampling has confirmed the presence of *P. megasperma* in areas along the South Coast.

It was first recorded in the South Coast Region at East Mt Barren within the Fitzgerald River National Park where it is associated with considerable plant deaths in the westernmost known stand of *Banksia speciosa.* It is also known from Cape Arid and Stokes National Parks. The damage it causes is influenced by protracted inundation and periodic drought. Its distribution nor its host range is as extensive as *P. cinnamomi*, but is nonetheless a cause for concern.

The Fitzgerald River National Park Management Plan 1991-2001 (CALM, 1991) expressed considerable concern over the potential distribution of this fungus because recovery and identification of the pathogen at East Mt Barren had been very difficult despite obvious visual symptoms at this site for some time and in many other areas in the park. Many other locations in the park were suspected as being infected. (See Map 7b Fitzgerald River National Park Management Plan). The ease of interpretation in many areas of the Park has been seriously limited by the extensive bush fires which occurred in summer 1989/90. The fires have removed the visual evidence of dead and dying plants so that assessment is mainly of post fire seedling regeneration.

Despite this situation very wet years in 1992 and 1993 led to conditions which were conducive to *P. megasperma* activity and sampling results have now confirmed a much more widespread distribution of this pathogen than that originally presented in the Management Plan. The evidence points strongly to infections having been present for some considerable time.

Sites of recovery of *P. megasperma* are usually associated with poorly drained, occasionally inundated sites associated with roads, and gravel pits. There is, however, potential for significant spread of this pathogen downslope through susceptible vegetation, particularly when soil in the area is saturated for extended periods notably following heavy summer rainfall events. It appears that the conditions promoting activity of the fungus occur irregularly but can result in "explosive" events with the potential for substantial spread through areas linked by excess moisture.

Other *Phytophthora* spp.

P. citricola and P. cryptogea have been isolated from disease sites in the Region, however, evidence suggests they are not a cause for concern.

Why Dieback is a Threat to the Vegetation of the South Coast Region

Dieback is a serious problem in the South Coast Region for the following reasons:

- Parts of the region have a warm, moist climate which favours the production of fungal spores, particularly after summer rains. Poorly drained soils which typify some of the Region, also favour the production of spores and spread of the fungi. Clay and laterite which are significant components of many of the soils in the South Coast Region, act as impeding layers and cause subsurface ponding which facilitates the production of spores. On these soils water tends also to drain laterally, thus spreading the fungus further. Soils developed on limestone seem not to be susceptible to the disease.

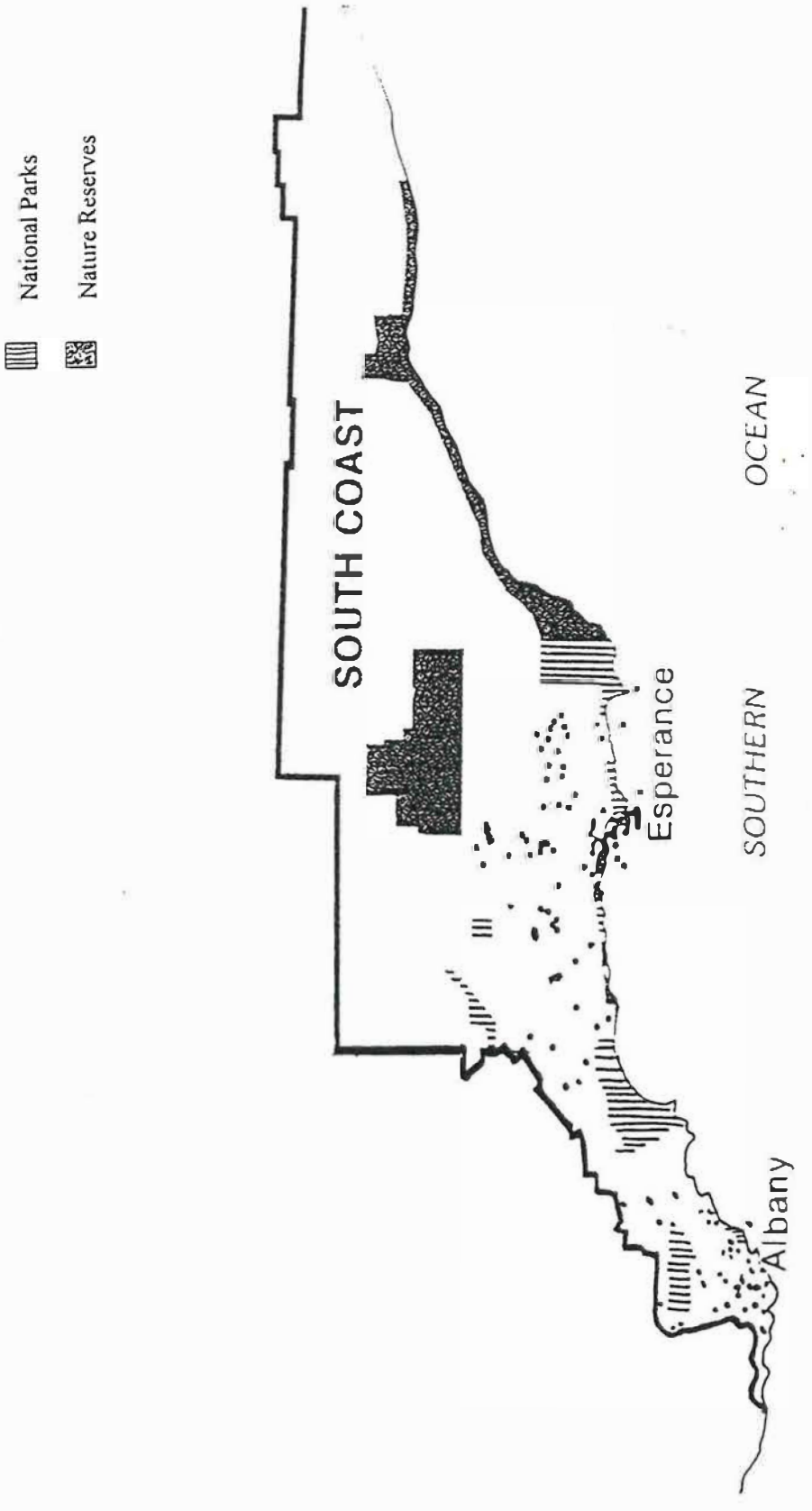
- Species of *Phytophthora* attack at least 1 000 plant species world-wide in a wide range of plant families. Many species of *Proteaceae, Fabaceae, Myrtaceae and Epacridaceae,* which together dominate many of the plant communities in the South Coast Region, are highly susceptible. A large proportion of species in the Stirling Range National Park are susceptible to *P. cinnamomi* (Wills 1993) so that the loss of plant cover and floristic

structure have potentially far reaching impacts. Many plant species are endemic to the South Coast and of these a significant proportion are declared threatened or priority species. Dieback is currently a serious threat to the viability of several declared rare species which are known from only a small number of populations all of which are now partly infected by the *Phytophthora spp.*

- Eradication is virtually impossible. Every effort must therefore be made to protect flora in the very substantial areas still free of the pathogens. The most effective protection is to ensure that the fungi are not introduced to uninfested areas.

  Unfortunately phosphonate treatment which induces resistance in otherwise susceptible plants does not eradicate the fungus. The focus for application to date has been on protecting endangered plants which are threatened by dieback. Wider operational use may be developed in the future.

In the light of these three factors, dieback is a serious problem in the South Coast Region.



MAP 1

CALM MANAGED LAND IN SOUTH COAST REGION

Results achieved during implementation of the 1989-93 plan are listed below under the strategy headings used in that plan.

1. Identification of Priority Areas

Hazard Zoning

The region was divided into three zones based on rainfall isohyets, *Phytophthora spp.* distribution and public usage of reserves. A broadscale Plan showing hazard has been completed for each zone.

More detailed zoning has been completed within each reserve based on geological/vegetation units.

Surveys for the Occurrence of Dieback in Proposed Conservation Lands

Surveys for the occurrence of Dieback have been completed in the following lands which were proposed for addition to the States' conservation reserve system in the South Coast Region Management Plan. (CALM, 1992.)

Broad scale maps identifying the general occurrence of dieback (Level 3) have been prepared for:

Gull Rock (unvested National Park)
Waychinicup (unvested reserves)

Preliminary Surveys to detect likely occurrence of dieback have been undertaken in:

Fitzgerald River Corridor	(VCL and unvested reserves)
Corackerup Creek Corridor	(VCL)
Lort River Corridor	(unvested)
Young River Corridor	(unvested)
Ravensthorpe Range	(VCL and unvested reserves)

Extent of Infection

Areas given priority for detailed mapping of dieback occurrence included:

Stirling Range National Park
Cape Le Grand National Park
Gull Rock National Park
Waychinicup National Park

In all these Parks the identification of areas apparently free of *Phytophthora spp.* was given a high priority because of the already significant level of infestation present in the reserves.

Surveys in the Fitzgerald River National Park also had a high priority because of the relatively small areas currently known to be affected.

Public Use

In 1992 a review of footpaths in the South Coast Region was undertaken to assess ongoing risk associated with their use. Many of the paths are subject to relatively high levels of use by visitors. As many paths pass through areas high in the landscape they can place considerable downslope areas at risk if a pathogen is introduced on them.

Management Capability

Diminishing financial resources have decreased management capabilities particularly in parks and reserves with no resident Ranger. To some extent this has also occurred in staffed parks particularly where considerable distances are involved, due to financial restrictions on vehicle usage.

2. Preparation of Guidelines for Dieback Management

Plans for the protection from dieback of areas of highest priority were prepared or reviewed. They were presented through inclusion in Interim Management Guidelines and area management plans.

During 1989-93 guidelines were prepared for the first time for:	Waychinicup National Park Fitzgerald River National Park West Cape Howe National Park Two Peoples Bay Nature Reserve Torndirrup National Park
Reviews of guidelines were conducted for:	Cape Arid National Park Cape Le Grand National Park Porongurup National Park Stirling Range National Park Stokes National Park
Preparation of guidelines were commenced for:	Gull Rock National Park William Bay National Park Quarram Nature Reserve Lake Shaster Nature Reserve Esperance Lakes Nature Reserve

In 1992 a review of the level of risk associated with ongoing use of all 'official' footpaths in the region resulted in a number of initiatives for dieback management on paths including use of strategically placed boardwalks, seasonal closures, boot cleaning stations and new information signs.

3. Provision of Regional Staff and Training

A Dieback Interpreter position was transferred to the South Coast Region attached to Albany District in July 1992.

The Environmental Protection Branch of the Department has provided the following training;

1990	Dieback Management Course
1992	Advanced Dieback Course

In addition the South Coast Dieback Interpreter has conducted on the job training for field staff in sampling techniques and dieback occurrence mapping procedures. The Dieback Research group located in Perth, headed by Dr Bryan Shearer, have also provided updates on current research activities in the region.

4. Increasing Community Awareness

Overall there has been increased community awareness of dieback during the past five years in the South Coast Region. This is due in part to the following achievements involving CALM staff:

- Assistance has been provided to the MRD to improve the disease management aspects in their planning for work along the South Coast.
- Advice has been provided to local authorities on request.
- A dieback speakers kit was launched by Albany Rotary International - the kit has subsequently been used by CALM staff and others giving talks on dieback at schools, service clubs, LCDC's.
- Continued distribution of the brochure "Dieback on the South Coast".
- Presentations have been provided to a range of interest groups, schools, etc.
- Liaison has occurred with the Shire of Albany over the development for them of a Dieback Policy.
- Interviews have been conducted on local radio concerning dieback issues.
- Articles have been developed in the local media concerning dieback related issues.

- Papers have been prepared for scientific journals and conferences (Wills 1993; Gillen and Watson, 1993).

- West Cape Howe/Stirlings, Porongurup Planning Workshops (public).

- Contractor education

5. Dieback Mapping

During 1989-1993 two of the three standards of mapping for dieback presence have been found applicable to the South Coast Region and subsequently developed. These are:

- ***Level 2 Dieback Occurrence Map***

  Intended for detailed planning and implementing operations where soil movement is a feature of the operation. These are generally linear maps along roads, firebreaks and of small features such as recreation site developments. These maps require intensive ground survey to provide the desired level of detail.

- ***Level 3 Dieback Occurrence Map***

  Intended only for a broad overview of the extent of dieback - not suitable for planning or implementing operations. This information is then used for compiling strategies for management within Interim Guidelines for Necessary Operations or Area Management Plans. These maps are upgraded as planning requires.

Level 1 dieback occurrence maps are the very detailed maps prepared for forest areas subject to intensive operations such as log harvesting.

Fixed wing aircraft surveys were conducted over the Stirling Range National Park in 1991 and Fitzgerald River National Park in 1992. The survey in the Stirling Range National Park was opportunistic whilst the survey in the Fitzgerald River National was proposed because of *P. megasperma* activity in widely distributed sites within the Park. The Fitzgerald River National Park was re-surveyed using a helicopter some months later which allowed opportunity for on site sampling in remote locations unavailable to vehicle access at the time. This enabled a broad area to be covered in a short time with the opportunity to land and survey/sample when needed.

Standard aerial photography has been found not to be particularly useful in mallee/mallee heath vegetation types which constitute significant areas in the dryer parts of the Stirling Range and Fitzgerald River National Parks.

Due to the expertise developed in the region, particularly through the Dieback Interpreter, level 3 maps have now been produced for all major Parks and some reserves. Some of these maps reflect a long history of *Phytophthora* infestation and

associated change in vegetation structure and composition (eg Two Peoples Bay Nature Reserve).

Considerable effort has been directed towards completion of mapping in the Stirling Range National Park which had been made difficult until recently by the impact of a large fire which occurred in 1983. This work has focused on the identification of areas that are apparently dieback free, so that management actions can be directed toward the ongoing protection of these areas. Particular attention has been paid to peaks which can be protected from the introduction or spread of *Phytophthora spp.* Areas with significant portions free of dieback have been found towards the central and western end of the park in more remote areas which have obviously had much lower levels of public usage than the more popular eastern peaks.

6. Research

Range of Distribution of Susceptible Species

Externally funded research has also been important in the region, particularly by the dieback research group within the Science and Information Division.

Increasing knowledge has developed through observation and experience by South Coast staff. A significant contribution in this area has been achieved through Malcom Grant, the South Coast Dieback Interpreter.

Useful indicator species have been identified for particular areas. For example in the Stirling Range National Park mountain surveys have been successfully completed using binocular scanning for presence/absence of *Xanthorrhea spp.*

Separate externally funded studies have been conducted in the Albany District on the impact of *Phytophthora spp.* on wild populations of *Banksia coccinea* and *B. baxteri.* The objective was to assess the conservation status of the species and make recommendations for future management. As a result in 1992 both species were removed from the list of species approved for commercial wildflower picking.

Hazard Rating of Plant Communities

Hazard ratings for particular landform/soil and associated vegetation types were developed in conjunction with the Broadscale Hazard Plan for the Region.

Mechanisms and Rate of Spread in Different Areas

The patterns of the disease in mallee/heath were being documented including identification of affected species.

A clearer picture of *P. megasperma* behaviour emerged from observation of sites in the Fitzgerald River National Park.

Strongly episodic bursts of disease expression associated with *P. cinnamomi* and *P. megasperma* along the South Coast has been recorded in the Fitzgerald River, Cape Arid and Stirling Range National Parks. This activity is strongly linked to extended periods of soil saturation and with heavy rainfall events during summer months.

Wills (1993) provided some quantitative estimates on the number of likely susceptible species in the Stirling Range National Park and offered some comment on the ecological consequences of changes to plant communities caused by the disease.

A better understanding of the behaviour of *P. megasperma* is essential for management operations to be conducted under the most appropriate and effective hygiene practices.

A programme of research on the occurrence, control and management of *P. megasperma* in the Fitzgerald River National Park commenced in 1992 and is ongoing.

Control Measures

Trials on the effectiveness of stem injection and foliar spraying of phosphonate has been conducted since winter 1990 in the South Coast by members of CALM's Science and Information Division. These trials have focused on Banksia species on a range of sites from Gull Rock to the Stirling Range National Park.

Operational use of phosphonate began in spring 1993 and has focused on the rare and endangered flora, *Banksia brownii* and *Andersonia sp.* These plants are at high risk in the wild due to the potential impact of existing infestation of *Phytophthora cinnamomi* in all of the known populations. Specific locations have been sprayed twice, monitoring of the effectiveness of treatment will continue.

Rehabilitation

No specific work has been commenced.

Historical Research

Analysis of old aerial photography has been completed for the Stirling Range National Park and Two Peoples Bay Nature Reserve. This confirmed that impact of the fungus was quite apparent in the mid 1940s in Two Peoples Bay Nature Reserve.

Aerial Satellite Photography

A study of the applicability of both Geoscan and Thematic mapper satellite imagery for dieback interpretation has been conducted by CALM in collaboration with CSIRO.

Geoscan airborne imagery technical trial data was captured over Two Peoples Bay Nature Reserve, Gull Rock, Fitzgerald River, Cape Arid and Stirling Range National Parks.

These trials have proved successful in identifying changes within closed canopy heath and suitably dense open heath vegetation due to infection by *Phytophthora spp.*

Detection of changes due to *Phytophthora spp.* infection in open sparse vegetation communities are not so successful.

The relatively small size of existing infections in Cape Arid and Fitzgerald River National Parks in combination with open canopy heath vegetation has made detection of damage due to *Phytophthora spp.* difficult in these areas.

Stirling Range National Park Geoscan data has not yet been fully processed for evaluation.

Thematic mapper Landsat imagery has to date been processed and then checked for accuracy in Cape Le Grand, Stirling Range, Waychinicup, Gull Rock National Parks and Two Peoples Bay Nature Reserve.

Thematic mapper Landsat imagery proved successful in detailing changes within vegetation due to *Phytophthora spp.* infection within the closed canopy heath.

7. Monitoring

Pegging Infection Boundaries

Ongoing measurements of plots in Two Peoples Bay Nature Reserve and Gull Rock National Park was undertaken by the Albany District interpreter, confirming previous estimates of rates of spread of approximately 1 metre per year.

Aerial Photography

Aerial photography has been taken of all the Stirling Range National Park and also of the Bell Track area in Fitzgerald River National Park. Photography was useful in checking inaccessible areas in the Stirling Range National Park, some of which were later ground checked. The Bell Track infection was shown not to have extended much further out from the track but was evident further south on the track than previously recorded.

Map Updates

Level 3 maps have been updated as required for planning. All field staff are now capable of updating existing maps. Those areas that received most attention were Stirling Range National Park, Fitzgerald river National Park, Cape Le Grand National Park, Cape Arid National Park and Porongurup National Park.

Action Plan

Guidelines for necessary operations were developed/reviewed to implement the strategies listed above (see page 9).

Conclusion

The major outcomes of work during 1989-93 are:

- Increased knowledge of *P. megasperma* distribution in the Fitzgerald River National Park and Cape Arid National Park.
- The unusual distribution of *P. megasperma* relative to *P. cinnamoni* along the South Coast. *P. megasperma* appears to be present in the landscape from the junction of the Bremmer Bay Road and the South Coast Highway, east into Bremmer Bay and then into Fitzgerald National Park. It has not been recovered west of the above mentioned site on the South Coast Highway.
- The important advances in use of indicator species in Two Peoples Bay Nature Reserve and Stirling Range National Park in helping to decipher old infection in the absence of current disease expression.
- Potential for satellite imagery.
- development of techniques for the operational use of Phosphonate.
- An increased emphasis on public awareness through educational programmes, talks and on site information such as new signs, clean down stations etc.
- Release of the South Coast Region Management Plan, 1992-2002 (CALM 1992).
- Appointment of a Dieback Interpreter to the South Coast Region.

Departmental Policy Statement Number 3 includes 10 policies applicable to the protection of the vegetation of parks and reserves in the South Coast Region from dieback. (See Appendix 1 for complete policy).

1. Objectives

The objectives of the policy statement which are particularly relevant to the South Coast are:

- To minimise the introduction, spread or intensification of the plant diseases caused by *Phytophthora* species throughout the State, with particular emphasis on the South-West;
- To undertake and support research into the disease and its control.
- To encourage the WA community to share our concern over the problem, and its management.

2. Strategies

The South Coast Region Management Plan (CALM, 1992) included the following updated Regional Strategies for the management of Plant Disease.

(i) Prevent the establishment of dieback in new areas and minimise additional spread in areas where the disease already occurs by controlling access and operations in susceptible areas.

(ii) Assess all operations and uses with an evaluation test (Hygiene Evaluation Test) for potential dieback impact.

(iii) Undertake all operations under hygienic conditions and monitor the effectiveness of such hygiene.

(iv) Identify priority areas within the Region for protection from dieback based on conservation values, risk of introduction and predicted impact.

(v) Assess dieback protection needs in the preparation of interim guidelines for necessary operations, proposals for compatible operations and in area management plans.

(vi) Improve understanding by the public and by CALM personnel of the dieback problem and protection measures on lands managed by CALM.

(vii) Undertake dieback mapping and assist with dieback research.

(viii) Monitor the spread of known infections and where possible develop and implement action steps to limit their spread.

(ix) Develop and adopt appropriate strategies for other plant disease species including Armillaria, canker and other Phytophthora species.

(x) Encourage other Government Departments and Local Authorities to adopt similar dieback control strategies.

Actions for implementing these strategies over the next five years are discussed in the next section.

The following actions are identified for implementing the intent of the Strategies set out in the Regional Management Plan

1. **To minimise the risk of *Phytophthora spp.* being introduced to uninfested areas.**

- Access plans for all roads, tracks and footpaths will be developed in each park and reserve.

- Control of access will be continued and improved on all non public roads and tracks on CALM managed land through the use of barriers, signs and permits.

- Rationalisation and closures will be considered for tracks and paths on the basis of necessary operations approvals and will be conducted in accordance with interim guidelines or management plans.

- Proposals for the construction of new roads or firebreaks or other major soil disturbance activities will be dealt with through the process of interim guidelines for necessary operations or management plans.

2. **To evaluate all proposed operations and uses for the threat they pose to the protection of south-coast ecosystems from the effects of dieback.**

All proposed operations will be subject to a appraisal in which the following points will be considered:

- Activity
- Hazard
- Risk
- Consequence
- Hygiene
- Evaluation

See Appendix 1 for an explanation of these.

This checklist is used to determine appropriate operational hygiene measures after balancing the risk of pathogen introduction and spread against the consequences of hygiene failure.

3. **Undertake all operations under hygienic conditions and monitor the effectiveness of such hygiene.**

- Hygiene conditions will be set for operations through the Hygiene Evaluation checklist.

- The effectiveness of hygiene will be monitored through a regionally co-ordinated monitoring program and a record maintained.

- Results from monitoring will be used to refine or develop new or modified hygiene measures.

4. Identify priority areas, based on conservation values, risk of introduction and predicted impact, within the region for protection from dieback.

- Broadscale hazard mapping of the region will be used to assist in the process of identifying priorities.
- More detailed hazard mapping will be applied to individual areas of land.
- Priority is to be given to CALM managed lands and lands which are proposed to be managed by CALM, as identified in the South Coast Regional Management Plan.
- Areas of land with very limited disease or remnants within areas of very extensive disease will be treated with equally high importance.
- Public areas where use is high will be identified as there is a greater risk of introduction of the fungi. Vehicles and pedestrians are potential vectors.
- Dieback management is likely to be more effective in areas where departmental field staff are close at hand to implement this plan. Management capability will be used as a factor in helping to identify priority areas.

Effective dieback management will be applied to all CALM managed land but with most energy concentrated on the areas identified using the above criteria.

5. In the preparation of interim guidelines for necessary operations, proposals for compatible operations and in area management plans needs for protection from dieback will be assessed.

- The protection plans for individual parks and reserves will address the following aspects:
  - ➢ the current description of each area and its key features;
  - ➢ the current dieback status (extent and impact) and hazard rating of areas presently uninfested;
  - ➢ proposed management actions to prevent introduction and spread of *Phytophthora spp.*

  In developing these plans, recreational access and fire protection will be considered and integrated with the need for dieback protection.

- Interim Management Guidelines will be completed for the following areas:

  Helms Arboretum - Esperance
  Esperance Lakes Nature Reserve
  Lake Shaster Nature Reserve
  William Bay National Park and Quarram Nature Reserve
  Gull Rock National Park
  Nature Reserves of the Albany District
  Nature Reserves of the Ravensthorpe Shire
  Ravensthorpe Range
  Eucla National Park
  Nuyts Nature Reserve

During the term of this plan additional areas may need protection plans as a result of changing priorities or new land vesting.

6. Improve understanding by the public and by CALM employees of the dieback problem and measures needed to protect native vegetation from dieback.

- Information and advice will continue to be provided to schools and community groups

- The opportunity will be taken to use local media outlets to provide information to the public on management and control of the disease and results of research investigations.

- Staff will continue to ensure that contractors are fully informed on dieback management and hygiene requirements

- Staff will continue to be trained in:

  - biology of *Phytophthora spp.*, recognition of symptoms due to Phytophthora infection and the method of sampling diseased plants to test for the presence of *Phytophthora spp.*;

  - use of the Hygiene Evaluation process and Necessary Operations Checklist;

  - use of dieback hygiene manual;

  - new information made available through research programmes.

7. Map dieback effected areas and assist with dieback research.

- Dieback mapping will be undertaken to produce either level 2 or level 3 dieback occurrence maps.

Level 2 maps will be produced for planning and implementing operations where soil movement will occur. Generally these maps will be developed for roads, firebreaks and recreation site developments.

Level 3 maps will be produced for CALM managed lands on a priority basis.

- Aerial photography and satellite imagery will be used to assist with mapping.
- Aerial surveillance will be used to assist with mapping projects.
- The region will continue to contribute to the identification of research priorities and to provide assistance on the ground with the implementation of research projects.

The region assists directly with research on disease control using Phosphonate and work on the biology and control of *P. megasperma* in the Fitzgerald River National Park.

8. Monitor the spread of known infections and where possible develop and implement action steps to limit their spread.

- Existing sites will continue to be monitored for rate of spread of the disease. In some cases this will include the use of aerial photography.
- Phosphonate will be utilised control disease in some areas.
- Phosphonate will be used on a priority basis to provide protection to rare species threatened by *Phytophthora spp.* in the wild.

9. Develop and adopt appropriate strategies for other plant pathogens including *Armillaria* and Canker fungi.

- Where required hygiene standards for other *Phytophthora* species will be those currently applied for *P. cinnamomi.*
- In the case of known Armillaria disease sites the same hygiene measures pertaining to *Phytophthora spp.* regarding soil movement will be applied.
- In the light of new research findings modification to hygiene procedures will be developed.

10. Encourage other government departments and local authorities to adopt similar dieback control strategies.

- Continue to provide advice to government departments and local authorities concerning dieback management measures.
- Make available written guidelines such as the hygiene manual for use by such organisations.

Strategy	Responsibility	Time Frame
1. To minimise the risk of *Phytophthora spp.* being introduced to uninfested areas.	South Coast Region District Staff	Ongoing
2. To evaluate all proposed operations and uses for the threat they pose with regard to the protection of South-coast ecosystems from the effects of dieback.	District Staff South Coast Region	Ongoing
3. Undertake all operations under hygienic conditions and monitor the effectiveness of such hygiene.	District Staff	Ongoing
4. Identify priority areas, based on conservation values, risk of introduction and predicted impact, within the region for protection from dieback.	District Staff	Ongoing
5. Assess protection needs from dieback in the preparation of interim guidelines for necessary operations, proposals for compatible operations and in area management plans.	District Staff South Coast Region Environmental Protection Branch	Ongoing Annual Review
6. Improve understanding by the public and by CALM employees of the dieback problem and measures needed to protect native vegetation from dieback.	South Coast Region Environmental Protection Branch Corporate Relations	Ongoing
7. Map dieback effected areas and assist with dieback research.	District Staff South Coast Region Science and Information Division	Ongoing
8. Monitor the spread of known infections and where possible develop and implement action to limit their spread.	South Coast Region District Staff	Ongoing
9. Develop and adopt appropriate strategies for other plant disease pathogens including *Armillaria* and Canker fungi.	South Coast Region District Staff Environmental Protection Branch	Ongoing
10. Encourage other government departments and local authorities to adopt similar dieback control strategies.	South Coast Region Environmental Protection Branch	Ongoing

(1) Develop priorities for research and management and implement prescriptions aimed at preventing or minimising the ecological and economic impacts of dieback.

(2) Evaluate the following factors before any operation proceeds which is likely to introduce, spread or intensify the impact of Phytophthora species (on land managed by CALM):

- Activity - whether the proposed activity needs to take place
- Hazard - the vegetation/landform type and the land use for which the area is being managed
- Risk - the risk of introduction, spread, intensification of disease
- Consequence - the consequences of infection on land use and ecological values
- Hygiene - the hygiene measures required to minimise the consequences
- Evaluation - the judgement of the manager regarding the adequacy of hygiene taken to minimise the consequences to a level that is acceptable

This appraisal is the HYGIENE EVALUATION.

(3) Determine dieback hygiene requirements before granting access to land managed by CALM and monitor the effectiveness of measures taken. The degree of control exercised will relate to the risk of introducing *Phytophthora* species, the chance of any introduction surviving and the magnitude of the consequences.

(4) Manage access on lands managed by CALM to minimise accidental introduction or spread of dieback by vehicles or during road maintenance or construction.

(5) Determine the location and extent of dieback on land managed by CALM. The highest priority will be given to those areas in which hazard and the risk of introduction or spread by natural or artificial means is the greatest, and where the values at risk are highest.

(6) Identify disease-free areas which can be specially protected to minimise the risk of infection.

(7) Undertake research into the diagnosis of the disease, the assessment of damage caused by the disease, disease dynamics, disease management and disease prevention and control, and disseminate research results.

(8) Monitor for *Phytophthora* activity outside the known range of the fungus and for the effectiveness of hygiene techniques.

(9) Train staff in dieback biology and control.

(10) Educate the community about the problem and encourage them to share with CALM the responsibility for dieback control.

CALM 1986, South Coast Dieback Protection Plan, 1986-88

CALM 1989, South Coast Dieback Protection Plan 1989-93

CALM 1992, South Coast Regional Management Plan, 1992-2002

Gillen, K.J., and Watson, J.R., (1993), Controlling the plant pathogen, *Phytophthora cinnamomi*, in mountain areas of South Western Australia, *Australian Ranger*, 27:18-20.

Wills, R.T., (1993). The ecological impact of *Phytophthora cinnamomi* in the Stirling Range National Park, W.A., *Australian Journal of Ecology*, (1993), 18:145-159.

4003-0594-300