CALMScience Division

STRATEGIC PLAN
1999 – 2004

Department of Conservation and Land Management

FOREWORD

This document is the second published Strategic Plan of CALM**Science** Division (formerly Science and Information Division). The first plan covered the period 1995-1999.

In 1996 the Western Australian Government's Perth Observatory (Astronomical Services Program) was transferred from the Department of State Services to CALM, and was placed in this Division. It constitutes Management Program 4 of the Department.

In preparing this plan, it proved difficult to integrate the core research function of the Perth Observatory in a coherent way with the biological research functions of the Division. Accordingly, the two revised strategic plans are kept separate but are published in the same document. This treatment should best satisfy the different audiences for our biological and astronomical research.

The Division is structured around four key science themes:

- Description and documentation of the State's biological diversity (Biological Information Group)
- Protection and conservation of the State's biological diversity (Biological Conservation Group)
- Sustainable utilization of the State's natural resources (Forests and Tree Crops Group)
- Astronomy research, education and information (Astronomical Services Group)

The Science Management Council, consisting of the Director, Science Adviser and Managers of the four science groups (themes) determines policy in the Division. Each science group consists of a number of outcome-based project teams, details of which are provided in the Division's Operations Plan.

Dr Neil Burrows
DIRECTOR

CONTENTS

BIOLOGICAL RESEARCH STRATEGIC PLAN

PURPOSE

This Strategic Plan sets out the role of the CALM**Science** Division by providing an overview of the mission, broad objectives and strategies of the Division. It also describes the aim of the key science themes and the objectives, strategies and indicators of success for the projects, which support these themes. This plan represents the first level of a three tiered Divisional planning process and is consistent with the Department's Corporate Plan 1998-2000. An Operations Plan (consisting of project team plans) and Science Project Plans (SPPs) provide increasing levels of detail about the resources, activities and outcomes of the Division.

INTRODUCTION

CALM's mission is to conserve and manage Western Australia's native plants and animals and the lands, waters and resources entrusted to the Department for the benefit of present and future generations. CALM has the following major objectives:

Conservation: To conserve indigenous plants, animals and ecological processes in natural habitats throughout the State.

Value and Use of Resources: To optimise the value and economic return to the community of wildlife, lands, waters and resources entrusted to CALM without compromising conservation and other management objectives.

Recreation and Tourism: To identify and provide opportunities and services to the community which will allow them to enjoy and value the wildlife, lands, waters and resources entrusted to CALM without compromising conservation and other management objectives.

Knowledge: To seek and provide an up-to-date and sound scientific and information basis for CALM's conservation and land management activities.

Community Support: To promote community awareness and appreciation of the values of the wildlife, lands, waters and resources entrusted to CALM, and to develop community understanding and support for CALM's conservation and land management activities.

CALM People: To recruit, develop, reward and retain knowledgeable and talented staff, and provide a stimulating, safe, productive and supportive work environment where staff can pursue individual goals consistent with those of CALM.

Corporate Efficiency: To optimise the efficiency, effectiveness and responsiveness of CALM in achieving conservation and other management objectives.

VISION

For CALM**Science** Division to be recognized as a world leader in the provision of high quality science and technology to underpin conservation and the sustainable utilization of natural resources in Western Australia.

MISSION

In consultation with CALM's Regions, Districts and Primary Programs, and in collaboration with other relevant agencies, CALM**Science** Division will provide up-to-date and scientifically sound information to uphold effective conservation and land management in Western Australia.

DIVISIONAL OBJECTIVES

To achieve its Mission, CALM**Science** Division has the following objectives:

- To provide a scientifically objective and independent source of reliable knowledge and understanding about conserving species and ecological communities in Western Australia, managing the public lands and waters entrusted to CALM, and carrying out CALM's other legislative responsibilities
- To ensure that CALM**Science** Division is responsive to the needs of policy makers and managers in CALM by bringing science to bear on the solution of the State's most pressing problems relating to conservation and land management.
- To advise CALM on sustainable resource development opportunities and to promote the conservation of biological resources through their sustainable utilization
- To communicate and transfer to managers in CALM the knowledge, information and other insights obtained through scientific investigation in Western Australia and elsewhere.
- To attain for CALM a worldwide reputation for excellence in science by publishing knowledge obtained through scientific research in the premier national and international scientific journals and through electronic means.
- To contribute, as an integrated part of CALM, to meeting the need for knowledge on conservation and land management matters by the public of Western Australia.

DIVISIONAL STRATEGIES

To meet its Mission and Objectives, CALM**Science** Division has adopted the following broad strategies:

- Work effectively with CALM's Regions, Districts and Primary Programs to prioritize the important scientific and technical issues that need to be addressed in order to achieve CALM's mission.
- Assemble outcome-based project teams to find scientifically sound and practical solutions and to develop new technologies within a specified time and budget.
- Secure the necessary resources to support the core functions and projects of the Division.
- Collaborate with CALM's Regional, District and other staff in technology transfer and timely implementation of practical solutions and new policies, prescriptions and technologies.
- Patent new technologies or innovations that have commercial potential.
- Keep abreast of worldwide scientific and technological advances via the literature and attendance at scientific meetings and seek opportunities to utilize or adapt these to suit CALM's needs.

- Communicate and market the contribution of CALM**Science** Division to attaining CALM's Mission.
- Develop and project CALM**Science** Division's reputation as a credible and dependable source of sound knowledge about conservation, land management and sustainable utilization matters.
- Uphold CALM's commitment to obtaining scientifically sound information through improved resourcing of CALM**Science** Division.
- Continue to apply the most cost-efficient means of carrying out research such as providing resources for post-graduates, collaborating with other agencies, actively seeking external funds and employing contract or consultant staff where appropriate.
- Carry out a balanced program of short-term and long-term research.
- Collaborate with other Government agencies, universities, industries, other interest groups and the public to conduct or co-ordinate research when such interaction will benefit CALM's objectives.
- Maintain science resources such as high standards of herbarium curation, computer and library facilities.
- Recruit, retain and reward talented and productive staff.
- Provide staff with opportunities to reach higher levels of self-development.
- Enhance project co-ordination and staff management skills.

In CALM's Corporate Plan1998-2000, CALM**Science** Division set three explicit targets, namely;

- To undertake a strategic review of CALM's research needs every three years.
- To present an annual series of technology transfer workshops to CALM operations staff.
- To achieve an average of two technical publications per scientist per year.

KEY SCIENCE THEMES AND SUPPORTING PROJECTS

Key Science Theme: Description and documentation of Western Australia's biological diversity (Biological Information Group). Western Australia has a very rich flora and fauna with a diverse array of ecosystems and habitats. CALM**Science** Division will continue with the inventory of systematic, biological and ecological information on the native and alien biota.

Supporting projects:

- Collections management
- Regional information network
- Information systems administration
- Information systems research and development
- Descriptive taxonomy and biosystematics
- Forest Region Flora
- Regional forest assessment
- Bioprospecting

Key Science Theme: Protection and conservation of Western Australia's biological diversity (Biodiversity Conservation Group). CALM**Science** Division will provide knowledge of threatened species and communities and of ecosystems, which are not well represented in the State's reserve system. We will continue to identify processes and organisms that threaten the State's biological

diversity and develop scientifically sound applied technologies to ameliorate these threats (e.g., introduced predators and herbivores, pests and diseases and inappropriate fire regimes). Systematic biological surveys of the State will be ongoing to provide the basis for a comprehensive, adequate and representative reserve system.

Supporting projects:

- Western Shield - fauna recovery
- Western Shield - introduced predator control
- Western Everlasting - flora recovery
- Carnarvon Basin biological survey
- Marine fauna conservation and management
- Aquatic ecosystems conservation
- Salinity Action Plan
- Monitoring rabbit calicivirus disease
- Disturbance management ecology
- Remnant vegetation reconstruction
- Monitoring river health
- CAR reserve system

Key Science Theme: Sustainable utilization of Western Australia's native forests and plantations (Forests and Tree Crops Group). CALM**Science** Division will provide the scientific basis to ensure that the State's native forests and plantation resources are used in an ecologically sustainable manner, which minimizes adverse impacts on the environment. Research will focus on the development of valid indicators of sustainable forest management, and the establishment of plantations for commercial products as well as for environmental benefits (enhancing biodiversity, controlling salinity and erosion, and for carbon sequestration).

Supporting projects:

- Ecologically sustainable forest management
- Forest microbiota management
- Forest fire management
- Sandalwood ecology and management
- Genetics and tree breeding
- Dryland tree crops
- Western bluegum plantations
- Softwood plantations
- Tropical plantations
- Vegetation Health Service

PLANNED ACHIEVEMENTS 1999-2004

Over the next five years CALM**Science** Division will be able to demonstrate success in meeting its obligations to provide up-to-date and scientifically sound information to underpin conservation and land management in an efficient and effective manner in the following areas:

KEY SCIENCE THEME: *Description and documentation of Western Australia's biological diversity*

AIM: *To establish a State resource centre for taxonomic, conservation and economic information on the flora and, in collaboration with other institutes, the fauna of the State*

RELEVANT CORPORATE OBJECTIVES:

- *Seek and provide an up-to-date and sound scientific and information basis for CALM's conservation and land management activities*
- *Conserve indigenous plants, animals and ecological processes in natural habitats throughout the State*

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
Collections Management	• Maintain and extend the State's scientific collection of specimens to adequately represent taxon distribution and variation. • Maintain currency of names in the corporate names database (WACENSUS), the State Collection and the specimen database (WAHERB).	• Collect, process, identify and name voucher specimens. • Ensure safe storage of the State collection and repatriate WA type specimens held overseas. • Maintain relevant databases. • Facilitate access and loan of specimens • Maintain ancillary collections.	• 5 000 accurately named voucher specimens curated in the State Collection per year.
Regional Information Network	• Develop and service a Regional Information Network to empower Landcare and kindred Groups to contribute and access information on native and alien WA flora.	• Extend volunteer program to regional communities. • Provide training in plant identification and specimen vouchering. • Establish regular communication with regional herbaria and landcare groups.	• 65 active regional herbaria with up-to-date, accurately identified specimens. • 15 000 specimens added to the State collection.

KEY SCIENCE THEME: Description and documentation of Western Australia's biological diversity (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
Information Systems Administration	• Provide the necessary LAN infrastructure to support the objectives of the Division.	• Design, install and maintain LAN equipment and software. • Configure PCs and other equipment to connect to LAN and Internet.	• All staff with access to LAN.
Information Systems Research & Development	• Develop the methodology and provide the mechanisms for utilizing information technology to satisfy the specialized needs of the Division. • Research and develop new approaches in integrating information systems across hardware and software platforms and geographical locations. • Develop new and/or improved research methods appropriate to the Division's requirements. • Collaborate with scientists on projects requiring a high level of analytical sophistication. • Raise and maintain standards of research, planning and analysis and ensure efficient design, information management and analysis in the Division.	• Develop WA Threatened Flora descriptive database. • Database and publish census of WA plants (WACENSUS). • Develop taxonomic database of WA plant genera. • Develop DELTA database engine. • Database and publish WA Herbarium specimen information (WAHERB). • Develop a descriptive catalogue of WA flora (DESCAT). • Develop a *Phytophthora* interactive identification and information retrieval system. • Develop WABIOTA.	• Publication of threatened flora book. • Testing and editing of INTKEY interactive system. • WACENSUS launched as part of Division's query interface on Naturebase web site. • Compilation of species richness maps. • Completion of CD files for compilation. • Availability of institutional system for users. • FloraBase launched as part of the Division's query interface on Naturebase web site. • Publication of CD ROM on *Phytophthora* identification. • Deployment of plant species distribution data over web.

KEY SCIENCE THEME: Description and documentation of Western Australia's biological diversity (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
	• Communicate and integrate with other groups within CALM and other appropriate external organisations to allow for exchange of research findings, ideas, data, software and other products.		
Descriptive Taxonomy & Biosystematics	• Provide an overview of biodiversity in WA by means of reliable censuses of organism groups and a system of classification reflecting the relationships of organisms. • Define species and provide an authoritative scientific nomenclature for them. • Develop and make available descriptive and image information and means of identifying organisms. • Augment scientific collections of organisms and relevant database systems	• Maintain a current, reliable and accurate plant census. • Maintain a classification system. • Maintain taxonomic research to define species. • Prepare descriptions and images. • Develop databases for storing and maintaining descriptive information. • Collect and process specimens.	• Completed taxonomy and inventory of legumes, grasses and lillies. • 20 species defined and provision of authoritative scientific nomenclature. • Descriptive and image information for 200 organisms and a means of identifying them. • Commence specimen examination and data recording.
Forest Region Flora	• Provide a user-friendly guide to vascular plants of the lower south west. • Contribute systematic and distributional data to	• Inventory the taxa recorded for the region. • Prepare taxonomic descriptions in DELTA format. • Devise keys to genera and species.	• Number of descriptions added to corporate data bases. • Number of illustrations prepared. • Publication of Flora.

KEY SCIENCE THEME: Description and documentation of Western Australia's biological diversity (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
	State-wide corporate data sets.	• Obtain illustrations of taxa. • Publish Flora.	
Regional Forest Assessment	• Complete the report on flora project for Regional Forest Agreement for WA. • Document biological/ecological characteristics of biota in the southwest forest ecosystems of WA. • Identify key indicator species suitable for monitoring environmental change. • Establish criteria for assessing the sustainability of landuse patterns in forest ecosystems of WA. • Maintain a framework for biodiversity research as part of the 20 year RFA.	• Compile and analyse existing data and data obtained from RFA vegetation plots.	• Species richness maps for the RFA area. • Identification of key indicator species and vital attributes.
Bioprospecting	• Establish and manage a comprehensive plant extracts library with voucher specimens incorporated in the State Collection.	• Collect in locations where general data are lacking. • Analyse site and taxon information to maximize coverage.	• An annual increment to library of 1 000 documented samples.

KEY SCIENCE THEME: *Protection and conservation of Western Australia's biological diversity*

AIM: *To provide a scientific basis for the protection and enhancement of the State's biological diversity and for the establishment of a comprehensive, adequate and representative reserve system*

RELEVANT CORPORATE OBJECTIVES:

- *Seek and provide an up-to-date and sound scientific and information basis for CALM's conservation and land management activities*
- *Conserve indigenous plants, animals and ecological processes in natural habitats throughout the State*

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
Western Shield – Fauna Recovery	• Determine the conservation status of fauna. • Identify and ameliorate threatening processes and organisms. • Develop management strategies for the recovery of threatened fauna.	• Determine conservation status using IUCN criteria and in consultation with WATSCU. • Undertake ecological research on threatened and vulnerable taxa. • Identify threatening processes and threat amelioration actions. • Undertake captive breeding of selected taxa. • Devise, implement and monitor translocation programs.	• Recovery of the following taxa: - Gilbert's Potoroo - Dibbler - Rock Wallaby - Chuditch - Shark Bay Mouse - Thevenard Island Mouse - Western Barred Bandicoot - Quenda - Numbat - Woylie - Tammar - Noisy Scrub- bird - Western Bristlebird - Ground Parrot - Pilbara Olive Python - Carpet Python - Lancelin Island skink.
Western Shield – Introduced Predator control	• Develop efficient and effective methods for controlling feral cats and foxes.	• Conduct a series of pen and field cafeteria trials to determine the acceptability of various cat bait types.	• Safe, cost effective reduction of feral cats and foxes to a level that facilitates the recovery of native fauna.

KEY SCIENCE THEME: Protection and conservation of Western Australia's biological diversity (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
		• Develop efficient bait delivery systems, and timing of baiting. • Develop a felid specific toxin in collaboration with other agencies. • Develop a reliable feral cat census technique. • Establish the origin and time of arrival of cats in Australia. • Establish a bait research and development facility. • Investigate the efficacy of a range of fox baiting regimes in the south-west, wheatbelt and arid zone. • Investigate the effects of various levels of fox control on fox population dynamics. • Participate in the Vertebrate Biocontrol CRC.	• Improved understanding of the role of feral cats in the decline and extinction of native fauna. • Cost-effective baiting regime operationalized. • Patenting of introduced predator control techniques.
Western Everlasting – Flora Recovery	• Determine the conservation status of threatened flora. • Identify and ameliorate threatening processes and organisms. • Develop management strategies for conservation and recovery of threatened flora.	• Determine conservation status using IUCN criteria and in consultation with WATSCU. • Undertake taxonomic, genetic and ecological research on threatened and vulnerable taxa. • Identify threatening processes and amelioration actions, particularly with regard to *Phytophthora* and weeds.	• Recovery of taxa from the following genera and family: - *Acacia* - *Banksia* - *Dryandra* - *Eremophila* - *Verticordia* - *Stylidium* - *Orchidaceae*

KEY SCIENCE THEME: Protection and conservation of Western Australia's biological diversity (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
		• Maintain *ex situ* germ plasm storage. • Devise, implement and monitor translocation programs.	
Carnarvon Basin Biological Survey	• Assess the adequacy of the current regional reserve system in the Carnarvon Basin.	• Systematic, quadrat-based biological survey to determine the occurrence and the distribution of organisms and species assemblages.	• A scientifically credible and comprehensive, adequate and representative reserve system for the Carnarvon Basin
Marine Fauna Conservation & Management	• Promote regional conservation of sea turtles and dugong.	• Co-ordinate research and monitoring to improve knowledge of ecology, population dynamics and threatening processes.	• A scientifically credible wildlife management document to guide operations to ensure long-term protection of sea turtles and dugongs.
Aquatic Ecosystems Conservation	• Provide scientific information necessary for the conservation of WA wetland ecosystems and maintenance of waterbird populations.	• Assess, identify and nominate wetlands of international importance. • Study the ecology of selected waterbirds. • Monitor various wetlands and waterbirds. • Document the distribution, endemicity and conservation status of aquatic invertebrates and of frogs.	• Management guidelines for Vasse-Wonnerup wetlands. • Directory of important wetlands in WA. • Identification and nomination of wetlands of international significance. • Monitoring and management protocols for selected wetlands.
Salinity Action Plan	• Provide a regional perspective on nature conservation values and priorities in the Wheatbelt Region to guide management.	• Systematic biological survey of representative habitat types.	• Biological survey completed, analysed and written up. • Identification of priority catchments for recovery action.

KEY SCIENCE THEME: Protection and conservation of Western Australia's biological diversity (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
			• Management guidelines for ecosystem recovery.
Monitoring Rabbit Calicivirus Disease	• Document the impact of RCD on selected rabbit populations and the consequent effects on the biota.	• Census rabbit populations and disease status at selected sites. • Monitor vegetation and vertebrate fauna.	• Quantification of the impact of RCD on rabbit populations and of the consequences on the biota.
Disturbance Management Ecology	• Scientific understanding of disturbance processes and their effects on the biodiversity of conservation lands.	• Study, by experiment and space-for-time, a range of perturbations, including fire, weeds and grazing, across a range of ecosystems.	• Prescriptions for the appropriate management of fire particularly in the Wheatbelt, Pilbara, Goldfields and Kimberley Regions.
Remnant Vegetation Reconstruction	• Provide scientific information necessary for the management of the conservation values of remnant bushland and regional parks.	• Assess the conservation status of plant species and communities. • Investigate the impact of weeds on conservation values. • Investigate revegetation techniques in selected ecosystems.	• Prescriptions for managing remnant bushland including weed control and revegetation.
Monitoring River Health	• Produce baseline data about community composition of rivers and streams in WA. • Develop a model to assess river health based on the composition of invertebrates in the river (AUSRIVAS).	• Survey and analyse aquatic invertebrates and water chemistry from a range of WA rivers and streams.	• AUSRIVAS (model) for assessing and reporting on river health.

KEY SCIENCE THEME: Protection and conservation of Western Australia's biological diversity (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
CAR Reserve System	• Provide scientific data and analysis for the advancement of a CAR reserve system for WA.	• Prioritize bioregion surveys on the basis of need for information and gaps in knowledge. • Systematic, quadrat-based biological surveys of bioregions.	• A scientifically based framework for a CAR reserve system for WA.

KEY SCIENCE THEME: *Sustainable utilization of Western Australia's native forests and plantations*

AIM: *To provide the scientific basis for ecologically sustainable forest management systems and for the cost-effective establishment and management of plantations for commercial and environmental purposes.*

RELEVANT CORPORATE OBJECTIVE:

- *Seek and provide an up-to-date and sound scientific and information basis for CALM's conservation and land management activities.*
- *Optimise the value and economic return to the community of the wildlife, lands, waters and resources entrusted to CALM without compromising conservation and other management objectives.*

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
Ecologically Sustainable Forest Management (ESFM)	• Provide the scientific basis for sustainable management of native forests for a range of values including biological diversity and commercial products.	• Research the effects of timber harvesting and associated activities on forest ecosystems. • Conduct space-for-time surveys to understand post-disturbance responses with time. • Carry out appropriate biological surveys to determine forest species and their distribution. • Develop and test the validity of using biological indicators of ESFM. • Develop and implement a program to monitor the performance of ESFM prescriptions.	• Silvicultural prescriptions and management systems which aim to achieve ESFM. • A forest operations monitoring system which documents ecosystem responses and guides the development of management prescriptions to achieve ESFM.
Forest Microbiota Management	• Investigate the impacts of timber harvesting and associated activities on invertebrates and fungi.	• Investigate, through a combination of experiments and surveys, the effects of timber harvesting and fire on invertebrates and fungi.	• Science-based advice on the effects of forest management activities on invertebrates and fungi.

KEY SCIENCE THEME: Sustainable utilization of Western Australia's native forests and plantations (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
	• Determine practical, science-based means of minimizing the impacts of insect pests and fungal disease in native forests and plantations. • Provide scientific information for the management of rare species of invertebrates and fungi.	• Identify and monitor potential plantation pests and diseases and test appropriate control measures. • Participate in integrated physiological and nutritional studies of tree crops on farms. • Maintain a general comprehensive reference collection of forest microbiota. • Assess importance of micro-habitats in mature and regrowth forest and diverse ecotype zones as refugia for rare species. • Focus on selected Gondwanan and other species with potential as bio-indicators.	• Advice on, and prescriptions for, the management of pests and diseases. • Prescriptions for managing rare microbiota.
Forest Fire Management	• Improve forest fire danger rating and fire behaviour prediction systems. • Determine science-based fire regimes to protect life, property, biodiversity and other environmental values.	• Experimental research on forest fire behaviour. • Use experimental research and space-for-time surveys to determine the long-term effects of various fire regimes on elements of the forest biota.	• Reliable fire behaviour models. • Implementation of fire regimes which protect life, property, biodiversity and other environmental values.

KEY SCIENCE THEME: Sustainable utilization of Western Australia's native forests and plantations (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
Sandalwood Ecology & Management	• Develop management procedures to improve sandalwood regeneration in the rangelands. • Determine sandalwood plantation establishment and management techniques for the wheatbelt.	• Investigate the ecology, genetic variability and silviculture of sandalwood. • Investigate the effects of site and host species on the performance of sandalwood plantations in the wheatbelt.	• Management prescriptions for enhancing sandalwood regeneration in the rangelands. • Increased planting of sandalwood in the wheatbelt.
Genetics & Tree Breeding	• Optimise wood production, wood quality, site tolerance and disease resistance of all plantation tree species.	• Adhere to a structured program of selection, breeding and production of superior genotypes • Use molecular genetics technologies.	• Significant improvement in wood production and wood quality in all plantation tree species.
Dryland Tree Crops	• Develop protocols to establish and manage commercial tree crops on farmlands across a range of sites and for a range of environmental benefits including land care and carbon sequestration.	• Establish trials and conduct surveys across a range of sites to determine relationships between climatic and edaphic factors, water use, fertilizer applications, planting patterns and tree growth. • Develop site evaluation systems and a regional afforestation framework.	• Prescriptions for the establishment and management of tree crops on farmland. • Increased areas of commercially viable tree crops on farms. • Improved soil and water quality on dryland farms.
Western Bluegum Plantations	• Maximize survival and growth rate of bluegum plantations.	• Conduct trials and regional surveys of relationships between site and tree growth attributes.	• Comprehensive, science-based prescriptions for the establishment and management of bluegum plantations

KEY SCIENCE THEME: Sustainable utilization of Western Australia's native forests and plantations (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
		• Establish trials across a range of sites to define relationship between water supply and water demand by plantations. • Investigate growth response to soil fertility and fertilizer application.	on farmland across a range of sites. • Increased profits from plantations.
Softwood Plantations	• Maximize wood production from high rainfall softwood plantations.	• Implement a series of fertilizer rate trials and element interaction trials to examine growth response and wood properties.	• Operations manuals for diagnosing nutrient deficiency and corrective measures. • Increased wood production.
Tropical Plantations	• Provide a reliable, effective silvicultural system for the establishment and management of Indian sandalwood plantations within the Ord River Irrigation area. • Evaluate the potential of other high value plantation timber species.	• Use a combination of pot culture and field experiments to examine interactions between parasite, host and the environment. • Establish and maintain growth trials of selected other high value tropical timber species.	• Commercially viable Indian sandalwood plantations in the Ord River Irrigation area. • A prioritised list of other high value tropical timber species suitable for commercial plantations in the Ord River Irrigation area.
Vegetation Health Service	• Provide an efficient plant diseases and disorders diagnosis service.	• Monitor the effectiveness of *Phytophthora* detection service. • Use isoenzyme laboratory for *Phytophthora* identification. • Develop and maintain skills for diagnosis of other diseases and disorders including nutrient analysis. • Investigate use of DNA technologies.	• 95% accuracy with disease and disorders diagnosis. • Ongoing demand for service. • Comprehensive database of host plants, diseases, and localities.

ASTRONOMICAL RESEARCH STRATEGIC PLAN

PURPOSE

This Strategic Plan sets out the role of Perth Observatory within the Department of Conservation and Land Management (CALM) and its CALM**Science** Division, providing an overview of its mission, objectives, strategies and success indicators. As for the Division, an Operations Plan (consisting of project team plans) and Science Project Plans (SPPs) provide increasing levels of detail about the resources, activities and outcomes of the Observatory.

INTRODUCTION

Astronomy is the study of the Universe and its contents, except the Earth, and is one of the oldest and most fundamental of sciences. At the same time it is one of the most modern and dynamic sciences. This century's discoveries, and their associated hypotheses such as the Big Bang and Relativity theories, have had a profound impact on the psyche and culture of developed societies.

Astronomy is also technology-intensive and has been central to the development of technologies such as computers, light detectors and radio communications; technologies that are now an integral part of the infrastructure of developed societies. There is also an ongoing community demand and a need for the provision of information concerning astronomy-related scientific, technological and sometimes philosophical issues in a professional, timely and authoritative manner.

Western Australia is well served in this task by the existence and activities of the Perth Observatory. It is the second oldest scientific institution in the state and was set up by WA's visionary first premier, Sir John Forrest, to conduct research and provide educational and practical services to the community as evidenced by his statements:

> "... something should be done in the direction of encouraging scientific pursuits in the Colony."
>
> "I believe this Observatory would be useful in many ways, and do a great deal of good, and at the time give us a status in the scientific world that the Colony did not at present possess."
>
> "We have a magnificent site for it on Mt Eliza, and I think it is about time we made a start with it, now we are entering on a progressive stage of our history."
>
> Sir John Forrest, Hansard, 1892.
>
> "This Observatory would prove, in the future, that it was a teaching place for the people. It would be a repository of knowledge of the movement of stars and other heavenly bodies in the Southern Hemisphere, ... and be of great value immediately and for all time."
>
> "It would bring us into great prominence with the scientific men all over the world, and with whom we would be workers in the paths of knowledge and peaceful progress. Other advantages would be obtained in providing exact time for all purposes including navigation and geodesy."
>
> Sir John Forrest, speech at laying of Perth Observatory foundation stone, 1896.

The conduct of research at Perth Observatory is fully consistent with the State Government's Science and Technology Policy (A Science and Technology Policy for Western Australia, 1997), particularly:

> *Objective 1.0*: Establish programs to raise the public image of science and technology and innovation,
>
> *Objective 2.0*: Use science and technology to increase our understanding of the environment and use this knowledge to encourage environmentally sustainable and competitive industries,
>
> *Objective 7.0*: Raise the technical competency of the Western Australian workforce and increase the level of innovation in management,

Objective 8.0: Assist outstanding post-doctoral science and engineering students to conduct strategic research,

Objective 11.0: State Government agencies conducting high quality, cost effective research in support of their core activities, and

Objective 22.0: Assist the establishment of internationally competitive science and technology infrastructure within the State's universities, the vocational education and training sector and other research centres.

On a national level, the Observatory's research activities are consistent with the astronomy discipline research strategy (National Committee for Astronomy, 1995):

Recommendation 4: That existing front-line facilities should be maintained in the context of the decade plan proposed in this Review, through the continual upgrading of instrumentation as technology and astronomical imperatives evolve.

Furthermore, Perth Observatory has some fundamental strengths such as its suitable climatic conditions, its isolated location (in both latitude and longitude) on the globe, and its Southern Hemisphere location where the centre of our galaxy, the Milky Way, a target of continuing and profound astronomical interest passes virtually overhead.

The State Government's Science and Technology Policy also provides direction and support consistent with Perth Observatory's educational activities that serve to highlight science in a positive and accessible manner to the public of Western Australia. As well as Objectives 1, 2 and 8 above it also contains:

Objective 5.0: Ensure that Western Australian schools address the human resource needs for the development of science and technology and contribute to establishing a society that values the contribution of science and technology in their lives, and,

Objective 6.0: Assist the State's vocational education and training sector to address the human resource needs for the development of science and technology.

Furthermore, the Observatory's educational activities are consistent with the astronomy discipline research strategy (National Committee for Astronomy, 1995):

Recommendation 6: That a strategy for enhancing astronomical education in schools, along the lines suggested by the Education subcommittee, should be formally adopted by the profession, and,

Recommendation 7: The astronomical institutions should continue to give strong support to public education in astronomy, collaborating effectively with public education institutions and with amateur groups for this purpose.

Provision of information is a practical application of the Observatory's expertise, required under Section 46A of the WA Evidence Act of 1906, and an entrepreneurial implementation of Objective 2.0 (see above) of the State Government's Science and Technology Policy.

In the context of CALM's mission, the Southern Hemisphere sky can be considered a natural resource that can be used for scientific study and recreation. Viewed this way, the Perth Observatory's activities align with many of CALM's objectives, specifically:

Conservation: One quality of life issue of concern to some communities is the need to consider the effect human activity, such as light pollution, has on the night sky, a natural resource that has inspired mankind through the ages. In some countries this has led to the establishment of laws and ordinances in order to conserve this natural resource at appropriate sites.

Value and Use of Resources: Encouragement of greater participation in, and satisfaction from, astronomical activity.

Recreation and Tourism: The accessibility of the sky means that it can be enjoyed by everyone and in a variety of ways.

Knowledge: For many people, viewing the night sky raises many scientific and philosophical questions, prompting the need for sound research and opening opportunities for acquisition and dissemination of information about our universe.

Community Support: Astronomy is arguably the most accessible of all the physical sciences. That observatories still exist even though they study objects at nearly inconceivable distances attests humanity's ingrained curiosity about the important questions associated with the Universe, its existence, contents, origin and fate.

VISION

To gain world recognition as a leader in astronomical research, education and information provision. These three core functions are clearly interdependent as the conduct of sound research aids the quality and authority of the educational and information services and clearly differentiates us from other less scientifically oriented astronomy enterprises.

Education and information activities open a clear channel to display our activities and expertise, and raise the profile of science, technology and innovation consistent with the State Government's Science and Technology Policy (A Science and Technology Policy for Western Australia, 1997) Objective 1.0.

MISSION

To meet the demand for general and specialized up-to-date astronomical information and services from the public, business and educational community while furthering scientific research in astronomy in conjunction with other astronomy institutions and universities.

PERTH OBSERVATORY OBJECTIVES

To achieve its Mission, Perth Observatory has the following objectives:

- To attain a worldwide reputation for excellence in astronomy by publishing knowledge obtained through scientific research in the premier national and international scientific journals.
- Provide up-to-date educational services that exceed the expectations and demands of customers.
- Provide specialised astronomical information that exceeds the expectations and demands of our customers.
- Demonstrate science in action, and the role of astronomy in everyday life.
- Develop the tourism potential of astronomy.

PERTH OBSERVATORY STRATEGIES

To meet its Mission and Objectives, and in addition to the relevant CALM**Science** Divisional strategies, Perth Observatory has formulated the following broad strategies:

- Conduct astronomical research, particularly that which exploits Perth Observatory's special position on the globe.
- Communicate research discoveries, upcoming astronomical events etc through all appropriate channels, at a wide variety of fora, and to all appropriate audiences.
- Keep abreast of worldwide astronomical and technological advances via the literature and attendance at scientific meetings and seek opportunities to utilize or adapt these to suit Observatory and Departmental needs.
- Develop and project Perth Observatory's reputation as a credible and dependable source of sound and up-to-date astronomical information.
- Develop and market up-to-date educational materials, services, "public outreach" programmes and other interactive/experiential activities.
- Maintain science resources such as astronomical equipment, computing, museum, workshop and library facilities.
- Collaborate with local, national, and international astronomy institutes, universities, Government agencies, industries, other interest groups and the public to conduct or co-ordinate research, educational and/or information activities when such interaction will benefit the Observatory and relevant Departmental objectives.
- Maximize output by automating equipment monitoring, data acquisition and presentation, providing resources for students, collaborating with other relevant parties, actively seeking external funds and employing contract or consultant staff where appropriate.

Key Science Theme: Astronomy research, education provision and information dissemination. Perth Observatory will expand its astronomy research activities. It will continue to exploit its suitable climatic conditions, isolation and optimal view of the Milky Way centre to further this research either in-house or in collaboration with other partners. In order to optimise research output, other observing sites within the state will be evaluated and developed as appropriate. There is a continuing demand for astronomy education and information services from many sections of the Western Australian community. Perth Observatory will utilize its scientific authority and resources to address this demand and develop new services as appropriate. New information dissemination systems will also be evaluated and employed as appropriate.

Supporting projects:

- Astronomical research
- Astronomy education services
- Astronomy information services

PLANNED ACHIEVEMENTS 1999-2004

Over the next five years Perth Observatory will be able to demonstrate success in meeting its obligations to provide for timely and high quality astronomical services in the following areas:

KEY SCIENCE THEME: *Astronomy research, education services and information provision*

AIM: *To serve the state with world-class astronomy research, educational services and information provision.*

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
Astronomical Research	• Monitor brightness changes in stars, comets, gravitational lensing events and other celestial bodies and participate in their further study. • Determine positions of minor planets (asteroids), comets and targets of opportunity. • Search for extra-galactic supernovae in low-redshift spiral galaxies. • Conduct spectrographic observations of relatively bright celestial objects.	• Exploit Perth Observatory's special position on the globe and evaluate other potential sites in Western Australia for astronomical observations. • Determine changes in celestial objects by comparing with existing library records of previous observations. • Communicate research results and keep up-to-date with latest findings. • Maintain and develop equipment and other resources.	• Better understanding of astrophysics (i.e., properties, constitution and evolution of celestial bodies). • Improved inventory of celestial bodies. • Publication and dissemination of findings.
Astronomy Education Services	• Provide relevant and timely education services. • Demonstrate science in action, and the role of astronomy in everyday life. • Facilitate the development of the tourism potential of astronomy.	• Communicate research discoveries and publicize forthcoming astronomical events. • Attempt to have all students in the State visit the Observatory at least once during their school years. • Provide access to Observatory library, museum and other facilities.	• Increased variety of educational activities available to the public. • Increased level of client satisfaction with services provided. Increased use of Observatory facilities and resources. • Increased revenue from public participation, grants and other sources.

KEY SCIENCE THEME: Astronomy research, education services and information provision (*continued*)

PROJECTS	PROJECT OBJECTIVES	STRATEGIES	INDICATORS OF SUCCESS
		• Facilitate world-wide internet access to Observatory educational resources. • Supervise student projects. • Assist with course work and develop linkages across a range of education institutions. • Develop and market up-to-date educational resources and educational services. • Provide tours of Observatory facilities and promote interactive programs. • Develop and market astronomy as a positive leisure activity.	
Astronomy Information Services	• Provide relevant and timely astronomical information.	• Develop and provide up-to-date information resources and services. • Provide and maintain an up-to-date and relevant Web site. • Provide an accurate time service (via the Internet). • Maintain and preserve historical and scientific archives and facilitate access.	• Increased variety and use of information services provided. • Increased level of client satisfaction with services provided. • Use of Internet time service. • Accessibility of archives and information over Observatory computer network.

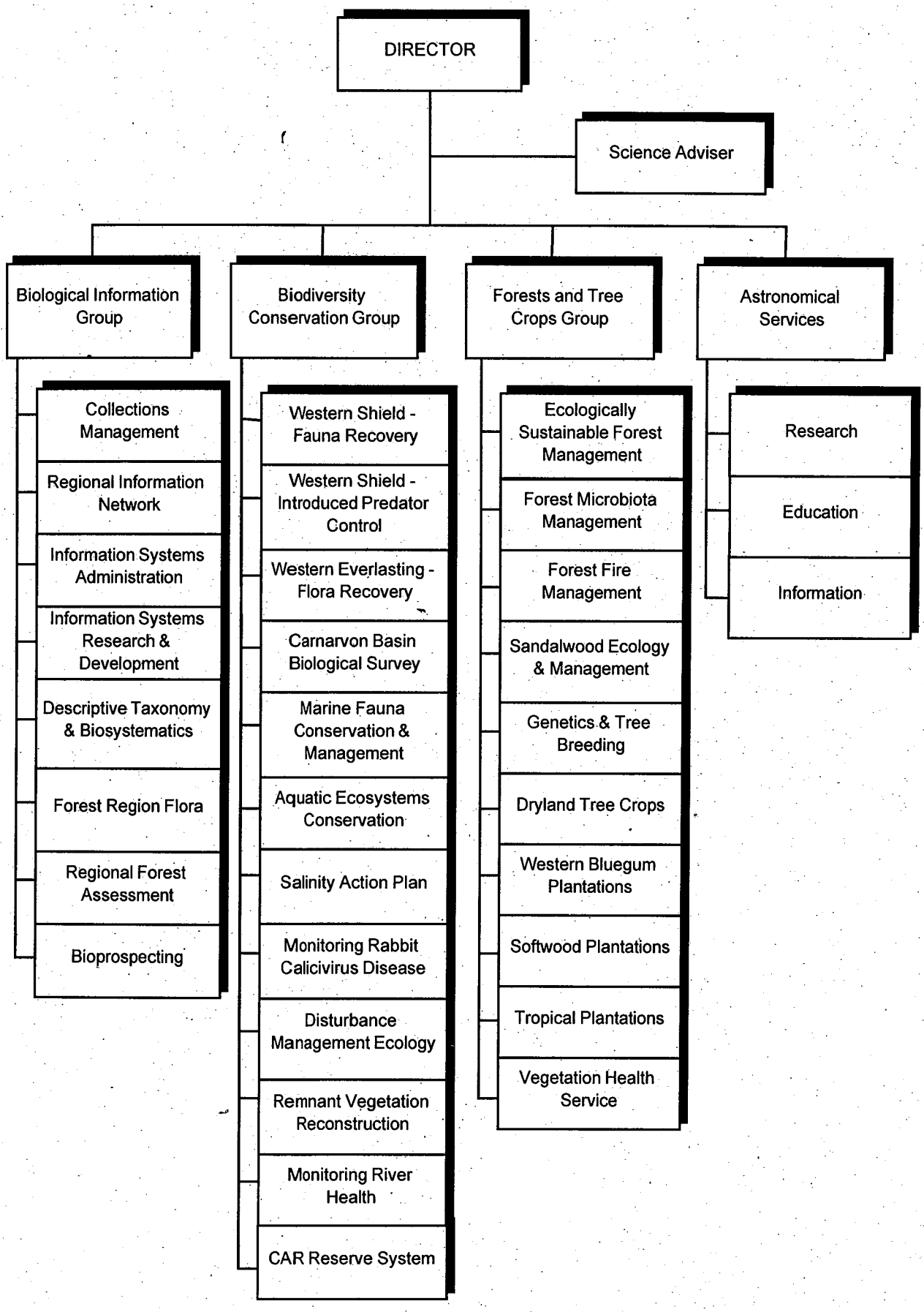
REFERENCES

A Science and Technology Policy for Western Australia (1997). WA Department of Commerce and Trade.

Australian Astronomy: Beyond 2000 (1995). National Committee for Astronomy of the Australian Academy of Science (a discipline research strategy).

Evidence Act 1906, 1986. Section 46A, WA Government Printer.

CALMScience Division Project Management Structure



CALMScience Division Management Council

Dr Neil Burrows
Director

Mr Keith Morris
Manager, Biodiversity Conservation Group

Dr Ian Abbott
Science Adviser

Dr John McGrath
Manager, Forests and Tree Crops Group

Dr Neville Marchant
Manager, Biological Information Group

Dr James Biggs
Manager, Astronomical Services