STATE OF THE ENVIRONMENT IN AUSTRALIA'S SOUTH-WEST

DISCUSSION PAPER

Prepared as part of a
Regional Environmental Strategy

for

South West (WA) Local Government Association

February 1996

Prepared by

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For

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The South-West (WA) Local Government Association is made up of the Augusta-Margaret River, Bridgetown-Greenbushes, Boyup Brook, Bunbury, Busselton, Capel, Collie, Donnybrook-Balingup, Harvey, Manjimup, and Nannup councils. The Association serves as a united voice for local government through the region, and works to promote regional cooperation on a wide range of issues.

YOUR INPUT

At this stage, we are asking that community groups and interested individuals read the document, and let us know if they have any concerns or additional information which they feel should be considered.

Are we on the right track?

If major changes are needed to our approach the sooner you let us know the sooner we can decide how to make them.

What vital information have we missed?

We have mainly used published information. Some of that is sure to be out of date, some may be incorrect. The people who live in a landscape generally know it better than anyone else, so we would appreciate any corrections or additional information you can send us. A quick note or a phone call is fine.

How can the document be made more useful?

... as both an information source, and to support group applications for funding and other assistance.

What's the deadline for comment?

Based on your comments and any additional information that comes to light the discussion will be finalised in February and March 1996. Comments by the end of February please.

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Section 1

BACKGROUND

Ignorance is no longer bliss. Decisions made in ignorance of their impact on the environment often come back to haunt us. The South West corner of Western Australia has a wonderfully diverse and attractive environment. But it is showing some wear and tear, at the very time we are making increasing demands of it.

Care of the environment is one of the most important issues facing the South West. Already, there is an impressive amount of environmental repair work underway, led by a wide range of enthusiastic and capable community groups. There is also, often within the same communities, considerable and often divisive disagreement over a range of land use and management issues.

To assist in establishing the priorities for both environmental repair and environmental protection, a range of objective information has been collated into this State of the Environment report.

This has been undertaken as part of the preparation of a Regional Environmental Strategy, hosted by the South West (WA) Regional Council.

REGIONAL ENVIRONMENTAL STRATEGY (RES)

This Strategy is one of nine being funded Australia-wide by the Federal Department of Housing and Regional Development, through the Australian Local Government Association.

It is hoped the Strategy will focus increased resources into environmental needs identified by South West communities, and help ensure that existing resources are used as effectively as possible. A strong emphasis is being placed on identifying and assisting projects that combine environmental management with job creation.

The **terms of reference** are to:

- Integrate information in the range of completed and ongoing environmental and landcare plans in the region.
- Identify any gaps in available information and activities
- Develop a environmental "big picture" for the region, particularly by linking environmental objectives, labour market programs and economic development
- Develop a blueprint to reduce unemployment through using labour market programs that assist communities tackle identified environmental issues
- Identify long term objectives for environmentally based employment, and how these can be met without ongoing government support.

The final Strategy will be underpinned, not so much by a *regional vision*, as by a *regional consensus*. There are already a lot of words written on what needs to be done. We need to get on with as much of the work as possible, as soon as possible.

This ***State of the Environment*** outline is the first of three discussion papers to be released during preparation of the Strategy. The two discussion papers to follow are:

Green Jobs for Australia's South West

This will briefly review and analyse opportunities for increasing the number of environmentally based jobs in the South West.

It is hoped to have a first draft of this paper distributed in February 1996.

The final strategy will be prepared by the end of April, 1996.

STATE OF THE ENVIRONMENT REPORTING

This is a way of packaging information on the health of the environment so that it can be readily accessed by both the community and government agencies. It shows not only the current condition, but whether particular aspects are improving or worsening. It can also provide a public account of the activities of government, industry and the community in protecting and restoring the environment.

The Western Australian Government produced its first State of the Environment Report in 1992, and an updated report will be prepared during 1996. The Commonwealth Government is currently working on a national State of the Environment Report, which is due to be released in February 1996. In some states, local councils are already producing reports on a regular basis.

The South West (WA) Local Government Association, in conjunction with the Australian Local Government Association, is seeking additional funds to expand the current State of the Environment discussion paper into an ongoing evaluation process involving community groups, local government, and state agencies.

Unavoidably this first paper is largely the bad news; the evidence of adverse environmental impacts that have occurred since 1829. However, there is no suggestion that we should return the whole South West to its original environmental condition - but to identify change in the environment, a benchmark is needed. 1829, the year European settlement began, is an easy point to start from.

As communities in the South West develop a shared vision of what is an acceptable level of development and change, the information collected can be compared with that vision.

DISCLAIMER

This report for the South West is very much an interim document. It concentrates on bringing together some of the basic information from which a more detailed report can be built. The emphasis is on identifying trends, and clarifying regional priorities for on-ground work.

This document also has severe limitations. It was written very quickly, and draws largely on published scientific papers, some of which are quite dated. A number of other papers will have been overlooked, and the wealth of information held by individuals and groups in the community has barely been tapped.

What the document does do is present for your comment a framework into which additional information can be progressively added. It also aims to stimulate discussion on the best way to collect and distribute State of the Environment information for the South West.

While care has been taken to present accurate information, there will be some mistakes. Responsibility for these rests with the coordinator, Keith Bradby. No comments in this document should be taken as representing the views of the South West (WA) Local Government Association.

Section 2

SUMMARY

This report provides a brief overview of the condition of the environment in Australia's South West Although based on published papers and well accepted information, it is not a definitive document. It has been produced to stimulate discussion and provide the framework for additional information to be placed into.

WATER

Our waterways are in an appalling state. Over much of the South West, rivers are becoming increasingly saline, algal blooms are common, pools are becoming filled with silt, river vegetation has been largely lost, and many species of fish and other aquatic animals are becoming increasingly restricted in range.

Water quality is at its worst on the west coast, as a direct result of clearing, subsequent use of the land, and degradation of river banks. Along the south westerly coast, from the Hardy Inlet east, rivers and streams are generally much healthier, and some are virtually pristine.

Although a number of programs to improve water quality have commenced in recent years, degradation and damage appears to be worsening.

LAND

Areas with good vegetation cover are stable. However, considerable amounts of soil are eroding from both agricultural land, and from urban development sites along the coast. On farmland, fertility and soil structure are being lost. Salinity of productive land is more widespread on the coastal plain than generally believed, and is causing considerable economic loss, particularly in the irrigation areas.

Large lengths of coastline are under the most intense recreational pressure of any in rural WA, and a range of rehabilitation works are required to repair existing damage and reduce future damage

The impact of rubbish disposal to landfill, lingering contamination on old industrial sites, and pre 1987 use of organochlorines are potential, but largely undefined, concerns.

BIODIVERSITY

There has been a significant decline in the level of biodiversity in the past 100 years, mainly as a result of widespread clearing and drainage, the introduction of diseases, foxes and cats, and more recently through weed invasion. Biodiversity levels are thought to be still declining, but with the losses occurring more subtly than in previous decades. Recovery of some species is occurring as a result of intensive management programs.

Compared to much of southern Western Australia the South West is still well vegetated, with almost 60 percent of the region, on average, still under the indigenous vegetation. However, there is considerable regional variation, with sections of the coastal plain 95 percent cleared. Research is only now starting to identify the ecosystems which we may have lost representative samples of.

The most significant loss has been of mammal species. It is likely that localised extinctions of plants, mammals and small birds is still occurring, as remnants become smaller and more degraded, and connectivity through linked areas of bush weakens.

ATMOSPHERE AND AMBIENCE

The general high quality of the region's atmosphere and ambience is being maintained. There are concerns at localised air quality decline, associated with specific industries located close to residential areas, and at dust from urban development. Days of poor air quality occur throughout the region due to large scale forest or stubble burning, particularly in spring and autumn. Noise connected with specific industries, and with trucking frequency through residential areas, is also an issue for many residents. Overall, the South West remains clean and attractive, but there are few measures in place to objectively measure whether conditions are improving or deteriorating.

Section 3

INDICATIONS OF ENVIRONMENTAL CONDITION

3.1 WATER

Definition

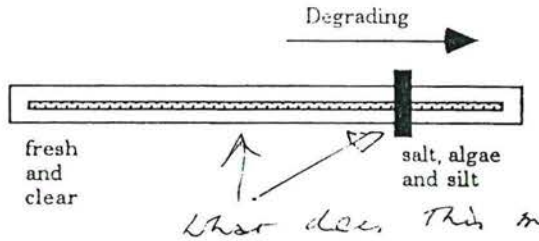
Water quality is taken to include the general purity of the water itself, and the general health of rivers, streams and other water systems.

Measurement

Readily measurable indicators of health are salinity, nutrient load, turbidity, the range of aquatic plants and animals present, indicators of ecosystem collapse such as toxic algal blooms, and the extent of fringing vegetation.[1] In the South West there is a significant body of data going back a number of years on salinity levels. Nutrient data is less common, and data on pollution very sparse. A major program of monitoring river health, using aquatic insects as indicators, commenced in mid 1994.[2] Communities are able to participate in assessing water quality through Ribbons of Blue programs.

Significance

The South West is the well watered part of Western Australia. Here fresh water is relatively abundant and dominates natural ecosystems, economic production systems, the character of the landscape, and many recreational activities.



Even though water is generally regarded in Australia as a precious resource, virtually all the major water sources in the South West have been damaged since European settlement, some severely. The main destructive forces are increases in salinity, nutrient loads, and soil erosion. Additionally, large areas of water based ecosystems; the rivers and wetlands, have been damaged or destroyed by the lowering of water quality, and by direct clearing or filling.

Water quality is at its worst on the west coast, as a direct result of clearing, subsequent use of the land, and degradation of river banks. Along the south westerly coast, from the Hardy Inlet east, rivers and streams are generally much healthier, and some are virtually pristine.

Though a number of programs to improve water quality have commenced in recent years, where clear data is available degradation and damage appears to be still worsening.

1 A more complete discussion of these characteristics is contained in CSIRO, 1992, *Towards Healthy Rivers - Seeking Solutions*, Consulting Report No. 92/44.

2 In Western Australia the Monitoring River Health Initiative is being managed through the Department of Conservation and Land Management, and involves a number of agencies and three universities. The contact person is Stuart Halse at CALM in Woodvale.

3.1.1 Salinity

The available historical information suggests that all the creeks and rivers of the South West were fresh (less than 500mg/l total soluble salts) at the time of European settlement.[3] Now ...

All the major catchments of the South West division which have been subjected to agricultural clearing and with upper reaches extending into lower rainfall areas show increasing stream salinity. The rate of increase is higher for lower rainfall areas. . . . the rate of increase has accelerated over the last two decades ... major rivers which are currently potable (fresh or marginal) or close to potable are continuing to deteriorate, namely the Collie, Denmark, Warren, Kent, Preston and Capel Rivers.[4]

Nowhere else in the world has the deterioration of available water resources been as great as in Western Australia.[3]

In the South West, the worst salinity increase is occurring in the Blackwood, which carries water from the dry inland wheatbelt areas. Most of this river is now brackish, though the salinity level is diluted in the lower reaches by water flowing from forested areas. The Collie and Warren Rivers have water that is now marginally saline. For the Collie the increase in salinity is around 4 percent per year. The same rate of salinity increase is occurring in the Capel River, while for the Warren River it is less than 2 percent. Smaller salinity increases are being recorded for the Preston and Ferguson Rivers. Other rivers such as the Brunswick, Margaret, Scott and Donnelly have shown no discernible change. By 1985, less than half of the amount of surface flow leaving the South West could be classed as fresh.[5] This has severely affected the flora and fauna of the rivers and reduced the amount of fresh water available for use in irrigation and domestic supplies.

Salinity is also severely affecting a number of inland wetlands in the region, such as the Unicup system east of Manjimup.

The causes and solutions of rising salinity levels are well understood. Many of our current land-uses (particularly agricultural) are inefficient at using the available rainfall. In the inland areas, where the rainfall is less than 900 mm a year, the excess water mobilises salts in the soil and carries them into the creeks and rivers. The only practical way of preventing or reversing salinity is to use the bulk of the water that falls on the landscape. In the agricultural areas this can be achieved by revegetation with perennial trees and shrubs, or by adoption of crops and pastures that use greater amounts of rai than existing farming systems.

3.1.2 Nutrient loads

Without food we die. With too much food death can be slower, but much uglier. It is the same with water systems.

Nutrients are essential to maintain the large array of plants and animals that flourish in creeks, rivers and wetlands. Over feeding through too many nutrients causes gross imbalances, collapse of the aquatic ecosystem, domination by one or two algal species (algal blooms), de-oxygenation of the water, and death of most fish and other aquatic animals. The soils of the South West are naturally low in nutrients, and our aquatic plants and animals have evolved in this low nutrient environment.

Most waterways are now nutrient enriched to some extent, and a number of cases of extreme enrichment have been recorded. For example, severe algal blooms have occurred in the south branch of the Collie River in 1984, 1989 and 1995,[6] and stretches of the Blackwood River in 1993 and 1994 These blooms are more frequent in the lower reaches of the rivers and in their estuaries. Since 1987 the Waterways Commission has recorded 26 potentially harmful phytoplankton (ie toxic blue green algae) blooms and red tides in the South West, mainly in the lower reaches of the rivers and in the estuaries. [7].

All the west coast estuaries are nutrient enriched (Leschenault, Vasse-Wonnerup, Toby's Inlet, Hardy Inlet). The two lagoons that make up the Vasse-Wonnerup system are the most eutrophic (nutrient enriched) in Western Australia.[8] They have suffered short periods of system collapse, leading to death of fish and other aquatic animals, specifically in 1987 and 1988. Management strategies now in place have reduced the algal problem

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3 I.C. Loh and R.A. Stokes, 1981, *Predicting stream salinity changes in south-western Australia*, Agricultural Water Management, 4 (1981) 227-254, Elsevier, Amsterdam.

4 N.J. Schofield, J.K. Ruprecht, I.C. Loh, August 1988, *The impact of agricultural development on the salinity of surface water resources of south-west Western Australia*, Water Authority of Western Australia Report No. WS 27, p xi.

5 Percentages calculated from Schofield et al (1988), p38, overall figure calculated by taking the estimate for divertible water of Schofield et al (1988), p. x, and applying it to all surface water sources

6 Leschenault Catchment Coordinating Group, May 1995, *Draft Management Strategy for the Leschenault Catchment.*

7 Wasele Hosja and David Deeley, 1994, *Harmful Phytoplankton Surveillance in Western Australia*, Waterways Commission Report No 43, p49-50

8 K.W.McAlpine, J.F. Spice, R. Humphries, May 1989, *The environmental condition of the Vasse Wonnerup wetland system and a discussion of management options*, EPA Technical Series No. 31, p 11-12

considerably,[9] though high nutrient loads continue.

Off-shore, the main concern has been in Geographe Bay, where high nutrient loads were thought to have caused some loss of sea-grass. An inventory of contaminants entering the coastal waters from Myalup to Cape Naturaliste has recently been completed, estimating that an average of 1 388 tonnes of nitrogen and 166 tonnes of phosphorus enter the bay each year.[10] This is probably within the capacity of the marine environment to absorb nutrients without undue harm.

Recent air photo analysis have shown that there was a major decline in the sea grass beds between the 1950s and the 1970s. These have now largely recovered, and the decline may have been due to sand movement or some other factor not connected with nutrients. However, while water quality in the bay is generally good, in summer there is a mucilaginous slime covering most of the shallow seagrasses, suggesting an already fragile system that may be easily degraded.[11]

Along the south western coast there are a number of estuaries. In the South West region these "are not polluted and all are in a healthy condition".[12] Estuaries further west towards Albany are nutrient enriched.

3.1.3 Silt and sediment

Water quality in a number of the watercourses is severely affected by the amount of soil that washes into them. A relatively high rate of soil loss throughout much of the region has been identified. (*See 3.2*). Much of this soil obviously ends up in the rivers and estuaries. While firm information on its impact is not available, anecdotal information strongly suggests severe sedimentation in a number of waterways, particularly from the Harvey River to the Blackwood River.

In some areas, there are additional concerns that changes to flow patterns have diminished the rate at which sediments were once flushed from the system. For example the Vasse Diversion Drain diverts a lot of water away from its original pathway.

Apart from the physical damage they cause, silts also carry large quantities of nutrients into the rivers and estuaries.

Silt movement into the streams of the forest zone is minimal.

3.1.4 Pollutants

Our present society uses a number of materials and chemicals which are not generally present in the environment in any quantity, if at all. Examples include heavy metals, pesticide and herbicide residues, and water soluble toxic substances such as PCBs. In some situations these may have been released or escaped into soil and waterways where they can persist and accumulate, and possibly cause harm.

Some sites in the South West where this has occurred are reasonably well known and documented, and are generally associated with industrial sites or large scale use of sprays. For example, acidic water containing some heavy metals flows into Wellington Dam.[13]

Organochlorines such as DDT, dieldrin, chlordane and heptachlor were once commonly used for a number of agricultural purposes. High levels of heptachlor were found in Lefroy Brook near Pemberton in 1981.[14] Studies conducted during the 1980s detected higher than advisable levels of organochlorines in the Preston River,[15] and another study conducted in 1987 found notable levels of organochlorines in the Blackwood River, and smaller quantities in the Harvey, Carbanup and Scott Rivers.[14] The most specific information probably relates to the organochlorine levels (dieldrin, DDT, aldrin, heptachlor) in the Preston River. When measured in 1980-81 these often exceeded safe environmental criteria, but by 1985 there was evidence that levels were dropping. There was no sign of the pesticides having accumulated in the silts of either the river or the estuary.

In July 1987, organochlorine pesticides were deregistered for agricultural use, and it is assumed that levels in the rivers have continued to drop since that time. Plans to re-assess levels in the Preston during 1992 were abandoned due to lack of funds.

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9 W.G. Martinick and Associates, November 1994, *A management plan for the Vasse River and Estuary*, draft prepared for the Shire of Busselton.

10 Holmes, R.M., June 1994., *Contaminants Inputs Inventory of Geographe Bay*, prepared for the Water Authority of Western Australia.

11 taken from Geographe Bay Advisory Committee and Ministry of Planning, November 1995, *Draft Geographe Bay Integrated Catchment Management Strategy*, Western Australian Planning Commission, p73.

12 Ernest P. Hodgkin and Ruth Clark, September 1989, *Estuaries of the Shire of Manjimup*, Environmental Protection Authority. Estuarine Studies Series No. 6.

13 Leschenault Inlet Management Authority, *1995 Report to the Community*, p 7.

14 Data quoted in Rutherford, P., December 1989, *Monitoring Pesticides - a review, a report to the Environmental Protection Authority*, EPA Bulletin 407.

15 Klemm, V.V., 1989, *Organochlorine Pesticide Residues in the Preston River Western Australia*, Leschenault Inlet Management Authority, Waterways Commission report No 12

These specific examples appear to be exceptions, and the South West seems generally free of major pollution problems. However, this is a generalisation, as there is only limited information available on the extent of chemical and other residues in the region. The Bunbury office of the Environmental Protection Authority considers that over the past decade or so, there have been a significant reduction in the levels of contaminants leaving industrial sites. While there is still room for improvement at some specific locations, most industrial point sources are now well managed, and there are no known major point sources of pollution remaining. This is a considerable achievement.

3.1.5 Groundwater

Large reserves of fresh groundwater underlie much of the South West, in shallow, mid level and deep aquifers. Environmental impacts occur through changes in the volume and purity of this water.

One impact of settlement in the past 100 years has been to change the amount of water entering the aquifers. In many areas clearing has raised the aquifer, and this can cause some surface flooding affecting wetlands, with paperbarks and other species being killed through too long a period of inundation. Conversely, overuse of the aquifer can drop the level of the near surface groundwater, killing trees and shrubs on the dry sandy ridges.

Much of the South West has large supplies of fresh groundwater, which can be extracted without harming the environment or affecting ongoing availability. However, in a few localised areas, where the balance between saline and fresh groundwater was always precarious and variable, there is some concern that adverse changes are occurring in the salinity of the superficial groundwater. Between Busselton and Cowaramup the Leederville aquifer is already over-allocated.[16]

Some localised groundwater pollution has occurred near the industrial areas of Australind and Kemerton, and measures are in place to recover the material from the groundwater to contain the plume.[17] Some broad scale, but largely undefined, nutrient enrichment of the superficial groundwater is occurring along the coastal plain from septic tanks and fertilisers.[18]

The Water Authority maintains an extensive network of monitoring bores throughout the South West.

3.1.6 Water systems

The health of our rivers, streams, wetlands and estuaries is important to maintain the quality of the water they contain, for biodiversity (see 3.3), and as special places in our landscapes.

3.1.6.1 Rivers and streams

As a generalisation the rivers of the south western coast (Donnelly River to Deep River) are believed to be little changed from their original condition. Substantial portions of their length is through forest, and in many cases through National Park as well. Though localised disturbance has occurred in various places, there is little serious impact on the integrity of the whole river system.

Elsewhere ... *The first, most serious and the most wide spread form of degradation, the removal of the natural riverine vegetation, is also a causative factor in subsequent forms of degradation and has occurred over more than 80% of the region.* [the "larger" South West]. *Thus the character of most of the regions rivers, over much of their length, have been changed from environments supporting a multiplicity of living forms to what are, in essence, open channel drains. This loss of vegetation from the stream courses, their floodplains, their banks and of what formed protective buffers along each, is also a major contributing factor in five of the other seven forms of degradation. The vegetation is no longer there to bind the streambed and banks, to keep the saline groundwater table down, to provide rich and varied aquatic and other riverine habitats, and to provide a filter of nutrients and other non-point and point source pollutants. It is these same cleared rivers which also suffer from river bank and bed erosion and siltation, salinisation, nutrient loading and eutrophication and other forms of pollution, as well as being those where increased run-off has raised the propensity for localised flooding and the need for river training and diversion.*[19]

The west coast streams have been particularly affected by the processes outlined above. Many are still subject to grazing

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16 this information is drawn from the working draft of the *Busselton-Capel Groundwater Area Management Plan* being prepared by the Water Authority of Western Australia.

17 Water Resources Directorate, Groundwater and Environment Branch, 1994, *Bunbury Groundwater Area Management Plan*, Water Authority of Western Australia, p24

18 Holmes, R.M., June 1994, *Contaminants Inputs Inventory of Geographe Bay*, Water Authority of Western Australia.

19 Williams, P.J., Hill, A.L., March 1992, *The state of the rivers and other wetlands of the south west of Western Australia and the role of vegetated buffers in their preservation and restoration*, Proceedings from Corridors of Green Conference, Greening Australia, Adelaide

pressure. Accelerated erosion is occurring along these rivers, changing their shape and filling the deeper pools. Much of the aquatic habitat has been lost, and eutrophication problems are exacerbated by the loss of shade trees along the rivers. Weed infestations are common. On the coastal plain a number of waterways have been engineered into constructed drains.

3.1.6.2 Estuaries

As with the rivers, it is the estuaries of the west coast that have been considerably modified, suffering some loss of natural values and water quality problems. Along the south coast the estuaries are relatively pristine.

It is difficult to form a clear picture of trends in the current environmental health of the west coast estuaries. All indications are that water quality is continuing to decline, but there is now an increased level of management in place over foreshore areas. However, this is happening at the same time as urban development is increasing around some of their foreshores.

3.1.6.3 Wetlands

Wetland areas have suffered severely since settlement. On the coastal plain between Harvey and Busselton, which was once largely wetland, it is estimated that as much as 96 percent has been drained.[20] While it is accepted that both clearing and drainage were necessary to enable settlement, the scale of loss of what are highly productive ecosystems is severe. However, in the view of one author

... *exact percentage losses of wetlands are not important. The pertinent fact is that there has been massive loss of wetlands on the coastal plain and the process is continuing in spite of the increasing biological importance of the wetlands as inland areas turn saline.*[21]

Many of the remaining wetlands are impacted upon by high nutrient levels, clearing, and physical disturbance. Flooding of once seasonal wetlands is a ongoing problem, and is killing the vegetation in a number of wetlands. Conversely, lowering of the water levels in others is impacting on nesting patterns. As far back as 1966 it was noted that

Where drainage has been effective, one of the most serious effects is that surface waters are drained away before clutches of young ducklings are able to fly. These birds are forced to walk across open territory to more permanent water and mortality is high.[22]

Wildlife conservation is not included in the schedules that govern management of the coastal plain drainage system, and landholders report that early lowering of a number of remaining wetlands still occur.

Inland of the Coastal Plain a number of wetlands continue to be adversely affected by rising salinity levels, which kill the remaining vegetation.

While the number of wetlands and their overall health is probably still declining, there is some encouraging work underway. A number of wetlands on agricultural properties are being rehabilitated, and landcare groups such as the Unicup LCDC have made wetland restoration a major goal. Some modifications to wetlands, such as management of water levelks on the Vasse Wonnerup, have proved beneficial to many waterbirds. Wetland creation has been successfully used as part of the rehabilitation of some old minesites at Capel.

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20 Riggert, T.L.,(1966) *A study of the wetlands of the Swan Coastal Plain*, Department of Fisheries and Fauna, Perth.

21 Halse, S.A., 1989 *Wetlands of the Swan Coastal Plain - Past and Present*, in Swan Coastal Plain Groundwater Management Conference proceedings, WAWRC.

22 Riggert, T.L.,(1966) *Wetlands of Western Australia, 1964-66*, Department of Fisheries and Fauna, Perth.

3.2 LAND

Definition

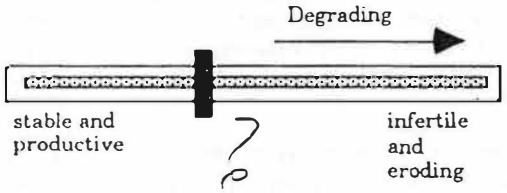
The "land" is the health, stability and productive potential of the soil and landforms.

Measurement

Land, precious resource that it is, is generally only measured by area, economic value or productive potential. We have few mechanisms in place to assess the ongoing health of the landscape, the loss or gain of fertility, or the biological health of soils. We only have an approximate measurement of the area lost to salinity, and the accuracy of even this loss has been re-assessed considerably in recent years. Figures of soil loss due to wind or water erosion, are only approximations. Other damage to the landscape, such as along the coastline, can only be assessed through collating details of ongoing programs of repair and management.

Significance

The South West contains the bulk of the well watered soils in Western Australia; large areas of which are also relatively fertile. Its landscapes are soft and gentle to the eye, and this aesthetic attractiveness helps makes the region the second most popular recreational and tourist destination outside Perth.



Areas with good vegetation cover are stable. However, considerable amounts of soil are eroding from agricultural land, and from urban development sites. On farmland, fertility and soil structure are being lost. Salinity is more widespread on the Coastal Plain than generally believed, and is causing considerable economic loss, particularly on irrigated land.

Large areas of coastline are under the most intense recreational pressure of any area in rural WA, with a range of rehabilitation works required to repair existing degradation and reduce future damage.

The impact of rubbish disposal to landfill, lingering contamination from old industrial sites, and pre 1987 use of organochlorines are potential, but largely undefined concerns.

3.2.1 Forest and plantation land

Under perennial vegetation cover, the landscape generally remains stable. However planting and harvest of timber can cause significant erosion unless carefully planned and executed.

Concerns have been raised in the community at some soil erosion from logged areas, and from plantations being established or logged on steep slopes. Severe erosion from logging roads and firebreaks has been a particular concern. It is understood that management measures to reduce erosion from these sites have improved in recent years.

3.2.2 Agricultural land

Agriculture occupies approximately 25 percent of land in the South West,[23] and is the second largest land-use after State Forest. While agricultural use of some areas dates back to European settlement in WA, large tracts have been cleared and brought into production in the past 30 to 40 years. Significant change to the original landscape is a recognised cost of agricultural development, but there is evidence that significant off site degradation is also occurring, and in some areas the agricultural potential of cleared land is being damaged by current practices.

Soil loss

... little assessment has been made of the degree of soil erosion. This is partly due to an acceptance by farmers that soil erosion is a part of farming in the region, and in part has been due to the lack of data outlining its effects on yields and the sustainability of the agricultural industry.[24]

During 1991 and 1992, a number of sites throughout the South West were sampled to determine average rates of erosion. These sites were without obvious visual indications of erosion, and covered a range of agricultural pursuits such as grazing, cropping, and horticultural use, and landscape types from steep slopes to the flats of the Coastal Plain.

Significant soil erosion was found to be occurring on most sites. The range of erosion occurring varied from minimal to as much as 23 tonnes/hectare/year. The mean soil movement ranged from 0.5 to 12 mm decade, with a region average of about 3 mm decade. Significantly the study found that *No*

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23 calculated from *South West Strategy*, South West Development Commission, 1994, p 7 and 42

24 all figures and quotes on direct soil loss are drawn from van Moort, J.C.P., George, R.J., Tille, P.J., Elliott, C.L., *Soil loss in the south-west of Western Australia as determined by Caesium-137*, publication unknown

relationship between slope length, slope angle and mean net soil loss is apparent from the data. However there appears to be a good relationship between land use and soil loss.

In effect, the study found that management was of more importance than steepness of slope, soil type, or the other factors we normally associate with soil loss.

It is important to note that the survey described above did not cover obviously eroding land, the slopes with defined gullies or small landslips that are readily visible through the region.

Other data has suggested that, in the Leschenault catchment, *More severe erosion occurs in limited areas, where vegetables are grown on sloping land in the Preston catchment. Most potato cropping has moved from this catchment to the coastal zone. However losses of up to 20 mm per decade (equivalent to about 20 tonnes/hectare/year) are common with vegetable growing. Extreme rates of soil loss of 60 mm per crop have been reported.* [25]

The figures taken over the South West indicate that around 2.5 million tonnes of soil is being moved from its original position each year on farmland, primarily by water erosion. Though a certain percentage of this may be deposited further down the slope, large amounts of soil are washing into waterways. In addition valuable nutrients and organic matter are being lost from places where they have a high value (paddocks) to areas where they have a high cost (waterways). This problem is exacerbated where river, stream and drain banks are also actively eroding, but no figures are yet available on this.

Apart from direct soil loss fertility can be damaged by decline in soil structure, loss of soil fauna, and increasing acidification.[26] Current Department of Agriculture estimates are that there is little "severe" soil structure decline in the region, generally less than five percent of agricultural land is affected, and often as little as one or two percent. However, over the whole region more than 40 percent of farmland is suffering minor soil structure decline, mainly due to compaction from livestock trampling and loss of soil fauna.

The worst affected soils are in some of the inland areas, where up to 80 percent is suffering from some minor structural decline. Length of time since the land was first cleared appears to be a factor in the scale of the problem. For example, on the Swan Coastal plain it is estimated that 40 percent is affected, while only five percent is estimated to be affected on the Scott Coastal plain.

Increasing water repellence and acidity are also significant problems, particularly on the two coastal plains. About 55 percent of the Swan Coastal Plain soils are now considered water repellent, and 50 percent suffer from soil acidity. While water repellence is less of a problem on the Scott Coastal Plain, more than 90 percent is considered to be currently acid and may acidify rapidly under high input farming systems.

Salinity

Clearing for agriculture has disrupted the hydrological balance and mobilised large quantities of soil stored salts. As outlined elsewhere, this has released large loads of salts into the creeks and rivers. In most agricultural areas between 7 to 10 percent of the land area is moderately affected by surface salinity. Inland of the 1000mm rainfall isohyet it is estimated that between 25 to 35 percent of the land may become affected in the future, while on the Swan Coastal Plain about 20 percent is affected and up to 40 percent may become effected in some Shires. These predictions, while not validated by firm data, are severe enough to be of major concern.

While the visual expression and impact of soil salinity is not as apparent or drastic in the South West as it is elsewhere in southern WA, it can still have a severe economic impact.

For example, the irrigation areas that stretch from Harvey to Dardanup present a lush and productive rural landscape. Farmers surveyed in 1993 reported that perhaps 2 percent of irrigated land was currently "visually" saline. In the same year the Wellesley and Dardanup Land Conservation District Committees initiated detailed salinity surveys of cross-sections of the area, which revealed that *About 10% of the surveyed area had soil salinities at levels ... which would kill most clover species, while greater than 80% of the area could incur some (~10%) yield reduction of both annual and perennial clovers.*

Thirty six percent of irrigated land had soil salinities high enough to cause a 50 percent reduction in the growth of sub-clover. Even then, this survey was considered to *underestimate the real extent and effects of salinity.*[27]

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[25] Leschenault Catchment Coordinating Group, May 1995. *Draft Management Strategy for the Leschenault Catchment*, p30.

[26] Data for this section has been supplied by Richard George, Department of Agriculture, Bunbury. While it can be considered tentative, it does give a good general guide to overall health of the agricultural areas.

[27] all data and quotes in this paragraph are from George, R.J., Bennett, D.L., Arkell, P.T., Vukelic, B., *Soil salinity in the south-*

The economic impact of these salinity levels is only partly measured by these losses in current productivity. It also includes loss of future opportunities for the intensification and diversification of agricultural production. In the future, saline lands may also result in a production focus on lower value products in areas where higher value products could have been grown

Waterlogging

Recent surveys have indicated significant areas where pastures and crops may be affected by waterlogging.[26] In a number of areas this is also affecting the health of the soil, by aiding compaction and reducing soil fauna. In some inland areas around 50 percent of inland soils may be affected by waterlogging in winter.

On the Swan Coastal Plain 40 percent is estimated to be winter waterlogged, and as much as 85 percent on the Scott Coastal Plain. However, while this may be seen as an agricultural issue, it is arguable if it can be used as a measure of environmental health. Both plains once contained extensive wetland areas, and waterlogging reflects that past. Winter wet paddocks provide valuable feeding areas for a range of waterbirds, and often produce much needed green pasture during the summer months.

However it does clearly represent declining environmental health where waterlogging increases water erosion, mobilises nutrients which then enter wetlands or waterways, or allows soil structure decline when the land is stocked.

3.2.3 Coast

Geographically the South West is, in many ways, a peninsula surrounded by ocean. It has over 400 kilometres of coastline. There are a range of landforms present; from the relatively sheltered low sandy coastline of Geographe Bay, the high wave energy rocky coastline between Capes Leeuwin and Naturaliste, and the exposed sandy coast from Augusta east. Human pressure on the coastline varies. Overall the South West coastline has more visitor pressure on it than any region outside metropolitan Perth,[28] with much of this pressure focused on the coast between Bunbury and Augusta. Stretches of coast in D'Entrecasteaux National Park are in near wilderness condition.

Regardless of human impact, coastlines are dynamic environments which can change form considerably in a relatively short time span. Some coastlines, such as that along the relatively undisturbed Leschenault Peninsula, are "retreating" inland at a measurable rate. In other areas the opposite may be occuring.

Measures of the level of degradation and the success of rehabilitation work do not exist.[29] However, it is well recognised that significant damage is occurring to coastal vegetation and dunes at a number of places. The level of damage, while well recognised locally, is largely unquantified. Coastal management plans only exist for a relatively small length of coast. However, over the past two years local government authorities and government agencies have been working together to formulate an agreed list of priorities for repair works. All local government authorities reported significant erosion along the coast, and a program of high priority repair work has been defined.

An additional complication is the anticipated slight rise in sea levels from global warming. There is potential for significant rises in sea levels of up to 65 centimetres over the next 100 years,[30] and this will put significant pressure on the existing coastline, particularly adjacent to the low lying coastal plain.

3.2.4 Waste management

Currently only a small percentage of waste material is recycled; the rest is disposed of in landfills, the majority of which are unsealed and on deep, sandy soils. A recent broad scale study found that

Pollution of surface and groundwater is highly dependent on the characteristics of the site and the operation of the landfill. Direct run-off from landfills has been identified as impacting on surface waters at(at least) two landfill sites within the South West. In addition, most of the landfills located on the sandy soils of the coastal plain are not lined. It is probable that these landfills are impacting on the quality of the local groundwater resource. This is especially the case at larger landfills in which liquid wastes are deposited in unlined pond areas. Secondary impacts can occur at landfills where seasonal rises in the shallow groundwater table results in water flowing over

west irrigation area: extent and management options, publication unknown

28 Donaldson, B., Eliot,I.G., Kay, R.C., 1995, *Review of Coastal Management in Western Australia*, Coastal Management Review Committee, Perth, p2

29 Donaldson, B., Eliot,I.G., Kay, R.C., 1995, *Review of Coastal Management in Western Australia* Coastal Management Review Committee, Perth, p21

30 Kay, Robert, in *Geographe Bay Land and Sea Conference*, 1994, Geographe Bay Advisory Committee, p10

the landfill site and draining into surface waters.[31]

It is reasonable to expect some leachates to have left these sites, but this has apparently not been noted by the limited amount of monitoring underway. One site, at Jindong south of Busselton, has recently been closed because of concerns over the potential for leaching of material into the groundwater.

Landfill sites are also significant sources of greenhouse gases such as methane.

A strategy is now being developed through the South West Waste Management Advisory Committee, with the objective of reducing solid waste disposal to landfill by 50 percent by the year 2000, and improving the overall management of waste in the South West.

A related issue that also requires resolution is the disposal of septage (largely septic tank pumpout) and other high nutrient waste to landfill. Opportunities exist for this to be recycled as a high value fertiliser onto farmland, through sub-surface injection or similar.

3.2.5 Pollutants

Our present society uses a number of materials and chemicals which are not generally present in the environment in any quantity, if at all. Examples include heavy metals, pesticide and herbicide residues, and water soluble toxic substances such as PCBs. In some situations these may have been released or escaped into waterways where they can persist and accumulate, and possibly cause harm.

Sites which are generally associated with heavy industrial use or large scale pesticide use in the South West are reasonably well known and documented. For example, there are known waste dump sites on the Leschenault Peninsula (now reclaimed), and at Dalyellup.

It is believed that there are a small number of old contaminated soil sites scattered through the South West. These are from outdated industrial processes such as the use of copper chrome arsenate to treat timber in the 1940s/1950s.[32] There is no register of such sites at the moment.

Pesticide residue has been a problem on some grazing areas. *Unacceptable levels of organochlorine pesticides have been found in cattle grazed in paddocks previously used for potato growing.*[33] The use of organochlorines to treat the soil around power poles has caused similar problems. While of major concern to growers because of the impact on export markets, contamination is thought to have been restricted to a number of identified sites which now have management programs in place.[34]

31 Sinclair Knight Merz, March 1995, *South West Recycling Blueprint*, South West Waste Management and Recycling Working Group, Appendix D, p6.

32 pers.comm Henk Van der Weile, EPA, 10/11/95.

33 Tille, P., and Lantzke, N., *Land Capability - Margaret River and Busselton*, Department of Agriculture.

34 Bond, M.P., 1988, *Pesticides - Effects on Agriculture and waterways*, in Managing environmental issues in the South West Symposium, Institute of Engineers, WA Division.

3.3 BIODIVERSITY

Definition

Biological diversity is the variety of all life forms - the different plants, animals and micro organisms, the genes they contain, and the ecosystems of which they form a part. It is not static, but constantly changing; it is increased by genetic change and evolutionary processes and reduced by processes such as habitat degradation, population decline, and extinction. The concept emphasis the interrelatedness of the biological world. It covers the terrestrial, marine and other aquatic environments.

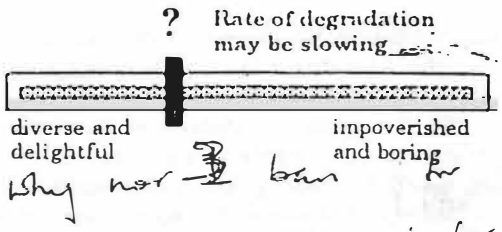
Draft National Strategy for the Conservation of Australia's Biological Diversity. (Undated)

Measurement

Regional biodiversity levels can only be measured very crudely, using the number of species and ecosystems or the area of habitat known to exist. This is particularly difficult to do in the South West as many species, particularly plants and insects, are yet to be discovered and scientifically described, and scientists are still defining the distinct ecosystems.

Significance

Biologically, Australia is a very diverse country, rich in species that occur nowhere else in the world. Levels of diversity in the South West are among the highest in Australia, particularly for plants. The South West, together with the northern jarrah forest, contains the only temperate forests in Western Australia, and has one of the two large areas of remnant vegetation left in southern Western Australia. (The large area of woodland and heath east of the wheatbelt being the other)



Compared to much of southern Western Australia, the South West is still very well vegetated. Almost 60 percent of the region, on average, remains under indigenous vegetation. However there is considerable variation across the region, and significant areas have little of their original vegetation left.

Research is only now starting to determine the ecosystems that we may have lost representative samples of.

There has been a significant decline in the level of biodiversity in the past 100 years, caused mainly by widespread clearing and drainage, the introduction of diseases, foxes and cats, and more recently though weed invasion. Biodiversity levels are thought to be still declining, though possibly at a reduced rate.

At a species level the most obvious loss has been of mammals. Localised extinctions of plants, invertebrates and possibly some vertebrates is likely to be still occurring as remnants become smaller and more degraded, and connectivity through linked areas of bush weakens.

3.3.1 Ecosystems and habitats

A number of distinct communities of plants and animals occur in the South West. On a regional scale these include the jarrah and karri forests, the coastal heath lands, and the life in and around the estuaries and wetlands. At a local scale a wide range of plant communities and differing habitats exist within each major grouping. The differing ecosystems and habitats are, in themselves, major expressions of the region's biodiversity, and are vital for the long term survival of individual species.

Averaged over the whole region there is almost 60 percent of land still under the indigenous vegetation.[35] However, there is considerable variation across vegetation types, and some are sure to be very poorly conserved. With our knowledge of species still poorly developed it can be expected that our knowledge of what comprises a distinct

[35] averaged from figures supplied by Spatial Resource Information Group, Department of Agriculture

ecosystem or plant community is also poorly developed.

The most drastically altered environments are those of the Coastal Plain, a landscape unit that extends from Dunsborough north to the Moore River. Large sections of the plain, particularly on the eastern side, are over 95 percent cleared. Some plant communities are now severely threatened, with the most severely threatened community on the entire coastal plain being the southern ironstone heaths which occur along the base of the Whicher Range near Busselton.[36] There is apparently only one site where the sequence of plant communities that occurred across the Coastal Plain remains. (Ruabon Rd.)

Other areas are much more heavily vegetated. For example, 88 per cent of the Shire of Nannup is under indigenous vegetation.

Of the existing plant communities, large areas have been adversely affected by the dieback disease *Phytopthora cinnamomi*, an exotic that reached Australia around the same time as foxes, cats and rabbits were becoming established.

It is extremely difficult to rebuild habitats and ecosystems once they are destroyed or damaged. Ongoing threats include weed infestation, continued grazing pressure, and clearing following subdivision. In some inland areas, rising water tables and the spread of salinity is threatening areas of remnant vegetation and nature reserves.[37]

There is considerable public debate underway on the extent to which the main forest ecosystem types need upgraded levels of conservation. Heavy emphasis is being placed on the age of the particular ecotypes (old growth or re growth). With senior administrative and scientific staff of both the Federal and State Governments unable to agree, and significant sections of the community also disagreeing, it would be presumptuous of a quickly prepared overview document such as this to enter that debate.

But, the existence of that debate, after almost 100 years of forestry management in WA does underline two important themes. One is that our knowledge of ecosystems is still developing and, secondly, community values and views on what is an acceptable level of conservation and management are also still developing.

3.3.2 Plants

Southern Western Australia, west of a line from Shark Bay to Israelite Bay, is one of Australia's richest botanical areas. In many areas the level of species diversity is equivalent to the tropical rainforests of South East Asia, and our knowledge of the flora is still developing. Southern Western Australia *has an estimated 8 000 species, 75% of which are to be found nowhere else, 30% are yet to be described by botanists, and possibly as much as 75% are yet to be grown in cultivation.*[38]

Because of this richness, and because the flora remains poorly studied even after 160 years of European occupation, it is difficult to be precise about the number of species and variations within them, that remain or are lost.

A comprehensive floristic study has just been completed of the Coastal Plain. Nearly ten percent of the plant species noted were scientifically undescribed. Thirty species "new" to science were found during the survey.[39]

Comprehensive regional flora lists have not been prepared for the other main areas in the South West, though considerable data has been collected during specific surveys. For example, studies along the Leeuwin Naturaliste Ridge found the area to be particularly rich in endemic species and other plants of conservation significance.

Data collated by CALM for its central and southern forest areas show only four species are presumed extinct, out of a total of 101 species about which little is known, and which are assumed to need protection. There are 112 "endangered flora populations" in those same regions.[40] Of these only 43 are on lands managed by the Department of Conservation and Land Management.

The number of plant species known only from small populations is quite high by Australian and international standards. It does, to some

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36 Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H., Lyons, M.N., 1994, *A floristic survey of the southern Swan Coastal Plain*, Unpublished report for the Australian Heritage Commission prepared by Department of Conservation and Land Management and the Conservation Council of WA (Inc.).

37 George, R.J., McFarlane, D.J., Speed, R.J., 1994, *The consequences of a changing hydrologic environment for native vegetation in sooouth western Australia*. Paper presented at the Nature Conservation: the role of Networks Conference, Geraldton.

38 Stephen D. Hopper, September 1993, *Gondwanan Botany: A perspective on remnant management in South-West Australia*, in Remnant Vegetation, Ten Years on - a decade of management and research, Proceedings of the Dryandra Workshop, CALM.

39 Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H., Lyons, M.N., (1994) *A floristic survey of the southern Swan Coastal Plain*, Unpublished report for the Australian Heritage Commission prepared by Department of Conservation and Land Management and the Conservation Council of WA (Inc.), p6.

40 Stephen D. Hopper, Stephen van Leeuwen, Andrew P. Brown, Susan J. Patrick, 1990, *Western Australia's Endangered Flora and other plants under consideration for declaration*, CALM.

extent at least, reflect the nature of plant evolution and distribution in the South West, as much as any endangering processes caused by humans.

Many of the species and plant communities with restricted distributions are subject to pressures such as weed infestation, stock grazing, and clearing during development work. Any future "state of environment" information on the health of indigenous vegetation will need to include information on the distribution of the main invasive weeds, and the rate of spread or control.

A range of introduced fungi is presently attacking Australian plants. The most virulent of these, jarrah dieback, (*Phytopthora cinnamomi*) is believed to have been introduced from South-east Asia around the turn of the century. Large areas of the jarrah forest and the coastal plain are affected. It is currently estimated that 14 percent of the state forest is significantly affected,[41] with the main concentrations of disease in the jarrah forest areas north of the Preston River, and in the Donnybrook Sunklands. Dieback also *frequently occurs on the acidic leached soils of the Bassendean Dunes System of the Swan Coastal Plain, Gavin sands of the Leeuwin-Naturaliste Ridge, laterite soils and winter wet flats of the D'Entrecasteaux and Walpole-Nornalup National Parks.*[42] One estimate for a section of the Scott Coastal Plain suggest that as much as 86 percent of the area is infected.[43]

3.3.3 Mammals of the land

Most of the Australian mammals are unique to this continent, having evolved in isolation from the rest of the world. They have been devastated since 1829; numerous extinctions have occurred and many species now occupy only a fragment of their former range. The loss of many of the small mammals is believed to have accelerated in the 1880s and was *most sudden and unaccountable ... due to some epidemic or disease, ... a kind of marasmus, perhaps brought into the country by introduced animals.*[44]

Further waves of disease are thought to have occurred early this century. Since then small mammals have been further affected by clearing, changed fire regimes, and predation by introduced foxes and cats.

Of the 32 species believed to have occurred in the region in 1829, five are now regionally extinct. Only one, the broad faced potoroo, is totally extinct. The western ringtail possums, black-gloved wallabies and quokka, were common throughout the region until only a few decades ago, but are now thought to be declining in numbers and distribution. Other species, such as the woylie were once very common, but are now restricted to a few small populations. Some species, such as the chuditch, have been drastically reduced in numbers, but still occur in small populations through the region.

The South West is extremely important for the survival of a number of species that once occurred across much of inland Australia:

Changes have not been as dramatic in the forest areas of the South West as in the agricultural and pastoral areas. ... However many species (particularly mammals) have declined in abundance and local extinctions are common. Populations of most terrestrial forest vertebrates are fragmented. Many species have been confined to the most fertile, high rainfall areas of their habitat and areas less conducive to introduced predators ...[45]

Of the 23 most threatened mammals in Western Australia, eight occur in the South West.[46] While the large forest and National Park areas of the South West are factors in the survival of so many mammals, other areas are also important. For example, *The Ringtail ... has declined alarmingly over much of its former range and is now abundant in only a few areas. Apparently viable populations occur within the towns of Busselton, Quindalup, Dunsborough and Albany.*[47]

There has been a downward trend in mammal numbers and distribution for at least the last 100 years. It seems probable that this trend is continuing, though possibly at a reduced rate than for most of this century. Not all the news is bad, and strategic reintroductions of species are underway in some areas, and major predator control programs have commenced.

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41 CALM, *Fight dieback - speakers kit*

42 Shearer, B.L., 1994, *The major plant pathogens occurring in native vegetation in south-western Australia*, Journal of the Royal Society of Western Australia, 77:11-22.

43 Hart, Simpson and Associates, 1991, quoted in *Beenup Titanium Minerals Project - Proposal to extend mining area*, BHP, September 1995.

44 Shortridge, G.C., 1909, *An account of the geographical distribution of the marsupials and monotremes of south-west Australia having special reference to the specimens collected during the Balston Expedition of 1904-1907*, Proc Zool.Soc. (London) 1909, 803-848

45 Grant Wardell Johnson, *Vertebrate fauna: Management and Conservation*, in Angela Wardell-Johnson and Mary Frith, The Jarrah Book: proceedings of a weekend workshop at Perup Field Studies Centre, Bridgetown WA, Bridgetown-Greenbushes Friends of the Forest, p14

46 CALM, 1992, *Draft Nature Conservation Strategy*, p80.

47 How, R.A., Dell, J., Humphreys, W.F., *The ground vertebrate fauna of coastal areas between Busselton and Albany, Western Australia*, Records of the Western Australia Museum, 1987, 13(4):553-574

3.3.4 Mammals of the sea

Bunbury's Koombana Bay is named for "the place where the whales spout".[48] Whales were once very common in the sea around the South West. While they suffered a major decline in numbers until the cessation of commercial whaling during the 1970s, the numbers of both humpback and southern right whales in the waters of the South West are increasing significantly.

This is a wonderful thing, and an inspiring piece of evidence that we **can** reverse downward trends in the environment.

3.3.5 Birds

... and I declare that neither in Victoria nor Queensland have I seen so many species and individuals within a similar area to that traversed. (Milligan, 1902).[49]

This historic quote refers to the birdlife of the Cowaramup-Margaret River area. Does it still?

Because the South West contains a mixture of wet and drier country species, it has a very rich array of bird species. Most are still present in the region, though the abundance and distribution of many has been reduced through changed burning patterns, clearing, grazing, and "the fragmentation of native vegetation".[50] A number of birds, particularly the smaller species, are no longer common in many localities, though only four species, stone plovers, western whipbirds, rufous bristle-birds and mallee fowl, are thought to have disappeared from the South West totally. At the turn of the century mallee fowl were not uncommon in the coastal scrub between Cape Naturaliste and the Warren River. Apparently this population was extinct by 1950.

Those are the drastic and relatively easily mapped changes. Data from observations made over many years is generally required to map more subtle reductions in species abundance and localised distribution patterns. If this information exists for the South West, we have not been able to source it yet. We can state confidently however, that many localised extinctions have occurred, and in many cleared areas small birds such as robins and wrens are now a rarity. Fears are held that some larger species, such as the red-tailed black cockatoos, will decline due to the loss of tree hollows that provide nest sites.[51]

Conversely, the changes since European settlement have suited other species admirably, and they have increased in abundance and possibly in distribution as well. For example the twenty eight parrot (= Port Lincoln parrot) was once largely a bird of the inland, but is now common enough in many areas to be considered a major pest of fruit crops. It is also known to cause significant damage to some areas of remnant vegetation.

3.3.6 Frogs and reptiles

Reptiles have not suffered as much since European settlement as mammals and birds. Though numbers have ben reduced because of clearing, no species have been lost, and most reptiles have the ability to persist in small remnants or in a modified environment.

There is no documented overview on the status of the frog population, though considerable data has been collected on specific areas and species. Significant decline in overall numbers has occurred as the result of clearing, drainage, the severe decline in water quality in many areas, and also probably through predation from introduced fish such as *Gambusia*. The southern forests, which have been least affected by clearing, "are therefore the most important area in the South West for frogs".[52]

But the regional assemblage of frogs is almost certainly still diminishing, at the very time that scientific awareness of the level of genetic diversity amongst the frogs is rising rapidly. We are now realising that what had been considered one species of frog may in fact be several very similar species. For example, the frog *Geocrinia rosea* is now considered to be four separate species, two of which have extremely restricted occurrences. One of these, *Geocrinia alba* (white bellied frog) is considered to be "one of the most restricted vertebrates in Australia"[53]. "Over 70% of the populations of this locally endemic species occurs on private land."[54] Together with its

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48 DPUD, 1993, *draft Bunbury-Wellington Region Plan*, p 50.

49 quoted in How, R.A., Dell, J., Humphreys, W.F., *The ground vertebrate fauna of coastal areas between Busselton and Albany, Western Australia*, Records of the Western Australia Museum, 1987, 13(4)553-574.

50 How, R.A., Dell, J., Humphreys, W.F., *The ground vertebrate fauna of coastal areas between Busselton and Albany, Western Australia*, Records of the Western Australia Museum, 1987, 13(4):553-574

51 Saunders, Denis, and Ingram, John, April 1995, *Birds of South western Australia* Surrey Beatty and Sons, Chipping Norton, p 116

52 Christensen, Per, 1992, *The karri forest*, Department of Conservation and Land Management,p31

53 Wardell-Johnson, G., Roberts, J.D., 1991, The survival status of the Geocrinia rosea complex in riparian corridors: biogeographical implications, in *Nature Conservation 2, The role of corridors*, Surrey Beatty and Sons, Chipping Norton, p173

54 Grant Wardell Johnston and Per Christensen, A review of the effects of disturbance on wildlife of the Karri Forest, CALM, *Research on the impact of forest management in south-west Australia*, CALM Occasional Paper 2/92, p42

near relative, *Geocrinia vitellina*, (yellow-bellied frog), also a South West species, they are the two most threatened frogs in Western Australia. Another relatively common species, the turtle frog, is also now considered to be made up of a number of distinct species.

Specialist staff at the WA Museum consider much of South West poorly sampled, particularly in the jarrah forest from Collie south. Other researchers have noted that "there is little documented evidence on the effects of disturbance on reptiles and amphibians in the Warren subdistrict".[55] With the awareness that the South West contains a much higher level of species diversity than previously recognised, there is concern that the declining health of the river systems is threatening frog populations and species.[56]

3.3.7 Marine animals

Gathering information on our knowledge and understanding of the state of the marine environment, and the many animals it contains, is a major task. It has not been undertaken during this phase of preparing a regional State of the Environment report.

A range of data exists that has been collected from commercial fishing operations, but this can reflect the changing technologies and economic of the fishing industry as much as the numbers of fish available to be caught. Further advice will be sought when updating this paper.

3.3.8 The largely unknown

... over 98% of the State's species are either invertebrate animals or lower, non-vascular plants. We have no idea of the status of more than a handful of these species, but given the scale of alteration to many ecosystem types, it is likely that some of them have become extinct, and probably many others have become threatened.[57]

If the community is serious about conserving the genetic heritage the South West has been blessed with, then the less noticeable life forms need to be considered. This has additional importance when it is appreciated that the economic benefits being gained from genetic engineering are often from these life forms.

There does not appear to be sufficient information available to assess the status and trend of these less recognised life forms, however some existing information does give a few clues. Firstly, there appears to be an extremely diverse invertebrate population, and the macro fungi may have a richness and complexity comparable to the flowering plants.[58] Secondly, there appears to be a level of localised endemism in the South West, with many species only occurring over a very restricted area.

This is well documented for a number of snails on the Leeuwin-Naturaliste Ridge, and for a number of "relic Gondwanan" spiders that occur in small pockets of the karri forest. These are species whose evolution can be traced back to when the continents of the southern hemisphere were joined.

3.3.9 Aquatic species

An area in which we are lacking the most basic of information is of aquatic life and of aquatic ecosystems. For example, the life cycle of only one of the South West Region's 20 or so native fish has been studied in any depth. We do not know the range, habits, breeding requirements, diet, etc., of any of the others. Nor do we know the effects that introduced competitive species, impassable barriers, increased salinity levels, loss of summer refuge pools or a number of other changes have had. Of what we are in ignorance of in the case of fish can be said, even more so, for the various other forms of aquatic life and for the mammalian and avian fauna that once depended on and flourished in and around our river systems. We basically don't know what we have lost and what we have left.[59]

Many fish species no longer occur in large sections of most west coast rivers, almost certainly due to declining water quality and loss of river habitat. For example, three or more species of fish were recorded in the Vasse river during the 1950s. "Nowadays the river bed appears to sustain neither aquatic plants nor native fish".[60] However the introduced carp is common in the same area.

Ten species of highly specialised burrowing freshwater crayfish are endemic to the South

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55 Grant Wardell Johnston and Per Christensen, A review of the effects of disturbance on wildlife of the Karri Forest, CALM. *Research on the impact of forest management in south-west Australia*, CALM Occasional Paper 2/92, p42

56 pers comm, Ken Aplin, WA Museum, 6 September 1995

57 CALM, 1992. *Draft Nature Conservation Strategy*, p27

58 Stephen D. Hopper, September 1993. *Gondwanan Botany: A perspective on remnant management in South-West Australia*, in Remnant Vegetation, Ten Years on - a decade of management and research, Proceedings of the Dryandra Workshop, CALM.

59 Williams, P.J., Hill, A.L., *The state of the rivers and other wetlands of the south west of Western Australia and the role of vegetated buffers in their preservation and restoration*, March 1992, Proceedings from Corridors of Green Conference, Greening Australia, Adelaide.

60 W.G.Martinick and Associates, November 1994, *A management plan for the Vasse River and Estuary*, Draft for the Shire of Busselton, p15

West. Many, only found in surface waters after heavy rains, have a subterranean life,, whilst others remain active where there is permanent water.

Because of their Gondwanan origins, they are of high biogeographic importance. A number have very limited distributions, and little is known of how they are withstanding the changes occurring to most water systems.[61] The most common is the marron, which was widespread throughout the South West, but whose range has contracted significantly,[62] and is possibly still contracting as water quality and habitat degradation worsens.

3.4 ATMOSPHERE AND AMBIENCE

Definition

Under this category we include the clarity and quality of the air, as well as more difficult to define environmental qualities, such as noise levels, aesthetics and the special features that attract so many people

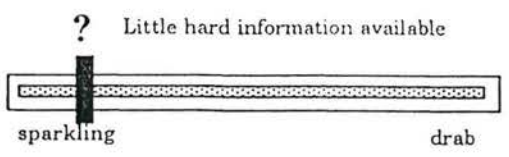
Measurement

There are scientific measures for a number of attributes, such as air quality and noise levels. But many qualities are only expressed through the appreciation of the people who live and work in the area. The increase in population, while most other rural areas elsewhere, is one measure. The readiness of a large number of community groups to care for, and spring to the defence of, their local environment may be another measure, as is the proliferation of cultural events that celebrate the South West.

Much of what make the South west such a special place is the province of the poets and painters, not the scientists and the analysts.

Significance

Like most of Western Australia, the South West has a largely unpolluted atmosphere. This is of added importance as most of the WA's population outside Perth, lives here.



The general high quality of the atmosphere and ambience is being maintained. There are concerns at some localised instances of changed air quality, associated with specific industries located close to residential areas, and at dust generated during urban development. Occasional days of poor air quality occur throughout the region due to large scale forest or stubble burning.

Noise connected with specific industries, and with trucking frequency through residential areas, is also an issue for many residents.

Overall, the South West remains clean and attractive, but with few mechanisms to provide objective measurement of the incremental changes occurring.

61 Tinley, K.L., Briggs, I.M., and Vellacott, S.R., (1986) *The South-West Peninsula*, Regional Synoptic Ecological Series on Western Australia, unpublished, Department of Conservation and Environment Bulletin, Perth.

62 Morrisey, N.M., (1978) *The past and present distribution of Marron Cherax tenuimanus (Smith) Western Australia*. Fish. Res. Bull. 22 1-38.

3.4.1 Air quality

Generally the South West enjoys clear unpolluted air, freshened daily by breezes blowing in off the vastness of the Indian Ocean. However, over the whole region there are regular periods of lower air quality, particularly when an easterly air stream and other climatic factors combine to trap smoke from large fires (Control burns in the forest, stubble burns further inland, or large wildfires). For instance, on the evening of 13 November 1995, Bunbury bore an uncanny resemblance to Los Angeles on a smoggy day. Additionally, there are local concerns at emissions from industries that adjoin residential areas. The widespread use of wood fires and stoves is also seen to be contributing to bouts of poor air quality in residential areas. Towns like Bridgetown in the lower parts of a valley are often subject to smoke filled air from domestic fires.

At present there is no official count of the number of days air quality is compromised. The Department of Environmental Protection is currently planning to establish monitoring sites for haze and airborne particulates at Busselton and Bunbury.[63]

As noted elsewhere, dust from urban development sites continues to be a serious problem. EPA requirements that air borne dust from these sites is below 1000 micrograms per cubic metre has been exceeded on many occasions, leading to numerous complaints from residents.[64]

3.4.2 Noise

Concerns about noise are common to a number of communities where industrial activities are close to residential areas, or where, roads with high truck traffic run through residential areas or shopping precincts. As the peacefulness of the South West is treasured by so many residents, there is possibly a sensitivity to intrusive background noise from industry or traffic. The town of Boyanup is a prime example. It straddles a main trucking route, and, on 1992 figures, had between 440-480 trucks pass through each day.[65] This figure is now probably much higher. It has been noted that *The "quiet backwater" and rural character of Boyanup, which many residents, new and old, obviously found attractive, has been reported as eroded by the increased through traffic.*[66] Vibration from heavy trucks is also an issue for residents near the main roads.

Large developments place a heavy noise penalty on nearby residents. During December 1995 residents near Wonnerup House reported over 680 truck movements per day past their homes.[67] It is not known what the impact of this high level of disturbance may have on native birds and animals.

Other noise pollution perceived by South West residents include gas guns used to scare birds from vineyards and orchards, irrigation pumps that run through the night, and timber mills.

Noise control measures on a number of industries have increased in recent years, and are routinely included in the environmental assessment of new or expanded industrial operations, for example, Kemerton and Wespine at Dardanup.

Dust and noise constitute 48 percent of all complaints investigated by the Bunbury office of the Department of Environmental Protection.[68]

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63 pers. comm. Henk van der Weile, DEP, Bunbury, 28/11/1995

64 pers comm Henk Van der Wiele, DEP, Bunbury.

65 Alan Tingay and Associates, 1992, *Proposed major expansion of pine log sawmill, Moore Road Dardanup*, Wespine Industries, p25.

66 South West Development Authority, 1990, *South West Mineral sands Industry Report - An Information Handbook*, SWDA, Bunbury, p7-6.

67 Information conveyed by Peter Goss, 28/11/1995.

68 Annual Report 1993-94, Environmental Protection Authority, p62.

Section 4

THE TURNING POINT?

The body of this document focuses on the physical changes in the environment. Most of the news is bad.

There is some good news. Although it is not detailed in this report, it is abundantly clear that over the past decade the health of the environment has become widely accepted as a major issue facing the South West. A range of agencies now have programs aimed at improving environmental management, mining companies and other businesses in the region are winning awards for environmental initiatives, local councils are involved in the environment on a diversity of fronts, and there has, quite literally, been an explosion in the number of community groups actively working to repair damaged parts of their natural local environment. This signifies an historically significant change in our attitude to the environment.

But it will take time for these changes to have significant impact on the ground. Currently there is little hard evidence of improvement in any of the main indicators of environmental health.

Significant improvements can be achieved in the next decade. There are a wide range of agreed strategies and priority projects ready to be implemented. There is a growing level of frustration among councils and groups at the need to swing greater resources into on ground works.

Little will be achieved unless that happens.