Salinity Seminar

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Presented by the
Midwest Oil Mallee Association
21st August 2001. Morawa Shire Hall

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DEPARTMENT OF Conservation AND LAND MANAGEMENT

Natural Heritage Trust
Helping Communities Helping Australia

Project: ***Increasing Non-Government Investment in Environmental Management***

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Registration: 8.00-8.40am
Welcome: 8.50-9.00am **Mike Kerkmans** President Midwest Oil Mallee Association

1) The principles of groundwater

9.00-9.30am **Margaret Smith** WRC Hydrogeologist –" Why is groundwater important?"
9.30-10am **Robin Smith** WRC Supervising Hydrogeologist –"Accessing (investigating) groundwater."
10.-10.30am **Russell Speed** AGWA –"Issues with managing groundwater quality"

10.30-11.am *Morning tea and* ***"Physical model demonstration"***

2) What are the impacts of salinity?

11.-11.30 **Nathan McQuoid** Greening WA
11.30-12.pm **Greg Keighery** CALM Program leader of Wheatbelt Biological Survey "Mid West Wildflowers and Salt: Past, Present and Future: Results of the CALM Biodiversity Survey."
12.-12.30pm **Amelia McClarty** and **Jessica Johns** AGWA - Social Impacts of Salinity project
12.30-1pm **John Bartle** CALM Manager of the Farm Forestry Unit -- How big can tree crop industries be?
1-2pm *Lunch*

3) What are the options for landowners?

2-2.30 **Clive Malcolm** Consultant on Land Rehabilitation "Eyesores to sore eyes - a new vision for saltland"
2.30-3pm **Ric Collins** Director Oil Mallee Company "Developing a new Industry"
3-3.30pm **Mike Clarke** Revegetation Officer AGWA "Rapid Catchment Appraisal, a new direction for salinity extension".

3.30-4pm *Afternoon tea*

4-4.30pm **Tom Sweeny** Development Officer AGWA "Targeting the engine room - better management of recharge"
4.30-5pm **Ben Carr** "The integration of the social economic and environmental aspects of salinity."
5pm Closing address: **Mr Jamie Edwards** MLA

"Wattle" CD demonstration by Bruce Maslin
Yarra Yarra "Catchman" CD demonstration by Jack Satchel

Oil Mallee Association Salinity Seminar
Morawa August 21 2001

Impacts of Salinity
Saline Symptoms and Management Mindsets
Nathan McQuoid, Greening Australia (WA)

The Salt River south of Kellerberrin, a healthy natural saline system.

1. Salinity is a symptom rather than a cause of land degradation and its impacts are on people and mindsets as much as on the land.
The so-called salinity problem appears as a complex array of degradation symptoms requiring a large continuum of ideas and techniques in order to consider, comprehend and manage land effectively as a whole community.
We seem to be engaging in yet another fight with the land and it seems the current spread of secondary salinity is symptomatic of an earlier scrap. Fighting salinity is a futile pursuit; decent and appropriate land and enterprise management will address the cause and allow easing of the symptoms, of which salinity is one.
A huge impacting issue is that as a community we may have an enterprise or lifestyle attachment to the land, but we actually know very little about this particular land. As a community we need to connect to it in an everyday understanding of its history, nature and capabilities. Programs such as the Natural Heritage Trust and The State Remnant Vegetation Protection Scheme have attempted to assist this process, but it remains insufficient.

2. The greater south-west is the oldest, flattest, and most fragile and poorly understood terrestrial landscape on Earth. Also now known to be one of the top 25 hotspots for biodiversity on Earth. As such the design of the average land and enterprise management systems need to take into account the limitations and opportunities of such an old and fragile land.

3. Attempts to manage salinity issues are being tried in an environment of frustration, where appropriate scale, structured, or systematic incentives to change land management and enterprise systems towards a sustainable base do not exist. The broader Australian community mind and enterprise set precludes appropriate land management and a fine indicator of this is that the actual costs of production are still not being recognised or met.

4. The decline in rural communities in number and diversity contributes to a limiting of the ideas and techniques pool. Many of the answers to management issues are going to come from what is currently considered left field and these left fields are important and central in a healthily broad rural community of people.

5. Naturally saline systems are a high priority for recognition, conservation and protection to bring them into line with the other well-known biological and physical diversity of the south-west. They are no less important than old growth karri forest; in fact need to be considered as more important given the possible threats to them, their lack of profile and the potential as a source for some solutions. The picture above is of a healthy naturally saline system.

6. Salinity risk modelling and mapping commonly suggests that valley floors and low lands are all doomed. Field truthing by interpreting the condition and processes in the natural vegetation in many cases displays the opposite. The woodlands and associated vegetation types in some drainage confluence zones appear commonly pristine in condition and function. We need to be careful to not believe carte blanche the information derived from remote sensing technology in the absence of sound field knowledge.

7. Reading and interpreting nuances in natural landscapes and vegetation of principally the lowlands and saline areas are important skills to develop. To better understand and plan effective land management and to truth other interpretation technologies.

8. It is possible that the manifestation of salinity is in some cases the result of soil loss from erosion. Friable soil that remains on the valley floors and salt pan perimeters often seems remarkably well vegetated and healthy in the face of saline watertable rise.
It may also be the case that trees and shrubs that live near or in saline systems are not salt tolerant and are only guilty by association, their thin veneer sandy substrates and extensive surface roots may be harvesting fresher water overlying salty areas. More information is needed on these issues.

9. We as a community need to look for ways of recognising and celebrating the worth of these wonderful landscapes.
There are no national parks to assist this process except on the fringes of an area that is the core one of the top 25-biodiversity hotspots in the world and the only representative in Australia. Recognition of this area and its people as a national monument of some type could assist a change in community thinking about the worth of an area and its biodiversity and its people.

STATE SALINITY STRATEGY – CALM BIOLOGICAL SURVEY OF THE AGRICULTURAL ZONE

Greg Keighery
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INTRODUCTION

This paper is developed in four sections: a brief background on the biodiversity survey of the Agricultural Zone of Western Australia (hereafter referred to as the Wheatbelt); general results of the survey; impact of rising groundwaters on biodiversity generally; and some potential uses of the survey results..

At this stage it is important to note that this paper is based on the information collected over four years of survey in the Wheatbelt and other related published and unpublished reports. Over the next year (2002) the survey information will be collated and analysed and further reports prepared. As a consequence the information and interpretation presented in this paper is preliminary.

BACKGROUND TO BIODIVERSITY SURVEY

The Wheatbelt is central to temperate south-western Australia which is recognised internationally as a mega diverse area for flowering plants. Significant parts of six (These are the Geraldton Sandplains, Swan Coastal Plain, Avon-Wheatbelt, Jarrah Forest, Mallee and Esperance Sandplains) of the eight biogeographic zones recognised in south-western Australia (Thackway and Creswell 1995) are found in the Wheatbelt. Two of these areas the Avon-Wheatbelt and Geraldton Sandplains are those forming the Mid West region.

The Western Australian Museum had surveyed the vegetation and vertebrate animals of 23 nature reserves of the northern and central wheatbelt during the 1970's (reports are in Biological Survey of the Western Australian Wheatbelt, Records of the Western Australian Museum supplements 1 – 13). While these will form an essential baseline for those reserves, the Wheatbelt has had no previous comprehensive systematic survey of the distribution and diversity of the plants and animals of the region. Under the State Salinity Strategy, a four year field survey (1997 –2000) was undertaken by the CALM**Science** Biological Survey Group with Greg Keighery as Project Leader.

The survey was structured under a series of themes. A large number of knowledgeable and experienced specialists in each of these areas, from a variety of institutions, are participating. This participation has allowed the survey to address the diversity of a wide variety of organisms at the species level. The themes and key participants are listed below:

Terrestrial Communities
Flora: Greg Keighery, Neil Gibson and Andrew Webb.
Fauna: Vertebrates - Norm McKenzie, Allan Burbidge, Jim Rolfe and Bill Muir; Invertebrates (CALM) - Paul Van Heurck, Nadine Guthrie, Lisa King and Bradley Durrant; Invertebrates (WA Museum) - Julianne Waldock, Barabara York Main and Mark Harvey; and Frogs (University of Western Australia) - Dale Roberts.
Soils: Trevor Stoneman

Wetland Communities
Flora: Mike Lyons
Fauna: Stuart Halse, Adrian Pinder, Jane McRae and Melita Pennifold (supported by many interstate and overseas specialists).
Detailed Wetland Monitoring: Jim Lane, Stuart Halse, Neil Gibson, Dave Cale, consultants from Edith Cowan University and Geohydro.

The biodiversity survey provides an overview of the distribution and conservation needs of the terrestrial and wetland biota of the Wheatbelt. Almost 2,000 sites have been established and scored, including over 300 terrestrial (see Map) and over 200 wetland fauna/flora inventory sites that will be able to be used as monitoring sites into the future.

RESULTS OF THE BIODIVERSITY SURVEY

The general outcomes of the survey, up to this stage, are considered under each theme.

Terrestrial Communities

Flora

The wheatbelt has an estimated vascular plant flora of ca 4,000 species, of which over 60% are confined (endemic) to the area. The region is the centre of species diversity for many of the species-rich groups of shrubs (*Acacia*, *Dryandra*, *Eucalyptus*, *Grevillea* and *Verticordia*) that characterise the south-west of Western Australia. The northern region has a greater concentration of members of the Myrtaceae (Eucalypt family) and the Asteraceae (Daisy family) than other regions of the Wheatbelt.

This huge number of species, and the diverse range of plant communities in which they grow, were systematically sampled on public lands across the landscape in over 750 standard area plots of 10X10 metres ($100m^2$). A series of these are associated with the 303 biodiversity sites (see Fauna below) while others were located independently of these sites. Approximately 200 sites have also been established on private and local government lands by members of the Wildflower Society of WA (Inc.) as part of the Bushland Plant Survey programme (Keighery 1994) and results are being incorporated into the overall study.

The biodiversity of the wheatbelt is much higher than previously estimated. For example:

- Detailed surveys of the Lake Muir/Unicup reserves (Gibson and Keighery 2000) have documented a vascular flora of almost 1,000 species (considerably higher than Mount Lesueur, a larger area on the northern sandplain considered exceptionally diverse).

- The small areas of bushland in and around the Quairading townsite (part surveyed with community volunteers) has a vascular flora of over 500 species, including two completely new species and the largest populations of two critically endangered taxa (Keighery *et al.* 2001 and survey data). Preliminary results from Marchagee Nature Reserve (near Coorow) has given a list of over 370 species.

- Plant species richness of equal area plots ($100m^2$) ranges between 20 and over 90 species, equal to most areas of the northern and southern heathlands. The winter wet and summer dry (ephemeral) wetlands and heathlands plots are often equally species rich. Heaths are species rich in shrubs, whereas the other communities are species rich in perennial and annual herbs. While it is often assumed that heaths and granite rocks are 'the species rich communities', as found here and previously on the Swan Coastal Plain by Gibson *et al.* (1994) ephemeral wetlands have very high species richness. This is because they contain several groups of species that grow, flower, seed and die or become dormant during the year, ie: one in autumn as the rains are filling the wetland, a winter group when the wetlands are full, another as the wetlands begin to dry in spring and a final group when the wetland is dry in early summer

- Three presumed extinct plants, and at least seven other previously unknown species have been collected and documented.

Naturally saline areas have major biodiversity values with a variety of plant communities and species confined to these specialised habitats. These areas, occupying the base of the broad valleys and representing the paeleodrainage lines, are widespread and of considerable age in the Wheatbelt. One indication of this specialised habitat is that at least 64 threatened and priority taxa are restricted to these areas. Several new taxa have been discovered during the survey. The plants and the communities they occur in are at major risk from rising water tables, altering the hydrological regime of these areas. A new biodiversity recovery catchment in the Wubin/ Latham area has been established to protected one of the northern saline drainage lines.

One of the outcomes of the plant survey is to identify native species of potential for revegetation. A database of species in naturally saline areas of the wheatbelt (from plot and herbarium records) is being compiled.

The Wildflower Society of WA (Inc.) studies have already established that areas of privately owned bushland in good condition frequently contain communities and species of plants of regional significance, some of which are not represented in the conservation network (Gunness *et al.* 2000, Gunness and Campbell 1998 and Keighery *et al.* 2001)

Fauna

The sampling sites (3 X 50 metre long pit lines with 10 spider traps) are positioned on a minimally disturbed example of each of the 11 principal geomorphic units in the landscape, as well as on a salt-affected example of two of the units. Sites with natural vegetation have been chosen on typical examples of each unit, preferably within a conservation reserve. At the conclusion of the survey 303 terrestrial biodiversity (fauna and flora) sites have been selected and sampled for ground-dwelling arachnids (spiders and scorpions), some other invertebrates (carabid beetles, centipedes and millipedes) and small vertebrates (mammals, reptiles and frogs).

The study has dramatically increased available data on the distribution, status and habitats of small wheatbelt vertebrates and ground dwelling invertebrates. For example:

- The survey has collected over 50,000 ground dwelling invertebrates, making this the most comprehensive study of these organisms in Australia.

- In the first two years sampling 113 species of small ground-dwelling vertebrates (reptiles, mammals and frogs) were recorded, compared with previous Museum records of 130 species for the whole agricultural region. The sampling recorded an average of 9 species of vertebrate per quadrat. This is despite the known historical loss of 16 mammal species from the Wheatbelt.

- The first year's survey (less than a third of the study area) recorded 33 scorpions (previously 13 recorded for the entire Wheatbelt), 24 centipedes (previously 23 recorded) and 329 spiders (previously 128 recorded). Spiders have been sorted into 1699 morpho-species for the Wheatbelt, suggesting a final tally of over 700 spider species. The sampling recorded 20-50 (average of 34) arachnid species per site.

- Although all vertebrates encountered can be assigned to described species, 60-70% of the arachnids were undescribed. At least 40% (210 of 500+ species) of the region's arachnids, and 25% (31 of 125 species) of its small ground-dwelling vertebrates, have distributions centred on the agricultural region or are endemic to it. Strong biogeographic patterns are apparent across the region in these faunas, and different communities of species occur on the different soil-types within survey areas (sands, clays, loams, saline floors etc).

- Biodiversity of terrestrial invertebrates is much higher than previously supposed for the wheatbelt.

Soils

Bulked surface soil samples from each site are collected for chemical analysis and the soil profile is described and sampled for chemical analysis. At each of the 303 sites a description, sampling and chemical analysis of soil profiles was made. This will allow use of Agriculture WA's soil profile database (10,000 profiles across the Wheatbelt) to interpolate the biodiversity-pattern models CALM expects to derive from the biological survey during 2002 (see McKenzie *et al.* 2000 for an example). In conjunction with ANUCLIM data (McMahon *et al.* 1995), these will allow modelling of species' "environmental envelopes", including their salinity responses. This will enable predictions of what are the tolerances of a wide range of plants and animals to changes in soil chemistry due to salinity.

Wetland Communities

Two hundred and thirty two wetlands were chosen to cover the full range of wetland types within the study area (water quality, geographic spread, primary and secondary saline sites and wetland morphology).

Flora

Within the 232 wetlands sampled for aquatic invertebrates about 750 sites ($100m^2$ or less) were established to document the floristics of these wetlands. Preliminary results have uncovered numerous new records and major range extensions of rare and priority flora. Several new taxa of Samphires (*Halosarcia* species) and *Frankenia* species have been discovered.

The study is confirming the high floral values of naturally saline areas and regional floristic differences in the salt lake chains.

Fauna

Survey work to date in wheatbelt wetlands has collected about 1,000 invertebrate species, distributed in 139 families and 270 genera. About 50% appear to be described species and approximately 15% are only known from the Wheatbelt.

Provisional data suggests numerous species are restricted to naturally saline wetlands, mostly *Parartemia* (Brine Shrimps), *Coxiella* (snails), Ostracods and Copepods (Crustaceans). These form a significant endemic (distribution confined to this area) component in south-western Australia.

Aquatic invertebrates from fresh water habitats in the Wheatbelt have significantly higher salinity thresholds than members of the same groups in Eastern Australia (Halse *et al.*, 2000). This suggests that these organisms have local adaptations to wetting and drying cycles (the pools become more saline as they dry) of the more seasonal wetlands of the Wheatbelt. As a consequence these species can tolerate higher salinity thresholds before they are lost from our wetlands.

South-western Australia has a highly rich and endemic aquatic fauna of microinvertebrates, especially Crustacea. This diversity may be of equal significance to the flowering plants on a world scale.

Of particular note, for wetland conservation, is that most freshwater wetlands in the Wheatbelt are on private lands. Some very significant wetlands are found around Dowerin, in Coalseam National Park and in sandsprings in the Mid West, but there are probably many others yet to be documented.

Detailed Wetland Monitoring

This project was designed to analyse and report trends in salinity and depth in wetlands that have been monitored since 1978. Recordings of salinity, depth and nutrient status are made in a broad range of wetlands. In addition changes in floristic composition, tree health, waterbirds and aquatic invertebrates in 25 wetlands are monitored.

Vegetation transects (2-5 per wetland, 80 in total) have been established at all 25 wetlands. Reference photos have been taken on each transect. Aerial photos showing position of transects and biophysical boundaries have been captured on Geographical Information Systems and are also available on CD Rom with the reports. Over 6,000 trees have been tagged on the transects and vegetation profiles constructed for each transect. Three major reports on these transects have been prepared and are lodged in the CALM Library at Woodvale in Western Australia. Monitoring bores have been established adjacent to these transects at 20 wetlands. Waterbirds and invertebrates (macro and microinvertebrates) have been sampled at 23 wetlands to prepare baseline data and five have been resampled.

Monitoring of wetlands has shown that wetlands often have different values for waterbirds, invertebrates and vegetation. Biodiversity is comprised of many groups that respond differently to the environment. A single biotic indicator cannot be used to summarise the overall biodiversity value of a wetland.

Summary

The biological survey of the Wheatbelt has revealed that :

- The agricultural zone of Western Australia is more biodiverse in all groups surveyed than previously recognised.

- Despite widespread and intensive clearing there have been only minor losses at the species level (except for mammals). However, there has been extensive depletion of communities and genetic variation. This loss will increase to the species level over the next 100 years if current trends continue. Even with intensive management and intervention there will further decline in most areas. We must carefully plan to minimize this impact and to maximise biodiversity values of these affected landscapes.

SALINITY IMPACTS ON BIODIVERSITY

Terrestrial Communities

Flora

Of the 4,000 species present in the Wheatbelt over 1,500 occur low in the landscape, in riverine valleys, freshwater or primarily saline lands. Of these taxa an estimated 450 are endemic to the Wheatbelt. These taxa are in danger of extinction over the next 100 years as a consequence of rising saline groundwaters. Several hundred other species found only in lowland woodland, Mallee and *Melaleuca* shrubland sites, will be under threat in the longer term. Another 400-500 lowland taxa are centred on the Wheatbelt although not confined to it. These taxa are also under immediate threat of major genetic erosion from salinisation and hydrological changes.

Areas affected by secondary salinisation show significant declines in vascular plant biodiversity and loss of structural diversity. Rich complex communities are replaced by a few succulent shrubs and weeds.

Outside of the Wheatbelt hydrological changes threaten the diverse floras of naturally saline landscapes and areas of species rich heathland and ephemeral wetlands of the northern sandplains and Swan Coastal Plain. The karst communities, both subterranean and surface heaths, of the northern Swan Coastal Plain (? And perhaps part of the Mid West) are threatened by flooding and perhaps increased impact of diseases from *Phytophthora* species.

Fauna

Approximately 25% (31 of 125 species) of its small ground-dwelling vertebrates (mammals, reptiles and frogs), have distributions centred on the Wheatbelt or are endemic to it. At least 40% (210 of 500+ species) of the region's terrestrial invertebrates, have distributions centred on the Wheatbelt or are endemic to it.

A significant decline in the biodiversity of terrestrial invertebrates is apparent at secondarily saline quadrats (even partially affected), which have an average of 30% fewer species than their non-salinised counterparts. This loss is actually higher as localised specialists are replaced by "weedy" generalist species.

Wetland Communities

Flora

The impacts are greatest low in the landscape in and around all wetland types, including Naturally Saline Habitats. Naturally saline areas contain a diversity of Mallet (*Eucalyptus spathulata*), Mallee (including the oil Mallees, *E, suggrandis* and *E. vergrandis*), Woodland (*Casuarina obesa*, *Eucalyptus salicola*, *E. sargentii* and *E. kondinensis*), shrubland, heath and herb communities that are at major risk from rising water tables. These areas probably contain the genetic biodiversity needed to find economic plants to revegetate the wheatbelt for salinity control (for example the oil mallees, Broomebush (*Melaleuca uncinata*), saline adapted shrubs and bunch grasses).

Fauna

Birds

Of the 61 more common waterbird species in the south-west, only 16 prefer strongly saline (more than 20,000 mg/L) or hypersaline (more than 50,000 mg/L) conditions. Data from a 1981-85 survey of the south-west showed that an average of five waterbird species used hypersaline wetlands, compared with 20 in saline wetlands and 40 in fresh wetlands containing live trees and shrubs. Death of shrubs and trees in many Wheatbelt wetlands, due to salinity, has caused a 50% decrease in the number of waterbird species using them. If the trend of increasing salinity continues, only 16 species, plus three or four species that use freshwater dams, will persist in the wheatbelt out of an original waterbird fauna of more than 60 species.

Invertebrates

In a preliminary analysis of the first 700 species recorded, 253 species (45%) were restricted to fresh water with salinity less than 3,000 mg/L. However, 35 of the species occur on granite rock outcrops where salinity is unlikely to occur, leaving 218 species (39% of the fauna) that are vulnerable to increasing salinity. If all wetlands in the wheatbelt became saline (more than 10,000 mg/L), most of these 218 species will disappear from the wheatbelt, despite the fauna being more saline tolerant than in eastern Australia.

Species richness declines with salinity and the average number of invertebrate species present in fresh wetlands is about 50, in wetlands with salinity 20,000 mg/L about 25, in wetlands with salinity 50,000 mg/L about 12 and in wetlands with salinity greater than 100,000 mg/L about four. As a rule of thumb, doubling salinity halves the number of aquatic invertebrate species (see figure).

Caveats that must be attached to the above statements at this stage of the work are that probably not all wetlands will become saline, some species will persist in dams, and many species have ranges that extend outside the Wheatbelt.

Summary

The areas most immediately threatened by salinisation are the valley floors of the Wheatbelt. These areas affected by secondary salination show major declines in vascular plant and animal biodiversity. Rich complex communities are replaced by a few succulents and weeds. Similarly major declines in diversity occur in animal communities where specialists are lost and/or replaced by generalist species.

Although dryland salinity is an Australian wide problem, information about the impact of hydrological change on biodiversity in Western Australia is more substantial than that of eastern Australia. For example, the Murray Darling Commission report on Salinity (Murray-Darling Basin Ministerial Council, 1999) noted
"No assessment has been made of the impact of dryland salinity on the biodiversity of the Murray-Darling Basin."

The challenge is what are we going to do with this new information? How to integrate these data into managing this changing landscape.

Summary

Salinity will impact on biodiversity of the Wheatbelt Valleys at all levels of biodiversity - community, species and population in a wide variety of the organisms studied.

WHERE TO?

This section will briefly focus on how the biodiversity survey will aid aspects of tackling salinisation to protect biodiversity. The survey of the wheatbelt will provide an overview of the patterning of many organisms across the region. It will enable the description and delineation of the areas with the most threatened communities and high levels of biodiversity. This will enable the selection of a further series of Biodiversity Recovery Catchments, in addition to the existing 6 recovery catchments, as outlined in the State Salinity Strategy.

The delineation of threatened species and communities will also be undertaken. A report on the conservation status of the vascular plants of the Wheatbelt is currently being prepared. Actions co-ordinated by CALM's Threatened Species and Communities Unit will target the most critically threatened communities and species for recovery actions.

The nature and degree of the impact on biodiversity at a site depends on a complex series of related hydrological factors. Crucially the time for impacts to develop-fast in higher rainfall areas is a major determinant of options to protect remnant vegetation. How pervasive are the impacts in the valleys, depending on the effect of microtopographic relief? This still leads to increased fragmentation of remnants caused by salinity and these effects are still poorly understood. These areas of operational research need to be addressed in the future.

Clearly salinity is only one of the problems faced by biodiversity in the wheatbelt. Broadscale clearing has lead to fragmentation of remnants with all the attendant problems of edge effects, loss of genetic diversity, weeds, feral animals, losses of connectivity, disruption of ecological processes and unnatural disturbance regimes. Obviously to keep our marvellous and unique Wheatbelt plants and animals everyone needs to respect, value, appreciate and understand their local biodiversity, hopefully the major outcome of the survey will be a major contribution to this process.

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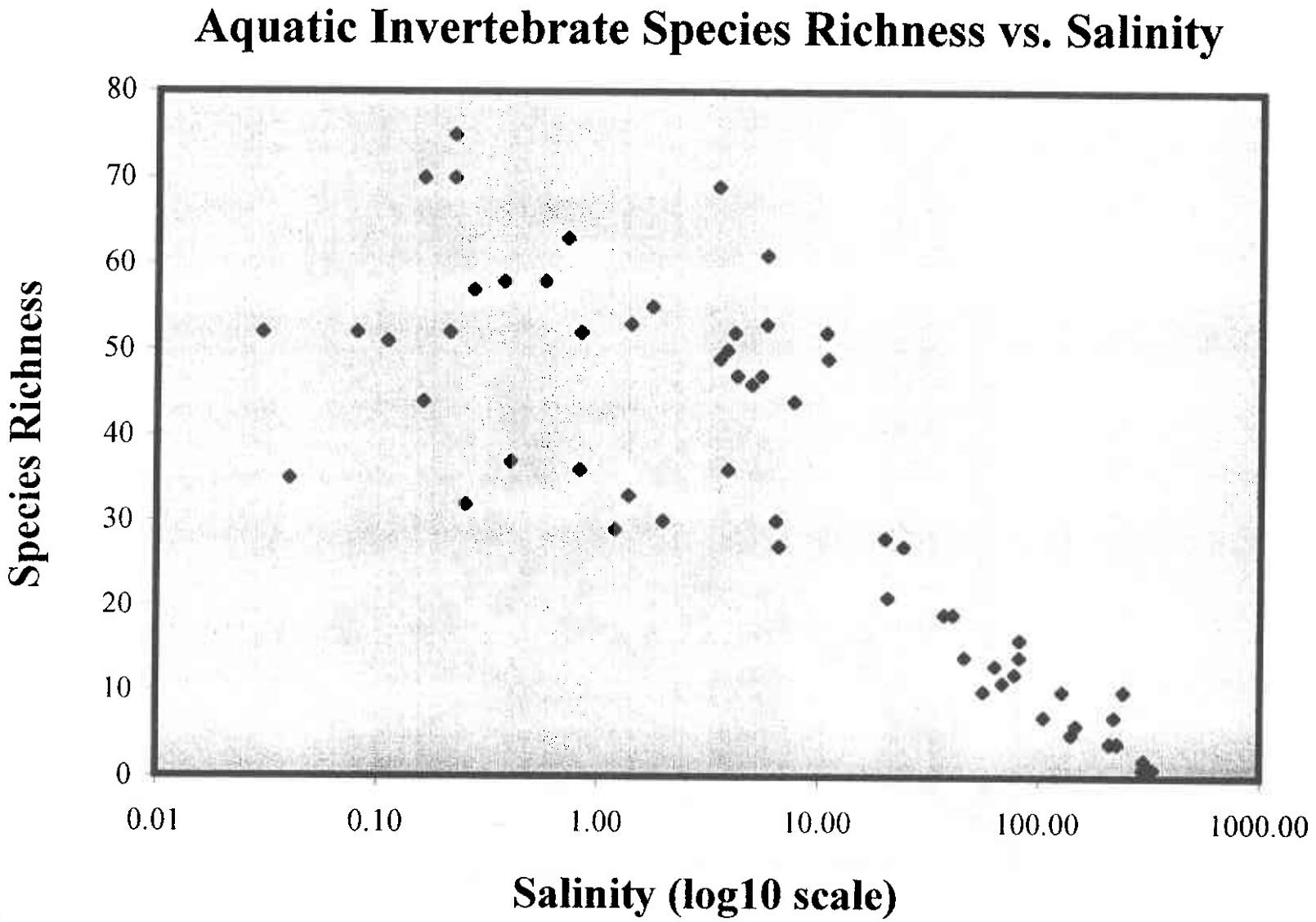
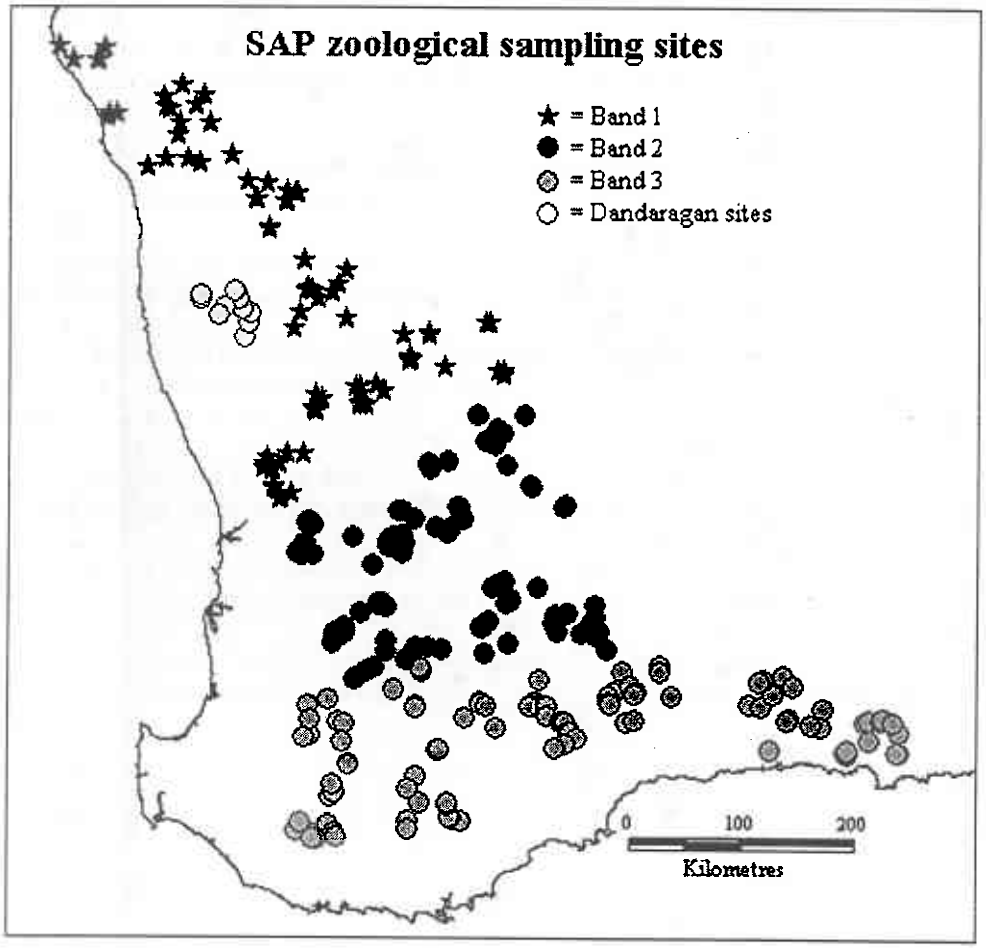

Aquatic Invertebrate Species Richness vs. Salinity
Species Richness
80
70
60
50
40
30
20
10
0
0.01
0.10
1.00
10.00
100.00
1000.00
Salinity (log10 scale)


SAP zoological sampling sites
= Band 1
= Band 2
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0
100
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Kilometres

New large-scale woody plant crops for WA

John Bartle Farm Forestry Unit Department of Conservation and Land Management

Introduction

Revegetating the Wheatbelt of Western Australia with perennial plants at the scale needed to reduce the adverse effects of salinity is an enormous task. Estimates range from 3 to 10 million hectares of new perennial vegetation.

Farmers cannot afford to replace this much of their conventional agriculture with perennial plants, unless those plants are at least as profitable as their current agriculture. Therefore, it is imperative to develop new commercial plant crops and new industries to process them.

The challenge of finding new commercial crops has been taken up by farm forestry, but the terms 'tree', and 'forestry' need panel-beating into new shapes to work in drier areas:

- 'tree' may come to include a wide variety of perennial plants – including quite small shrubs.
- 'forestry' may include rotations as short as two years, and use harvesting machinery more like a mower or a forage harvester than conventional forestry gear. Handling of these new 'forestry' products is more likely to use bulk handling technology than conventional stick by stick handling.

Both agriculture and forestry will need to be modified to successfully develop new perennial crops for farmland in drier areas.

What needs doing

Some of the tasks are:

<u>Find suitable perennial crops</u>

The current list of tree crops developed for southern WA is very short, and few are suited to medium and low rainfall areas.

Oil mallees are the only woody perennial crop currently being developed for the drier half of the Wheatbelt, and even this industry is still in its infancy, and is unproven.

New perennial crops are urgently needed to fill this gap.

Getting the R&D right to get new crops established

Much work will be needed on:

- Genetic selection and improvement
- Growing techniques
- Harvesting and transport techniques

Developing new farming systems

Perennial crops could be grown in many different ways, including:

- long term timber trees in wide-spaced plantations or rows.
- alley farming layouts with grazing or cropping between belts of perennial trees or shrubs. This system suits perennial plants which resprout after harvesting at ground level.
- phase farming of perennial plants with cropping. This system suits plants which do not resprout after harvesting, so that they can be replaced easily by annual crops.

Starting new processing industries

This is not an easy task. Some native plants may produce raw materials which can be used immediately in existing industries without much new technical development. But others will need extensive testing and process development before they can be used. For example, some acacias have been found to make high quality MDF (at the laboratory scale). However, to bring them into full scale production, much new work would be needed to develop suitable adhesives, to optimise the manufacturing process, and to bring them successfully to market.

Selling the products

Major challenges are to:

- gain acceptance for new raw materials in existing markets
- develop new products and markets
- beat the competition

For example, cineole (a valuable component of eucalyptus oil) will be produced in the proposed integrated treatment plant for oil mallees at Narrogin. But new markets need to be developed for cineole to take it beyond the low volume, high value market which currently exists, into new industries which can use large volumes at a lower (but still profitable) price.

Now lets look at these new crops from a marketing perspective

Opportunities

- Large volume of material will enable new industries to be major players in markets in our region. If 6 million ha of new perennial crops are developed, at least 60 million tonnes of green material will be produced each year.
- Low cost of production due to the economies of large scale production, and the use of efficient bulk handling methods
- Demand for wood fibre is likely to be strong. Three reasons are:
  - ⇒ reduction in traditional supplies of timber from native forests (through exhaustion, degradation, conversion to agriculture, or restrictions on their management and harvesting).
  - ⇒ an increase in the value of wood products relative to other products if greenhouse gas policies are adopted (that is, policies that place a value on the carbon contained in wood products, or place a value on the fossil fuel saved by substituting them with fuels derived from wood).
  - ⇒ increasing global wealth. Demand for wood products is related to economic growth, which is growing at about twice the rate of the world's population, (so demand for wood products should grow faster than demand for food).

Risks

- New industries are not yet developed.
  Their feasibility is not yet demonstrated. However, the oil mallee industry, which is the first of these new industries, is a fair way down the development path and looks very promising.
- Competition from other regions.
  Other countries and regions are also looking at ways of making profits from tree crops, so there will be lots of competition.
- Competition from other raw materials.
  The use of non-wood materials and recycled wood products is increasing, especially for reconstituted products such as paper, packaging materials and panel boards.
- Competition from other tree crops which are subsidised by taxation deductions or government-sponsored credits (carbon credits, salinity credits, etc). For example - if markets for paper pulp are unable to use all the plantation timber being grown for that purpose, then any surplus timber will be competing in other fibre markets with other farm-grown tree crops.

Desirable characteristics of potential new perennial crops

Let's look briefly at some of the characteristics which new perennial plant crops and processing industries will need, to be successful.

Grow quickly

Plants which grow quickly will produce more saleable material in a shorter time.

Easy to grow

This covers a range of issues, such as availability of seed, ease of propagation, tolerance to a range of environmental conditions (especially soil and climate) and tolerance to pests and diseases.

Short rotation

Short rotation crops giving early and regular returns will enable farmers to finance their own tree crops, or make them more attractive to external investors.

Native species

Native species should have some natural advantages as new perennial crops. They are well adapted to local conditions, they are less likely to become weeds, and we can gain a competitive advantage by exploiting our own genetic resources.

Compatible with agriculture

Annual cropping and grazing industries will probably be with us for a long time yet; so new crops need to be compatible with them. Issues to be considered are competition for light, water and nutrients, and palatability or toxicity of the new crops.

Suited to extensive production systems

Australian farmers are world leaders in producing grain crops in large volumes at very low cost of production. Suitable tree crops would be suited to this style of production, with high volume harvests, mechanised materials handling, and bulk transport.

Large market for their products

Revegetating one third of the cleared agricultural land in southern WA could produce 60-90 million tonnes of green plant material each year. Processing this material and selling it into domestic and export markets will be a major task, and will require our new industries to be important players in South East Asian markets for all major product types.

Unless plant biomass captures a large slice of the electricity generation market in WA, and becomes a major source of liquid fuels used in WA, it will be difficult to sell all the biomass produced.

Products can be processed locally

Most bulk wood products will have values per tonne of only 10-20% of that of grain crops. Therefore it is not possible to cart them from the wheatbelt to the coast without eroding most of their value in transport costs.

To maximise returns to farmers from new crops, and minimise the cost of raw materials to processors, it is desirable to process them close to where they are grown, and then export high value products.

No residue

Crops for which all parts can be used will be favoured because they do not generate waste material, which could be a pollution risk, or an added cost to dispose of.

Ideal scenario

Our ideal scenario would be to develop a number of new industries that can accept a wide range of raw materials, and can produce a number of different products.

Then, several different species could be grown to feed a single processing plant, maximising the environmental benefits of diverse plantings. Similarly, if many different products are produced from a single processing plant, then there should be little or no waste.

The Search project

This project is managed by CALM, and AGWEST, with funding from the federal government's Bushcare and Farm Forestry Programs. The aim of the project is to identify perennial species and processing options with good chances of commercial success, then start the pre-feasibility work needed to prove up new industries. Search can be seen as the first step of developing large scale new industries that drive large scale planting of woody perennials in the wheatbelt.

The key steps in the search project are:

1. Identify products with commercial potential

The amount of feedstock that can be produced by wide scale planting of perennials dictates that the product have large accessible markets. Products must have sufficient value to allow transport from the wheatbelt after being produced from cheap feedstock.

Products that fit this description include:

- Wood composites
- Paper products
- Solid and liquid fuel
- Chemicals by transformation
- Chemicals by extraction
- Food and fodder

2. List their desirable feedstock characteristics

For each product group feedstock characteristics need to be defined and prioritised. For example wood dimensions, wood colour, wood density and fibre length.

3. Develop a short list of species suitable for incorporation into farming systems

The process of short listing the species consists of three stages:

- Select species on general characteristics using the SIFT database for example in the genus Acacia the following criteria can be used to stepwise to "sift" out likely taxa:

Criterion	Remaining taxa
All native WA taxa	13,190
Acacias	799
Non-priority taxa	592
Occur in at least one of the four IBRA regions included in the wheatbelt	377
At least 4m tall	88
Occur in three of the four IBRA regions included in the wheatbelt	23
Occur in all four of the IBRA regions included in the wheatbelt	7

- Seek expert advice to trim the species lists
- Use extra data where it is available or can be collected easily

4. Test feedstock characteristics of promising species

Use the characteristics developed for each industry in a stepwise manner to eliminate species from the list developed in step 3. As a general rule characteristics that are cheap to test will be tested first eliminating most species before running the more expensive tests.

5. Design potential new industries around the most promising species and products

This stage is crucial. Systematically identifying the best commercial prospects is probably not enough for commercial operations to emerge. Unless the prospect is quite outstanding there will be too many uncertainties and too much risk for entrepreneurs to invest. Also we need to be working towards very large scale industries. Therefore, public investment is required to explore and develop the prospect within a whole industry context. This involves building the technical, environmental and commercial practices and structures for the industry.

The technical steps span the whole gamut from genetic improvement, establishment and management of the growing crop, harvest, processing and product/market development. The environmental aspects include ways to make the industry compatible with our aspirations for the environment – salinity control, biodiversity protection, flood control and amenity. The commercial development includes building up a committed base of growers and resource and making a commercial prospect that will attract investors.

If this work is done well enough the entrepreneurs will start showing interest. They will conduct feasibility investigation, raise investment capital, undertake operational scale testing of processing options and the industry is away!

Conclusion

Seminars like this provide a good opportunity to discuss a wide range of crops and products, with different market sizes, different marketing methods, and different industry development pathways. The good news is that there is room for all - the revegetation task needed to revitalise Australian agriculture is so large that there is more than enough room for a large number of new industries.

EYESORES TO SORE EYES - A NEW VISION FOR SALTLAND

by Clive Malcolm

I'm fed up with seeing pictures of dead trees, samphire and bare white salt encrusted soils on TV and in the papers, as though that is the only possible vision for saline land. By 1953, 48 years ago, the late Bevan Parker had shown that he could convert his saltland into valuable bluebush and saltbush pastures. He was getting complaints from the shearers because his sheep were so big. He had some of the highest cuts of wool per head and the best wool prices in his district and he attributed it to his bluebush pastures which he used in a myriad of ways for various mobs of sheep in combination with dry pasture, stubbles and hay. Bevan sold the farm to a neighbour, Mr Lucchesi who continued to use the bluebush pastures. In February 2001, I visited the old property to see what had happened to the farm. I was delighted to see an old bluebush stand which I had photographed in 1960 still being used for regular grazing, still having a healthy cover of burr medic under the bushes and proving beyond doubt that it is a sustainable land use. We need a new vision for saltland.

A NEW VISION FOR SALTLAND

Western Australia expects to have come on stream a major new resource. 4-6 million hectares of saline land will become available for productive use. Farmer experience has shown that with current technology this land is capable of supporting, conservatively, 3 to 6 sheep per hectare or around 25 million sheep for the agricultural areas in a manner that can be marketed as clean and green. The shrub pastures supporting the sheep will at the same time sequester about 10t/ha of carbon dioxide equivalent, worth of the order of $20 per tonne and totalling, for 5 million hectares, one billion dollars. In addition, watertables will be lowered, flooding mitigated, erosion controlled and the survival of threatened biodiversity ensured. In addition, Western Australia will be recognised as the leader in revegetation of saline land because it has achieved the largest revegetation project of degraded land ever undertaken and those responsible will be sought to extend the technology interstate and overseas. This is the vision, now is the time to make it a reality!

SPECIAL FEATURES OF THE VISION

The vision has five key attractions:

* profitability;
* sustainability;
* environmental benefits;
* community benefits; and,
* practicability.

Let us explore these in turn.

1 Profitability

Experiments and farmer experience show that saltland shrub pastures grazed in conjunction with dry pastures, stubbles or hay can increase the carrying capacity of a property by several thousand sheep. Because the shrubs are perennials they level out the rainfall variability, giving reliable supplies of feed when it is most needed and most valuable, autumn. Research in the Department of Agriculture has shown that there are a number of ways to increase the productivity of saltland pastures and most of these have not yet been put to general use so there is potential to increase on-farm productivity of saltland pastures.

2 Sustainability

Stands of river saltbush established in 1976 on saltland with a shallow saline watertable at several sites in the wheatbelt and grazed every year since are still healthy and producing. The 41-year bluebush stand has already been mentioned.

3 Environmental benefits

Apart from being no longer an eyesore, revegetated saltland has erosion controlled, flooding reduced, nutrient run-off reduced, watertables lowered and habitat improved. Also, farmers who revegetate their saltland are tying up about 10 t/ha of carbon dioxide equivalent in woody branches and roots and soil organic matter which may attract about $20 per tonne providing they maintain the stand.

4 Community benefits.

Bringing saltland back into production creates jobs for seed harvesting and sales, contract seeding, fencing and the sale of new products such as saltbush mutton

5 Practicability

The beauty of it is that there are farmers out there who have already got the system working and have been proving it can be done . For example, Kim and Neil Diamond at Maya, Tony York at Tammin, Greg Tippett at Shackleton, and Michael Lloyd at Pingaring. The species are available, the niche seeding system has been in use by contractors for about twenty years and numerous farmers are familiar with how to use saltland pastures in a farm system.

WHY IT WORKS

The key to why the system works is that the water that is the prime cause of the salt problem in the broad wheatbelt valleys is the water that sinks in on the valley floors. The bluebushes and saltbushes can use the water and the watertable actually falls without any treatment of the catchment. The amount of water and salt arriving beneath the valley floors from the uplands in the broad valleys is sufficiently small that the shrubs can use the water and store the very small amount of salt, along with the vast quantities that are already present below the surface.

IT IS TIME NOW TO CHANGE SALTLAND FROM AN EYESORE TO A SIGHT FOR SORE EYES
- LET'S GET IT DONE!

OIL MALLEE
COMPANY

DEVELOPING A NEW INDUSTRY

Short rotation integrated perennial tree crops including "Oil Mallees"

1 Why bother - Triple Bottom Line Benefits
Generate Revenue
Protect Environment
Improve Rural Towns (Social)

2 What has been done

2.1 Significant new market opportunities identified
- Biomass
- Eucalyptus oil
- Renewable energy
- Wood composite products
- Liquid fuel
- Carbon credits?

2.2 Production systems established
- Seed orchards established
- 20 nurseries have some knowledge on how to grow mallees
- 10 region advisers
- 7-10 species available of superior genetics
- 20 million mallees planted (enough for a small IMP plant)
  - equivalent to 8,000 ha
  - dispersed over 60,000 ha

2.3 Harvest, Transport and Distillation
- Prototype harvester
- Harvester development program designed and funds arranged (millions of dollars)
- Transport system designed, costed and funds arranged
- Prototype new distillation
- Distillation development program designed and funds arranged (perhaps a million dollars)

2.4 Investment exceeds $20m

3 What is being done

3.1 Demonstration Scale Mallee Processing plant to be built in Narrogin in 2002.

Needs 20,000 tpa biomass (1,000 ha mallees)
- γ 1 MW electricity
  Activated carbon
  Eucalyptus oil

3.2 Corporate tree planting in Esperance with a view to a biomass fired power station meeting some of the Esperance electricity demand.

3.3 Discussions with regional interests with an assessed combined electricity demand exceeding 250 MW electricity.
ie equivalent to 250,000 ha oil mallees dispersed over 1.5 million ha

3.4 Research (CALM, CALM/OMC, OMC)

Mallee Growth under Commercial Conditions
Root Development and Water Use
Carbon Sequestration
Germination
Genetics of Mallees
Eucalyptus Oil Uses and Markets
Activated Carbon and MDF from Mallees
Industry Development – attitudes and drivers
Other Species
Other States

3.5 Capital raising through an Offer Information Statement
(farmers could own this new industry)

4 What is to be done

More research
More market development
Much more mallee planting (100 ha/farm a target)
Investment/financing options
Harvest, transport, distillation commercialisation
Processing plant demonstration and regional development.

5 A Regional Focus

A Shire -	150,000 ha
10% mallee planting	15,000 ha
Biomass production	300,000 tpa
Enough for	15 MW electricity
	10,000 t activated carbon
	3,500 t eucalyptus oil
	$4-5m revenue from biomass,
	$4-5m from harvest and transport
	$40-50 million pa revenue from processing
	30 + people employed

Also 150,000 hectares with some protection against rising water tables and salinity.

Regional Centres have a chance to make their own luck!

Rapid Catchment Appraisal
A new direction on salinity extension for the Department of Agriculture.

Since 1989 the Department of Agriculture has been providing farmers throughout the state with a range of extension methodologies relating to managing salinity. Farm and catchment plans were developed with many catchment groups throughout the 1990's and this developed into focus catchment work with the release of the Salinity Action Plan in November 1996. Under the focus catchment methodology, however, it was going to take more than 20 years to cover Western Australia's agricultural areas

The review of this Plan and the subsequent release of the States first Salinity Strategy in March 2000 has seen a new direction for salinity extension, namely **Rapid Catchment Appraisal**. Under this project and **within five years, all farmers in the State will be provided with access to the following information.**

- An assessment of current salinity and potential for further shallow watertables
- Options for management
- Impact of those options (economic and biophysical)
- Access to further information

The foundation to this new direction is the release of information provided under the Land Monitor Project. This was a collaborative project between seven government agencies and the Natural Heritage Trust. The products include baseline salinity and vegetation data and their trends as well as digital elevation models which can provide land managers with a tool for predicting areas in the landscape that have potential for shallow watertables.

To meet the five year obligation large catchment areas will be completed each year, commencing in **2001 with the Yarra Yarra**. 2002 will see the Moore River completed and the remaining three years will be focused on the drainage lines of the West Midlands, the Irwin/Greenough and the rivers of the Northampton Block.

The response from farmers in the Yarra Yarra to the draft maps has been very positive with the maps showing areas in paddocks that were just beginning to show early signs of salt. The good news is that some of the farmers are already trialling crops of forage sorghum and lucerne on these areas. These plants can use more water than tradition annual crops and therefore offer an option for reducing recharge.

Several farmers at Carnamah and Three Springs successfully established lucerne during 1999. After providing valuable feed during 2000, the lucerne has also survived the following dry summer so is showing long term promise for the area.

Farming Systems Development Officer with AGWEST, David Rogers, ground truthing maps with farmers at Three Springs

Maurice Bryant, a farmer near Latham, with his 9 year old stand of sorghum on a seepage site.

Other farmers have similar stories relating to forage sorghum. A farmer east of Latham has been grazing the same stand of sorghum for nine years, then this year, following high summer rainfall the stand was thinned out by extensive waterlogging.

One main recurring message relating to developing saltland is, don't delay in changing management. The longer farmers leave the salt to develop before changing management, the lower the amount of options that are available. Early signs include poor crop performance and the appearance of barley grass patches. Farmers that act early, are able to capitalise on options such as lucerne, forage sorghum, balansa clover, tall wheat grass, puccinellia or perhaps even cropping on raised beds.

An established lucerne pasture on a shallow water table east of Three Springs

If early signs are ignored and the salt allowed to develop further by grazing or conventional cropping then the options become limited to saltbush grazing or planting out to salt tolerant native plants such as Melaleucas and Sheoaks. If allowed to develop through to bare white salt then water erosion can spread the degraded area well into the paddock, much further than what it would have, had it just been salt affected.

The results of the RCA for the Yarra Yarra including the full set of maps will be available in spring. These can be viewed at the September round of public meetings and there after at Shire Council Offices and a proposed web site.

Mike Clarke
Rapid Catchment Appraisal Team Leader
Agriculture Western Australia
Geraldton

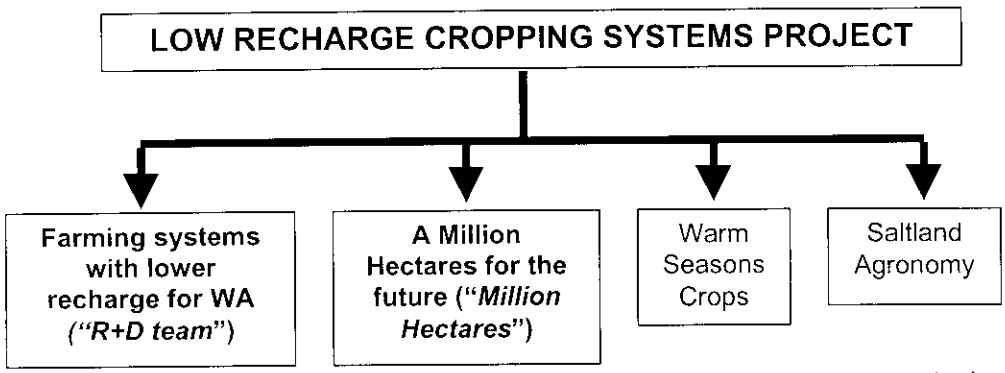
Low Recharge Cropping Systems Project

Update # 1: Where does the Million Hectares subproject fits in?

Background:

The Low Recharge Cropping Systems Project (LRCS) commenced in February 2000 with AGWEST and GRDC funding

The LRCS project encompasses 4 subprojects as shown below:



The R+D team comprises of Richard Olive, Diana Fedorenko and Clayton Butterly. This subproject will focus on research into different farming systems (perennial and animal based) through the establishment of trials on primary farmers' properties

The Million Hectares subproject, comprising of Tom Sweeny and Richard 'DON' O'Donnell, has 4 main objectives:

1. To identify farmer groups (e.g. Topcrop, Woolpro, catchment groups, etc) that have an interest in learning about water movement, especially recharge, on their land (Tom)
2. To develop a process to estimate recharge on your property, based on farm rainfall and rotation/ soil type interactions (DON)
3. To develop a modular learning process about recharge and its implications for farm management (Tom and DON)
4. To develop an Environmental Improvement System (a basic quality assurance process) that includes management options and support to implement appropriate changes to the farming system (Tom and DON)

For further information contact:

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The Midwest Oil Mallee Association would like to thank all delegates for attending and hope you have gained further insight into the opportunities and management of salinity for your region.

We would also like to thank:

The presenters for their time & expertise

Our sponsors:

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Helping Communities Helping Australia

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Morawa Kids Care Centre for the catering and childcare
Midwest Development Commission
Ag WA for administration support
Everyone who has volunteered their time to set up the day

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