CALM Biodiversity Survey of the Agricultural Zone
June 2001, Status Report

SALINITY ACTION PLAN – BIOLOGICAL SURVEY OF THE AGRICULTURAL ZONE

This is a status report on the biological survey of the agricultural zone being conducted as part of the Salinity Action Plan, as at June 2001. The information presented is subject to review in the light of further information as the analysis of the survey data is still to be undertaken

Background Statement

The agricultural zone of Western Australia covers all or significant parts of 6 (Geraldton Sandplains, Swan Coastal Plain, Avon-Wheatbelt, Jarrah Forest, Mallee and Esperance Sandplains) of the eight biogeographic zones recognised in temperate south-western Australia.

The area has had no previous systematic survey of the distribution and diversity of the biota of the region.

Organisation

A four year field survey was undertaken by the CALMScience Biological Survey Group with Greg Keighery as Project Leader.

For the survey, project management has been divided into four areas of responsibility:

1) Flora (terrestrial and wetlands): Greg Keighery, Neil Gibson and Andrew Webb.
Terry Rose (flora checklists)
Mike Lyons (Research Scientist responsible for wetlands).
Margaret Langley and Angas Hopkins contributed data from the Dandaragan Plateau.

2) Fauna (Terrestrial):
Norm McKenzie, Allan Burbidge, Jim Rolfe and Bill Muir (Vertebrates).
Paul Van Heurck, Nadine Guthrie, Lisa King and Bradley Durrant (Invertebrates).
Julianne Waldock and Mark Harvey (WA Museum, Invertebrates).
Dale Roberts (University of Western Australia, Frogs).
Trevor Stoneman (soil profiles).

3) Wetland Fauna: Stuart Halse, Jane McRae, Melita Pennifold and Adrian Pinder.
Russ Shiel (CRC for Freshwater Ecology, Albury, NSW).

Detailed monitoring of 25 selected wetlands: Jim Lane, Stuart Halse, Neil Gibson, David Cale, consultants from Edith Cowan University and Geo&Hydro. This is funded separately from the biological survey.

Approach

The area was divided into four zones for the purposes of the survey - a northern, central and southern bandand a fourth consisting of the Dandaragan Plateau and Esperance area. All field sampling was completed in 2000.

GENERAL OUTCOMES

The biological survey will identify 6-10 potential natural diversity recovery catchments by 2001. The first (Lake Bryde) has been identified and action commenced in April 1999. The second in the Watheroo area was identified and action commenced in 2000. A small scale remedial recovery

catchment around Drummond Nature Reserve has been identified and nominated as the third recovery catchement nominated by the results of the survey..

The broad scale biogeographic survey currently underway will provide an overview of the distribution and conservation needs of the terrestrial biota of the wheatbelt. There will be almost 2,000 sites established, including over 300 complete fauna/flora inventory sites that will be able to be used as monitoring sites.

Longer term studies of individual recovery catchments and more detailed surveys of communities and regions identified will be needed after 2001. Some reports on individual recovery catchments at Lake Muir and Drummond have already been published or are in press.

Monitoring of actions to recover catchments, and control and reverse salinity would be needed to fine tune management actions, especially in regard to potential weeds, drainage, gypsum mining and other disturbances.

CURRENT STATUS

1. Terrestrial Communities – Flora

General

Vegetation: The entire region has been mapped for structural vegetation at a scale of 1: 250,000 and 1:1,000,000 by J.S. Beard. These maps have been captured digitally.

Previous Studies: Numerous larger scale vegetation and flora studies, usually for individual reserves have been undertaken. These published and unpublished studies have been updated from Lyons and Gibson (1994)[Lyons, M.N. and Gibson, N. (1994) Bibliography of location based studies in Western Australia. CALM Science Supplement One.].

Current Status of Survey

Approximately 660 terrestrial quadrats have been established, scored and databased for the three bands surveyed. This has involved identifying some 30,000 flora records and preparing some 5,000 flora vouchers. Another 200 sites have been established as part of the community survey on private and local government lands. Soil samples have been collected at all sites, with approximately 400 analysed and databased. The remainder of the soils samples are currently being analysed.

Quadrat data from Cape Arid and the Eastern Goldfields previously collected will be used to help identify unique communities of the Wheatbelt.

Current Outcomes

1. The agricultural zone has an estimated vascular plant flora of ca 4,000 species, of which over 60% are endemic to the area. The region is the centre of species diversity for many of the species-rich groups (*Acacia*, *Dryandra*, *Eucalyptus*, *Grevillea* and *Verticordia*) that characterise the south-west of Western Australia.

2. Of these ca 4,000 species over 850 are found only in fresh or naturally saline lowlands, which are directly threatened by rising ground water and salinity. The first report on these threatened species covering the Ferns, Gymnosperms and Monocotyledons has been prepared. Several hundred other species found only in woodland sites will be under threat in the longer term. 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 agricultural zone (from site and herbarium records) is being compiled, with field checking.

3. The biodiversity of the agricultural zone is much higher than previously estimated. For example:

a) Detailed surveys of the Lake Muir/Unicup reserves have documented a vascular flora of almost 1,000 species (considerably higher than Mount Lesueur). Dryandra State Forest has a vascular flora of at least 850 vascular plants , also more than Mount Leseur.
b)The small Quairading Shire Reserve (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.
c) Species richness of quadrats ranges between 20 and over 90 species, equal to most northern heathlands. Richness of woodlands and wetlands being in herbs rather than shrubs.
d) Survey has also rediscovered three presumed extinct plants, and discovered seven other previously unknown species.

4. Naturally saline areas have major biodiversity values (at least 64 threatened and priority taxa are currently restricted to these areas and several new taxa have been discovered during the survey; see flora section of wetlands report below) and these plants and the communities they occur in are at major risk from rising water tables. The survey is revealing major regional floristic differences in the salt lake chains occupying the paleodrainage systems of the Agricultural Zone.

5. Of the 4,000 species present in the agricultural zone over 1,500 occur low in the landscape, in riverine valleys, freshwater or primarily saline lands. Of these taxa 450 are endemic to the agricultural zone. These taxa are in danger of extinction as a consequence of rising saline groundwaters.

6. Another 400-500 taxa are centred on the agricultural zone although not confined to it. These taxa are also under immediate threat of major genetic erosion from salination and hydrological changes. These are often the herbs that give the richness to wetlands and woodlands.

7. Areas affected by secondary salination show major declines in vascular plant biodiversity. Rich complex communities are replaced by a few succulents and weeds. Most lowland communities, including tall woodlands, Mallee and Melaleuca shrublands, freshwater and naturally saline wetlands will be lost unless remedial action is taken. The wheatbelt will lose much of its local landscape character.

8. With funding separate from the biological survey, vegetation, flora (including threatened flora), wetland vertebrate and invertebrate lists have been prepared for the Muir-Unicup natural diversity recovery catchment, and 47 monitoring sites established.

9. Approximately 200 sites have been established on private and local government lands by members of the WA Wildflower Society and results are being incorporated into the overall study. Detailed reports on the areas surveyed are placed in major libraries and a copy is held by CALMScience.

10 A major publication on the floral values of the Lake Muir Recovery Catchment was published in CALMScience. A publication on the Floral Values of Drummond Nature Reserve (potential recovery catchment) has been accepted for publication in CALMScience.

In summary, the wheatbelt is more biodiverse than previously realised. Patterning of this biodiversity across the landscape is being revealed via the biological survey. Salination will cause significant loss of plant communities that typify the area and a major rise in the extinction rate of native plants unless significant efforts are undertaken to reverse current threats.

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 are threatened by flooding and perhaps increased impact of *Phythophthora* species.

2. Terrestrial Communities – Fauna

As noted previously 11 people are involved in the survey.

Twenty four field survey areas (organised in 4 bands) have been established from Geraldton to Esperance to achieve a regional coverage.

The sampling recorded 20-50 (average = 34) arachnid species per quadrat.

In the northern and central bands 113 species of small ground-dwelling vertebrates (reptiles, mammals and frogs) were recorded, compared with Museum records of 130 species for the whole agricultural region. The sampling recorded an average of 9 species of vertebrate per quadrat.

Although all vertebrates encountered belonged 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).

A significant decline in the biodiversity of terrestrial animals is apparent at secondarily saline quadrats (even partially affected), which have an average of 30% fewer species than their non-salinised counterparts.

3. Wetlands

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).

Floristics

The 232 wetlands sampled for aquatic invertebrates had 762 quadrats established on them 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* spp) have been discovered. The study is confirming the high floral values of naturally saline areas and regional floristic differences in the salt lake chains. The flora of both fresh and naturally saline wetlands of the northern wheatbelt is distinct from the remainder of the Wheatbelt and the central/western wheatbelt naturally saline areas are a conservation priority because of the threat of hydrological changes.

Fauna

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 5 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 3 or 4 species that use freshwater dams, will persist in the wheatbelt out of an original waterbird fauna of more than 60 species.

Survey work to date in wheatbelt wetlands has collected almost 1,000 invertebrate species, distributed in about 140 families and 300 genera. About 50% appear to be described species and approximately 15% (c.150 species) are only known from the Wheatbelt.

South-west Western Australia has a highly rich and endemic aquatic fauna of microinvertebrates, especially Crustacea. Provisional data suggests numerous species are restricted to naturally saline wetlands, mostly *Parartemia* (Brine Shrimps), *Coxiella* (snails), Ostracods and Copepods (Crustaceans). These may form a significant endemic component in south-west Western Australia and are under threat if naturally saline wetlands become wetter because of rising groundwater.

Almost half of the species collected are restricted to fresh water with salinity less than 3,000 mg/L. However, some of the species occur on granite rock outcrops where salinity is unlikely to occur, but

about 40% of the fauna is vulnerable to increasing salinity. If all wetlands in the wheatbelt became saline (more than 10,000 mg/L), most of these freshwater species will disappear from the wheatbelt. While many have ranges that extend beyond the Wheatbelt, their ranges and the threats likely to face them elsewhere are poorly known because of the lack of survey. It is likely there is a significant element of the freshwater fauna restricted to the Wheatbelt. For example, some recently described Dytiscid beetles from Lake Muir are known only from that area and there are sevearl rare Copepods abd Ostracods known only from the southern Wheatbelt.

4. Monitoring of Wetlands

Project Objective

- Analyse and report trends in salinity and depth in wetlands monitored since 1978.
- Monitor salinity, depth and nutrient status of a broad range of wetlands.
- Monitor changes in waterbirds, fish, frogs and aquatic invertebrates in 25 wetlands.
- Monitor changes in floristic composition and tree health in 25 wetlands.

Vegetation transects (2-5 per wetland, 80 in total) have been established at all 25 wetlands. Reference photos have been taken on each transect, Airphotos showing position of transects and biophysical boundaries have been captured on GIS. Over 6,000 trees tagged on transects and vegetation profiles constructed for each transect. Three major reports on these transects have been prepared and are lodged in Woodvale library.

Groundwater monitoring bores have been established adjacent to the transects.

Waterbirds and invertebrates (macro and microinvertebrates) have been sampled at 23 wetlands to prepare baseline data, and 15 wetlands have been resampled (see Fig. 1 as an example of the product of this sampling).

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
- Cannot use a single biotic indicator to summarise overall biodiversity value of a wetland.

Fig. 1

Sampling of invertebrates in 1997 and 1999 at secondarily saline Lake Coyrecup shows community composition varied little in relation to communities at other lakes (ie degradation stable at present - if the two sample points were in different parts of the graphs it would indicate change had occurred). Coyrecup is less degraded than Parkeyerring, has a different community from naturally saline Campion and is quite different from the fresh Noobijup and Yaalup.