CALM Biodiversity Survey of the Agricultural Zone
September 1999 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 September 1999. The information presented is subject to review in the light of further information as the survey is still underway.

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, 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 survey is being undertaken by the CALM**Science** 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.
Mike Lyons (Research Scientist responsible for wetlands).
Margaret Langley, Angas Hopkins and Judith Harvey are undertaking a survey of the West Midlands as part of another project and are contributing data from the Dandaragan Plateau.
Terry Rose (flora checklists)

2) Fauna (Terrestrial):
Norm McKenzie, Allan Burbidge, Jim Rolfe and Bill Muir (Vertebrates).
Paul Van Heurck, Nadine Guthrie, Elisha Ladhams and Bradley Durrant (Invertebrates).

3) Wetland Fauna: Stuart Halse, Dave Cale, Winston Kay, Jane McRae, Adrian Pinder and Michael Scanlon.

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

Approach

The area was divided into three zones for the purposes of the survey - a northern, central and southern band, as shown on the attached map. Establishment and sampling of terrestrial sites has occurred in the central and northern bands and in the central and southern bands for wetlands. Establishment and sampling of the southern band is underway.

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 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 1,000 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.

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. 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.

Another 600 quadrats have been established to document the wetland flora of the study area.

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. 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 detailed surveys of the Lake Muir/Unicup reserves have documented a vascular flora of almost 1,000 species (considerably higher than Mount Lesueur). 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. Survey has also rediscovered one presumed extinct aquatic plant, and discovered two 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 these plants and the communities they occur in are at major risk from rising water tables.

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.

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 CALM**Science**.

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.

2. Terrestrial Communities – Fauna

The attached map shows the 24 field survey areas (organised in bands) and quadrats (solid dots) being sampled, and the geographical coverage currently achieved.

A total of 12 to 13 biodiversity quadrats are positioned within each survey area:

- At least one quadrat is positioned on a minimally disturbed example of each of the 10 main geomorphic units in the landscape, as well as on a salt-affected example of two of the units.
- Uncleared sites have been chosen on typical examples of each unit, preferably within a conservation reserve.
- 266 terrestrial biodiversity (fauna and flora) quadrats have been selected and established so far.

At each biodiversity quadrat:

- The assemblage of ground-dwelling arachnids and small vertebrates (spiders, scorpions, centipedes, mammals, reptiles and frogs) is sampled, and the botanists list and score the plants.
- The vertebrates are sampled for 8 days in spring and another 8 in summer/autumn, using a minimum of 12 fenced pit-traps.
- The arachnids are sampled using five 2-litre pit-traps which contain glycol so that they can stay open for the whole 12 months.
- Bulked surface soil samples from each quadrat are collected for chemical analysis and the soil profile is described and sampled for chemical analysis. In conjunction with BIOCLIM data, these will allow modelling of species' "environmental envelopes", including their salinity responses. The description, sampling and chemical analysis of soil profiles 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.

The survey is divided into three broad bands for field sampling:

1. The central band areas were sampled in 1997-98. Vertebrate collections from this band are about 95% identified, and arachnid collections more than 90%.
2. The northern band areas were sampled in 1998-99, and the specimen sorting and identification has only just commenced.
3. Quadrats in the southern band areas are nearly established, and field sampling commences in November 1999.

During the fourth year of the survey, the following will occur:

- Sampling of the last 3 survey areas.
- Identification of the year-3 arachnids, and supplementary sampling at any quadrats that seem to have been poorly sampled.
- Compilation and analysis of the data to identify natural diversity recovery catchments.

Write-up for publication will occupy the fifth year.

Even the first year of the survey, which covered only the central third of the study area, has dramatically increased available data on the distribution, status and habitats of small wheatbelt vertebrates and arachnids species, for example:

- Over 500 species of ground-dwelling arachnids (spiders, centipedes and scorpions) were recorded, compared with Museum records of ca 165 species for the whole agricultural region. The sampling recorded 20-50 (average = 34) arachnid species per quadrat.
- Over 80 species of small ground-dwelling vertebrates (reptiles, mammals and frogs) were recorded, compared with Museum records of 125 species for the whole agricultural region. The sampling recorded an average of 10 species per quadrat.

Although all vertebrates encountered belonged to described species, 65-70% 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.

Quadrat status	Average ratio of species per quadrat	
	Arachnids	Vertebrates
non-saline	2.3 (1.3)	2.8 (0.8)
primary salinity	1.0 (0.8)	1.0 (0.2)
secondary salinity	1.3 (0.7)	1.9 (1.0)

(standard deviation in brackets)

3. Wetland 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 about 565 invertebrate species. Of these, 253 species (45%) are 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.

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 4 (see attached graph). As a rule of thumb, doubling salinity halves the number of aquatic invertebrate species.

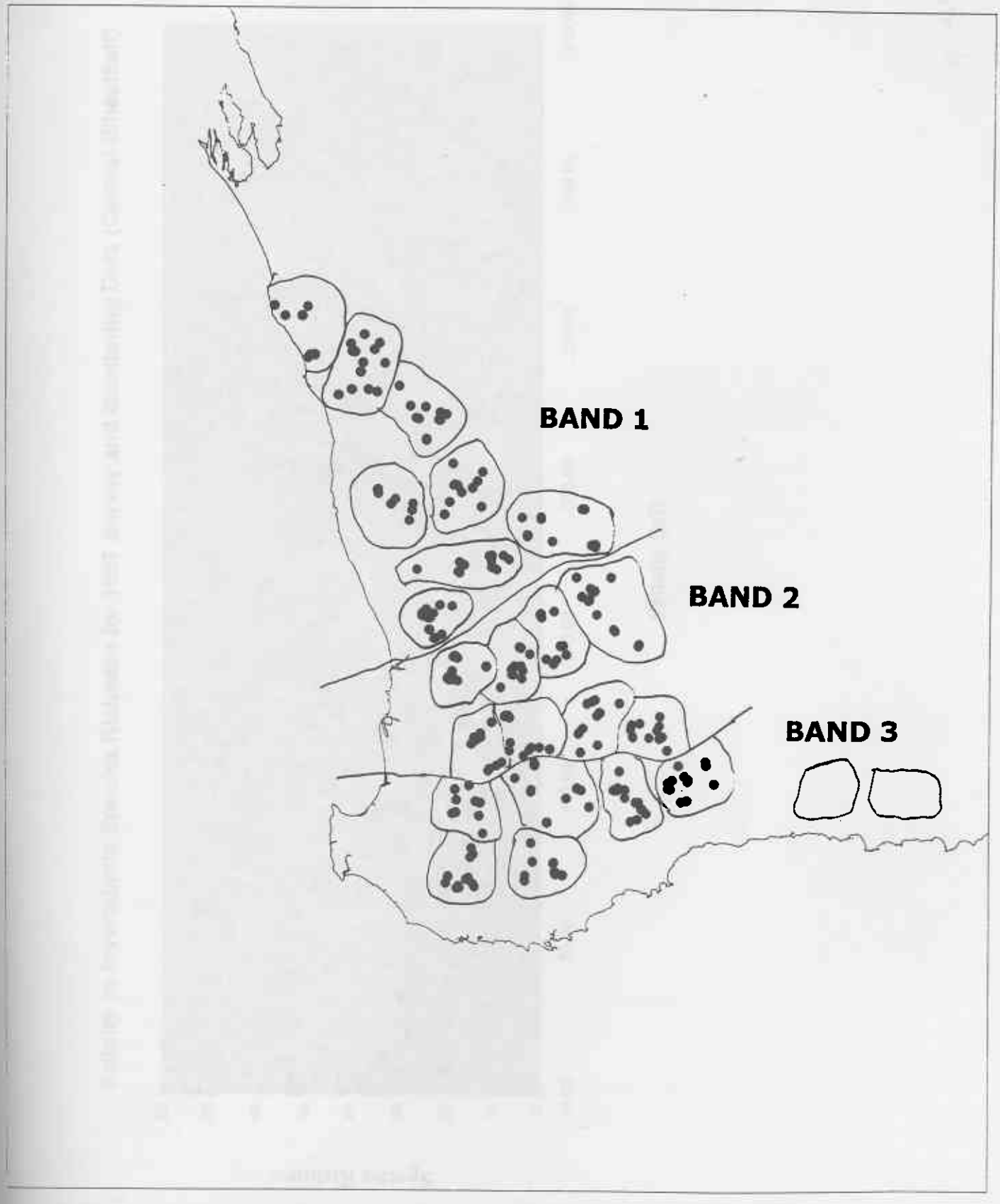
Caveats that must be attached to the above statements at this stage of the work are that probably not all wetlands will become saline, some species will persist in dams, and plenty of species have ranges that extend outside the wheatbelt.

4. Monitoring of Wetlands

Currently 17 of 25 wetlands have been sampled. Two major reports on the first 17 have been produced. The final 8 wetlands have been selected and sampling of these is underway.

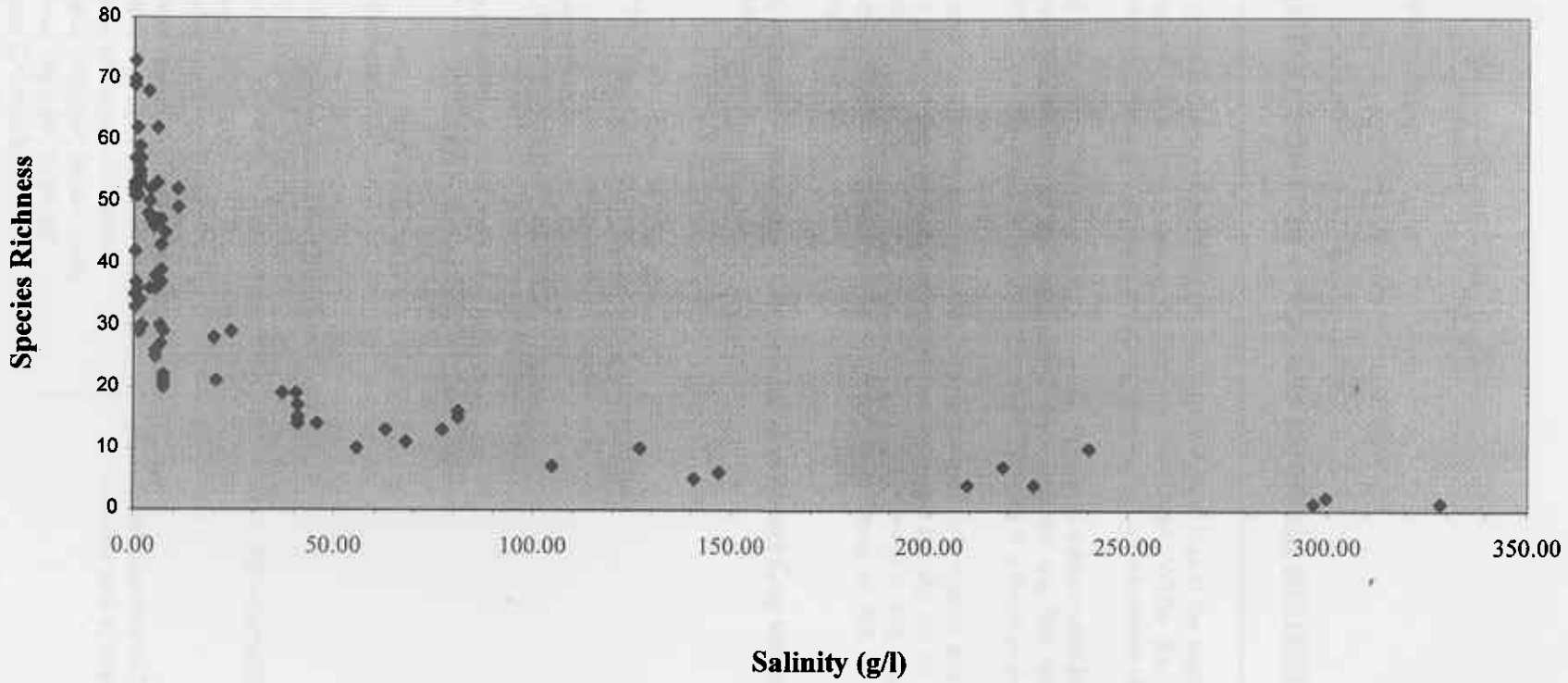
Department of Conservation
And Land Management

September 1999



TERRESTRIAL BIODIVERSITY QUADRATS ESTABLISHED FOR THE SALINITY ACTION PLAN SURVEY AT 30/9/99

Salinity vs Invertebrate Species Richness for 1997 Survey and Monitoring Data (Central Wheatbelt)



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Subject: **SALINITY ACTION PLAN – PROGRESS REPORT ON BIOLOGICAL SURVEY**

One of the projects funded through the Salinity Action Plan is the biological survey of the south-west agricultural zone that is being carried out by CALM. While the survey is still underway, the preliminary results it is yielding are being used in the current review of the Plan.

There is no doubt that the biological survey represents a major step forward in our understanding of the rich biodiversity of the agricultural zone and for the first time we are seeing some real quantification of the extent to which increasing salinity is a threat to the conservation of biodiversity.

Attached is a progress report on this project, for your information and that of your staff. It should be borne in mind that the progress report was prepared initially for an audience that is very familiar with the WA Salinity Action Plan and the current review of it. The progress report therefore does not include contextual or background information in terms of the current and predicted extent of salinity.

If you have any queries about the survey, please contact Greg Keighery or one of his colleagues at CALM**Science**.

Keiran McNamara
DIRECTOR OF NATURE CONSERVATION

21 October 1999
KMCN:RM MEMOSMEMO-057

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