

**Extracts from 'Proceedings of the Salt Lake Ecology Seminar' held
on 07/7/1999 at Perth Zoo Conference Centre.**

**See JL's office computer for a digital copy of the entire Proceedings
and see the '*Water Depth & water Quality Measurements, Aquatic
Invertebrate Sweeps, Food Availability, Feeding & Drinking
Observations at Lakes Ballard & Marmion in 1995*' RMCR for hand-
written notes made by JL at this Seminar.**

PROCEEDINGS OF THE SALT LAKE ECOLOGY SEMINAR

Wednesday, 7 July 1999
Perth Zoo Conference Centre

Organised by the Centre for Land Rehabilitation
on behalf of the
Salt Lake Ecology Working Group



THE CHAMBER OF
MINERALS AND ENERGY
OF WESTERN AUSTRALIA INC

The University of Western Australia



CENTRE FOR LAND REHABILITATION

SALT LAKE ECOLOGY SEMINAR

JULY 1999

List of Papers and Authors

Paper	Author
Flyer	
Media Statement	
Group Discussion Topics	
Limnology of Lake Carey	Jacob John
Lake Carey Invertebrates	Shane Chaplin
Ecophysiology of Halosarcia	Tim Colmer, Jeremy English David Jasper
Botany of Wheat Belt Lakes	Mike Lyons
Diversity and Distribution of Salt Lake Invertebrates	Stuart Halse
Hydrogeology of Salt Lakes in Western Australia	Philip Commander
Surface Hydrology of Salt Lake Systems	Jeff Turner
Discharging mine water-Normandy Golden Grove	Brian Fowler, Daniel Seketa
Lake Carey Catchment Management Group Report	Celeste Beavis
Lake Lefroy-Theory to Practice	Greg Morris
Community Involvement-Lake Carey	Rory Lamont
Evaluation criteria for discharges into saline wetlands	Mark Coleman
Saline drainage criteria	Mark Coleman
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The University of Western Australia



SALT LAKE ECOLOGY SEMINAR

Wednesday 7th July 1999

at The Perth Zoo Conference Centre

This one day seminar is presented by the Salt Lake Ecology Working Group and is the second annual presentation. The Salt Lake Ecology Working Group, organised by the Chamber of Minerals and Energy of WA, includes representatives from mining, government and research bodies. The Working Group collects current information on the ecology of WA's salt lake margins, particularly in relation to possible impacts from mining and exploration, in order to ensure appropriate management and regulatory regimes are applied. The Working Group is also collating current research and this seminar will act as one method of disseminating that information to interested parties.

The seminar will open with a keynote address, by Sally Robinson, Deputy Chair of the EPA, on the topic of : "Salt Lakes as a significant element of our environment", then proceed to background information, mining case studies, policy and a general forum on directions for future research.

The program is divided into two sessions:

- 1) Baseline Ecology- speakers from Curtin University , University of WA & Department of Conservation & Land Management.
- 2) Operational - case studies from WMC Resources, Normandy Golden Grove & Placer (Granny Smith) plus issues relating to current activities around salt lakes and their implications for the future. Representatives from CSIRO & Water & Rivers Commission.

Speakers include:			
Sally Robinson	Deputy Chair, EPA	Jacob John	Curtin University
Shane Chaplin	Curtin University	Mike Lyons	CALM
Stuart Halse	CALM	Greg Morris	WMC Resources
Tim Colmer	University of WA	Rory Lamont	Placer
Mark Coleman	Actis Environmental	Brian Fowler	Normandy
Jeff Turner	CSIRO	Daniel Seketa	Normandy

The cost of the seminar is \$175 full fee & \$125 for students & members of conservation bodies. This will include all refreshments, a copy of proceedings & drinks afterwards. The schedule starts at 8.30am and concludes at 4.30 pm.

For any further details, please call:

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MEDIA STATEMENT

Tuesday, July 6, 1999

Minerals industry leads salt lake ecology research

Environmental experts from around the State will be meeting tomorrow to discuss developments in salt lake ecology research. About 100 representatives from the minerals industry, government, conservation organisations and research bodies will attend the *Salt Lake Ecology Research Seminar* that will be held in Perth.

The aim of the seminar is to explore policy issues and case studies as well as research on the ecology of salt lakes, which represent a significant element of the Western Australian environment. This will improve knowledge about the status of salt lakes and also help to improve management of impacts from a range of land uses.

The seminar has been coordinated by the Centre for Land Rehabilitation at the University of Western Australia, with guidance from the Salt Lake Ecology Working Group. The Working Group, organised by the Chamber of Minerals and Energy of Western Australia, collects and discusses information on the ecology of Western Australia's salt lakes in order to continually improve environmental management associated with exploration, mining, agriculture and other land uses.

The seminar will open with a key note address by Mr Bernard Bowen, Chairman of the Environmental Protection Authority on the topic of *Salt Lakes – A Significant Element of our Environment*.

A feature of the seminar will be a presentation on a \$350,000 research project into salt tolerant vegetation. The project is examining *Halosarcia* species, for their ability to grow in saline and waterlogged soils. This collaborative project in the Centre for Land Rehabilitation, under the direction of Dr Tim Colmer and Dr David Jasper is supported by minerals companies, the Australian Research Council, the Minerals and Energy Research Institute of WA and the WA Herbarium.

Dr Jasper said that, "Research such as that on the *Halosarcia* species, are important in increasing our knowledge of salt lake ecology. Despite their ecological importance, and their potential in revegetation, knowledge of the physiology and ecology of native halophytes is scanty".

Other topics for discussion at the seminar include

- Baseline ecology
- Operational case studies
- Policy issues

For further information about the:

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GROUP DISCUSSION TOPICS

Salt Lake Ecology Seminar - A synthesis of issues raised in group discussions

Dr David Jasper
Director
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Seminar attendees were divided into 7 groups and asked to list at least 5 of the most important issues in relation to salt lake ecology. A flow chart summarising some of the likely impacting factors and the ultimate ecological impacts was given to the groups to assist the discussion (Figure 1).

The actual information prepared by the groups is attached (Table 1). I have attempted to integrate the issues raised, to create a synthesis of opinion from the seminar. The issues fall generally into three major categories: research, communication and policy.

Research

Classification of salt lakes

An issue of primary importance in developing an integrated approach to the management of salt lakes is their classification. Until a system of classification is developed, and it is understood how one lake type compares to another, then it is very difficult to apply information from previous studies to management of current issues. An example is the need to differentiate between natural salt lakes and those resulting from secondary salinity. An inherent contributor to the absence of classification is the lack of baseline data for WA's salt lakes.

Poor classification constrains any attempt to place an ecological value, and thus conservation significance, on the salt lake systems in a global, regional or local context.

Function of salt lakes

The lack of baseline data on WA's salt lakes is a critical issue. Baseline data on all aspects of the lake systems is essential in developing an understanding on how they function. It is important that in each case, the data extends to catchments and paleochannels, which support the lake, and to its physical characteristics and stratigraphy.

It will be valuable if a standard approach can be developed to characterising and monitoring salt lakes. It is especially critical that that general research approach, the techniques used and their timing are standardised. An integral aspect of validating concepts of lake function is access to long-term data. There is a lack of long-term studies of lake systems.

Access to specialists such as hydrogeologists and hydrologists is important for progress to be made in understanding lake function, but in general the expertise that is currently available for research into salt lakes is limited.

Resilience

Impacts on lakes can be via surface and/or groundwater flows, or directly through activities in or near the lake basin. The main areas of impact include groundwater aquifers, and aquatic and terrestrial biota.

The most important factors impacting on the lake environment are changes in hydroperiod, and water quality, especially salinity, turbidity and trace metals. The actual impacts of changes in these factors are only beginning to be studied, and currently are based on empirical observations. There is a need to develop techniques, which can be used to determine likely responses more quickly. This may include identifying suitable bio-indicators.

Assessments of potential impacts on salt lake ecology need to be comprehensive in their approach, and ensure that cumulative impacts of the various factors are taken into account.

Communication

Assembling databases

A key issue in advancing knowledge of salt lake ecology is to create a database of existing information. This information should be made widely available, for example through the worldwide web. This would be an especially valuable resource to local groups who may be relatively isolated from researchers and research institutions. Pooling data needs to occur at two scales, firstly at a local scale, where different organisations may have collected data independently, but relating to the same catchment. The Lake Carey catchment group is a good example of this. Secondly, a database needs to be established at least at a state level. The Salt Lake Ecology Working Group is considering a proposal along these lines.

To complement the research database, it is also important that a database listing the relevant expertise be established.

Transferring knowledge and management approaches between industries

A first step in transferring current knowledge of salt lake ecology is to enhance communication between the mining and agricultural industries. Currently, there seems to be relatively more data available as a result of research initiated by the mining industry. This information needs to be integrated into the agricultural areas.

In contrast to relative activity in research, agricultural areas are generally more advanced in group structures for catchment management. Extension of these co-operative management models into the rangelands and mining industry would be beneficial. An advantage of catchment groups with a salt lake focus is that it will provide a structure through which data access is likely to be more easily achieved.

Community consultation

In considering the management of salt lakes it is important to involve the community, and incorporate their values in to management planning. Aboriginal knowledge of salt lakes is likely to be an important resource.

Policy

Establishing values

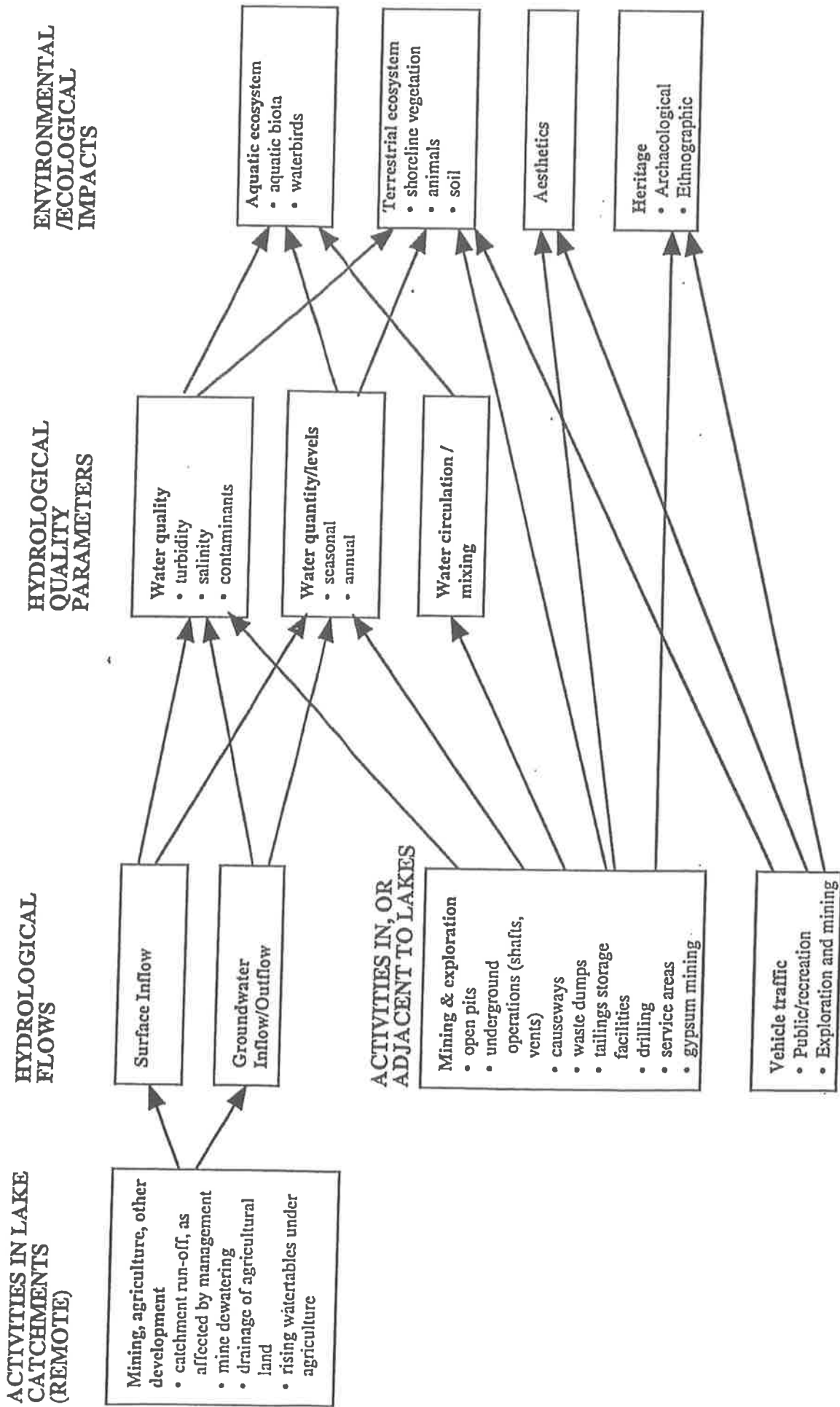
It is important to establish values at two levels, firstly the ecological and thus conservation value of salt lakes needs to be established. To date this has received little consideration

but is an important step in ensuring adequate representation in conservation reserves and in assessing future proposals. Secondly, the resource values of lakes, and of activities such as mine dewatering, need to be considered. Options for using salt lakes for production (aquaculture, algae) also need to be considered

Inputs into policy

There needs to be increased public awareness of the issues surrounding salt lakes and the potential impacts of mining and agricultural activity. A component of this is greater interaction between government, the community and research groups. Fora such as the Salt Lake Ecology Symposium could be extended to other regions and stakeholders.

Salt lake ecology needs to be integrated into the long-term policy framework and needs to address causes of impacts, rather than the symptoms. The policies developed need a statewide focus rather than for particular industries. It is especially important that activities of mining and agriculture that may impact on salt lakes should be subject to equally rigorous processes of review and approval.



D.A. Jasper
Centre for Land Rehabilitation

Figure 1: A summary of factors that may potentially affect salt lakes, and the possible ecological impacts

Table 1: Transcriptions of issues raised by discussion groups

Group 1

- Community values
- Ecological value in global, regional and local context
- Ecosystem may be expanding
- Differentiate between natural salt lakes vs secondary salinised
- Resilience of salt lakes
- Knowledge of data base
- Public awareness
- Resource values
- Resource values of dewater
- Evaluation of options

Group 2

Conservation ie. better represented in conservation reserves

Classification of wetlands criteria

Hydrological impacts ie. aquifers

1. Dewatering
Baseline Data
Need for classification of lakes/lake system
2. Final voids and impact on lakes ie. \uparrow evap \downarrow GW
Mine closure/completion criteria
Indicators
Trace Metals
Hydro period
Turbidity
Biomonitoring
Community consultation

Group 3

Coordination/Forum

- Coordinate salinity action at a higher level.
- Involve government/community and research groups.
- Integrate salt lake ecology into longer framework.

Communication

- Expertise from salt lakes needs to be integrated into wheatbelt.
- Catchment group structure/information from wheatbelt needs to be integrated into Goldfields/Rangelands

Research Issues

- Effect of hydroperiod and waterlogging – on vegetation
- Data Reporting – how applicable is EC for reporting – need to define standards
- More information required on paleochannels
- Make expertise more available
 - Web Pages
 - Lists of experts
- Fast response bio-indicator/assay techniques

Options

- More money for research to identify profitable/productive options
- Aboriginal knowledge
- Address cause not symptoms

Group 4

- Research on salt lakes specifically on “how they function”. (snapshots vs long term).
- Coordination and sharing of research (Lake Carey model).
- Criteria and process for identification of conservation value.
- Broader perspective statewide rather than focus (mining and agricultural impacts).

Group 5

1. Access to Resources

- Catchment Planning
- Specialists
 - Hydrogeologists
 - Hydrologists

- Benefits – High
- Achievable – Yes

2. Dissemination of Information

- Training
- Spread of Knowledge
- Access to Information Sources
- Good Information Available

3. Gaps in Knowledge

- Regional
 - Values
 - Databases
- Research

4. Equal Regulation

- Impacts of Agricultural activities should undergo similar rigorous review to other sectors.

5. Monitoring

- What, why, when, who decides

6. Standardise data collection

Group 6

Fauna (biotic) impacts

Lack of baseline data

- site specific
- regional context

Strategic planning (what if)

- cumulative impacts

Lack of proven modelling/precedence (long time frames)

Physical characteristics/stratigraphy

Catchment issues (other land uses/management)

Post

- Aesthetics
- Social +ve and -ve
- Biological
- Safety
- Cultural (Rehabilitation for bush tucker)

Lack of classification with respect to conservation significance

Funding

Group 7

Issues:

- Lack of baseline data.
- Lack of effective data integration including resources to manage existing data so (catchment approach endorsed) it's available.
- Lack of appropriate criteria and consistent approval processes for all land users.
- Closure and rehabilitation of disturbed areas.
- Identify comprehensive impacts (ie. include groundwater fauna, terrestrial fauna, paleochannel dewatering for processing).
- Sustainable development principles (social, environmental and economic).

List of Participants for Salt Lake Ecology Workshop

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Wednesday 7 July 1999

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English, Jeremy	PhD Student	University of WA	Plant Sciences Hackett Drive NEDLANDS WA 6907	08 9380 1991	08 9380 1108		Jenglish@agric.uwa.edu.au
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Haise, Stuart	Principal Research Scientist	CALM	PO Box 51 WANNEROO WA 6065	08 9405 5100	08 9306 1641		Stuarth@calm.wa.gov.au
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Lamont, Rory	Sustainability Coordinator	Placer Granny Smith	PO Box 33 LAVERTON WA 6440	08 9088 2208	08 9031 3103		Rory_lamont@placerdome.com
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Seketa, Daniel	Environmental Officer	Normandy Golden Grove	PMB 7 GERALDTON WA 6530	08 9093 2766	08 9961 3860		Daniel.seketa@normandy.com.au
Turner, Jeff	Principal Research Scientist	CSIRO	Private Mail Bag WEMBLEY WA 6014	08 9333 6314	08 9387 8211		Jeffrey.turner@per.clw.csiro.au

Science Project Plan (SPP) for '*Breeding ecology and conservation of the Banded Stilt*' ('Band Stilt SPP 1999.doc'), 'Request No. WD/0023'. Note the proposed start (15/03/1995) and finish (15/03/2005) dates.

Department of Conservation and Land Management

CALMScience Division

Science Project Plan

(Page 1)

Important: Refer to the *Explanatory Notes* (Staff Guideline No. 7) when preparing an SPP.

PART A Title and Location

SPP Number: [allocated by D/AA]
Request No: [allocated by WASPP] WD/0023
Concept Plan No: [allocated by D/AA]

1. Project Title: Breeding ecology and conservation of the Banded Stilt
2. CALMScience Group: Biodiversity Conservation Project Team: Aquatic Ecosystems
3. Staff [Names and estimates of percentage of time]:
 - Supervising Scientist: J. Lane (15% in 1999/00)
 - Other Scientists:
 - Technical Officers: G. Pearson (2% in 1999/00)
A. Clarke (10% in 1999/00)
 - External Collaborators: Dr C. Minton (Australian Wader Study Group)
 - Volunteer(s): A. Chapman
4. a) Departmental Program(s): Nature Conservation
 - b) Land Tenure(s): Vacant crown land, pastoral lease, CALM-managed land.
 - c) CALM Region(s): Goldfields, Wheatbelt, Pilbara
 - d) CALM District(s): All within above regions.
 - e) Location of plots/transects [Name] : Not applicable
5. Related SPPs: WD/0024 (*A Directory of Important Wetlands In Australia*)
6. Proposed commencement date: Phase 1: 1995 Phase 2: 1999
7. Proposed completion dates: Phase 1: 2001 Phase 2: 2005
8. Date of submission of this Plan and signature of Supervising Scientist:

PART B Endorsements

9. List the relevant District Manager(s), Business Unit Manager(s), and/or Regional Manager(s) whom you have consulted about the SPP. If the SPP relates to all Regions, you should confer with the Director of Regional Services:

Goldfields Regional Manager (Ian Keally)

10. Biometrician:

Return comments to D/AA

11. Animal Ethics Committee:

Return comments to D/AA

12. Project Team Leader:

Return comments to D/AA

13. Group Manager:

Science Group Manager to forward to D/AA

14. Divisional Administrative Assistant (D/AA):

Divisional Admin. Assistant to manage approval process, load approved SPP on WASPP, arrange filing at SOHQ, publish in CALMScience News, send photocopy of completed SPP to Supervising Scientist and notify Biometrician of SPP No., copy cover sheet to Regional Manager, District Manager and relevant Program Manager (for their information)

PART C Relevance and Outcomes

15. Background: The Banded Stilt *Cladorhynchus leucocephalus* is an Australian endemic. It nests in large colonies (up to 100,000+ pairs) on small islands (about 1-5 ha) on huge (100+ km²) claypan lakes of inland Western (mainly) and South Australia following exceptional rainfall events (c. 3-7 year intervals). Its breeding biology has been little studied, due mainly to the difficulty of finding and gaining access to breeding colonies. Nesting attempts fail spectacularly if lakes dry prematurely during breeding attempts. Few known nesting locations are within conservation reserves, and these only partly. The mining industry is showing substantial interest in mining the beds of claypan lakes and utilising them for storage / disposal of wastes and for water supply. Without an improved knowledge of Banded Stilt breeding biology and environmental requirements, CALM is not well placed to ensure conservation of the species.
16. Project aims:
- Determine the principal breeding locations of Banded Stilt in Western Australia and their relative importance.
 - Develop an improved understanding of their breeding biology.
 - Quantify key environmental factors (e.g. hydrological regime, salinity) governing breeding success;
 - Identify any significant human-induced threats to nesting colonies and habitats.
 - Obtain and disseminate knowledge needed to ensure conservation of the species.
17. Anticipated project outcome(s): Scientific and other publications that will provide information necessary to ensure that the principal breeding sites and habitats of the Banded Stilt can be adequately conserved and wisely managed.
18. Anticipated users of the knowledge to be gained and technology transfer strategy: CALM, Department of Environmental Protection, Environmental Protection Authority, Department of Minerals & Energy, mining and tourism industries, conservation groups. Results of Phase 1 have been transferred through articles in the media, popular and ornithological magazines, an ABC television documentary, presentation at Southern Hemisphere Ornithological Conference. Scientific publication is also proposed.
19. Milestones [Describe tasks and when they will be completed]:
- Phase 1: (1995-2000)
- | | |
|---|----------|
| • Aerial survey to locate Banded Stilt breeding colonies in Eastern Goldfields following passage of Cyclone Bobby. | Mar 1995 |
| • Establishment of base camp to study Lake Ballard breeding colony | Apr 1995 |
| • Collection of data on breeding colony characteristics, timing of nesting, clutch size, incubation period, hatching & fledging success, fledging period, lake filling / drying cycle, water chemistry. | Jun 1995 |
| • Collection of stilt adults and chicks for gut content analysis. | Jun 1995 |
| • Leg banding and flagging of chicks on Lakes Ballard and Marmion. | Jun 1995 |
| • Sorting, identification and quantification of macroinvertebrate sweep samples and stilt gut contents. | Dec 1999 |
| • Extraction of clutch size, incubation period, hatching success data from photographic monitoring of 1995 Ballard nesting event. | Dec 1999 |
| • Preparation and write-up of 1995 breeding event data and observations for scientific publication. | Apr 2000 |
| • Publication of 1995 breeding event results in journal <i>Emu</i> . | 2001 |
- Phase 2: (1999-2005)
- | | |
|---|------|
| • Monitor rainfall reports from Eastern Goldfields and Wheatbelt. | 2004 |
| • <i>In the event that exceptional rainfall occurs (annual probability low),</i> conduct aerial surveys to locate and photograph breeding colonies. | 2004 |

- *In the event that exceptional rainfall occurs and breeding colonies become established, conduct aerial (& possibly ground) monitoring to determine colony success and major limiting factors.* 2004
- *In the event that successful fledging of chicks appears probable, 2004 conduct banding and leg flagging of chicks.*
- Prepare and write-up of data and observations for publication. end 2004
- Publish in *Emu* or other scientific journal. 2005

PART D Study Design

20. Method [including statistical analysis]: Phase 1 (1995-2000): Conduct aerial survey of Lakes Barlee & Ballard following Cyclone Bobby (Feb 1995) to locate breeding colonies. Establish base camp on Lake Ballard. Establish quadrats in nesting areas for daily monitoring (photographs) to determine laying rate, clutch size, incubation period and hatching success. Collect adults and chicks to determine diet. Conduct macro-invertebrate (standardised sweeps) to monitor food availability. Install continuous recorder to monitor lake water level. Sample water chemistry. Develop safe method of catching chicks. Band / leg flag chicks. Conduct additional aerial surveys to monitor fledging success. Analyse results. Prepare for publication. Publish.
- Phase 2 (1999-2005): Rainfall in the main breeding range of the Banded Stilt (in WA) will be monitored using daily rainfall data obtained by the Bureau of Meteorology. Following exceptional rainfall events (approx 3-7 year intervals) and reports of flooding, aerial surveys will be conducted to locate and monitor breeding colonies. Colonies will be photographed from the air and, if feasible, visited on the ground to determine number of breeding pairs, nesting and fledging success, water depths, water chemistry and food availability. Chicks will be banded and leg-flagged to obtain information on movements and longevity. Standard statistical techniques will be used where appropriate.

PART E Data Management and Budget

21. Voucher specimens [how many are anticipated to be collected and where will they be lodged?]: Voucher specimens (at least) from macroinvertebrate samples will be retained and curated at CALMScience Woodvale.
22. Data management [how and where are data being archived/maintained?]: The original data (field note books, other papers) and nest monitoring photographs are held by J.Lane at CALM Busselton. Data from a continuous water level recorder (Lake Ballard 1995) are on disk in a datasafe in JL's office. The 1995 macroinvertebrate samples are held and curated by A.Clarke at CALMScience Woodvale. Data to be collected (Phase 2) will be held by JL at Busselton.
23. Budget Estimate [anticipated expenditure]:

Consolidated Funds (CALM)

	Year 1 (94/95)	Year 5 (98/99)	Year 6 (99/00)
FTEs - Scientist	0.2	0.02	0.15
FTEs - Technical	0.5	0.03	0.12
Equipment	0	0	200
Vehicle	0	0	500
Travel	0	0	500
Other	0	5 000	1 800
TOTAL	0	5 000	3 000*

	Years 7 to 10 (00/01 to 03/04)	Year 11 (2004/05)	
FTEs - Scientist	0.05	0.1	
FTEs - Technical	0.1	0.05	
Equipment	200	200	
Vehicle	500		
Travel	500		
Other	1 800	800	
TOTAL	3 000*	1 000	

External Funds

	Year 1 (94/95)	Year 5 (98/99)	Year 6 (99/00)
Salaries/Wages/Overtime			
Overheads			
Equipment			
Vehicle			
Travel			
Other			
TOTAL	10 000**	1 200**	**

	Years 7 to 10 (00/01 to 03/04)	Year 11 (2004/05)	
Salaries/Wages/Overtime			
Overheads			
Equipment			
Vehicle			
Travel			
Other			
TOTAL	**	**	

* CALMScience funding (\$3,000 each year) is being sought from 1999/00 to 2003/04 to enable a *rapid response* in the event (<50% probability) that potentially-suitable rainfall events occur. These funds will be used for aerial surveys. External funds will be sought to support follow-up work in the event that breeding colonies with a high likelihood of success are located. In years when potentially-suitable rains do not occur (by end of April), *the funds could be reallocated* to other projects.

** There is a strong possibility of significant, external, in-kind support (\$1,000s) being provided (as occurred in 1994/95 & 1998/99) to this project by the mining industry and other sources in the event that suitable rainfall events occur in 1999/2000 and subsequent years.

24 Budget Actual [to be updated at the end of each financial year by D/AA and local AA]:

Consolidated Funds (CALM)

	Year 1 (94/95)	Year 5 (98/99)	Year 6 (99/00)
FTEs - Scientist	0.2	0.02	
FTEs - Technical	0.5	0.03	
Equipment	0	0	

Vehicle	0	0	
Travel	0	0	
Other	0	0	
TOTAL	0	0	

	Years 7 to 10 (00/01 to 03/04)	Year 11 (2004/05)	
FTEs - Scientist			
FTEs - Technical			
Equipment			
Vehicle			
Travel			
Other			
TOTAL			

External Funds

	Year 1 (94/95)	Year 5 (98/99)	Year 6 (99/00)
Salaries/Wages/Overtime			
Overheads			
Equipment			
Vehicle			
Travel			
Other			
TOTAL	10 000**	2 000**	

	Years 7 to 10 (00/01 to 03/04)	Year 11 (2004/05)	
Salaries/Wages/Overtime			
Overheads			
Equipment			
Vehicle			
Travel			
Other			
TOTAL	**	**	

25 Account code(s) for this SPP [allocated by Group AA]:

26 Latitude and longitude of plots/transects: Not applicable (no permanent plots/transects)

A copy of 'Coate, K. (1999). *Bird notes for the Easter campout at Goongarrie Station*. The Naturalist News, May 1999, p.4.

Includes description of active BaSt nesting colony found on Lake Goongarrie on 02/4/1999.

Note that JL has B&W aerial photos of Lake Goongarrie (and Lake Marmion) and photocopies of these are to be included in another RMCR.

pillars of cemented laterite pebbles somewhat reminiscent of the Pinnacles. There was little evidence left of the Cobb & Co. Staging Post which had been built nearby. The Main Road through the area had skirted the western side of the Valley.

We lunched in a pleasant Eucalypt woodland down by the Lake. Several of our party left leaving six to return to base and home on Tuesday.

Of course the botanists and the birdoes had their eyes open on all the outings. Several birds sighted were not on the Station or Park lists and also several plant species. 32 flowering plant specimens were collected, most yet to be identified. Many Euros were sighted. Dragon lizards were everywhere and tadpoles and frogs were evident around the soak areas. The wet conditions had brought up a lot of fungi even including mushrooms at the mallee fowl mound. Kevin will tell you about the birds including his adventures on Lake Goongarrie, in a separate account.

In spite of the disappointing Mallee fowl mound sweep, the excursion was most successful. The recent heavy rain had filled many scenic lakes providing us with opportunities to observe many species of waterbirds. The country has its fascination with its Acacia, Mallee and mixed woodlands, Eremophilas and other shrubs in flower dotted here and there, the compact shapes, colours and textures of the Gimlets and many Casuarina cristata (Black oak) and the almost exotic appearance of the occasional Brachychiton gregorii and Callitris preisii ssp. verrucosa. These generally reflect the underlying soil types, red loam flats, pinkish residual granitic sandy country including sand ridges, breakaways with many colours and forms, the lakes and clay pans, the granite outcrops and the soaks. Thanks to Daphne for a well organised Excursion and to CALM for the use of their excellent facilities.

"The Naturalist News"
May 1999

Gilbert Marsh

BIRD NOTES FOR THE EASTER CAMPOUT AT GOONGARRIE STATION.

Some Club members travelled directly to Goongarrie Station, while others with more time took alternative routes. On the Mt Jackson road Lake Deborah and small ephemeral lakes were full and attracting all kinds of waterfowl, including Pink-eared Duck and Australian Shoveller. Several Australian Shelduck and Maned Wood Duck were seen in forested areas, obviously seeking nesting hollows. Two Major Mitchell Cockatoo were seen 30kms north of Lake Deborah.

On the 2nd April 1999, Banded Stilt were discovered breeding on a very isolated low island in Lake Goongarrie by following their distant sounds carried on a strong easterly wind. Initially it was thought the breeding colony at a conservative estimate, consisted of about 3,000 birds with about the same number feeding out in the lake away from the breeding area. (The shallow water had an abundance of Brine Shrimps.) However, after looking at photographs taken at the time, it is possible there could be up to 10,000 birds.

It appeared as if they had all suddenly gone down to nest after Cyclone Elaine. During Cyclone Vance in March thousands of eggs were abandoned after being covered with

sand, blown into piles or washed down the slope into the lake.

103.

Since Cyclone Vance the colony has restructured and breeding is continuing with many fresh scrapes and newly laid eggs. It is expected that the breeding colony of Stilt will increase rapidly over following weeks as hundreds of copulating pairs were to be seen on the lake. However, the depth of water covering the lake was low and unless there is more follow up rain in the area within the next month, it could well be that the colony will be abandoned. Due to the isolated nature and difficult access to areas where these birds breed, there have been less than 25 breeding records in Australia since white settlement.

Shield Shrimp and Brine Shrimp were plentiful in ephemeral lakes close to Goongarrie Station homestead and others we visited on the way to Goongarrie National Park. Black Swan, Hoary-headed Grebe, Australian Shelduck, Grey Teal (up to 96 on one lake), a single Australian Shoveller, Red-necked Avocet and White-faced Heron were recorded.

On our early morning bird walks from the homestead, interesting birdlife included about six Hooded Robin. Red-capped Robin were reasonably plentiful and there was a lot of courting behaviour going on between pairs. Splendid Wrens, Southern Whiteface, Chestnut and Yellow-rumped Thornbill were also reasonably common. Horsfield's Bronze-Cuckoo were seen and heard. Spiny-cheeked Honeyeater were common and Crested Bell Bird heard often. The Owllet Nightjar calling at dawn near the shed close to the homestead possibly had a roost there. After our unsuccessful hot walk in formation along grid lines to monitor Mallee Fowl, it was gratifying next day to find distinctive fresh tracks near an unused nest mound not far from the grid line area. While doing this walk Shy Heath Wren, Mulga Parrot, White-fronted Honeyeater and White-eared Honeyeater were seen.

On Lake Wangine near Siberia, there were considerable numbers of Black Swan, Grey Teal, Australian Shelduck and Eurasian Coot to be seen. Returning to Perth, near Northam we stopped to view a Barn Owl sitting on a road sign.

Kevin Coate

YOUNG NATURALISTS EXCURSION

A BUGS LIFE

And it certainly was a bug's life. Rather unwittingly, over thirty junior and senior Naturalists ventured into a world of assassins and poisons of adventure.... and cockroaches. Saturday, 7th March, a heated morning on Wireless Hill, Applecross was the scene, Eric McCrum our man. While the main focus was insects, we were still able to view the swift and deadly accurate male Darter, and a magnificent sparrow hawk, showing her beauty from high in the sky. Also, the celebrity reptile of the day - a Bobtail Skink found by David and its attached ticks that completed the pack. At 38cm in length and 810g this bobtail provided the group with a chance to touch, hold and watch her devour a supply of apple. The ticks were extracted from the earhole and back region, and we were able to view these squeamishly fascinating arachnids from a close range.

Letter (27/4/1999) from Mary E. White, D.Sc., to JL seeking BaSt photos for a book, '*Water in a Changing Land*', she is writing. See her letter of 20/7/1999 above for response.

Note that this book was apparently to contain, inter alia, material (checked by Andy Chapman) about Lake Boonderoo.

Borrow a copy of this book to see content re BaSt and Lake Boonderoo.

Mary E. White D.Sc.

34 Beatty Street
Balgowlah
NSW 2093
ph. 02 99485269
27th April, 1999

Mr Jim Lane
CALM
14 Queen Street
BUSSELTON
WA 6280

Dear Mr Lane,

Andrew Chapman suggested that I should write to you in the hopes that you might have a slide or a colour print of a banded stilt to illustrate a section of my book *Water in a Changing Land*. I have a major study of the palaeodrainages of WA with their playas and Andrew has kindly supplied the scientific papers and information on the stilts. He has also checked my account of the region where the nesting occurs and Lake Boonderoo etc. The story of those birds is so interesting that it would be nice to see what they look like. Andrew sent me good pictures of the full lakes and one of eggs on the ground.

I enclose a flyer so that you can see the sort of book I am writing -- it is to be a companion volume to Listen ... Our Land is Crying. If you have publications which provide extra information on water birds (or others) whose behaviour is related to the filling of the lakes, I would be most interested to hear from you.

Thanking you,

Yours sincerely,

A handwritten signature in cursive script, appearing to read 'Mary E. White', is written over a horizontal line.

LISTEN... OUR LAND IS CRYING

AUSTRALIA'S ENVIRONMENT:
PROBLEMS & SOLUTIONS

MARY E. WHITE

Williams, W.D., De Deckker, P. & Shiel, R.J. (1998). *The limnology of Lake Torrens, an episodic salt lake of central Australia, with particular reference to unique events in 1989*. Hydrobiologia 384:101-110. Refer to when writing up water level, salinity, aquatic invertebrate 'sweep samples', BaSt gut contents (diet) and brine shrimp sections of report on Lakes Ballard and Marmion in 1995.



The limnology of Lake Torrens, an episodic salt lake of central Australia, with particular reference to unique events in 1989

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³ Murray-Darling Freshwater Research Centre, Albury, NSW 2640, Australia

Key words: salt lakes, desert lakes, Lake Torrens, Australia, episodic

Abstract

Lake Torrens, a large (~ 6 000 km²), episodic, saline playa lake in arid central Australia, filled for the first recorded time in March 1989. This unique event followed unprecedentedly heavy rain over its catchment. Water remained in the lake until early 1990. Salinities remained low (< 40 g l⁻¹) until November 1989, then increased rapidly to > 200 g l⁻¹ before the water evaporated completely. Na and Cl probably dominated the ions. Twenty-nine taxa of aquatic animals were recorded. Crustaceans dominated and of these *Parartemia minuta* (anostracan), *Daphniopsis queenslandensis* and *Moina baylyi* (cladocerans), and several species of ostracods were the most important. Other significant taxa included *Tanytarsus barbitarsis* (chironomid), *Brachionus plicatilis* (rotifer) and *Craterocephalus eyresii* (fish). The fauna was dominated by widespread forms that are either part of a distinct assemblage found widely in central Australian salt lakes (especially *P. minuta*, *D. queenslandensis*, *M. baylyi* and *Trigonocypris subglobosus* [ostracod]), or cosmopolitan forms (*B. plicatilis*), or forms found widely in Australian salt lakes (e.g. *Diacypsis compacta*, *Tanytarsus barbitarsis*). However, possibly three new species also occurred: a new species of a new genus of mytilocypridid, *Branchinella* nov.sp. and *Heterocypris* nov. sp. Their occurrence is anomalous. It is suggested that further work will show that they too are widely distributed. Both genera of the latter two taxa are typical of temporary waters and specimens may have been washed in from nearby water-bodies.

Sixty-four species of bird were recorded when the lake contained water, many breeding. The breeding of the banded stilt (*Cladorhynchus leucocephalus*) was notable; breeding of this species had been unknown in South Australia since 1930. A large population built up until breeding was stopped by predation from the silver gull (*Larus novaehollandiae*). When dry, the lake has a depauperate but well-defined and regionally restricted 'terrestrial' fauna (scorpions, spiders, beetles, ants).

Introduction

Almost 20 per cent of the world's land surface comprises arid and hyper-arid regions, i.e. regions receiving < 300 mm mean annual precipitation. Notwithstanding their aridity, numerous lakes occur in such regions: for 'deserts', a climatic category approximately equivalent to arid and hyper-arid regions, Meybeck (1995, Table 11) listed almost 1000 lakes with surface area > 1 km², with a total lake area > 125 000 km² (of which, however, some 50 per cent is contributed by the Aral Sea in central Asia). Meybeck's values

are likely to be underestimates because many usually dry lakes in deserts would undoubtedly have been excluded from consideration. Lakes that are usually dry, nevertheless, may on occasion contain substantial amounts of water. These occasions occur more or less unpredictably, often infrequently, and the lakes they fill are best referred to as *episodic* lakes (*sensu* Williams, in press). They are confined to arid and hyper-arid regions, but are most typical of arid regions.

Episodic lakes *ipso facto* have been little studied by limnologists. They are often inaccessible, only infrequently and unpredictably contain water as noted,

and many if not most are saline when water is present. These features, however, do not mean that they lack scientific interest or biological value; they are simply difficult to study with few opportunities to do so. They are best known in Australia. Here, recent limnological studies include those of Bayly (1976), Williams & Kokkinn (1988) and Williams (1990) on Lake Eyre, and Timms (1993, in press a, b) on the Paroo lakes of inland New South Wales and Lake Wyara, Queensland.

An opportunity to study another Australian episodic lake occurred in 1989 following unprecedently heavy rain in March of that year over the catchment of Lake Torrens, a lake not known to have filled in recent times. The main aim of the present paper is to report on this unique event and its results. A second aim is to summarize other limnological features of the lake which despite its large area (it is the second largest in Australia after Lake Eyre North), is surprisingly rarely mentioned, except briefly, in the limnological literature. It is scarcely mentioned, for example, in Hammer's (1986) comprehensive global treatise on salt lakes or the inventory of important South Australian wetlands by Morelli & de Jong (1996).

General limnological features

Lake Torrens is located between 30 and 32° S and 137 and 138° E (Figure 1) and situated at 30–35 m above sea-level. Maximum length is 220 km, and maximum width, ~ 70 km. Total area is 5923 km² (upper values of 30 000 km² given in some texts, e.g. Gleick (1993), are incorrect; Bowler (1981) gave a surface area of 5640 km² and a catchment area of 27 800 km²). The lake is very shallow; mean depth when full is 0.5 m; maximum depths (1.5 m) occur on the western side of the lake and this part was the last to dry in 1990 as shown by examination of satellite images (Landsat). The volume of the lake when full is ~ 3000 km³. The bed is not completely flat and areas of low relief (islands in 1989) occur, several associated with mound springs located on the lake bed, especially towards the western margin. These mound springs may be 0.1 to 2 m high as a result of gypsum deposition.

The geology and hydrology has been investigated especially by Johns (1963, 1967) and Schmid (1985, 1990). Bowler (1981) discussed the hydrology of the lake and concluded that under the present climatic regime it would never fill and retain water. The lake

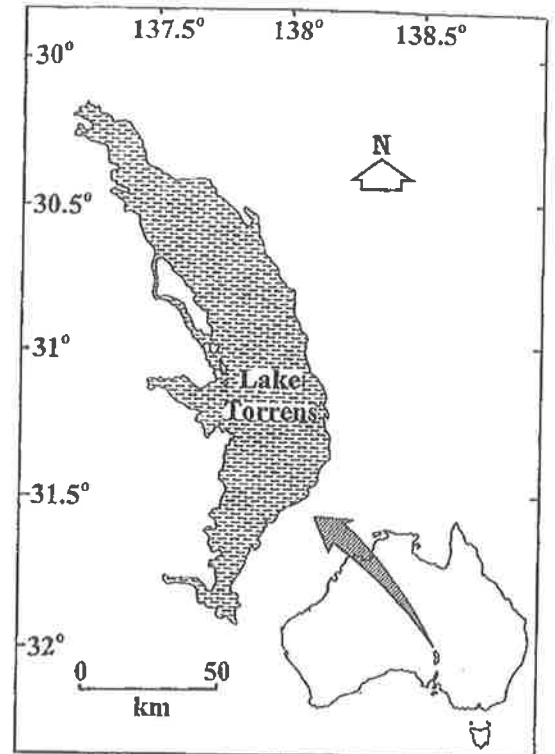


Figure 1. Location of Lake Torrens, Australia.

is best described as a playa within a graben resting on sediments that are of Cainozoic age and 300 m deep. A geological fault delimits the western edge of the lake which is overlooked by the Arcoona Plateau, a dissected, flat region of sandstone. The eastern edge of the lake lies adjacent to an extensive, low, flat, alluvial plain. The lake arose when the block on the eastern side of the fault or fracture zone sagged at the end of the Cretaceous (~ 70 million years ago) and sediments began to accumulate in the fault-angle valley so formed (Twidale & Campbell, 1993). Gypsum has precipitated in the topmost 100 m of sediments, deposited in Quaternary times, especially towards the lake's centre. Rather small amounts of halite occur on the surface of the lake, a feature explained by Schmid (1990) as due to the low rate of evaporation (50 mm per annum) of groundwater. As a whole, the bed of the lake is gypsiferous clay and large areas remain damp for considerable periods even in the absence of precipitation.

All major inflowing streams arise in the Flinders Ranges to the east of the lake. However, they only rarely discharge into the lake; most debouch their wa-

Table 1. Mean monthly and annual precipitation near Lake Torrens. Data supplied by the South Australian Regional Office of the Bureau of Meteorology and reproduced with permission. Values as mm

Station	J	F	M	A	M	J	Jy	A	S	O	N	D	Ann.
Oakden Hills ¹	14.3	16.4	11.5	12.1	18.6	19.1	12.7	14.3	14.3	15.8	15.2	12.8	177.9
Woomera airport ²	16.9	21.1	14.9	13.1	23.8	15.0	16.5	14.1	16.1	15.3	17.8	12.7	197.2
Leigh Ck airport ³	22.7	12.8	33.2	10.7	26.7	17.1	24.4	20.6	12.1	14.6	19.6	39.0	261.7

¹ Period of record, 1879–1996

² Period of record, 1982–1998

³ Period of record, 1949–1998

Table 2. Mean monthly and annual precipitation near Lake Torrens in 1989. Data supplied by the South Australian Regional Office of the Bureau of Meteorology and reproduced with permission. Values as mm. Data for March 1989 in italics

Station	J	F	M	A	M	J	Jy	A	S	O	N	D	Ann.
Oakden Hills ¹	0.0	0.0	<i>199.8</i>	55.6	38.2	24.7	26.8	0.0	6.3	7.4	9.8	7.4	367.0
Woomera airport ²	0.0	0.0	<i>191.2</i>	26.0	58.8	27.4	26.2	1.4	1.2	7.2	7.0	9.6	358.0
Leigh Ck airport ³	0.0	0.4	<i>175.1</i>	12.9	32.2	21.8	53.4	0.2	4.2	14.5	64.8	22.6	402.0

ter on to the eastern, permeable plain. Except in 1989, the only water on the lake comprises shallow (< 2 cm deep), isolated, short-lived saline pools which move across the lake under the action of the wind and which result from small episodic rainfall events over the lake itself.

Climate

Mean annual rainfall in the region is ~ 200 mm so that according to most climatic criteria (e.g. Grove, 1977, and Beaumont, 1989) the region is arid. Rainfall events, as usual in such regions, may occur at any time of the year. Table 1 provides data on mean monthly and annual precipitation at three meteorological stations near the lake, two ~ 50 km east of it (Oakden Hills, Woomera airport), and one ~ 50 km to the west (Leigh Creek airport). Maximum air temperatures in summer are frequently > 40 °C (mean maximum, 34 °C) but in winter are often near 1 °C (mean minimum, ~ 4 °C). Mean annual pan evaporation is ~ 3 m.

For lakes in arid regions, it is not mean monthly or annual values of precipitation that are important but rather maximum values of unpredictable events. As indicated, an event of unique magnitude took place near Lake Torrens in 1989. In March of that year, unprecedentedly high amounts of rain fell over the lake's catchment, with values surpassing any previously or subsequently recorded. Monthly values for the whole

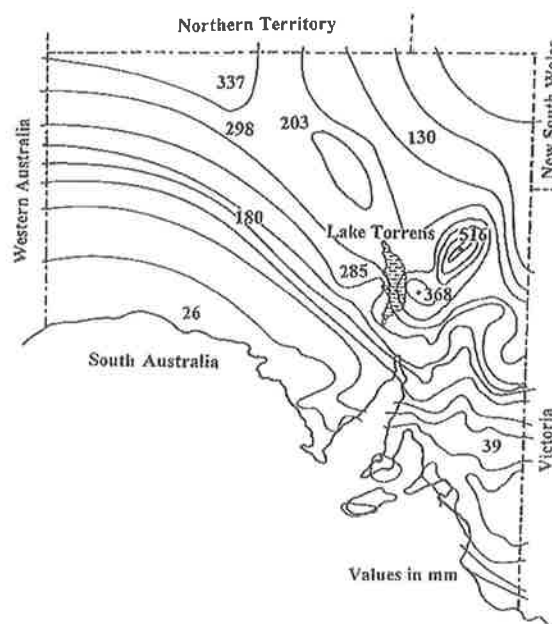


Figure 2. Spatial patterns of rainfall in March 1989. Modified from Robinson & Minton (1990).

of 1989 at Oakden Hills, Woomera airport and Leigh Creek airport are given in Table 2. The most significant rain began to fall on March 9, with peak falls on March 14. The maximum value recorded was 676 mm (Gammon Ranges immediately south of the lake; Robinson & Minton, 1990). Rainfall was unevenly distributed

Table 3. Major ion composition of interstitial water in Lake Torrens in 1983 and surface water of some water-bodies near Lake Torrens. All data as $g\ l^{-1}$

Lake	Na	K	Ca	Mg	Cl	SO ₄	HCO ₃ + CO ₃	Salinity
Torrens ¹	103	0.7	0.6	4.3	185	7.0	0.0	301
Eyre South ²	9.1	0.0	0.6	0.1	14.3	1.3	0.1	25.5
Island Lag. ³	100	0.3	1.4	4.8	16.0	7.2	<0.1	274
Nr Wirrappa ³	229	0.1	0.6	2.5	45.3	2.5	0.1	73.9
Nr Ironstone ³	90	0.6	1.0	10.6	177	9.4	0.2	288
Nr Pematty ³	108	0.8	0.7	9.1	189	12.4	<0.1	320

¹ Interstitial brine near centre of lake, 21 May 1983. From Schmid (1985).

² From original data summarized in Williams and Kokkinn (1988).

³ Pool on or near water-body, 3 September 1996. Unpublished data.

Table 4. Salinity of Lake Torrens April 1989 – Feb. 1990. Salinity data as $g\ l^{-1}$

Date	No. of samples	No. of sites	Range of salinity	Mean salinity
April 1989	2	2	13–19	16
May	5	4	18–52	29
June	4	3	19–37.5	30
July	1	1	19	19
August	1	1	20	20
September	3	3	22–32	26
October	2	2	30–40	35
December	5	5	31–273	138
January 1990	1	1	181	181
February	1	1	249.5	294.5

as Figure 2 indicates; while some areas received > 500 mm, others towards the coast received < 50 mm.

Overall, it can be seen that the events of 1989 illustrate clearly the central climatic feature so far as the occurrence of episodic lakes in arid regions is concerned: the temporal and spatial unevenness and unpredictability of sufficient rain to form a lake.

Chemical features

The ionic composition of subsurface waters of Lake Torrens was investigated by Schmid (1985). His data relate to near surface interstitial waters collected prior to 1989. No analyses of major ions in surface waters were made in 1989. It is unlikely, however, that the major ionic composition of these differed significantly from that of other surface waters in the region and subsurface brine in the lake itself. A selection of data is provided in Table 3. The table shows that like al-

most all other inland saline waters in Australia (Hart & McKelvie, 1986), Na and Cl are the dominant ions with only small amounts of HCO₃. For Lake Torrens itself, the pattern of ionic dominance in subsurface water was Na > Mg > K > Ca: Cl > SO₄ > HCO₃, with Na forming 92 per cent (by equivalents) of total cations, and Cl, 97 per cent of total anions. Schmid's (1985) investigations showed some vertical differences in ion proportions; Na and Cl became even more dominant at lower levels.

The pattern of salinity change in the lake in 1989 was determined from surface water samples collected from April to December. Salinity was derived by determination of conductivity and the use of the regression equation of Williams (1986). Samples were diluted when necessary. They were obtained by several collectors at a variety of sites. A summary of results is shown in Table 4. This illustrates the following points:

- (i) Despite the large volume of fresh water that entered the lake in March 1989 (~ 3000 km³), water in the lake was clearly saline by the time first sampled (April 25).
- (ii) Spatial variation in salinity occurred, particularly towards the end of 1989. In December, for example, salinities at different sites but collected on the same day (Dec. 21) ranged from 69.3 to > 200 $g\ l^{-1}$.
- (iii) Notwithstanding the extent of spatial variations, mean lake salinity remained relatively low (< 40 $g\ l^{-1}$) for most of the time water was present, i.e. until November. After November, salinity rose rapidly and in early 1990 was at or near > 200 $g\ l^{-1}$. It was undoubtedly near saturation shortly before disappearing in early 1990. This pattern is a little different from that found at Lake Eyre South by Williams & Kokkinn (1988) when that lake

filled in 1984. Here, salinities were low at first, rose steadily thereafter, and then rapidly during the final months when water was present.

Biological features

Lake inundated

Two elements of the biota were investigated in 1989: the aquatic fauna and the avifauna, particularly the banded stilt (*Cladorhynchus leucocephalus*). Only the aquatic fauna is discussed in detail here; the biology of the stilt was investigated by others and has been discussed elsewhere (Phillipps, 1990; Robinson & Minton, 1990) but with details yet to be published. Only a brief synopsis of their results is given.

Aquatic fauna

Samples of the aquatic fauna were obtained at a variety of times between April and December 1989 as opportunities arose. Several collectors were involved, each using slightly different collecting techniques and nets (mostly zooplankton nets). Several sites were involved. Often water samples were not obtained at the time of collection. Despite differences of this sort, a relatively consistent pattern of temporal distribution and taxonomic composition emerged.

The results of the sample analyses are given in Table 5 and Figure 3. Table 5 lists all taxa recorded in 1989 and the range of salinity over which they occurred derived from mean monthly salinities. Figure 3 illustrates the temporal pattern of distribution for all taxa recorded in at least two separate months. Not provided here are estimates made of relative abundances of taxa.

Several obvious points emerge from consideration of Table 5, Figure 3 and the abundance data.

(i). The number of taxa (29) recorded from Lake Torrens is not high but is comparable with the number found in other episodic salt lakes in Australia, namely, Lake Eyre South, the Paroo lakes and Lake Wyara; Williams & Kokkinn (1988), Timms (1993, in press a,b).

(ii). Nektonic and zooplanktonic crustaceans dominated the fauna, with *Parartemia minuta*, *Daphniopsis queenslandensis*, *Moina baylyi* and ostracods the most important. Of the insects, only *Tanytarsus barbitarsis* was recorded abundantly and more than twice, with

all other insect groups found only sporadically and always in low numbers.

(iii). Most of the fauna characteristic of predictably-filled salt lakes of South Australia, i.e. those which contain water on an annual predictable basis, was absent, notably calanoid copepods, *Coxiella*, and *Haloniscus searlei*.

(iv). Many of the taxa occurred on an apparently intermittent basis – present on separate occasions but unrecorded between these. Likewise, abundances varied widely. For example, one sample obtained on May 10 was dominated by cladocerans and ostracods with anostracans not abundant (numbers in a subsample were 1000+, 500 and 10 individuals, respectively), whereas a sample obtained later the same month (May 28) was dominated by anostracans with cladocerans and ostracods subdominant (numbers were 1396, 970 and 870, respectively). Shortly afterwards, in a sample obtained on June 4, ostracods dominated with cladocerans and anostracans not important (numbers were 1000+, 4 and 77 individuals, respectively).

(v). Except for *Triops australiensis australiensis*, no well-defined temporal patterns of succession or restriction to particular salinity ranges were obvious. Moreover, salinity tolerance ranges displayed no unusual features for the taxa involved.

A central question which arises from these points is: to what extent is the macrofauna of Lake Torrens similar to that found in other Australian episodic salt lakes and to what extent does it support the hypothesis of Williams & Kokkinn (1988) that most aquatic macroinvertebrates of episodic salt lakes are geographically widespread because such lakes are poor evolutionary loci? Before this question can be adequately addressed, individual taxa found in Lake Torrens (Table 5) require separate comment.

Both species of rotifers found are regarded as cosmopolitan, though until the identity of Australian 'strains' of *Brachionus plicatilis* are discriminated it is appropriate to designate collections of this species from Lake Torrens as *sensu lato*.

The single notostracan recorded, *Triops australiensis australiensis*, is widespread throughout central and northern Australia (Williams & Busby, 1991) where it is usually confined to fresh waters. However, it has been recorded from mildly saline waters by Timms' (1993) in a Paroo lake, viz. at 19 g l⁻¹. Unfortunately, no water sample was collected when specimens were collected. Possibly it was able to survive only during the initial period when the lake

Table 5. Macrofauna recorded in Lake Torrens, 1989, and salinity ranges (derived from mean monthly salinities)

	Taxon	Salinity range (g L ⁻¹)	
Rotifera	<i>Brachionus plicatilis</i> Muller	26-30	
	<i>Hexarthra fennica</i> (Levander)	29	
Notostraca	<i>Triops australiensis australiensis</i> Spencer and Hall	16	
Anostraca	<i>Parartemia minuta</i> Geddes	19-30	
	<i>Branchinella</i> nov. sp.	19	
'Cladocera'	<i>Daphniopsis queenlandensis</i> Sergeev	16-30	
	<i>Moina baylyi</i> Forro	16-30	
	<i>Daphnia</i> sp.	29	
Copepoda	<i>Apocyclops dengizicus</i> (Lepeschkin)	26	
	<i>Metacyclops</i> sp.	16-29	
Ostracoda	<i>Australocypris insularis</i> (Chapman)	16-35	
	<i>Heterocypris</i> nov. sp.	20-35	
	<i>Diacypris whitei</i> (Herbst)	29-30	
	<i>D. dictyote</i> De Deckker	29-35	
	<i>D. compacta</i> (Herbst)	20-(~ 80)	
	mytilocypridinid gen. et sp. nov.	29	
	<i>Platycypris baueri</i> Herbst	29-30	
	<i>Trigonoocypris subglobosus</i> De Deckker	29-35	
	<i>Reticocypris walbu</i> De Deckker	35	
	<i>Necterosoma dispar</i> (Clark)	26	
	<i>Sternopriscus clavus</i> (Clark)	35-138	
	<i>Tanytarsus barbitarsis</i> Freeman	26-138	
	<i>Tanytarsus</i> sp.	26	
Insecta	<i>Cladotanytarsus</i> sp.	30	
	<i>Procladius paludicola</i> Skuse	35-138	
	<i>Pentaneura</i> sp.	26	
	Ceratopogonidae	30	
	Ephydriidae	29	
	Pisces	<i>Craterocephalus eyresii</i> (Steindachner)	26-(138)*

* Dead and dying specimens only.

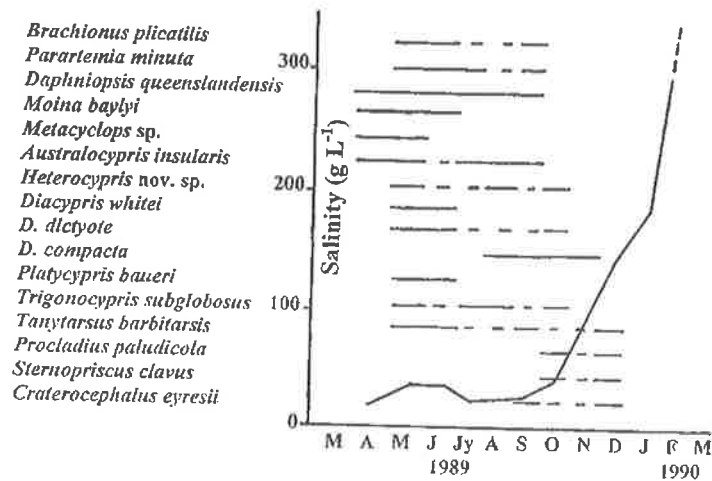


Figure 3. Occurrence of major macrofauna in Lake Torrens in 1989.

contained water after the first inflow of fresh water. It was collected at only one time (April 24) and site.

The anostracans almost entirely comprised *Parartemia minuta*, a species previously recorded from Lake Eyre, Lake Buchanan (Timms, 1987) and some Paroo lakes (Timms, 1993). Specimens of *Branchinella* together with *P. minuta* were also collected on one occasion, a co-occurrence remarkably analogous to that of *B. nicholli* and *P. minuta* in Lake Buchanan, Queensland, at a salinity of $\sim 42 \text{ g l}^{-1}$ (M. Geddes, pers. comm.). The species of *Branchinella* at Lake Torrens, however, is not *B. nicholli* and is considered to be new to science (M. Geddes, pers. comm. 3.8.93).

The two most abundant cladocerans, *Daphniopsis queenslandensis* and *Moina baylyi*, fall within the range of morphological variation for these species. Both probably occur widely in central Australia, having been recorded from Lake Buchanan, the Paroo lakes and Lake Wyara (Timms, 1987, 1993, in press a, b). *Daphniopsis queenslandensis* is also probably the species found by Williams & Kokkinn (1988) in Lake Eyre South, as suggested by them. *Moina baylyi* is similarly widespread; it is known from Western Australia, Lake Eyre, Lake Buchanan, the Paroo lakes and Lake Wyara (Geddes et al., 1981; Williams & Kokkinn, 1988; Timms, 1987, 1993, in press a,b). Given current revisions of species of *Daphnia* in Australia (C. Wilson, pers. comm.) and the emerging complexity of its taxonomy, no specific name can be advanced at present for this taxon with confidence.

Of the copepods, only cyclopoids were collected. The material of *Apocyclops* is close to if not conspecific with *A. dengizicus*, a species found in Western Australia, Lake Buchanan, the Paroo lakes and Lake Wyara (Geddes et al., 1981; Timms, 1987, 1993, in press a, b). No species name could be assigned to the material of *Metacyclops*.

All ostracod species, apart from *Heterocypris* nov.sp., have previously been recorded from Lake Eyre, Lake Buchanan, or elsewhere. Thus, *Australocypris insularis* (= *A. hypersalina*) also occurs in western Victoria, south-eastern South Australia and Western Australia. *Diacypris whitei* has been found in Lake Eyre, Western Australia and elsewhere, *D. dictyote* in south-eastern South Australia, inland NSW and elsewhere, and *D. compacta* from Lake Buchanan to Western Australia. The latter is one of the most ubiquitous hypersaline ostracod species in Australia. The new mytilocyprid ostracod shares many morphological similarities with *Mytilocypris splendida*, but is larger, has a rounded posterior end and a very broad

inner lamella all around the periphery of the shell. It has been recorded from Lake Eyre and many other saline lakes in central Australia. It has also been found in Lake Annean in northern Western Australia. *Platycypris baueri* has been widely recorded from salt lakes in south-eastern and south-western Australian salt lakes. It has not, however, previously been recorded from any in central Australia (including Lakes Eyre, Buchanan, Wyara and the Paroo lakes). *Trigonocypris subglobosus*, on the other hand, is known from all of these lakes. *Reticocypris walbu*, originally described from freshwater mound springs north of Lake Torrens, also occurs in Lake Buchanan. It was not found, surprisingly, by Williams & Kokkinn (1988) in Lake Eyre South; they recorded only *R. kurdimurka*. The *Heterocypris* species resembles *H. tatei* redescribed by De Deckker (1979); this also occurs in mound springs north of Lake Torrens. This genus and its Australian representatives display much morphological variation. Possibly it entered Lake Torrens from the Flinders Ranges during the flooding of the creeks there for these creeks frequently have temporary or ephemeral pools. The remains of organisms which live in such waters (e.g. conchostracans) have been found on the dry salt floors of lakes in central Australia.

All insect taxa, so far as can be determined, are widespread forms. *Tanytarsus barbitarsis* occurs not only in southern salt lakes but also in those of central Australia including Lakes Eyre, Buchanan and Wyara.

Craterocephalus eyresii is widespread in central Australia (e.g. Glover & Sim, 1978; Paxton et al., 1989). Curiously, it is absent from some lakes there; it has never been found, for example, in the well-investigated Coongie lakes north-west of Lake Eyre (J. Puckridge, pers. comm.). Although specimens from Lake Torrens were collected on three occasions, only dead and dying specimens were collected in Dec. 1989 and Jan. 1990 (J. Bye, pers. comm.). It has been suggested that populations of this fish in Lake Torrens were derived from small populations known to live in some of the mound springs on or near the lake (J. Read, pers. comm.). In any event, Glover & Sim (1978) have recorded the species at salinities of up to 110 g l^{-1} within the Murray-Darling catchment basin.

It is clear from the above that many of the species recorded in 1989 do indeed appear to belong to a widespread faunal assemblage that seems to characterize central Australian salt lakes of which most if not all are episodic. Characteristic macroinvertebrate species in this assemblage are *P. minuta*, *D. queenslandensis*, *M. baylyi*, *Trigonocypris subglobosus*, *Reticocypris walbu*

and the new ostracod genus. Additional taxa within this assemblage are cosmopolitan forms (*B. plicatilis*, *H. fennica*) or widespread Australian forms (e.g. *T. barbitarsis*).

It is also clear, however, that differences occur between the faunal assemblages in individual lakes. Thus, although *R. kurdimurka* occurred in Lake Eyre in 1984 (Williams & Kokkinn, 1988), it was not found in Lake Torrens where only its congener occurred, *R. walbu*. *Parartemia minuta* was not found by Timms (in press, b) in Lake Wyara. *Boeckella triarticulata* was not found by Williams & Kokkinn (1988) in Lake Eyre but was found in this lake on an earlier occasion by Bayly (1976) and also occurs in Lake Wyara (Timms, in press, b). Several explanations for these differences can be offered. One, of course, relates to the intensity of collecting; more intensive collecting may have yielded species absent from initial collections. A second one involves subtle differences in the chemistry of the lakes. The ostracods of Lake Torrens, for example, appear to be those tolerant of low calcite saturation levels. A third one involves chance, especially with regard to the occurrence of congeneric species. Chance has already been invoked as an explanation of why similar salt lakes in Western Australia are inhabited by several species of *Parartemia* but only one species in each lake (Williams & Geddes, 1991). Thus, chance may determine which species of *Reticypis*, *R. walbu* or *R. kurdimurka*, reaches an episodic lake first and then excludes its congeners. Chance is also involved in determining the season when episodic rain falls, and this in turn may determine what species occur. Note in this connection that the intermittent salt lakes in southern Australia fill with water first in autumn.

Less easy to explain is the occurrence of two of the unknown species in Lake Torrens (*Branchinella* nov. sp., and *Heterocypris* sp.), particularly since Williams & Kokkinn (1988) hypothesise that episodic salt lakes are not suitable loci for speciation. The occurrence of these new species is anomalous and would seem to negate this hypothesis. However, given that (1) most species in Lake Torrens and other episodic salt lakes in Australia are widespread, (2) studies of Australian episodic salt lakes are still sparse, (3) our knowledge of certain groups remains incomplete (e.g. of *Daphnia*), and (4) small numbers of new and apparently restricted species are recorded whenever an episodic lake is first studied but have subsequently proved on further study to be not restricted to that lake (cf. Williams & Kokkinn, 1988), it is suggested that the hypothesis still remains plausible. Moreover,

Branchinella and *Heterocypris* are typical of temporary waters and they could have been washed into the lake from temporary pools on the catchment. In the lake they merely survived rather than reproduced. Further studies of episodic salt lakes in Australia are needed, whenever and wherever opportunities arise, as are studies of the distribution of the new species of *Branchinella* and *Heterocypris*. It is suggested that further studies of these species will show they too are widely distributed.

As for the reasons why most species in episodic salt lakes are widespread, these must certainly involve enhanced abilities of resting eggs to survive long dry periods and highly effective dispersal mechanisms. However, the extent, nature and relative importance of these features remains unclear at present.

Avifauna

A large number of bird species was recorded at Lake Torrens during 1989; Bellchambers & Carpenter (1990) listed a total of 64 species, most of which, however, could be regarded as only facultatively associated with the lake. Of waterbirds, the banded stilt (*Cladorhynchus leucocephalus*), silver gull (*Larus novaehollandiae*), gull-billed tern (*Sterna nilotica*) and red-capped avocet (*Recurvirostra novaehollandiae*) were the most important. All bred on the lake in 1989. The breeding of the banded stilt was particularly notable and large populations developed. This species is endemic to Australia and a characteristic bird of salt lakes throughout the continent. Even so, after its original description in 1816, breeding was not recorded until 1930 when it was seen to breed in some episodic salt lakes in Western Australia and South Australia (Lake Callabonna). No further breeding in South Australia was recorded until it bred in Lake Torrens in 1989. The event was closely monitored by a number of ornithologists and popular accounts of their observations were published in 1990 (Phillipps, 1990; Robinson & Minton, 1990). A more detailed account of their observations is in progress. A brief synopsis of their observations was also published in 1996 (Boulton & Williams, 1996).

In brief, breeding began on islands only four weeks after the arrival of water in the lake. Eggs (3–4, sometimes 5) were incubated by both parents continuously for 19–21 days. Newly hatched chicks were not fed by the parents but led immediately to the edge of the lake where they began to feed themselves. Shortly after hatching and beginning to feed, the chicks formed bands with other chicks and some adults and these

bands swam away from the nesting sites to new feeding areas. In some cases, the bands moved up to 100 km. Those adults remaining at the nesting sites then began a second breeding cycle. Thus, the first breeding cycle was more or less complete only two months after the filling of the lake, i.e. by early May, and the second cycle by mid-June. Large populations of the banded stilt built up. However, further breeding was restricted by heavy predation of eggs and chicks by the silver gull which had also bred and built up considerable populations. Eventually the breeding of the stilt was terminated by this predation (not by adverse environmental conditions or a shortage of food).

The silver gull is favoured by human waste dumps near most modern Australian townships (Murray & Carrick, 1964) so that large populations of this ubiquitous and omnivorous species have built up over recent decades. Whether these populations now pose a threat to the continued viability of the banded stilt is not known. Even so, for a species like the stilt whose breeding is tied to unpredictable and infrequent events, any threat to its maximum use of resources during these events must *a priori* be considered a potential threat of some importance.

Lake when dry

The attention of limnologists has focussed almost exclusively upon the biota of temporary lakes when these contain water. Nevertheless, information is accumulating which indicates that a smaller, but nonetheless well-defined biota also occurs on the dry bed of at least episodic salt lakes. This typically and mainly comprises scorpions, spiders, ants, beetles and orthopterans. All of these groups have been recorded from Lake Torrens and/or adjacent lakes when dry (P. Hudson, pers. comm.). None occurs in adjacent fully terrestrial areas, that is, all are confined to habitats on the dry surface of Lake Torrens and adjacent lakes. Present evidence suggests that, unlike the aquatic fauna of episodic salt lakes which seems mainly to comprise widespread forms, the 'terrestrial' fauna of episodic salt lakes comprises much more regionally restricted forms. Thus, *Lycosa eyrei*, appears confined to a group of episodic salt lakes in central South Australia (including Lake Torrens and Lake Eyre; Hudson, 1996, 1997). Allozyme electrophoretic studies indicate that gene flow is limited between populations of this (and other) species and reveals that population substructuring is common within the species and often to the finest level of geographical sampling (Hudson &

Adams, 1996). The possibility arises, therefore, that the evolution of the 'terrestrial' fauna of episodic salt lakes – including Lake Torrens – shows the reverse of the pattern suggested for their aquatic fauna by Williams & Kokkinn (1988). Extended, this leads to the suggestion that episodic salt lakes are important evolutionary loci for their 'terrestrial' biota, whereas predictably filled salt lakes are not and are populated (if at all) by a widespread fauna. This suggestion remains to be explored. In this connection, it may be noted that the 'terrestrial' fauna of episodic salt lakes has only a limited ability to withstand inundation (days, not weeks).

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Johnstone, R.E. & Storr, G.M. (1998). *Handbook of Western Australian Birds. Volume 1. Non-Passerines (Emu to Dollarbird)*, pp.206-207, Plate 30, Egg Plate 20 (Banded Stilt).

Pages re Silver Gull are also reproduced here. J 03/5/2014.

HANDBOOK OF
WESTERN AUSTRALIAN
BIRDS

VOLUME I

**NON-PASSERINES
(EMU TO DOLLARBIRD)**

R.E. Johnstone and G.M. Storr

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Back cover: Lesser Noddy *Anous tenuirostris*. Photograph by Michael Morcombe

Square-tailed Kite *Hamirostra isura*. Photograph by Max Howard

Carnaby's Cockatoo *Calyptorhynchus latirostris*. Photograph by Simon Nevill



other; a third or more birds may also join in. Conversely, an aggressor may rush another bird with head down in crouched posture; or alternatively the approach may be slower, with a more strutting gait, with head, neck and fore-body raised (sketch C) (J. Darnell).

Remarks. Several birds in aberrant plumages have been observed and photographed in Cockburn Sound. They differ from normal plumage in having the lower back blackish (not white); the uppertail coverts marked with black; the black breast extending further onto the upper belly; and belly, flanks and undertail coverts streaked with black (see figure 36).

Measurements (mm). Bill exposed length 69-84 in 4 males (87-88 in 3 females), entire length 78-95 (97-98), depth 12.5-14 (14.5-16.5), width 12-14 (14.5-15); wing 267-287 (276-281); tail 98-111 (110-114); tarsus 56-60 (58-60); middle toe and claw 40-41 (41-42).

Sooty Oystercatcher *Haematopus fuliginosus*

Gould 1845

Plate 30

Egg Plate 21

Description. Length 39-48 cm (female slightly larger than male). Weight 580-720 g.

Plumage sooty black with slight gloss on neck and back and brown tinge on tail and flight feathers. Iris red, reddish brown or brown; skin around eye orange or reddish orange; bill red with pale tip; mouth orange; legs reddish pink.

Distribution. North coast and continental islands from the Berkeley River south-west to Admiral Bay; north-west and upper west coasts from Cape Keraudren south to Point Quobba, northern Peron Peninsula and Dirk Hartog I.; mid-west coast around the mouth of the Murchison and the

Houtman Abrolhos; lower west coast, north to Rottneest I. and Burns Beach (casual at Green Head and Beagle Is); south coast and islands (as far offshore as Eclipse, Termination, Salisbury and Daw). Also eastern Australia and Tasmania.

Habitat. Mainly rocky coasts and tidal reef and mud flats; also estuaries (but not very deep inlets like Cambridge Gulf, King Sound and Hamelin Pool), beaches (especially at banks of cast-up seaweed) and near-coastal short grass (a lawn at Albany in winter).

Status. Moderately common north of tropic; moderately common to uncommon between the tropic and the Abrolhos; rare visitor (mainly in winter) to lower west coast; uncommon to very common on south coast (abundance increasing eastwards). Usually in pairs or family parties, occasionally small flocks (up to 10) and loose aggregations (up to 47).

Food. Stomachs of six birds contained gastropods and crabs.

Breeding. Singly and only on islands. Nest a scrape in sand, often located near a rock. Eggs laid from July to early September in north (south to the Abrolhos), late September to November off south coast; clutch 2 (rarely 1); slightly lustrous; creamy white or buff with black and brown spots, blotches and streaks and grey underlying marks; oval; 60-66 x 41.5-44 mm (mean of 17 eggs from 9 clutches, 62.5 x 42.9).

Voice. Similar to Pied Oystercatcher.

Geographic variation. Width of bare skin around eye increases from south to north: width in front of eye on south coast 1.5-3 mm (N=8, mean 2.1), on upper west coast from the Abrolhos north to Point Quobba 3-4 mm (N=4, 3.8), and in Pilbara and Kimberley 6.5-7 mm (N=2, 6.6).

Measurements (mm). Bill exposed length 64-78 in 8 males (70-85 in 5 females), entire length 77-91 (82-97), depth 14.5-16 (14-15.5), width 15-16 (14.5); wing 278-297 (277-297); tail 108-121 (111-126); tarsus 51-60 (52-61); middle toe and claw 44-52 (45-49).

FAMILY Recurvirostridae

A worldwide group of seven moderately large inhabitants of wetlands and plateaux with long slender bill, very long slender legs and partly or fully webbed feet. Gregarious and noisy.

Black-winged Stilt *Himantopus himantopus*

(Linnaeus 1758)

Plate 30

Egg Plate 20

PREVIOUS NAMES: White-headed Stilt, Pied Stilt.

Description (of subspecies *H. h. leucocephalus*). Length 33-38 cm (male slightly larger than female).

ADULT. White except for black or sooty black nape, upper half of neck, upper back and wings (oily green or greenish blue gloss on upper back and scapulars), grey or pale grey central tail feathers and sometimes greyish or blackish marks near tip of lateral tail feathers. Axillaries

white; underwing black or sooty black. Undertail mostly white. Iris red or reddish brown; bill black; legs bright pink.

IMMATURE. Differs in having crown and feathers around eye grey; neck grey or pale grey; upper back and wings brownish black; some marginal underwing coverts tipped white.

Distribution. Better-watered parts of State, but not north-west and central Kimberley, Darling Range or far south-west (south of Busselton and west of Lake Muir and Denmark); casual elsewhere, including Dirk Hartog, Pelsaert and Rottneest Is. Also eastern Australia, south New Guinea and



New Zealand; casual further north, from Philippines, Borneo and Java east to Bismarcks. [Other subspecies in south Europe, Africa, south Asia, Hawaii and Americas.]

Habitat. Shallow open fresh or brackish waters: swamps, lagoons, claypans, rain-freshened samphire flats and saltlakes, floodwaters, river pools, dams and sewage and mining ponds. Also saltlakes (including saltwork ponds) and estuaries.

Status. Nomadic. Common in well-watered flatlands; common in wet years in drier parts of range but generally scarce to moderately common. Usually in ones, twos or small parties, occasionally flocks (up to 200), also much larger aggregations (up to 5,000) in south-west in summer.

Food. Stomachs of five Parry Creek birds contained many small molluscs (swallowed whole), insects (including beetles) and small hard seeds.

Breeding. Reported north to Sandfire and east to Lake Nabberu, Lake Barlee, Kalgoorlie and Esperance. Nest a shallow depression in bare ground of islet in temporary lake or swamp with or without lining of grasses or rootlets, or (if no dry land available) a depression in platform of herbage in a samphire or grass tussock just above water level. Eggs laid from January to November, mostly in autumn in north and spring in south; clutch 2-4 (mostly 4); smooth or dull; buffy brown or buffy olive with black and dark brown blotches, spots and scrawls and underlying grey marks; pyriform to oval; 40-46 x 28-32 mm (mean of 27 eggs, 43.2 x 30.7). Downy chicks (weight 11.5-13 g): upperparts mottled with black, buff and grey (the black forming several large blotches on back and wings); underparts white; iris dark; bill brownish grey; legs bluish grey.

Voice. Nasal yaps or yelps. Immatures utter a soft whistling.

Measurements (mm). Bill exposed length 59-66 in 7 males, mean 61.6 (57-63 in 6 females, mean 60.3), entire length 70-77, 72.7 (67-72, 70.2), depth 6-7, 6.4 (6-7, 6.5), width 6-7.5, 6.6 (6.5-7.5, 6.9); wing 214-235, 226.2 (208-228, 219.7); tail 67-76, 72.4 (64-74, 70.8); tarsus 109-123, 116.1 (100-131, 113); middle toe and claw 39-46, 42.6 (37-44, 40.8).

Banded Stilt *Cladorhynchus leucocephalus*
(Veillot 1816)

Plate 30
Egg Plate 20

Description. Length 36-40 cm. Weight 172-302 g.

ADULT. White except for dull black or brownish black scapulars and folded wing; broad chestnut or dark chestnut band on breast, edged above by blackish line and continuous below with dark brown, brownish black or dull black patch in centre of belly. Outer primaries dull black or blackish brown; inner primaries blackish brown grading to white on inner web; secondaries white with some greyish brown at base of outer web; tertiaries black. Sometimes brownish tinge on uppertail coverts and central tail feathers. Marginal and outer lesser and median underwing coverts blackish grey, occasionally tipped white; primary coverts grey; rest of underwing coverts white; outer primaries dark grey; rest of flight feathers white. Iris dark brown; bill black; legs pink.

IMMATURE. White except for some greyish brown smudges on head (mainly forehead, lore and around eye) and occasionally blackish spot in front of eye; wing dark brown, inner primaries tipped white; central uppertail coverts brownish grey; central tail feathers pale grey; underwing as in adult; legs brown, greyish brown or dull pink. In slightly older birds greyish brown on head restricted to lore; wing blackish brown; breast band a mixture of dark grey, chestnut and white feathers; belly patch dark grey mixed with white. Birds in juvenile-immature plumages, i.e. with completely white underparts or with only a trace of breast band and belly patch, are capable of breeding.

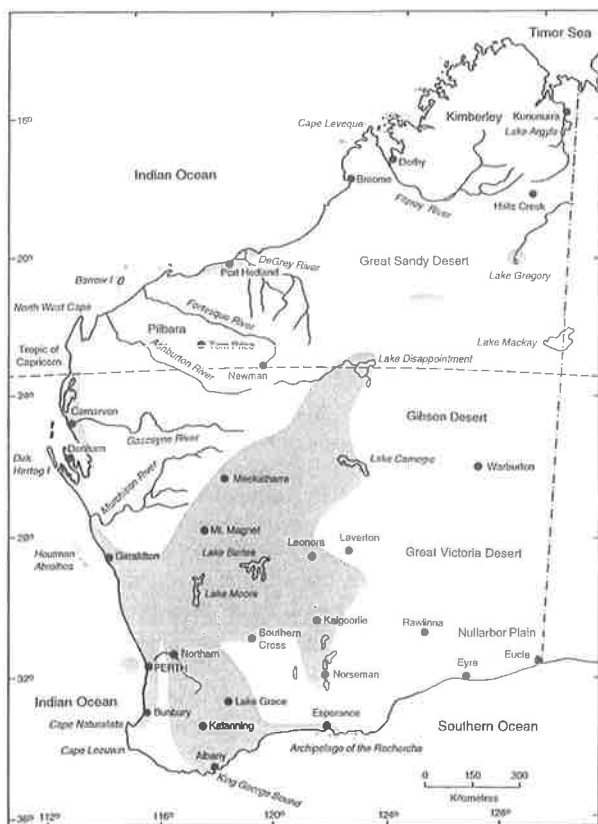
Distribution. Patchily in arid, semiarid and subhumid wetlands north to 20°S and east to 123°E, including Rottneet I.; casual elsewhere, including Lake Gregory and Barrow and Pelsaert Is. Also eastern Australia (south).

Habitat. Mainly saltlakes (including saltwork ponds) and estuaries; also fresh and brackish lakes and swamps.

Status. Nomadic or migratory, spending off-season on permanent lakes, mostly on coastal plains (north to Leslie Saltworks, Lake Gregory, Lake MacLeod and including Rottneet I.) and in south-western interior; moving after heavy rains between late summer and early winter to breeding range, but not necessarily nesting every year. Usually in flocks (sometimes of thousands).

Food. Mainly brine shrimps *Artemia salina* and *Parartemia* spp. Also said to feed on 'small black ostracods' floating on surface and a 'slender-spined mollusc'.

Breeding. Nesting colonially (up to 20,000 pairs) in arid and semiarid southern interior (reports from Wagga Wagga Lake and Lakes Barlee, Ballard, Marmion, Goongarrie,



?Cowan, King and Grace; in ?1904, 1930, 1932, 1960, 1963, 1973, 1974, 1975, 1980, 1988 and 1995); also subfossil eggs from much further north (Percival Lakes in 21°22'S). Nest a scrape, c. 13 cm across, 3-4 cm deep and 30 cm to a metre apart, in bare ground of islet in partly-filled saltlake. Eggs laid from April to August; clutch 2-5 (mostly 3 and 4); smooth; chalky white (sometimes a slight creamy tinge) with black or dark brown blotches, spots and scrawls and grey underlying marks; oval; 51-59.5 x 36-40 mm (mean of 89 eggs, 54.6 x 38.2). Downy chick (4-7 days old, weight 19-28 g): white except for grey at base of bill and in lore; iris dark brown; bill black; mouth grey; legs dull grey. Feathered runner white except for greyish brown forehead and lore, black spot in front of eye, greyish brown speckling on crown and brownish black wing. Non-flying young fend for themselves, running and swimming with ease; many are said to be taken by aborigines, *Corvus* spp., Whistling Kites, Wedge-tailed Eagles and foxes.

Measurements (mm). Bill exposed length 70-75 in 8 males, mean 71.5 (63-70 in 12 females, mean 67.8), entire length 78-85, 81.4 (72-81, 77.4), depth 5-8, 6.4 (5.5-6, 5.7), width 6-8, 6.8 (5-7.5, 6.3); wing 195-204, 198.5 (178-201, 190.8); tail 74-86, 79.3 (70-84, 76.5); tarsus 84-92, 87.1 (73-85, 79.7); middle toe and claw 32-36, 33.5 (31-34, 32.3).

Red-necked Avocet *Recurvirostra novaehollandiae*
 Vieillot 1816
 Plate 30
 Egg Plate 20

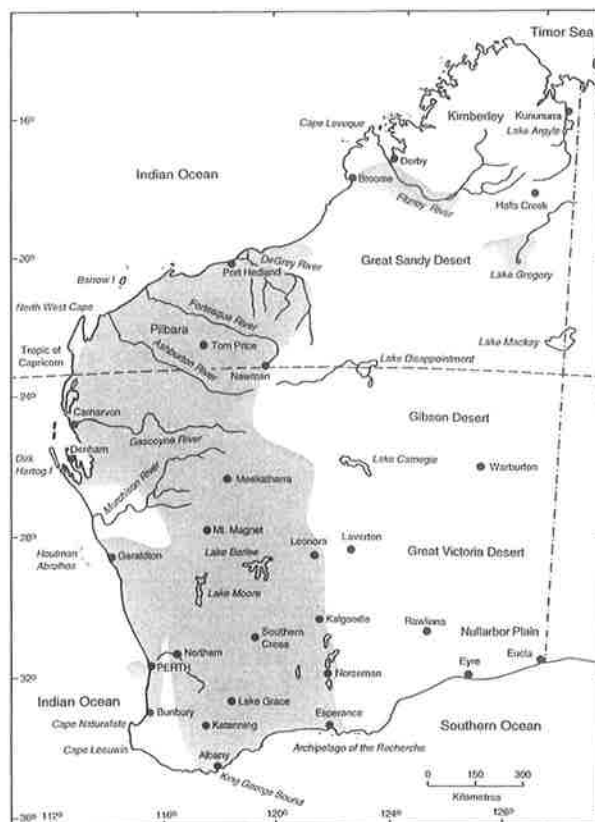
Description. Length 41-45 cm. Weight 195-439 g.

ADULT. Head, upper neck and throat chestnut except for whitish around base of bill and white eye ring. Lower neck, back and rump white. Outer scapulars white; inner scapulars black, large feathers paler and with whitish tip and outer web (blackish scapulars forming dark stripe on each side of back). Marginal and lesser upperwing coverts white; median coverts black; greater coverts white with black at base of outer web; outer seven primaries black, inner feathers black with white at base of inner web; innermost primaries white with blackish tip; secondaries white; upper tertiaries blackish, lower mostly white. Central tail feathers pale grey; lateral feathers grading to white, outermost with greyish smudge near tip. Rest of underparts white except for greyish white undertail. Underwing white except for blackish outer primaries. Iris dark brown or reddish brown; bill black; legs bluish grey.

IMMATURE. Differs in having head greyish brown with whitish mottling on forehead and chin, and blackish parts of plumage replaced with dark brown.

Distribution. Better-watered flatlands north to the Fitzroy, including Rottnest I. but not far south-west (south of Busselton and west of Denmark); casual elsewhere (as far north as Port Warrender and on Pelsaert I.). Also eastern Australia; vagrant in Tasmania and New Zealand.

Habitat Shallow open fresh, brackish or salt waters (swamps, lagoons, claypans, estuaries, saltwork and sewage ponds, ephemeral waters and dams).



Status. Nomadic. Rare to common (generally more numerous in south than north and near coast than in interior). Usually ones, twos or small flocks; occasionally large aggregations (up to 4,000), especially in summer and autumn in south.

Breeding. North to Sandfire and east to Lake Nabberu, Lake Way, Lake Goongarrie and Kalgoorlie (Hannan Lake), but in south-west not west of Three Springs, Lake Ninan, Northam, Lake Grace and Pingrup, except occasionally on Rottnest I. Nest a slight hollow lined with rootlets or fine dry samphire twigs, usually on islet in partly-filled saltlake. Eggs laid from March to early January (mostly autumn in north and spring in south); clutch 2-6 (very rarely 2, 5 or 6);

smooth and dull; creamy buff or buffy brown with blackish spots, blotches, scrawls (occasionally) and underlying grey marks; oval; 48-54 x 34.5-36.5 mm (mean of 20 eggs, 51.3 x 35.6) [82 eggs measured by J.N. Dunlop et al. at Lake Way ranged from 47-56 x 32-38 mm]. Downy young: upperparts greyish brown with some blackish marks on head and back; underparts whitish; bill and legs bluish grey. Young at Rottnest I. preyed on by Silver Gulls and Ravens.

Voice. Yapping notes lower-pitched and less sharp than in Black-winged Stilt.

Measurements (mm). Bill exposed length 88-97 (N=6), entire length 94-105, depth 6.5-7.5, width 9-11; wing 226-238; tail 78-87; tarsus 79-98; middle toe and claw 37-45.

FAMILY Charadriidae

The plovers, lapwings and dotterels, a fairly large worldwide group of small to medium-sized shorebirds with short straight bill and moderately long legs. They inhabit coasts, margins of lakes and other inland waters and bare or grassy plains.

Masked Lapwing *Vanellus miles* (Boddaert 1783)

Plates 24 and 28
Egg Plate 20

PREVIOUS NAMES: Masked Plover (for *V. m. miles*) and Spurwinged Plover (for *V. m. novaehollandiae*).

Description (of *V. m. miles*). Length 30-35 cm. Weight 191-282 g.

Forehead, crown and nape black. Neck white except for narrow median brownish grey stripe. Back, upperwing coverts and rump pale brownish grey; side of rump white.

Tail white with wide subterminal black band (narrowing towards sides), feathers tipped greyish white or white. Primaries black; outer secondaries black with grey base, black decreasing inwards; inner secondaries and tertiaries brownish grey. Underparts white except for small brownish grey patch on shoulder and side of breast (often hidden by closed wing). Underwing coverts white; primaries black; outer secondaries black and grey base, black decreasing inwards; inner secondaries and tertiaries pale grey. Undertail as in upper surface. Iris yellow; bill yellow, creamy brown or olive brown; wattles yellow (extending down 19-36 mm and back 3.5-9.5 mm from eye); legs purplish red or olive brown.

V. m. novaehollandiae is slightly larger (weight 340 g) and has wide black stripe on back of neck, large black patch on shoulder and side of breast, and smaller wattles (extending down 13-19 mm and back 1-2 mm from eye).

Distribution. *V. m. miles*: far north, south to Roebuck Plains, Christmas Creek and Lake Gregory; vagrant in Pilbara and south-west. Also eastern Australia (north) and south New Guinea; casual on Ambon, Banda, Kai Is, Letti, Babar and Tanimbar.

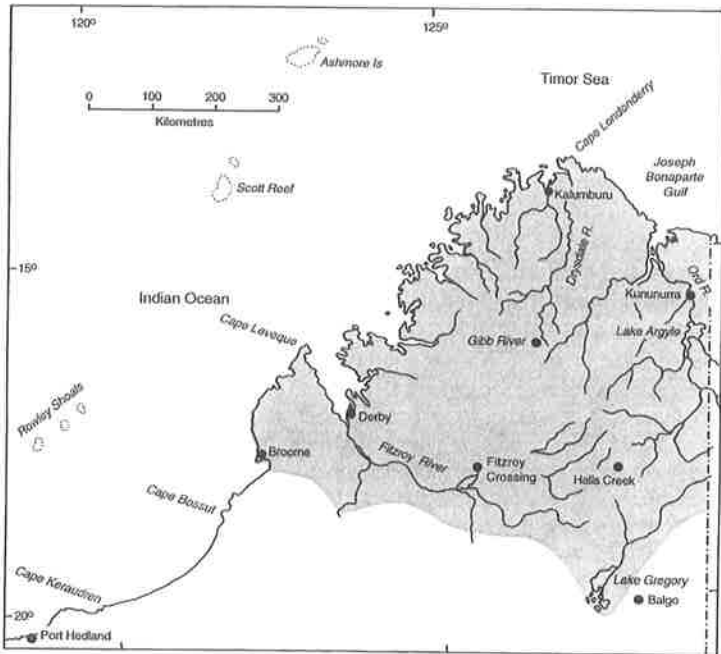
V. m. novaehollandiae: mid-eastern and south-eastern Australia, Tasmania and recently New Zealand; vagrant in south of Western Australia and one record from Lake Gregory (K. Coate).

Habitat. Edge of freshwater swamps, lagoons, claypans, river pools, bore overflows, sewage ponds and floodwaters.

Status. Nomadic. Moderately common (at least in wet season) in north-east and south Kimberley flatlands; rare in hilly north Kimberley. Usually in pairs or small flocks.

Food. Stomach of a Wyndham bird contained beetles.

Breeding. Nest a slight depression on bare ground (including shingle of river beds), with or without a scanty lining of dry grass and sometimes sheltered from above by a tussock of





J. C. BARKELL

Red-necked Phalarope *Phalaropus lobatus*
(Linnaeus 1758)

Plate 29

OTHER NAME: Northern Phalarope.

Description. Length 18-20 cm. Weight 29-34 g.

NON-BREEDING. Head white except for black spot or short vertical bar in front of eye, curving below eye to join black ear coverts. Nape and centre of neck grey or blackish grey; upper surface of neck white towards sides. Back, scapulars, centre of rump and central tail coverts grey to blackish grey, most feathers edged and tipped white; side of rump and lateral tail coverts mostly white. Marginal, lesser and median upperwing coverts blackish grey, median coverts tipped white; primary coverts blackish, inner feathers tipped white, rest of greater coverts dark grey or blackish grey broadly tipped white (forming white wing bar); primaries

blackish, inner feathers grading to white at base; secondaries basally white, distally dark grey or blackish grey and narrowly tipped white; tertiaries dark grey or grey, edged white. Tail dark grey or grey, lateral feathers narrowly tipped white, outermost with white outer edge. Underparts white except for some grey on side of breast and flanks. Marginal underwing coverts blackish or dark grey, tipped white; primary coverts grey tipped white; rest of coverts white; flight feathers mostly grey. Undertail mostly grey. Iris dark brown; bill needle-fine and black; legs grey or black.

BREEDING FEMALE. Differs in forehead, crown, centre of neck and side of head dark slaty grey except for white spot above and below eye; chestnut half-collar from behind ear down side of neck and across top of foreneck; throat white, often outlined with grey; lower foreneck, upper breast and flanks slaty grey, most feathers tipped white; back and scapulars slaty grey, upper back feathers and upper scapulars edged pale brown or golden buff (forming pale streak down side of back) and some feathers tipped white.

BREEDING MALE. Paler and less clearly patterned.

Distribution. Breeding in far north of Europe, Asia and North America and wintering at sea off east Africa, east Asia (from Ryukyus south to Sundas and east to Bismarcks) and western South America. Casual in Australia.

Habitat. Mainly near-coastal saltlakes, including saltwork ponds.

Status. Very rare visitor (August to April). Reported from 15 km SE Wyndham, Leslie Saltworks, Lake Hinds, Swan River estuary, Rottne I. and Eyre. In ones, twos or small parties (up to 20).

Measurements (mm). Bill exposed length 20-23 (N=6), entire length 26-29, depth 3, width 3-3.5; wing 108-113; tail 45-53; tarsus 20-21; middle toe and claw 20-21.

Voice. In flight a short rather hard 'twik'.

Remarks. Normally feeds whilst swimming, picking up prey from surface.

PLATE 30

1. Bush Stone-curlew *Burhinus grallarius* (p. 202)
(A) adult, (B) adult in flight (above) and (C) chick
2. Beach Stone-curlew *Esacus neglectus* (p. 203)
(A) adult, (B) adult in flight (above) and (C) chick
3. Pied Oystercatcher *Haematopus longirostris* (p. 203)
(A) adult, (B) adult in flight (above), (C) adult in flight (below) and (D) chick
4. Sooty Oystercatcher *Haematopus fuliginosus* (p. 205)
(A) adult of southern form, (B) head of northern form, (C) adult in flight (above), (D) adult in flight (below) and (E) chick
5. Black-winged Stilt *Himantopus himantopus leucocephalus* (p. 205)
(A) breeding, (B) immature, (C) juvenile, (D) chick, (E) adult in flight (above) and (F) adult in flight (below)
6. Banded Stilt *Cladorhynchus leucocephalus* (p. 206)
(A) adult, (B) juvenile, (C) chick, (D) adult in flight (above) and (E) adult in flight (below)
7. Red-necked Avocet *Recurvirostra novaehollandiae* (p. 207)
(A) adult, (B) juvenile, (C) chick, (D) adult in flight (above) and (E) adult in flight (below)

FAMILY Rostratulidae

Two species of moderately small marsh birds, one in the Old World and one in southern South America, superficially like the true snipes but distinguished by their slower and more direct flight and sexual dimorphism (female more brightly coloured and slightly larger than male).

Painted Snipe *Rostratula benghalensis*
(Linnaeus 1758)

Plate 23
Egg Plate 19

Description (of *R. b. australis*). Length 26-28 cm.

ADULT FEMALE. Head mostly dark brown or blackish brown, some feathers tipped white; median white or buff stripe from bill to nape; eye ring white, widening behind eye and extending as stripe to above ear coverts. Neck chestnut, some feathers barred or tipped black. Upper back brownish grey, feathers barred and blotched with blackish

brown; scapulars brownish grey with olive tinge, blackish bars and pale tip, outer webs of some feathers edged or barred buff, some concealed feathers white with or without narrow and blackish subterminal bars; lower back grey finely barred black; rump, tail coverts and tail grey to pale grey, feathers with fine black bars and large round black-edged white and buff spots (mostly white on rump and base of tail feathers). Marginal and greater wing coverts olive green, finely barred black; lesser and median coverts grey to olive green with fine black bars and black-edged white spots; outer web of primary coverts buffy brown to grey with large black-edged

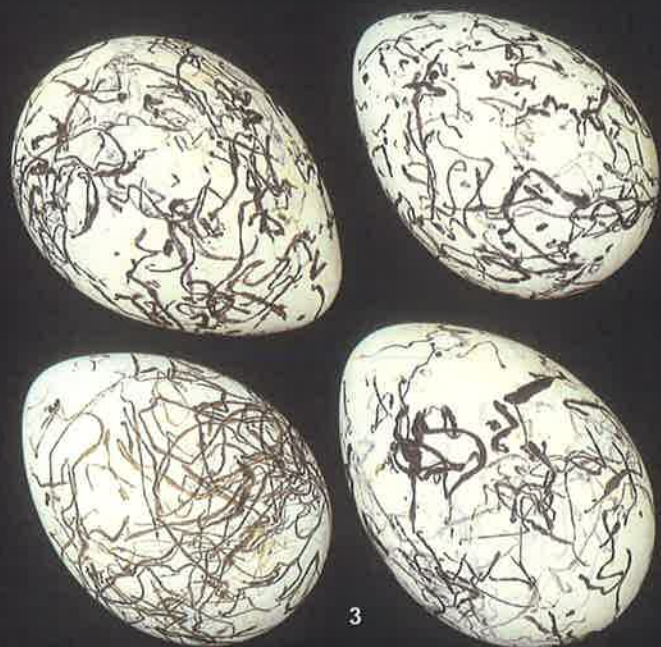


PLATE 20

1. Banded Lapwing *Vanellus tricolor* C/4. Canning Vale, WA. (p. 209)
2. Masked Lapwing *Vanellus miles miles* C/4. Roebuck Plains, WA. (p. 208)
3. Banded Stilt *Cladorhynchus leucocephalus* C/4. Lake Marmion, WA. (p. 206)
4. Banded Stilt *Cladorhynchus leucocephalus* C/4. Lake Marmion, WA. (p. 206)
5. Black-winged Stilt *Himantopus himantopus* C/4. Wownaminya Lake, WA. (p. 205)
6. Red-necked Avocet *Recurvirostra novaehollandiae* C/4. Wubin, WA. (p. 207)

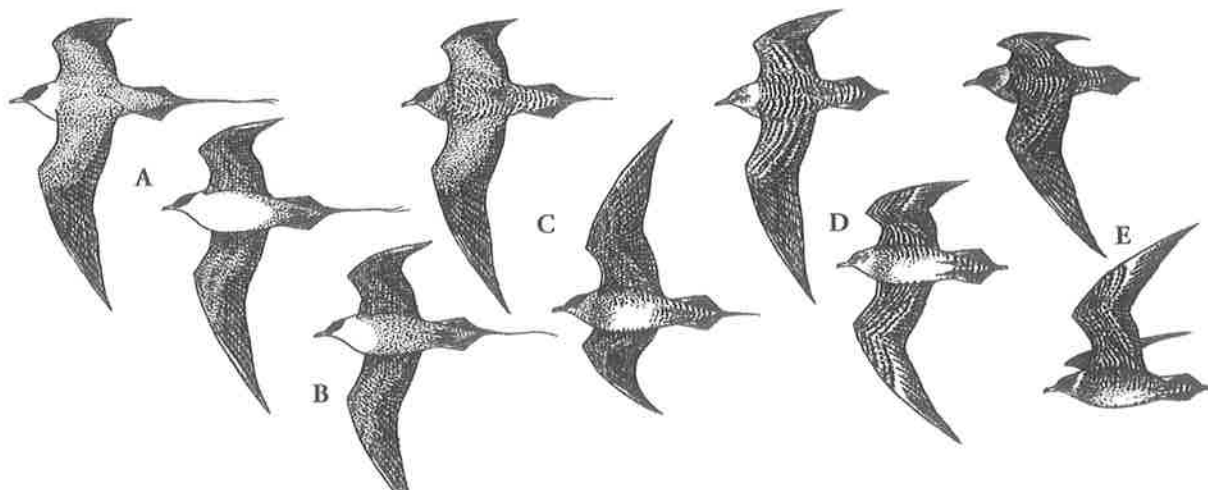


Figure 44. Long-tailed Skua (A) breeding pale phase, (B) breeding dark phase, (C) non-breeding adult, (D) immature pale phase and (E) immature dark phase. (G. Miller)

primaries dark brown (old) or blackish brown (new); secondaries blackish brown; tertiaries greyish brown; rump and uppertail coverts mainly barred greyish brown and white; tail dark brown except for new blackish central feather; underparts white except for brown streaks and smudges on breast and some greyish brown bars on flanks and undertail coverts. Axillaries mostly grey or barred brown and white; underwing grey except for some white bars, tips and mottling on marginal and lesser coverts; undertail mostly grey.

Distribution. Breeding in arctic Europe, Asia and North America, and dispersing southwards. Accidental in Western Australia.

Status. Four southern records: an immature found near Boyup Brook (far south-western interior) after a storm in late February 1979; an immature found at Lake Forrestdale on 22 March 1992; an immature seen off Fremantle on 5 February 1990 and a beach-washed bird found at Eyre Bird Observatory on 10 November 1994. Also reports from Timor Sea in October 1996.

Measurements (mm). Bill exposed length 30 in Boyup Brook specimen (25-29 in 5 others, including 2 Russian breeders), entire length 43 (34-40), depth 10.5 (8.5-10), width 12.5 (8.5-10.5); wing 280 (295-315); tail 130 (133-345); tarsus 43 (41-45); middle toe and claw 37 (36-38).

Silver Gull *Larus novaehollandiae*

Stephens 1826

Plates 31 and 32
Egg Plate 22

OTHER NAME: Red-billed Gull (New Zealand).

Description (of *L. n. novaehollandiae*). Length: male 37-44 cm, female 36.5-42.5 cm. Weight: male 250-420 g, female 194-368 g.

ADULT (Perth to Albany). Head, neck, upper back, rump, tail coverts, tail and underparts white. Lower back, scapulars and marginal, lesser and median wing coverts pale grey; outer primary coverts white; rest of greater coverts

pale grey. Outermost primary (p10) black with white tip (often worn), long white mirror distally (sometimes margined with black on inner web), narrow white tongue basally, shaft black in black part of feather and white in white part; p9 similar but mirror slightly smaller and always margined black on inner web, basal white tongue wider and longer (up to half length of feather on both webs), shaft white except through black tip; p8 similar to p9 but mirror small or absent and tongue wider and longer (up to nearly two-thirds of feather on both webs); p7 white (grading through grey to black on outer web) with broad black subterminal bar and white tip; p6 similar but grey part of feather larger, p5 grey with blackish subterminal bar and white tip; rest of flight feathers pale grey. Axillaries and marginal underwing coverts white; rest of coverts pale grey; outer primaries black with white mirror and tongue; rest of flight feathers pale grey. Iris white; orbital ring reddish orange, orange or orange-yellow; bill red, dark maroon with tip tinged black, orange-brown with blackish brown tip; brick red with reddish brown tip or maroon to brick red with tip tinged brown; legs brick red, dark reddish brown, reddish brown, reddish orange or orange-yellow.

IMMATURE (8-10 months old). Like adult but some brownish marks on wing coverts, smaller mirror on outer primaries, and wide blackish brown subterminal bar on secondaries. Iris dark brown; orbital ring greyish black; basal half of bill greyish brown, rest blackish brown; mouth pink; legs grey. In transition from juvenile to adult the tail band is lost first, then the speckling on wing coverts and finally the black bar on the secondaries.

Distribution. Most coasts and many islands (as far offshore as Adele, Bedout, Montebellos, Dorre, Houtman Abrolhos and Termination); also Lake Muir in south-west interior; casual elsewhere in interior (north to Lake Gregory) and on south-east coast (east of Israelite Bay). Also eastern Australia and Tasmania. Vagrant in south New Guinea. [Other subspecies in New Caledonia and New Zealand.]

Habitat. Islands, coasts, estuaries and near-coastal lakes (including saltwork ponds), flooded samphire flats and sewage ponds. Also brackish and fresh waters in interior, including sewage ponds and dams. Attracted to schools of

fish, surface-breeding seabirds (especially Terns in south and Brown Boobies and Lesser Frigatebirds in north), garbage dumps, fishing boats, whale factories, shipping, dredge and sewer outlets, town parks, sports grounds, holiday camp sites, flooded rivers, inundated pastures, and reservoirs (for bathing).

Status. *Coastal populations.* Largely sedentary. Scarce to very common (most plentiful at Lacepede Is and within 30 km of Fremantle and 15 km of Albany; least on coasts remote from towns and seabird-breeding islands). In ones, twos or flocks (up to 300); occasionally much larger flocks (up to 5,000) in estuaries and when flying to roosts.

Interior. Lake Muir birds are morphologically indistinguishable from birds of far south-west coast; there is evidently some interchange of birds, for numbers vary with lake levels. Elsewhere in south-western interior (north to Yarra Yarra Lakes, Lake Hinds, Walyormouring Lake and Lake Champion) scarce and only recorded from July to November (except after tropical cyclone of March 1943); until their wing pattern is examined their origin will remain unknown (we suspect that most of them come from south-western Australia). Further north and east, gulls are rare; specimens from Lake Gregory and Newman sewage ponds evidently came from south-eastern Australia, and we suspect the same origin for the birds observed at Lake Violet, Lake Barlee, Kalgoorlie, Lake Boonderoo and dams on Nullarbor Plain.

Food and feeding Away from seabird colonies and human habitation they feed on dead or live marine or aquatic animals in water and on shores, including brine shrimps *Artemia salina* on Rottne I. At seabird-breeding islands they take eggs of Sooty Tern, Common Noddy, Pied Cormorant, Brown Booby etc. and steal food intended for nestling Common Noddies, Brown Boobies etc. R.H. Stranger related that they eat all non-commercial fish discarded from fishermen's nets at Mandurah except devil fish *Gymnapistes marmoratus*, leatherjackets *Scobinichthys granulatus* and items more than c. 15 cm long (which are usually lost to pelicans and cormorants). Observed feeding on flying ants (May to August) in south-west and on Barrow I., kelp fly maggots in rotting seaweed at Mandurah, light-attracted insects in Perth at night, and scorched insects and lizards on Rottne I. after a bushfire.

Breeding. Usually colonially and almost wholly on islands: in north-west Kimberley (Jones I.), Dampier Archipelago (Elphick Nob), Montebello Is (Long I., Ah Chong I.), Lowendal Is (Abutlon I., Bridled I., Parakeelya I. etc.), off Barrow I. (Mushroom I., Middle I., Boodie I.), Bernier I., Dirk Hartog I. (including Egg I. and Meade I.), in Freycinet Estuary (Slope I., Friday I., LeFebre I., Charlie I., Freycinet I., White I., Wilds I., Mary Anne I., South Guano I., Salutation I., Three Bays I., islet in Depuch Loop), Houtman Abrolhos (North I., West Wallabi I., Plover I., Long I., islet north of Rat I., formerly Rat I., Roma I., Dry I., Gilbert I., Alexander I., Serventy I., Gibson I., Suomi I., Keru I., Shearwater I., Wooded I., Bynoe I., Helms I., Stokes I., Joe Smith I., Leo I., Coral Patches, The Nook, Jackson I., Newman I., Coronation I., Burton I., Post Office I., Uncle Margie I., Pelsaert I., Stick I., Murray I., Gun I., Middle I., Sweet I., Ship Rock, Jon Jim I.), Beagle I., Snag I., Drummond Rock, Lipfert I., Milligan I., Fisherman Is, Sandland I.,

Favorite I., Osprey I., Tern I., Essex Rocks, Cervantes I., Buller I., Whittell I., Lancelin I., Rottne I. (including Cathedral Rocks, Crayfish Rock, Armstrong Rock, Parakeet I., rock in Geordie Bay, Clune Rock, Monday Rock, Duck Rock, Phillip Rock, Joan Rock, Dyer I. rock off Salmon Point and Green I.), Mewstone, Carnac I. (including West Rock and Flat Rock), Garden I. (formerly), rock off Cape Peron, White Rock, Bird I., Gull Rock, Seal I. (Shoalwater Bay), Shag Rocks, Penguin I. (including rock to north-east), Passage Rock, The Sisters, Sugarloaf Rock, Cape Mentelle, Hamelin I., Seal I. (off Cape Leeuwin), St Alouarn I., Flat I., Sandy I., islet in Normalup Inlet, Stanley I., islet in Wilson Inlet, Seagull I., Eclipse I., Breaksea I., Seal I. (King George Sound), Gull Rock, Green I., Coffin I. and in Archipelago of the Recherche (Canning I., Charlie I., Frederick I., MacKenzie I., Sandy Hook I., Lorraine I., Goose I., Middle I., Bellinger I., Six-mile I.); also at Lake Walyungup and Lake Muir and casually on moored boats in Swan River estuary and on Lake Gregory and lakes in south-western interior (from Walyormouring Lake south to Murapin Lake). Nest a more or less substantial basin of twigs, algae, grass, pieces of coral or feathers, with or without a scanty lining of dry grass, *Posidonia* and small feathers; usually placed among low vegetation or rocks, but sometimes on bare ground in open. Eggs laid in summer and autumn off north-west coast, from mid-March to mid-December off west coast (Shark Bay to Shoalwater Bay), from late July to December on south-west and south coasts, and from late August to late March at Lake Muir; clutch 1-4 (mostly 2, commonly 1, occasionally 3 and very rarely 4); slightly lustrous, pale buffy olive to brown with blackish brown and brown spots, blotches and scrawls and grey underlying marks; oval to long oval; 49-58 x 36-41 mm (mean of 48 eggs from 26 clutches, 54 x 38.9). Birds lay 2, 3 or even 4 clutches per season (R.D. Wooller and J.N. Dunlop), usually to replace eggs taken by the lizard *Egernia kingii* and other predators. A few pairs fledge two broods per season (C.A. Nicholls). Downy young: upperparts mottled buff and blackish brown; underparts buff to buffy grey with some blackish brown marks on throat; iris dark brown; orbital ring grey; bill grey; legs blackish brown. Fledglings with trace of down on forehead, chin and tail (5-6 weeks old, length 33-35.5 cm, weight 286-360 g): forehead and lore whitish; crown, nape and ear coverts grey; blackish spot in front of eye; cheek white; neck white, some feathers with grey or greyish brown subterminal bar and white or buff tip; back, scapulars and lesser and median wing coverts pale grey to greyish white, each feather with dark brown or blackish brown subterminal band(s) and buff or pale reddish buff edge (longer feathers with more than one dark band are buff or pale reddish buff between bands); marginal coverts pale grey; primary coverts white, outer feathers with black central streak on outer web; rest of greater coverts pale grey with dark brown or blackish subterminal bar and white or buff tip; outer primaries black with white tip, small mirror and white tongue on outer two; rest of flight feathers (except inner tertiaries) pale grey with wide blackish subterminal band and grey or greyish white tip; inner tertiaries mostly blackish brown with reddish buff subterminal bars and tip; rump pale grey; tail white except for buff or whitish tip and dark brown or blackish brown subterminal band on all but outermost feathers. Underparts white except for greyish brown subterminal band on inner tail feathers. Axillaries white. Marginal underwing coverts white rest of coverts

pale grey; outer primaries black with white mirrors and tongues; secondaries and outer tertiaries grey with dark grey subterminal band; inner tertiaries mostly greyish brown with reddish buff subterminal bars and tip. Unfeathered parts as immature.

Non-flying young hide under vegetation etc. or take refuge in sea.

Voice. Adults are generally very noisy, uttering a loud deep 'Kaar' when defending territory or personal space and when squabbling over food or perches, but during so-called 'dreads' all birds rise in massed silent flight, circle and settle, especially at breeding grounds but also at feeding sites.

Geographic variation. Birds from the Archipelago of the Recherche have smaller primary mirrors than Perth-Albany birds, e.g. mirror on p8 greatly reduced or absent, and some have rosy tinge to underparts; they are also the smallest birds in the State with respect to bill and wing measurements and weight. In northern Western Australia there is a marked decrease in size of mirror on outer two primaries and there is no mirror on p8; the white tongue on primaries is also reduced, especially on p8 and p9.

Measurements (mm). Bill entire length 45-56 in 34 males, mean 50.8 (41-52 in 41 females, mean 45.7), depth at gonys 10-13, 10.9 (8.5-11, 9.6); wing 280-319, 300.3 (268-306, 288.0); tail 107-128, 118.8 (10.3-125, 113.1); tarsus 45-54, 49.8 (41-51, 46.6); middle toe and claw 39-46, 42.6 (37-44, 40.3).

Relationships. It belongs to the *Larus cirrocephalus* species-group, which comprises *L. cirrocephalus* of South America and Africa, *L. hartlaubii* of south-west Africa, *L. novaehollandiae*, and *L. bulleri* of New Zealand.

Black-headed Gull *Larus ridibundus*
Linnaeus 1766

OTHER NAME: Common Black-headed Gull.

Description. Length 38-43 cm.

BREEDING ADULT. Head blackish or blackish brown, with border of hood set high on hindneck; prominent white crescent around rear of eye (forming a broken eye ring). Hindneck white. Back, scapulars and upperwing coverts pale grey or blue-grey (the wing coverts slightly darker than back); outerwing coverts white (forming with white on primaries a white panel on leading edge of wing). Outer primaries white with black tips and edges to inner webs, and outermost with narrow black leading edge (not reaching tip); inner primaries mostly grey with black tip and inner edge (innermost all grey); secondaries grey shading to pale grey at base and almost white at tips. Rump, uppertail coverts, tail and rest of underparts white. Underwing grading from white on lesser coverts to grey on primary coverts and secondaries and blackish on all primaries except outer two

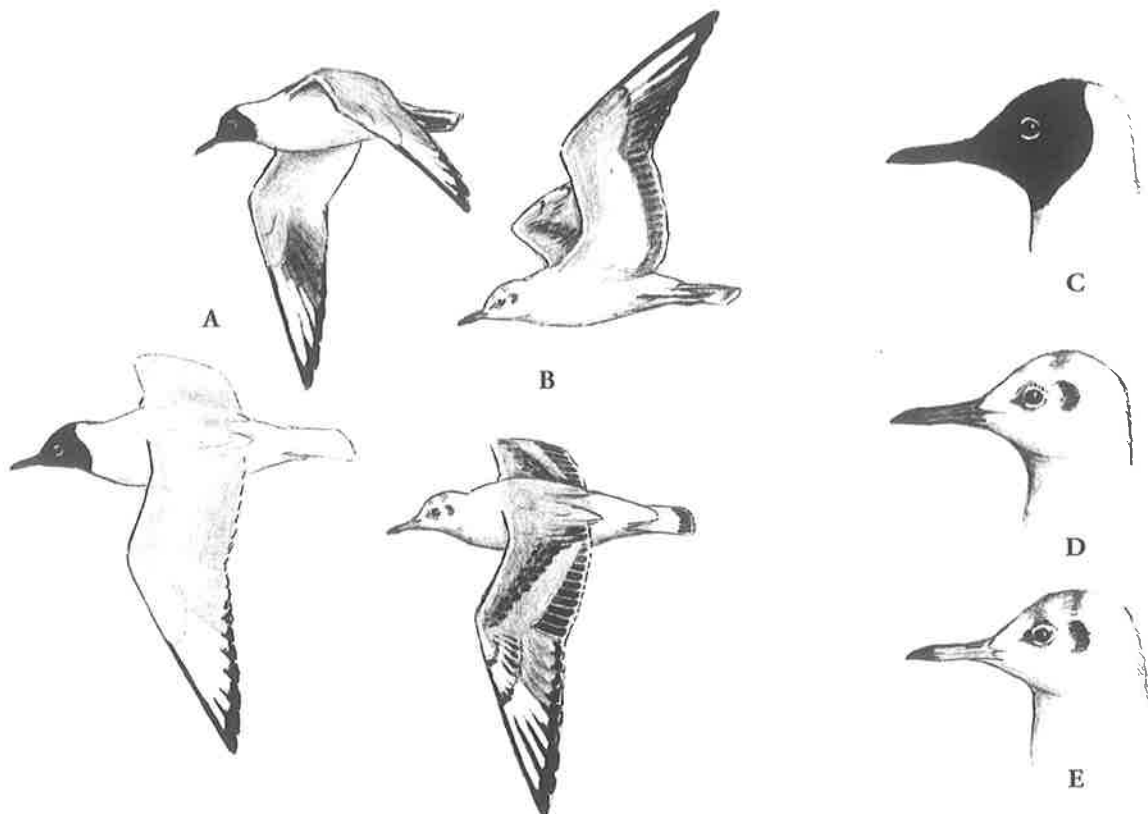


Figure 45. Black-headed Gull (A) breeding adult, (B) first-year plumage, (C) head of breeding adult, (D) head of non-breeding adult and (E) head of first-year plumage. (J. Darnell)

**Article (12/3/1998, p.26 in 'Busselton-Margaret Times') headed
'Banded stilt visits tagger'.**

**Refers to JL sighting a leg-flagged BaSt on Vasse-Wonnerup 'last
week'. '... the second such bird to visit Busselton from the 500 stilts
that were tagged ... in 1995'.**

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If you'd like to talk to Caroline Beamong...

Banded stilt visits tagger

BUSSELTON Conservation and Land Management's principal research scientist Jim Lane was reacquainted with an old friend last week about three years after they first met.

Through binoculars, Mr Lane spied in the Vasse-Wonnerup estuary this week a banded stilt with a distinctive yellow tag on its leg, placed there three years ago when Mr Lane was on a field trip to Lake Ballard, near Menzies.

The bird had flown about 700 kilometres for the chance encounter with Mr Lane, the second such bird to visit Busselton from the 500 stilts that were tagged during the field trip in March, 1995.

The usually dry salt lake had filled to an enormous size after the remnant of Cyclone Bobby dumped 380mm of rain in the area.

This weather event gave scientists a great chance to study the opportunistic breeding pattern of the

banded stilt and its subsequent movements.

The scientists found more than 20,000 banded stilt nests on Lake Ballard.

The stilts have special habitat requirements for breeding. They need recently flooded salt lakes because the young are predominantly fed on brine shrimps.

The opportunity to breed only arises every few years. Only about 20 nesting events have ever been recorded, most of them in WA.

The scientists tagged 500 young chicks to track their movements. As Lake Ballard dried up, the birds dispersed to the coast.

So far, birds have been seen near Port Hedland, Dampier, Thompson Lake in Perth, Peel-Harvey Inlet and Busselton.

Mr Lane recognised the special yellow flag-tag on the visitor to the local wetlands and has been able to add to our knowledge of the handsome wading bird.



Banded stilts

Free concert for youth **Advocare**
THE Lotteries Commission's Gordon Reid seminar **seminar**

***'Les Lacs du desert' ['Western Australia's Desert Lakes'] p.22 in
'Antipode AFA' – News Francais et Australien – No.5 – Dec 1997.
Written by JL and focussing on BaSt breeding at Lake Ballard in
1995.***

Lake Ballard (800 km²) is filled by cyclonic rains once or twice each decade



Photo : Jim Lane

LES LACS du désert

L A K E S I N T H E D E S E R T

When the Banded Stilt crosses the life of the pink shrimps in the salt lakes of Western Australia, the population of Stilts grows and the shrimp population diminishes. Conversely, when the Banded Stilt migrates, it leaves empty lakes and a desolate and reduced population of shrimps. Such a wonderful timing for reproduction and feast makes the interior lakes of WA a real treat for nature observers.



Photo : Jim Lane

Banded Stilt breed in colonies of 20 000 or more pairs

Un simple coup d'œil sur une carte de l'Australie Occidentale permet de voir de nombreux lacs intérieurs, en particulier dans la moitié méridionale de l'état. Bien sûr, quiconque connaît cette terre on ne peut plus ingrate, sait que ces «lacs» sont, en fait, de vastes bassins très secs, incrustés de sel, où la chaleur est insupportable en été, le froid glacial en hiver, et d'où la vie est totalement absente. Ou du moins, est-ce ainsi qu'on les a longtemps considérés. Récemment, on a découvert que, une fois ou deux par décennie, ces immenses cuvettes de sel (leur surface peut atteindre 1.800 km²) se remplissent d'eau à ras bord et, pendant quelques mois, favorisent le développement d'une abondante vie aquatique.

La pluie, source de vie...

La plupart du temps, les pluies sont rares à l'intérieur de l'Australie. Mais, quand il pleut, ce sont des trombes. Chaque été, des cyclones tropicaux

prennent naissance au large des côtes nord-ouest du pays. Ordinairement ils se dissipent bientôt, après avoir atteint les terres. Cependant, parfois, ils se développent en dépressions chargées de pluie et traversent le continent en direction du sud-est. Il en résulte de fortes pluies incessantes et des précipitations de 300 à 400 millimètres en trois ou quatre jours. La terre est alors ravagée par des pluies diluviennes. Ces cuvettes salées, si longtemps asséchées, sont transformées en de vastes mers intérieures.

Etant remplies d'eau, elles sont le théâtre d'une explosion de vie. D'innombrables œufs minuscules qui gisaient dans les sédiments, en sommeil, grossissent et éclosent. En moins d'une semaine, des eaux profondes de 50 centimètres se mettent à grouiller de «crevettes des Fées», *Parartemia*, crustacés longs de 5 cm. qui affectionnent particulièrement les eaux salines et éphémères.

Que le festin commence !

Simultanément, se produit un événement encore plus remarquable. Durant les jours où se remplissent ces bassins salés, des milliers de Banded Stilts *Cladorhynchus leucocephalus* (oiseau de la famille des échassiers) quittent les eaux permanentes près des côtes et volent vers l'intérieur du pays à quelque 500 ou 1.100 km de distance. Ces oiseaux majestueux qui furent décrits pour la première fois, en 1806 par le scientifique français Vieillot, viennent ici pour s'accoupler, pondre leurs œufs et élever leurs petits grâce à la surabondance de crevettes. Deux semaines après les pluies, les Banded Stilts ont formé des îles de colonies de 20.000 nids, à 30 cm les uns des autres, contenant chacun un ou deux œufs.

Puis suivent deux semaines d'incubation et les œufs commencent à éclore. En moins d'un jour, les poussins sont guidés hors des nids vers le rivage où ils n'ont qu'à picorer les crevettes qui ne s'y attendent pas. Quelques groupes quittent leur île, naviguant au gré du

vent, se nourrissant en se déplaçant. Des dizaines de milliers se rassemblent dans des eaux peu profondes à l'extrémité du lac, à une distance de 50 ^{km} ou plus de leur nid. Là, les jeunes oiseaux qui se rassasient de ces abondants invertébrés grandissent rapidement.

Le grand départ ...

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L'éternel recommencement...

Les «Crevettes des Fées» ont leur propre stratégie pour survivre pendant les longues périodes sèches en attendant les pluies. Elles pondent des œufs résistants à la sécheresse. Ils éclosent avec les prochaines pluies qui vont tout inonder. Les Banded Stilts s'envolent vers la côte pour commencer leur longue attente de la prochaine occasion de se reproduire, peut-être cinq ou dix ans. Seule une autre inondation rapprochera ces deux espèces qui ont su superbement s'adapter.

Jim LANE

Principal Research Scientist
Western Australian Department of
Conservation and Land Management

Note : Il reste encore beaucoup à apprendre sur les Banded Stilts. On n'a pas encore répertorié tous les sites de reproduction et les recherches de ces colonies par des moyens classiques sont excessivement coûteuses à cause de l'étendue des surfaces à parcourir.

Etant donné que cette espèce a été découverte par une expédition française, il n'est peut-être pas étonnant que la technologie française - langage imagé d'après le système du satellite SPOT - offre un des moyens les plus prometteurs de mieux connaître cet oiseau aquatique, unique en Australie.

↑ 50 Km not 50cm

Lake Ballard (800 km²) is filled by cyclonic rains once or twice each decade.



Photo : Jim Lane

LES LACS du désert

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WESTERN AUSTRALIA'S DESERT LAKES

A glance at a map of Western Australia shows many large lakes in the interior, particularly in the southern half of the State. Of course anyone familiar with this most-arid land, knows that these "lakes" are actually vast, dry, salt-encrusted pans, unbearably hot in summer, freezing cold in winter and totally devoid of life.

Or, at least, that is how they used to be regarded. Recently it has been discovered that, once or twice each decade, these enormous salt pans (up to 1800 km² in area) fill to the brim and for a few short months support a rich abundance of aquatic life.

In most years, little rain falls in the Australian outback. But when it does, it comes down in buckets. Each summer, tropical cyclones develop off the north-west coast. Normally they dissipate soon after reaching land. On occasions, however, they evolve into rain-bearing depressions and travel across the continent in a south-easterly direction. Heavy rains result; continuous downpours of 300-400 millimetres in three or four days. The land is deluged. Long-dry salt pans are transformed into vast inland seas.

As the pans fill, they explode with life. Myriads of tiny eggs lying dormant in the sediments swell and hatch. Within a week, the half metre deep waters are swarming with Fairy Shrimp *Parartemia*, 5 cm long aquatic crustaceans with a penchant for saline, ephemeral waters.

Simultaneously, an even more remarkable event occurs. Within days of the salt pans filling, thousands of Banded Stilt *Cladorhynchus leucocephalus* fly in from permanent waters near the coast, some 500-1100 km distant. These stately birds, first described in 1806 by French scientist Vieillot, come to mate and lay their eggs and raise their young on the super-abundant shrimp. Two weeks after the rains have finished, the stilts have formed island colonies of 20 000 or more nests, each 30 cm apart and containing 2-3 eggs.

Three weeks of incubation follow and the stilt eggs begin to hatch. Within a day, the chicks are led from their nests to the waters' edge where they peck at unsuspecting shrimp. Small parties leave the island, paddling downwind, feeding as they go. Tens of thousands gather in the shallows at the end of the lake, 50 km or more distant from their nests. Here the young birds grow rapidly as they gorge on the abundant invertebrates.

Seven weeks later the chicks are fully feathered and ready for the long flight to the coast. The entire breeding event takes less than four months. It's just as well because the evaporation rate in this part of Australia is extreme. The lakes usually dry within six months of filling and the young birds must leave before the water becomes too saline and all the shrimp die.

The Fairy Shrimp have their own strategy for surviving the long dry period between fills. As the lakes dry, the shrimp lay drought-resistant eggs. These will hatch with the next flooding rains. The Banded Stilt fly to the coast to begin their long wait - perhaps five or ten years - for the next opportunity to breed. Only another flood will bring these two superbly-adapted species together again.

Jim Lane
Principal Research Scientist
Western Australian Department of Conservation and Land Management

Note : Much remains to be learnt about the Banded Stilt. Not all breeding localities have been found and searches for colonies by conventional means are prohibitively expensive because of the huge areas involved. Given that the species was first discovered by a French expedition, it is perhaps not surprising that French technology - imagery from the SPOT satellite system - offers one of the most promising means of learning more about this unique Australian waterbird.

12.9.1997
FINAL VERSION

WESTERN AUSTRALIA'S DESERT LAKES

A glance at a map of Western Australia shows many large lakes in the interior, particularly in the southern half of the State. Of course anyone familiar with this most-arid land, knows that these "lakes" are actually vast, dry, salt-encrusted pans, unbearably hot in summer, freezing cold in winter and totally devoid of life.

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Jim Lane
Principal Research Scientist
Western Australian Department of Conservation and Land Management
12 September 1997



**Fax (30/7/1997) from CDTM to JL and JL's faxed (01/8/1997) reply.
CDTM writes, inter alia, 'I'm delighted you are picking up the
Banded Stilt ball and are going to lead the running on it!**

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
BUSSELTON DISTRICT
FAX NO: (097) 521 432

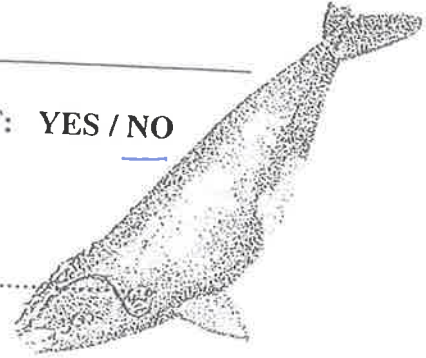
FAXED

TO: CLIVE MERRON URGENT: YES / NO NO

AT:

FROM: JIM LAKE

Fax No.



DATE: 1/8/97

Your Ref:

Local Ref:

Thanks for the fax, comments + info. I spent yesterday in Perth with Grant + Alan Clark sorting out the water level + water quality info and organising the gut and sweep (invertebrate samples). Grant did have the missing info about the stick so the water level info now looks good. Cheers

No. of pages inc. this page: (1)

~~opening~~
note in my diary is the one you already have, Grant will be able to answer your question about the stick position I hope.

I did not get back to Ballard in 1996, I look forward to seeing draft sections in due course, and I'll head on some later in the year.

Best wishes,

Clive 03-9589-4901

30/7/97

Fax to Tim Lorne 08-97-521432

I'm delighted you are picking up the Banded Still Ball and are going to lead the running on it! My decks are now clearing & I'll be able to input too over the next few months.

Re your specific questions on water levels, I left this entirely to Grant except where I was specifically asked to make recordings. My only note in my diary is the one you already have, Grant will be able to answer your question about the stick position I hope.

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Best wishes,

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Several pages by JL 'prepared 22-24/7/97' headed: 'The Following is the Makings of the "Water Depth and Quality Section" of the Final Publication on the 1995 Banded Stilt Work'.

THE FOLLOWING IS THE MAKINGS OF THE "WATER DEPTH AND QUALITY SECTION" OF THE FINAL PUBLICATION ON THE 1995 BANDED STILT WORK

PREPARED 22-24/7/97 *Printed 24/7/97*

The following is a compilation of all data and observations relevant to this section of the report. When this has been completed, prepare a draft of the text for publication.

Water Depth of Ballard (observations in chronological order)

- Lake Ballard was dry when rain began to fall on 25 February (check) (JDay 56) 1995.
- Judging by rainfall records for (locations), Lake Ballard had been dry since at least (month/year).
- Rain from Cyclone Bobby began to fall on (date), and fell continuously for .. days, by which time a total of .. mm had fallen.
- Rain between then and 15 March (time of first ground visit (by helicopter) to lake) was ... mm.
- I could use my photos (ground) to estimate the maximum flood level (as well as the water level at the time of the photos (e.g. 12 & 15 /3/95), which should be evident on the islands.
- An article by CM, GP & JL in The Tattler (April 95) says "Marj Reni, Grant and Clive did a 4.5 hour aerial survey from Kalgoolie on 12 March. They covered lakes Marmion, Barlee and Ballard ... All of the lakes were full .."
- Photos were presumably taken by GP and CM which could be used to estimate water level at time of first aerial inspection (12 March) (J_Day 71)..
- A stick with tape around it was used (by JL, GP & CM) to mark the water's edge (shoreline) on the south side of Camp Island on Wed 15 March (J_Day 74).
- If no further observations were made of water level in relation to stick (above) I could use my photos (need to go through my slides, and the prints in the BaSt box) from this day and subsequent days to calculate water level of 15/3. I took air photos of colony on 15/3 (see folios 14-16 of V1 for tracings), did I take photos of colony on subsequent air survey?
- Some "rough jottings" made (when?) in preparation for talk at SHOC held on 7/10/96 say water depth "estimate c. 50cm - on 15/3". Source? This may have been (probably was) an estimate by me at the time of doing the jottings, based on the other depths I jotted on same sheet.
- On 15 March photos were taken (by JL at least) on the ground and from the helicopter) that could be used to estimate water level at that time.
- Grant installed a continuous water level recorder on 1 April 95 (JDay 91) (date by deduction from logger records).
- A "stake" (wooden stake - see my notebook entry (2nd) of 28/4/95) was installed on N side of Camp Island on .. (date - on or before 28/4). *← it was a nail by CP*
- The first Wingspan article (June 1995, p15) says "And, who knows, a further round of the breeding cycle may be aided by an unexpected 70 mm "top up" of rainfall on 10 April (J_Day 100), which restored the gradually drying lake almost to its maximum level". Can Clive supply supporting data?
- My rough notes on file (folio 80) have CM telling me by telephone on .. April 95 (after he was on the island - calling from Broome Bird Observatory) that "rain added 13 cm (51 cm water depth at stake on .. 4 days after rain)". Folio 88 (see below) indicates the missing date was 14/4/95. Therefore the water level before the rain was 51-13= 38 cm on 10/4/95 (prior to the rain on 10/4).
- CM's fax to JL on 24 April 95 (folio 88) says "Water depth at marker beside island. 4pm 14/4/95 (JDay 104). 51cm (depth of water)"
- JL flew Ballard on 27/4/95 and observed (folio 97) "Many family parties ... all the way to the W end of the lake. Water appears too shallow for outboards here and access difficult"
- Folio 106 (photocopy from ACI notebook) says "28/4/95 (JDay 118) 8.30 (am). depth top -> water ← 0.89m. bottom to top of water 0.54" (also gives pH and temp readings). This data collected at gauge post on N side of Camp Island.

*89
54
143 cm*

*38
+ 98
136 cm*

1st April 95 - water at stake was 38 cm deep and 98 cm exposed (CP's notebook)

2/4/95 - water level - 161 mm from bottom of red tape at 0807 hrs. (CP notebook) (Jday 92, 338)

AC says means 2nd breezy island 2

- Depths taken by ACI on 2/5/95 (J_Day 122) when he, JL and ACh shot adults and chicks were
 - “1st shoot. 10.30am. 1km south of 2nd island. Depth 0.47m”
 - “Adult 2. 11.45am. Depth 0.48m”
 - “Adult 3. 12.10am. Depth 0.49m”
 - “Adult 4. 1.50pm. Depth 0.33m”
 - “Adult 5. 2.20pm. Depth 0.31m”
- (folio 109; photocopy from ACI ? notebook) 4/5/95 (JDay 124) 0.97 depth top of stick to water. 0.44 depth from bottom to water level of stick (temp and pH also read)
- Mark Lamble and Cam were further west (see map on folio 129 - also shows boat limit due to too shallow) on 16th & 17th May (folio 131). They filmed chicks “Birds marched E during day & west at night. 2-3cm depth. Chicks were wading not swimming (folio 119).”
- ACh flew Ballard on 6/6/95, five rafts of flight-capable stilt there, “Most of the larger rafts were in the NW sector .. and would be inaccessible to dinghy with outboard” (folios 138-140a). Definitely no flightless chicks or signs of further nesting. Grey Teal in 1000s, Shel in 100s.
- Grant downloaded logger data on 9 June 95 (J_Day 160) and “reset to record every hour and average every 6 hours” (folio 154). “Water levels varied from 398 (units) to 689 for the 70 days it was in place”.
- GP’s memo (folio 154) says “Camp Isd (9 June 95, JDay 160) .. Depth 775mm”. ← This is the extent length of shore.
- ACh flew over Ballard (and Marmion) on Fri 14/7/95. “He did 4 passes over Ballard - 6-7000 BaSt all flying - no further nesting” (folio .. V2). See later folios for full report. The traverses were all E to W or W to E.
- ACh also flew over Ballard (and Marmion) on 22/8/95. Did four traverses. “western end of lake - dry”. Counted 11,000 BaSt. Also Grey Teal, Shelduck, Avocet. Flock of 1,500 BaSt at “eastern end of lake”. Some avocet and teal were around camp Island.
- JL memo of 23/8/95 to GP says “Monday’s air survey by Andy Chapman showed that Lake Marmion will be dry in a week or so and Ballard in the next month or two”. (folio .. V2).
- JL memo of 29/8/95 to GP says “Your suggestion that you go to Kal and Ballard is a good one .. As well as retrieving the logger, I would like you to go (walk?) out to Camp Island and do standard sweeps, water samples etc, as before”. (folio .. , V2).
- GP retrieved water level recorder on 14 Sep 95 (J_Day 257). Depth of water at the logger was 315mm (i.e. still high!). He didn’t go out to Camp Island.
- Did Andy C or anyone else from Kalgoorlie fly over Ballard subsequently and see it dry? When?. Get satellite imagery to work out when dried (on 23/7/97 I asked GP to get Ballard “quick looks” for Jan 95 or pre 25th Feb 95, and Sep - Dec 95). Get evaporation rate data for individual months Sep to Dec (actual for 95?) (also get Feb-April data to provide another method of estimating maximum flood level in March 1995). Use with rainfall data for same period. Did Clive Minton walk out to the colony at Camp Island at end of June 1996 (as he suggested he might)?

97
0.44
141

Water Temperature of Ballard

- Folio 106 (photocopy from GP or AC notebook) says “28/4/95 8.30. ... Temp top 19.0. Bottom 19.0 (also gives depth and pH data). This data collected at gauge post on N side of Camp Island.
- Folio 109 (photocopy from ACI notebook) says “4/5/95. ... temp top 12.6 bottom 12.6” This data collected at gauge post on N side of Camp Island.
- GP’s memo (folio 154) says “Camp Isd (9 June).. Temp?NA” But hand note by me says “yet, (Alan has)”.

ACI's notes say "temperature not working"

Water pH of Ballard

- Folio 106 (photocopy from GP or AC notebook) says “28/4/95 8.30. ... pH Top 7.89. Calibration - Solution 7.01 read 6.95. Solution 10.01 read 9.78. Tried to calibrate, meter read E4”. This data collected at gauge post on N side of Camp Island.
- Folio 109 (photocopy from ACI notebook) says “4/5/95. ... Standardisation - buffer 7.01 read 6.99, buffer 10.01 read 9.75. pH at surface 7.78”. This data collected at gauge post on N side of Camp Island.

- GP's memo (folio 154) says "Camp Isd (9 June) .. pH 8.67". ✓ *AKA*

Water Salinity of Ballard

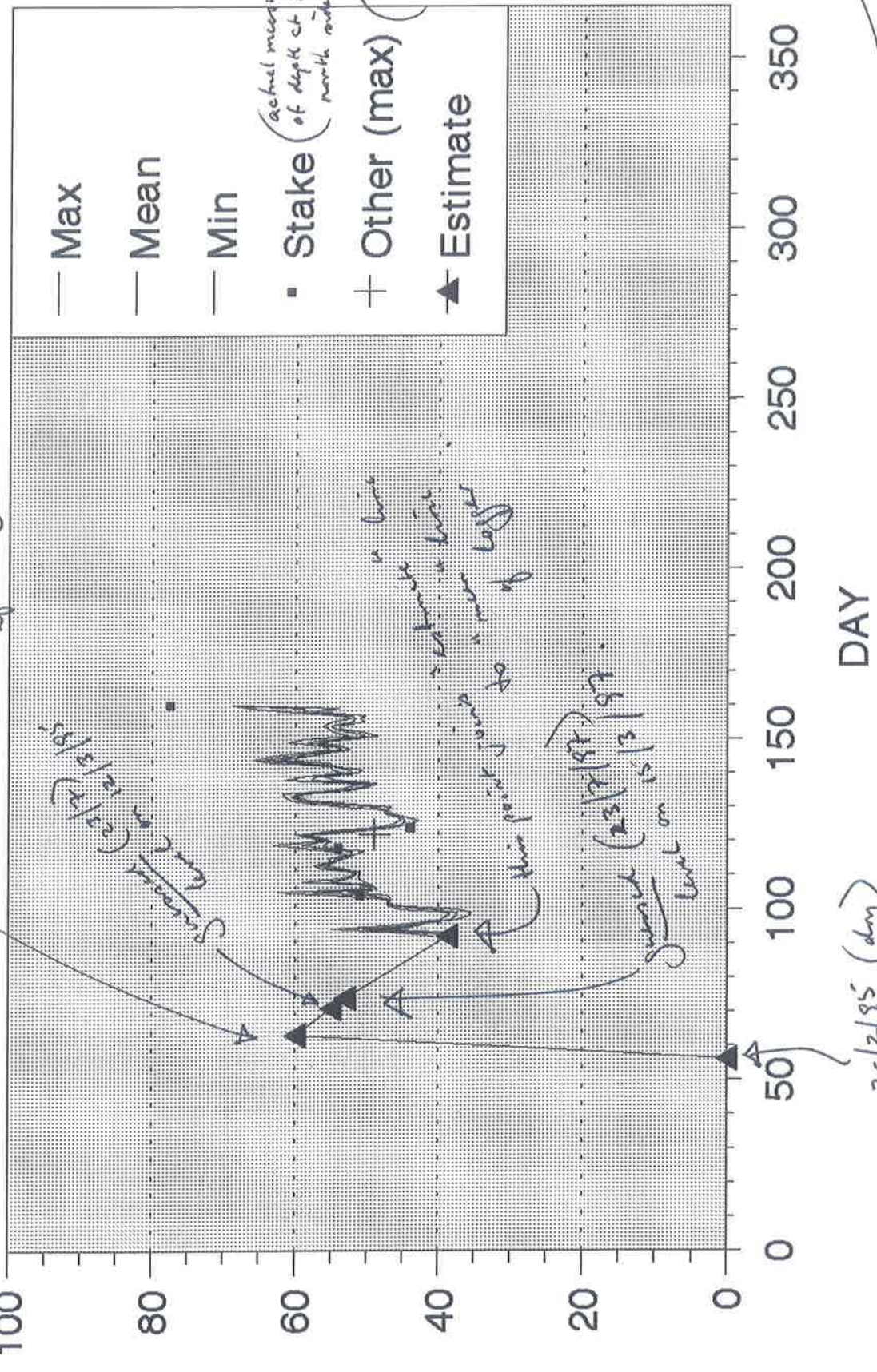
Observations of drinking by adults and chicks?

Water Phosphorus of Ballard

This point on 23/7/97

Sumner (23/7/97) depth around (SD) here around 100cm on the night 60 cm off

Need to subtract 0.05 m from all these depths
20/8/97



Were any depths greater than that at Camp I. found? GSP? Folio 7

LAKE BALLARD 1995: Depth, salinity, etc.

Fax (23/7/1997) from JL to CDTM saying inter alia: 'In order to make some progress with this [write-up of the 1995 BaSt work at Lakes Ballard and Marmion] I have decided to work on the data and write it up section by section ...' 'As I complete draft sections I will send them to you for comment / corrections / input etc.' 'I am currently working on the water level and water quality data from Lake Ballard'. JL then asks CDTM some questions relating to this data.

FAXED

70.
2 pages

TO: CLIVE MINTON

SUBJECT: THE 1995 BANDED STILT WORK AT BALLARD & MARMION

In order to make some progress with this I have decided to work on the data and write it up section by section, fitting it in as best I can around other commitments. As I complete draft sections I will send them to you for comment / corrections / input etc.

I am currently working on the water level and water quality data from Lake Ballard.

My rough notes of a phone call you made to me from Broome Bird Observatory and a fax you sent to me on 24/4/95 indicate that at 4pm on 14 April ("four days after rain which added 13cm to the lake") the water depth at the marker beside Camp Island was 51cm.

Do you have any other depth records for Ballard?


In particular, do you have any post 15 March 1995 observations of the water level in relation to the small stick we positioned at the water's edge on the south side of Camp Island on this day (day of visit by helicopter)?

Also, did you visit Lake Ballard in June or July 1996, as at one stage you thought you might? If so, I assume it was dry (?)

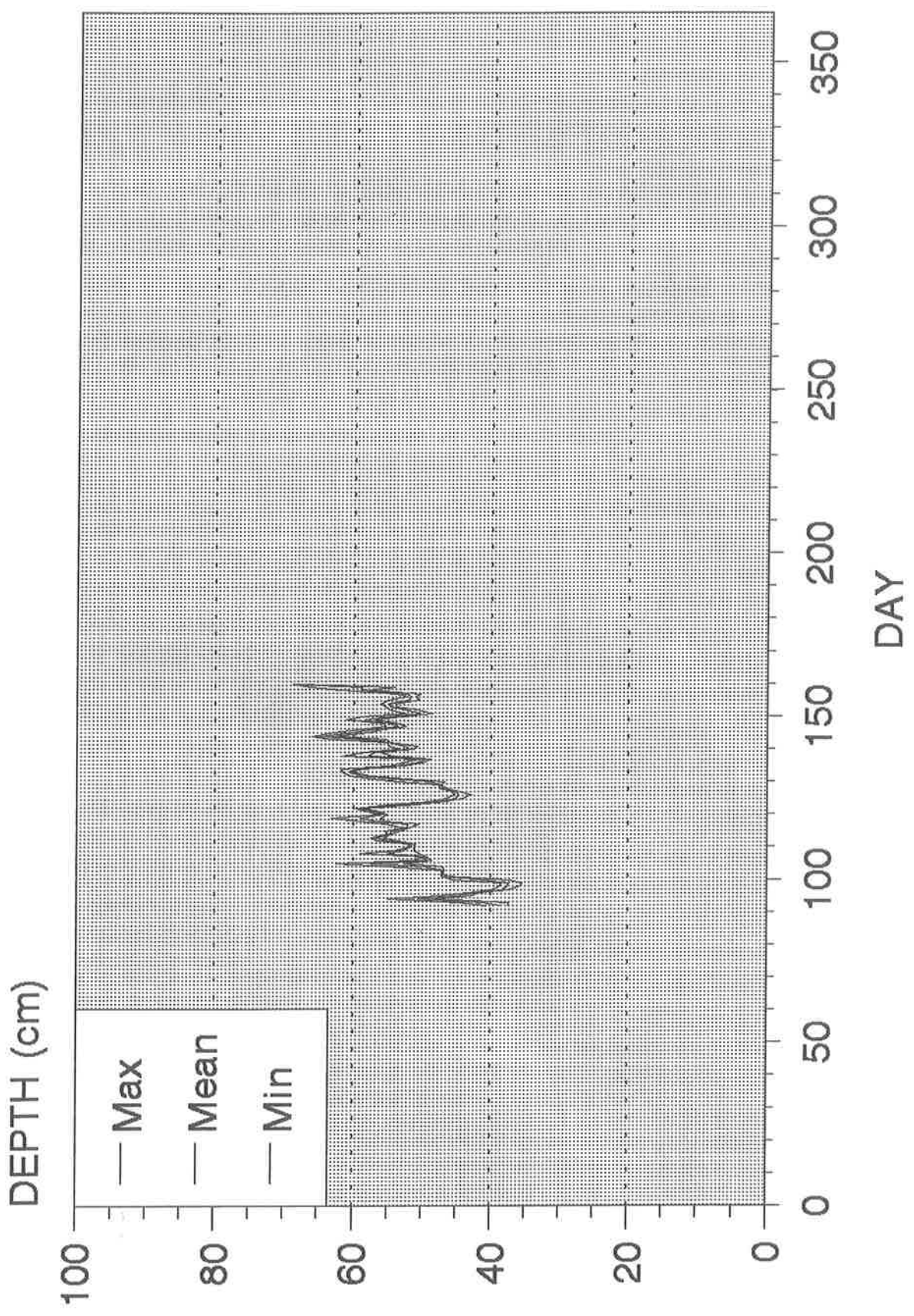
For interest, attached is a graph of the 2 April to 9 June data from the continuous water level recorder that Grant installed on 1 April. The data from the period 10 June to 14 September (when the recorder was retrieved) will be added next week.

Thanks for your help with this.

Best wishes to you and Pat.



Jim Lane
23 July 1997.



LAKE BALLARD 1995: Depth, salinity, etc.

**Letter (undated but probably early 1997) from Sue Palmer,
Secretary, Busselton Naturalists Club Inc., thanking JL for his
presentation 'last month' (check diary for date) re the BaSt breeding
at Lakes Ballard and Marmion in 1995.**



BUSSELTON NATURALISTS CLUB INC.

Mr Jim Lane,
CALM
Busseton 6280

Dear Jim,

A belated thank you to you for a most wonderful presentation to our Club last month. Your slides were quite superb and we are envious of your work although we suspect these trips come up at short notice and never when it is entirely convenient. I do hope you get some sightings of yellow leg flags on the banded stilts.

On a more personal note, Geoff and I would like to go bird watching with you before we all take off on the Canning Stock Route in July then we could be sure of recording any sightings correctly. Our CSR trip is 5 vehicles and we are all keen bird watchers but not very knowledgeable so we would appreciate some guidelines. We are generally available all week except Wednesdays and Thursdays.

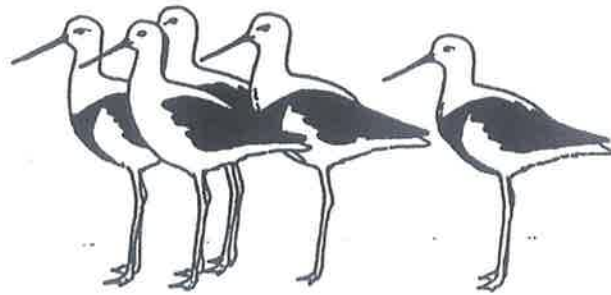
Yours sincerely,

S. R. Palmer

Sue Palmer
Secretary

**Rogers, D.I.R. & Eades, D.W (April 1997). *Belly-Soaking and Egg-Cooling behaviour in a Red-capped Plover Charadrius ruficapillus*.
Stilt 30: 53-54.**

Relevant to JL *et al.* observations of nesting BaSt dunking their breast-abdomen feathers into the water on 15/3/1995 at main breeding colony on Lake Ballard.



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- The Editor does not know of any records from this region, or indeed from the Flyway, of fish feeding of Marsh Sandpipers (except for the paper by Harrison given above). In this sense, it still appears to be a “new” prey item for the species in the region, and worthy of mention and publication.
- Weineke and Cross note that their account of the status of Marsh Sandpipers is qualified by the word “usually” and is based on a wide coverage in the area. Harrison makes the interesting point that many of the sites with higher numbers are difficult to access. Indeed, limited access to certain sites might distort our idea of population dynamics and even population estimates and it is worth bearing in mind!
- Nevertheless, the authors idea of the status of Marsh Sandpipers in the Townsville area is not mutually exclusive. Notwithstanding the inevitable problems with the definition of certain words (such as “flock”) what is really needed is the generation of a frequency distribution of different sized social units, at all sites and habitats, at different times of the year. This is a massive task, and beyond the scope of the papers presented.

The Editor would like to thank the three authors involved for their contributions, and the constructive and positive attitude they have demonstrated here.

Michael Weston, *Editor*.

BELLY-SOAKING AND EGG-COOLING BEHAVIOUR IN A RED-CAPPED PLOVER *Charadrius ruficapillus*.

Rogers, D.I.R.¹ and D.W. Eades².

¹340 Nink's Rd, St Andrews, Vic. 3761, AUSTRALIA

²Birds Australia, 415 Riversdale Rd, Hawthorn East, Vic. 3123, AUSTRALIA

The Gurdies, Westernport Bay, Victoria (Australia), was a blazingly hot place at 1300 hrs on the 19 January 1997. We had gone there to watch waders, but having misjudged the tide, found ourselves on a sandy beach separated from the sea by about 1 km of mudflats. We had just agreed that the temperature was over 40° C, that there was no shade and that in the absence of any breeze or interesting waders, we would do well to go elsewhere. At about this time we noticed an adult female Red-capped Plover *Charadrius ruficapillus* moving over the beach and adjacent sandy mudflats, running in short bursts and often pausing to look at us. From its agitated movements we guessed we were near to a nest, and kept an eye on the bird. After a minute or so of observation it crouched or sat briefly behind a clump of earth on the seaward edge of the beach. We investigated the site but it was not a nest; in retrospect the bird may have been “false-brooding” in order to lure us away from the real nest site, as has been reported for Hooded Plovers *Thinornis rubricollis* (Marchant & Higgins 1993).

Cunning, but this bird was no match for us; we backed off for about 10 metres and resumed observations.

After a bit more aimless running about, the Red-capped Plover moved onto the sandy mudflats next to the beach. After one of its brief sprints, it slowed down in a shallow puddle (perhaps 2–3 cm deep) of seawater and after a look around, walked briskly in a crouched posture so that about a cm of its belly was immersed; it also crouched momentarily on the rear edge of its tarsi. It splayed its flanks and belly feathers as it did so, thus soaking a large proportion of its underparts. As soon as it had done this it ran onto the beach, moving directly to a small hollow in the dry sand where it crouched or sat for about half a minute; a small dune in front of the bird prevented us from seeing its exact posture. It then moved off, apparently still disturbed by our presence 15 metres away. Examining the point where it had been, we found a nest: two eggs set in a small cup in hot dry sand. We moved off and within a minute the bird had moved back to the nest; again, the hummocky sand prevented us from telling whether the bird was crouching over or sitting on the eggs.

One possible interpretation of this behaviour was that the bird was simply cooling itself down, and that it was coincidence that took it to its nest immediately afterwards. This seems inconsistent though, with DR's experience of cooling behaviour of waders in Roebuck Bay, north-west Australia; larger waders there, including Whimbrel *Numenius phaeopus*, Eastern Curlew *N. madagascariensis*, Grey-tailed Tattlers *Heteroscelus brevipes* and Grey Plovers *Pluvialis squatarola*, often crouch in hot weather with the rear edge of their tarsi immersed in small rock pools, but they have not been noticed splaying and soaking their flank and belly feathers. It seems more logical to conclude that the Red-capped Plover at the Gurdies was soaking its belly feathers in order to cool down its eggs. Belly-soaking behaviour has been reported in several other species of plover and lapwing nesting in tropical and subtropical environments (Reynolds 1985). Marchant & Higgins (1993) mentioned two reports of similar behaviour in two species of wader nesting in Australia: (1) A Hooded Plover has been seen dipping its belly in water and then standing over its eggs to shade them on a hot day (Bransbury 1991); (2) A Black-fronted Dotterel *Elseya melanops* has been seen placing small drops of water on its eggs in hot weather (Thomson 1917). We have been unable to find any published records of this behaviour in Red-capped Plovers but given that they often nest on surfaces that must become extremely hot when exposed to direct sunlight, it may be an important ploy to prevent their eggs from cooking. Certainly the bird we saw at the Gurdies seemed very anxious to return to its nest on a day when the eggs were surely not in urgent need of incubation.

Continued →

REFERENCES:

- Bransbury, J. 1991. Biology and Behaviour of Breeding Hooded Plovers. Unpubl. Rep. to Dept. Environ. and Plan., SA.
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- Marchant, S., & P.J.J.F., Higgins. 1993. The Handbook of Australian, New Zealand and Antarctic Birds. 2. Raptors to Lapwings. OUP, Melbourne.
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CAPE YORK PENINSULA, AUSTRALIA, AS A STOPOVER SITE FOR LATHAM'S SNIPE *Gallinago hardwickii*.

Garnett, S.T.¹ and S. Shephard²

¹P.O. Box 117, Parndana, SA, 5220, AUSTRALIA

²Artemis Station, P.M.B. 10, Cairns, Qld, 4870, AUSTRALIA.

Most Latham's Snipe *Gallinago hardwickii* leave south-eastern Australia by late February and all have left Tasmania by late March (Naarding 1983). Fat levels of birds caught in mid February suggest snipe there have built up enough fat to fly as far as Queensland before needing to feed. Birds caught in early March in coastal New South Wales (Frith *et al.* 1977), were heavy enough to fly to the Philippines (Lane & Forest 1984), though records from the Philippines are considered doubtful (Naarding 1985, Lane 1987). Lane & Forest (1984) thought it more likely that most snipe, particularly from southern Australia, stopped in Queensland before flying directly to Japan, and emphasised the importance of finding these pre-migratory fattening areas. They suggested that by late March, when southern swamps are nearly all dry, wetlands in northern Australia are likely to be at their peak of productivity following the summer wet season. Most snipe return to Japan in mid April (Naarding 1985).

Latham's Snipe were found by us on Artemis cattle station in central Cape York Peninsula south of Musgrave, northern Queensland, during each of 1993, 1994 and 1995. In 1993 they were also found 15 km north of Coen. Identification was confirmed by two specimens brought in by the station cat and several of the birds spread their tail as they flushed, revealing bold barring on the outer feathers. The habitat in which birds were seen was seasonally-inundated grassland dominated by the annual grasses *Eriachne burkittii* and *Ischaemum fragile* in association with a range of annual sedges and herbs. Apart from a single snipe seen by a farm dam on 18 August 1993, in the dry season, all records were during the late wet season from 21 March to 17 April. Sixteen individuals were seen in 1993 when approximately 8 km of suitable habitat was traversed

regularly on foot while looking for Golden-shouldered Parrots *Psephotus chrysopterygius*. Five birds were seen in each of 1994 and 1995 but most patrolling during those years was by motorbike and suitable snipe habitat was largely avoided as it was untrafficable.

The snipe were always flushed singly, though 2 were once seen within 100 m of each other. They were never flushed from the same patch of habitat on successive visits. Both birds brought in by the cat had distended layers of subcutaneous and abdominal fat. One, a male caught on 31 March, weighed 183 g. Its gut was empty apart from a little gravel. As the station was over a kilometre from the nearest wetland it is thought the captured birds had been attracted to the station lights while in flight.

The presence of snipe at both Coen and Musgrave, 200 km apart, suggests that snipe are well-dispersed through the grasslands on Cape York Peninsula while on passage to Japan. The sole weight obtained is higher than for non-breeding birds (Frith *et al.* 1977) and suggests that birds on the Peninsula are putting on fat in preparation for migration, though the individual weighed would have had insufficient energy to fly all the way to Japan. However the timing of observations of snipe on Cape York Peninsula and their arrival in Japan suggests that the 6,500 km flight may be achieved in a single flight.

The grassland habitat occupied by Latham's Snipe on Cape York Peninsula occurs as long ribbons through tropical savannah woodland. This habitat is unfailingly inundated every January during the wet season, drying out again during the early dry season from May to July. South of Cape York Peninsula the reliability of rainfall is lower and the rains sometimes fail altogether (Garnett & Taplin 1990). Though grassland is currently widespread and the area of potential snipe habitat large, a change in fire regime is resulting in the replacement of grassland by woodland of broad-leaved ti-tree *Melaleuca viridiflora* at a rate of about 5% per decade (Crowley & Garnett in press). If the trend continues the carrying capacity of snipe on Cape York Peninsula may be reduced and the snipe counted among other threatened grassland birds of the region.

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- Frith, H.J., F.H.J., Crome & B.K., Brown. 1977. Aspects of the biology of the Japanese Snipe *Gallinago hardwickii*. Australian Journal of Ecology 2, 341-68.

Article headed '*Stilts a stunning sight on lake*' on front page of 'Great Southern Herald (26/2/1997).

Refers to 15-20,000 BaSt sighted on Lake Dumbleyung by ACI and relates to banding & flagging done at Lakes Ballard & Marmion in 1995.

Vol. 96, No. 3994
 Wednesday, February 26, 1997
 60c Recommended Price

49 Clive Street, Katanning, W.A. 6317
 Telephone (098) 21 1100

FILE:		
DATE:		
Forecast:	fine, light winds	
Outlook:	fine and warmer	
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RFDS changes putting lives at risk say staff

By CARYN COATNEY

ROYAL Flying Doctor Service past and present employees claim changes to the RFDS structure are jeopardising country people's lives.

"The employees want a government inquiry into the service with one source, who wanted to remain anonymous, saying: "The place is slowly, but surely, being destroyed from within."

"It's being run in a rag-tag manner and service doesn't mean a thing anymore."

Another claimed: "They're sort of wandering around, plugging holes and trying to stop it all running away from them."

But RFDS State chief Bruce Rathbone says the allegations are 'wildly inaccurate' and limited to a tiny minority.

He says the critics oppose his attempts to improve the private, Government-funded service so it can operate successfully on a limited budget in a highly competitive atmosphere.

Since the restructuring of the RFDS WA operations last year, disgruntled staff and Mr Rathbone have been locked in a bitter dispute which has spilled into the Federal Industrial Relations Commission.

For the past six months, critics have claimed the reduced number of pilots at the central RFDS base, in Jandakot, has endangered country people, who depend on the flying doctor for quick evacuations to major hospitals.

Mr Rathbone has agreed that a shortage of pilots in Jandakot, which services the Great Southern and South-West regions, has meant staff from as far away as Meekatharra and Kalgoorlie-Boulder have been called to evacuate patients in Katanning, Wagin, Humberly and Busselton.

The sources say remote RFDS bases are left without pilots for long periods because staff are evacuating southern WA patients.

They claim Mr Rathbone has treated the Great Southern and South-West regions with disdain by reducing Jandakot from eight operational pilots in June 1995 to five.

But Mr Rathbone said the pilot changes allowed the RFDS to operate more efficiently and did not pose a risk to country people.

Though pilot numbers have dropped in Jandakot, they have increased in remote areas, ensuring all country people are covered equally by the RFDS.

Under the new system the five WA bases, including an expanded one in Meekatharra, have five pilots each.

"I have a great commitment to ensuring the very scarce resources in the RFDS are equitably distributed," Mr Rathbone said.

He said pilots flying long distances to reach patients on the south coast was not a problem.

Planes also were being diverted from Jandakot to Wiluna and from Port Hedland to Kunmurra.

The new RFDS system does not separate the State into different boundaries.

"This is a single system," Mr Rathbone said.

"The South-West doesn't own the assets — they are there for everyone in the State."

He said there might be the odd day when there was not enough staff to meet demands.

But this did not justify 'fiddling' with staff numbers.

"People would not believe they were getting value for money," he said.

"We give the people of Western Australia as much



BANDED STILTS: Between 15-20,000 of these birds converged on Lake Dumbleyung last December. (Photo courtesy of CALM)

Stilts a stunning sight on lake

IT was a sight to behold as 15-20,000 banded stilts converged on Lake Dumbleyung to feast on the lake's invertebrates.

Department of Conservation and Land Management researcher Allan Clarke, from Woodvale, saw the birds when he was passing by the lake late December last year.

CALM officers think the birds may have been passing through and are interested in gaining more information on them, to contribute to the existing body of knowledge.

Some of the birds may have been wing tagged, a process which causes no harm to the birds, but helps in identifying them and finding out more about them, particularly their movement habits.

Katanning CALM wildlife officer Tony Zidarich said if anyone had seen them they should contact CALM.

The adult banded still is 36-38 cm tall and is white with a red-brown breast band above a deep brown mid-belly patch.

It has a long fine black bill

and a red eye and in flight it has long coral-pink legs which trail behind.

It makes a yelping call and is often seen in fresh and salt water marshes, and flooded paddocks.

The immature banded still has a grey head and nape patch and juveniles have no black nape and their back and wings are brown and feathers edged in buff.

It was not until 1930 that a breeding colony of the banded stilt was recorded, 114 years after the species was described.

Since then there have been few reports of actual or probable breeding documented.

Mr Zidarich said if anyone saw these or other unusual animals to contact him at the Katanning office on 21 1296 so he could work towards informing the wider community, but he needed information quickly.

"Banded stilts, particularly in this amount, represent a part of our heritage, and they should be shared with the larger community," Mr Zidarich said.

23 Broomehill blocks to get underground power

By ERIN McGRATH

must be repaid within 15 years.

Western Power will connect lot numbers 400 to 423 on both sides of McGuire Road and the right-hand-side of Albany Highway heading towards Tambellup.

In a recent survey conducted by the council, residents voted 13 to eight in favour of the scheme that will bring them partially underground power by 1998.

Broomehill Shire Chief

executive Peter Mason said the council was happy to go ahead with the program after discussing the community response to its survey in the full council meeting.

He said if a majority had elected not to go ahead with the power scheme, then council would not have proceeded.

Mr Mason said the council, under the new Local Government Act, was under no obligation to ask residents to put forward their opinions if the proposal was seen to be in the best interests of the residents of

Broomehill, but added the council understood the matter was serious enough to put the issue to a community vote.

"We know the rate increase is a large one, but considering for some blocks it will cost up to \$20,000 per block for power, we think the extra charge is reasonable for the service provided," Mr Mason said.

"People are finding it hard to establish themselves on these blocks, and the lack of power is preventing them from building homes and therefore impeding the development of the town."

• More page 2

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THE Shire of Broomehill has voted to partially connect underground power to 23 blocks of land in a scheme which will cost over \$100,000.

By ERIN McGRATH

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Various copies of text of '*Leg-Flagged Banded Stilts*' article by JL apparently published in 'WA Bird Notes' in December 1996 (sent to editor on 23/10/1996).

Check other RMCR's or WA Bird Notes for the published article.

TO: G. PEARSON

* M.B. - RAOU
has to - expeditions
for base in collaboration
with us.

LEG-FLAGGED BANDED STILTS

(138)

Last year, following torrential rains and successful breeding on Lakes Ballard and Marmion near Menzies, 500 Banded Stilt chicks were leg-flagged and 800 banded (see WABN Nos. 74-76 for details).

Since then, the following sightings have been reported.

DATE	LOCATION	NUMBER SIGHTED	DISTANCE (KMS)	REPORTED BY
24.10.95	Lake Arrow	1	110 (S)	Andy Chapman
21.1.96	Rottneest Island	1	610 (SW)	Fran Head
28.2.96	Port Hedland Saltworks	4*	1075 (N)	Grant Pearson
07.3.96	Dampier Saltworks	1	1100 (NNW)	Steve van Leeuwen
29.9.96	Yarra Yarra Lakes	1	520 (W)	Brenda Newbey

* 3 flags and 1 band only. All other sightings are of flags.

We are very keen to get as many sightings as we can during the next few years (the flags should last that long) and the next twelve months in particular. These are the only Banded Stilt to have ever been leg-flagged and it may be many years before another opportunity to study this fascinating species arises.

So, should you sight a leg-flagged stilt we would be most grateful if you could pass the details on to Grant Pearson at CALM's Woodvale office (ph 09 405 5163 or fax 09 306 1641) or to Jim Lane at CALM's Busselton office (097 52 1677 or fax 097 52 1432).

The leg-flags are small, made of stiff yellow plastic and positioned above the "knee".

The information we are seeking is location, date, number of flagged stilts seen, how well-developed the breast bands of the flagged stilts were, the total number of stilts at the site and any other information of possible interest. Please also include the name of the observer and a contact number or address.

If you would like advice on where (which lakes, estuaries, saltworks etc.) to look for Banded Stilt, please ring Grant or myself.

Also, if you are interested in joining, on a cost sharing basis, a special search for flagged stilts this summer, please contact Grant Pearson. We are trying to organise a trip.

Hope to see you out on the briny!

Alan's

Jim Lane

Grant: Here sent this to John Blyth today for inclusion in Dec. issue of WABN.

Please discuss marked page with Alan & me.

23/10/96

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
BUSSELTON DISTRICT
FAX NO: (097) 521 432

13.

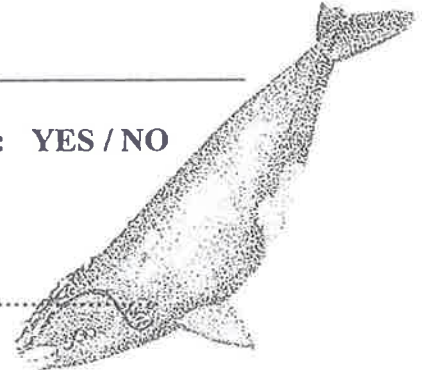
FAXED

TO: JOHN BLYTH URGENT: YES / NO

AT: WRC

FROM: JIM LANE

Fax No.



DATE: 23/10/96

Your Ref:

Local Ref:

Have Emailed attached article for Dec
issue of WABN to you today. Cheers

No. of pages inc. this page: 2

Please call us on (097) 521 677 if this message was incomplete or illegible

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23/10/96

Published in "WA Bird Notes" Dec 96

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23/10/96

Fax (23/10/1996) from JL to Verna Costello, CALM Corporate Relations, with material ‘... that could be used as basis for article in “Bush Telegraph”. Primarily aimed at asking people to report any sightings of leg-flagged BaSt. See leg-flag sightings RMCR.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
BUSSELTON DISTRICT

FAX NO: (097) 521 432

16

FAXED

TO: VERNA COSTELLO URGENT: YES / NO

AT: CORP REL.

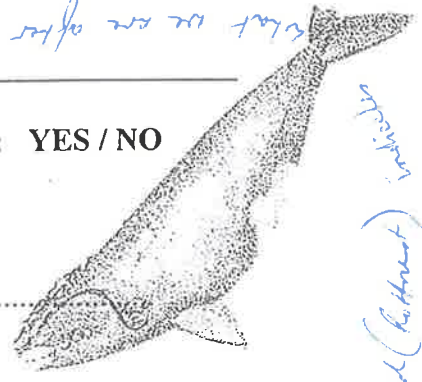
Fax No.

FROM: JIM LANE

DATE: 23/10/96

Your Ref:

Local Ref:



Received your phone message. I am in the office for a few days and then away for most of 3 weeks. Attached is some info that could be used as basis for article in "Bush Defend". The most important thing now is for anyone who rights leg-flagged stilt

No. of pages inc. this page: 5 do report them to us. The attached
Please call us on (097) 521 677 if this message was incomplete or illegible

THE INFORMATION WE ARE SEEKING, PARTICULARLY

For each observation:

- **Location** (i.e which lake on Rottnest)
- **Date and time** of observation
- **Observer's name(s)** and contact details
- **Total number of Banded Stilt** seen at location
- Estimate of % of these birds with chestnut chest bands
- **Number of Banded Stilt with yellow leg flags** seen at location
- Whether or not the flagged stilt have chestnut chest bands

The most important information to be obtained is shown in bold. From this we will gain information on timing and direction of dispersal from breeding areas, and subsequent movements. The other information requested will give us an indication of breeding success, plumage development and (possibly) age at first breeding.

Note especially that all data gathered are valuable, regardless of whether flagged birds are seen or not.

Records can be sent to Mr Grant Pearson, Senior Technical Officer, Department of Conservation and Land Management, Woodvale, 6065; (ph) 405 5163, (fax) 306 1641.

Queries may be directed to Grant in the first instance. If he is not available I can be contacted by phone on (097) 521 677 or by fax (097) 521 432.

copy of a letter to Jim Lane (Rottnest)



Please address all enquiries to:

14 Queen Street
BUSSELTON WA 6280

Your Ref:
Our Ref:
Enquiries:

Ms Fran Head
Environmental Department
ROTTNEST ISLAND WA 6161

Dear Fran,

Following on from our telephone conversation last week, I thought I would send you copies of recent articles concerning the Banded Stilt research we are doing. You will see that the second article makes mention of the leg flagging.

Now that inland waters are drying out (the forecast for Kalgoorlie is 37 degrees today!), we are keen to find a small number of volunteers who could assist us in monitoring the birds' return to the coast.

Rottnest Island is a favourite coastal haunt of the Banded Stilt and provides a very suitable monitoring site.

The information we are seeking, preferably on a weekly basis but fortnightly would be OK, is as follows:

For each observation:

- **Location (i.e which lake on Rottnest)**
- **Date and time of observation**
- **Observer's name(s) and contact details**
- **Total number of Banded Stilt seen at location**
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9,

Finally I would like to emphasise how significant any observations of flagged birds will be. This is the first time that Banded Stilt (a species found only in Australia) have ever been flagged, so all sightings will add significantly to our understanding of this beautiful bird's fascinating life.

Thanks very much for your interest in this. As mentioned the other day, Grant will come over to Rottnest some time soon to meet you and any other volunteers.

Yours sincerely,



Jim Lane
Principal Research Scientist
30 October 1995

Copies: Grant Pearson
Mike Bamford (WA Wader Study Group)

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
Science and Information Division



SEMINAR

17 May 1996

presented by Jim Lane

BANDED STILT BREEDING IN THE GOLDFIELDS

Banded Stilts *Cladorhynchus leucocephalus* are endemic to Australia and unique among the 214 species of wading bird in the world in that they nest colonially, have white downy chicks and raise their young in creches. Breeding is confined to recently flooded saline lakes of the arid interior. Here the birds nest in the tens of thousands and feed on a super-abundance of brine shrimps *Parartemia*. Because of the considerable difficulty of finding and gaining access to nesting islets, Banded Stilt breeding has been infrequently observed and little studied.

In February 1995, Cyclone Bobby dumped 380 mm of rain to the north of Kalgoorlie in four days of continuous downpour. An aerial survey on 12 March revealed a colony of Banded Stilt on an islet in the 60 000 ha Lake Ballard. During ensuing months this breeding event was followed by CALM scientific and management staff, Clive Minton of the Australasian Wader Study Group and a film crew from the ABC TV Natural History Unit. Preliminary results of this work will be presented.

Time: 3:00 pm

Venue:

Wildlife Research Centre
Ocean Reef Rd (near Joondalup Drive)
Woodvale

Contact for Seminar: C Farrell 405 5146

Update on Banded Stilt breeding event

The June edition of Wingspan (Vol. 5 (2): 13-15) featured an article by Clive Minton, Jim Lane and Grant Pearson, describing the beginning of this historic Banded Stilt breeding event at Lake Ballard, WA. Banded Stilts only breed on recently-flooded salt lakes, and only about 20 nesting events have ever been recorded. In the June feature, we left the breeding colony just as the chicks were hatching. Here is an update on how they have fared since...

Research work by Jim Lane, Grant Pearson and other officers from the Department of Conservation and Land Management (CALM) in Western Australia has continued at the Banded Stilt breeding locations in the Goldfields. The ABC Natural History Unit also made a follow-up visit in late May to film chick creching and fledging.

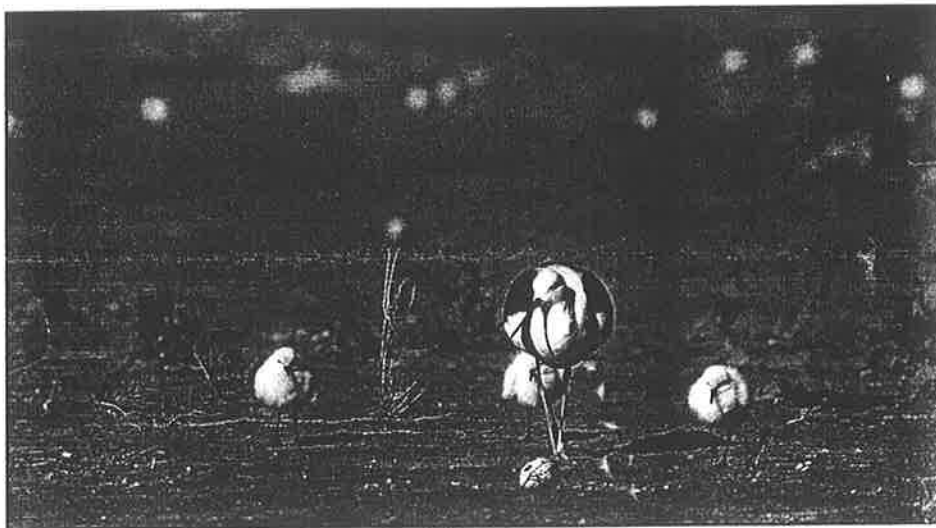


Above: Banded Stilt chick taking a first drink at the water's edge.

Left: Each brood is accompanied only by a single parent as it leaves the colony for the water.

Below left: A newly-hatched chick, still wet, is visible under this incubating adult

PHOTOS BY CLIVE MINTON



It seems that breeding has been successful, with an excellent rate of young birds surviving to fledging. Mark Lamble, the ABC camera-man, reported 'tens of thousands' of well-grown chicks on the western end of Lake Ballard.

Although the newly-hatched chicks could swim and feed in the normal metre-deep water, they seemed to prefer to make their way gradually down to the shallow parts of the lake (30 km away) for the bulk of their fledging period. There they marched around on the wet mud or

in very shallow water picking up minute items of food — too small to be the brine shrimp that are thought to be their preferred diet.

In contrast, the accompanying adults — which had greatly reduced in number as the chicks gradually coalesced into hundred-strong groups — seemed to find feeding in the shallows unsatisfactory. Thus they periodically left the chicks to fly to deeper water, presumably to feed on the now abundant supply of brine shrimps.

Banding and colour-flagging of chicks went very well, with nearly 1,000 birds marked. To do this, we caught chicks in a handnet from a moving boat — a method which proved reasonably straightforward. When the chicks were still in family parties we found it necessary to catch only part of the brood at a time, then to return these birds to the parent before catching the rest of the brood. We also followed this precautionary procedure with larger groups of chicks. Incidentally, the behaviour we observed while catching the chicks provides yet another con-

trast between Banded Stilts and other waders: Banded Stilts neither actively defend their young nor perform distraction displays (such as the 'broken-wing trick') to deter intruders, as do other waders.

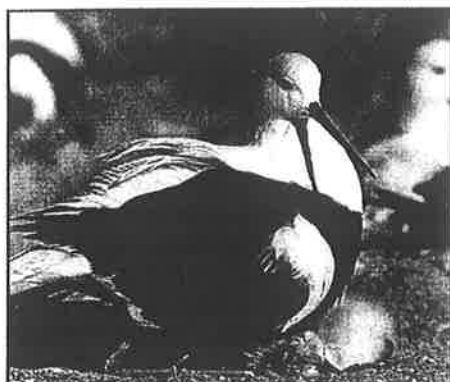
So far there has apparently been no second round of breeding at Lake Ballard, unlike the breeding event at Lake Torrens in 1989. However, plenty of adults are still present on the Lake, and some excited gathering and even copulating has been observed, so further nesting may occur.

A further aerial survey is planned for mid-July to see if any further nesting attempts have been made, and to log the number of adults and juvenile birds still present. The water levels are holding up well, which is encouraging.

A small nesting colony (5,000 pairs) did form on nearby Lake Marmion, and at least 2,000 chicks were seen in June, but nesting success was probably lower there than at Lake Ballard due to the regular presence of predators in the form of a Wedge-tailed Eagle and a Peregrine Falcon.

Would everyone, especially in Western Australia, please keep a look out for banded and leg-flagged birds? Please also monitor, by regular counts, the return of birds to traditional non-breeding areas as they leave the drying salt lakes in the future.

CLIVE MINTON, JIM LANE AND GRANT PEARSON



A copy of Lane, J. (1995) *Leg-flagged Banded Stilts*. WA Bird Notes No.74, p.19 (June 1995 issue), under the heading 'STOP PRESS', that JL had intended sending to Verna Costello (see above) but did not send, for the reason given in an annotation by him.

Yvonne Costello

not sent as calls for info to go to me - shall be to GBP

Copy of last years call for info

Request still applies - particularly coming dry season

J. Lane

23/10/96

STOP PRESS Leg-flagged Banded Stilts

Tens of thousands of Banded Stilts have nested at Lake Ballard near Menzies during the past two months, following cyclonic rain in January. During the first week of May, Alan Clarke, Andy Chapman and I leg-flagged 170 chicks at various stages of growth. The leg-flags are small, made of stiff yellow plastic and located above the left "knee" (on the tibia).

The lake's water level is high and food supply (brine-shrimps) abundant so the majority of these chicks should survive to fledge and disperse to other wetlands.

Should you sight any of these leg-flagged stilts we would be most grateful if you could pass the details on to me at CALM's Busselton office (ph: 097-521677 or fax: 097-521432 or mail c/o Dept. of CALM, Queen Street, Busselton, 6280). Information we would like is location, date, number of "flagged" stilts seen, total number of stilts and any other information of possible interest. Include the name of the observer and a contact number or address.

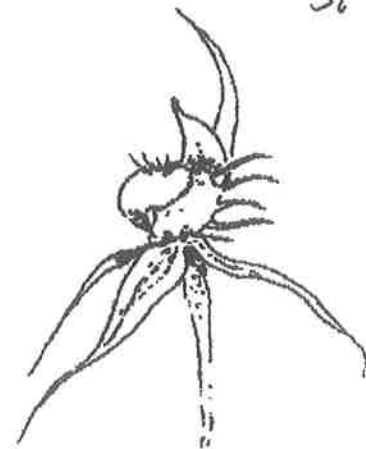
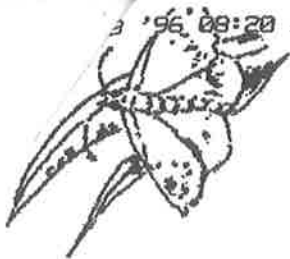
Jim Lane

WABN # ~~74~~ p 19.

final numbers

were 500 leg flagged and 800 banded.

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Date:

Jim Lane

To:

At:

From:

No. of Pages
(incl. face sheet)

Message:



Leaders: Jan and Rob Hill

O	E.A	M
S	A	N
S		J

Monday 25 September Meeting — Herdsman Lake Wildlife Centre 8.00 pm

Neil Hamilton is Section Keeper of Birds at the Perth Zoo and will talk about the Zoo's role in bird conservation, a role often performed in conjunction with other organisations such as government departments and other zoos.

Monday 23 October Meeting — Herdsman Lake Wildlife Centre 8.00 pm

Michael Craig, a former secretary of the WA Group, will help us with wader identification, a source of considerable difficulty to many, as migrant wader species, normally in WA in the summer, are then less distinctive.

Monday 27 November Meeting — Herdsman Lake Wildlife Centre 8.00 pm

Some time ago Gordon Tozer and others started a photographic group within the RAOH in Perth. Gordon, Peel Howden and Mavis Norgard will show 15 slides apiece and Dusty Millar will display print photographs. In discussing their work, they will be giving helpful hints for beginners in bird photography.

STOP PRESS Leg-flagged Banded Stilts

Tens of thousands of Banded Stilts have nested at Lake Ballard near Menzies during the past two months, following cyclonic rain in January. During the first week of May, Alan Clarke, Andy Chapman and I leg-flagged 170 chicks at various stages of growth. The leg-flags are small, made of stiff yellow plastic and located above the left "knee" (on the tibia).

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Jim Lane

WABN #74 p.19.

June '95 issue (No 74, p.19)

"Washed Ants
Dust Notes"

FAL
1995 SOUTH
SPECTAC

Camping 1-15 Oct (15
1st Nov (11days 10nights)

1996 AF

We continue our success to some of the finest in Nat. Park (the big five h We may miss the herd just opened). 20th Aug expensive than Zimba beautiful Drakensberg 4th - 12th Sept: \$1250 (Perth, small reduction)

KIMBERLEY '96

Travel with someone w - Kununurra 2 - 17 Ju 21 - 29 June \$950 G I Simons Perth, Western A

STOP PRESS Ele

Following what so a Night Parrot sighting Blyth and Phil Fuller of about 25 km south eas

Unfortunately, the southwestern species Goldfields, but presum following heavy rain least four birds and pr not, it must be said, as Night Parrots would h

Fax (14/10/1996) from CDTM to JL referring to two overhead projections sent to him by JL for use in New Zealand 'later this week'.

Also refers to 'sheets of data' JL referred to during his presentation at the SHOC conference in Albany earlier in the month (see below) and slides (photos).

14/10/96

Fax to Tim Lane CALM Dunedin 097-521-432

14/10/96

How thoughtful of you to send me the two OHPs. Many thanks. I will use them in New Zealand later this week!

It also seems to me that a photocopy (not OHP) of the sheets of data you showed in your talk would also be useful to me. They may contain some facts I don't remember & will also ensure we tell the same story. Could you fax them to me please?

Re slides. I don't think I need the banding ones. And I don't think I've got anything that you haven't. If I do come across something I'll copy it to you.

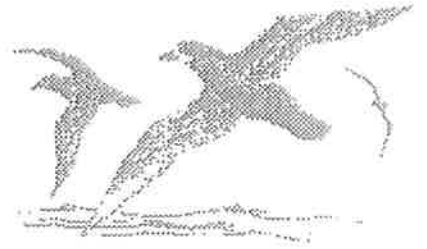
Great to see you & to meet Garratt. I have you both on the 'provisional' list for Aug - Oct 1998!

Best wishes, Clive 03-9589-4901

Part of the Program and Abstracts of the 'Southern Hemisphere Ornithological Conference' (SHOC) in Albany, WA, 05-09/10/1996. Relevant abstract is: '*Banded Stilt breeding at Lake Ballard, Western Australia*' by J. Lane, G. Pearson, & C. Minton, presented by JL on 07/10/1996.



Western Spinebill *Acanthorhynchus superciliosus* (Wells/CALM)



Southern Hemisphere Ornithological Congress

The ecology, conservation and management
of southern hemisphere birds

ALBANY, WESTERN AUSTRALIA
OCTOBER 5-9, 1996

PROGRAM & ABSTRACTS

Hosted by the Royal Australasian
Ornithologists Union



Wader migration strategies in the Australasian- Asian Pacific flyway

C Minton (Wader Studies Group, Australia)

A comprehensive analysis of all recoveries of waders banded in the Australian-East Asian Flyway, together with sightings of colour leg-flagged birds, has been undertaken. The information will be used to outline migration routes and key stopover locations for different species. Weight data collected on migrants prior to departure will also be used to delineate the different migration strategies employed by various species in the flyway. Such data are the foundation for conservation initiatives now being promulgated, including the Australasian-East Asian Flyway Shorebird Reserve Network.

Banded Stilt breeding at Lake Ballard, Western Australia

J Lane (WA Department of Conservation and Land Management, Australia), **G Pearson** (WA Department of Conservation and Land Management, Australia) and **C Minton** (Wader Studies Group, Australia)

Banded Stilts *Cladorhynchus leucocephalus* are endemic to Australia, and unique among the 214 species of wading bird in the world in that they nest colonially, have white downy chicks and raise their young in creches. Breeding is confined to recently-flooded saline lakes of the arid interior. Here, the birds nest in the tens of thousands and feed on a super-abundance of brine shrimps *Parartemia*. Because of the considerable difficulty of finding and gaining access to nesting islets, Banded Stilt breeding has been infrequently observed and little studied. In February 1995, Cyclone Bobby dumped 380mm of rain to the north of Kalgoorlie in four days of continuous downpour. An aerial survey on 12 March revealed a colony of Banded Stilt on an islet in Lake Ballard (60,000ha). During ensuing months, this breeding event was followed by CALM scientific and management staff, Clive Minton of the Australasian Wader Study Group and a film crew from the ABC TV Natural History Unit. Preliminary results of this work will be presented.

Conservation of endemic New Zealand waders

R Pierce (Department of Conservation, New Zealand)

New Zealand has nine species of endemic waders, three of which also exhibit sub-specific variation. Of the nine endemic species, eight are considered threatened. The rarest taxa are the Chatham Island Oystercatcher (*Haematopus chathamensis*), Shore Plover *Thinornis novaeseelandiae*, Black Stilt (*Himantopus novaeseelandiae*), and the southern sub-species of New Zealand Dotterel (*Charadrius obscurus*), each of which numbers fewer than 150 individuals. Management programmes for all species have focused on combinations of habitat restoration, predator control, public awareness, captive breeding and release, translocations and pest contingency planning. Habitat restoration has focused primarily on mainland sites, particularly riverbeds and other wetlands which have become infested with weeds. This is best illustrated by Project River Recovery in the MacKenzie Basin where clearance of willows from riverbeds has resulted in recolonisation and breeding by four endemic species of wader, and other riverbed birds. Some predator control has been undertaken, with varying success, for Black Stilt nest protection, and elsewhere for southern and northern races of the New Zealand Dotterel and Variable Oystercatcher. Public awareness programmes have been successful in increasing the productivity of shorebirds generally, particularly on North Island beaches where many breeding grounds are fenced off from an increasingly beach-going public. Captive breeding programmes for the Black Stilt have resulted recently in the release of up to 30 juveniles (or sub-adults) into the wild each year, with some of these birds being recruited into the Black Stilt population. Shore Plovers have been raised in captivity in recent years, and two experimental releases on to mammal-free islands off the New Zealand mainland have taken place, the first failing because of predation by moreporks (*Ninox novaeseelandiae*) and dispersal of survivors to the mainland. Further releases of captive-reared

1540	Avian diversity and insect-induced dieback in remnant eucalypt woodlots M. Grey (La Trobe University, Australia), M. Clarke (La Trobe University, Australia) and R. Loyn (Victorian Department of Natural Resources and Environment, Australia)	Nocturnal habitat use and foraging behaviour of Pacific Golden Plover (<i>Pluvialis fulva</i>) in northern NSW D. Rohweder (Southern Cross University, Australia)	Fire and its impact on avian population dynamics B. Baker, B. Dettmann and S. Wilson (Australian Nature Conservation Agency, Australia)
1600	AFTERNOON TEA		
	EFFECTS OF FIRE AND HABITAT FRAGMENTATION ON BIRD COMMUNITIES (CONT.) (Flinders Room) Chair: D. Saunders (CSIRO Division of Wildlife and Ecology, Australia)	WADER BIOLOGY AND MOVEMENTS (CONT.) (Adelaide Room) Chair: P. Hockey (FitzPatrick Institute of Ornithology, South Africa)	
1630	Biology of the Blue-breasted Fairy-wren in a fragmented landscape in the wheatbelt of Western Australia M. Brooker (CSIRO Division of Wildlife and Ecology, Australia)	Wader migration strategies in the Australasian- Asian Pacific flyway C. Minton (Wader Studies Group, Australia)	
1650	Use of remnant forest habitat by birds during winter in subtropical Australia: patterns and processes C. Catterall, M. Kingston and K. Park (Griffith University, Australia)	Banded Stilt breeding at Lake Ballard, Western Australia J. Lane (WA Department of Conservation and Land Management, Australia), G. Pearson (W.A. Department of Conservation and Land Management, Australia) and C. Minton (Wader Studies Group, Australia)	
1710	Habitat dynamics, species interactions and habitat models: a case study of the White-winged Chough and the Australian Magpie S. Cox and J. Bauer (Charles Sturt University, Australia)	Conservation of endemic New Zealand waders R. Pierce (Department of Conservation, New Zealand)	

TUESDAY, 8 OCTOBER

0830 - 1600	MID-CONGRESS FIELD TRIPS
1930 - 2300	Optional Congress Dinner at Pyrmont House

WEDNESDAY, 9 OCTOBER

0900	PLENARY LECTURE (Flinders Room) Chair: I. Rowley (CSIRO, Australia) Southern perspectives of bird breeding systems M. du Plessis (FitzPatrick Institute of Ornithology, South Africa)	
1000	MORNING TEA	
	BREEDING BIOLOGY IN BIRDS (Flinders Room) Chair: I. Rowley (CSIRO, Australia)	DISTRIBUTION AND ABUNDANCE OF BIRDS (Middletons Room) Chair: D. Dow (Consultant, USA)
1030	Avian adaptations to the deserts of the Northern and Southern Hemispheres: a comparison G. Maclean (University of Natal, South Africa)	Use of the Australian Bird Count to identify important bird areas S. Ambrose (RAOU, Australia)
1050	Food division in the Arabian Babbler nest: adult choice or nestling competition? R. Ostreher (Tel-Aviv University, Israel)	
1110	Life history in Australian honeyeaters: influence of phylogeny and ecology H. Ford (University of New England, Australia)	Endemic bird areas in the southern hemisphere and their relevance to conservation A. Stattersfield (BirdLife International, UK)
1130	The annual cycle of doves from regions with contrasting precipitation patterns in Venezuela C. Bosque, M. Pacheco and S. Garcia (Universidad Simon Bolivar, Venezuela)	The effect of animal and observer movement on line transect density estimates L. Chambers (Deakin University, Australia)
1150	Breeding behaviour of the semi-nomadic Regent Honeyeater D. Geering (Independent, Australia), D. Oliver (University of New England, Australia) and S. Jessup (Independent, Australia)	An investigation into bird communities of farm windbreaks and related vegetation C. Kinross (Orange Agricultural College and Charles Sturt University, Australia)
1210	The breeding biology of an Indian Ocean population of Wedge-tailed Shearwaters <i>Puffinus pacificus</i> M. Garkaklis and C. Sims (Murdoch University, Australia)	The distribution of birds in suburban Perth M. Bamford (Consultant, Australia)

Some additional materials gathered / prepared by JL when preparing the 'overheads' referred to below, i.e. for the '*Banded Stilt breeding at Lake Ballard, Western Australia*' presentation by J. Lane, G. Pearson, & C. Minton (presented by JL) at SHOC, Albany, on 07/10/1996.

"folio 56" collection
"folio 56" 10/20/24

- Material used to prepare
for Best talk at Sthn.

Hon. Com. Congress

on 7/10/96

- This material not actually used on
the day

- includes inter alia cyclone tracks
for 1967-77 and 1985 (83?) → 94

from met Bureau. Should make more
use of this later.

"folio 56" collection.

17/01/2014

- Material used to prepare
for Be ST talk at Sthn.
Hem. Con. Congress on 7/10/96

- This material not actually used on
the day

- * - includes inter alia cyclone tracks
for 1967-77 and 1985 (83?) → 94
from met Bureau. Should make more
use of this later.

This map (coverleaf) is a section of

the "MENZIES" 1:250,000 Type

(About SH 51-5' EDITION 1
National Topographic Map Series)

R

15/10/2012

LEG FLAG & BAND SIGHTINGS

500 CHICKS FLAGGED & 800 CHICKS BANDED

CHICKS FLEDGED MAY-JULY 1995

<u>DATE</u>	<u>LOCATION</u>	<u>No.</u>	<u>KM</u>	<u>DIR'N</u>	<u>DAYS</u>
24.10.95	L. ARROW	1	110	S	90 - 160
21.1.96	ROTTNEST	1	610	SW	180 -250
28.2.96	PORT HEDLAND	4*	1075	N	220 - 290
07.3.96	DAMPIER	1	1100	NNW	230 - 300
29.9.96	YARRA YARRA	1	520	W	430 - 500

* 3 flags and 1 band. All other sightings are of flags.





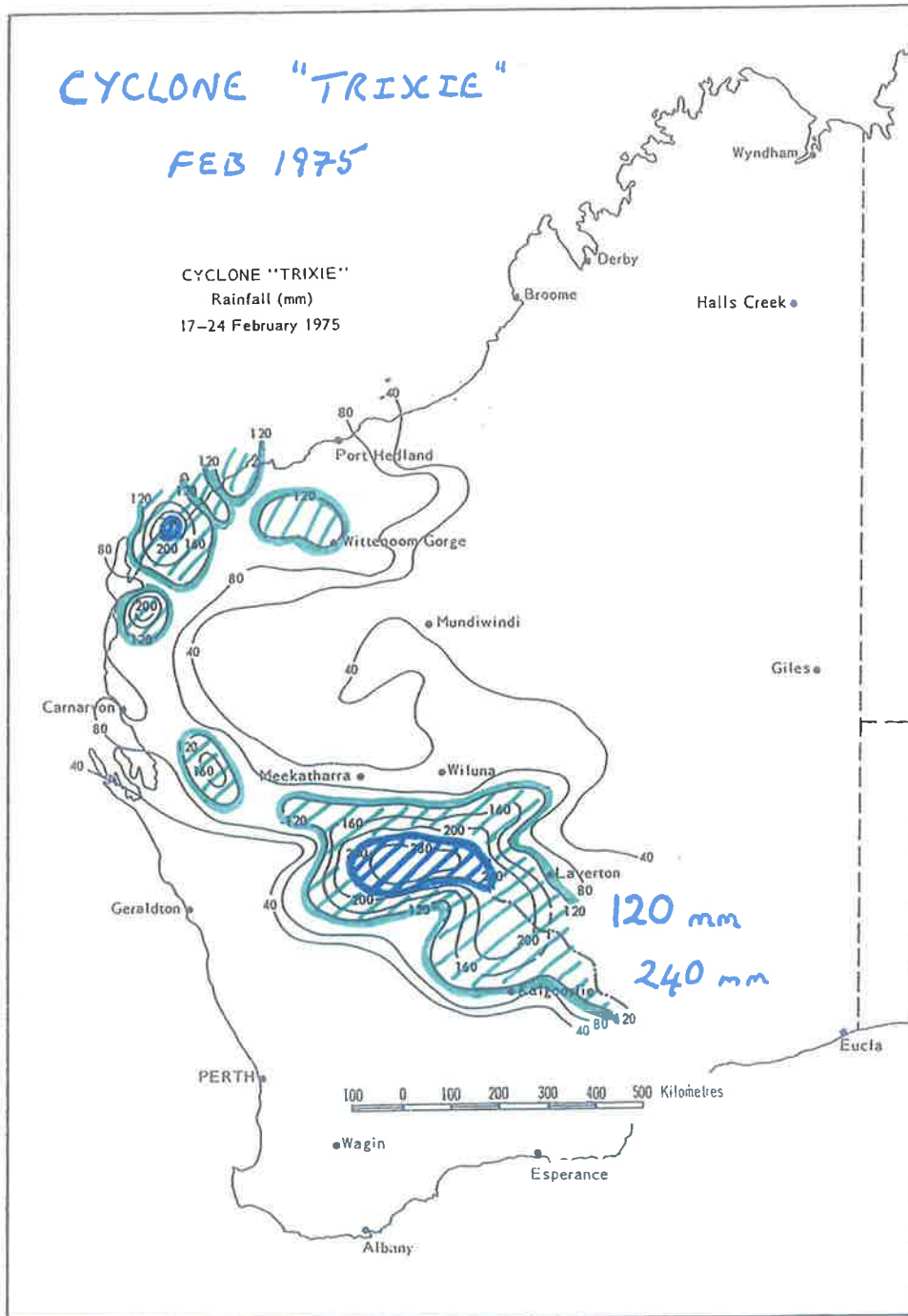


Fig. 7.13 Cyclone Trixie rainfall (mm) recorded during the period 17-24 February 1975

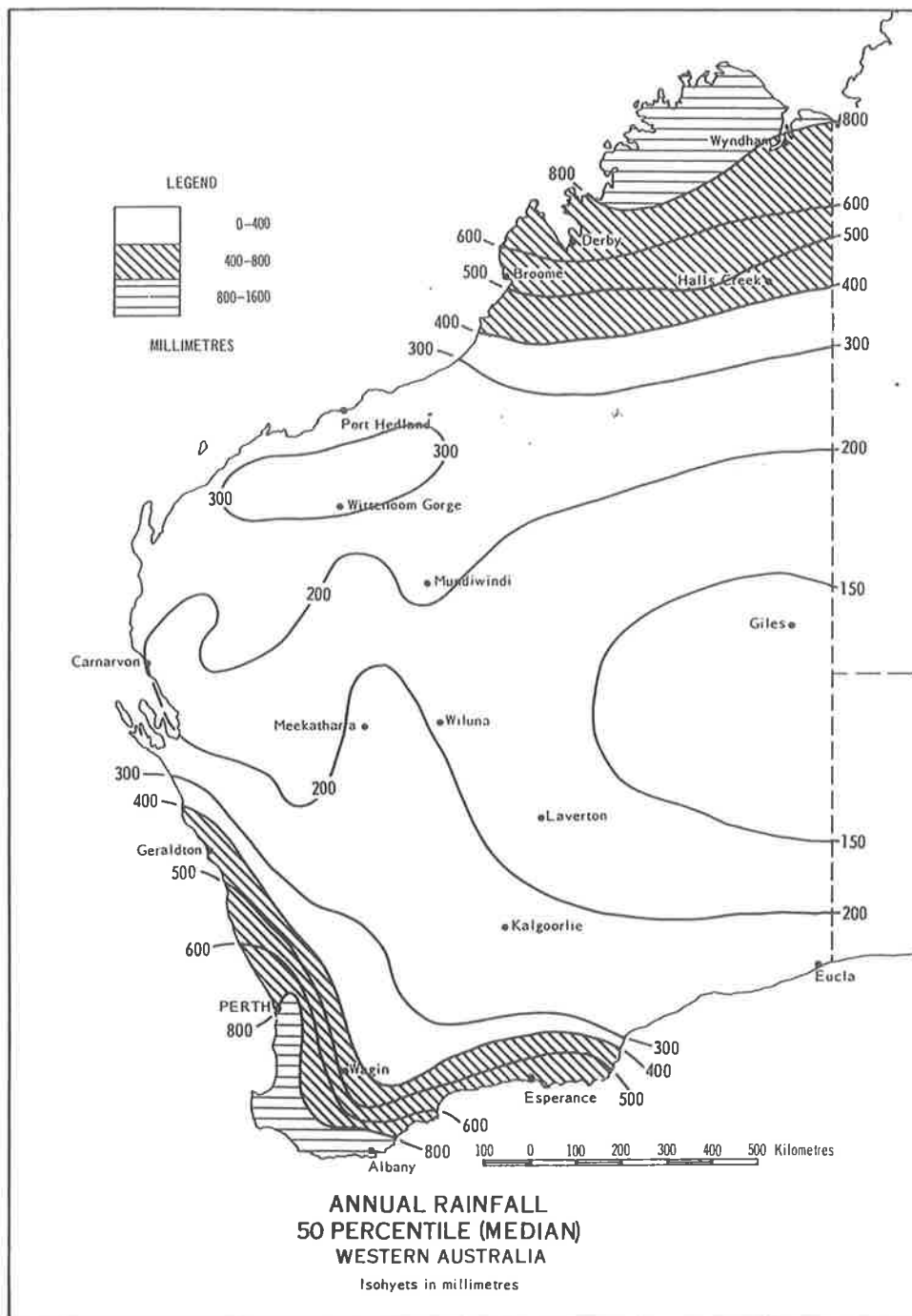


Fig. 7.12 Annual rainfall—50 percentile (median), W. Aust.

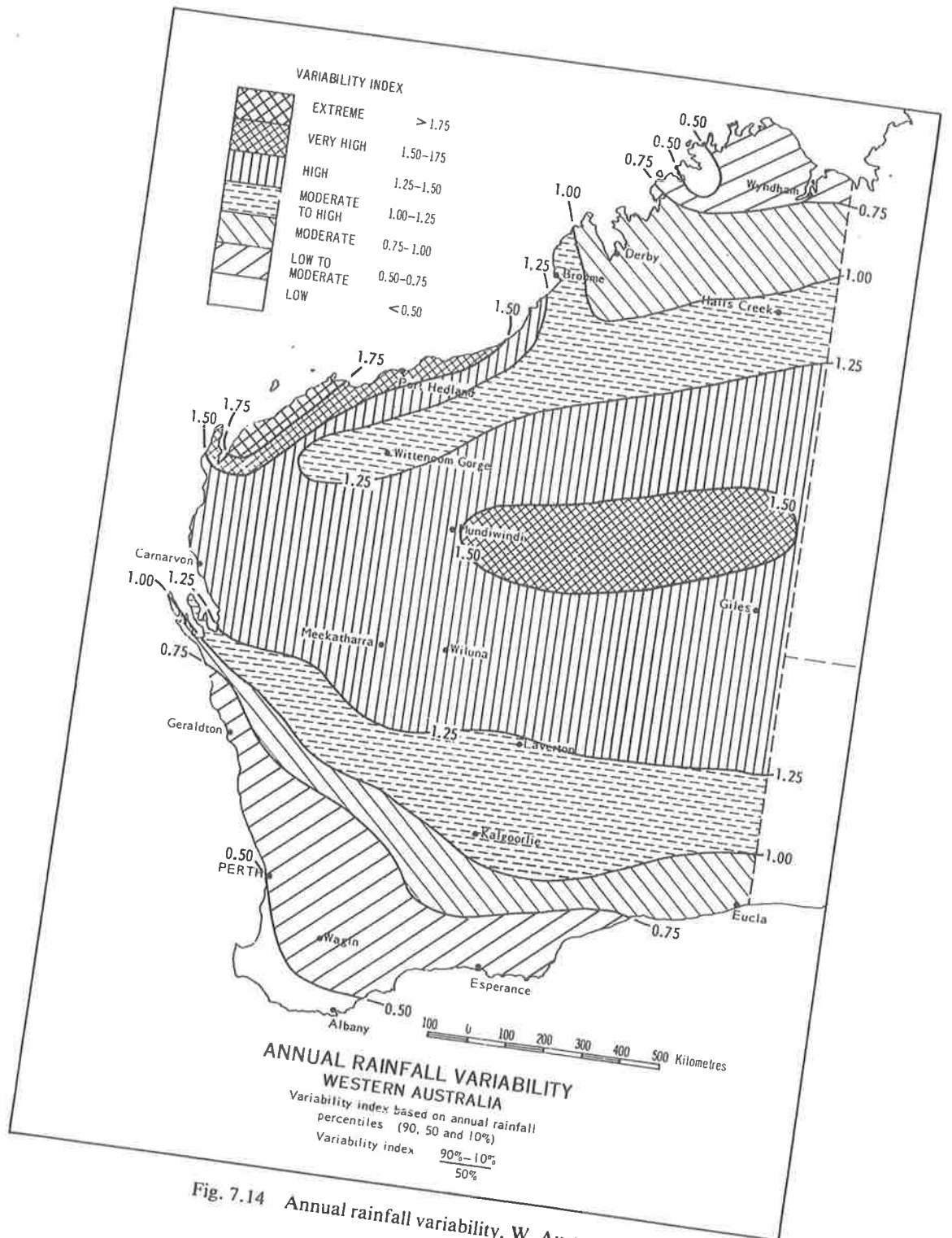


Fig. 7.14 Annual rainfall variability, W. Aust.

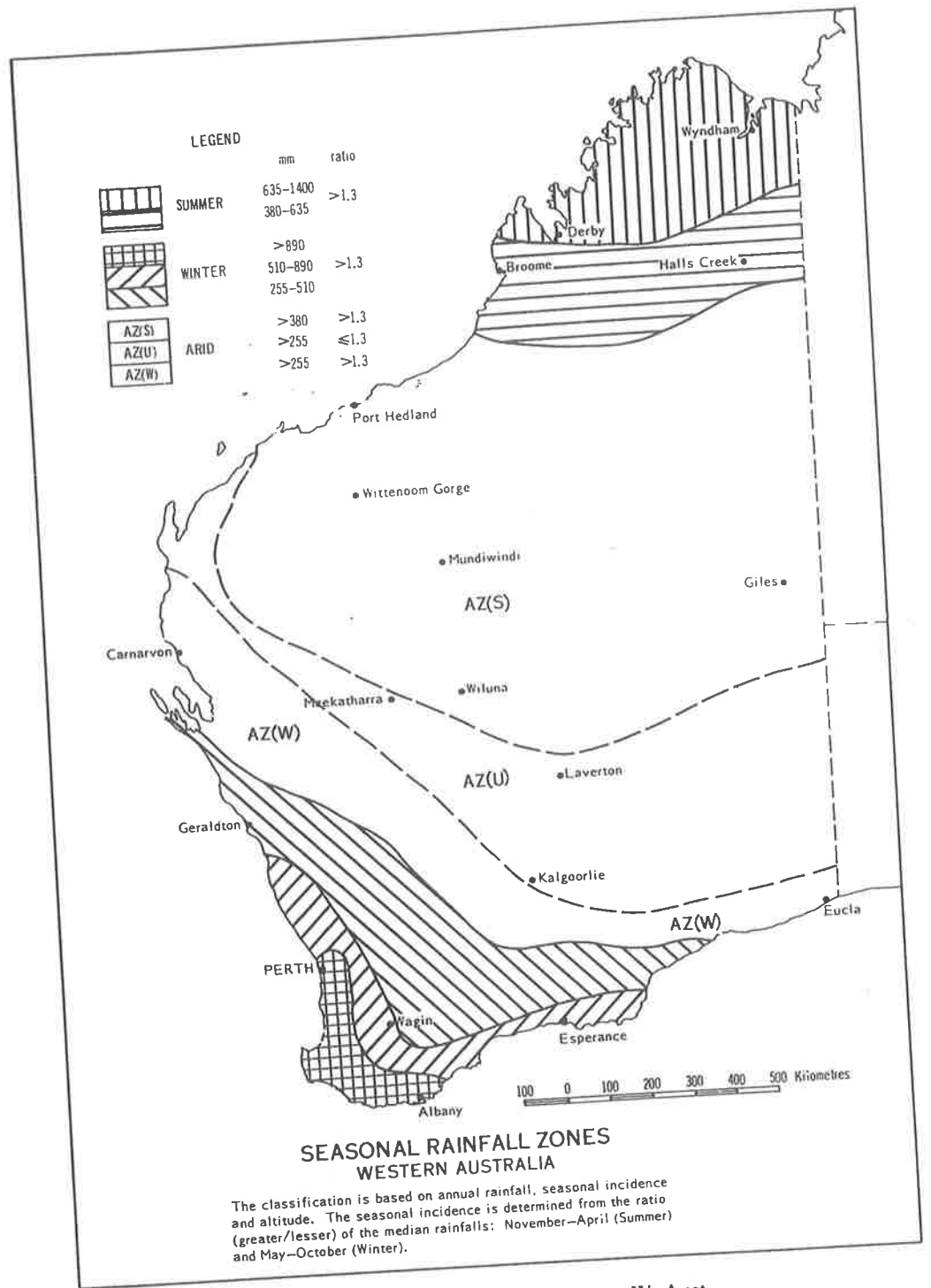


Fig. 7.11 Seasonal rainfall zones, W. Aust.

WESTERN AUSTRALIA

