

THE AUSTRALIAN SOCIETY OF
HERPETOLOGISTS
INCORPORATED



NEWSLETTER 40

Australian Society of Herpetologists Incorporated History of Office-bearers

Formation Committee (April 1964)

Convenor, MJ Littlejohn; Editor, AK Lee; State Representatives, IR Straughan (Qld), FJ Mitchell (SA), HG Cogger (NSW), G Storr (WA), RE Barwick (ACT), JW Warren (Vic).

First AGM (23 August 1965)

President, MJ Littlejohn; Vice-President, NG Stephenson; Secretary-Treasurer, AA Martin; Asst. Secretary-Treasurer, KJ Wilson; Ordinary Members, FJ Mitchell and IR Straughan; Editor, AK Lee.

President: MJ Littlejohn (1965-69); AK Lee (1969-1970); HG Cogger (1971-73); J de Bavay (1974); H Heatwole (1975-76); GC Grigg (1976-77); MJ Tyler (1978-79); GF Watson (1979-81); AA Martin (1981-82); RS Seymour (1982-83); R Shine (1983-84); GC Grigg (1984-86); J Coventry (1986-87); RE Barwick (1987-88); Jcovacevich (1988-91); M Davies (1991-92); R Shine (1992-94); A Georges (1994-96); D Roberts (1996-98); M. Bull (1998-1999); R Swain (1999-2001); S Downes (2001-).

Vice-President: NG Stephenson (1965-67); RE Barwick (1967-69); HG Cogger (1969-70); MJ Littlejohn (1971-72); MJ Tyler (1973); HG Cogger (1974); J de Bavay (1975-76); H Heatwole (1976-77); GC Grigg (1977-79); MJ Tyler (1979-80); GF Watson (1981-82); AA Martin (1982-83); RS Seymour (1983-84); R Shine (1984-86); GC Grigg (1986-1987); J Coventry (1987-88); RE Barwick 1988-91); J Covacevich (1991-92); M Davies (1992-94); R Shine (1994-6); A Georges (1996-98); D Roberts (1998-99); M Bull (1999-2001); R Swain (2001-).

Secretary/Treasurer: AA Martin (1965-67); GF Watson (1967-72); LA Moffatt (1973-75); J Caughley (1975-76); RWG Jenkins (1976-77); M Davies (1978-83); G Courtice (1983-87); J Wombey (1987-1999); S Keogh (1999-).

Asst Secretary/Treasurer: KJ Wilson (1965-69); JJ Loftus-Hills (1969-70); DF Gartside (1971-72); J Barker (1973-75); R Longmore (1976-77); T Burton (1978-83); A White (1983-86); E Bugledich (1986-90); A Georges (1990-94); T Burton (1994-1999); I Scott (1999-).

Ordinary members: FJ Mitchell (1965-67); IR Straughan (1965-67); HG Cogger (1967); JL Hickman (1969-70); NG Stephenson (1969-70); PA Rawlinson (1971-72); MJ Tyler (1971-72); J de Bavay (1973-74); MJ Littlejohn (1973-74); H Heatwole (1974-75); R Winokur (1975-76); RS Seymour (1975-76); R Humphries (1976-77); MJ Littlejohn (1976-77); RS Seymour (1978-80); AA Martin (1978-80); R Humphries (1980-82); AE Greer (1980-81); R Longmore (1981-83); D King (1982); B Firth (1983-84); J Coventry (1984-86); R Shine (1986-88); G Czechura (1988-90); RWG Jenkins (1990-91); K Chrisitian (1991-92); M Thompson (1992-94); K McDonald (1994-95); L Schwarzkopf (1995-98); M Anstis (1995-98); R Alford (1998-99); Nancy Fitzsimmons (1998-1999); C James (1999-2001); S Hudson (1999-2001); P Horner (2001-); G Gillespe (2001-).

Editor: AK Lee (1965-67); AA Martin (1967-73); GC Grigg (1973-76); JD Roberts (1976-82); L Taplin (1982-84); R Longmore (1984-1999); J-M Hero (1999-).

Public Officer: R Longmore (1983-).

Honorary Members: JA Moore (1969); MJ Littlejohn (1982); HG Cogger (1996).

Coat-of-Arms design: GF Watson.

Newsletter of the Australian Society of Herpetologists Incorporated

No. 40

May 2003

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Direct all membership enquiries to Dr Scott Keogh, Secretary/Treasurer, School of Botany and Zoology, The Australian National University, Canberra 0200, ACT. Membership forms can be downloaded from the ASH web site.

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Editorial

In case you didn't notice, this newsletter is a long time overdue. In the words of Jeffrey Lebowski, in the 4 years since you last received ASH news "a lot of new shit has come to light". Rather than squeeze this information into one enormous document, I decided to create two newsletters.

The purpose of Newsletter 40 is to provide a record of the "house keeping" of ASH from January 1999 until May 2003. This includes important records such as the Minutes from Annual General Meetings, Minutes from the Meetings of Council, Auditor's Reports, and the Abstracts from ASH Conferences from the all too distant past (Yungaburra, Queensland in 1998; Ross River, Alice Springs in 1999; Gum Leaves, Tasmania in 2001). Please be warned: not only is this Newsletter incredibly boring, it spans a huge number of pages of text. Rest assured that all of the really juicy information, including uncensored pictures of members at ASH2002, can be found in the more colourful Newsletter 41 (also produced in May 2003).

This may well be the shortest editorial in the history of ASH. However, rest assured that I am saving myself for Newsletter 41.

Yours in Herpetology,

Sharon Downes
President

**Minutes of the 27th A.G.M.
Australian Society of Herpetologists Incorporated**

Minutes of the Annual General Meeting held at Ross River, NT on Saturday 11 December 1999. The meeting opened at 6.08 pm with President Michael Bull in the chair.

Members present: John Wombey, Ric Longmore, Rick Shine, Nicki Mitchell, Sharon Downes, Jane Melville, Scott Keogh, Frank Lemckert, Dale Roberts, Steve Williams, Mark Hutchinson, Mark Hearnden, Glenn Shea, Stan Orchard, Simon Hudson, Roy Swain, Michael Scroggie, Graeme Gillespie, Jean-Marc Hero, Rod Kennett, Graeme Watson, Paul Horner, Mike Thompson, Simon Blomberg, John Coventry, Michael Mahony, Tom Burton, Craig James, Brian Malone, Michael Bull, Steve McAlpin.

Non Members present: James Schulte, Paul Doughty.

Apologies:, Roger Seymour, Peter Harlow, Gordon Grigg.

Minutes of the 26th AGM held at Yungaburra, Queensland:

Minutes of the 26th AGM were circulated in Newsletter No.39. These were taken as read and confirmed as a true and accurate record of that meeting.

Moved: D Roberts

Seconded: T Burton

Correspondence:

None of the correspondence presented was considered in need of a reply.

Treasurer's Report:

The 97/98 financial statement of income and expenditure as published in Newsletter No. 39 were examined and accepted by the meeting.

Motion: that the auditor's report and balance sheet be adopted.

Moved: G Watson

Seconded: S Blomberg

The 98/99 financial statement of income and expenditure was tabled at this meeting.

Motion: that the auditor's report and balance sheet be adopted.

Moved: M Mahoney

Seconded: S Hudson

President's Report:

The Society's financial state is considered to be healthy but a need is seen to maintain a reasonable buffer so that financial assistance or research grants for students can be considered. It is in the hands of the incoming committee how this will function and could be in the form of application by students at the time of meeting registration. An increase in funds could be met by raising meeting registration fee levees or annual subscriptions to non student members.

A motion was moved to raise non-student membership fees by \$10 per annum providing surplus funds to be used to contribute towards attendance costs of ASH student members to meetings.

The motion was not passed.

An amendment to the motion above was moved to the effect that any student, member or non-member of ASH could benefit from financial assistance.

Moved: R Swain

Seconded: B Malone

Carried

ASH Constitution:

Motion to accept the revised Constitution as presented at the 1995 meeting.

Moved: R Shine

Seconded: T Burton

Carried

Incorporation Status of ASH:

As the Society has some difficulty in complying with the requirements of incorporation, in particular the need to hold an AGM within 5 months of the end of the financial year, the desirability to remain incorporated was canvassed. John Wombey and Ric Longmore have agreed to investigate alternative liability options, if any exist.

End of an Era:

The current Secretary/Treasurer, John Wombey and Editor, Ric Longmore have given notice that they wish to stand down from their respective committee positions. The meeting expressed a vote of thanks and a round of applause.

Motion: that John Wombey and Ric Longmore be nominated as Honorary Members of the Society in recognition of their efforts in their respective committee roles.

Moved: M Hero

Seconded: R Shine

Carried with acclamation

Election of Office Bearers:

As no further nominations were received, the members nominated at the Annual Meeting at Ross River on the 10 December 1999 are hereby elected.

President:	R Swain
Vice President:	M Bull
Secretary/Treasurer:	S Keogh
Asst. Secretary Treasurer:	T Burton
Editor:	M Hero
Public Officer:	R Longmore
Ordinary Members:	C James and S Hudson

Editors Report

The outgoing editor, Ric Longmore, thanked the many members that contributed to Newsletter No. 39. With the advent of computers, E-mails and the net, accumulating and publishing information are now evolving rapidly and it may well mean that periodic information to members may take the form of computer-linked contact in future, but this would be up to the incoming editor. Ric said he had enjoyed his 16 years as editor and wished Marc Hero all the best in his new role.

Appointment of Regional Representatives:

Ric informed the meeting that many members had made contributions to newsletters, and that the old days of regional representatives, whose task it was to gather and collate regional information, may have come to an end. This generated some discussion with some members thinking that regional focal points should be maintained. This will be up to the new editor.

Venue for next meeting:

The meeting agreed to consider Roy Swain's suggestion of Tasmania in February 2001. Roy has agreed to investigate this option.

Other Business:

Naming of Student Prize: The Society is to consider renaming the students prize for Honours/Masters research as the "Murray Littlejohn Prize" subject to the President seeking permission from Murray to do so.

Conference Proceedings registration: Craig James put forward for consideration the possibility of the Society having Conference Proceedings registered with ISSN. Some discussion followed this, largely around the possibility of escalating costs, and the meeting agreed to have the matter considered.

A motion was put forward that anyone with the initials M. J. be expelled from the meeting

Moved: D Roberts

Seconded: G Watson

Carried

Thanks: Michael Bull proposed a vote of thanks to Craig James for the organisation of an excellent conference meeting and venue.

Moved: M Bull

Seconded: everyone - to thunderous applause.

Student Prizes: After detailed discussions, Session Chairs finally selected the following prize winners which were announced by the outgoing President:-

Student Prize for Honours/Masters research

Bob Wong - "Cold and psychic in Canberra: Effects of temperature and rain on acoustic signalling in the common eastern froglet *Crinia signifera*".

Peter Rawlinson Student Prize - best paper on a postgraduate student project

Sharon Downes - "Why does tail loss increase a lizard's later vulnerability to (some) snake predators?".

No other business. [NOTE:- Of the over 100 registrants who attended this meeting, only 31 bothered to attend the AGM. Given that we were all confined in a small space, this was disappointing. It may reflect that the majority was happy with how the Society was going, or to the fact that it was nice to have a cold beer under the trees at the end of a busy day. The reason is not clear; we hope it was the former.]

New members: Ed Meyer, Alexa Ryhorchuk, Sarah Smith, Megan O'shea, Mitchell Ladyman, Lyn Nelson, Greg Horrocks, Genaya Misso, Devi Stuart-Fox.

Meeting closed at 7.05 pm.

COUNCIL REPORT 1999

Report of Council, December 1999

President - Michael Bull

Vice President - Dale Roberts

Secretary/Treasurer - John Wombey

Editor and Public Officer - Richard Longmore

Assistant Sec/treasurer - Tom Burton

Dale Roberts put forward the suggestion that the student honours/masters prize be named the Murray Littlejohn prize. It was agreed to have this discussed at the AGM. The financial status of the Society was discussed and is considered to be in good shape. As no suggestions for amending the draft Constitution have been put forward the meeting will be asked to consider accepting the draft. Amendments can still be made at future meetings if the need arises. Ric Longmore discussed the possibility of the position of President being held for more than one term. John Wombey drew attention to the difficulty of the Society holding AGM's within the designated time stipulated by the incorporation regulations. At this stage the Society pays a late entry fine for returns after the due date but there may be other ways to deal with liability issues which the Society could explore.

John Wombey and Ric Longmore gave notice that they did not wish to be nominated for the positions of Secretary/Treasurer and Editor.

John Wombey

Secretary/Treasurer

Ric Longmore

Editor

**Minutes of the 28th AGM
Australian Society of Herpetologists Incorporated**

Minutes of the Annual General Meeting held at "Gumleaves", Tasmania on Sunday 11 February 2001. The meeting opened at 5.50pm with President Roy Swain in the chair.

Members present: Sharon Downes, Scott Keogh, Ricky Spencer, Jane Melville, Rick Shine, Marg Davies, Bruce Firth, Ingrid Belan, Greg Kerr, Glenn Shea, Arthur Georges, Gerry Marantelli, Lyn Nelson, Jenny Taylor, Frank Lemckert, Graeme Gillespie, David Chapple, Megan Head, Warwick Smith, Ian Scott, David Newell, Tony Tucker, Keith McDonald, Andrew Hamer, Mike Bull, Di Barton, Steve Williams, Tracy Langkide, Ross Alford, Will Osborne, Robert Davis, Joan Whittier, Dale Roberts, Murray Littlejohn, Kylie Leonard, Raelene Hobbs, Paul Horner, Erik Wapstra, Nancy Fitzsimmons, Paul Doughty.

Apologies: Peter Harlow, Mike Tyler.

Minutes of the 27th AGM held at Ross River, Northern Territory:

Minutes of the 27th AGM were circulated at the meeting. These were taken as read and confirmed as a true and accurate record of that meeting.

Moved: R Swain

Seconded: S Downes

Correspondence:

None of the correspondence presented was considered in need of a reply.

Treasurer's Report:

The 98/99 financial statement of income and expenditure was tabled at this meeting.

Motion: that the auditor's report and balance sheet be adopted.

Moved: R Swain

Seconded: S Downes

The Treasurer reported that ASH needs to obtain an ABN number in order to waive the need to consider GST as a society.

Keogh proposed that a firm date be set for membership renewals and that a small proportion (~A\$500) of the budget be allocated to transforming the current members database to an electronic format.

Moved: Marg Davies

Seconded: Rick Shine

President's Report:

The Society's financial state is considered to be healthy but a need is seen to maintain a reasonable buffer so that financial assistance or research grants for students can be considered. It is in the hands of the incoming committee how this will function, and these people are responsible for liaison with the winner of this years postgraduate student prize (Kylie Leonard) to determine the precise mechanism by which funds will be awarded. This will happen before the end of April so that students have enough time to apply for funding, for example, to attend the World Congress of Herpetology in Sri Lanka in December 2001.

Election of Office Bearers:

As no further nominations were received, the members nominated at the AGM at Gumleaves on 11 February 2001 are hereby elected.

President:	S Downes
Vice President:	R Swain
Secretary/Treasurer:	S Keogh
Asst. Secretary/Treasurer:	I Scott
Editor:	M Hero
Public Officer:	R Longmore
Ordinary Members:	P Horner and G Gillespe

Editors Report:

The editor was unable to attend the meeting, but the Secretary/Treasurer spoke on his behalf. A call was put forward for information for the ASH webpage, including links to labs in Australia studying herpetology. The idea of putting a list and contact address for every ASH member on the website was also discussed, however the general consensus was that this practice was unnecessary.

Motion: that an additional \$500 be allocated to upgrading the website, which would be organised by the editor.

Moved: S Keogh

Seconded: S Downes

Venue for next meeting:

The meeting agreed to hold the next meeting in Canberra in the winter of 2002. The exact dates are still to be decided. Paul Horner raised the possibility of holding a meeting in Darwin in 2002 but since the practicality of this option was not certain, it was decided that this venue may be appropriate for the 2003 meeting.

Other Business:

Archival material: Concern was expressed over losing important historical documents concerning ASH and a decision was made to make sure that material that is now distributed electronically is also produced in hard copy format. It was suggested that a call be made to all members for archival material and that this material stay with the Secretary/Treasurer rather than the Public Officer.

Ejection: A motion was put forward to eject Murray Littlejohn from the meeting.

Moved: D Roberts

Seconded: R Shine

National Database of Herpetofauna: G Gillespe mentioned that a possible long term goal of the society may be to collate an electronic National Database of Herpetofauna. He proposed that members negotiate with key institutions and attempt to obtain Government funding for the project (e.g., NHT funding). He agreed to investigate the possibility further.

Student prizes: Murray Littlejohn agreed to having the Honours/Masters Award named in his honour. A new evaluation system was implemented this year to provide students with valuable feedback on their talks. Session chairs were asked to score certain aspects of a students' presentation. This information was also used as a guide to judging the talks. The following prize winners were announced by the incoming President:

Murry Littlejohn prize for Honours/Masters Research:

Winner (\$200)—Allie Mokany, "Interactions between tadpoles and mosquito larvae"

Honorable mention—Anja Klingenbock, "Family business? What drives habitat usage of the land mullet (*Egernia major*, Scincidae)?"

Peter Rawlinson prize for Postgraduate Research:

Winner (\$300)—Kylie Leonard, "The effects of light and temperature on *in vitro* melatonin rhythms of the sleepy lizard, *Tiliqua rugosa*"

Honorable mention—Ricky Spencer, "Predation risk and nesting: the role of the fox in modifying the behaviour of a freshwater turtle"

Honorable mention—Clare Morrison, "Altitudinal variation in tadpole growth and developmental rates"

Prize for best poster:

Winner (\$100) - Tracy Langkilde, "Tail waves in the rainbow skink, *Carlia jarnoldae*"

New members: Joanne Chambers, David Chapple, Naomi Doak, Michelle Drew, Joern Fischer, Alison Fitch, Jane Girling, Donna Hazell, Geoff Heard, Raelene Hobbs, Anke Maria Hoefer, Sacha Jellinek, Greg Kerr, Samantha Kneives, Tracy Langkilde, Bonnie Lauke, Kylie Leonard, Lorrae McArthur, Allie Mokany, Louise Osborne, Konrad Osterwalder, Richard Peters, Kylie Robert, Marko Sacchi, Dan Salkeld, Chloe Schauble, Ben Smith, Jessica Stapley, Adam Stow, Leonie Valentine, Bob Wong, Danny Wotherspoon.

Ejection: A motion was put forward to eject absent friends (i.e., Mike Tyler) from the meeting.

Moved: M Littlejohn

Seconded: M Davies

The meeting closed at 6.45 pm.

COUNCIL REPORT 2001

Report of Council, February 2001

President - Roy Swain

Vice President - Mike Bull

Secretary/Treasurer - Scott Keogh

Public Officer - Richard Longmore

Assistant Sec/treasurer - Tom Burton

Scott Keogh put forward the suggestion that a firm date be set for membership renewals. It was agreed to have this discussed at the AGM. The financial status of the Society was discussed and is considered to be in good shape. The possibility of allocating some of the ASH funds to support student research was discussed and it was agreed to bring up this topic at the AGM.

Scott Keogh

Secretary/Treasurer

J.M. Neill
CHARTERED ACCOUNTANT
(A.B.N. 59 971 007 603)

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**AUDITOR'S REPORT TO THE MEMBERS OF THE AUSTRALIAN
SOCIETY OF HERPETOLOGISTS INCORPORATED**

1. I have audited the attached accounts being the Income and Expenditure Statement for the year ended 30 June 2000 and the Balance Sheet at that date in accordance with Australian Auditing Standards.
2. As an audit procedure it was not practicable to extend my examination of fund raising beyond the accounting for amounts received as shown by the books and records of the Association.
3. Subject to paragraph 2, I report that in my opinion:
 - (a) The accounts are properly drawn up so as to give a true and fair view of the matters required by subsection 72(2) of the Associations Incorporation Act, 1991 to be dealt with in the accounts.
 - (b) The accounts are properly drawn up in accordance with the Act.
 - (c) The accounts are properly drawn up in accordance with proper accounting standards.
 - (d) I have obtained all the information and explanations required.
 - (e) Proper accounting records and other records have been kept by the association as required by the Act.



J M NEILL
CHARTERED ACCOUNTANT

31 January 2001

HEREPAR.DOC

THE AUSTRALIAN SOCIETY OF
HERPETOLOGISTS INCORPORATED

BALANCE SHEET
AT 30 JUNE 2000

Last Year		\$	\$
	ACCUMULATED FUNDS		
14587	Opening Balance		15992
1405	Surplus (Loss) for the year		3468
-----			-----
15992	Closing Balance		19460
=====			=====
-----			-----
15992	TOTAL FUNDS		19460
=====			=====
	REPRESENTED BY:		
	CURRENT ASSETS		
1392	Stock on Hand - at cost	1124	
0	Bank Cheque on hand	18372	
4	Cash on Hand	4	
9942	Cash at Bank	0	
4704	Bank Savings Account	0	
150	Subscriptions in arrears	0	
-----		-----	
16192			19500
-----			-----
16192	TOTAL ASSETS		19500
	CURRENT LIABILITIES		
200	Subscriptions in advance	40	
-----		-----	
200			40
-----			-----
15992	NET ASSETS		19460
=====			=====

THE AUSTRALIAN SOCIETY OF
HERPETOLOGISTS INCORPORATED

INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED 30 JUNE 2000

Last Year		\$	\$
	INCOME		
0	AGM Fees		2604
4558	Subscriptions		1340
0	Newsletter		220
0	Sale of T Shirts, etc - profit		118
5	Interest		6
-----			-----
4563	TOTAL INCOME		4288
	LESS EXPENSES		
200	Audit Fee	240	
221	AGM Expenses	0	
8	Bank Fees	16	
0	Filing Fees	64	
2238	Newsletter	0	
0	Prizes	500	
491	Stationery & Postages	0	
-----		-----	
3158	TOTAL EXPENSES		820
-----			-----
1405	SURPLUS (LOSS) FOR THE YEAR		3468
=====			=====

THE AUSTRALIAN SOCIETY OF HERPETOLOGISTS INCORPORATED**NOTES TO AND FORMING PART OF THE ACCOUNTS
FOR THE PERIOD ENDING 30 JUNE 2000**

Last Year

1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

S

The Society is not a reporting entity because in the directors' opinion there are unlikely to exist users who are unable to command the preparation of reports tailored so as to satisfy specifically all of their information needs, and these accounts are therefore special purpose financial reports that have been prepared to meet the requirements of members and income tax law.

The entity has applied Accounting Standard AASB 1025 Application of the Reporting Entity Concept. No other Accounting Standards or Statements of Accounting Concepts have mandatory applicability.

The significant accounting policies which have been adopted in the preparation of the financial statements are:

- (a) Accrual accounting has been applied and the accounts have been prepared on the basis of historical costs and do not take into account changing money values nor, except where stated, current valuations of non-current assets.

2. BANK CHEQUE ON HAND

Both bank accounts were closed on 13 June 2000 and new accounts were not opened until after 30 June 2000.

Abstracts from the 26th AGM of ASH Yungaburra, Queensland 1998

Alford, Ross A. Competitive interactions of larval cane toads, *Bufo marinus*, from three Townsville populations.

Bufo marinus eggs were collected from three sites in the Townsville region. Eggs of *Limnodynastes ornatus* and *Litoria inermis* were collected from a single site. Tadpoles were reared in 440 mL laboratory containers in six experimental treatments. These were: one *Bufo* tadpole, 1X food; six *Bufo* from a single site, 6X food; one *Bufo*, 6X food; 1 *Bufo*, 5 *Limnodynastes*, 6X food; 1 *Bufo*, 5 *Litoria*, 6X food; and two *Bufo* from each population (six total), 6X food. *Bufo* from different populations grew at different rates. *L. ornatus* tadpoles had a greater competitive effect on *Bufo* than did other *Bufo*. *L. inermis* tadpoles affected the growth of *Bufo* very little, but appeared to be strongly inhibited by *Bufo*. *Bufo* in the mixed-population treatment appeared to grow slightly faster, and varied more in larval period and metamorphic mass, than *Bufo* from single populations grown at the same density and food supply rate. These results suggest differential maternal or genetic effects on the growth of *Bufo* from different Townsville area populations, and that native species may be affected differentially by competition with cane toad larvae.

Barton, D.P. Did *Bufo marinus* (Amphibia) introduce any parasites to Australia?

Bufo marinus was introduced to Australia in 1935 in an attempt to control sugar cane beetles. At the time of its introduction, no tests were carried out to determine if it carried any parasites and/or diseases. In a recent survey of the helminth parasites of *B. marinus*, 27 helminth species were reported. Of these 27 species, it can be determined that the majority were acquired by the toad post-introduction. Extensive searching of the literature and museum collections found that many species had been described in native amphibians prior to the arrival of the toad or in areas well out of the present range of the toad. Two genera, however, cannot be definitively determined as of Australian origin. Both of these genera, *Rhabdias* (Nematoda) and *Mesocoelium* (Digenea), have been recorded in *B. marinus* in its native range. Various factors, with regard to the introduction of the toad, are likely, however, to have prevented their introduction.

Beggs, Kerry* and Arthur Georges. Melding the physical and the physiological: Do temperature differences with soil depth cause developmental asynchrony in turtle nests?

The existence of thermal gradients within turtle nests is an important issue to be dealt with when investigating the relationship between incubation temperature and embryonic development. The difference in temperature regimes with soil depth and the effects of this variation on turtle embryonic development have not been specifically investigated. A field experiment involving eggs of the pig-nosed turtle *Carettochelys insculpta* was undertaken to evaluate the influence of soil depth on temperature and embryonic development. Fresh eggs were collected and reburied with temperature probes at known depths on a nesting beach in an arrangement such that eggs from the same clutch were spread over depth/temperature treatments. Eggs were removed and opened twice through the incubation period, to assess embryonic development, with the remaining eggs left to incubate to hatching. At the various soil depths, mean daily temperatures were not significantly different, though the cycles were out of phase and the magnitude of daily fluctuations was significantly higher at shallower depths. Despite the variation in thermal regimes, there was no significance difference in embryonic development or incubation period at different soil depths. This study has shown that, provided incubation temperatures remain above developmental zero, variation in thermal regime with depth does not result in developmental asynchrony. This influences our theories on the evolution of late term metabolic depression.

Berry, Oliver. Evidence for high mobility by the Sand Frog, *Heleioporus psammophilus* (Anura : Myobatrachidae), near Perth, Western Australia.

The Sand Frog, *Heleioporus psammophilus* is a highly habitat specific breeder. Choruses only occur in patchily distributed sand bodies in the Darling Range and Swan coastal plain. The genetic relationships amongst breeding populations of *H. psammophilus* were investigated. Based upon allozyme electrophoretic data, significant sub-structuring among populations was recorded, with a mean F_{st} value of **0.0884**. Evidence suggests that river catchment boundaries and the Darling Scarp are determinants of the relationships among populations. However, the level of differentiation between breeding populations is low relative to other frog species studied, and is not clearly correlated with their spatial relationships. This suggests that *H. psammophilus* is a highly mobile species and exhibits limited philopatry. Management implications are discussed.

Blamires, Sean J. Impact Of Predation On Sea Turtle Nests By Goannas At Fog Bay, Northern Territory

Sea turtle nesting has been assessed opportunistically at the Fog Bay rookery by NTU Turtle research since 1986. The species of sea turtles nesting in the area are flatback (*Natator depressus*) and olive ridley (*Lepidochelys olivaceous*) sea turtles. The Fog Bay rookery contains four beaches from 1 to 1.5 klm each, differing in character and nesting density. The major predator of nests at the site is the goanna *Varanus panoptes*. The four beaches were surveyed during two time periods (breeding season of 1989 and 1997) to determine the number of flatback and olive ridley nesting in the area. The location of nests in accordance to position on the dune was recorded and number of nests raided by goannas. Between 50% and 60% of all the nests were raided by goannas. At first glance it would appear a definite advantage for the turtles to nest on the slope, since nests on the dune slope attracted less predation (13% to 22%) than those below the dune slope (51% to 64%). As between 78% and 85% of nests are laid below the dune slope each year, this area, despite high predation rates, has the potential to contribute markedly to the productivity of the beaches in terms of hatchling sea turtles surviving to enter the sea. Management practices that transplant sea turtle eggs from high risk areas, may exploit, on a limited basis, areas of low predation. Caution should be applied to active control of native predators of sea turtle nests until more is known about the productivity of rookeries in terms of supplying hatchlings to the sea.

Booth, D.T. The thermal environment of freshwater turtle nests.

Because the freshwater turtles *Chelodina expansa* and *Emydura signata* construct relatively shallow nests, nest temperature fluctuates on a daily basis and also varies throughout the incubation period. Nest location has an important influence on mean nest temperature and the amplitude of daily fluctuations with nests exposed to full sun throughout the day experiencing higher mean temperature and greater temperature fluctuations. Location within the nest also influences the thermal environment with eggs at the top of the nest experiencing greater diurnal temperature fluctuations compared to eggs at the bottom of the nest. There is also a consistent hysteresis between the heating and cooling phase of the daily temperature cycle with nests in the sun heating faster than they cool.

Bradbury, M.R. Fungal infection and embryonic death in *Crinia signifera*.

Amphibians are considered reliable indicators of environmental condition. Shrinking populations have been reported around the world but declines are irregular and often occur in relatively undisturbed locations. Local and global factors, including UV-B radiation, pH and pathogenic fungi, have been associated with frog declines. In this study mould was observed on embryos of the frog *Crinia signifera* at several locations in South Australia. Fertile *C. signifera* eggs held in the laboratory died as a result of fungal infection. The mould *Rhizopus microsporus* was identified from samples taken from these eggs. It is suggested that the presence of a mould such as *Rhizopus microsporus*, when combined with stream pollution or other stressing factors, has the potential to increase mortality of *C. signifera*.

Bradfield, K.S.* and Ross A. Alford. The effects of behaviour and group size-structure on vulnerability to predators.

Many species exhibit size specific vulnerability to predators; small individuals are often more vulnerable than large ones. It is thus possible that an individual's use of antipredator strategies such as aggregation and changes in activity level or pattern may change with body size. Within size-structured aggregations, the benefits of these strategies may vary among individuals. We used *Bufo marinus* tadpoles, which form size-structured aggregations, to investigate the effects of (1) group size-structure on size-specific predation risks and (2) predator presence on size specific activity levels. Small and large tadpoles exhibited similar activity levels when predators were absent, and both classes significantly reduced activity in the presence of a predatory odonate naiad (*Hemianax papuensis*). Naiads preyed at higher rates on small tadpoles when prey of both size-classes were present. Predation rates on small and large tadpoles decreased with increasing group size. Our results thus indicate that (1) small groups of tadpoles of either size class can reduce their risk of predation by joining other groups and (2) small groups of tadpoles of either size would maximise this gain by joining groups of small individuals. This produces a conflict between the interests of tadpoles of different sizes.

Broomhall, S.* and W. Osborne. Comparative effects of ultraviolet-B radiation on two sympatric species of Australian anurans, *Crinia signifera* and *Litoria verreauxii alpina*.

Increased levels of solar ultraviolet-B radiation (UV-B) (280-320nm) due to ozone depletion may be involved in the declines of a number of amphibian species in the last decade. The research reported here compared survivorship of embryos and tadpoles of a declining anuran species, *Litoria verreauxii alpina*, with a sympatric non-declining species, *Crinia signifera*, under natural UV-B levels in a replicated and controlled experiment established at three different altitudes (1380 m, 1600 m and 1930 m). At all altitudes the exclusion of UV-B radiation significantly enhanced survival for the declining species *L. v. alpina* and the non-declining species *C. signifera*, with the effect being particularly pronounced in *L. v. alpina*. Overall, the probability of dying was highest in the unshielded, open treatments and lowest under the UV-B blocking filter for both species over all altitudes. The probability of dying was considerably higher in *L. v. alpina* than in *C. signifera* for a given treatment without exception. The lower temperatures evident at high altitudes appear to have augmented any deleterious effects of UV-B radiation, although the exact mechanism for this is unknown and requires further study. The results support the hypothesis that ultraviolet radiation is a potential factor in the disappearance of *L. v. alpina* at high altitudes in Southern Australia.

Browne, R.K. *, J. Clulow, and M. Mahony. Cryopreservation of sperm from the cane toad (*Bufo marinus*).

Sperm cryopreservation has the potential to play an important role in the conservation of genetic diversity in wild and captive populations of endangered amphibians. We know of no published protocol for the preservation of sperm in any amphibian species. Therefore, we investigated possible protocols for freezing amphibian sperm using the cane toad as a laboratory species. Sperm were collected by the maceration of cane toad testes (following euthanasia with MS222) in an isotonic amphibian Ringer. Two cryoprotectants (glycerol and DMSO) were tested at various concentrations in protocols employing fast and slow cooling rates. The results of preliminary experiments showed that rapid cooling to the temperature of liquid nitrogen (-196°C) was detrimental to sperm viability. It was found that cane toad sperm have a high level of tolerance to glycerol and DMSO, and thus it is not critical to minimise the time in solutions containing cryoprotectant. High post-thaw recovery of both sperm motility (> 50% motile) and fertilizing capacity was demonstrated in sperm frozen in DMSO and glycerol based diluents with concentrations varying from 10-20% v/v. The highest fertilization rate was achieved with sperm frozen in 20% glycerol (post-thaw mean fertilization rate of $77 \pm 17\%$).

Bull, C. Michael* and Clare Griffin. Scat piling in *Egernia* skinks.

Anecdotal accounts suggest several species in the genus *Egernia* produce obvious piles of scats close to their refuge. We have documented this behaviour in laboratory colonies of *Egernia stokesii* and *E. striolata*, both rock crevice refugers, but not in *E. inornata*, a sand burrower. Rock crevice lizards of other genera do not show this behaviour. Scat piling seems a dangerous practice in that predators could easily be alerted to the location of refuging lizards. The lizards may use scat piles as occupancy markers, similar to the use of territorial latrines by many mammals. This requires that lizards can distinguish between scats from different individuals. Our preliminary investigations show that *stokesii* and *striolata* can discriminate between their own scats and those of conspecifics, but *inornata* cannot. The scats are probably coated with secretions from a cloacal gland. Lizards can discriminate between chemical extracts of their own scats and of scats from conspecifics. We suggest that the evolution of scat piling and the additional ability to communicate, has contributed to the unusually high levels of social organisation in many *Egernia* species.

Burton, T.C. The distal extensor muscles in the fingers of frogs are an adaptation to arboreality.

Hand muscles of frogs are often assumed to reflect ecological adaptations rather than phylogeny, but the roles of adaptation and phylogeny in hand muscles have never been analysed. I dissected the hand muscles of frogs from families with arboreal members – Allophrynidae, Bufonidae, Centrolenidae, Hylidae, Hyperoliidae, Leptodactylidae, Microhylidae, Ranidae and Rhacophoridae. Some muscles proved highly conservative in confamilials of vastly different ecologies. However, two presumed adaptations to arboreality have evolved several times – division of the main wrist flexor (the *m. palmaris longus*) into segments; and possession of distal extensors of the fingers (the *mm. extensores breves distales*). Distal extensors occur in arboreal frogs from all families except Bufonidae and Leptodactylidae. These muscles occur also in non-arboreal hylids, hyperoliids, and pseudids, but not in non-arboreal leptodactylids, microhylids and ranids. This indicates an arboreal ancestry for hylids, hyperoliids and pseudids, and a non-arboreal ancestry for the other three families. The microhylids *Cophixalus* and *Oreophryne* apparently had non-arboreal ancestry.

Burton, T.C. Myobatrachidae may exist: the evolution of some hand muscles of frogs.

Much of the hand musculature of frogs is very conservative. The *mm. transversi* connect adjacent metacarpals, and the *mm. flexores teretes* are the deepest flexors of the basal finger joints. I examined these muscles in 313 species and 164 genera from all frog families. During the course of evolution, the *mm. transversi I* and *II* shifted from dorsal to more ventral positions, and the origins of the *mm. flexores teretes III* and *IV* moved medially to lie dorsal to the *mm transversi*. This occurred twice – in the ancestor of Pipidae; and in the ancestor of a clade in the Neobatrachia consisting of Allophrynidae, Brachycephalidae, Bufonidae, Centrolenidae, Hylidae, Leptodactylidae, Pseudidae, Ranoidea, and Rhinodermatidae .but not Heleophryne, Myobatrachidae and Sooglossidae. Unique conditions of the *m. transversus* – *m. flexor teres* complex characterize Centrolenidae, Microhylidae, and a group of ranine frogs. The superficial flexor musculature of the third finger is also informative, suggesting a number of close relationships, e.g., between dendrobatids and hyloids and between myobatrachines and limnodynastines.

Byrne, Phillip. Multiple male mating reduces fertilisation efficiency in the West Australian myobatrachid frog *Crinia georgiana*.

Multiple mating by females is a common phenomenon in animals. One hypothesis for the adaptive function of this behaviour is that it ensures fertilisation by avoiding any risk of low sperm number, poor sperm quality or problems of incompatibility. This hypothesis was tested in the West Australian myobatrachid frog *Crinia georgiana* whose mating behaviour is characterised by multiple male single female mating assemblages. The results of the investigation did not support the fertility insurance hypothesis. Comparison between the fertilisation efficiency of egg clutches derived from single and multiple male matings revealed that the involvement of extra males drastically reduced fertilisation efficiency. When a female mated with a single male there was an average fertilisation efficiency of

94%. In matings where females were amplexed by two males, however, there was only 68% fertilisation and where females were amplexed by 3 to 5 males there was only 64% fertilisation efficiency. This result demonstrates a major reproductive cost to females of mating with multiple males and raises questions about the adaptive significance of this behaviour. Alternative hypotheses to explain the evolution of multiple male mating in this species are discussed.

Clark A.K., M. Mahony* and J. Clulow. Triploidy and survival rate of cane toad (*B. marinus*) eggs subjected to cold shock.

The release of sterile males into wild populations has been used successfully with some invertebrate species as a means of biological control. Some characteristics of cane toad biology (such as mating with only one male per spawning) indicate that the sterile male approach may be applicable as a method of biological control for cane toads. One mechanism for producing sterile individuals that has been demonstrated in a number of amphibian species is the induction of triploidy in developing embryos, usually by the application of cold shock to newly fertilized eggs. We examined the feasibility of producing triploid cane toads using cold shock by subjecting freshly fertilized cane toad eggs to cold shock at 0-4°C for 0 to 120 minutes. Ploidy was determined in metaphase spreads of chromosomes from the tail tips of tadpoles directly after hatching. The results (20 tadpoles examined per treatment) demonstrated that triploidy could be induced at a high rate (0, 53, 50 and 77% respectively for eggs subjected to 0, 15, 30 and 60 min. cold shock). Survival, however, was inversely proportional to the cold shock interval (and hence rate of triploidy) being respectively 75, 54, 54 and 23%. Chemical induction of triploidy using cytochalasin B was also demonstrated, but the rate achieved was low.

Conroy, S. Population regulation in *Geocrinia alba* and *G. vitellina*.

Population regulation in the anurans occurs primarily during the embryonic and larval phases. In this study survival of *Geocrinia alba* and *G. vitellina*, two terrestrial breeding frogs from the southwest of WA, was determined during the embryonic, larval, and juvenile phases, as well as from calling males. Calling male survival for both species, determined using mark-recapture studies, was high. Embryonic and larval survival was recorded from nests *in situ*. Pre-metamorphic survival in these species is variable and may be low. Mark-recapture studies were also used to determine juvenile survival. Metamorphs were both toe-clipped and bathed in a tetracycline solution to ensure they would be recognisable as adults. Preliminary results suggest that juvenile survival is low. However, the poor survival of juveniles and the variable survival of embryos and larvae are not sufficient to explain the limited recruitment of calling males observed.

Donnellan, Stephen, Mark Hutchinson*, Kathleen Saint and Jan Birrell. Molecular evidence for the phylogeny of Australian gekkonoid lizards.

We determined partial sequences of the mitochondrial 12S rRNA and nuclear c-mos genes for 12 species of gekkonoid lizards representing the traditional four major taxa of the Australian region, the Diplodactylini and Carphodactylini (forming the subfamily Diplodactylinae), the Pygopodidae and the Gekkoninae, and a non-Australian gekkonoid lineage, the Eublepharinae. We used the combined sequence data to reconstruct the underlying molecular phylogeny which we used to test the monophyly of the diplodactyline tribes and conflicting hypotheses of relationships of the pygopods and of the genus *Oedura*. Monophyly of the Diplodactylinae is supported, while pygopods form a monophyletic sister lineage to all Diplodactylinae. The molecular data support the monophyly of the Diplodactylini, with *Oedura* firmly placed as a diplodactylin. Monophyly of the Carphodactylini is not supported, the genera studied forming a paraphyletic cluster at the base of the Diplodactylini. Pygopods are nested within the traditional Gekkonidae, pygopods plus diplodactylines being well-supported as monophyletic with respect to the remaining gekkonoids, the gekkonines and eublepharines.

Doody, Sean* and Arthur Georges. Are pig-nosed turtles manipulating offspring sex?

We are currently undertaking a three-year study of sex determination in pig-nosed turtles (*Carettochelys insculpta*) on the Daly River, NT. *Carettochelys* has temperature-dependent sex determination and nests twice per season every second year. One objective is to determine if nest temperature is an ingredient in nest site selection, and if so, whether there is individual variation among females in nest site selection that spans the range of temperatures that produce males or females. Most clutches tend to be unisexual. Do individual females lay nests that are random with respect to sex outcomes, or that tend to produce offspring that are biased toward one sex or the other (aggregated outcomes), or that tend to balance offspring outcomes (even spread of outcomes)? This is an important question for understanding the evolutionary significance of TSD and in forecasting the likely impacts of global warming or habitat modification. Available data indicate that the opportunity exists for nesting turtles to produce one sex or the other both on a spatial scale (among and within nesting beaches) and on a temporal scale (among and within years). Linking females to their nests has proven exceptionally difficult, but evidence is mounting against the notion that nesting turtles cue to temperature in a way that would systematically bias sexual outcomes. Such evidence includes the paucity of like-sex production among clutches of individuals, little nest site/beach fidelity, and the ephemeral nature of beaches.

Duffield, G.A.* and C.M. Bull. Long term group fidelity of the Gidgee skink, *Egernia stokesii*.

We are investigating the aggregation of Gidgee skinks, *Egernia stokesii* Grey, which inhabit rock crevices in the Flinders Ranges of South Australia. During five consecutive seasons lizards from a single population have been regularly caught, individually marked, measured, sexed and released at the site of capture. Annual home ranges for adult lizards are determined by capture locations, observations and thread trailing. Social behaviour at three focal crevices is observed from hides. Gidgee skinks in this population form stable groups of 2-17 individuals. These groups have persisted with few changes during the entire five years of study. Lizards within a group periodically sleep, bask and defecate together at 1-6 suitable refuge sites. All groups have at least one adult of both sexes, but 3-4 adults of the same sex within a group is not uncommon. Young appear to remain in the natal group for 3-4 years until mature. Individuals within a group have highly overlapping home ranges. Group ranges remain stable during successive seasons and have little overlap with neighbouring group ranges. Agonistic encounters between groups do not frequently occur. Less detailed results at four nearby populations also suggest large stable groups. Social groupings of this kind are reported extremely rarely among reptiles.

FitzSimmons, Nancy N. Multiple paternity in green turtles ?

Multiple matings of females have been observed in green turtles (*Chelonia mydas*) but the frequency and success of these matings is unknown. Multiple matings may be advantageous for females if mating success varies and multiple paternity is a possible consequence. I investigated clutch paternity in green turtles using highly polymorphic nDNA microsatellite loci. This involved the identification of alleles in offspring and their mother across several loci and the interpretation of data through principles of Mendelian inheritance. I present results from 22 clutches laid by 13 females for which I sampled half of the offspring, including several successive clutches throughout the season. Although green turtles are promiscuous breeders and there was an expectation of finding extensive multiple paternity, only two clutches were multiply sired, and in these, very few eggs had been fertilised by a secondary male. The rarity of multiple paternity may reflect a low proportion of multiple matings by females in this population or of sperm competition, possibly resulting from a first male sperm preference.

Flannagan, H.J.* and Robin A. Fordham. Conservation of the endangered New Zealand gold-stripe gecko (*Hoplodactylus chrysosireticus*).

The gold-stripe gecko is known from only two localities, coastal Taranaki (west coast of the North Island) and Mana Island (30 km north of Wellington), separated by approximately 250 km. Like most New Zealand reptiles, little is known of the natural history of this species outside of captivity. Over the past 15 months observations have been made on the behaviour and activity patterns of this species. Uncharacteristic for most geckos, this species exhibits a high level of diurnal activity. Since the eradication of rodents from Mana island in 1989, lizard populations on the island have expanded rapidly. Recently, as part of the ecological restoration of Mana Island, there has been a proposal to reintroduce Duvaucel's gecko (*Hoplodactylus duvaucelii*). Currently, there are no areas where the two species occur sympatrically. Adult duvaucels geckos are almost twice the size of gold-striped geckos and as both species may be attracted to the same limited resource (flax nectar), displacement of gold-stripe geckos may occur. To address this possibility, cage trials are being conducted on Mana Island in which both species are contained within the same habitat. The cages are being monitored for evidence of displacement of gold-stripe geckos. The outcome of these trials will determine whether duvaucel's geckos will be suitable for release on Mana Island at this time.

Gardner, Michael*, Glen Duffield, Steve Cooper, Mike Bull and Warwick Grant. Whose been sleeping in MY crevice?: microsatellite DNA and mating systems in gidgee skinks.

Aggregations in lizards have generally been thought to result from mutual attraction to environmental features rather than any particular social function (Heatwole and Taylor 1987; Graves and Duvall 1995). Unlike most lizards, however, aggregations are found consistently in several species of the Australian skink genus *Egernia*, where groups of individuals live together in burrow or crevice refuges, and are variously described as families or colonies (Greer 1989; Swan 1990; Hutchinson 1993). Central to a thorough understanding of this observed sociality, is knowledge of the genetic relationships within and among supposed family groups. We have chosen to use microsatellite markers to assess these relationships in the group living species *Egernia stokesii*, and have isolated several variable loci. Preliminary results from an examination of the genetic relationships within and between crevice groups will be presented as well as data on the utility of these markers in other skink species.

Georges*, Arthur, Jan Birrell, Katherine M. Saint, William McCord and Stephen C. Donnellan. A phylogeny for the Pleurodira based on mitochondrial and nuclear gene sequence variation.

Several aspects of the phylogeny of the Chelidae are contentious. Two detailed morphological analyses establish the long-necked Australasian *Chelodina* and the long-necked South American *Hydromedusa* and *Chelus* as a monophyletic clade spanning continental boundaries. This suggests a common derived origin of the long neck and associated habits that predated the separation of Australia from South America. A third morphological analysis does not regard any of the genera as being particularly closely related, the long necks having evolved independently in response to shifts toward a piscivorous diet. In this study, we add molecular data from three gene sequences, mitochondrial *16S rRNA* and *CO1* genes, and the nuclear *c-mos* gene, to that already available for the *12S rRNA* gene and allozyme data to test the currently accepted phylogeny of the families Pelomedusidae and Chelidae. Our analyses firmly reject any notion of close relationships among any combination of the three long-necked lineages, even between the South American taxa. The South American chelids form a monophyletic clade and it is likely, though we could not establish it unequivocally, that the two continental chelid faunas are reciprocally monophyletic. Both the genus *Phrynops* and the genus *Elseya* are paraphyletic, requiring some adjustment to our current generic level classification. Several unresolved trichotomies remain, in particular one involving *Rheodytes*, *Elusor* and *Elseya/Emydura*.

Gillespie, G.R. Population Dynamics of the Spotted Tree Frog (*Litoria spenceri*).

Knowledge of the population dynamics of a species is necessary for understanding factors which influence variability in abundance of species in space and time. The population dynamics of many amphibian species are poorly understood, which has hampered interpretations of the nature of recent population declines. The Spotted Tree Frog is a riverine species in south-eastern Australia which has declined throughout its former range. Populations of *Litoria spenceri* were studied to gain an understanding of the population dynamics of temperate riverine frog species, and the nature of population declines. Two populations were studied over several years in two streams with markedly different environments and population densities, so that differences in population dynamics could be examined. Aspects of the population dynamics at both sites are compared, including annual variation in population size, recruitment, dispersal and age structure. Factors influencing variation in population dynamics of the species, and the significance for interpreting population declines, are discussed.

Goodman, B. The effects of thermal regime and food availability on growth rates of two populations of the southern water skink, *Eulamprus tympanum*.

Low and high-altitude populations of the southern water skink, *Eulamprus tympanum*, were compared in order to examine the effects of the thermal environment and food availability on the growth of juveniles and subadults. Temperature profiles from both sites suggest that, during the active season, individuals from the high-altitude population have only two-thirds of the time available for activity than individuals at low altitude. There was no indication that high-altitude individuals emerged at lower environmental temperatures. High-altitude individuals also emerged from hibernation one month later than their low-altitude counterparts. Seasonal prey abundance and activity at the two localities did not differ significantly over the duration of the active season, and body conditions of low and high-altitude individuals were similar, implying that food availability is unlikely to produce any differences in growth rates between the two populations. Despite the differences in thermal regimes, growth rates did not differ between the two sites, but were faster in the high-altitude population after differences in the length of the active seasons were accounted for.

Grigg, G.*, A. Taylor, G.F. Watson and H. McCallum. A method for long-term, automatic monitoring of calling activity by frogs.

Much anecdotal information asserts that the expansion of Cane Toads into a new area has a deleterious effect on native fauna. Obtaining hard, quantitative data is not a simple task, partly because changes in abundance of the animals usually thought to be affected (e.g. goannas, snakes, quolls, as well as frogs) are difficult to pin down. Because native frogs are open to competition from toads in both larval and adult stages and, furthermore, lend themselves to acoustic monitoring, we developed an automatic system which has the capability to identify and log to memory nightly calling activity by frogs, along with rainfall, temperature and other data. Five pairs of such units are deployed this wet season between Roper Bar and Mataranka in the N.T., in an area judged likely to be soon invaded by toads. Four sites are being set up in Kakadu National Park also. The systems have the capacity to record calling activity for several hours every night throughout the whole wet season, thus offering a very high sampling intensity. Potentially, the method has application wherever monitoring of sounds is useful.

Hero, Jean-Marc. Ecological correlates of reproductive traits in Australian amphibians.

The reproductive traits (egg number, egg size and total clutch volume) of 89 species of amphibian and their relationship with female body size were examined. After removing the effects of body size, the relationships between these reproductive traits with the following ecological variables; 1) reproductive mode, 2) larval habitat, 3) adult activity period, 4) adult microhabitat, and the following geographical characteristics; 1) geographic range and 2) latitudinal range, were examined. Egg number (clutch size) and egg volume were significantly related to female body size and, negatively with each other. After removing the influence of female body size: egg number

significantly increased as the reproductive mode shifted towards egg and larval development in the aquatic environment, and as geographic range increased; inversely, egg volume significantly increased as the reproductive mode shifted towards terrestrial development and as geographic range decreased. Furthermore, egg volume increased as larval habitat shifted from lentic ponds to lotic streams (after removing direct-developing species of the terrestrial environment). Clutch volume was significantly related to female body size but not associated with any ecological or geographic variables. The implications of these results on amphibian ecology and their application to the declining amphibian syndrome are discussed.

Hudson, S.C. Life history patterns in southeastern Australian viviparous skinks.

Biophysical models of the influence of temperature on lizard life histories predict that many life history traits should covary along a single axis associated with variation in annual activity period. This study examined covariation of life history traits among 10 species of *Niveoscincus* and *Pseudemoia*, small viviparous skinks largely restricted to cool and cold temperate southeastern Australia including Tasmania. Reproductive traits were described from late-term gravid females, with age estimated using skeletochronology. Multivariate analysis of nine life history traits (corrected for body size where appropriate) revealed a single axis of covariation which accounted for more than half of total life history variation among species, and was significantly correlated with all traits except RCM. This axis was correlated with temperature and latitude, as predicted by biophysical models. Species from cooler environments had smaller clutches of relatively larger offspring, lower clutch frequency, lower reproductive investment, later maturity at a relatively larger size and older mean age of mature females relative to species from warmer environments. However, this pattern was confounded with habit, although partial correlation of life history covariation, climate variables and morphological variation indicated that both habit and climate were independently associated with life history. Phylogenetic analysis found few correlations among changes in life history traits, indicating that the pattern was also confounded with the effects of phylogeny.

Jones, Sandie. Population ecology of the threatened pink tailed legless lizard, *Aprasia parapulchella*.

Aprasia parapulchella is a small, fossorial pygopodid which has a patchy distribution in eastern Australia, occurring most often in sites dominated by native grasslands. Little is known about the population ecology of this species: it is rarely captured in large numbers and historically it has not been possible to determine the sex of live individuals. This study presents three years of data on the population ecology of *A. parapulchella* at four sites in Canberra. Results from a mark-recapture study and capture without replacement estimates suggest that *A. parapulchella* occurs in populations which are larger than previous surveys have suggested. Densities at most sites were still low, ranging between 2 and 14 lizards per 1000 rocks surveyed. Adult males averaged 109 mm SVL, while females were significantly larger at 120 mm SVL. Sex ratios were even over all populations, however SVL was significantly higher for an isolated, urban population when compared to a continuous river population. The results provide some of the first data on field population ecology for any *Aprasia* species and have implications for the conservation status and management of the *A. parapulchella* in Canberra.

Judge, D.K. * The current status of the Sydney short-necked turtle (*Emydura macquarii*) in the Nepean River.

The short-necked turtle *Emydura macquarii* has only recently been recognised in the Sydney region, where it is found at low densities in scattered populations. One site where it can be found in relatively high numbers is at Norton's Basin on the Nepean River, where a mark-recapture study has been undertaken since 1995. Results from this study have been compared with those from other more abundant populations (Brisbane, Macleay, Hunter, and Murray Rivers) of *E. macquarii* to determine possible reasons for its rarity. Distribution of *E. macquarii* on the Nepean River seems to be concentrated mainly around Nortons and Bents Basin's (Wallacia), with no current evidence of

occurrence in the upper catchment. Results from the Nepean River population differ greatly from those of other rivers which followed the more conventional patterns of turtle biology. Nepean River turtles were a lot less abundant, male biased, dominated by juveniles, and contained few old turtles. Turtles from the Nepean grew exceptionally fast (both adults and juveniles), resulting in them maturing a lot earlier. They also have larger clutch sizes and lay smaller eggs, however a high proportion of clutches failed to develop. The results suggest a young, expanding population in a productive environment, with little intraspecific competition. While it is still relatively uncommon, *E. macquarii* is currently thriving in the Nepean River, and is likely to increase rapidly over the next decade. The most likely explanation for these outcomes is that *E. macquarii* is not in fact native to this region, but has become established from illegal dumping of pet turtles

Kluge, A. and G. Shea*. A cladistic analysis of relationships among the pygopod lizards.

A cladistic analysis of the 35 species of pygopod lizards was performed, using 162 characters from a wide variety of sources, including cranial and postcranial osteology, dentition, soft organ anatomy, scale sensory organs, scalation, coloration and behaviour. Character states were polarised using the hypothesis of relationships (Eublepharidae (Gekkonidae (Pygopodinae (Carphodactylini, Diplodactylini)))). Data were analysed with Hennig86. The relationships among pygopod genera were the same regardless of whether character states were treated as additive or non-additive: (*Pygopus* (*Paradelma* (*Delma* (*Lialis* (*Pletholax* (*Ophidiocephalus*, *Aprasia*)))))). The monotypic genus *Aclys* was consistently nested within *Delma*. Relationships within the two genera represented by more than two species (*Aprasia* and *Delma*) were less well resolved. The patterns of limb reduction and body elongation in pygopod lizards are not simple patterns of gradual unidirectional change.

Knowles, R., H.B. Hines*, K. Thumm, M. Mahony, and M. Cunningham. Oviposition of the barred-frogs (*Mixophyes* species) in southeastern Australia with implications for management.

Four species of barred-frogs occur in the ranges of southeastern Australia. Three species, *M. balbus*, *M. fleayi* and *M. iteratus* have declined for unknown reasons and are now considered threatened. The fourth species, *M. fasciolatus*, remains common. Within these four species there are two modes of oviposition. *Mixophyes balbus* and *M. fleayi* construct a nest in the shallow running water that occurs between pools in relatively wide, flat sections of mountain streams. Eggs are either deposited in a shallow excavation in the stream bed or pasted directly onto bed rock. Preliminary investigations suggests that this mode of oviposition, away from deeper water, protects the eggs from predation by native fish and large tadpoles of their own species. *Mixophyes fasciolatus* and *M. iteratus* deposit their eggs out of water, under overhanging banks or on steep banks of larger pools. This too appears to be a strategy to avoid aquatic predators. Unlike the other species *M. fasciolatus* also lays its eggs in pool and pond environments away from streams, a factor likely to be important in this species remaining widespread and common. The stream microhabitats used by the three threatened species for oviposition are limited. These sites are subject to a range of deleterious impacts (e.g. trampling by domestic stock). Ongoing research into the breeding biology of these species is enabling managers to develop better prescriptions for ameliorating potential impacts.

Lemckert, F.* and Cameron Slatyer. Surveying for the green-thighed frog (*Litoria brevipalmata*) - How to ruin a good new year.

The distribution and abundance of the *Litoria brevipalmata* was assessed in the Bulahdelah area of NSW through a series of surveys performed between January and March 1997. Searches concentrated on locating breeding choruses and were performed during or immediately after heavy (>10mm) rainfall events. Only four breeding choruses were located, even though 116 potentially suitable breeding sites were surveyed, indicating that this species is uncommon in the area. Notably, frogs were heard chorusing for only one night at each of these sites. Breeding activity was related to rainfall in the area of the breeding site, but the patchiness of heavy rainfall events resulted in breeding events being more difficult to predict than expected necessitating repeated surveying of sites. Additionally, if the rainfall did not fill the breeding site, breeding activity did not commence. The results indicate that surveys for this species need to be both opportunistic and intensive to ensure an acceptable chance of success. Tadpoles surveys may offer a better approach to deal with this frustratingly unpredictable frog.

Littlejohn, Murray* and Michael Scroggie. Territorial behaviour in a hybrid population of the *Geocrinia laevis* complex (Anura: Myobatrachidae).

The parapatric taxa *Geocrinia laevis* and *G. victoriana* have distinctive advertisement calls, and there is a narrow hybrid zone where their geographic distributions contact in south-western Victoria. A hybrid index, based on pulse rates of notes in advertisement calls enables characterisation of parental taxa and hybrids. Males call from concealed positions in litter and grass. Calling sites are also used for oviposition and subsequent intracapsular development. Previous studies with conspecific advertisement calls as stimuli indicated that males of *G. victoriana* are strongly territorial, and have distinctive encounter calls and associated agonistic behaviour; in contrast, males of *G. laevis* lack encounter calls and do not display territorial behaviour. At Jancourt, a central location in the zone of contact, is a hybrid population with great variability in advertisement calls. To establish the association between structure of advertisement calls and production and structure of encounter calls, calling hybrid males were presented with a tape recorded advertisement call of *G. victoriana* at an intensity above the previously established threshold of about 110 decibels peak sound pressure level. If suitable oviposition sites are limiting, then hybrid males with strong territorial behaviour should be favoured through natural selection. The playback experiments will be discussed in the light of these considerations.

Madsen, T.* and R. Shine. *Tyrannosaurus rex* was an endotherm - a study of pythons and rats in tropical Australia.

We present data on population numbers and densities of water pythons (*Liasis fuscus*) and their primary prey species (dusky rats, *Rattus colletti*) on the Adelaide River flood plain in tropical Australia. Due to seasonal migration of both prey and predators, our data only refer to dry-season numbers. Overall densities of both prey and predators were remarkably high, averaging 53000 rats/km² (corresponding to a biomass of 4000 kg/km²), and approximately 700 pythons/km² (corresponding to a biomass of 880 kg/km²). Floodplains may be the most productive natural higher plant communities known. The high densities of rats reflect the high rates of production of suitable food, mainly roots and corms of grasses and sedges. We suggest that the extreme abundance of prey is the ultimate factor for the high abundance of predators. We also discuss the relationship between predator and prey when the top predator is an ectotherm, and compare this relationship to that in ecosystems where top predators are endotherms. Last but not least, we compare our data with paleontological data on predator - prey relationships from the Triassic and Cretaceous periods.

McCoull, C.* & Roy Swain. A comparison of basking site preference and microhabitat use in five populations of the Tasmanian metallic skink, *Niveoscincus metallicus*.

Niveoscincus metallicus is the most widespread of all Tasmanian reptiles, occurring on most offshore islands and on the Tasmanian mainland from sea level to alpine elevations, in a range of habitat types. It also has a limited mainland distribution. This study examines basking site preferences and general microhabitat selection in populations from five sites covering the cold temperate/cool temperate, high/low altitude range of the species. Data suggest that animals at high altitude bask overtly on rock surfaces while those at low altitude are more covert and bask on logs. Low altitude lizards also bask under vegetation cover or within dead wood. These differences may result from variation in thermal conditions between high and low altitude sites. The lizards at low altitude may be able to adopt cryptic basking behaviour because warmer microhabitats are more constantly available. Conversely, individuals which occur at high altitude are forced to bask more overtly because of unpredictable basking opportunities. The results of a multivariate analysis to quantify these differences are presented.

McDonald, K.R. and Margaret Davies*. Unusual reproductive biology in an Australian hylid frog

The Australian hylid frog *Litoria longirostris* Tyler & Davies 1977 lays pale green eggs on vegetation overhanging pools at the sides of streams in the McIlwraith Range on the Cape York Peninsula. Amplexus between males and females does not appear to occur. Egg nests are attended by the female for the period before hatching and she remains with the abandoned jelly matrix after the larvae have escaped and fallen into the pool below. It is postulated that the role of the female in nest attendance is to maintain water content of the egg mass. Larvae do not have extreme lotic adaptations.

Melville, J. An ecomorphological study of the evolution of scansoriality in the Tasmanian skink genus *Niveoscincus*

I have investigated the evolution of the scansorial habit in the lizard genus *Niveoscincus*, through the use of comparative phylogenetic techniques. The project has provided insight into evolutionary processes in small ectotherms. Particular attention was paid to the morphological, locomotory, and behavioural inter-relationships in the eight species of *Niveoscincus*. The genus provides a rare opportunity to examine evolutionary processes and patterns in reptiles from temperate climates. Three phylogenetically distinct ecomorphs have been identified: ground-dwelling; semi-arboreal; and saxicolous. The ground-dwelling species have relatively short limbs and long inter-limb length. The ability to climb appears to have evolved in the semi-arboreal species, and has involved a decrease in body size and an increase in leg length. The saxicolous species have evolved the ability to jump, with an increase in hind limb size and a decrease in front limb length. Performance ability, morphology and behaviour have been shown to correlate directly to the microhabitats in which each species lives.

Meyer, E., B.G.M. Jamieson and D.M. Scheltinga*. Sperm ultrastructure of six Australian hylid frogs from two genera (*Litoria* and *Cyclorana*): Phylogenetic implications.

There has been, and remains, considerable disagreement over the affinities of Australia's fossorial hylids (Anura, Amphibia): *Litoria alboguttata* and *Cyclorana* spp. Sperm ultrastructure, which has previously been examined in some *Litoria* species but not in *L. alboguttata* and *Cyclorana* spp., has proved useful in resolving phylogenetic relationships at various taxonomic levels within the Tetrapoda. Seeking clarification of the phylogeny of Australia's fossorial hylids, we compared the spermatozoa of *Cyclorana brevipes*, *C. novaehollandiae*, *C. cryptotis*, *Litoria alboguttata*, *L. moorei*, *L. aurea* and previously examined *Litoria* species. The evidence of sperm ultrastructure, supported by previously published molecular, morphological and karyological data, places *L. alboguttata* within the genus *Cyclorana*. On the basis of sperm ultrastructure three separate lineages are discerned within *Cyclorana* s. lat., (1) *C. cryptotis*; (2) *L. alboguttata* and *C. novaehollandiae*; and (3) *C. brevipes*.

Meyer, E.A.* and C.E. Franklin. Acid tolerance in larval *Litoria fallax* and *Litoria cooloolensis* (Amphibia: Anura).

Disrupting sodium balance, acidic waters of pH 4.5 or less are toxic to most gill- and skin-breathing vertebrates. Nevertheless, there are frog species which naturally reproduce in acidic waters of pH less than 4.5. Amongst these are the 'acid' frogs of the wallum (east Australia's coastal sandy lowlands). Breeding in waters as acidic as pH 3.2, these species provide an excellent model for the study of the mechanisms underlying tadpole acid tolerance. Comparative ion flux, morphological and morphometric data from laboratory-reared acid-frog (*Litoria cooloolensis*) tadpoles and acid-sensitive *Litoria fallax* tadpoles indicate the involvement of resistance mechanisms enabling the maintenance of sodium balance in low pH waters. Such mechanisms include an efficient and presumably high affinity Na⁺ uptake system and increased mucus production at respiratory surfaces (i.e., the gills and tail) with mucus acting as a physical and/or chemical buffer to H⁺ ions in the external environment and/or Ca²⁺ attractant.

Moritz, Craig *, Chris Schneider, Michael Cunningham and Keith McDonald. Genes, herps & refuges: effects of rainforest contraction on evolution of rainforest herpetofauna.

The wet tropical rainforests of north Queensland have a well documented history of contraction and expansion associated with climatic fluctuations over the past 2 million years. These forests are also home to a diverse endemic herpetofauna. Geographic patterns of genetic (mtDNA) variation in endemic species of skink, gecko and frog from the wet tropics provide evidence for:

- geographically congruent contraction of populations to rainforest refugia;
- historical reductions in population size; and
- subsequent range expansions, in some cases across areas that do not currently support rainforest.

The extent of these effects varies among species, with the more arboreal reptiles being the most strongly affected. The genetic evidence for population isolation and recolonisation can be correlated with changes in late Pleistocene and Holocene rainforest distributions as predicted by paleoclimatic modelling. However, in many cases the magnitude of molecular divergence among areas suggests far older isolation events, more consistent with early Pliocene than Pleistocene effects. Although shifts in rainforest distribution have had major effects on distribution patterns and have resulted in isolation of populations over millions of years, this typically has not resulted in significant divergence in morphology. A more detailed investigation of one species, *Carlia rubigularis*, indicates that morphological divergence occurs among habitat types (open vs. closed forest) rather than between historically isolated units. The significance of these observations for conservation planning in the region will be discussed.

Oakes, W.P.*, C.L. Laing and D.R. Fraser. Transport of vitamin D into the eggs of oviparous vertebrates - the role of vitamin D-binding protein (DBP).

The embryos of oviparous vertebrates require vitamin D for normal development. Large quantities of cholecalciferol (vitamin D) have been found in chicken eggs, and it has been proposed that a cholecalciferol-specific isoform of the plasma vitamin D-binding protein (DBP) found in this species is responsible for the transport of this compound into the yolk during vitellogenesis. To investigate whether this mechanism is present in other species the quantity of cholecalciferol was measured in a range of vertebrate eggs. The yolk concentration of cholecalciferol was higher than the concentration in blood plasma. In addition, the yolk cholecalciferol concentration was higher than the yolk concentration of the major metabolite circulating in the blood, 25-hydroxyvitamin D (25(OH)D₃). To investigate the mechanism of cholecalciferol accumulation in yolk, the plasma of reproductively active female Eastern water dragons (*Physignathus lesueurii*) was examined with ion-exchange chromatography. Two DBP isoforms were observed, suggesting that the mechanism proposed for the accumulation of cholecalciferol in the chicken egg is widespread amongst vertebrates.

O'Connor, D. Molecular Systematics of the genus *Eulamprus* (Scincidae): preliminary results from mitochondrial DNA analysis.

The phylogenetic relationships of species in the genus *Eulamprus* are poorly known. The main character distinguishing the genus from other members of the *Sphenomorphus* lineage is ovoviviparity. Similarities in morphology of species in the genus has prevented resolution of a hypothesised phylogeny below the level of the three species clades (the *E. quoyii*, *E. murrayi* and *E. tenuis* clades). In the current study, mitochondrial DNA sequencing of the 16S region was used to test the current hypothesised phylogeny and provide resolution below the level of the species groupings. Phylogenies derived using the sequencing data support the separation of the *E. quoyii* from the *E. murrayi* and *E. tenuis* groups. There is strong evidence that the *E. quoyii* group is monophyletic and that the *E. murrayi* and *E. tenuis* groups are not. Mitochondrial sequencing indicates that *Nangura spinosa* and *Gnypetoscincus queenslandiae* are more closely related to the *E. murrayi* and *E. tenuis* groups than the species from the *E. quoyii* group. Based on mitochondrial data it is highly likely that *Eulamprus* is a paraphyletic genus. Sequencing of the ND4 region is currently being conducted to test these findings.

Olding, P. The diversity of microhylid calls from the Wet Tropics with particular reference to the calls as species isolating and specific mate recognition systems.

A comprehensive investigation was made into the diversity of calls produced by the Wet Tropics microhylids. All calls were recorded in situ from October 95 to March 97. Using computer sound analysis software, the calls were dissected into a range of components, from the level of gross morphology to fine-scale microstructure. Within species, relationships were assessed between the call components and associated environmental and body factors. Between species, variation in call components was analysed to see which components were possibly involved in the isolation and recognition mechanisms of the species. No evidence was found to suggest reinforcement or character displacement was playing any role in the narrow overlap zone of two *Sphenophyrne* species. Two new species groups were proposed from Mt Lewis based on the uniqueness of their call compared to sympatric species. The fine microstructure described for each species revealed that some species produced amplitude modulated calls whereas others had calls comprised of discrete pulses.

Parmenter, C.J. Two decades of monitoring Queensland sea turtle rookeries - attempts to address the question of population status.

This report follows the development of data sets concerning sea turtle nesting in Queensland, with focus on the progression of census methodologies leading to current practice. Indices used to evaluate population status and change based on nesting numbers are discussed. Data are presented (primarily for the Flatback, *Natator depressus*) and interpretations made. Brief discussion of "population management units" is given.

Pearson, D. When an idyllic sun-drenched island may not be enough: a recovery plan for the Lancelin Island Skink (*Ctenotus lancelini*)

A small island with a wide sandy beach, a good surf break and exceptional wind-surfing may seem like nirvana, but these qualities pose some threats to the conservation of the Lancelin Island Skink. In 1992, an apparent population decline of *Ctenotus lancelini* prompted research on its biology and management techniques to improve its conservation status, culminating in the preparation of a recovery plan in 1997. Results to date will be discussed. They indicate that the observed decline was an artefact of earlier collecting techniques, with the Island still possessing a large population occupying most available habitats. Searches for other populations resulted in the capture of only one individual on the adjacent mainland, as foretold in a local children's book. Allozyme electrophoresis revealed the taxonomic distinctiveness of *C. lancelini* relative to *Ctenotus labillardieri* and identified the possible existence of a sibling taxon at coastal sites near Pinjarra and Meelup, 180 and 285 km south of Lancelin Island. The impact on *Ctenotus* of a herbicide used to control weeds was examined. Finally, the results of a captive breeding programme at Perth Zoo and visitor management planning to minimise habitat disturbance will be reported.

Peterson, G. Microhabitat utilisation in the *Eulamprus tympanum* complex in central southwest Victoria.

The Southern Water Skink (*Eulamprus tympanum tympanum*) is a widespread, cool temperate water skink and in central southwest Victoria inhabits open coastal woodlands and forests. The Corangamite Water Skink (*E. t. marnieae*) inhabits "islands" of basaltic rock piles associated with remnant vegetation and permanent or ephemeral lakes and is restricted to central southwest Victoria. Multivariate analyses were used to describe and compare microhabitat utilisation of the two taxa. Corangamite Water Skinks select sites in open areas with large, closely aggregated rocks with little lichen cover, with many cracks and close to vegetation. Southern Water Skinks were mainly observed basking on large logs in open areas. While these differences are obviously due to habitat differences, placement of the two taxa along the same environmental gradients indicated that the Southern Water Skink basked in areas with lower light intensity, cooler air temperatures, larger numbers of shrubs, less ground vegetation and closer to vegetative cover. These results suggest that the thermal ecologies of the two lizards are distinct. The relevance of my results to the conservation of the endangered Corangamite Water Skink will be discussed.

Peterson, G. and Brian Malone.* Taxonomic and conservation status of the Corangamite Water Skink (*Eulamprus tympanum marnieae*).

The Corangamite Water Skink (*Eulamprus tympanum marnieae*) is currently considered a distinct form of the Southern Water Skink (*E. tympanum tympanum*). It is known only from central southwest Victoria where it inhabits basalt rock piles associated with remnant vegetation and inland lakes north, east and west of Lake Corangamite. Its classification as a subspecies was based upon samples of individuals from localities east and west of Lake Corangamite which appeared to be intermediate between the two forms in both colour patterns and scalation. Morphological analyses carried out on the two subspecies and intergrades provided little evidence for intergradation between *E. t. marnieae* and *E. t. tympanum*. These results suggest that the taxonomic status of *E. t. marnieae* should be reconsidered. Surveys of the Lake Bolac and Lismore localities support the results of previous attempts to record lizards at these sites and indicate that these populations may now be extinct. A new population of *E. t. marnieae* was located near Dreeite. Results of more recent surveys will be reported.

Pomeroy, M.J. Clulow*, R.K. Browne & M. Mahony. Non-invasive collection of sperm from the cloaca of cane toads (*Bufo marinus*) using hormonal induction.

Protocols for the cryopreservation of amphibian sperm are now being successfully developed (see abstract by Browne *et al.*). However, one limitation on the use of sperm cryopreservation for conserving and managing genetic diversity in endangered amphibian species is the means available for collecting sperm. In amphibians, the testis is the organ of sperm storage, and the most common way of collection of sperm is by maceration of testes removed from killed males. Whilst acceptable for common and laboratory species, this method of collecting sperm is unacceptable for endangered species. An alternative approach is to use hormonal administration to induce the release of sperm from the testis into the urine by gonadotrophins, gonadotrophin releasing hormones or catecholamines. We are examining different hormonal induction protocols to obtain the maximum yield of sperm in cane toad urine. Rapid appearance of sperm in the cloaca has been obtained with human chorionic gonadotrophin ($9.74 \pm 10.8 \times 10^6$ collected one hour after 100 IU, $n = 5$) and pregnant mare gonadotrophin. The sperm collected are motile, capable of fertilisation and can be cryopreserved.

Rawlings, L.H.* and S.C. Donnellan. Mitochondrial d-loop sequence analysis of the carpet python, *Morelia spilota*.

The carpet python *Morelia spilota* is found across Australia except for the inland desert regions and southern South Australia, Victoria and Tasmania. Its highly polymorphic colour and patterning appears to correlate with geographic location. Most authors recognise three subspecies, some recognise six. A population on St Francis Island, South Australia has been described as *M.s. imbricata*, the Western Australian subspecies. An allopatric population in central Australia has been designated by some as a separate species, *M. bredli*. Distributions of some subspecies overlap and intergrades are known, while some populations have been isolated for significant periods of time eg. island populations of South Australia and Western Australia. This study uses mitochondrial d-loop sequence to determine the extent to which genetic substructuring mirrors the geographic distribution of colour and pattern. It also investigates the genetic difference between island populations and their mainland counterparts and the genetic difference between *M. bredli* and *M. spilota*.

Retallick, Richard W.R. The distribution of tadpoles in streams with respect to predation.

The most immediate selective pressure on tadpoles is predation. Predation theory predicts that prey should favour habitats which harbour minimal risk of predation. The distribution of tadpoles among habitats with respect to the distribution of their predators forms the basis of this study. Predation trials were run with five species of tadpoles and four types of aquatic macroinvertebrates, to determine the vulnerability of each species to each type of potential predator. Macroinvertebrates were effective predators of tadpoles, although there were differences in predatory effects among tadpole species and among predators. Relative abundances of predators and tadpoles in four habitats of stream systems were then obtained by seasonal visits to streams at Eungella National Park. Tadpoles and predators showed strong patterns in their use of the habitats. Tadpole abundances were

highest in pools that were isolated from the main stream channel, and two species occurred exclusively in that habitat. Three species regularly used mid-stream pools, and one of those species used that habitat exclusively. No tadpoles used fast flowing waters. In contrast, the abundances of predators were greatest in mid-stream habitats, and lowest in isolated pools. These distribution patterns and experimental results suggest that tadpole distributions in streams may be influenced by the distribution of invertebrate predators.

Reynolds, Stephen. Impact of the introduced mosquitofish (*Gambusia holbrooki*) on anurans in Perth metropolitan lakes.

Mosquitofish (*Gambusia holbrooki*) were introduced into Australia early this century and are now widespread. They occupy a variety of aquatic habitats throughout southwest Australia and are common in lakes on the Swan Coastal Plain. Previous studies indicate that mosquitofish are capable of consuming the eggs and larvae of anurans, but there are no specific studies in an Australian context examining impacts on aquatic developmental stages of native anurans, although the general consensus amongst herpetologists is that they are a menace. During laboratory feeding trials the palatability of native anuran eggs and larvae to mosquitofish and the influence of alternative (invertebrate) prey on feeding behaviour was examined. Field based observations indicate that anurans and mosquitofish coexist in some Coastal Plain lakes. An examination of the breeding biology of six anuran species occurring on the Swan Coastal Plain indicates that, particularly in natural systems, mosquitofish impacts may not be as significant as previously thought.

Roberts, J. Dale *, Rachel Standish and Paul Doughty. Multiple paternity in the frog *Crinia georgiana*.

Multiple paternity may have both costs and benefits to both males and females. Multiple paternity is apparently rare in anuran amphibians. Only one study, using DNA fingerprints in the phyllomedusine frog, *Agalychnis callidryas*, has conclusively demonstrated that more than one male can fertilise eggs from a single female when both males are in simultaneous amplexus. If focal males are excluded in the rhacophorid frog, *Chiromantis xerampelina*, secondary males can fertilise eggs but no data are available to exclude the possibility that normally, only focal males fertilise eggs. In the myobatrachid frog, *Crinia georgiana*, multiple males amplex a single female simultaneously in a third to a half of matings. Genetic analysis of paternity using gel electrophoresis - yes it still works - showed that at least two males fertilised eggs in two matings, both involving a single female and three males. Males in the standard inguinal position and amplexed ventrally had about equal fertilisation success. Third males amplexed over the right leg apparently fertilised no eggs but may have had a low level of paternity.

Rose, S.*, Lin Schwarzkopf, Ross A. Alford and John A. Endler. The influence of the light environment on signalling and thermal ecology of lizards.

Animal colour patterns and behaviour have coevolved to maximise conspicuousness to conspecifics and crypsis for predator avoidance. The perceived colour of a patch depends on the light environment in which it is viewed, and therefore whether it appears conspicuous or not. I used the lizards *Carlia jarnoldae* and *C. pectoralis* to determine (1) the effect of the light environment on the behaviour of lizards, (2) the relationship between colour pattern and microhabitat choice and (3) the interaction between the light environment and thermal ecology of lizards. I examined the tradeoffs between remaining cryptic to predators, obvious to conspecifics, and maintaining suitable body temperatures. Results of this study reveal which colour patterns are the most appropriate to use in particular light environments, and the subsequent effect this has on the behavioural ecology of the lizards.

Seebacher, F.* and G.C. Grigg. Do changes in thermal conductance play a significant role in reptilian thermoregulation?

According to a central paradigm in reptilian thermal biology, reptiles can alter the rate of their peripheral blood flow and hence thermal conductance. It is believed that this mechanism is used to enhance heating and retard cooling, so minimising the time a behaviourally thermoregulating reptile spends basking. This idea is, however, untested in free-ranging animals. We used telemetry to measure heart rate - as an indicator of blood flow - and body temperature (T_b) in free-ranging bearded dragons (*Pogona barbata*). We also recorded behaviour and environmental variables. In reptiles, heart rate increases with temperature, and to separate temperature dependent variation in heart rate from changes possibly caused by cardiovascular adjustments, we determined the relationship between heart rate and T_b in lizards at thermal equilibrium in a constant temperature room. Preliminary data from *Pogona* indicate that heart rate increased more than expected from temperature-heart rate relationships when the animal increased its T_b during basking in the sun. In contrast, after basking, when the lizard moved into vegetation, heart rate was slower than expected. These data may confirm the traditional interpretation that lizards increase blood flow to facilitate warming during basking, while they slow blood flow in a cooling environment to decrease rates of cooling. In future work, we will address the same questions in goannas and crocodiles as well.

Shine, R*, M. Olsson, R. Mason, M. LeMaster and L. Moore. Life on the prairie: necrophilia, cross-dressing, masturbation and Swedish sex aids.

Many thousands of red-sided gartersnakes (*Thamnophis sirtalis parietalis*) emerge from communal overwintering dens in central Manitoba every spring, and immediately launch themselves into a frenzy of mating activity. We travelled to Canada in May 1997 to test evolutionary-ecological hypotheses on natural selection and sexual selection in this remarkable system. Enclosure experiments quantified the role of body size as a determinant of male mating success in large *versus* small mating groups. This work revealed consistent phenotypic determinants of male mating success, even within superficially chaotic "mating balls" involving large numbers of snakes. Field observation clarified several other issues such as thermal dependence of antipredator responses, and the vulnerability of different size classes to avian predation.

Shoulder, J.* and R. Shine. Effects of temperature on developmental patterns in the cane toad (*Bufo marinus*).

The thermal conditions experienced by eggs and tadpoles of the cane toad (*Bufo marinus*) were experimentally manipulated to investigate phenotypic plasticity of development in this species. A single clutch of *B. marinus* eggs was split into three groups and incubated at 17°C, 22°C or 28°C. Tadpoles hatching from each of these treatments were again divided into groups, and raised at each of the incubation temperatures. I monitored morphological traits of the offspring during tadpole life and shortly after metamorphosis. Anti-predator behaviour and locomotor performance of the tadpoles were also quantified, at three trial temperatures. Analysis showed that the temperature at which tadpoles were maintained affected their rate of growth and differentiation, their body shape, anti-predator behaviour and swimming speed. Egg temperature had similar effects on tadpole morphology with incubation at 22°C producing larger and faster developing tadpoles. More surprisingly, egg incubation temperature also exerted powerful and long-lasting effects on the phenotypes of the young toads. Individuals incubated as eggs at 22°C metamorphosed earlier and at a smaller size than their siblings incubated at 28°C.

Spencer R-J*, Thompson M.B. and G. Wardle. The impact of the Red Fox (*Vulpes vulpes*) on the Murray River Turtle, *Emydura macquarii*. Matrix projections and management strategies.

Emydura macquarii is a short-necked turtle that inhabits the permanent waters of the Murray river. Predation on the turtle's eggs is greater than 96%, with the introduced Red Fox, accounting for 93% of these. A 3% fox predation rate on nesting adults, however, may have a greater influence on the

populations stability. The aim is to determine the stability of the Murray River populations of *E. macquarii*, and if they are declining, what management strategies could be employed to stabilise these populations. *Emydura macquarii* can be divided into certain life stages, and the population can be modelled by a stage-based projection matrix. We developed a square transition matrix that contains survival, growth and fecundity values over a one year period. Three distinct stages were chosen for the model; an Egg/Hatchling stage, a Juvenile stage, and an Adult stage. From the matrix, We determined that *E. macquarii* populations are declining at 3% per year and adult survival is the most critical stage in this model, indicating that protecting eggs or hatchlings alone, will not prevent the decline. A reduction in fox numbers will increase population growth from a 3% decrease to a 10% increase per year. Matrix projections are not a prediction of future or past populations, they are powerful tools to demonstrate the current state of a population.

Sumner, Joanna. The effect of rainforest fragmentation on reptiles and microhylid frogs in the wet tropics of Australia

The effect of fragmentation on reptiles and microhylid frogs has been little studied. This study investigates the effect of anthropocentric forest fragmentation on the Atherton Tableland in the Wet Tropics of Australia. Two late Wet season and two late Dry season trips have been completed to survey 11 rainforest fragments ranging from 1 to 75 hectares, as well as 7 sites in nearby continuous rainforest. Timed searches were completed at each site, measurements were taken on captured animals, and tail tip, or toes were removed for genetic analysis. Comparisons between continuous and fragmented forest sites show that individual capture rate per hour is related to fragment size for some species, but there is no relationship for other species. Comparisons of morphological characters between conspecifics in fragments and continuous forest found that on average individuals are significantly smaller in fragments. Mark-recapture data shows no evidence of dispersal between sites, and very little movement within an area indicating high site fidelity.

Thomson, S.* and A. Georges. Homoplastic morphology of long-necked piscivorous turtles.

Many turtles have evolved attributes to facilitate capture of fast moving pelagic prey. Most notable among the side-necked turtles are elongated necks, attenuated strike and gape mode of feeding, and a suite of associated characters, all of which enable a piscivorous diet. Examples of long-necked piscivorous genera may be found across a range of turtle families in both the Cryptodira and the Pleurodira. Such genera include *Chelodina*, *Hydromedusa*, *Chelus*, *Deirochelys*, *Emydoidea* and *Chitra*. Typically, long-necked turtles have cervical vertebrae three to four times longer than wide. Pleurodires have a greater number of vertebrae that can potentially be elongated, as Cryptodires cannot have an elongated eighth vertebrae which must articulate with the first thoracic in the vertical plane to enable neck retraction. Only the Pleurodires have accomplished the fusion (either sutural or complete) and elongation of the atlas-axis complex. Many of the characters that typify long-necked turtles have been used in phylogenetic analysis but with no consideration of the combined effects of homoplasy and lack of independence among shared derived characters. We examine the function of the characters associated with neck elongation, and argue that many so-called synapomorphies (shared derived characters) are in fact a series of homoplastic autapomorphies (convergent unique characters) and of little use in phylogenetic analysis for higher level taxonomy. Furthermore, lack of independence among convergent suites of characters inflates support they collectively give to incorrect nodes in the resulting phylogeny. We recommend the development of morphological analyses that take into account the functional relationship of characters to enable polarisation and the identification.

Thompson, Graham G.* and Eric. R. Pianka. Activity areas, daily movements, egg laying, and thermoregulation of an arboreal monitor lizard (*Varanus tristis*) during the breeding season.

During the breeding season, male *Varanus tristis* move greater daily distances (186.5 m) than females (99.7 m) and have larger activity areas (40.3 ha vs 3.7 ha). In the western Great Victoria Desert *V. tristis* retreat predominantly to live and dead upright *Eucalyptus gongylocarpa* (marble gum) trees

that have hollows in their trunks and limbs. *V. tristis* lay their eggs in a burrow they dig in the ground. Breeding behaviour, colour variation in neonates, and their general ecology are also described. During the breeding season in the Great Victoria Desert of Western Australia, active field body temperature of *Varanus tristis* reaches 40 °C ($n = 6$) with the mean 33.2 °C between 1100 and 1800 h, its main activity period.

Thumm, Karen* and Michael Mahony. Does Size Count? Does ovum size in *Pseudophryne australis* (Red-Crowned Toadlet) explain hatching variability?

Red-Crowned Toadlet egg masses are rarely subjected to long-term inundation. Terrestrial egg masses are generally laid within a slope where water will flow through the egg mass after a heavy rain episode. This may explain the difference in hatching behaviour observed between Red-Crowned Toadlets and some other *Pseudophryne* species, in which the tadpoles are reported to halt development between Gosner Stages 26 - 28 and then hatch when the water table rises. Eggs of *Pseudophryne australis* can hatch earlier (Stage 23) or much later (Stage 36), and eggs from within one egg mass can hatch over an extended period, even when inundated. Egg masses vary in the spread of hatching stages and time taken to hatch. Variation in maternal provisioning has been suggested as a cause of developmental differences, and can be viewed as an adaptation to an uncertain environment (Crump 1981, Capinera 1979). The distribution of ovum sizes of different clutches has been investigated. Although there appears to be considerable size variation between clutches and within clutches there is no evidence to date of ovum size influencing the time taken to hatching.

Torr, Geordie A.* and Stephen J. Richards. Patterns of microhabitat use in a lowland rainforest skink community in Papua New Guinea.

The question of how communities are structured has long intrigued ecologists. This question is particularly relevant for tropical rainforest environments where biotic diversity is high but the factors promoting the evolution and maintenance of this diversity remain poorly understood. We studied the patterns of microhabitat use in a rainforest skink community in Papua New Guinea. We were unable to detect any differences in the lizard communities inhabiting riparian and alluvial rainforest. The patterns of microhabitat use of the lizards found in the rainforest were strongly influenced by their thermal needs. The majority of the species encountered were heliothermic and their distributions were tied to the availability of sunlight for basking. One species, however, appeared to thermoconform and its distribution was related to its foraging strategy. The differences in thermal requirements and microhabitat use were also influenced by phylogenetic history.

Tucker, A.D., H.I. McCallum, C.J. Limpus and K.R. McDonald. Male bias in natal dispersal for a long-lived polygynous reptile (*Crocodylus johnstoni*).

We investigated natal dispersal for a long-lived polygynous crocodile (*Crocodylus johnstoni*). The study involved a natural linear arrangement of river pools containing different assemblages of crocodiles. We analysed distances travelled by crocodiles from natal pools to their recapture locations 12-18 yr later. Philopatry was assessed in terms of adult social distances. A female social distance was 0.46 pools and a male social distance was 1.0 pools. By these criteria, both sexes showed low levels of philopatry (7-12%). However, males are predicted to move further than females in polygynous mating systems, and males were found to be 2-3 times farther than females from the natal pool. Intramale aggression appeared to account for male dispersal, whereas young females minimized dispersal costs by finding nest sites near the natal pool. Low levels of philopatry by both sexes suggested that inbreeding avoidance and habitat instability may also influence the system.

Walker, Steven J. Skeletal Abnormalities of frogs in the Flinders Ranges.

Recent attention (particularly in the popular press) has been brought to the presence of abnormal frogs around the world, and there has been much speculation as to the causes of abnormality. It is popularly believed that pollution in the environment is the major cause of these abnormalities. If this is the case then areas of low pollution should have a correspondingly low incidence of abnormal frogs. A field trip to the Flinders Ranges in South Australia provided the impetus for an investigation of abnormalities in an area low in environmental pollution. The incidence of skeletal abnormality in the region was very low when compared to those of the Mt Lofty Ranges Region and the Adelaide metropolitan area. It is interesting to note that the levels of injury in the Flinders Ranges were quite high, especially by creek crossings and walking tracks.

Young, Jeanne E.*, J. Sean Doody, Arthur Georges and Robert Taylor. Home range and movements of the pig-nosed turtle *Carettochelys insculpta* in the wet-dry tropics of northern Australia.

As part of a three-year study of temperature dependent sex determination in the pig-nosed turtle, *Carettochelys insculpta*, on the Daly River of the Northern Territory, dry season movements of adult turtles were monitored using radiotelemetry and mark recapture. One of the objectives of the study was to determine the scale of movements in relation to the spatial scale of distribution of nesting banks with different thermal characteristics. A second objective was to investigate variation in home range size and dynamics between females and males and breeding and non-breeding females. The scope of movements of breeding turtles typically encompassed a range of beaches that produced predominantly one or the other sex. Adult females possessed larger home ranges than adult males, and gravid females have larger home ranges than non-gravid females. Radiotelemetry fixes during the wet season floods indicate that the turtles move into the flooded riverine forests adjacent to their dry-season home ranges rather than migrating to the lowland floodplains as has been suggested. Overall, pig-nosed turtles show great fidelity to site, with many animals remaining in the same stretch of river for more than 11 years.

Abstracts from the 27th AGM of ASH Ross river, Northern Territory 1999

Abstracts

In alphabetical order. Asterisks indicate a student presentation. First author is the presenting author unless otherwise indicated by underlining.

D. P. Barton

School of Tropical Biology, James Cook University, QLD

Helminth parasites of sea snakes in the Gulf of Carpentaria.

Sea snakes are a common component of the by-catch of prawn trawlers in the northern seas off Australia. As part of a study of the biology of by-catch organisms, a large collection of sea snakes became available for documentation of their helminth parasite fauna. Thirteen species of sea snakes have been examined so far revealing a depauperate helminth fauna. Sea snakes are infected with an intestinal nematode (*Paraheterotyphlum australe*), trematode (*Harmotrema* sp.) and cestode; a larval trypanorhynch cestode encysted in the body cavity is also present.

Spoken Paper, Sunday, 10:30

G. S. Bedford and K. A. Christian

Biological Sciences, Northern Territory University, NT

Be prepared to sit and wait!: Australian python motto.

Standard metabolic rate (SMR) has been used for over 50 years as a measure of the minimum energy used by an animal at rest. Australian pythons have SMRs lower than those of other Australian snakes and those of pythons from other regions. After feeding, pythons exhibit an increase in metabolic rate. This increase is reportedly as high as 45 times SMR in the Burmese python. This huge increase in metabolism after feeding, and the ability to atrophy the gut between meals, suggests the Burmese python is well suited to a life as a sit and wait forager. We examined the metabolic response to feeding in a number of Australian python species and found some differences compared to the published results from the Burmese python. We collected the following data from hatchling olive pythons: (1) SMR (2) peak metabolic rate after feeding (PMR), and (3) the metabolic rate of hatchlings after fasting for more than 100 days. The results suggest that the conditions under which SMR is measured must be carefully defined. In addition to the pattern of gut up-and-down-regulation described for the Burmese python, Australian pythons also exhibit metabolic depression, which further conserves energy during periods of uncertain food availability.

Spoken Paper, Monday, 9:00

O. Berry

Department of Environmental Biology, University of Adelaide, SA

Wagons to wirelasses to the WWW: frog call descriptions correlate with cultural change.

The inherent appeal of anuran vocalisations and their utility for the identification of species has led call descriptions to be a common feature of the biological literature. Descriptions may be in onomatopoeic form (eg. *Limnodynastes dorsalis*: bonk...bonk...), or, more recently, in technical language such as frequency range and pulse rate. Another descriptive method is the simile. Writers use similes to convey ideas through comparison to a familiar sensory or cultural experience (eg. Alice Springs is as hot as hell in December, or *L. dorsalis*: sounds like a banjo being plucked). I was interested in how the types of reference subjects used in call-similes changed over time. I surveyed two centuries of biological literature for descriptions of frog calls that were in simile form, and collated those that referred to technological objects. When records are put in chronological sequence, a clear progression that parallels technological advancement over this period is apparent. While some similes are more enduring, many descriptions have a limited lifespan because their reference object may have become less familiar to modern biologists.

Poster.

S. Blomberg and I. Owens

Department of Zoology, University Of Queensland, QLD

Mate choice and sexual selection in the small skink, *Carlia pectoralis*.

Mate choice is an important prerequisite in many models of sexual selection, yet there are very few examples of mate choice in lizards. We present data from experiments on the small skink, *Carlia pectoralis*, that demonstrates that females prefer larger, brighter males. Females show no preference for large, dull males or for small, bright males, indicating that both large body size and bright coloration are required in combination for female choice. A multiple poisson regression indicated that bright, highly developed coloration was a predictor of mite load for males. If bright coloration is costly, as suggested by current theory, male skinks may be advertising to females their ability to cope with high parasite burdens.

Spoken Paper, Monday, 09:30

M. Bonnett¹, D. Eifler², M. Gardner¹ and M. Bull¹

School of Biological Sciences, Flinders University, SA; ²Biology Department, University of Wisconsin, Wisconsin

The ecology, group structure and mating systems of a rock-dwelling population of *Egernia striolata*.

A primarily rock-inhabiting population of *Egernia striolata* was studied in Para Wira Recreation Park, S.A., during spring and summer. Most individuals in the population were captured and marked, with toe clips being collected from each individual. Home ranges, patterns of crevice usage and interactions between individuals were recorded from direct field observations. Samples were examined at four microsatellite DNA loci and these data were used to determine the relatedness between individuals. Individual interactions and grouping structure were found to differ greatly from those recorded for eastern tree-dwelling populations. We found that individuals at this site tended to congregate in highly related groups within specific areas. The incidence of shared crevices and group basking was also high. At the conclusion of the field survey gravid females were collected and allowed to give birth in captivity. An attempt was made to assign paternity to the offspring and the presence of possible multiple paternity within litters was examined. The rate of multiple paternity was found to be relatively low compared to some other reptile species but similar to those of related species with complex social behaviour.

Spoken Paper* Sunday, 9:45

J. H. Bowsher and N. J. Gemmell

Department of Zoology, University of Canterbury

Intraspecific variation in New Zealand's endemic frog *Leiopelma hochstetteri*.

New Zealand's endemic frog species, *Leiopelma hochstetteri*, is of great interest as a model for studying the effects of population fragmentation on patterns of genetic diversity. The potential for autosomal divergence between isolated populations is apparent from the great extent of cytogenetic diversity between populations, in the form of varying numbers of supernumerary chromosomes. I am using sequence analysis of the mtDNA gene cytochrome b to examine the relationship between 15 different populations of *L. hochstetteri*. will quantify genetic divergence between populations and genetic diversity within populations, and determine the relationship, if any, between supernumerary chromosome number and genetic divergence.

Poster

G. Brown¹, A. Bennett² and P. Macak¹

Arthur Rylah Institute for Environmental Research, Victorian Department of Natural Resources and Environment, VIC; ²School of Aquatic Science and Natural Resources Management, Deakin University, VIC.

Reptiles in disturbed rural environments: the conservation status of reptiles in the Northern Plains of Victoria.

The Northern Plains of Victoria is a typically fragmented rural ecosystem characterised by widespread clearing for agriculture and the irregular occurrence of small, isolated woodland remnants. It has been extensively cleared, such that tree cover is approximately 8% of what it was 120 years ago, with selective loss of box woodlands and native grassland. To determine the status of reptiles in this

environment, a comprehensive study was carried out at 193 sites representing a variety of remnant types in different climatic and vegetation zones. Reptiles were surveyed at stratified sites by area-constrained transect censusing and active searching, and pitfall trapping. There has been a widespread decline and local extinction of reptiles ? while a small number of species were relatively widespread, most species were patchily distributed and occurred in very low numbers. The distribution and abundance of reptiles in the rural environment is influenced by several factors, operating at different levels: the environmental gradient (reflected in climate and vegetation), the pattern of remnant vegetation, major habitat type, and microhabitat characteristics. Generally, reptiles were associated with structurally heterogeneous microhabitats. Linear remnants, particularly roadside vegetation, yielded the highest reptile densities and richness per site, and the greatest substrate complexity. A number of actions that would benefit reptiles in rural environments are advocated.

C. Browne and S. Burgin

Centre for Integrated Catchment Management, University of Western Sydney (Hawkesbury), NSW.

The present distribution of freshwater turtles in urban Sydney.

The Eastern Longnecked Turtle, *Chelodina longicollis*, was first described in 1794 and appears in early drawings of the fauna of the Sydney region. During 200 years of European settlement the city has been extensively developed and the flow of many water bodies changed. Prior to a study on urban impacts such as pollution, introduced turtle species, and urban predators, the distribution of turtles in the Sydney area was ascertained. Four fyke nets were laid for three consecutive 24-hour periods at fifteen randomly selected freshwater sites within the higher density area of Sydney. The distribution of *C. longicollis* was found to be patchy within this area (no captures at four sites, four sites producing only 1-2 turtles, with larger numbers at the remaining seven sites). The translocated Macquarie turtle, *Emydura macquarii*, was found at six sites, but at no site exclusively. Where capture rates were high, *E. macquarii* populations were shown to have wide size range, whereas *C. longicollis* was only found to have an abundant juvenile component at one of the sites. The presence of *E. macquarii* in large numbers at co-inhabited sites may suggest a competitive advantage, possibly due to its herbivorous nature (compared to the obligate carnivory of *C. longicollis*). The dearth of juvenile *C. longicollis* suggests a reproductive problem, possibly due to nest predation by introduced predators, scarcity of food resources or nesting sites, or pollution effects on fertility: factors to be looked at in the future.

M. Bull and D. Burzacott

School of Biological Sciences, Flinders University, SA

Time and duration of pairing in the sleepy lizard *Tiliqua rugosa*.

We looked at the duration and time of pairing in a population of *T. rugosa* over 15 years at Mt Mary 160 km north east of Adelaide. Each year the study season was divided into 25 four day time blocks from September 1 to December 8. Over 375 four day time blocks we captured 25,665 live adult sleepy lizards. We defined the start of pairing as the time block when the proportion of lizards in a pair first exceed 10% and the end of pairing as the last time block when there were more than 10% of the lizards in pairs. We also determined the level of pairing in each year. We looked at timing and level of pairing in relation to rainfall and temperature in each year. The start of pairing ranged from September 1 to September 29, pairing ended between October 31 and November 23. Duration of the pairing season was from 9 to 18 time blocks, duration tended to be longer if pairing started earlier. Cooler days in July and August tended to delay the start of pairing and warmer days in September and October were associated with an earlier end to pairing. Duration of pairing was not significantly correlated with any of the climatic parameters measured. The level of pairing varied from 29.1% to 41.2%. Pairing was significantly positively correlated with rainfall during September and October.

Spoken Paper, Saturday, 14:45

M. Bull and C. Griffin

School of Biological Sciences, Flinders University, SA

Burrow behaviour and burrow choice in the skink, *E. inornata*.

E. inornata is a burrow dwelling skink and probably depends on the burrow system for protection and thermoregulation. However, very little is known about its behaviour in, and the use of its burrow

system. Burrow choice experiments showed that they prefer burrows of a certain height, diameter, and length. Observational experiments using laboratory constructed burrows revealed that within their burrows individuals usually sit in the front section near the entrance with their eyes closed for the majority of the time. Also lizards spend a portion of each night hour outside of the burrow suggesting some nocturnal activity. When given a choice of two burrows (an unfamiliar and their own) individual lizards did not discriminate between the two. However, when two unfamiliar individuals were placed in the same cage with the same choice of two burrows both preferred their own burrow. This suggests that *E. inornata* mark their burrows with some cue allowing them to identify between burrows. They only avoid unfamiliar burrows when another lizard is present suggesting that burrow defence may occur.

Spoken Paper, Saturday, 14:00

M. Bull, C. Griffin, M. Gardner and S. Cooper

School of Biological Sciences, Flinders University, SA

Communication and kin recognition in skinks.

Skinks of the genera *Tiliqua* and *Egernia* discriminate between cues from related and non-related individuals. In part, the *Egernia* lizards with social groupings (like *Egernia stokesii*) are responding to familiar cues from close relatives that remain within the social group. However, with *Egernia striolata*, juvenile lizards discriminate between juveniles from other litters that are genetically close or far, when there has been no previous contact between any of the litters. This implies a genetically controlled signalling system. It contributes towards our understanding of how sleepy lizards (*Tiliqua rugosa*) can pick as their monogamous partners, individuals that are significantly more distantly related than a random choice of potential partners.

Spoken Paper, Friday, 15:15

T. Burton

Division of Biological Sciences, La Trobe University, VIC

More than one way to dig a hole: foot muscle morphology in burrowing frogs.

Two modes of hind-foot burrowing ('backwards shuffling' and 'corkscrewing') have been described in myobatrachids and hylids, and related to two distinct morphologies of thigh and calf musculature (Sanders and Davies 1984). I examined the foot musculature of well over 100 specimens of myobatrachids, over 60 species, representing all genera but one, and a number of hylids and pelobatids. I found no morphological differences between 'shufflers' and 'corkscrewers' in the foot musculature. Comparisons of burrowing and non-burrowing congeners suggest that features of the musculature that give greater mobility to the inner metatarsal tubercle represent an adaptation to burrowing. Some differences in morphology support the notion that *Limnodynastes ornatus* and *L. spenceri* adopted the burrowing mode of life independently of other *Limnodynastes*. *Uperoleia* has well developed inner and outer metatarsal tubercles, but the musculature of the inner tubercles is poorly developed, and no muscles attach to the outer tubercle. Similarly, the back-foot shuffling *Cyclorana* species I have examined possess foot musculature indistinguishable from that of non-burrowing *Litoria*. These data suggest that burrowing.

Spoken Paper, Friday, 15:30

P. G. Byrne

Department of Zoology, University of Western Australia, WA

Costs, but no benefits of multiple paternity in the Australian myobatrachid frog *Crinia georgiana*.

Multiple paternity may have benefits for females in two major areas: assurance of sperm quality, compatibility or availability and improved survival of offspring generated by enhanced genetic variation amongst offspring. About half the natural matings of the frog *Crinia georgiana* involve between two and nine males, all amplexed simultaneously. There is always one male (focal) amplexed dorsally and second males adopt a ventral position. Additional males scramble for position around these two males. Simultaneous polyandry leads to at least the focal and ventral males fertilising eggs but we cannot exclude paternity for other males. Analyses of fertilisation success showed that multiple paternity is a major cost for females. For matings involving two or more males, fertilisation success was reduced on average by over 30 %. Fighting amongst males during egg

deposition probably causes this reduction. Egg clutches were produced with one or two fathers and a common mother. Eggs were reared under drying conditions or continuous immersion. Tadpoles were raised with constant or varying water depths simulating repeated pond drying. For both experiments there were no differences in survival, size and time to either hatching or metamorphosis. Simultaneous polyandry in this species may be a consequence of forced copulations by males with major costs for females but no compensating benefits.

Spoken Paper, Monday, 10:45

K. Christian and J. Webb

Biological Sciences, Northern Territory University, NT; ²Biological Sciences, Northern Territory University, NT

Physiological ecology of bluetongue lizards in the wet-dry tropics.

Bluetongue lizards (*Tiliqua scincoides*) were studied near the Adelaide River floodplain in tropical Australia. Field metabolic rates (FMR) were measured (using doubly labelled water) during the wet and dry seasons. Additional measurements, including body temperatures (T_b) of free-ranging animals, the set-point range of temperatures selected by animals in a laboratory thermal gradient and standard metabolic rate (SMR) of recently-caught animals, allowed a sub-division of the FMR measurements into more ecologically relevant components. FMRs in the dry season (40 kJ/kg d; n = 9) were significantly lower than those in the wet season (138 kJ/kg d; n = 7). Part of this seasonal difference can be related to the decreased activity of the lizards during the dry season which is correlated with a decrease in food availability during this season. The relative roles of activity, T_b and SMR in determining the seasonal differences in FMR will be discussed. The data from Bluetongue lizards will be compared to the seasonal energetics of other reptiles of the wet-dry tropics, and trends related to metabolic depression and changes in thermoregulatory patterns will be described.

Spoken Paper, Saturday, 8:30

T. Colvill

Department of Zoology, La Trobe University, VIC

Offspring size and survivorship of embryonic and larval *Limnodynastes tasmaniensis*.

A study of the influences of egg size on embryonic mortality and larval size on predation risk showed that larger offspring have a fitness advantage. Generally, egg diameter determined hatching success, but its influence was reduced by maternal effects. Larval size was found to contribute to larval fitness in the presence of a gape limited predator (*Gambusia holbrooki*). Once larvae reached a threshold size, the risk of predation was greatly reduced. Optimum offspring sizes were not reflected in egg and larval size distributions. Variability in offspring size is probably an adaptation to variable maternal and offspring environments.

Spoken Paper*, Sunday, 11:45

N. C. Doak, M. N. Hearnden and R. A. Alford

School of Tropical Biology, James Cook University, QLD

The consequences of overlapping extended and explosive breeding behaviours on the life histories of burrowing frogs, (*Cyclorana novahollandiae*, *Litoria alboguttata* and *Limnodynastes ornatus*).

This study investigated the larval and adult ecology of *Cyclorana novahollandiae* (Steindachner 1867) and *Litoria alboguttata* (Gunther 1867) in the Townsville region of north Queensland. Both species are characterised by large burrowing adults and large, rapidly developing larvae. They have sympatric distributions in much of central and eastern Queensland, breeding at high densities in temporary water bodies with a typically short habitat duration. The duration of breeding activity during the study was dependent on rainfall events. *C. novahollandiae* has a restricted intensive period of breeding activity relative to *L. alboguttata* whose extended period of activity is opportunistic, often dependent on sufficient rainfall. To investigate the presence and impact of historical effects in temporary pond communities where these species coexist, an experimental design was used to determine what effects priority, density and multi-species competition had on larval cohorts of *C. novahollandiae*, *L. alboguttata* and a third burrowing species *Limnodynastes ornatus*. *Cyclorana novahollandiae* and *L. alboguttata* responded similarly to interspecific competition with each other.

The tadpoles of both these species clearly have adverse effects on each other, greater than the effects of conspecifics on each other. *Limnodynastes ornatus* experienced a depressed survival and mass in response to competition with the older heterospecifics relative to conspecifics. Larvae of *L. alboguttata* were clearly dominant in the 3-way competitive interaction. In 2-way competitive interactions, *L. ornatus* had a much reduced negative effect of the larval fitness of *L. alboguttata* compared with *C. novahollandiae*, whose larvae experienced a prolonged larval period and an depressed survival rates. Historical effects have an important impact of larval life-history outcomes.
Spoken Paper, Monday, 11:00

S. C. Donnellan¹, M. A. Adams¹, K. P. Aplin² and M. N. Hutchinson¹*

¹Evolutionary Biology Unit, South Australian Museum, SA, ²Western Australian Museum, WA

Evidence for the first case of a unisexual skink.

Preliminary morphological, allozyme, and mtDNA studies of the scincid lizard genus *Menetia* from WA and SA have revealed that the current morphological taxonomy of this genus considerably understates its true diversity. Overall these analyses suggest the presence of 11 genetically similar taxa, a number of them broadly sympatric, within *M. greyi*/*M. amaura*/*M. maini*.. We present evidence from gene dosage of allozymes, karyotypes and sex ratios that some of these taxa are unisexual triploid parthenogens. Similar to all other cases of vertebrate parthenogenesis, our data suggest hybrid origin(s) for the triploids. Comparisons with the gecko *Heteronotia*, the only other reptile parthenogen of the Australian arid zone, show remarkable similarities in the distribution and postulated origins of triploids in both genera suggesting a common biogeographic scenario of their origins and spread.

Spoken Paper, Sunday, 13:30

J. S. Doody, A. Georges and J. E. Young

Applied Ecology Research Group, University of Canberra, ACT

Reproductive biology of the pig-nosed turtle: Why lay two clutches every other year rather than one clutch each year?

During a study of the ecology and sex determination of the pig-nosed turtle (*Carettochelys insculpta*) in the Daly River, NT, we documented aspects of its reproductive biology. We were surprised to find that the turtles reproduced every other year, and yet laid two clutches when they did reproduce. We examine how current life history theory on animals with low frequency reproduction fits the *C. insculpta* pattern, and speculate on the causes of that pattern. *Carettochelys* showed marked variation (5 weeks) in timing of reproduction during the three year study, possibly attributed to the magnitude of wet seasons in the two years prior to nesting. Collectively, the data indicate that phenotypic plasticity may be a key factor explaining variation in *C. insculpta* reproduction.

Spoken Paper*, Sunday, 14:15

P. E. Doughty

Department of Zoology, University of Western Australia, WA

Developmental plasticity in response to changing conditions in *Crinia georgiana* tadpoles.

Adaptive phenotypic plasticity is expected to evolve in unpredictable environments. Species of frogs that breed in temporary water bodies are predicted to have tadpoles that respond to pond drying by accelerating development and metamorphose quickly to avoid being fish out of water. I tested this hypothesis in tadpoles of *Crinia georgiana*, a species that breeds in very shallow (< 2 cm deep) seeps during winters in southwestern Australia. Tadpoles hatch at relatively large size and advanced developmental stage, and development proceeds rapidly. At several stages of development, water depth and food availability were changed to see if tadpoles would accelerate development but at the cost of emerging at a smaller metamorphic size. Preliminary results indicate that an acceleratory response exists but at a cost of metamorphic size. Furthermore, the egg is so large that tadpoles do not even need to feed to complete metamorphosis. I will discuss these results and studies currently underway.

Spoken Paper, Monday, 11:45

S. Downes

School of Biological Sciences, University of Sydney, NSW

Why does tail loss increase a lizard's later vulnerability to (some) snake predators?

No single study has thoroughly examined the ramifications of tail loss for a lizard's subsequent escape effectiveness. I investigated this issue for a diurnally active skink (*Lampropholis guichenoti*) faced with nocturnal and diurnal snakes. During staged replicate encounters between unrestrained lizards and snakes in outdoor enclosures, I estimated the vulnerability to predation of lizards with recently autotomised tails ('tailless') and lizards with intact tails ('tailed'). Tail loss increased a lizard's vulnerability to predation by the diurnally foraging snake (yellow-faced whip snake, *Demansia psammophis*), but not by the nocturnal species (eastern small-eyed snake, *Rhinoplocephalus nigrescens*). To gain insight into the behavioural processes that affected prey vulnerability, I performed a series of manipulative experiments and quantified variation in behaviours of lizards and snakes that influence prey susceptibility. Neither type of predator actively behaviourally selected tailless prey. Tailless lizards were not easier to detect than tailed lizards (visually or via chemoreception), and the responses of tailless skinks to snake scents did not differ from those of tailed skinks. Instead, the increased vulnerability of tailless lizards to whip snakes probably reflects reduced running speed, and their tendency to flee sooner and thus elicit attack by this visually oriented predator. In contrast, overnight retreat-site selection (rather than tail length) determined a lizard's vulnerability to the nocturnal small-eyed snakes. These results suggest that tail loss can induce shifts in several behaviours of predator-prey interactions that are important determinants of a lizard's later vulnerability to some kinds of predators but not others.

M. Fitzgerald

School of Biological Sciences, University of Sydney, NSW

Ecology of Stephen's Banded Snakes (*Hoplocephalus stephensi*).

The ecology of an endangered Elapid snake was investigated using radiotelemetry. Sixteen adult Stephen's Banded Snakes were tracked and monitored in Whian Whian State Forest in northeastern NSW. Snakes were highly cryptic and predominantly arboreal, using both live and dead trees at heights up to 35 metres above the ground. Usually snakes sheltered in hollows, occasionally using large vine tangles, epiphytes and fractured arboreal termitaria. Snakes in rainforest spent little time on the ground but snakes in hardwood forests commonly foraged in tall sedges before returning to trees. Snakes preyed upon the young of Bush Rats, and Fawn-footed Melomys. Eastern Pygmy-possum, Brown Antechinus, Feathertail Glider and Southern Angle-headed Dragon are also recorded as prey. The effect of forestry management practices on *H. stephensi* habitat are being investigated. Interactions between the rate of loss of standing hollow trees and the rate of recruitment of hollow-bearing trees have the greatest potential to produce impacts upon populations of this hollow-dependent snake.

Spoken Paper, Monday, 8:45

P. T. Japaljarri, N. Gambold, L. Nakamarra, F. Walsh and G. B. Nungarrayi

Central Land Council, Alice Springs, NT

Herpetofauna of the Warlmanpa Homelands.

From 1995 to 1997 the Central Land Council conducted a participatory land assessment project on Karlantijpa ALT north west of Tennant Creek. This work attempted to describe the flora, fauna, landforms and soils of the area via the perspective of the traditional Warlmanpa owners. Although data on the fauna was collected in a relatively opportunistic fashion, over the years a fairly comprehensive inventory of the local herpetofauna accrued, annotated by several senior community members. The Tennant Creek region, and in particular the large area to the west that comprises the Karlantijpa North Aboriginal Land Trust is very poorly known in terms of its biota. Although it has been lumped within the Tanami bioregion it takes in extensive uplands such as Whittington and Short ranges, which are most biophysically similar to the southern most reaches of the Sturt Plateau. The herpetofauna reflects this habitat diversity with a total of fifty-five reptile species and six amphibians so far recorded from the area. In this talk I will describe this herpetofaunal assemblage with reference to its biogeographic affiliations, discuss the role of reptiles and amphibians as traditional resource and give an overview of the participatory approaches developed during this pilot land resource assessment project.

Spoken Paper, Saturday, 14:15

M. Gillam

4 Hele Cres, Alice Springs, NT

***Aprasia striolata* in central Australia?**

The geographic distribution of *Aprasia striolata* is unusual in the pygopodids because it is discontinuous. There are several populations scattered across the southern coastline of the continent, and one population from Mt Buring in central Australia. Only three specimens of the central Australian population exist and so its status needs to be established for the purposes of management. After exhaustive examination of historical records, maps, the specimens of *A. striolata*, and the suitability of bioclimatic envelope and habitat for *A. striolata* in central Australia, it is concluded that the c. Australian population is fictitious. The reasons for this conclusion are: (1) there is no c. Australian landmark named after Buring; (2) no member of the Buring family visited c. Australia around the purported time of collection; (3) the morphological features for the c. Australian specimens are similar to those for the Adelaide populations; and (4) habitat and climatic conditions in c. Australia are very different than for those of southern coastal populations. It is likely that the three *A. striolata* specimens in question were collected by someone from the Buring family who lived in the Barossa valley at the reported date of collection, and were inadvertently bottled with material from c. Australia.

G. Gillespie

Natural Resources and Environment (Vic), Arthur Rylah Institute for Environmental Research, VIC

The impact of increased sediment loads in streams on tadpole growth and development of the Spotted Tree Frog *Litoria spenceri*.

Anuran larvae are potentially important consumers in stream ecosystems; however, the impacts of catchment disturbances on lotic anuran larvae have received little attention. The impact of increased deposited sediment loads, substrate type and tadpole density was assessed on growth and development of tadpoles of the Spotted Tree Frog *Litoria spenceri* in south-eastern Australia. This was conducted in stream enclosures with varying tadpole densities, food substrate types and deposited sediment loads. Tadpole growth and development were not significantly affected by food substrate type, but there was a trend toward greater growth and development on periphyton compared with detritus. Tadpole growth and development were negatively affected by increases in tadpole density and sediment load. These effects were independent, suggesting that increased sediment load reduced food quality or accessibility rather than food quantity. Increased sediment input into streams may therefore reduce tadpole fitness and anuran population recruitment. Activities in catchments which increase sediment loads in streams may adversely affect growth and development of anuran larvae. Disturbance processes which increase stream sediment loads, such as forestry activities and associated road construction, may potentially have contributed to the observed declines of *L. spenceri* and other lotic anurans in south-eastern Australia. Major steps have now been taken through the *L. spenceri* National Recovery Plan and Regional Forest Agreement process to reduce sediment input into streams supporting populations of *L. spenceri*.

R. L. Goldingay and D. A. Newell

School of Resource Science & Management, Southern Cross University, NSW

Species neglect: continuing degradation of the habitat of an endangered Australian snake.

Protected areas are commonly viewed as safe havens for endangered species. To test this notion, we experimentally constructed small rock outcrops for the endangered broad-headed snake (*Hoplocephalus bungaroides*) within a National Park near Sydney, Australia. Rock outcrops provide vital shelter sites during the cooler months of the year. Eight of our 22 rock outcrops were disturbed by people over a 15 month period. The types of disturbance documented included simple displacement of some rocks but also included deliberate destruction of the loose rock habitat where rocks were smashed. Disturbance occurred up to 450 m from a track or road but not at our more distant outcrops. Such disturbance is also known from natural outcrops, demonstrating a continuing decline in the quality of this snake's habitat. Twenty of our rock outcrops were colonised by velvet geckos (*Oedura lesueurii*), the primary prey of this snake. One broad-headed snake was found in one outcrop. The use of our experimental sites by these species offers some encouragement for habitat restoration. The main inference from this study is that restoration sites should be located >500 m from a track or road. This study highlights the value of targeted experiments that precede larger-scale habitat restoration.

T. Halliday, M. Dyson and P. Henzi²

Biological Sciences, The Open University; ²Dept. of Psychology, University of Natal.

What determines the mating success of male African painted reed frogs in a small chorus?

We monitored a small breeding population of *Hyperolius marmoratus* for 5 months. Males attended the breeding site on 128 out of 167 nights, with individual males showing considerable variation in chorus tenure (median: 5 nights, range 1 to 86 nights). We observed 86 matings. Male mating success was highly skewed; 23 of 45 males did not mate at all, and successful males mated with 1 to 16 females. Male mating success was not related to body size or to condition at the start of the season. The most important correlate of male mating success was chorus tenure duration. In addition, we found that the act of mating itself lead to an increased probability of further mating success. Possible reasons for this effect will be discussed.

Spoken Paper, Friday, 17:45

C. Hayes, I. A. W. Scott and S. J. Keogh

Department of Botany and Zoology, Australian National University, ACT.

Development of microsatellite markers for investigating paternity in the Southern Water Skink *Eulamprus heatwolei*.

Genetic analysis of natural populations has allowed biologists to ask a wide variety of questions which previously could only be answered by extensive observation of the group in question. Of these analytical markers microsatellites have become the preferred choice for elucidating patterns of relatedness within populations. Microsatellite markers are sequence motifs, typically 2-6bp in length, repeated several to many times. Microsatellites have several characteristics which make them desirable. Microsatellites are found in large numbers and are relatively evenly spaced throughout the genome. Most microsatellite loci are selectively neutral which makes them compatible with assumptions of most population genetic theory. Microsatellite loci can be amplified using the Polymerase Chain Reaction (PCR) and alternative alleles can be detected using non-radioactive methods and unambiguously sized on polyacrylamide gels. Perhaps most significantly microsatellites have been found to be variable in populations which have low levels of allozyme and mitochondrial DNA variation. As a means of elucidating patterns of paternal success in an ACT population of the Southern Water Skink *Eulamprus heatwolei* we have developed 24 microsatellite markers to the stage of identifying polymorphic loci. In this poster we detail the procedure involved in developing microsatellite markers.

Poster.

J. M. Hero

School of Environmental and Applied Science, Griffith University Gold Coast, QLD

Managing the Northern Territory Cane Toad invasion.

The invasion of the Cane Toad in northern Australia cannot be stopped and the impacts of this invading exotic animal are poorly understood. Summarising evidence from the literature and my own unpublished data, I evaluate the potential impact of Cane Toads on the wildlife of the Northern Territory. Important impacts are likely to be the direct effects of Cane Toads on the native animal populations that are important bush tucker for indigenous Australians (i.e. goannas, snakes and turtles) and the social impact of Cane Toads interacting with humans (invasion of our living space). Land-use practices (waterbody construction) and management strategies (e.g. using islands as refuges for native species) that can be used to mitigate the impacts of Cane Toads are also discussed. Research on the impacts of the Cane Toad on the wildlife in Kakadu has enormous value as it would be an important study documenting the actual impact of Cane Toads on the native fauna of the Northern Territory. Furthermore, this information would provide information on the ecology of invading species that will assist managers in the future.

Spoken Paper, Monday, 11:15

P. Horner¹ and M. Adams²

¹Terrestrial Vertebrates, NT Museum & Arts Gallery, NT; ²Evolutionary Biology Unit, South Australian Museum, SA

Cryptic crypto's - an analysis of variation in Australian populations of the genus *Cryptoblepharus* (Scincidae) using electrophoretic and morphological data.

The scincid lizard genus *Cryptoblepharus* has a wide, almost circumglobal geographic range. Morphologically conservative, the genus contains about 40 described species, which were once regarded as geographical races of a single species (*C. boutonii*) and thought to be the world's most widespread lizard species. Most taxa are now recognised as distinct species, six of which occur on the Australian continent. Results of an allozyme electrophoresis analysis of Australian populations suggest that at least four of the six taxa are complexes of cryptic species. Morphological identification of some of these forms is supported by subtle mensural and meristic features. An instance of hybridisation between two taxa is also identified by the electrophoretic analysis.

Spoken Paper, Friday, 14:45

T. L. How and M. Bull

School of Biological Sciences, Flinders University, SA

Foreplay - do female sleepy lizards need it?

The sleepy lizard is a large viviparous skink which forms monogamous pairs for 6-8 weeks each spring. The functions behind such a long pairing period before mating occurs are unknown. It has been suggested that a long pairing period could help the males to 'prime' the females. If this was the case then female sleepy lizards would require the presence of the males to ovulate. This hypothesis was tested experimentally in the field over two spring breeding seasons. The experiment consisted of separating pairs and measuring their reproductive hormone levels. It was assumed that the level of reproductive hormones would correspond with the reproductive status of the lizards. A number of behavioural observations were also made to determine differences between paired and separated lizards. The results suggest that the presence of the male does not induce the female to ovulate, however not all females reproduce each year. Several of the paired and separated females failed to increase their hormone levels throughout the season and hence failed to breed. Research into the functions of an extended pairing period and monogamy in the sleepy lizard is continuing and further experiments are being conducted.

Spoken Paper*, Saturday, 8:15

M. Hutchinson, S. Donnellan and K. Saint

Evolutionary Biology Unit, South Australian Museum, SA

Chinese dragons? Phylogenetic relationships among the acrodont lizards.

We used a 'molecules and morphology' approach to recover the major patterns of phylogenetic relationships among the lizards traditionally placed in the family Agamidae. Molecular data were obtained from the nuclear gene c-mos and the mitochondrial gene ND2. Morphological data were taken from two data sets, that of Moody's unpublished PhD thesis and the published data set of Frost & Etheridge (1989). DNA data were obtained from taxa selected to represent the following major groups: Australian agamids (*Amphibolurus muricatus*, *Ctenophorus decresii* and *C. nuchalis*), Papuan agamids (*Hypsilurus bruijinii*), water dragons (*Physignathus cocincinus* and *P. lesueurii*), SE Asian forest agamids (*Calotes mystaceus* and *C. versicolor*, *Gonocephalus chamaeleontinus*), central Asian and African agamids (*Agama atra*, *Phrynocephalus mystaceus*), leiolepidines (*Leiolepis guentherpetersi*, *Uromastyx aegyptia*) chamaeleons (*Chamaeleo jacksonii*); the phrynosomatid iguanian *Sceloporus grammicus* was used as an outgroup. Hypotheses tested by the data set include: Are Australian agamids monophyletic? Do the Australian agamids lie at the base of the acrodont radiation or are they a recent derivation from Asian precursors? Are chamaeleons the sister lineage of agamids, or contained within agamids?

Spoken Paper, Monday, 9:45

S. J. Keogh¹, I. A. W. Scott¹ and J. D. Scanlon²

¹Department of Botany and Zoology, Australian National University, ACT; ²Department of Zoology, University of Queensland, QLD

Molecular phylogeny of viviparous Australian elapids and the affinities of Australia's rarest snake.

The rare Australian venomous elapid snake *Echiopsis atriceps* has been the subject of considerable taxonomic instability with the five known specimens assigned to four genera by various authorities. Phylogenetic affinities of the rare *Elapognathus minor* also are poorly understood and have been the subject of some disagreement. To examine the phylogenetic affinities of these two rare taxa, a molecular data set comprising 1680 base pairs of mtDNA was assembled from a representative of each of the terrestrial Australian viviparous elapid genera and two species of *Drysdalia*, a genus about which there also has been phylogenetic controversy. A total of 936 base pairs of 12S rRNA, 454 base pairs of 16S rRNA and 290 base pairs of cytochrome b mtDNA sequences were sequenced for fifteen species. Parsimony analyses of the unweighted, combined data set resulted in a single fully resolved most parsimonious tree 1225 steps long. These data strongly support a sister group relationship between *Echiopsis atriceps* and the Australian broadheaded snakes of the genus *Hoplocephalus* with a bootstrap value of 99%. Templeton tests soundly reject all previous taxonomic arrangements for this species. Our data also strongly support a sister group relationship between *Elapognathus minor* and *Drysdalia coronata* with a bootstrap value of 98%. Importantly, *Drysdalia coronata* and *Drysdalia coronoides* do not form a monophyletic group, supporting previous studies. Based on our results, we allocate *Echiopsis atriceps* to a new monotypic genus and re-describe *Elapognathus* to include *Drysdalia coronata*.

Spoken Paper, Friday, 15:00

R. Kennett

Centre for Indigenous Natural and Cultural Resource Management, Northern Territory University, NT

Tracking miyapunu: satellite tracking of sea turtles in the Gulf of Carpentaria, Australia.

Sea turtles are an important cultural and natural resource to the indigenous people (Yolngu) of north East Arnhem Land. Yolngu are actively engaged in a sea turtle (miyapunu) conservation and research project that combines traditional knowledge and skills with contemporary research and management methods. An important component of the project is identifying the co-users of this migratory resource. To achieve this, satellite telemetry was used to follow the migration routes and identify home feeding grounds of post-nesting sea turtles in the Gulf of Carpentaria, Australia. Migrating turtles generally followed a coastal route and all home feeding grounds appear to be within the Gulf of Carpentaria. The biological, cultural and management implications of these findings will be discussed.

Spoken Paper, Saturday, 10:30

M. Ladyman, A. Barber, P. Runham, J. Rodger, L.D. Beazley and S. A. Dunlop

Department of Zoology, University of Western Australia, WA.

Optic axons fail to regenerate to visual centres in the gecko *Nephrurus stellatus*.

The ability to regenerate severed axons and restore vision following optic nerve crush is not universally observed. In birds and mammals, severed axons do not grow beyond the lesion and animals remain blind. In fish and frogs however, regenerating optic axons regrow to the brain and vision is restored. The success of optic nerve regeneration in the order Squamata appears to vary. In the lizard *Ctenophorus ornatus* (Agamidae), axons regenerate within a month but do not maintain a retinotopic map and animals remain functionally blind via the experimental eye. Optic nerve regeneration also occurs in the snake *Viper aspis* (Serpentes) but axons reach the optic tectum only by 6 months; however, it is unknown whether a retinotopic map reforms. To explore further the outcome of optic nerve regeneration in reptiles, we have examined the gecko *Nephrurus stellatus* (Gekkonidae). Unilateral optic nerve crush was performed under anaesthesia with sodium brietal. Animals were assessed behaviourally between 1-6 months in an open-field arena and their responses to moving prey monitored by video camera. Within the monocular field of the un-operated eye, animals tracked, struck and captured prey but, via the experimental eye were unable even to track prey. Further comparisons with other reptile species, including *Gehyra variegata* and the oblong turtle, *Chelidonia oblonga*, are in progress.

E. Lanham and M. Bull

School of Biological Sciences, Flinders University, SA

Why play happy families? Benefits of grouping together in the Gidgee Skink *Egernia stokesii*.

Gidgee skinks (*Egernia stokesii*), form stable aggregations of up to 17 individuals, usually in rock crevices. The home ranges of all members of the group overlap considerably and they can often be found with many animals sharing one crevice. Recent work by our research group has discovered that these groups remain stable within and between years. We present data suggesting that ecological constraints (ie lack of suitable crevices) does not fully explain this behaviour, since groups presented with multiple similar crevices remained aggregated. We suspect there are at least two benefits to individuals when they form these groups. Firstly juvenile *E.stokesii* spend more time out of their crevice and more time active when in a group than when they are alone, suggesting enhanced protection from predation in a group. Secondly, aggregation during cooler months appears to confer some thermal advantage because aggregated lizards are able to maintain a higher body temperature as ambient temperature decreases in the afternoon/evening.

Spoken Paper*, Saturday, 11:15

M. Lee

Department of Zoology, University of Queensland, QLD

Rates of molecular and morphological evolution in reptiles (including birds).

It is frequently assumed amounts of morphological and molecular evolution along branches of phylogenies are quite independent. This might cause problems with application of PD (phylogenetic diversity) methods for conservation evaluation, which rely on branch lengths to identify priority taxa. If molecular branch lengths do not reflect morphological branch lengths, then different data sets might imply different priority taxa, leading to a real agony of choice. However, even if morphological and molecular evolution are not causally related to each other, they are both correlated with time: taxa with a long independent history, all things being equal, would be expected to accumulate many morphological and molecular changes. This suggests that morphological and molecular branch lengths should be correlated. Investigation of recent combined (morphological and molecular) cladistic data sets for reptiles (including feathered, volant forms) reveals that this correlation indeed holds, albeit with a fair amount of scatter. Thus, priority taxa selected by PD analysis using molecular data (e.g. mitochondrial DNA) will also often coincide with those suggested by morphological data, and vice versa.

Spoken Paper, Sunday, 9:15

F. Lemckert and T. Brassil

Forest Research and Development Division, State Forests of NSW, NSW

Make up your mind! - Movements of the giant burrowing frog, *Heleioporus australiacus*.

The movements of seven giant burrowing frogs have been followed in the Eden and Gosford areas of NSW using radio-transmitters implanted under the skin. Giant burrowing frogs rarely use the riparian zone, preferring the open forest where they usually burrow 1-3 cm below the surface. Deeper burrows are only used occasionally and some burrows have been used on multiple occasions. Logs and the leaves of fallen saplings have also been used for shelter. Most frogs remained within a 30m radius of their release point, but twice individuals moved several hundred metres to a new site. The frogs have shown no obvious preferences in the forest habitat they use. The conservation of these frogs requires a different approach than simply protecting the streams in which giant burrowing frogs are expected to breed and it remains unclear if these frogs even require protection from selective logging operations. Fire may represent the greatest threat and require the greatest consideration.

Spoken Paper, Friday, 17:30

M. Mahony

Biological Sciences, The University of Newcastle, NSW

The use of population structure data to monitor the conservation status of selected populations of great barred river frogs (*Mixophyes*).

Over a five year period two populations of each of three species of barred river frogs (*Mixophyes iteratus*, *M. balbus*, *M. fleayi*), were studied using mark-release-recapture methods. One objective was to determine the most effective means of assessing whether the populations were declining.

Sampling involved standardised search methods on defined transects. Previous studies indicated that detection varied considerably between sampling periods, and could not be predicted by climatic factors. Comparisons were made of several possible approaches to population monitoring; population size estimates, survivorship rates, sampling counts, and population structure. Because the activity of the frogs varied considerably between sampling periods it was necessary to obtain measures that would be robust despite the variance in detection rates. Data on body measurements, gender and condition were recorded for all individuals, growth curves constructed and the age structure for each population was determined. The largest data set was obtained for *M. iteratus* and it was possible to detect differences in recruitment and mortality rates from year to year. These frogs are relatively long lived, some individuals were re-caught numerous times during the study and the growth curves indicate they may live up to 10 years. Population size and survivorship estimates produced high levels of variance, however, population structure revealed consistent relationships between age and gender classes. Changes in population structure provide the most easily detected and first indication that changes may be occurring in a population, they also provide an indication of which part of the life cycle was effected.

Spoken Paper, Sunday, 8:00

B. Malone

Department of Zoology, La Trobe University, VIC

Temporal variation in life history traits of a population of Southern Water Skinks (*Eulamprus t. tympanum*).

Geographic and temporal variation in life history traits are due to differences in the way individuals allocate energy to growth and reproduction. Data will be presented which show that reproductive output, litter size, and offspring size differed in a low altitude population among years. Evidence suggests that these traits are phenotypically plastic and may be influenced by the maternal environment (eg prey availability and temperature regime).

Spoken Paper, Sunday, 15:00

A. Manzano, S. Moro and V. Abdala

Centro de Investigaciones y Transferencia de Tecnología a la Producción; Instituto de Herpetología, Fundación Miguel Lillo; Fac. de Ciencias Naturales e IML, U.N.T.

Morphological variation of anuran depressor mandibulae muscle.

There is considerable diversity in anuran cranial structure, evidenced by variation in bone structure and associated muscles. The depressor mandibulae is the jaw muscle that opens the mouth. It is derived from the hyoideus arch and is innervated by the facial nerve. Many authors have done comparative studies of anuran and other vertebrate jaw muscles. However, there is still great controversy on the value of the depressor mandibulae as a relationship-indicating character. The goal of this study is to verify the existence of general patterns of the depressor mandibulae in anurans, and, if patterns exist, to determine whether they can be used to infer phylogenetic relationships among the groups in the order. For this work, 187 adult specimens were studied. Sixteen morphological groups can be distinguished within the anuran species analyzed. There is less variation at the insertion point, which remains stable in most of the cases. The origin is also rather uniform, except in *Hemisus* and *Arthroleptis*, which have an anterior branch coming from the maxillary bone. Most variation involves the shape of the muscle. This diversity of the depressor mandibulae is due to variations of cranial morphology in Anura. The relatively weak correlation between depressor mandibulae morphology and higher taxonomic categories in frogs makes the usefulness of the muscle dubious in understanding phylogenetic relationships.

Poster.

G. Marantelli, R. Hobbs and R. Hirst

Amphibian Research Centre, VIC

Volunteers in pyjamas saving frogs from bananas.

Frogs and other organisms are known to travel through the transport of fresh food produce and horticultural materials. However, the magnitude of this problem has not been documented. Recently, concerns have been raised about the welfare of transported frogs as well as their potential to impact on local ecosystems. In 1995 a survey covering 133 businesses involved in the shipment and sale of

produce and plants demonstrated that at least 8,000 to 10,000 frogs were accidentally transported into Melbourne annually. Almost 70% of these were released into the local environment. In 1996 a program to retrieve these frogs was established. Victorian Frog Group volunteers act as couriers to cover zones and ferry frogs to the Amphibian Research Centre where they are quarantined, assessed and eventually placed in captive collections. To date animals have been retrieved from produce travelling from all Australian states as well as Asia and South America. Eighteen species of native frogs, the Cane Toad and two other exotics have been retrieved. Our research indicates that wildlife is transported from every Australian state to every other state and that a number of these transports occur across geographic barriers and into areas where the species in question are absent but could arguably establish. Increasing the retrieval rate of displaced amphibians by this technique, has the potential to mitigate threats, as well as salvaging - at no additional cost to the environment - a resource of potential captive and experimental animals that are otherwise being wasted.

Spoken Paper, Sunday, 14:00

G. Marantelli¹, D. Hunter² and W. Osborne²

¹Amphibian Research Centre, VIC; ²Applied Ecology Research Group, University of Canberra, ACT

An egg in the hand is worth what in the bush? Assessment of captive recruitment enhancement in the recovery process for the endangered Southern Corroboree Frog, *Pseudophryne corroboree*.

Captive husbandry is an integral component of the recovery program for the endangered Southern Corroboree Frog, *Pseudophryne corroboree*. The primary focus has been to facilitate the implementation of a population augmentation experiment, but it has also aided studies into other aspects of the ecology of this species. The aim of this experiment was to assess the viability of using husbandry to increase recruitment across developmental stages known to be currently exhibiting low survival in the field. Naturally deposited eggs were collected each summer and the resulting tadpoles released in spring at several small breeding populations. Embryonic and tadpole mortality were significantly reduced through captive rearing when assessed against their siblings left in-situ. Captive reared tadpoles were further assessed against their field-reared siblings by the use of in-situ enclosures and monitoring development through to metamorphosis. A comparison of tadpole developmental rates and size also suggested that there was no loss of fitness as a result of being reared in captivity. Field survival of larval stages through winter is currently extremely low and highly variable. Many clutches and some entire populations have been shown to have no recruitment in some years. The increases both in numbers of recruits and representation of clutches achieved by this experiment is hoped to secure current populations against further declines while causal agents are identified. Monitoring the number of calling males at experimental and control sites will be used to assess whether these actions ultimately result in increases in adult breeding populations.

Spoken Paper, Sunday, 8:45

S. McAlpin

14 Mills St Alice Springs, NT

Researching *Egernia kintorei* at Uluru - a process through two cultures.

The basic biology and ecology of the Great Desert Skink *Egernia kintorei* was recorded during a one year research project at Uluru - Kata Tjuta National Park. A monitoring program for this nationally vulnerable skink was subsequently established. This was achieved through a co-operative process that pivotally involved the Anangu traditional owners and custodians at Uluru. Field research of a biological organism is generally undertaken within the boundaries of well-established scientific techniques. However research at Uluru encompasses an additional complex component incorporating traditional ecological knowledge and Tjukurpa or Law. Few researchers have the benefit of access to a vast array of information from collaborators with unparalleled field expertise and historical knowledge. The benefits from such collaborative work are discussed as well as the methodology for monitoring and some of the early monitoring results.

Spoken Paper, Saturday, 13:45

K. McInnes

School of Ecology and Environment, Deakin University, VIC

Toothpicks for tadpoles: Investigations into the treatment of the amphibian chytridiomycete fungus in larvae of the Great Barred Frog *Mixophyes fasciolatus*.

Increasing evidence suggests that a newly discovered genus of chytrid fungus is associated with the recent declines and extinctions of a number of frog species. Current data suggests that all specimens of the chytrid fungus viewed so far, belong to the same keratin digesting species, *Batrachytrium dendrobatidis*. It has been demonstrated that the fungus is able to infect tadpoles as soon as keratinised mouthparts develop. Following metamorphosis, the entire epidermis of the amphibian becomes keratinised, and chytrids subsequently colonise all areas of the skin. In favourable conditions the fungus is able to overwhelm the frog in as little as ten days. Treatment of infected but otherwise healthy tadpoles may provide a means to reduce the role of chytrid infections in future extinctions. Once an outbreak is detected it is often too late to salvage adult frogs, but tadpoles may be removed, treated and held in captivity to provide stock for re-establishing wild populations. Research was conducted on *M. fasciolatus* tadpoles in order to develop a method of treatment for the chytrid fungus. Treatment regimes safe for tadpoles were determined for a number of different fungicides and then tested on the fungus in-vitro. Groups of tadpoles were exposed to cultured chytrids and then monitored until suitable levels of infection were recorded. Treatments found to be effective against the fungus in-vitro were then tested on individually housed infected tadpoles. Methodologies utilised throughout this study and the success rates of each treatment type will be presented.

J. Melville and J. Losos

Department of Biology, Washington University, MO

An ecomorphological analysis of habitat utilization in a lizard assemblage from the Mojave Desert, California.

Habitat utilization was investigated in an assemblage of 10 iguanids and one teiid in the Mojave Desert. Microhabitat occupation, behavior, performance abilities and morphology were quantified to allow an analysis of habitat utilization using comparative phylogenetic techniques. A principal components analysis of ecological, behavioral and morphological characters revealed distinct differences between the species, with six ecomorphs being identified. These included three specialists (saxicolous, arboreal, sand-dwelling), two widespread ecomorphs (bajada/rocks, open desert) and one generalist species. However, a phylogenetic analysis using independent contrasts revealed that when the effect of phylogeny was removed there was not a relationship between habitat and hindlimb length. This indicates that factors other than morphology may be important in habitat utilization in desert lizards. There was a significant relationship between hindlimb length and behavior and between habitat and behavior. Many of the behavioral factors recorded varied with the foraging mode of the species, from an active forager (*Cnemidophorus tigris*) to varying degrees of sit-and-wait foraging.

S. Milne

Environmental Biology, University of Adelaide, SA

Sprint speed in small agamids - is it gait or size that really matters?

Species within the agamid genus *Ctenophorus* exhibit considerable variation in size, shape, limb length and running gait. Hind-limb length has been shown to be important in determining sprint speed in a number of lizard groups, and it has been suggested that bipedal running may also allow an increase in maximum sprint speed. I investigated the importance of running gait and morphology as determinants of maximum sprint speed in *Ctenophorus* using a photocell-timed racetrack and high-speed video equipment. The bipedal *C. cristatus* ran faster than other species of equivalent size. However, when the effect of hind-limb length was removed, there was no difference between the speeds of this bipedal runner and less specialized quadrupedal runners such as *C. decresii* and *C. nuchalis*. The smaller *C. pictus* and *C. isolepis* ran much faster than predicted based on running speeds of other species, and they used both quadrupedal and bipedal gaits. These results are discussed in relation to the kinematics of bipedal and quadrupedal gaits in *Ctenophorus*. Specialization for bipedal running does not necessarily increase maximum speed; other factors that may have influenced its evolution in *C. cristatus* are proposed.

G. E. Misso and M. Bull

School of Biological Sciences, Flinders University, SA

Individual recognition in sleepy lizards (*Tiliqua rugosa*).

It is known that female sleepy lizards and their offspring are able to recognise each other, and that each year, adult lizards form monogamous pairs in spring and these pairs reform each year for several years. Sleepy lizards also appear to have a stable social organisation. All of this implies that these lizards must have a sophisticated communication system. The aim of the project therefore was to investigate individual recognition in sleepy lizards. A series of initial laboratory experiments will be described which were conducted to investigate the lizards' abilities to recognise each other, and also to investigate the nature of the signals used.

Spoken Paper, Saturday, 14:30

N. Mitchell

Department of Environmental Biology, University of Adelaide, SA

Is wetter better? Substrate water potential affects male nest-site selection and calling behaviours in the terrestrial breeding toadlet, *Pseudophryne bibroni*.

The 'wetter is better' principle of terrestrial egg incubation proposes fitness benefits to the wettest eggs and is well supported by laboratory studies of several vertebrate groups. Non-random selection of nest sites under field conditions is also well documented, and where eggs are externally fertilised, as in most frogs, female choice of a nest site is clearly tied to the choice of a mate. *Pseudophryne bibroni* is a terrestrial breeding toadlet whose females oviposit in nests of territorial males. A field experiment tested the hypothesis that artificially wetted plots of breeding habitat would attract more males than equivalent unwetted plots and that wetted males would experience greater mating success. Watering of plots commenced prior to the breeding season and continued for 7 weeks. For the first 6 weeks weather was unusually dry. Fifteen males colonised wetted plots during this period whereas no males colonised unwetted plots. When compared to males that called in unwetted areas outside experimental plots, wetted males called earlier in the season, on three times as many nights, and achieved more matings. Following heavy rainfalls in the sixth week, most wetted males deserted experimental plots, called from new nests and experienced mating success similar to that of other males. Although 19 of 20 egg clutches were laid in wet nests, female selection for wetness is probably indirect and linked to greater calling effort of males in wet conditions.

Spoken Paper* Saturday, 9:45

C. Morrison¹, J. M. Hero¹ and W. P. Smith²

¹School of Environmental and Applied Sciences, Griffith University - Gold Coast, QLD; ²Department of Zoology, James Cook University, QLD

Mate selection by female *Litoria chloris* and *L. xanthomera*: size doesn't always matter.

It is generally accepted that high quality males are those that succeed in male-male competition: in either aggression or rivalry to attract and be selected by females. Previous studies have suggested that one of the main characters indicating male dominance is body size with larger males being more successful either through direct or indirect selection. Other factors include variation in call characteristics and calling behaviour, body condition, age, and chorus tenure. In this paper we examine the characters influencing female mate choice in two closely related frog species *Litoria chloris* and *L. xanthomera*. We show that smaller males of both species are more successful than larger males and we attribute this success to the increased chorus tenure and better body condition of smaller males in *L. xanthomera*. The increased chorus tenure was attributed to the higher second dominant call frequency (F2) of smaller males which is less energetically expensive to produce than the deeper call frequency of larger males. Whether increased chorus tenure explains female mate choice in *L. chloris* is uncertain but is highly probable given the strong similarity between the two species in both ecology and call characteristics.

Spoken Paper*, Sunday, 14:45

S. Morrison

Division of Botany and Zoology, Australian National University, ACT

Territoriality in the Water Skink *Eulamprus heatwoli*.

Within the Scincidae several species belonging to the genus *Eulamprus* have demonstrated complex social systems and strong territorial behaviour. This study uses the Southern Water Skink *Eulamprus heatwoli* as a model to investigate variations in male and female territoriality within a single small population. I will present preliminary data from an ongoing study of territory size and structure gathered through field observations and combined with data on individual size and fitness. I will outline the social structure of the population as well as the traits indicative of successful territory ownership. Ultimately, this work will form the basis for research into *Eulamprus* mating systems which will employ microsatellite DNA techniques (see poster by Christine Hayes).

Spoken Paper*, Saturday, 11:45

L. Nelson

Department of Botany and Zoology, Australian National University, ACT

Differences in SVL:mass ratios and temperature selection in *Tympanocryptis pinguicollis*.

The only known extant populations of the endangered Grassland Earless Dragon, *Tympanocryptis pinguicollis*, occur at two altitudes in south eastern Australia: 570-595m near Canberra and 880-990m near Cooma. Work near Canberra shows this Agamid to be largely an annual species with recruitment in mid to late summer. A study of aspects of the thermal ecology of these populations and associated life history traits has shown that temperatures selected by *T. pinguicollis* in a laboratory temperature gradient show no difference between altitudes, sex, SVL or season. However, animals from near Canberra spent significantly more time thermoregulating ($p < 0.001$) and were less active than higher elevation animals whilst in the gradient. Statistical models constructed to examine relationships between the log of SVL and log of mass show that for a given SVL (log), animals from the higher elevation are 18% bigger in mass (log) than animals from lower elevation ($p < 0.001$). Preliminary growth data suggest slower growth rates in young animals from the end of autumn to the end of spring at higher elevation sites. This lends support to the hypothesis that the thermal niche is more restrictive on the development rates of *T. pinguicollis* at higher elevations which may lead to delayed sexual development and the need to live longer prior to reproducing.

Spoken Paper*, Saturday, 8:45

D. Nunan

Centre for Resource and Environmental Studies, Australian National University, ACT

Amphibian conservation in an agricultural landscape.

A majority of Australia is privately owned and subject to modification, such as agriculture. Little is known on how such environments are utilised by amphibians. The objective of this research is to examine the attributes of farm-dam habitats in relation to amphibian utilisation in an agricultural landscape in the Upper Shoalhaven Catchment on the Southern Tablelands of NSW. Seventy farm dams from fourteen properties were surveyed for the presence of amphibians in Spring of 1998. Species richness was compared with the following biotic and abiotic attributes of each dam: aquatic vegetation cover, dam size, ground cover vegetation and tussock cover in the riparian zone. Dam placement in relation to other physical elements in the landscape was also examined including distance to nearest creek, proximity to other dams and area of native canopy cover within a 1km radius. Total number of amphibian species recorded at each dam ranged from zero through to seven with a mean of 3.5. Preliminary analysis using Restricted Maximum Likelihood (REML) indicate a positive relationship between species richness and extent of aquatic and riparian vegetation cover, as well as the amount of native canopy cover in the surrounding landscape. Five natural waterbodies were also surveyed with differences found between species recorded at these sites in comparison to dams surveyed in the study. This has prompted the hypothesis that farm dams do not provide suitable habitat for all pond breeding species still occurring in this agricultural landscape.

Spoken Paper*, Saturday, 12:15

M. O'Shea, C. Hocking, A. Reiss and S. Russell

School of Life Sciences and Technology, Victoria University of Technology, VIC.

The potential of harmonic direction-finder technology for monitoring the Striped Legless Lizard *Delma impar* and other small reptiles in the field.

The Striped Legless Lizard *Delma impar* is listed as a nationally threatened species. Habitat destruction and degradation have been identified as the main processes threatening the long-term survival of this species. Since an initial investigation into the conservation biology of the Striped Legless Lizard in 1990, ongoing research has been hampered by its cryptic habit. A better understanding of habitat utilisation and the home range of the species would assist with the development of conservation programmes. However, only low recapture rates have been recorded in pit-fall trapping surveys. The small size of the animal has, until now, precluded the use of conventional tracking methods. Harmonic direction-finders have previously been used for monitoring the movements of small animals, including invertebrates. Recent reductions in the size of tags, has enabled movements of juvenile Sharp-tailed Snakes *Contia tenuis* to be studied (Engelstoft et al, 1999). This presentation outlines the method of implantation of harmonic direction-finder tags into Striped Legless Lizards, which have a maximum snout-vent length of approximately 100mm. Recent improvements in this technology and proposed methods for collecting field data on the movements of the species, are also included.

Poster.

R. Paltridge and T. Nano

Parks & Wildlife Commission NT, NT

Cohabiting burrowing frogs in the Tanami Desert.

The emergence of large numbers of desert frogs after rainfall has been well documented, but the lives of these frogs during the intervening dry times is relatively unknown. This presentation reports on the fossorial habits of two species of burrowing frogs, *Notaden nichollsi* and *Uperoleia micromeles*, in the Tanami Desert. *N. nichollsi* is a favoured food source for Aboriginal People in this area, and we were fortunate to have the opportunity to learn about these frogs from Warlpiri Traditional Owners. *N. nichollsi* and *U. micromeles* were found living together in large communal burrows containing up to 80 frogs. The burrows were approximately one metre deep. Possible advantages of this cohabitation will be discussed.

Spoken Paper*, Saturday, 13:30

R. Palmer¹ and S. Pidcock²

¹Department of Zoology, University Of Queensland, QLD; ²Marine Group, Environment Australia, ACT

The return of long-necked turtles (*Chelodina longicollis*) to their point of capture following a year in captivity: implications for animal ethics committees.

Animal ethics committees often request the return of wild caught common vertebrate species to the place of capture following non-invasive research rather than euthanasing the animals. The long-term implications of these actions on the returned individuals and on the wild population are poorly understood, especially for herpetofauna. The artesian boredraains of western Queensland supply water for stock, and also provide an ideal habitat for long-necked turtles. In January 1993, approximately 28 adult turtles were removed from two boredraains and transported to the Zoology Department UQ. These turtles were the subjects of a non-invasive honours project on osmoregulation. Twenty-two turtles were returned to their general point of capture in December 1993. On release, each turtle was measured and individually marked by shell notching. Forty-one wild turtles were also captured and marked in the same sections of boredrain for comparison. Since 1993, monitoring has continued on an annual basis. Data on weight, growth and position were collected from marked individuals. We will provide a detailed description on the survivorship, growth and movement of these two groups of turtles and discuss some of the issues surrounding the return of common species to the wild after a long period in captivity.

Spoken Paper, Sunday, 14:30

D. J. Rogers

Department of Environmental Biology, University of Adelaide, SA

Individuality of advertisement and territorial calls in the Australian frog *Pseudophryne bibroni*: potential for censusing individuals.

Pseudophryne bibroni is a small terrestrial *Uperoleia* and *Cyclorana* use a stiff-footed mode of burrowing, unlike the burrowing mode in *Heleioporus*, *Limnodynastes*, *L. ornatus* and *L. spenceri*, *Neobatrachus*, *Notaden*, and the pelobatids.

Spoken Paper, Friday, 16:15frog inhabiting the south-east of Australia, the males of which call from burrows, both to attract females and maintain territories. This study investigates the capacity for using advertisement calls of *P. bibroni* to census and monitor frog individuals, through the analysis of individually distinct call features. Discriminant analyses revealed that, for 40 individuals, 80% of individual calls were correctly classified. Given the high level of call individuality in *P. bibroni*, the potential exists for advertisement calls to be used to identify frog individuals. A system based upon these results is currently being developed, which should provide a practical, field-based method of individual frog identification based on call, allowing the long-term monitoring of frog populations without the necessity for more invasive identification techniques.

Spoken Paper*, Saturday, 09:15

J. D. Scanlon¹, M. S.Y. Lee¹ and D. J. Barrie²

¹Department of Zoology, University of Queensland; ²1 George Terrace, Coonalpyn, SA.

Snake phylogeny and the affinities of Madtsoiids

Madtsoiids were one of the earliest groups of snakes to appear, and are represented by abundant postcranial remains from the Cretaceous to early Tertiary of Africa, Madagascar, Europe, South America and Australia. Surprisingly, however, their affinities remain uncertain because of lack of adequately studied cranial material; thus, their implications for snake origins remain unknown. New and previously identified cranial and postcranial material demonstrates that *Wonambi*, from Pleistocene cave deposits in southern Australia, was a late-surviving member of this enigmatic snake family. Phylogenetic analysis demonstrates that *Wonambi* (and thus madtsoiids), *Pachyrhachis* and *Dinilysia* all fall outside the clade comprising all living snakes, i.e. below scolecophidians and 'anilioids'. Deletion tests demonstrate that the position of scolecophidians above the three fossil forms is not the result of convergence with anilioids "pulling" them up the tree. Thus, despite its late age (which might have overlapped with human history in Australia), *Wonambi* is among the most primitive snakes known and is almost as basal as the Cretaceous forms *Pachyrhachis* and *Dinilysia*. None of these primitive snake lineages shows features associated with burrowing, so the widely-held 'subterranean' theory of snake origins is refuted. Fossorial snakes (scolecophidians and anilioids) must have evolved their burrowing adaptations after the origin of the snake body form and jaw apparatus in a surface-active, or possibly aquatic, ancestor.

Poster.

J. Schulte

Department of Biology, Washington University, MO

Evolutionary ecology and phylogenetics of the iguanid lizard genus *Liolaemus*.

The South American iguanid lizard genus *Liolaemus* is the second most speciose lizard genus in the world. Species exhibit great diversity in ecology and life history. In many areas there can be up to 5 species in sympatry and almost half of the 160 species are viviparous. The evolution of these characters requires a phylogenetic framework. A hypothesis of multiple origins of viviparity in *Liolaemus* is presented and tested. Preliminary work on the ecology of *Liolaemus* assemblages will also be discussed.

Spoken Paper, Sunday, 15:15

T. J. Schultz, J. Webb and K. A. Christian

Biological Sciences, Northern Territory University, NT

The energetics of reproduction in a viviparous snake, *Acanthophis praelongus*.

As part of a broad field study of energetics and thermoregulation in northern death adders, *Acanthophis praelongus*, we measured the partitioning of energy throughout the reproductive cycle in order to ascertain the cost of pregnancy in this viviparous species. Death adders provide most of the

embryo's nutrients in a large yolk (lecithotrophy) which is gestated over 5-6 months. Gas exchange occurs across the placenta, and the increase in oxygen consumption due to embryo metabolism must be met by increased maternal respiration. We measured the metabolic cost of pregnancy in mid-late term adders, and metabolism after birth in mothers and newborns. Metabolism of pregnant adders increases dramatically, and tends to plateau, 20 days before parturition, indicating rapid development and increased metabolism of the embryos. The increase in maternal metabolism is above that expected for a given increase in maternal mass, suggesting that the metabolism of the embryos does not scale directly with maternal mass. The metabolism of a newborn is substantially higher than an embryo; in fact the total metabolism of a newborn clutch is greater than that of the mother, despite being less than one half the mass. Female metabolism decreases immediately post parturition, and continues to slowly decrease after one week. In terms of energy flow in populations, it is important to recognise that the energy demands of pregnant females are disproportionately high.

Spoken Paper, Monday, 10:30

A. W. Scott¹, S. J. Keogh¹ and M. Whiting²

Department of Botany and Zoology, Australian National University, ACT; ²Department of Animal, Plant & Environmental Sciences, University of the Witwatersrand.

Relationships among members of the southern African lizard genus *Platysaurus* (Cordylidae): Evidence from the mitochondrial ND4 gene.

The genus *Platysaurus* has speciated explosively in Zimbabwe and adjacent areas of South Africa, Botswana, Malawi and Mozambique. Fifteen species are presently recognised, many of which have local races. Taxa are often identified by male breeding colours, which makes identification of females and juveniles difficult. However, given that few taxa are sympatric, identification of species can be made according to locality. Despite this, relationships amongst members of the genus are poorly understood. As part of a larger collaborative effort examining the evolution of mating systems and behaviour a well resolved phylogeny for the group is necessary. A preliminary phylogeny for 13 taxa has been generated using data from the mitochondrial ND4 gene. This phylogeny has revealed not only a) several taxonomic inconsistencies, but b) a substantial phylogeographic signal which divides the genus into eastern and western geographic groups, a finding consistent with palaeogeographic evidence

Spoken Paper, Friday, 16:45

M. Scroggie

Department of Zoology, University of Melbourne, VIC

Variation in mating success of male *Geocrinia laevis*, *G. victoriana* and their natural hybrids.

The mating success of individual male *Geocrinia* (defined as the number of egg masses deposited in an individual male's territory during the course of a breeding season) was assessed during the 1997 and 1998 breeding seasons. Observed variation in male reproductive success in populations of this species complex was moderate when compared to published values for a variety of anurans. There were no differences in variation in male mating success between populations of *G. laevis*, *G. victoriana* or a population near the centre of a hybrid zone between the two species. With the possible exception of very small, non-territorial males, mating success of males was unrelated to body size. The relationships between advertisement call traits and mating success in *G. laevis* and in the hybrid population were assessed during the 1998 breeding season. The pulse rates of repeated notes in advertisement calls were apparently unrelated to observed mating success in *G. laevis* or hybrids. These results suggest that within the hybrid zone, sexual selection on male advertisement call traits that differ between the two species is not particularly intense. Such a conclusion is consistent with the consistently high levels of variation in advertisement call traits that have been encountered in hybrid populations of this species complex.

Spoken Paper*, Saturday, 11:00

F. Seebacher and G. C. Grigg

Department of Zoology and Entomology, University Of Queensland, QLD

Heart rate and body temperature in goannas (*Varanus varius*): thermoregulation?

Thermally induced changes in heart rate and blood flow in reptiles are believed to be of selective advantage by allowing animals to exert some control over heating and cooling. Hence, 'set-point'

thermoregulators, which goannas are believed to be, could increase heart rate and blood flow during basking to accelerate rates of heating, and decrease heart rate in a cooling environment to prolong the time spent at a high Tb. We measured environmental variables, and heart rate, body temperature (Tb), and behaviour in six goannas in the wild. When environmental conditions were favourable, goannas emerged to bask in the morning after which they were actively moving for most of the day until retreating into a shelter in the evening. Heart rate during heating (basking) was significantly faster at any given Tb than heart rate during cooling (shelter), confirming that heart rate hysteresis does occur in undisturbed animals in the wild. During the day, Tb of active goannas fell between 33 - 36°C, implying thermoregulation. However, there was no indication that lizards 'shuttled' between sun and shade. We used a mathematical model to predict the Tb of randomly moving goannas under field conditions. Using indices from the recent literature which define thermoregulation, we show that randomly moving goannas 'thermoregulate' as well as 'real' goannas in the field. These results may call for a rethink of 'set-point' thermoregulation.

Spoken Paper, Friday, 17:15

G. M. Shea

Department of Veterinary Anatomy and Pathology, University of Sydney, NSW

Nomenclatural nightmares in a skink paradise: preliminary results from a revision of the genus *Sphenomorphus* in New Guinea and the Solomon Islands.

Sphenomorphus is the largest genus of skinks in New Guinea and the Solomon Islands, with 75 names proposed for what most recent checklists list as 54 recognised species. However, apart from some revisionary work by Allen Greer and Fred Parker between 1967 and 1979, the genus has not been revised in the region since Rooij's monograph on the lizards of the Indo-Australian Archipelago in 1915. Even the modern concept of *Sphenomorphus* is the product of neglect: it is the residue of species left when Mittleman (1950) split the even larger genus *Lygosoma*, with species assigned to *Sphenomorphus* mostly on the basis of original descriptions. This paper summarises the first results of a revision (in collaboration with Allen Greer) of *Sphenomorphus* in New Guinea and the Solomon Islands, with a reduction in the number of recognised named species. Several nominal species previously known only from poorly-known type specimens have proven to be synonyms (sometimes senior synonyms) of other better-known species, one species is based on a mislocalised Asian type specimen, and seven species do not belong in the genus *Sphenomorphus*, even in its present broad and undefined state. Even the type species of *Sphenomorphus*, *S. melanopogon*, poses nomenclatural problems.

Spoken Paper, Monday, 9:15

R. Shine¹, P. Harlow¹, M. P. LeMaster², I. T. Moore² and R. T. Mason²

¹School of Biological Sciences, University of Sydney, NSW; ²Oregon State University, OREGON, **Boys will be girls: transvestites in the snake den.**

Snakes on the Canadian prairie indulge in cross-dressing as well as group sex. In large mating aggregations of red-sided gartersnakes (*Thamnophis sirtalis parietalis*) in Manitoba, some males (she-males) act as female mimics. By producing female-like pheromones, they attract vigorous courtship from other males. She-males are common, and are not simply males that have rubbed against females. Mating trials reveal remarkable subtlety within the superficially chaotic mating balls. For example, she-males are mostly courted by small (young) males rather than by larger animals, and the she-males themselves court intensely only when the probable pay-off is high (i.e., in the presence of large females and the absence of large rivals). Contrary to previous studies, she-maleness is not an alternative strategy pursued by a subset of males. Instead, most or all-male snakes in this population pass through a brief (< 48 h) she-male phase immediately after emerging from hibernation. During this recovery period, they are weak and slow, and thus cannot compete successfully for matings. Producing female-like pheromones may confuse other males during this period, and also tends to switch off the she-male's own courtship.

Spoken Paper, Sunday, 9:00

L. P. Shoo¹, J. M. Hero¹ and H. B. Hines²

¹School of Environmental and Applied Science, Griffith University - Gold Coast, QLD; ²Conservation Resource Unit, Queensland Parks and Wildlife Service, QLD

Differences in macrohabitat associations among three species of *Mixophyes* (Anura: Myobatrachidae) in southeast Queensland.

Factors limiting the distribution of common and endangered species of *Mixophyes* (Anura: Myobatrachidae) are not known. An investigation of the macrohabitat occupied by three closely related species individually and at sympatric sites was undertaken. Habitat data for 31 stream locations occupied by the three species were generated from maps and other published material. An ordination vector for habitat was then used to rank sites to maximise the overall difference in species composition. Minimum rainfall in the driest quarter, altitude and upstream catchment area were habitat characteristics used to differentiate between stream locations occupied by the two endangered species, *M. iteratus* and *M. fleayi*. Habitat occupied by *M. iteratus* is characterised by large catchments at low to mid-altitude which are subject to low levels of rainfall. In contrast, *M. fleayi* occupies the upper reaches of catchments at high altitude with variable levels of rainfall in the driest period. The observations suggest that the spatial resource is partitioned strongly between these two species. The relationship between resource partitioning and the coexistence of *M. fasciolatus* with its congeneric species, however, is less clear. *Mixophyes fasciolatus* displays a relatively broad tolerance to the habitat gradient measured in the study. Habitat appears to explain much of the variation in species composition within the genus. However, the mechanism for the observed differentiation in habitat use is yet to be determined.

Spoken Paper, Sunday, 11:00

J. Shoulder and F. Lemckert

Forest Research and Development Division, State Forests of NSW, NSW

The diets of three species of barred frogs (Genus *Mixophyes*).

We dissected preserved specimens of the southern barred frog (*Mixophyes balbus*), great barred frog (*M. fasciolatus*) and giant barred frog (*M. iteratus*). These are sympatric species and we wished to determine if they are dietary specialists and to what degree their diets overlap. Each species was found to take a wide range of prey invertebrates. Relatively large invertebrates such as crickets and spiders formed the major components of their diets and very small (<5mm) food items were only rarely present in their guts. Frogs were found in the gut of one giant and one great barred frog and these were the only vertebrates recorded in this study. The diets of each species appeared to broadly overlap and there was no obvious preference by either of the three species for one particular prey type. All three species appear to be dietary generalists that consume anything able to be subdued.

Spoken Paper, Monday, 11:30

M. Smith and D. D. Roberts

Department of Zoology, University of Western Australia, WA

Selection on call structure in the frog *Crinia georgiana*.

Male *Crinia georgiana* call in small groups of 2 - 10 males. We compared call structures of males who mated with those who did not: a) within groups and b) with mated versus unmated males treated as two groups irrespective of group origin. Selection in this mating system may result from both male-male interactions and female choice. Selection gradient analyses showed males with higher calling rates, higher pulse numbers or both were more likely to mate: these call characters were subject to directional selection. Other call properties investigated, note number and dominant frequency, were not subject to selection. Note number and call rate were dynamic, and pulse number and dominant frequency, static properties. These results contrast with Gerhardt's prediction that static properties of frog calls should be under stabilising selection and dynamic properties under strong directional selection. These data will be discussed in the context of the evolution of mating tactics in *Crinia georgiana* and other studies on selection on call structure in frogs.

Spoken Paper, Saturday, 12:00

S. Smith

Evolutionary Biology Unit, South Australian Museum, SA

How many nodes is enough? Inferring evolutionary change in reproductive mode.

Phylogeny based comparative tests are widely recognised as the most appropriate way to address questions about the evolutionary origins of organismal traits. However, even when a robust phylogenetic hypothesis is available, inferring the history of a particular trait is not always straightforward. I will discuss this problem in relation to reconstructing the evolutionary history of reproductive mode in reptiles.

Spoken Paper*, Sunday, 8:30

R. J. Spencer

School of Biological Sciences, University of Sydney, NSW

Hatch or wait: a dilemma in Chelonian incubation.

Animals often form groups to reduce the risk of predation through the per capita dilution of their individual predation risk. The advantages of grouping also influence the timing of reproduction in many species. In particular, synchrony in the timing of births may have evolved as a predator-avoidance strategy as it dilutes the risk of predation upon vulnerable newborn and naive young. Eggs of an Australian freshwater turtle, *Emydura macquarii*, can hatch synchronously despite developmental asynchrony among eggs of a clutch and hatchlings have a reduced predation risk by emerging from the nest as a group. Developmental asynchrony within clutches was induced to reflect natural nests by dividing clutches and incubating them at either 25°C or 30°C. Some eggs were then reunited with their clutch-mates and hatching occurred synchronously in some of these groups. In groups where synchronous hatching did not occur, less advanced eggs still hatched earlier than the normal incubation period. Synchrony occurred because the less advanced eggs hatched up to five days earlier than the control embryos. Hatchlings were also placed in excavated turtle nests as groups and individually. Relatively fewer hatchlings in groups were killed by predators, because hatchlings may have a degree of defence against avian predators, at least until other members of a clutch have entered the water. Thus, we conclude that the less advanced embryos within a clutch either accelerate their development or hatch prematurely to ensure synchrony of hatching because predation risk upon emergence is reduced via the 'dilution' effect.

Spoken Paper*, Sunday, 12:00

R. J. Spencer

School of Biological Sciences, University of Sydney, NSW

To catch a turtle and fool a fox

Freshwater turtles rival fish in their biomass in the River Murray system, but predation from foxes may severely reduce juvenile recruitment. I determined the spatial distribution and efficient capture techniques of the freshwater turtle, *Emydura macquarii*, in the Upper Murray River. I also compared habitat variables of nests of *E. macquarii* to determine properties that may allow a nest successfully avoid predation, as well as evaluating cues used by avian and terrestrial predators to discover turtle nests. More *E. macquarii* were captured in permanent ox-bow lagoons than in lakes or the mainstream of the River, and the capture rates per trapping session were also more consistent. Additionally, the placement of decoy turtles in hoop traps increased capture rates significantly. Lagoons are more productive and much warmer than other habitats and can support greater densities of turtles than either lakes or the River. *Emydura macquarii* are able to produce viable eggs much earlier in lagoons than in lake populations and thus may have a longer nesting season when conditions are most favourable or to produce multiple clutches. Females that nest a medium distance away from the water, far from trees during the day and in sand are more likely to be left intact than nests in other areas. Nests that are not in the immediate vicinity of another nest also have a greater chance of survival and foxes are able to detect nests by both smell and slight soil disturbance.

Poster.

J. R. Stewart¹ and M. B. Thompson²

¹Department of Biological Sciences, East Tennessee State University, Tennessee; ²School of Biological Sciences, University of Sydney, NSW

Yolk sac placentation of lizards of the genus *Pseudemoia*.

The lizard genus *Pseudemoia* contains some of the most highly placentotrophic species of squamate reptiles. The chorioallantoic placenta of these species is unusual in having a specialized region termed the placentome. Structural attributes of the chorioallantoic placenta have been known for seventy five years and because it is a unique structure, the placentome recently has been suggested as a synapomorphy for the genus. The presence of these two highly unusual characteristics has led to speculation that the placentome has a prominent role in the evolution of placentotrophy. Recently, a specialized omphaloplacenta has been found in species within this genus. The embryonic epithelium of the omphaloplacenta is cuboidal or columnar and the apposing uterine epithelium is folded and consists primarily of columnar cells. Vascular support for the omphaloplacenta is unusual compared to many species of placental squamates because the epithelium is directly apposed to the highly vascular yolk sac splanchnopleure. This structural profile does not differ from the defining characteristics of the placentome. The similarity between these two placental sites suggests that if the placentome is a significant site of nutrient transfer, the yolk sac placenta must also be an important site. Future models for the evolution of placentotrophy among species of the genus *Pseudemoia* must address the functional role of both the omphaloplacenta and the chorioallantoic placenta.

Spoken Paper, Sunday, 9:30

C. A. Streatfeild and J. M. Hero

School of Environmental and Applied Science, Griffith University - Gold Coast, QLD

Spatial movements of the endangered Giant Barred River Frog (*Mixophyes iteratus*) and the common Great Barred River Frog (*M. fasciolatus*).

Understanding how frogs utilize their habitats is important for effective conservation management. We radio tracked and spool tracked two *Mixophyes* species in south-east Queensland: the endangered Giant Barred River Frog (*M. iteratus*) and the common Great Barred River Frog (*M. fasciolatus*) between January and July 1999 to determine the use of riparian space and daily movement patterns. Total distance moved in twenty-four hours whilst less, was not significantly different for male *M. iteratus* than male *M. fasciolatus*. The displacement (straight-line distance) between successive diurnal retreat sites was significantly smaller for male *M. iteratus* than male *M. fasciolatus*. Both total distance and displacement between successive diurnal retreat sites, were less for female *M. iteratus* than female *M. fasciolatus* however, insufficient replication did not permit statistical analyses. Both male and female *M. iteratus* inhabited significantly more exposed shelter sites which were located closer to the stream than male and female *M. fasciolatus*. Most individuals of both species remained in close proximity to the stream however some individuals moved up to 142 metres away from the stream. These results suggest existing buffer zones are inadequate for the protection of *Mixophyes* species in eastern Australia.

Spoken Paper, Sunday, 13:45

Devi Stuart-Fox and Ian P. F. Owens

Department of Zoology & Entomology, University of Queensland, Brisbane, 4072.

Correlates of species richness in agamids and chamaeleons.

Many intrinsic and extrinsic characteristics of organisms and their environment have been suggested as promoters of cladogenesis. We use phylogenetic comparative methods to test for an association between a number of these characteristics and species richness in a reptilian group, the acrodonts (Agamidae and Chamaeleonidae). In contrast to patterns found amongst bird families, we found no evidence that species richness is correlated with indices of sexual selection. Furthermore, we found no support for other traditional explanations of differences in rates of cladogenesis amongst lineages such as body size, life-history, indices of ecological specialisation or occurrence in particular habitats. Species richness is, however, significantly negatively correlated with latitudinal range, though not latitude per se. These results pave the way for experimental manipulations or field-based tests of possible mechanisms.

R. Swain

Department of Zoology, University of Tasmania, TAS

Facultative placentotrophy helps maintain neonate fitness when birth is delayed in the metallic skink.

Embryonic nutrition in the viviparous skink, *Niveoscincus metallicus*, is mainly lecithotrophic, with some obligate provision of electrolytes. However, in addition there is the capacity to supplement embryonic nutrition through facultative placentotrophy (FP). Previous experiments have established that one role for FP is to supplement embryonic fat reserves when the opportunity arises. These reserves presumably facilitate survival in the relatively short pre-hibernatory period available to newborn animals. Our data indicate that they also play a vital role in maintaining pre-natal condition if birth is delayed by adverse weather, a common occurrence in this species. In such circumstances the yolk is used up well before birth and the placental membranes have degenerated by this time, so the embryo must survive on its own reserves. The consequences of delayed birth for neonatal fat reserves, neonate condition, and postnatal growth and performance capacity are documented. FP appears to be a uniquely squamate adaptation that provides flexibility in embryonic nutrition, enabling offspring fitness to be optimized in an unpredictable temperate climate

G. Thompson¹ and E. Pianka²

¹Centre for Ecosystem Management, Edith Cowan University, WA; ²Department of Zoology, University of Texas at Austin, Texas

Allometry of clutch and neonate size in goannas.

Varanus vary greatly in body mass and are therefore a useful genus to explore the influence of adult body size on egg, clutch and neonate size. Data on goanna reproduction, clutch and neonate size, incubation time and temperature have been accumulating progressively in the literature over the last 20 years. We present an analysis of data from two primary sources; captive-bred varanids and field observations, most of which comes from the available literature. Incubation time for varanid eggs is positively correlated with egg mass ($r^2 = 0.34$), neonate snout-to-vent length (SVL) ($r^2 = 0.53$) and maximum adult SVL ($r^2 = 0.51$). Incubation period of heavier eggs is proportionally less than for smaller eggs at 30 °C. Individual egg mass was positively correlated ($r^2 = 0.79$) with maximum adult SVL and has positive allometry (max. adult SVL \gg 1.6). Neonates of larger species have longer SVL, however, they have smaller SVLs as a proportion of maximum adult SVL than for smaller species; negative allometry (max. adult SVL \gg 0.54). Clutch sizes are larger and more variable for larger species, however, clutch sizes for larger species relative to maximum adult SVL are smaller than for the smaller species; negative allometry (max. adult SVL \gg 0.78). The intraspecific influence of maternal SVL is greater than the interspecific influence of maximum adult SVL on clutch size.

K. Thumm and M. Mahony

Biological Sciences, The University of Newcastle, NSW

The evolution of repeated breeding in the red-crowned toadlet, *Pseudophryne australis*.

Intensive field and laboratory studies have revealed that the red-crowned toadlet breeds in every season (iteroparous), in spite of inhabiting an uncertain environment in a temperate area, conditions which generally are considered to favour selection for annual breeding (semelparous) organisms. Females and males are active throughout the year, with individual females returning gravid to the breeding area several times a year. Males are territorial and call all through the year from nesting sites. Oviposition has been recorded in the field in all months of the year except June. In captivity one female laid 28 clutches over a period of 4 _ years. This almost continuous breeding capacity and frequency of oviposition is unusual for temperate frogs as is shown by the majority of frogs found in the Sydney region, the area in which the species is found. Only two other species *Crinia signifera* and *Limnodynastes peronii* also breed throughout the year. We postulate that selection for continuous breeding is the result of the low survival of juveniles. Low survival rates during the egg and tadpole stages are related to the ephemeral conditions in which breeding occurs, and the unpredictability of rainfall, the resource required for offspring survival. It appears that among the adaptations to breeding in ephemeral situations, natural selection has led to a life history that is markedly different to most other frogs in eastern Australia.

M. B. Thompson¹ and N. Nelson²

¹School of Biological Sciences, University of Sydney, NSW; ²School of Biological Sciences, Victoria University of Wellington, N.Z.

Nesting rookeries of tuatara on Stephens Island.

We have been studying nests of tuatara, *Sphenodon punctatus*, in the pasture on Stephens Island where females congregate to nest in rookeries. We have been unable to detect any difference in the physical features (slope, aspect, vegetation cover, presence of rocks) of rookeries and areas not used for nesting. Here we propose that social facilitation results in the formation of rookeries. Incubation of eggs in natural nests take about a year and the inter-nesting interval of females is about 4 years. Complete nest failure is about 20%. Nest construction may take many days, or even weeks, and the spoil of nests under construction frequently contains eggshell from previously hatched egg. We propose that the females are somehow able to locate nests that have been successful, and they re-excavate the nest as their own. The presence of one female digging in such an area then attracts other females to that site. Furthermore, our recent observations suggest that many nests hatch prior to the next nesting season and that hatchlings are frequently entrapped in quite hard soil. We suggest that females in subsequent years excavate and release hatchlings from at least some nests, suggesting the possibility that vocal communication by hatchlings is a mechanism by which females can locate successful nest sites.

Spoken Paper, Friday, 17:00

C. L. Tyrrell¹, A. Cree¹ and K. Newgrain²

¹Department of Zoology, University of Otago, ; ²Wildlife and Ecology, GPO BOX 28 Canberra, ACT

Field metabolic rates in female tuatara (*Sphenodon punctatus punctatus*) on two islands following rat removal.

We used the doubly-labelled water method to compare field metabolic rates (FMR) in free-ranging, non-gravid female northern tuatara between two islands from which introduced rats (*Rattus exulans*) had been eradicated. Mean FMR of females on Lady Alice I. (3 years post-eradication, mean \pm SE = 0.049 \pm 0.004 ml CO₂ g⁻¹h⁻¹, n = 7) was significantly higher (p < 0.05) than on Coppermine I. (3 months post-eradication, 0.036 \pm 0.003 ml CO₂ g⁻¹h⁻¹, n = 10). Males and non-gravid females also had higher body condition (ln body mass/SVL) on Lady Alice I. than on Coppermine I. However, there were no differences in water influx and efflux rates between the two islands (p > 0.05). The significant differences in physical condition and energetics of female tuatara between islands were consistent with an increase in food consumption for tuatara following rat removal. Further studies across a wider range of tuatara islands would help determine the consistency of this association. The FMR technique may be useful as an indicator of the relative ecological impact of introduced mammals on tuatara and other rare reptiles. FMRs of female northern tuatara are the lowest reported for active reptiles, and probably reflect the lower normal activity temperatures of tuatara compared to other reptiles.

Spoken Paper, Sunday, 11:15

B. Waldman¹, G. H. Rodda² and J. S. F. Lee¹

¹Department of Zoology, University of Canterbury; ²USGS Midcontinent Ecological Science Center, Colorado.

Do sympatric anurans have convergent release calls?

Male anuran amphibians often produce vocalisations to attract mates and sometimes to defend territories. Among those species that breed "explosively", males appear to indiscriminately approach and clasp males, females, and even inanimate objects while searching for a mate. When a male clasps another male, the clasped individual gives a release call to effect its release. Often, more than one species will be simultaneously active in a breeding pond. In such multi-species breeding congregations, interspecific clasps occur and these too may elicit effective release calls. As previously suggested by Brown and Littlejohn (1972) and Rand (1988), one might expect release calls of sympatric species to show convergent properties because male-male clasping is unproductive whether it occurs between conspecifics or heterospecifics. We tested this hypothesis by comparing release calls of sympatric species co-occurring in breeding aggregations (*Bufo americanus*, *Rana*

sylvatica, and *Rana pipiens*) to each other and to those of an allopatric species (*Bufo boreas*). Sympatric species were more similar to each other than to allopatric species in call duration, intercall interval, and pulse frequency, but not in dominant frequency or number of pulses per call. Call characteristics of sympatric species, even across generic lines, were more similar to each other than to those of allopatric congeners. These results suggest that similarities among the sympatric species are due to convergence rather than to conservative evolution.

Poster.

J. Webb¹, K. Christian¹ and R. Shine²

¹Biological Sciences, Northern Territory University, NT; ²School of Biological Sciences, University of Sydney, NSW

Maternal effects and genetic influences: determinants of offspring phenotype in a viviparous snake from tropical Australia.

Studies on reproduction in reptiles have revealed strong maternal effects on offspring morphology, locomotor performance, and behaviour. That is, most variation occurs between rather than within litters. To what degree do these maternal effects reflect genetic factors, rather than proximate environmental influences (e.g., maternal thermoregulation or food intake during pregnancy) or gene x environment interactions? To investigate this question we measured offspring phenotypes in a viviparous elapid snake, the northern death adder (*Acanthophis praelongus*) from tropical Australia. To detect paternal (= purely genetic) influences on offspring phenotypes from maternal effects (genetic plus environmental effects), we used a full-sib, half sib design whereby each of 7 males was mated to 4 different females. Gravid females were kept in identical outdoor cages (temperature range 24-36°C) and fed 2 mice per fortnight. We measured size (SVL, TL, sex, mass) and swimming speed of 531 neonatal death adders from 24 clutches. We found strong maternal effects on all offspring traits (body size, shape, swimming speed, anti-predator behaviour), whereas paternal effects only influenced swimming speed and anti-predator behaviour. In our population, free-ranging gravid females (tracked via radio-telemetry) remained on floating grass mats during wet season flooding, and gave birth to young during late March. Depending on the degree and duration of wet season flooding, female death adders can give birth in flooded areas or on dry land. Thus, in natural populations, offspring traits (body size versus swimming speed, antipredator behaviour) may respond quite differently to episodes of natural selection.

Spoken Paper, Saturday, 11:30

B. Wong

Division of Botany and Zoology & Research School of Biological Science, Australian National University, ACT

Cold and psychic in Canberra: Effects of temperature and rain on acoustic signalling in the common eastern froglet, *Crinia signifera*.

This study sought to examine the effects of various environmental and social factors on acoustic signalling for three populations of the common eastern froglet (*Crinia signifera*) in the A.C.T. The number of frogs calling and the relative intensity of calling were used as measures of calling activity. This calling activity was monitored from the beginning of April through to early September in order to determine the population response to temperature and rain. During field visits, the calls of individual frogs were also recorded. Various spectral and temporal components of the calls were then measured or calculated in order to gauge the response of the individuals themselves. Frogs were heard calling at microsite temperatures ranging from 5 to 21°C. However, calling activity was greatest in the temperature range 8 - 11°C. The calling season commenced in early May, reached peak calling activity in mid-winter before declining in late winter. Temperature was found to co-vary with the progression of the season with the result that any direct effect of temperature was confounded by seasonal change. Attempts to isolate the effects of temperature by conducting experiments under controlled conditions proved unsuccessful. The imminence of rain was found to have an effect on calling activity with more animals recorded calling if rain fell in the two days after a field visit. Rainfall also had an effect on individual call rate. Specifically, frogs call at higher rates after rain presumably in response to the availability of water and the presence of gravid females.

Abstracts from the 28th AGM of ASH Gumleaves, Tasmania 2001

Ross A Alford and Martin Dziminski

School of Tropical Biology, James Cook University, Townsville, Queensland 4811

Intraclutch variation in egg provisioning in tropical Australian frogs: its consequences for larval ecology

An extensive survey documented the clutch parameters (number of eggs and mean and variability of yolk volume) of over 150 batches of eggs of 15 anuran species occurring in tropical savanna woodlands near Townsville. Laboratory growth experiments determined the effects of initial yolk volume on growth patterns in four species. Intraclutch variation in yolk volume occurred to some degree in all species surveyed. Some species have low and some species have high intraclutch variation in yolk volume but all species in which some clutches are highly variable also produce clutches with low variability. The occurrence of high intraclutch variation does not appear to be phylogenetically constrained, but may be related to ecology and possibly to body size. This suggests that elevated intraclutch variation in yolk volume has probably evolved more than once. Under benign laboratory conditions tadpoles from eggs with larger yolk volumes hatched at larger sizes and this size difference persisted through a substantial proportion of the larval stage. This study showed that intraclutch variation in yolk volume is common in a wide range of anuran species and that it has ecological ramifications which can determine larval success. This provides evidence in support of models that predict intraclutch variation in offspring provisioning should evolve in organisms that reproduce in unpredictable habitats.

Lyn Anderson^{PG} and Shelley Burgin

Centre for Integrated Catchment Management, University of Western Sydney, Hawkesbury

Skinks on the edge: the influence of edge effects on the predation of ubiquitous small skinks of the Cumberland Plain (NSW)

The fragmentation of native bushland in Australia, by removing the endemic vegetation and replacing it with an alternative ecosystem, often produces an increased number of edges. The proximity of such varying landscapes can cause abrupt, and at times brutal changes to environmental conditions, in the areas where they meet, known as edges. These edges often open the way for increased predation, disease and the invasion of non native species. The effects of these changes can reduce both the number and composition of endemic species. A previous study conducted, by the authors, indicated that the abundance and diversity of small generalist skinks differed significantly between edge and core areas of woodlands of the Cumberland Plain. The variation was shown not to be caused by the differences in habitat characteristics. It was then hypothesised that avian predation rates may increase at the edge causing the disparity in abundance and diversity. A new study was commenced, using skink 'decoys', to test this hypothesis.

Lyn Anderson^{PG} and Shelley Burgin

Centre for Integrated Catchment Management, University of Western Sydney, Hawkesbury

Skinks on the edge: the influence of edge effects on the ubiquitous small skinks of the Cumberland Plain (NSW) [poster]

Native bushland is diminishing in Australia, primarily due to human activity. These activities often result in the fragmentation of the remaining bushland, by tracts of introduce ecosystems, such as agricultural paddocks. The proximity of such varying landscapes can cause abrupt, and at times brutal changes to environmental conditions, in the areas where they meet, known as edges. These effects can in turn impact upon the native flora and fauna, resulting in the loss of both abundance and diversity. During March and April and again in September and October 1999, a study was

conducted in seven remnant woodlands of the Cumberland Plain, Richmond New South Wales, to determine the effects edges had on both abundance and diversity on small generalist skinks. The results indicated that the abundance and diversity of three skinks (*Lampropholis guichenoti*, *Lampropholis delicata* and *Cryptoblepharus virgatus*) differed between the core and perimeter of remnants ($R = 0.417$, $P < 0.029$). It was observed that the differences were not caused by habitat characteristics. Habitat variables measured were more different within the core and edge ($R = 0.343$, $P < 0.00$) than they were between them ($R = -0.021$, $P < 0.486$).

Natalia Atkins^{1hons}, Sue Jones¹ and Ashley Edwards²

¹School of Zoology, University of Tasmania; ²Department of Biological Sciences, Macquarie University

Fecal testosterone assays may not be useful for monitoring reproductive status in males of the blue-tongued lizard, *Tiliqua nigrolutea* [poster]

Fecal steroid assays offer the possibility of non-invasive sampling to establish reproductive status in animals. We have developed a technique for extraction of testosterone (T) from feces of male blue-tongued lizards. Initially the extracts contained substances that interfered with the radioimmunoassay of T; we needed to include extra purification steps in the extraction protocol to alleviate this problem. The overall mean recovery was 25 % and T was detectable in all fecal samples assayed. Differential ether/water extraction indicated that 12 % of the T measured by RIA was free steroid, with 88 % of fecal T representing conjugated steroid. The relatively high concentrations of T in feces suggest that most of the steroid is excreted via this route. Fecal T concentrations varied significantly between reproductive stages, but fecal T concentrations were lowest ($554 \pm$ standard error 129 ng g^{-1} of dry feces) in animals during the mating period, rising significantly to $1398 \pm 187 \text{ ng g}^{-1}$ in reproductively quiescent animals. This pattern contrasts markedly with the annual profile of plasma T concentrations, suggesting that fecal testosterone concentrations may not be correlated with plasma T in males of this species.

Diane P Barton, T Machado and L Schwarzkopf

School of Tropical Biology, James Cook University, Townsville

Parasites of the introduced house gecko, *Hemidactylus frenatus*, in Northern Australia

Hemidactylus frenatus was introduced to Australia, most likely in the 1970s, via shipping from South-East Asia. Its distribution throughout northern Australia is patchy, focussing on major shipping ports (Darwin, Cairns, Townsville). Despite a vast body of literature on the parasites of *H. frenatus* from outside of Australia, no study has looked at its parasite fauna within Australia. Almost 200 *H. frenatus* were collected from 7 (of 11) locations from Cairns to Mackay in North Queensland. A total of 6 parasite species were found: an external mite *Geckobia* sp., two digeneans *Paradistomum geckonum* and *Mesocoelium* sp., a cestode *Nematotaenia* sp., and two nematodes *Skrjabinodon* sp. and *Maxvachonia* sp. Eighty percent of geckoes were infected with at least one parasite, with a mean species richness of 2 per infected gecko. The potential sources of the parasites recorded from this introduced gecko in Australia are discussed.

Sara Broomhall

Biological Science, Heydon Laurence Building, University of Sydney,
NSW 2006

Short and long-term effects of temperature and pesticides on development and fitness in some Australian anurans

Does the interaction between multiple "stressful" impacts (i.e., temperature and pesticides) have different developmental effects on anurans than either stimulus operating in isolation? If so, sublethal anthropogenic influences may have unanticipated effects on population health. In the first season of this project, the effects of temperature on growth and survival at the embryo and larval stage were investigated in three frog species, in a 2x2 factorial design. There were species specific and treatment differences in survivorship. In conflict with simplistic notions of thermal effects, there

were no significant differences in time to metamorphosis, yet tadpoles in colder treatments metamorphosed as larger animals. Thus, the commonly assumed trade-off between developmental age and size at metamorphosis has somehow been modified or avoided by these animals. I also explored tadpole performance in staged encounters between *Limnodynastes peronii* tadpoles and predatory odonates (*Hemianax papuensis*). Tadpoles that had been incubated at low temperatures during the egg stage survived longer than those that were raised at warmer temperatures - irrespective of tadpole rearing temperature regime in some (but not all) experimental situations. Thus short-term thermal experience as eggs may affect larval fitness some months later.

Geoff Brown¹, Ralph MacNally² and Greg Horrocks²

¹Arthur Rylah Institute for Environmental Research, Department of Natural Resources and Environment, Heidelberg, Victoria 3084; ²Section of Ecology, Department of Biological Sciences, Monash University 3800, Australia

Reptiles and habitat fragmentation in the box-ironbark forests of Central Victoria, Australia [poster]

There are few published accounts addressing the impact of habitat fragmentation on biodiversity of terrestrial reptiles. We provide information on the saurofaunas of fragments of box-ironbark forest of central Victoria, gathered over three years. Data for fragments of four size-classes (10, 20, 40, 80 ha) are compared with similar information for 'reference areas', sites of the same size-ranges but set within large blocks of continuous forest (> 10 000 ha). These comparisons are used to differentiate fragmentation effects from normal species-area relationships. Two sets of data are presented: an 'extensive' set based on 68 fragments and reference areas surveyed by using transect counts and area searches; and an 'intensive' set that also included pitfall trapping, but was restricted to 17 fragments and reference areas. The reptilian fauna was both depauperate and of low general abundance. Differences in capture-rates and species richness between fragments and reference areas collectively are minor, but there are significant differences in species richness between area-classes, and there are important differences in the occurrence of certain species. The two most abundant species in reference areas were very rare in fragments, while a number of species were either in much greater numbers or only occurred in fragments. The saurofaunas are 'nested subsets' by area, with strongest nesting apparent in the intensive data-set for reference areas.

Mike Bull¹, Travis How¹, Dale Burzacott¹ and Steve Cooper²

¹Flinders University; ²Evolutionary Biology Unit, SA Museum

Why do Sleepy Lizards stay together so long?

Each spring male and female sleepy lizards (*Tiliqua rugosa*) form monogamous pairs and retain those partnerships for an average of 43 days before they split up after mating. 81% of litters were exclusively fathered by the male partner. We asked why the pairing occurred such a long time before mating. Females appear to gain advantage from the male presence through enhanced vigilance. Males may be guarding their partners from rivals, although it is not clear why they should do that for so long. Furthermore their response to challenges from a model male lizard were not impressive as a demonstration of partner defence. An alternative is that females need to be primed over an extended period to become reproductively active. However experimentally divorced females had the same hormonal surge as normally paired females, and were mated at the end of the season as frequently as paired females. Experiments conducted so far have not provided answers.

Dale Burzacott and Mike Bull
Flinders University

Juvenile Sleepy Lizards, three years to grow up and thirty years to live

The sleepy lizard (*Tiliqua rugosa*) is a large viviparous skink common over much of southern Australia. Our observations suggest this species is characterised by long-lived adults in a stable population. We estimate life span to be up to thirty years with sexual maturity being reached at three years in most cases. Females do not bear young every year and survivorship of juveniles is low. About 5 percent of the 32000 lizards captured by random encounter between 1983 and 1999 were juveniles. There are a number of unanswered questions; for example, what is the chance of reaching adulthood for a juvenile sleepy lizard? And what is the cause of mortality in juveniles?

David Chapple^{hons} and Roy Swain
School of Zoology, University of Tasmania

'Costs' of caudal autotomy in *Niveoscincus metallicus*

The locomotory, thermoregulatory, energetic and reproductive consequences of caudal autotomy were investigated in the metallic skink, *Niveoscincus metallicus*. Analysis of the energetic reserves of this species revealed that the majority (~50-75%) of its lipid reserves are stored within the tail. Most (~90%) of these caudal reserves were located within the proximal third of the tail. Examination of tail loss in natural populations revealed that autotomy usually (~70% of occasions) occurs in tail regions beyond the proximal third. Such 'economy of autotomy' was interpreted as a lipid conserving strategy that also acts to limit the time taken to regenerate the tail. However, both complete and partial tail autotomy during vitellogenesis still resulted in a reduction in reproductive investment, presumably as a result of the energetic diversion to tail regeneration. Caudal autotomy did not influence the thermoregulatory behaviour of *N. metallicus*, although locomotor performance was affected. However, the effect of tail loss on performance exhibited variation between the sexes and locomotor traits. Recovery of locomotor performance occurred within 3 months for females but not males. Overall, tail loss was found to have two main impacts on *N. metallicus*: 1) restriction of locomotor performance; and 2) depletion of energetic reserves. However, this species was found to possess several behavioural and anatomical modifications to limit the 'costs' incurred from autotomy.

Michelle Christy
Institute of Wildlife Research, School of Biological Sciences, University of Sydney

Responsible parenting: reproductive ecology of the Green and Golden Bell Frog (*Litoria aurea*)

Amphibian declines are often attributed to external or biotic factors, such as habitat depletion, predation or disease, which cause unnaturally high rates of mortality. If such processes are subsequently removed, the long-term viability of a species may then depend on its ability to recover. Such recovery can be influenced by environmental constraints, resource availability, local selection pressure and mate availability.

The determinants of reproductive success in the endangered Green and Golden Bell Frog (*Litoria aurea*) are poorly understood, and the management of the species without such information is difficult. Based on comprehensive field research and the examination of museum specimens, I report on the reproductive output of two local populations, with particular emphasis on the effect of environmental factors and possible mate choice on fecundity and mating success. The reproductive biology of *L. aurea* will be discussed in light of conservation implications for the species.

Nick Clemann¹ and Peter Robertson²

¹Arthur Rylah Institute for Environmental Research, Heidelberg, Vic 3084; ²Wildlife Profiles, West Heidelberg, Vic

Feeling drained! The decline of the Swamp Skink *Egernia coventryi* in Victoria [poster]

The Swamp Skink *Egernia coventryi* is a threatened species of scincid that occurs in southeastern Australia. This poster summarises the biology and habitat preferences of this species, and discusses survey techniques, as well as threats to and current status of the Swamp Skink in Victoria.

Jackie Wilson, J and Alison Cree

Department of Zoology, University of Otago, Box 56, Dunedin, New Zealand

Female reproductive cycle of a diurnal viviparous gecko from southern New Zealand

Previous research suggests diversity in the length of pregnancy among viviparous lizards in southern New Zealand. In the nocturnal common gecko, *Hoplodactylus maculatus*, pregnancy lasts up to 14 months in at least one population (at Macraes), whereas in some diurnal skinks it lasts only about 4 months. To help determine whether prolonged pregnancy is characteristic of viviparous geckos in general or only those that are nocturnal, we examined the female reproductive cycle of a diurnal gecko, *Naultinus gemmeus* (the jewelled gecko). This cryptic, arboreal species is restricted to southern New Zealand and vulnerable to habitat modification, so we used a non-lethal technique (palpation) to assess reproductive condition. Prior studies on *H. maculatus* show palpation to be a reliable way of distinguishing among pregnant, vitellogenic and non-reproductive female geckos. We found that mature females of *N. gemmeus* (9-17 g, 63-79 mm SVL) contained vitellogenic follicles from late autumn until spring, and were pregnant from September/October until April/May. The inference of autumn birth was supported by the appearance of neonates. *N. gemmeus* therefore has a pregnancy of about 7 months, intermediate in length between diurnal skinks and a nocturnal gecko in this region. Reproduction in female *N. gemmeus* appears annual, rather than biennial as in the Macraes population of *H. maculatus*. In fact, the time taken for embryonic development appears similar in *N. gemmeus* and Macraes *H. maculatus*, but the latter holds fully formed embryos over winter whereas the former delivers them in late autumn.

Margaret Davies, Thomas C Burton and Michael J Tyler

Department of Environmental Biology, University of Adelaide, South Australia 5005

Thumbs up - *Limnodynastes depressus* exposed

Limnodynastes depressus has been known from the holotype since 1976. Examination of newly collected and reidentified material indicates that the species can be separated readily from morphologically similar congeners *L. fletcheri* and *L. tasmaniensis* by the loss of a phalanx on the thumb, the absence of a preorbital process on the pars facialis of the maxilla and differences in the musculature of the jaw, pectoral girdle and first finger. These include the origin of m. depressor mandibulae from the dorsal fascia and the tympanic ring but with no fibres originating from the otic ramus, exposure of the anterior margin of the m. coracoradialis, and pennate insertion of mm. lumbricalis indicis brevis and flexor teres indicis on the palmar surface of the metacarpal. Advanced tadpoles reach a total length of 80 mm or more and the mouth disc has three upper (one divided) and three lower (one divided) rows of labial teeth. Larvae resemble those of *Limnodynastes fletcheri* but are generally larger. Spawn is laid as a foamy mass in water-filled depressions in the ground. The chondrocranium differs from that of *L. tasmaniensis* and *L. fletcheri* in the attachment of the processus ascendens of the arcus subocularis with the prootic.

Robert Davis

Department of Zoology, University of Western Australia, 35 Stirling Highway, Crawley, 6009

Impacts of habitat fragmentation and salinity on *Heleioporus albopunctatus* [poster]

Heleioporus albopunctatus is a widespread species with a range encompassing most of the south-west of Western Australia (WA). Although currently considered a common species, it has been suggested that it has become extinct in many areas of the West Australian wheatbelt or declined in numbers, as a result of salinity and habitat modification (Main 1990). My study involves investigations of the population ecology and genetic structuring of this species in the highly fragmented landscape of the central wheatbelt of WA. Research involves population biology of breeding populations, including dispersal, recruitment success and age structure. Preliminary indications suggest that there are a number of important core or source breeding sites important for the continued persistence of this species. Surrounding these sites are a host of satellite sites, fluctuating temporally in numbers, but with most failing to recruit in most years. It is suggested that this is due to a combination of increasing salinity of breeding sites and the forced switch to using man-made breeding sites which usually evaporate more quickly and thus lead to the recruitment failure of populations. Genetic analysis of this genetically unstudied species is being undertaken to determine genetic structuring across its range, and to examine if the effects of habitat fragmentation are manifested in genetic subdivision of the species.

Corrine de Mestre^{hons}

School of Zoology, University of Tasmania

The effect of long-term captivity stress on the Southern Snow Skink, *Niveoscincus microlepidotus*: an initial project outline [poster]

Lizards brought into captivity frequently undergo a stress response involving increased activity of the adrenal gland (i.e. increased secretion of corticosterone). However, discretion must be employed in interpreting patterns of change in plasma corticosterone concentrations because of the confounding effects of season. Snow Skinks are unusual in that they show a biennial reproductive cycle and carry full-term young through winter hibernation. This biennial cycle allows for a comparative study between groups of females in two reproductive conditions at one time, removing out the confounding effect of season. Firstly, I will determine whether a seasonal pattern of corticosterone exists in male and female snow skinks by taking blood samples from wild animals at monthly intervals and measuring plasma corticosterone by radio-immunoassay. Males and females will be collected in October, December, and February and held in captivity for 4 weeks. Six females in each of the two reproductive stages will be housed in groups of three. A single blood sample will be taken after 4 weeks to produce a blood smear for differential white blood cell counts and for analysis of corticosterone using radio-immunoassay. Due to the small size of Snow Skinks blood extraction will be limited to one sample per lizard. Males will be housed in 5 groups of 3 and 5 groups of singles. This trial was designed in order to determine if circulating corticosterone concentrations differ in male Snow Skinks housed in groups of high or low density. Preliminary results will be described in this poster.

Sean J Doody^{pg}, A Georges and JE Young

Applied Ecology Research Group, University of Canberra, ACT

The ecology and behaviour of pig-nosed turtles in the NT: challenges of the wet-dry tropics

The pig-nosed turtle of the wet-dry tropics of the Top End has proven to be unique among turtles in a number of ways, including its morphology (strictly aquatic features such as soft skin on plastron), ecology (biennial reproduction and double clutching, largest home range of riverine turtles), and behaviour (embryonic aestivation, explosive hatching). After a five-year ecological study on sex determination, reproductive biology, movements, nesting, hatching, emergence, and general behaviour, we argue that much of its uniqueness involves adaptations for, or constraints imposed by, the wet-dry climate. Specifically, we attempt to answer why pig-nosed turtles: (1) nest twice every

other year, rather than once each year (2) exhibit embryonic aestivation and explosive hatching (3) occupy the largest home ranges of riverine turtles, and (4) exhibit a female bias in home range, movements, and activity. The findings and hypotheses emerging from the study highlight the need for understanding how animals respond, in evolutionary terms, to challenges presented by dramatically contrasting seasons.

Paul Doughty

Department of Zoology, University of Western Australia, and Division of Botany and Zoology, Australian National University

Adaptive phenotypic plasticity in *Crinia georgiana* tadpoles: responses to deteriorating aquatic conditions in a species with a large egg size

In this study, tadpoles of *Crinia georgiana* were subjected to changes in aquatic conditions to determine how cues and developmental stage affect the adaptive acceleration of metamorphosis. This species has a large egg size and breeds in very shallow seeps that often dry before tadpoles have metamorphosed. Tadpoles were exposed to one of three drying treatments over a wide range of developmental stages: a decrease in water depth, a food cut-off, or both. A control group experienced constant food and water conditions throughout development, and another group of tadpoles with constant water depth were never fed. Tadpoles with constant water and food levels had long larval periods and achieved the largest body sizes compared to the other treatments. Tadpoles that were never fed completed metamorphosis at approximately the same time as tadpoles under constant conditions, although at much smaller body sizes and with higher mortality. This indicates that the large amount of maternal provisioning in the egg is an adaptation for low food conditions in nature. Almost all the tadpoles that experienced a deterioration in conditions during development completed metamorphosis earlier and at smaller body sizes than tadpoles kept in constant conditions. Patterns in growth and development suggested that changes in depth produce a stronger acceleratory response in this species than decreases in food. This supports the notion that frequent pond drying in nature selects for the means to detect and respond adaptively to cues that reliably predict future conditions.

Sharon J Downes and Dirk Bauwens

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Does the allopatric distribution of two ecologically similar lizards reflect behavioural interference?

Podarcis sicula and *P. melisellensis* are two closely related lacertid lizards of comparable body size and with similar ecological requirements. Both species occur along the Adriatic coast of Yugoslavia and on its numerous islands, but they are rarely distributed sympatrically. One common hypothesis for this trend is that the generally more robust *P. sicula* of Italian origin has invaded the range of the Adriatic *P. melisellensis*, and that on small islands where *P. sicula* gained a foothold, *P. melisellensis* has been replaced through competitive exclusion. We examined the potential for behavioural interference in hatchlings of these two species by providing a single basking site during staged encounters between pairs of conspecific lizards and pairs of heterospecific lizards. The number of encounters and levels of aggression between pairs were not significantly different among conspecific and heterospecific combinations, nor did significant variation exist among treatments in the occurrence of a clearly dominant individual. After these short-term encounters, pairs of lizards remained in their test arena for several weeks and we periodically measured body size and use of different resource sites by each individual. There was no significant variation among conspecific and heterospecific combinations in the use of sites of different thermal value. Consequently, there was no significant variation among treatment combinations in the difference in growth rates of lizards from each pair. Collectively, these data do not support the hypothesis that *P. sicula* and *P. melisellensis* are distributed allopatrically because of competitive exclusion.

Michelle M Drew^{pg}

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Amphibian community composition and relative abundances in natural and constructed wetlands [poster]

Evaluating the suitability of anthropogenic habitats to act as surrogates for the natural habitats they replace is a key issue in conservation biology. On the Swan Coastal Plain of Western Australia, constructed wetlands (including dams, mining waste attenuation wetlands) are used by numerous anurans for breeding and foraging. However, no published research in Australia, has determined whether the use of artificial wetlands, by anurans, is simply the exploitation of available habitat by a few highly adaptable "weed" species or if artificial wetlands represent habitats that can be utilised by an entire suite of frogs typically found in undisturbed, natural wetlands. By assessing the reproductive success (measured as a function of: presence of calling males, egg masses, larvae and the timing and success of larval metamorphosis) of anuran communities in constructed wetlands, I intend to determine whether artificial ponds can supplement natural wetland ecosystems. This will facilitate the provision of anthropogenic habitats for frog communities in regions where habitat clearing and degradation of remnant ecosystems has reduced or eliminated their natural habitats. Preliminary evidence, from the Capel and Mundaring regions of Western Australia, suggests that the presence of calling males is not indicative of successful breeding, with constructed wetlands apparently devoid of anuran larvae despite the presence of large populations of calling males.

Don A Driscoll

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Reptile declines in the NSW sheep-belt: management options at a landscape scale

Reptiles are small critters in general, and so are probably able to maintain large populations in small areas. In this respect they are likely to be pre-adapted to survive in remnants of vegetation in agricultural landscapes. Indeed, early research into reptiles of the Western Australian wheatbelt suggested that the sparse nature reserves could maintain all reptile species native to the region. Unfortunately more recent work, including my study of reptiles in remnant mallee of central NSW suggests quite the opposite. In three replicate agricultural areas I have sampled ten major landscape elements, as well as sampling an uncleared area of mallee as a pseudo-control. A simple classification of species into response types based on distribution suggests that up to nine species may be declining and two species may be extinct. I am gaining additional insight into factors explaining the distributions using generalised linear models.

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Melatonin rhythms in the Freshwater Crocodile, *Crocodylus johnstoni* [poster]

The pineal gland of many non-mammalian vertebrates has been shown to contain an important component of the circadian timekeeping system, as pineal removal (pinealectomy) often results in arrhythmicity of locomotor activity rhythms. It is believed that the pineal hormone melatonin is under the control of this intrapineal oscillator, because the rhythmic output of melatonin (high at night and low in the day) continues in isolated pineal glands in organ culture. The melatonin rhythm is also influenced by environmental light and temperature, thereby providing the organism with information about seasonally changing photoperiod and thermoperiod. Although pineal organs are present in the majority of vertebrate species, they appear to be absent in the Crocodylia. Therefore, if the melatonin rhythm is crucial to the survival of the organism, we would expect the rhythm to be present in crocodiles. We measured blood plasma melatonin over a 24 h period in freshwater crocodiles (*C. johnstoni*) in their natural habitat at the end of the dry season (November) and found

no discernible melatonin rhythm. However, another group of *C. johnstoni*, under controlled light and temperature cycles, sampled in the early dry season (June) showed a well established melatonin rhythm. These results suggest that either an extrapineal source of melatonin exists in crocodiles or that there is some residual pineal tissue in their diencephalon which heretofore has not been discovered. Further studies are also needed to determine whether there is a seasonal change in the expression of the melatonin rhythm linked to wet-dry conditions.

Nancy FitzSimmons^{1,2}, Jacob Gratten¹, Mona Lisa Jamerlin¹, Craig Moritz¹ and Jason Buchan¹

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Taking a bite out of the crocodile story - recent advances in molecular ecology and phylogenetics

Over the last three years we have been studying the history and behaviour of crocodiles in the Australasian region using genetic markers. This has included studies of (i) gene flow and population structure within both species of crocodiles in Australia, (ii) mating systems in captive saltwater crocodiles, and (iii) the phylogenetic relationships among crocodilians in the SE Asia region. Recent findings will be presented along with implications for management.

Arthur Georges¹, Mark Adams² and William McCord³

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Electrophoretic delineation of species boundaries within the genus *Chelodina* (Testudines: Chelidae) of Australia, New Guinea and Indonesia

Specimens of long-necked chelid turtle (*Chelodina*) were obtained from drainages of Australia, Papua New Guinea and the island of Roti in Indonesia. Ten diagnosable taxa were identified using allozyme profiles at 45 presumptive loci. *Chelodina expansa*, *C. parkeri*, *C. rugosa* and an undescribed form from Arnhem Land and the Kimberly plateaus of northern Australia are in a Group A clade, *C. longicollis*, *C. novaeguineae*, *C. steindachneri*, *C. pritchardi* and *C. mccordi* are in a Group B clade, and *C. oblonga* is in a monotypic Group C clade, with each clade thought to represent a distinct sub-genus. *C. siebenrocki* is synonymised with *C. rugosa*. An eleventh taxon, *C. reimanni*, could not be distinguished from *C. novaeguineae* on the basis of allozyme profiles, but it is morphologically distinct. Its status is therefore worthy of further investigation. Three instances of natural hybridisation were detected. *C. rugosa* and *C. novaeguineae* hybridise in the Gulf country of Queensland, with evidence of backcrossing to *C. novaeguineae*. *C. longicollis* and *C. novaeguineae* hybridise in central coastal Queensland, and *C. rugosa* and the plateau form hybridise along their zone of contact in the plateau escarpment streams and pools. A phylogeny for *Chelodina* is presented.

J Whitfield Gibbons

University of Georgia's Savannah River Ecology Laboratory, Aiken, SC. USA

Evaluating distribution and abundance patterns of herpetofauna based on >five decades of sampling and one million individuals

Data on distribution and abundance were compiled for more than one million individuals of 100 species of reptiles and amphibians recorded between 1951 and 2000 on the U.S. Department of Energy's Savannah River Site in South Carolina. Analyses reveal that perceptions of herpetofaunal species diversity are strongly dependent on level of effort; hence, land management decisions based on short-term databases for some faunal groups should be viewed with caution. The information available provides a perspective of what might be achieved if long-term, coordinated research efforts were instituted for faunal groups in which sampling is often sporadic and unpredictable.

Graeme Gillespie*Arthur Rylah Institute, Natural Resources and Environment (Victoria), Heidelberg, Vic 3094***Comparative habitat use by two forest skink species, and the effects of forest disturbance on their relative abundance, in South-east Sulawesi**

Sulawesi, Indonesia, is a large equatorial island with a diverse herpetofaunal assemblage. Despite high levels of endemism and the biogeographical significance of the region, knowledge of the herpetofauna is poor. As with elsewhere in the tropics, the biodiversity of Sulawesi is threatened by deforestation and human encroachment. The effects of tropical deforestation are typically considered in terms of habitat loss or gross habitat change, through timber clear-felling operations or conversion to agriculture, or partial deforestation resulting in fragmentation. As with elsewhere in the world, comparatively minor habitat modifications occur throughout the forests of Sulawesi, and many potential effects on animal populations have not been explored. Reptiles are important elements of forest ecosystems, yet even basic information regarding their use of forest habitat or the impacts of disturbance processes is poorly known. I investigated habitat use and activity patterns of two sympatric forest lizards, *Mabuya rudis* and *Sphenomorphus textum*, on Buton Island, south-east Sulawesi. I compared the relative abundances of these species across forest structural gradients associated human disturbance. Marked differences were detected in the activity patterns and microhabitat associations of these species. Based upon variation in relative abundance, these species exhibited markedly different responses to forest disturbance processes, which appear to reflect underlying differences in their ecological requirements. These preliminary findings suggest that selective resource extraction from these forests may significantly affect reptile community structure.

Jane Girling and Susan Jones*School of Zoology, University of Tasmania***Cool temperatures do not prevent the stimulation of parturition by arginine vasotocin in southern snow skinks (*Niveoscincus microlepidotus*)**

Southern snow skinks, *Niveoscincus microlepidotus*, are found in alpine regions of southern Tasmania, Australia and exhibit an unusual biennial reproductive cycle due to the cool and variable climate they experience. Females ovulate in the spring and pregnancy extends over the summer and winter; parturition occurs the following spring. Prior to the winter, females contain fully developed embryos *in utero*; the mechanism preventing parturition at this stage is not known. It was hypothesised that the temperatures experienced by pregnant females prior to the winter inhibit the hormonal cascade causing parturition. We aimed to determine whether arginine vasotocin (AVT) could trigger parturition prior to winter in pregnant females held at various temperatures (28, 22, 15 and 8°C). At each temperature, females were divided into three groups (n=6) and received either a single, intramuscular injection of 2.0µg AVT/0.05 ml saline or 0.05 ml saline, or no injection. All females receiving AVT gave birth, whereas none of the control females gave birth. The time between the AVT injection and parturition increased as temperature decreased (28°C: 0-2 h, 22°C: 2-3 h, 15°C: 3-6 h, 8°C: 9-60 h). The results suggest that pregnant females are capable of responding to an AVT stimulus at the temperatures that they would experience during autumn. It is now necessary to determine how the production and secretion of AVT varies in *N. microlepidotus* in response to changing environmental conditions. The above experiment will be repeated with a closely related skink (*N. metallicus*) with an annual reproductive cycle; the results will be discussed.

Brett A Goodman^{pg}

James Cook University, Cairns campus, Queensland, 4878

Patterns of microhabitat use and morphological convergence within lygosomine skinks

I conducted an investigation of the relationships between microhabitat use and morphology of 12 skink species belonging to four genera (*Carlia*, *Cryptoblepharus*, *Lampropholis* and *Lygisaurus*) from the family Lygosominae. Microhabitat use spanned a continuum from species that are strongly associated with litter and vegetation/canopy cover, to species that utilise open, rocky microhabitats. There was also a single distinct arboreal/closed canopy species. Morphological measurements of skeletal elements obtained from radiographs were used to compare morphological traits among the taxa. Congeneric species pairs that exhibited contrasting microhabitat use were compared to determine the relationship between microhabitat use and morphology. Congeneric species tended to be morphologically more similar to each other than to other species sharing their microhabitat type. Thus, across genera, species sharing a similar microhabitat type were quite varied morphologically. However, the direction of morphological variation within each genus was related to microhabitat type. The results of this research will be used to investigate how species that differ morphologically, but which utilise similar microhabitats, perform at ecologically relevant tasks.

Andrew J Hamer^{pg}, Simon J Lane and Michael J Mahony

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Discriminant analysis of habitat determinants for the Green and Golden Bell Frog *Litoria aurea* on Kooragang Island, New South Wales

Recent amphibian studies have employed discriminant function analysis (DFA) to ascertain habitat characteristics that can predict the presence/absence of species. This technique was applied to 43 waterbodies on Kooragang Island, New South Wales, with the aim of determining those habitat features that can predict the presence/absence of the green and golden bell frog *Litoria aurea*. Waterbodies were surveyed three times for frogs and habitat data was collected from September 1999 to March 2000. A principal components analysis (PCA) reduced 52 variables to 17 principal scores along four components (water chemistry, vegetation structure, waterbody physiognomy and spatial autocorrelation). A stepwise DFA was performed on the scores, with the dependent variable consisting of 21 occupied and 22 unoccupied waterbodies. Spatial autocorrelation within a 500 m radius was the sole habitat variable that could significantly predict the presence/absence of *L. aurea*. That is, the probability of a waterbody being occupied was dependent on both the number and distance from other occupied waterbodies within 500 m. This result highlights the importance of spatial scale when constructing habitat models for amphibians and demonstrates that a landscape-level approach is required to effectively conserve populations of *L. aurea*.

Christine M Hayes¹, J Scott Keogh¹, Ian A W. Scott¹ and Mark Hutchinson²

¹*Division of Botany & Zoology, Australian National University, ACT* ²*Herpetology Department, South Australian Museum, SA*

Phylogeography and microsatellite diversity in Australian tiger snakes [poster]

Australia's island tiger snakes represent one of the most famous examples of insular body size variation because *a.* both giant and dwarf populations exist, *b.* the magnitude of body size differences among mainland and different island forms is enormous and *c.* body size differences have evolved extremely quickly. A number of competing hypotheses have been proposed to explain the evolution of insular gigantism and dwarfism but these have not been tested in an historical context. We have generated a molecular phylogeny using mitochondrial nucleotide sequence data (~1450bp). We discuss the implications of the observed historical relationships for body size evolution and the taxonomic status of different island populations. We also have developed microsatellite markers for *N. scutatus* with a view to investigating levels of genetic diversity within and between island populations. We have screened individuals representing the geographic range of *N. scutatus* and present preliminary details of potentially useful microsatellite loci.

Donna Hazel^{PS}

Centre for Resource and Environmental Studies, The Australian National University, Canberra, A.C.T., 0200

Impact of post-European stream change on frog habitat on the Southern Tablelands of NSW

Stream hydrology and form in Australia has been modified substantially since European settlement. In the case of the Southern Tablelands in New South Wales and the Australian Capital Territory, detailed notes and maps of early explorers, scientists and government surveyors have provided insight into the nature of these changes. Early explorers described most streams in this area as 'chains-of-ponds'. These are ponds connected by short lengths of channel or divided by grassy intervals. Many of these systems were converted to incised channels once Europeans arrived. An examination of the life history characteristics of frogs and their physiological limitations provides an example of how these changes are likely to have affected frog habitat. Chains-of-ponds provided permanent breeding ponds for frogs, allowing species with extended larval stages to develop. The environment surrounding these ponds flooded regularly, providing breeding environments for species with a preference for ephemeral waterbodies, and flushing terrestrial frog's eggs into free-standing water to complete development. Flood-waters also created a moist, well-vegetated environment for adult frogs during the non-breeding season. Channel incision of chain-of-pond systems resulted in many physical changes in pond characteristics and the nature of the surrounding environment. Species in the *Litoria aurea* complex and *Pseudophryne bibronii* appear most likely to be susceptible to these changes. Survey efforts to locate remaining populations of these species on the Southern Tablelands may prove fruitful if they are directed towards intact chain-of-pond systems that remain in the region.

Megan Head^{hons}

Australian National University, Division of Botany and Zoology

Scent of a woman: can male water skinks (*Eulamprus heatwolei*) distinguish between receptive and nonreceptive females via chemoreception?

Advertisement/detection of the location and reproductive condition of potential sexual partners is a crucial component of sexual behaviour. While we have a thorough understanding of the role that chemical signals play in the sexual advertisement of mammals and insects, our knowledge of the part it plays in reptiles is limited. In this study, I used retreat site choice experiments, where males had the choice of sleeping under tiles treated with various odours, and behavioural observations of staged encounters to examine whether male water skinks could distinguish between the odours of receptive and nonreceptive female conspecifics. Three choice trials were conducted during the mating season. These were receptive vs. nonreceptive females, receptive females vs. odourless control and nonreceptive females vs. odourless control. In my talk I will discuss the results and their adaptive significance.

Harry Hines¹ and Woo O'Reilly²

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Detectability of Fleay's Barred-Frog at Cunningham's Gap, southeast Queensland

Fleay's Barred-Frog, *Mixophyes fleayi*, is a poorly known stream breeding frog of the wet forests of south-east Queensland and north-east New South Wales. There have been no quantitative assessments of the temporal patterns of male calling. This knowledge is necessary for developing survey and monitoring methodologies for this endangered species. Since July 1996 we have monitored Fleay's Barred-Frog at Cunningham's Gap in south-east Queensland using a stream transect method that has been used widely in studies of stream-breeding frogs. From July 1997 we augmented this with automated tape recorders, that recorded a one minute period at 2000 hrs and midnight. One thousand and sixty-nine one-minute recordings were made over a period of 22 months, although data

were not continuous due to logistical constraints and equipment failure. As expected Fleay's Barred-Frog showed significant variation in calling activity across seasons. No calls were detected in winter months and there were peaks in activity in late spring and late summer - early autumn. We also found that there was significantly greater calling activity at 2000 hrs than at midnight. We will present data that shows that within the calling season, stream flow was a significant influence on daily patterns of calling. We hypothesise that this is a reflection of the availability of oviposition sites. The implications of our findings for targeted surveys and for assessing monitoring results are discussed.

Simon Hudson

School of Biological Sciences, University of Sydney, NSW 2006

Lizard sexual dimorphism: big-headed males or svelte females?

In many lizard species, males have relatively larger heads than do females, and the sexual difference in head size often increases with increasing SVL. This is often attributed to sexual selection for increased head size in males, because males with relatively larger heads are more likely to win agonistic encounters with other males, and thus have more access to females. However, a similar pattern of dimorphism would be produced if females exhibited allometric elongation of the body but males did not, so that increasing elongation resulted in female head size relative to SVL becoming smaller than that of males as body size increases. This could be a result of selection for increased abdomen length in females in order to increase reproductive output. Distinguishing between these two explanations is difficult in many cases because most data is published in the form of ratios with SVL as the denominator. I investigated this question by measuring male and female morphological characters in a variety of lizards, and comparing overall shape using multivariate methods. Results will be discussed, but preliminary results indicate that in a number of skinks, it is allometric elongation of the female body rather than allometric increase in male head size that accounts for this pattern of sexual dimorphism.

David Hunter¹, Will Osborne¹, Ken Green² and Ross Cunningham³

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Testing the hypothesis that UV-B radiation is implicated with the decline of the Alpine Tree Frog, *Litoria verreauxii alpina*

We undertook a field experiment testing the hypothesis that current levels of UV-B radiation is causing high mortality and reduced fitness in the early life history stages of the Alpine Tree Frog, *Litoria verreauxii alpina*, in the Southern Highlands of NSW. This experiment was conducted in both natural (bog pools) and artificial (man made dams) water bodies above 1300 metres altitude across 10 sites in the Snowy Mountains Region of Kosciuszko National Park. Paired one meter by one meter wide enclosures, one with a UV-B blocking mylar filter and the other without, were positioned within dams and ponds so that tadpoles had access to their natural range of pond substrates and microhabitats. Water depth and extent of submerged vegetation within enclosures were held constant within pools but varied greatly from one pool to another. 50 recently laid *L. v. alpina* eggs were placed into the centre of each enclosure and the number, size, mass and developmental stage of surviving tadpoles was assessed after six weeks. Habitat variables specific to particular pools and enclosures, including temperature, pH, water depth, extent of submerged vegetation and dissolved organic and inorganic carbon levels, were measured to assess their interactive effect with UV-B radiation. The results of this experiment failed to find a negative influence of UV-B radiation exposure on the survivorship or fitness of the early life history stages of *L. v. alpina*. These results and the importance of conducting field experiments for assessing amphibian declines will be discussed.

Michael Kearney^{pg}

School of Biological Sciences, University of Sydney

Clones, clines and climate: latitudinal variation in the ecophysiology of sexual and asexual geckos

The earth's climate has changed considerably throughout evolutionary history and significant change is forecast for the next century due to greenhouse gas emissions. Thus it is important that we understand the ways that organisms respond to climate change. The *Heteronotia binoei* species complex is an excellent system with which to investigate the potential impact of climate change on reptiles because it occurs across a wide geographic range and includes lineages that reproduce sexually as well as asexually by parthenogenesis. I have collected sexual and asexual lizards from 22 localities in central Australia, across a latitudinal gradient of 1200 kilometers, in a hierarchically replicated factorial design. I will use these animals to address three basic questions: 1) is there evidence for local climatic adaptation? 2) is there genetic variation for climate-sensitive traits? 3) how is sensitivity to climate dependent on conditions experienced during early development? Preliminary findings indicate significant latitudinal variation in metabolic rates and in thermal preferences and tolerances.

J Scott Keogh and Ian AW Scott

Division of Botany and Zoology, Australian National University, Canberra, ACT 0200

Origin of elapid snakes

The Family Elapidae is highly diverse with some 61 genera and over 300 species in the Americas, Africa, Asia, the Australo-Papuan region, and the Pacific and Indian Oceans. Identifying the living sister groups and determining the limits of Family has been the subject of debate for more than four decades. The problem of elapid origins and affinities, and the literature dealing with the subject, is intimately tied up in the evolution of front fang venom delivery systems. The relationships of the enigmatic African genera *Atractaspis* and *Homoroselaps* have featured heavily in the ongoing discussion of the origin of venom delivery systems and elapids. Although *Atractaspis* species possess a proteroglyphous (elapid) dentition system, a number of other morphological features have clouded understanding of their affinities. As a result, the genus has variously been classified as a colubrid, viper, elapid, or an independent lineage and *Homoroselaps* has variously been classified as a colubrid or an elapid. To elucidate the true affinities of *Atractaspis* and *Homoroselaps*, and determine the living sister group to elapids, we obtained mitochondrial DNA sequence data from 22 individuals representing 21 taxa. The complete data set comprised 2777 base pairs of mitochondrial DNA derived from portions of four genes including 290 bp of cytochrome b, 490 bp 16s rRNA, 936 bp 12s rRNA, and 880 bp of ND4. Phylogenetic results and their implications for our understanding of venom delivery systems and elapid classification will be discussed.

Gregory D Kerr^{pg} and C Michael Bull

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Social interactions in *Tiliqua rugosa*

Field observations of sleepy lizards (*Tiliqua rugosa*) have revealed complex social interactions not normally attributed to reptile communities. The sleepy lizard forms monogamous pairs during the spring. Longevity of the pair bond is dependent on a number of factors such as challenges by unpaired males or males who have already mated that season. Pair bonds are also terminated by the loss of a partner. The strength of the pair bond is illustrated by the continued interaction between one male with his partner for two days after her death. My observations indicate that head and body size have important outcomes in determining whether a male is successful in challenging another male for a partner.

Anja Klingenböck

Geobotanical Institute, Swiss Federal Institute of Technology, Zollikerstrasse 107, CH-8008 Zurich

Family business? What drives habitat usage of the Land Mullet (*Egernia major*, Scincidae)

The Land Mullet, *Egernia major*, is one of the largest of all Australian skinks (total length > 600 mm) and is distributed in rainforest areas along the central eastern coast of Australia. To study patterns of habitat usage, miniature radio-transmitters were surgically implanted into 12 adult Land Mulletts from a population living at Barrington Tops 250 km north of Sydney, NSW. The animals were monitored over a seven-week period in spring 1998 (October to December). Highest densities of *Egernia major* occurred in forests with intermediate canopy cover (versus open eucalypt forest or dense-canopy rainforest) where ground cover and large hollow logs provided suitable refugia and sufficient sunlight penetrated the ground to allow basking. This combination of features meant that the lizards primarily used ecotonal areas at the fringe of rainforest clearings. The activity of radio-tracked animals was centred on large hollow logs on the forest floor. The home range of each animal consisted of a clearly defined core containing one to several such logs (minimum convex polygon (MCP) estimate, based on the central 80% locations = 2,253 m², SD = 1909 m²) plus an outer foraging area that received less frequent visitation (MCP estimate based on 100% locations = 10,951 m², SD = 8149 m²). Home ranges of different groups show very little overlap, whereas home ranges of individuals within the same group overlapped almost completely. This pattern of habitat usage (clear boundaries between and high overlap within groups) suggests a family-based social structure of Land Mulletts.

Amelia J Koch

Griffith University, Gold Coast

Designing efficient and effective monitoring techniques for a population of the endangered frog species *Mixophyes iteratus*

It is important to design monitoring programs in order to gain accurate results without wasting time and resources. This is a pilot study determining the most efficient way to monitor a population of the endangered frog species *Mixophyes iteratus*. Repeated field surveys in a range of environmental conditions indicated that the optimal conditions in which to survey is during temperatures at or above 18 °C. The relevance of surveying males, females and juveniles was considered in light of the known biology of this species and the aim of the proposed monitoring program. As little is currently known about the relationship between juvenile and adult population size, only adults were included in estimates of population size. Several estimators of population size were used to determine the most appropriate model for this population. Order two of the jackknife model provided the best estimate of 19 ± 5 males. No estimate for females could be made, so the size of the female population was estimated assuming an equal sex ratio. Finally, iterations of the jackknife model were used to determine how many surveys were required to get an accurate population size estimate under different environmental conditions. The results of this study indicate that a minimum of nine surveys in temperatures of 18 °C or greater are needed to get an accurate estimate of the male population size, while the most efficient way to estimate female population size is to assume an equal sex ratio with males.

Tracy Langkilde and Ross A Alford

School of Tropical Biology, James Cook University, Townsville, Queensland 4811

The tail wags the frog: attached transponders affect movement behaviour in *Litoria lesueuri*

Externally attached transmitters are often used to determine the fine-scale home range sizes, movement patterns and daily and seasonal activity patterns of animals. We are tracking frogs using a harmonic radar system. It emits a microwave signal which is received and re-emitted by externally attached transponders. The transponders are simple diodes with attached antennas, and are much smaller and less expensive than conventional radio transmitters. They are attached to animals using waistbands. To determine whether behaviour might be affected by attached diodes, we looked at their effects on movement patterns of *Litoria lesueuri* in the laboratory by filming individuals for 12 hours immediately after attachment of diodes and comparing their movement with that of control

individuals. We scanned the path taken by each frog into a computer, and determined the total distance moved, the average length of each move and the total number of moves for each animal. We used a statistical model to decompose our results into estimates of individual intrinsic movement rates, differences between nights, and differences due to the attachment of a diode. Our preliminary results suggest that diodes affect movement patterns, increasing total distance moved and number of moves, but not affecting the average length of each move. If this pattern continues to the end of our experiments, it will have implications for field studies using tracking.

Tracy Langkilde, Lin Schwarzkopf, and Ross A Alford
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Tail waves in the rainbow skink, *Carlia jarnoldae* [poster]

Although there are many hypotheses about the function of tail signals in vertebrates, few studies have determined their function in any taxon. In lizards, behavioural studies suggest that tail displays may be used as anti-predator signals, or in social communication, but no study has attempted to distinguish between these hypotheses. We described tail displays and determined the contexts in which they occurred in the rainbow skink, *Carlia jarnoldae*. Observations were made in the wild and in field enclosures. We conducted a series of 20-minute focal animal observations of resident male skinks when they were alone, with a male or female conspecific intruder, and when they were threatened by a human or predatory bird. Tail displays consisted of waves and undulations, which occurred in different contexts. The proportion of males that performed tail waves was lowest when skinks were approached by a human or avian threat in the wild, suggesting that tail waves in this skink are not signals to predators, but are reduced in the presence of predators, perhaps to reduce conspicuousness. In enclosure observations resident males performed tail waves in all contexts but intruder males almost never performed tail waves. It appears that tail waves in rainbow skinks are similar to territorial bird songs, being broadcast displays performed by residents even when no conspecifics are present, but which are reduced in the presence of a predator.

Bonnie Lauck^{PS}
School of Zoology, University of Tasmania

Impact of forestry practices on amphibian life histories [poster]

This study will investigate aspects of reproductive and population ecology of four amphibian species (*Crinia signifera*, *Crinia tasmaniensis*, *Litoria ewingi*, *Litoria burrowsae*) found in the southern Tasmanian forests. Amphibians have very flexible life histories and these life history strategies have been found to relate closely with local environmental conditions. For example, amphibians are able to vary the time spent in the tadpole stage depending on pond permanency, temperature, elevation, competition and predation. These strategies all have repercussions on the subsequent survival, dispersal and reproductive success at adult stage. In addition, amphibians are also potentially valuable monitors of environmental health since they are dependent on the integrity of both aquatic and terrestrial ecosystems. This study also aims to investigate the impact of forest management upon amphibians. Forest management may have a number of effects on amphibian habitats such as changing pond turbidity, pond productivity/shading, water temperature, the availability of food, the abundance of predators and varying pond microhabitats etc. The study will compare the life history of amphibians in ponds that are surrounded by recently logged/burned land or plantations and ponds where little forest management has taken place in recent times.

Francis Lemckert
Forest Research Division, State Forests of NSW, PO. Box 100, Beecroft, NSW 2119

Rare, medium or well done: the impacts of fire on frog populations at Dorrig

In September 2000, light to moderate fires burnt at least 75% of the dry eucalypt forests west of Dorrig. Surveys of stock/fire dams conducted immediately before and during the fires indicated that spring/summer breeding species of frogs had apparently not yet migrated to their breeding sites as

would normally have been the case. Hence, most individuals should have been in areas burnt by the fires and the populations of frogs may have been decreased through fire mortality. These dams have been surveyed two months post-fire and, along with data collected at the same sites in previous years, and the counts made at burnt sites compared with counts made at dams not burnt in September. Large numbers of frogs have been recorded at all sites during the most recent surveys. Initial analysis indicates that the fires did not reduce the numbers of frogs and numbers of species at burnt sites in comparison with unburnt sites. Further surveys are to be undertaken to determine if there are changes in numbers at a later time period. These forests have a history of burning and frogs in the area may be reasonably tolerant of lower intensity fires.

Francis Lemckert and Traeacey Brassil

Forest Research Division, State Forests of NSW, PO. Box 100, Beecroft, NSW 2119

Long-term survivorship of frog populations in corridors of native vegetation within a pine plantation [poster]

We undertook a survey of corridors of native vegetation that were retained within pine plantations established in the early 1980s in Bondi SF on the NSW/Victorian Border. This was compared with data obtained from the area at the time the plantations were established to assess how the status of different species had altered. Information was also collected on populations in the corridors at differing distances from larger tracts of native forest. Ten species were recorded in this survey compared to 11 found originally. One new species was recorded but two species were not relocated in the recent surveys (*Heleioporus australiacus* and *Mixophyes balbus*). Notably, these were two endangered forest dwelling species, but their absence may have been due to sampling difficulties and/or declines for other reasons. The data suggests that many species of frogs can be maintained in a landscape through the presence of retained corridors of native vegetation, but larger forest dependent species may be vulnerable.

Kylie Leonard^{1pg}, Bruce Firth¹, Robert Moyer², Mark Hutchinson³ and David Kennaway⁴

¹Departments of Anatomical Sciences; ²Molecular Biosciences, ³Obstetrics and Gynaecology, University of Adelaide, South Australia, 5005; ⁴Museum of South Australia, North Terrace, Adelaide, South Australia, 5000

The effects of light and temperature on *in vitro* melatonin rhythms of the Sleepy Lizard, *Tiliqua rugosa*

The pineal gland is a photo-thermo-neuroendocrine transducer that has been shown to relay the environmental light and temperature conditions to the organism through its hormonal signal, melatonin. This signal has an effect on daily activity, reproductive cycles and thermoregulation. Previous studies in the sleepy lizard, *Tiliqua rugosa*, have shown that the rhythm of plasma melatonin content is highest in the dark phase of a light-dark cycle. Further, the rhythm can be shifted (ie entrained) by temperature cycles in constant light and darkness and in light-dark cycles with the highest levels usually occurring in the cool phase of the thermocycle (Firth *et al.* (1999) *Am.J.Phys.*). The aim of the present study was to test whether these responses are intrinsic to the pineal gland or are the result of neural input from other brain centres. The pineal organ was isolated by culture in a dynamic perfusion system where two-hourly samples were collected for radioimmunoassay. Results show that photocycles and thermocycles independently entrained the melatonin rhythm. More robust rhythms and maximal levels were achieved when both light and temperature cycles were present. In constant darkness and 30°C the rhythm persisted with a relatively lower amplitude. These results reflect those achieved *in vivo* suggesting that the pineal works independently of other brain centres to generate the melatonin rhythm in response to the environment light and temperature conditions.

Michael Bull¹ and Christian Lindle²

¹Flinders University, ²University of Vienna

Trail following behaviour in Sleepy Lizards (*Tiliqua rugosa*)

Sleepy lizards (*Tiliqua rugosa*) form monogamous pairs each spring before mating and spend the rest of the year separated. Partners find each other by a combination of following chemical trails, using airborne scent signals and meeting at familiar sites. This work focuses on the impact of chemical trails on partner location and choice. Y-maze tubes were used to test trail following in 21 pairs of lizards. Individuals were offered a choice between the partner's trail or a blank arm of the tube. In another treatment lizards were offered a choice between their partners trail or the trail of an unfamiliar individual of the same sex. Ovulation state of females and the degree of relatedness of all experimental individuals was determined after trials were conducted.

Murray Littlejohn

Department of Zoology, University of Melbourne, Victoria 3010

Geographic variation in the advertisement call of the Common Froglet *Crinia (Ranidella) signifera*

Crinia signifera has an extensive continuous peripheral distribution on the south-eastern and eastern Australian mainland, with disjunct populations on the lower Eyre Peninsula and the adjacent larger continental islands. This present fragmented distribution is seen as a consequence of the rise in sea level of some 130 m from about 15,000 to 6,000 years ago during the late Pleistocene and the Holocene Epochs. Tape recordings of advertisement calls of males of *Crinia signifera* from Tasmania, King Island, Kangaroo Island, and the south-eastern Australian mainland were analysed. Four attributes were measured: number of pulses, call duration, pulse rate (calculated from the first two measurements), and dominant frequency. The data were adjusted for effects of temperature, and for correlations with body size of the caller where available. The samples were then combined with previously published data (Littlejohn, M.J., 1964, *Evolution* 18: 262-266; Littlejohn, M.J., and Wright, J.R. 1997, *Trans R. Soc. S. Aust.* 121: 103-117) and compared for possible regional patterns of variation.

Colin McCoull^{PG} and Roy Swain

School of Zoology, University of Tasmania

Geographic variation and thermal adaptation in the Tasmanian Metallic Skink (*Niveoscincus metallicus*)

The metallic skink, *Niveoscincus metallicus*, is the most widespread of all Tasmanian reptiles, occurring from sea level to alpine elevations, in a range of habitat types. The phylogenetic history of *N. metallicus* across its entire distributional range was examined, using restriction fragment length polymorphism analysis (12s-16s rRNA gene) and nucleotide sequence divergence information (16s rRNA sequence). Five phylogenetically distinct subtypes were revealed, four of which are found within Tasmania. Four field sites from within the distributional range of one of these subgroups were selected for a detailed study of inter-population variability in thermal biology. Sites selected covered the altitudinal range of the species (two high altitude and two low altitude sites). Within each altitude group, sites were chosen to represent open (little tree cover) and closed (complex tree cover) habitats. The importance of acclimatization and genetic adaptation to the thermal physiology and performance of *N. metallicus* was examined in a series of field and laboratory experiments. Preferred body temperatures did not differ between sites. Nevertheless, thermal adaptation does occur in this species. Animals from high altitude tolerate significantly lower environmental temperatures, and can sprint significantly faster at extreme body temperatures. These differences appear to represent genetic adaptation, and thus data from this study support the "labile" view of thermal adaptation.

Keith R McDonald¹, R Speare² and R Piper³

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³Scientific Advisory Services, Cardstone Road, Tully, Queensland 4854

Frogs in banana cartons: preliminary results from North Queensland

Concern has been expressed at the inadvertent movement of large numbers of frogs in banana cartons from Queensland to fruit markets in southern Australia and the potential to transmit disease such as the chytrid fungus to southern frog populations. Preliminary results will be presented on frogs associated with the banana industry in the Tully Valley, north Queensland. Species encountered during processing, packing and transportation are being investigated and methods trialed to minimise inadvertent transportation. The presence of diseases in banana frogs is compared to the results obtained from frogs in adjacent rainforest stream monitoring sites.

Jane Melville, James A Schulte, II, and Allan Larson

Department of Biology, Washington University, Campus Box 1137, St Louis, MO 63130, USA

Molecular phylogenetic evidence of ecological trait evolution and the tempo of diversification in the Australian lizard genus *Ctenophorus*

Incorporating phylogenies into macroevolutionary studies of character evolution is crucial because reconstructing the phylogenetic history of a trait is an essential step in understanding how the trait evolves. We use a 1639 base-pair segment of mitochondrial DNA to assess the phylogenetic relationships and monophyly within the agamid lizard genus *Ctenophorus*, using both parsimony and maximum likelihood analyses. A number of new phylogenetic analyses, such as the test of independent ecological transitions and the taxon resampling technique, are used to examine the evolution of ecological traits and the tempo of diversification in *Ctenophorus*. Taxon resampling is used to reject the null hypothesis of a hard polytomy in *Ctenophorus*, indicating that there have been sequential branching events rather than a rapid burst of diversification in *Ctenophorus*. We classified the species of *Ctenophorus* into three ecological character states: saxicolous, open-ground dwelling and burrowers. Previous evolutionary theories that ecological-types form monophyletic groups were rejected but we were not able to show that there had been independent transitions of ecology. We also recommend the incorporation of *Rankinia adalaidensis* into the *Ctenophorus* genus on the basis of Wilcoxon-signed ranks and SOWH tests. The results of this study suggest that ecology alone cannot explain the patterns of phylogenetic relatedness within *Ctenophorus* and that ecology and morphology, as used in previous taxonomic studies of this genus, are not reliable indicators of relatedness.

Allie Mokany^{hons}
University of Sydney

Interactions between tadpoles and mosquito larvae

Tadpoles and mosquito larvae co-exist in many natural fresh water bodies. Although these organisms are often found in sympatry, their ecological interactions remain poorly understood. The aim of my project was to determine the extent of ecological interactions between tadpoles and mosquito larvae. I performed a series of artificial pond experiments to investigate interactions between tadpoles and mosquitoes reared together. Tadpoles were found to have a significant negative effect on mosquitoes and vice versa. Negative effects on tadpoles included reduced width, weight and length. The primary mechanism involved in producing this effect on tadpoles appears to be food competition and mechanical interference from the mosquitoes. Negative effects of tadpoles on mosquitoes involved increased pupation time, decreased wing span and survival. The primary mechanism involved in this effect appears to be chemical interference from tadpoles. The conclusion that mosquito body size may be affected by ecological factors during the larval stage is important for public health, as a mosquito's body size can determine its disease-carrying potential. Thus my work may clarify the feasibility of reducing the spread of mosquito-borne disease by encouraging frog populations.

Clare Morrison^{PG} and Jean-Marc Hero
Griffith University Gold Coast

Altitudinal variation in tadpole growth and development rates

Altitudinal variation in larval growth and development rates in two subtropical species of frog, *Litoria chloris* and *L. pearsoniana* was experimentally examined. The larvae of both species raised at high altitudes (regardless of tadpole origin) had slower development rates than larvae raised at low altitudes. Slower growth rates were found in high altitude larvae of *L. chloris* while a similar (but not significant) trend was recorded in *L. pearsoniana*. Reciprocal transplant experiments indicated that most of the variation in growth and development rates in the two species was due to environmental factors rather than genetic or phylogenetic factors with water temperature having the greatest effect. Tadpole survival in either species did not appear to be significantly affected by environmental or genetic factors in this study.

Lyn Nelson^{PG}

Botany and Zoology Dept, Australian National University, CANBERRA ACT 0200, and Wildlife Research and Monitoring, Environment ACT, PO Box 144, LYNEHAM, ACT 2602

Comparison of field temperatures and energetic requirements of *Tympanocryptis pinguicollis* (Grassland Earless Dragon) in the ACT and NSW

Field metabolic rate (FMR) was measured using the doubly-labelled water technique in lizards from two *Tympanocryptis pinguicollis* populations (Cooma 950 m and ACT 600 m). Other lizards were radio-tracked with temperature sensitive transmitters to determine temperatures selection in the field whilst environmental temperatures were recorded throughout the study. Analysis of covariance showed that FMR did not differ between populations. Body temperature also did not appear to vary during the active periods. This study suggests that altitude does not affect the daily physiological budget, but ecological differences may exist because of limited availability of food and appropriate thermoregulatory habitat for the higher population over the year.

David Newell^{PG} and Ross Goldingay

School of Resource Science and Management, Southern Cross University, Lismore, 2480

A review of human impacts on threatened frogs in New South Wales [poster]

Frog populations have declined markedly in many parts of the world. Declines have been sudden, with some species now presumed extinct. The majority of the declines have occurred within the confines of Protected Areas, many of which are listed as World Heritage areas. There has been much speculation about the cause and pattern of these declines. Indeed, several prominent ecologists have argued that a water-borne disease was responsible for the declines. The subsequent identification of a fungus in sick and dying frogs from eastern Australia, Central America and the USA is highly suggestive as a factor in these declines. There is now widespread concern among amphibian biologists about further spread of the fungus and detailed protocols have been developed for use by these field workers to minimise the risk of inadvertent transmission. However, many Protected Areas in NSW containing threatened frog populations have high levels of human visitation and management of these areas has not kept pace with frog conservation requirements. Moreover, it appears that a high proportion of threatened frog populations in NSW are potentially vulnerable to several forms of disturbance. We review these forms of disturbance and the difficulty they pose for the conservation of threatened frogs in NSW.

David O'Connor^{PG} and Rick Shine
School of Biological Sciences, University of Sydney

Sociality in the Black Rock Skink, *Egernia saxatilis*

The black rock skink, *Egernia saxatilis*, is often found in the field in what appear to be family groups. That is an adult male, adult female and some subadults and/or juveniles all sheltering under the one rock. With increasing evidence of quite complex social structure in some species within the *Egernia* lineage, it is important to investigate the extent and degree of variation in sociality within this lineage. Here we report on the degree of sociality displayed by *E. saxatilis*. The black rock skink appears to represent an intermediate social structure between the long term pair associations of *Tiliqua rugosa* and the relatively stable group structure of *E. stokesii*. From a field study it has been possible to identify individuals that are consistently found together in the field. Their associations are however quite fluid with animals moving about within the "family" territory in groups at times but independently at other times. The composition and movements of individuals within these groups and some tests of possible mechanisms maintaining group structure will be discussed.

Terry J Ord^{1PG} and Daniel T Blumstein²
Animal Behaviour Laboratory,¹*Department of Biological Sciences, Macquarie University, Sydney NSW 2109*; ²*Department of Organismic Biology, Ecology and Evolution, University of California, Los Angeles, CA 90095-1606, USA.*

Allometric constraints on the evolution of display complexity: large lizards have simple visual displays

The extraordinary diversity of animal signals has fascinated biologists since Darwin (1872). Current models of signal evolution explain this diversity by invoking a variety of social, perceptual and environmental factors. Body size is also an important determinate of signal design. Using published data on display behaviour, body size and the phylogenetic relationship of 110 iguanian lizard species, we investigated whether body size has influenced macro-evolutionary trends in repertoire size. We found evidence that signal complexity, as reflected by repertoire size, is negatively associated with body size. However, this relationship was not strictly linear. Rather, body size seems to impose a threshold on signal evolution. Specifically, the evolution of large repertoire size appears to be constrained above a particular size threshold, which results in large-bodied lizards having a significantly lower probability of evolving elaborate displays. This relationship may reflect the influence of body size on resource use and the emergent social dynamics it promotes. Large lizards tend to be herbivorous and typically do not defend foraging patches. Consistent with this hypothesis is the previously reported finding of a similar size threshold dividing herbivorous from non-herbivorous lizards. Our findings suggest that if we are to fully understand the evolutionary processes acting on communicative systems, it is important to identify both the selective forces involved and the nature of their influence.

Konrad Osterwalder
Geobotanical Institute, Swiss Federal Institute of Technology, Zollikerstrasse 107, CH-8008 Zurich

Cool beasts. Thermoregulation of a large rainforest skink (*Egernia major*, Scincidae)

The Land Mullet, *Egernia major*, is one of the largest of all Australian skinks and ranks amongst the largest 5% of lizard species in the world. It is distributed in rainforest areas along the central eastern coast of Australia. To study the Land Mullet's thermoregulation we surgically implanted miniature temperature-sensitive radio-transmitters into 12 adults from a population living at Barrington Tops 250 km north of Sydney. The animals were monitored over a seven-week period in spring 1998 (October to December). Through heliothermy, the Land Mullets maintained an average temperature of $32.8 \pm 6.3^\circ$ throughout most of their activity time (12-15 h) even in relatively cool weather. Their body temperatures showed strong diurnal cycles. On warm days (average daily temperature $>20^\circ\text{C}$) the lizards basked in the early to mid-morning period and reached temperatures close to 35°C . Even on cold days (average daily temperature $<16^\circ\text{C}$), the animals often reached temperatures close to

35°C, but mostly only attained these temperatures in the afternoon. The lizards were able to thermoregulate precisely despite the thermally difficult rainforest conditions and the fact that their large body size extends the period of basking needed for them to attain their thermal preferenda. Choosing a habitat with shelter sites next to basking spots as well as the dark colour of the Land Mullet seem likely to be thermoregulatory adaptations.

Kirsten Parris

Australian Research Centre for Urban Ecology, Melbourne

Pond-breeding frogs in urban and suburban Melbourne [poster]

A population can be defined as a group of conspecific individuals that form a breeding unit and share a particular habitat at a given time. A metapopulation is an assemblage of spatially separated, local breeding populations connected by some level of migration. Metapopulation theory is an appropriate framework for studying populations of pond-breeding frog species, as wetland or pond habitats are naturally patchy and interspersed with terrestrial habitats of varying suitability for frogs. In urban areas, ponds and wetlands are often highly modified and isolated from one another by a matrix of habitats such as housing estates and busy roads. This is likely to present a challenge to frogs dispersing from one pond or habitat patch to another. I have commenced a study of pond breeding frogs in urban and suburban Melbourne, to investigate whether habitat quality at lentic waterbodies and/or habitat fragmentation are influencing the probability of persistence of native frogs in the study area. I am conducting a field survey of ponds and wetlands from the inner city to the urban/rural fringe, and will use the resulting data to construct spatially realistic metapopulation models. These models can be used to investigate problems such as the probability that a metapopulation will persist in a given set of habitat patches, and the effects of habitat quality on the probability of that a pond will be occupied by different frog species.

Ben Phillips, Stuart Baird and Craig Moritz

Department of Zoology and Entomology, University of Queensland, St Lucia, Qld, Australia 4067

Assessing the effects of allopatry and genetic divergence on reproductive isolation: *Carlia rubrigularis* in Australia's Wet Tropics

Empirical evidence for speciation processes is notoriously difficult to obtain as inference is often confounded by poorly resolved historical contingencies. Australia's Wet Tropics offers an excellent natural laboratory in which to base such studies due to its relatively well known history. Many rainforest dependent species in Australia's Wet Tropics consist of two genetically divergent yet apparently morphologically static lineages. These lineages have arisen as a consequence of long periods of allopatry between northern and southern populations. This paper maps the location and characterises the zone of secondary contact between lineages of the endemic skink, *Carlia rubrigularis*. One mitochondrial and eight nuclear (2 introns, 6 microsatellites) markers were used for this purpose. These markers delineated a narrow asymmetrical cline in allele frequencies between the lineages. This observation coupled with strong hybrid genotype deficits and weak linkage disequilibrium at some loci provides strong evidence for lowered hybrid fitness. This shows that a degree of reproductive isolation can be attained despite an apparent lack of morphological divergence and that allopatry even in the absence of strong morphological selection differentials can initiate reproductive isolation

Graham H Pyke

Frog Ecology & Behaviour Group, Australian Museum, 6 College St, Sydney, NSW 2010

Population size and dynamics in the Green and Golden Bell Frog (*Litoria aurea*)

Despite the frequently-claimed role of frogs as bioindicators of environmental change and the alarming worldwide declines in frogs and other amphibians, we are extremely limited in our abilities to both estimate population sizes of frogs and to understand those factors which determine their distribution and abundance. In this talk I present results from a study of the Green and Golden Bell Frog (*Litoria aurea*) which aims ultimately to determine a reasonable method for estimating

population size and how it varies in space and time, to apply this method to a number of populations, to evaluate correlations between the observed temporal and spatial variation in population size and quantitative habitat variables, and finally to experimentally test any hypothesised relationships that emerge from these correlations. Results so far indicate that the standard capture-recapture models do not accurately estimate population size and other population parameters such as mortality and recruitment because of movement of individuals and the fact that individual frogs are not all equally likely to be captured at a given time. Simply counting detected frogs does not work well either. However, based on patterns of capture and recapture, it is possible to estimate these parameters. In this talk I illustrate how this can be done and present initial results in terms of the relationship between population size and habitat extent.

Kathryn C Read^{hons}

Division of Botany and Zoology, Australian National University, Canberra, ACT 0200

The phylogenetic relationships of *Crinia*, *Geocrinia* and related genera: a molecular approach

The Australian frog genera *Crinia* and *Geocrinia* show extreme morphological similarity and this has made phylogenetic reconstruction problematic. More recent molecular approaches resulted in contradictory rather than corroborating phylogenies. To try and address this, I constructed a phylogeny for all 14 *Crinia* species, six of the seven *Geocrinia* species and representatives of all other myobatrachine genera using the mitochondrial genes 12SrRNA and ND2. Analyses were performed at three taxonomic levels: all taxa using representatives of each species, *Crinia* species only using all representatives and all *Crinia signifera* individuals. Phylogenetic analyses were performed on a combined data set of 1450 bases using maximum parsimony, maximum likelihood and distance methods. While the deepest nodes were not well resolved, the rest of the phylogeny is well resolved and well supported. The phylogeny supports the monophyly of *Crinia* and *Geocrinia* and I will discuss the relationships within these genera. In addition, *Crinia tasmaniensis* formed a clade with *Bryobatrachus nimbus*, and together they form the sister to the rest of *Crinia*. Based on this, I propose the synonymy of *Crinia tasmaniensis* with *Bryobatrachus tasmaniensis*.

Robert N Reed^{PS} and Richard Shine

Department of Biological Sciences A08, University of Sydney, Sydney NSW 2006

Lying in wait for extinction? Ecological correlates of conservation status among Australian elapid snakes

Why do some species decline rapidly with anthropogenic disturbance, whereas others readily exploit disturbed habitats? Plausibly, ecological characteristics of some species may render them especially vulnerable to extinction. Previous analyses have identified a number of intrinsic ecological predictors of vulnerability, but snakes have not been studied in this respect. We collated ecological data on Australian venomous snake species in the family Elapidae, based primarily on examination of preserved specimens in museums, to investigate possible differences between threatened and non-threatened taxa. We also used comparative (phylogenetically-based) analyses to identify functional associations with endangerment, as well as overall correlations. Correlates of conservation vulnerability identified in previous studies did not discriminate successfully between threatened versus non-threatened elapid species. However, threatened and non-threatened elapids differed significantly in two main respects. First, threatened species tend to rely upon ambush foraging rather than actively searching for prey. Sit-and-wait foragers may be vulnerable because (i) they rely on sites with specific types of ground cover, and anthropogenic activities disrupt these habitat features; and (ii) ambush foraging is associated with a suite of life-history traits that involve low rates of feeding, growth and reproduction. The second major correlate of endangerment involves the mating system. Endangered species typically lack male-male combat; in such taxa, females grow larger than males and are more vulnerable to human predation. Our analysis also identified non-listed taxa that share many of the ecological traits of the endangered group. These results may facilitate future attempts to prioritize conservation actions for Australian snakes.

Dale J Roberts, RA Davis, M Drew and M Smith

Department of Zoology, University of Western Australia, Nedlands, WA 6907.

Conservation status and population biology of *Spicospina flammocaerulea*

Spicospina flammocaerulea was discovered in 1994 and formally described in 1997. Since then a total of 12 populations have been located for certain with another one possible. Five of those populations are on privately owned land, the remainder in state forest or national parks. Counts of calling males after a wild fire at Mountain Road in 1994 gave a minimum number of adult males of around 120. Comparable numbers of calling males have never been seen since at this site. At Trent Rd #2, there was a similar burst of calling activity after fire in 1999. This talk will: a) relate counts of calling males to mark-release-recapture estimates of population size b) look at seasonal patterns of calling based on data from call boxes placed at five locations through 2000 and into 2001 c) offer some speculations about the role of fire in *Spicospina* populations d) evaluate the current status of this species based on field surveys over the years 1998 - 2000.

Dan Salkeld and Lin Schwarzkopf

Dept. Zoology & Tropical Ecology, James Cook University, Townsville, QLD 4811

Lizards, parasites and ecology (*Eulamprus* and haemogregarines) [poster]

Parasites affect the life-histories and fitness of their hosts. These effects can vary considerably between populations due to genetic differences in the hosts or parasites, transmission dynamics, or environmental factors. However, systematic geographical variation in the effects of parasites has been little studied. It has been suggested that tropical parasites exert a larger impact on their hosts than do their temperate counterparts and that this could partly account for the large biodiversity of the tropics but there is little direct evidence for this. I intend to look for geographical variation in the host-parasite relationship of eastern water skinks (*Eulamprus quoyii*) and their haemogregarine parasites (malaria-like blood protists) to test the hypothesis that parasites are more virulent in the tropics. Studying the interaction between lizards and the haemogregarines over the lizard's geographical range (from tropical to temperate zones) will allow me to address questions about macro-geographical variation in levels of parasitism, virulence and co-evolution. Using a combination of field-work and lab-based research I will compare the behaviour and life-histories of parasitised and non-parasitised *Eulamprus quoyii*, as well as studying the life-histories of the parasites themselves. The interactions of skinks from different geographical populations with different strains/species of parasites of haemogregarine will be elucidated. This poster presents current ideas in the literature with a view to gaining valuable input at an early stage in the study.

Ian AW Scott¹, Brigitte Gottsberger¹, J Scott Keogh¹ and Lin Schwarzkopf²

¹Division of Botany & Zoology, Australian National University, ACT; ²Department of Zoology & Tropical Ecology, School of Tropical Biology, James Cook University, QLD

Phylogeographic relationships among populations of the Eastern Water Skink *Eulamprus quoyi*

The Eastern Water Skink *Eulamprus quoyi* is the most widespread member of the genus, occurring along the coast and ranges of eastern Australia from northern Queensland to southern New South Wales, and extending inland via the Darling River system to north-western Victoria and south-eastern South Australia. Given marked geographic differences in offspring body size and the broad range of habitats in which the species occurs, we were interested in evaluating the phylogeographic relationships among populations. A preliminary phylogeny has been generated using nucleotide sequence data from the mitochondrial ND4 gene. Using other members of the "quoyi group" for outgroup comparison, we have detected extensive genetic divergence and geographic structure among *E. quoyi* populations. The taxonomic implications of these results will be discussed.

Glenn Shea

Faculty of Veterinary Science, University of Sydney, NSW 2000

Spermatogenic cycle seasonality, sperm storage and sustentacular cell size in a southern scolecophidian

Spermatogenesis in the southern Australian blind snake *Ramphotyphlops nigrescens* is seasonal, with sperm production peaking in autumn, reduced in spring, and testicular recrudescence occurring from late spring to summer. Sperm is present in the epididymides from autumn to early summer. The retrocloacal sacs of this species do not function as sperm storage organs, contradicting previous hypotheses on the function of these structures. A peculiar feature of the testes of this species is the very large size of the sustentacular (Sertoli) cell nuclei, much larger than the spermatogenic cells.

Sohan Shetty^{PS} and Richard Shine

Biological Sciences A 08, University of Sydney, NSW 2006, Australia

Philopatry and contrasting ecological traits of sea snakes (*Laticauda colubrina*) from two adjacent islands in Fiji

Even in superficially homogeneous habitats, many kinds of organisms display a high degree of philopatry. This behaviour can result in spatial structuring within a population, such that animals from adjacent patches of habitat differ from each other in attributes such as body sizes, age distributions and growth rates. Such heterogeneity can influence the spatial scale at which localised anthropogenic disturbances impact on natural systems. Over a two-year period, we studied the yellow-lipped sea krait (*Laticauda colubrina*) on two small islands in Fiji. One island was uninhabited by people whereas the other (5.3 km away) was highly modified for tourism. Although foraging movements by these snakes extend over many kilometres, recovery of marked snakes showed that the populations on these two islands were essentially separate. Relocated snakes returned "home" almost immediately after they were released. Snake populations on the two islands also differed in age structure, growth rates and mean adult body sizes. The tourist island had very few young animals, and adult males there were larger, but grew more slowly, than did snakes from the nearby uninhabited island. The high site fidelity of these animals means that activities such as resort development or commercial harvesting for the skin trade are likely to have intense localised effects rather than diffuse broad-scale effects on sea-krait populations.

Rick Shine, L Sun, M Kearney and M Fitzgerald

Biological Sciences, University of Sydney; and Snake Island Natural Protection District, Lushun, China

Adventures in pit-viper paradise

An endemic species of pit-viper (*Gloydius shedaoensis*) occurs in extraordinary population densities on a small island (Shedao) in northeastern China. The snakes feed almost entirely on migrating passerine birds, that use the island as a stepping-stone for migrations in spring and autumn. At these times, the branches of small trees on Shedao are festooned with large snakes lying in ambush for birds. The island has been a major focus of research by Chinese scientists for decades. On recent trips to Shedao, we have gathered detailed information on topics such as the cues that elicit feeding strikes (e.g., the size, shape, temperature and movement of the prey) and the criteria used by the snakes in selecting their ambush sites. Determinants of antipredator responses have also been quantified. Radiotelemetric and mark-recapture studies have commenced. The talk will describe this extraordinary system, and review some of the results from our initial studies.

Michael J Smith^{PS} and J D Roberts

Michael Smith, Department of Zoology, University of Western Australia, Nedlands WA 6907, Australia

Preference patterns of satellite males for advertisement call structure in the frog *Crinia georgiana* (Anura: Myobatrachidae)

Satellite behaviour occurs commonly in the frog *Crinia georgiana*. We tested whether satellite males could recognise advertisement calls that are attractive to females, and thus, presumably increase their potential for reproductive success. Using two-speaker discrimination trials, we showed that satellite males preferred the same call parameters as females - average dominant frequency, higher call rates, and more pulses. However, we did not find any significant differences between the calls of males with and those without satellites under field conditions. Call rate is a particularly variable property and field observations indicate that males increase their call rate in the presence of females. We therefore suggest that our methodology made it difficult to detect preferences for higher call rates, as females were only seen rarely in the chorus. We also argue that a lack of variation in call structure between the males with and without satellites was due to their larger size. Both dominant frequency and pulse number vary significantly with body size, thus limiting the expression of satellite male preferences for these characters. Nonetheless, unlike the males without satellites, none of the males who attracted satellites had a dominant frequency below 2.2 kHz (population average = 2.4 kHz). Females clearly dislike calls with frequencies well below the population average. That satellites avoided males with calls well below the average frequency was taken as evidence that their choice of focal male was, at least partly, based upon frequency. These data demonstrate that satellite males can recognise calls that are attractive to females.

Warwick JS Smith^{PS}

Division of Botany & Zoology, Australian National University, ACT

Phylogeography of Rosenberg's Goanna, *Varanus rosenbergi*: conservation implications

Varanus rosenbergi occurs across southern Australia in three apparently disjunct regions: WA, South Australia/western Victoria and southern New South Wales/ACT. The species is listed as Vulnerable in NSW and there is some concern for the mainland populations in other regions. There are large differences in body size and behaviour between these populations and there has been some speculation regarding the taxonomy of the species which was only elevated from a subspecies of *V. gouldii* in 1980. Before conducting a comparative behavioural study on two of these populations we decided to determine the phylogeographic relationships between all of the populations across southern Australia and determine whether or not we were in fact working on closely related populations. I have developed a well resolved phylogeny using nucleotide sequence data from the mitochondrial ND4 gene. While finding considerable genetic divergence, the results of this work have confirmed that *V. rosenbergi* is a single species across its range and also that its separation from *V. gouldii* was appropriate.

Ricky-John Spencer^{PS}

School of Biological Sciences, Heydon-Laurence Building (A08), University of Sydney, NSW 2006

Predation risk and nesting: the role of the fox in modifying the behaviour of a freshwater turtle

I investigated the influence of predation risk on nest site selection in the freshwater turtle *Emydura macquarii*. Females were observed nesting throughout November (1996-1999) around four lagoons near Albury. Distance from water, nearest nest and tree were measured from females that were nesting. During 1997 and 1998, foxes were removed from two sites using FOXOFF and remained at lower densities prior to nesting in the two removal sites compared to the non-removal sites. Nest predation rates declined by over 50% in the two removal sites, but remained above 85% in non-removal sites. Similarly predation on nesting females was eliminated, but remained at 2-3% at non-removal sites. Female turtles nested much further away from water when foxes were removed and as a result, nests were less clumped and away from trees. Lower densities of nests that are far from trees reduce nest predation because predators increase search efforts in higher density areas and birds are more likely to destroy nests close to trees. Thus, a trade-off between decreased hatching

success and the risk of direct predation by foxes may occur. Foxes are not native and perhaps the presence of predators in nesting areas deters turtles from nesting in preferred areas. However I tested whether olfactory cues such as fox bedding and faeces, as well as that from a native predator, influences nesting behaviour. Preliminary results from this experiment will also be discussed.

Jessica Stapley^{pg}

Division of Botany and Zoology, Australian National University, ACT

Behavioural responses of the skink *Pseudemoia entrecasteauxii* to the chemical stimuli of snakes

Chemoreception has been shown to play an important role in many aspects of lizard behavioural ecology including in the detection of predatory snakes. Most studies have measured differential tongue-flick rates in response to chemical stimuli of predator snakes and non-predatory snakes. Differences in tongue-flick rates allow authors to make inferences about the adaptive significance of discrimination between these chemical stimuli, however fail to reveal the subsequent predator avoidance strategies adopted by the lizard. Behavioural responses of lizards to snake chemical stimuli may vary with snake species and foraging mode of the snake. In order to determine if skinks show differential behavioural responses to snake species I investigated retreat-site selection and daily movement patterns of the skink *P. entrecasteauxii* when confronted with a variety of snake species chemical stimuli. The results of a series of laboratory experiments will be described that investigated the behavioural responses of lizards to the chemical stimuli of five species of snakes.

Adam Stow

Department of Biological Sciences, Macquarie University

The impact of habitat fragmentation on dispersal of Cunningham's skink (*Egernia cunninghami*): evidence from allelic and genotypic analyses of microsatellites

The effect of habitat fragmentation on processes within and amongst populations is important for conservation management. Despite a broad spectrum of lifestyles and the conservation significance of many reptiles, very little work on fine-scale population genetics has been carried out on this group. This study examines dispersal patterns of a rock crevice-dwelling lizard, Cunningham's skink (*Egernia cunninghami*), in a naturally vegetated reserve and an adjacent deforested site. Both genotypic and genic approaches were employed, using microsatellite loci. The spatial organization of individuals with respect to pairwise relatedness coefficients and allele frequencies, along with assignment tests, were used to infer dispersal characteristics for both sexes in the natural and cleared area. The distribution of relatedness in both habitats was spatially structured, the *E. cunninghami* showing relatively high pairwise relatedness within their rocky retreat sites. Analysis of relatedness over different spatial scales, spatial autocorrelation of alleles, and assignment tests, all indicated that both sexes in the cleared area show less dispersal than their counterparts in the reserve. Furthermore, deforestation inhibits female dispersal to a greater extent than males. The geographic structuring of allele frequencies for adults in the cleared area, but not the reserve, indicates that habitat fragmentation has the potential to alter at least the microevolution of *E. cunninghami* populations.

Roy Swain and Andrew Welling

School of Zoology, University of Tasmania

Life at the end of the line: agamids in Tasmania [poster]

The Mountain Dragon, *Tympanocryptis diemensis*, is Tasmania's only agamid lizard. It is widely distributed around the island, being found mostly in warmer habitats, but also on the Central Plateau where, until recently, the Australian Antarctic Division used to conduct survival training! Since Australian agamids are generally associated with warm/hot habitats, operate at relatively high body temperatures, and are oviparous, the cool temperate, and often unpredictable climate of Tasmania presumably presents a number of challenges. However, our preliminary investigations of the reproductive and thermal biology of this species suggest that it meets these without major departures from the agamid 'party line'. A selection of the more interesting data is presented, dealing with sexual dimorphism, reproduction, and thermoregulation.

Jennifer E Taylor^{pg}

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Comparison of the thermal biology of sympatric *Ctenotus robustus* and *Ctenotus taeniolatus*

Ctenotus robustus and *C. taeniolatus* (Scincidae) are sympatric on the regenerating sand-mined areas of coastal dune systems of Tomago Sandbeds and Myall Lakes National Park, NSW. Neither species is present in adjacent forest similar to the forest that occupied the dunes prior to sand mining. On average the larger species, *C. robustus*, inhabits less vegetated areas than *C. taeniolatus*, although the two co-exist at medium vegetation densities. One possible explanation for this habitat selection is that these species have different thermal requirements. Here I report on laboratory and field experiments to examine how thermal requirements may affect the pattern of abundance of these two species. In laboratory a thermal gradients *C. robustus* selected a higher mean body temperature than *C. taeniolatus*. In the field, I used copper models to measure the range of operative temperatures available to the lizards across the range of vegetation densities inhabited by these species in sand-mined coastal dunes. Both field and laboratory data suggest that thermal requirements may affect the pattern of abundance of *Ctenotus robustus* and *C. taeniolatus*. However, this does not preclude other factors such as interspecific competition, dietary differences or differential predation from also affecting the pattern of abundance of these two species.

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Home ranges of Fitzroy Turtles (*Rheodytes leukops*) overlap riffle zones: does flow regulation threaten a critical microhabitat?

The endemic Fitzroy Turtle is reputed to be highly dependent on riffle zones of free-flowing rivers, yet no detailed longitudinal studies have clearly quantified this affinity. We used radio telemetry to determine home ranges of ten Fitzroy Turtles (*Rheodytes leukops*) at the type locality. During periods of active stream flow, females remained in or within a few hundred meters of the prominent riffle zones. As stream flow declined in the dry season, females moved to the deeper sections of pools upstream or downstream of the adjacent riffle zone. Female home ranges approximated the average distance from a riffle focal zone. The home range overlaps with riffle zones raise a vital concern about the loss of fluvial habitats on the main-stem and tributaries of the Fitzroy River. As riffle habitat included the core activity area for both sexes of *Rheodytes*, protection of these areas is recommended.

Erik Wapstra^{1,2}

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How to cope with being a Tasmanian (lizard)

Tasmania has a restricted reptile fauna represented by just 20 species (16 skinks, 1 agamid and 3 elapids). The genus *Niveoscincus* ("snow skink") has 7 species within Tasmania. The genus contains some species that have highly restricted distributions and are highly adapted to cold alpine conditions; other species have a wider geographic and climatic distribution. The spotted skink, *Niveoscincus ocellatus* is a widely distributed small to medium size skink (3-12 g) which occurs throughout eastern and central Tasmania in a variety of climatic regimes. This study describes the life history and reproductive adaptations at the climatic extremes of the species' distribution. *Niveoscincus ocellatus* shows major reproductive cycle adaptations (viviparity, overwinter sperm storage with concomitant asynchrony of male and female gonadal cycles) that are often associated with colder climates. However, this species maintains essentially the same reproductive pattern

throughout its range, despite occurring sympatrically at high altitude with alpine species that show unusual biennial reproductive patterns. There are however, large differences in key life history characteristics between sites. For example, cold site individuals adults are significantly larger, mature later (and at a larger size) and have larger clutches of larger offspring. Through a series of investigations, I show that the reproductive events and life history traits of *N. ocellatus* are phenotypically plastic, responding predominantly to temperature. These two populations are presently and historically geographically isolated leading to genetic divergence, yet investigations failed to detect underlying genetic differences able to account for the observed life history differences.

Pat Whitaker and Rick Shine

School of Biological Sciences A08, The University of Sydney

Thermal biology and activity patterns of the Eastern Brownsnake (*Pseudonaja textilis*): a radiotelemetric study [poster]

Eastern brownsnakes (*Pseudonaja textilis*) from south-eastern Australia are alert, well-camouflaged, secretive, fast-moving and dangerously venomous, and spend much of the time hidden in burrows. Thus, direct observation of this species is difficult. However, distinctive patterns in environmental thermal heterogeneity, coupled with knowledge of the snakes' thermal preferences, enabled us to infer their location and activity based on remotely-monitored body temperatures (obtained from surgically implanted radio-transmitters). We used data on 40 radio-tracked snakes to evaluate patterns of thermoregulation, activity and habitat use. Captive snakes actively selected body temperatures around 31°C, and free-ranging snakes displayed similarly high body temperature levels while active. From data on temperatures of the soil, operative models and shaded air, we could reliably identify activity schedules of the snakes (especially, times of emergence from and retreat into burrows). Snake activity was bimodal over the year, with the highest incidence of above-ground activity in late spring and late summer. Thermal profiles suggest that inactive snakes in burrows spent most of their time at approximately 20 cm depth, but moved to shallower depths at some times (e.g., during summer, when they sometimes spent entire nights above-ground) and to deeper depths at others (e.g., ≥ 40 cm in winter), while reproductive females with eggs in mid-summer occurred at about 30 cm. Burrow temperatures were frequently high, so that the snakes did not need to emerge in order to elevate body temperature. Overall, the telemetered snakes spent an average of 56% of active-season days, 64% of all days, and 93% of all hours below-ground. Hence, this species largely depends on in-ground temperature for thermal energy exchange.

Arthur W White¹ and G. Daly²

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Current distribution of the Barred River Frogs *Mixophyes iteratus* and *M. balbus* in central and southern New South Wales

The Giant Barred Frog *Mixophyes iteratus* and the Stuttering Frog *M. balbus* are listed as "endangered" and "vulnerable" respectively on the *NSW Threatened Species Conservation Act 1995*. Field observations suggested that both species had undergone a range contraction in the last thirty years, particularly in the southern portions of their ranges. Extensive surveys, commissioned by the NSW National Parks and Wildlife Service were undertaken in 1999/2000 for both species in the area from the Victorian border northwards to the Hunter River. All historical sites were surveyed and survey methods followed prescribed methods involving transects and playback recordings. In addition, areas of suitable habitat where the frogs had not been recorded were also surveyed. Over 200 sites were surveyed. 16 sites were found where *M. balbus* was still present while only 5 sites were found with *M. iteratus* still present. *M. balbus* was only found in three locations south of Sydney while 13 sites were confined to the central coast with most sites being in the Watagan Mountains. No *M. iteratus* populations were found south of Sydney and all 5 extant populations were confined to the Watagan Mountain block. Altitude and geographic trends were evident in the change of distribution of both species. There was also some evidence for a reduction in usage of particular habitats.

Arthur W White

Biosphere Environmental Consultants, Rockdale, NSW

Impact of chytrid disease on a captive population of Green and Golden Bell Frogs [poster]

In 1997, a small pond was created in Marrickville in central Sydney. The pond was designed to test the idea that back yard frog ponds could be used as a conservation approach in protecting Green and Golden Bell Frogs, a species that is continuing to disappear from natural sites in New South Wales. 22 tadpoles were released into the pond in March of 1998. The tadpoles were monitored by a community group ("Friends of the Green and Golden Bell Frog" - Marrickville chapter) as were the juvenile frogs that were produced. By the following spring 14 adult frogs were present in the pond (which was fenced off to prevent unwanted species from establishing in it). As female Bell frogs do not sexually mature, no breeding occurred in the pond that year. Some frog deaths resulted from attacks by black rats *Rattus rattus*. In June 2000, part of the frog fence was taken down and four Striped Marsh Frogs *Limnodynastes peronii* entered the pond. In July, the first deaths of Bell frogs to chytrid resulted. Dead frogs were autopsied by Dr Karri Rose of Taronga Zoo. By August, only one Bell frog remained alive (and this frog is still alive). More Bell frog tadpoles will be introduced into the pond in December 2000, after the pond has been slightly salinised. This pre-treatment of Bell frog ponds needs to be tested as chytrid disease will ultimately affect all captive Bell frog populations.

Arthur White

Biosphere Environmental Consultants, Rockdale, NSW

Using frogs as indicators of urban stormwater pollution [poster]

Many organisms are sensitive to pollutants. Some of these organisms have been used in the monitoring artificial compounds under controlled conditions. However, relatively few organisms have been tested in field conditions against a variable array of substances. Macro-invertebrates have been increasingly used to assess water quality with changes in species abundance and type being the indicators of levels of water pollution. In 1998/1999 matched field surveys designed to test local frog species as indicators of water quality were carried out in the Blue Mountains, west of Sydney. Twenty two pairs of sites were chosen and each pair of sites was surveyed on the same night. Each pair consisted of an upper catchment comprising a first order stream and associated perched swamp. Sites were matched according to elevation, aspects, hydrology and vegetation, the major difference being that one catchment was within an urban run off area while the other was not. Frogs surveys consisted of line transects, measures of frog calling intensity and frequency and tadpole surveys. By examining the differences in the number of frog species present, differences in calling parameters and tadpole abundances, the urban-affected sites could be ranked according to the level of disturbance of the frog community. In addition, the frog species could be ranked according to their level of sensitivity to urban pollutants i.e. most sensitive to least sensitive species. Using frogs as bio-indicator organisms of urban pollution appears to be a cost-efficient method of environmental monitoring.

Arthur W White

Frog and Tadpole Study Group of New South Wales

Standardising frog common names [poster]

In 1997 the New South Frog and Tadpole Study Group (FATS) was approached by local and state governments agencies to recommend a list of preferred common names for frogs. Government agencies found that there was not a commonly agreed set of names and that disputes had erupted over the use of certain common names. In undertaking this task, FATS sought to initially survey the general herpetological community to determine the range of common names currently in use. 230 survey forms were distributed, 64 were returned. The full range of common names used were tabulated in order of their most frequent use. The second phase of the survey entails asking herpetologists to consider the names in use and to rank them in order of suitability. The criteria that are being requested in assessing or ranking the names are: the common name should be correct; the common name should convey some meaningful information about the species; the common name

should allow for an Australia-wide perspective of frog names (instead of a local or regional basis for the name); where possible, the names should be consistent with natural groups (e.g the common names for *Pseudophryne* toadlets should indicate a relationship to other members of the genus). Response forms will be available at the ASH meeting. All registrants with an interest in frogs will be asked to complete the forms and return them as indicated. All respondents will be notified of the result of the survey and be asked to also contribute to the third phase of the survey. In the third phase a preferred list of common names will be circulated for formal vetting by the herpetological community.

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Adrenocortical responses of sea turtles to stressors during breeding and non breeding seasons

As part of a larger study of the reproductive endocrinology of marine turtles in Eastern Australia we have studied the adrenocortical responses of loggerheads (*Caretta caretta*) and green sea turtles (*Chelonia mydas*) over a five year period. Females have been sampled at nesting beaches under a range of natural conditions including remote beaches with extremely high and low densities of nesting turtles. Naturally stranded females exposed to extreme heat stress have been sampled as well as nesters exposed to a large number of tourists. Breeding male turtles have been sampled during participation in both sedate and violent scramble mating bouts. Males and females of various ages have also been sampled during non-breeding seasons during which they have been subjected to capture and holding protocols. Our data suggest that marine turtles are capable of physiologically inactivating or modulating their adrenocortical responses during the breeding season. Corticosterone, the primary glucocorticoid produced by turtle interrenal tissue, varies during the nesting season with maximal levels (up to 10 ng/ml) being found during later nesting episodes. These changes are unrelated to acute stress. Breeding females and males do not elaborate significant amounts of corticosterone in response to conspecific disturbance, human interference or even, remarkably, exposure to lethal temperatures. The seasonal corticosterone profiles may reflect altered metabolic status during the prolonged energy-consuming nesting season during which the animals are aphagic. Nonbreeding adults, subadults and juveniles, in contrast, exhibit significant adrenocortical responses to capture and handling during the internesting season. This finding is significant because it is during this period many turtle populations experience significant potential stressors. These include exposure to water pollution and pathogens as well as a high incidence of fractures resulting from boat strikes. Elevated corticosterone levels during the nonbreeding season may increase susceptibility to pathogens, may inhibit fracture healing, and may contribute to slow growth rates. Susceptibility to stress during the internesting period may also prevent accumulation of lipid stores used for future breeding seasons.

Steve Williams, Samantha Fox and Emily Bolitho

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Wet Tropics vertebrate database [poster]

One of the key tools needed to examine the determinants of rarity is a detailed database that compiles the distributional data, taxonomy, conservation status and ecology of each species. We have constructed this database and the collation of data is ongoing. To date, we have over 40000 point records of vertebrates within the region and expect the total to be over 100000. These data will provide an extremely valuable tool in modelling distributions, analysing patterns of rarity and examining the ecological correlates of rarity. We will be able to produce the first detailed maps of rarity and biodiversity hotspots throughout the region. We ask the help of anyone who is willing to provide us with precise locality data for any vertebrate species in the region. All sources of data are recorded in the database and will be cited in any use of these data.

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Understanding rarity in rainforest vertebrates: filling in the gaps

Three different forms of rarity are currently recognized: abundance rarity, geographic rarity and ubiquity (or patchiness). Detailed distributional data is a necessity in order to examine geographic rarity. Our first aim is to compile point data on all species and to complement existing data with field surveys. The field surveys will be targeted, using an environmental gap analysis, to fill gaps in both geographic and environmental space. We will then use spatial modelling to produce fine-resolution distribution maps of all the vertebrate species. The distribution maps will provide an estimate of geographic range size that can be used to examine patterns of geographic rarity, biodiversity and environmental correlates throughout the region. Analyses relating the relative rarity and the ecological characteristics of each species will increase our understanding of why a species is rare. These outputs will have major implications for conservation and management since we will provide improved distribution maps for each species, regional maps of the hotspots of diversity and rarity and a greater understanding of the determinants of rarity in the region. Here we detail the methods we have used to identify gaps in environmental space and some examples of the preliminary results.

Yvette Williams, Chris Johnson and Ross Alford
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Rarity of microhylid frogs in the Wet Tropics

Ten species of microhylid frog of the genus *Cophixalus* are endemic to the Wet Tropics of North Queensland. While some of these species occur across most of the Wet Tropics region, some species are restricted to single mountain ranges. This project investigates the ecological reasons behind the geographical rarity of these species: that is, comparing the ecological characteristics of restricted and wide-spread species. I will be investigating the potential versus realised habitat distribution of each frog species to look at climatic and vegetation requirements. Additionally, I will compare the diet, age structure, behavioural ecology and reproductive biology of rare and common species. Preliminary results suggest that: there is no relationship between geographical rarity and local abundance; there is no relationship between geographical rarity and body size; reproductive biology appears to be similar between common and rare species; diet appears to be similar between rare and common species; species differ in their calling microhabitat. These results and their implications for determinants of rarity are still being examined.

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Variation in call rate at different temperatures is related to social environment

The effects of social environment and temperature on frog calls often have been considered in isolation without regard as to how these important variables might interact to influence calling. We sought to redress this deficit using a winter-calling population of the common eastern froglet (*Crinia signifera*) in the Australian Capital Territory. By recording and analysing the calls produced by individuals throughout the calling season, we found that social environment affected the calls of frogs at particular temperatures. Duetting animals alternated their calls with their neighbours to avoid signal overlap and called at rates that were independent of temperature. However, calling in solitary animals was found to be highly temperature sensitive with frogs increasing their call rate with temperature in a manner consistent with the patterns reported in other frog species. In contrast, chorus participants showed an inverse temperature response to those of solitary callers: the mean call rate of chorusing individuals at 8°C was comparable to the rates being attained by solitary animals at 11°C. These results probably reflect individual differences in the inherent physiological capacities needed to sustain the cost of call production at various temperatures. The results also show that in the face of intense vocal competition, some individuals in the population are able to attain the highest call rates during the coldest times of the year.

Doug Woodhams^{pg}

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The effects of temperature on the activity and immune function of a tropical rainforest frog, *Litoria genimaculata*

Amphibian population declines have occurred in many species throughout tropical North Queensland (McDonald and Alford 1999). Disease is a suspected factor in many of these declines, especially in areas protected from direct human impacts (Daszak *et al.* 1999). Because declining frogs of North Queensland are generally high elevation species, and many species show seasonal variation in rates of population decline, cold temperatures are implicated as one factor underlying the susceptibility of frogs to disease and subsequent population declines. One approach to examining the hypothesis that environmental stressors increase the susceptibility of frogs to infection is to determine how frog behaviour and physiology respond to environmental stress, such as prolonged cool temperature. Although some temperate zone amphibians species show immune system suppression when exposed to very low temperatures (5°C), no studies have examined tropical species exposed to relatively low temperatures. Green-eyed treefrogs, *Litoria genimaculata*, occur at high and low elevation in tropical rainforest streams, and are sympatric with declining species. Their populations have declined in the past, but subsequently recovered. Sixteen *L. genimaculata* were placed in two temperature treatments, 15°C and 25°C, for a period of 4 weeks. Blood samples of 8 frogs were obtained immediately upon capture and all frogs were sampled after 3 weeks in captivity. Developmental asymmetry, differential leukocyte counts, and an immunosuppressive hormone (corticosterone) were measured to determine relative stress and immune condition. In addition, microhabitat use and activity were recorded daily, and natural chytridiomycosis infections were diagnosed. Contrary to expectations, preliminary results suggest that frogs in the warm treatment group were more stressed, and also more active.