SID NEWS

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DEPARTMENT OF PARKS AND WILDLIFE

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Edited by Pam Burgoyne and Kathryn Lee, WA Herbarium, Locked Bag 104, Bentley Delivery Centre, Como WA 6983 ph (09) 334 0500 fax (09) 334 0515 email: pamb@calm.wa.gov.au

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Editor's notes

contributed by Pam Burgoyne

It is with bitten fingernails that I write this, as it has been nervewracking putting together this issue for the Web. Kathryn and I just hope you'll find the new format appealing and easier to use than our previous hard-copy-only issues. We are asking all centres to have hard copies available for those people who are not linked to Netscape so that nobody misses out. Anyway, please provide us with feedback. You can do so by email, of course! We expect some negative responses, as it is hard to please everyone, but we acknowledge that this migration to the Web was inevitable. So, here we go!

P.S. I had a last second news flash from Jack Kinnear as follows:

> The CRA funded Calvert Range Rock-wallaby Project has been renewed for a further two years. The initial grant was for $49,000 and the renewal funds amount to $37,000. Jack Kinnear says, "I was pleased that the report I wrote covering our work since 1994 was well received. We believe that we have arrested the decline and we hope that the population will recover in due course."

pamb@calm.wa.gov.au

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SID Safety Statistics

contributed by Neil Burrows

The following graph summarizes all available data concerning SID's safety record and puts this record in the Departmental context.

Two conclusions may be drawn from the information presented:

1. The frequency rate of lost time injuries is lower in SID than for the Department overall.

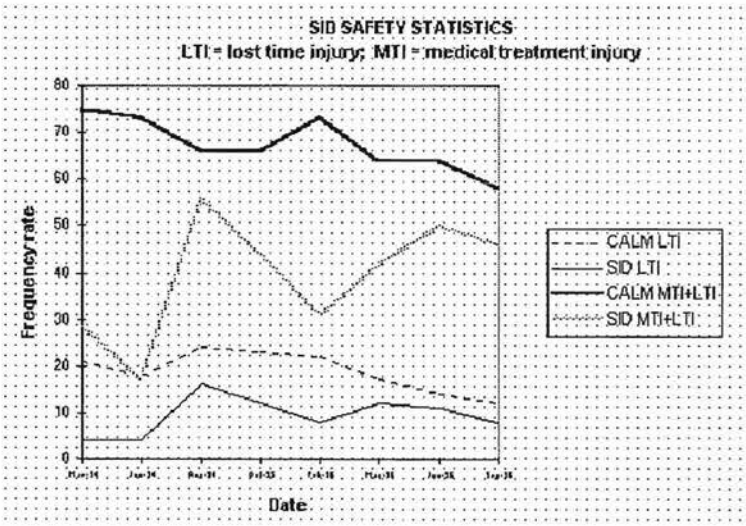
2. The frequency rate of lost time injuries combined with medical treatment injuries is lower in SID than for the Department overall.

In both cases, frequency rate is calculated as the number of occurrences in each 3 monthly period x 106/total hours worked.

SID places great importance in providing a safe working environment for all staff. Interestingly, the graphs reveal that our safety record was better 3 years ago.

As a first step in improving our safety record, I suggest that all staff re-familiarize themselves with Staff Guideline No. 2 (Safety) and the relevant portion of Staff Guideline No. 1 (Appointment and Induction of Staff).

It is also essential that the Health and Safety Committee at each Research Centre meets regularly and is pro-active in promoting safety issues.



neilb@calm.wa.gov.au

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Herbarium

contributed by Pam Burgoyne

We have had a flurry of new volunteers very recently which has kept Chang Sha on his toes with delegating tasks. The Wildflower Society volunteers have been working very hard on the WA Flora Image Database and have scanned more than 2000 slides, making >200 composites, where possible of four slides each showing botanical details. They have gone through one third of the Rare Taxa list and are asking for donations of slides of these species. If anyone out there has a possible donation, Kath Napier will send you a list on request. You can have a look at what they've done so far on Netscape.

New bright shiny face at the Herbarium is Russell Miners, who has come to be Technical Officer for Margaret Byrne, who, by the way, was the only lady who received floral attention on Valentine's Day.

After spending about 9 months working for the Information Management Branch, Diane Johns has decided to take up their offer to remain there permanently as a Level 1 officer. We have put out an "Expressions of Interest" and have had some responses. Hopefully, in the very near future we'll have a new receptionist for the Herbarium. Of course, we have been blessed with having Marilyn Mawkes and Angie Walker job sharing all the time that Di has been away, and owe then a huge "thank you" for their splendid efforts.

Sheila Hamilton-Brown and Ben Richardson will be doing a few week's contract work for Terry Macfarlane so we'll be continuing to see them awhile longer.

Leigh Sage has finished his stint as liaison and ID botanist funded by Greening WA and other groups. Leigh will be working with Patrick Pigott for the next 3 months on the salmon gum woodland SPP. The main tasks will be manuscript preparation and data analysis. Hopefully several publications will eventuate.

Also, Patrick has finally been able to get a weeds story into Landscope - watch out!

Had a surprise last week when the fire alarms suddenly went off unexpectedly causing a huge fire truck to arrive and security people scurrying around. Now, it wasn't quite chaotic, really, people were calm and got outdoors alright, but it certainly highlighted some problem areas for us and galvanised us into modifying our evacuation procedures. We still don't know why the alarms were triggered. Perhaps some divine finger pushed a button to remind us that we need to keep ourselves organised? Something for the X-files.

Other BIG news is that Bruce Maslin has moved from Bioresources group into Sustainable Resources, although he will continue to work from the Herbarium so we won't actually be "losing" him.

pamb@calm.wa.gov.au

The Scarlet Pimpernel Strikes Again *contributed by Ray Cranfield*

They seek them here and they seek them there; those elusive drug bearing taxa. CALM's bioprospecting team has now been actively collecting and sampling the State's flora, ensuring that all collections are vouchered in CALM Herbarium.

As a result of this collecting activity several important discoveries have been made and these have helped enhance the state collection. We have rediscovered extinct species, new species records for the state, several undescribed taxa, many morphological variants and many range extensions.

The herbarium now stores non-flowering specimens if they voucher an ecological record or other science information. The bioprospecting venture has already added a lot of information about species such as when their seeds are dropped, what shape are the leaves they retain over summer, We have collected plants under stress for various reasons including summer heat in an attempt to see if there are resulting chemical changes.

The scarlet refers to the red complexion of the collectors (40+ days) and the blue pimpernel emerges frequently on days below 10 degrees.

rayc@calm.wa.gov.au

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Woodvale Library *contributed by Lisa Wright*

The indexing of the Centre Archives has begun. All archived Admin files and documents have been sorted, indexed, boxed and shelved. Data sheets and files belonging to Steve Hopper and Grant Wardell-Johnson have also been done. Hopefully indexing of all the kangaroo information currently on the Archive shelves will commence soon! Then I will start gathering archival materials from other people around the centre for indexing and storage.
lisaw@calm.wa.gov.au

Woodvale Centre *contributed by Judith Harvey*

Woodvale Awards 1996 were presented at the Christmas party on 20th December.

David Pearson was awarded the Safety Award which was given for almost cutting his leg off with a chainsaw while up a tree trying to capture a python at Dryandra.

Catering Award to Jill Pryde for creating recipes to use the 24 two kg cans of beetroot which were sent to the Montebello Islands instead of tomatoes.

The Gardening Award went to Jane McRae for introducing a new species of kangaroo paw *Angiozanthus prostrata* to the court yard when she fell down during the Beer Fest.

Best Criminal Impersonation to David Algar for impressing 2 detectives who risked life & damaged professional pride to arrest him as being an escaped prisoner at the Moon and Sixpence.

The Big Kid Award to Grant Pearson for fighting the gathering years by buying more new toys this year.

The Best Dressed Award to Peter Orell for wearing a cute little lemon banlon nightie to morning tea one morning. Rumour has it that he was going to wear it to the Woodvale Christmas party and sit on Father Christmas's knee.

Alan Clarke, Emma Holland and Neil Thomas tied for first place in the Fecundity Award (most children in one year) for helping to add to population expansion during the year with one child apiece (all females! What *is* in the Woodvale water?)

The 1996 Productivity Award went to Greg Keighery who submitted 13. papers for publication. He was closely followed by Tony Friend with 12 and Neil Gibson with 9.

Val English was awarded this years 'I promise I won't do it again Award' for not acknowledging funding agencies in her Report. P.S. Can you please fund her again?

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Manjimup Centre Notes

contributed by Lachie McCaw

Staff

Richard Mazanec has taken over the reins as Manager of the Manjimup Research Centre from Lachie McCaw, who had been Centre Manager since 1988. As well as providing the opportunity for Richard to gain experience in the position, the move will allow Lachie to concentrate on his role as Manager of the Natural Products Section, and on several new research projects.

Adrian Wayne has been appointed on a three month contract at Manjimup to work on forest ecology research at the Kingston project. The Forest Ecologist position is to be re-advertised within a month or two, as the applicant recommended in the previous selection process declined the position at the last moment.

Tingle seeding study

Study of post-fire recruitment of Red Tingle and Karri seedlings

Seedling recruitment of Red Tingle and Karri is being studied in two areas of mature forest in the Walpole Nornalup National Park that were burnt in autumn 1996.

The purpose of the study is to investigate the extent of seedling regeneration that occurs following low to moderate intensity fires in Tingle/Karri forest, and to monitor the subsequent survival and growth of seedlings.

There is ample evidence of successful regeneration of both species following high intensity wilfires such as occurred in 1937 and 1951, and following the timber harvesting operations in Giants block during the early 1970's. However, the extent of regeneration following less severe forms of disturbance, such as prescribed burning, has not been investigated.

During August 1996, transects to monitor seedling emergence were established in burnt stands of Red Tingle and Karri located near Shedley Drive, west of Walpole, and near Anderson Road in the Giants block. Two transects were established at each location, one beneath a full overstorey canopy and the other in an opening up to 50 metres across. Each transect consists of ten quadrats of 1 m2 area spaced at 10 m intervals. The number of seedlings of Red Tingle and Karri has been recorded within each quadrat at approximately monthly intervals since August. Individual seedlings have been marked with coloured sticks to allow detailed assessment of germination and mortality during the course of the study. Seed bed conditions within individual quadrats, and the basal area and height of the overstorey trees have also been assessed.

Care was taken to examine the distinctive features of cotyledons and juvenile leaves on each species to ensure that seedlings were correctly identified. Seed of known source was germinated and grown at the CALM Research Centre in Manjimup to confirm observations of seedling characteristics made in the field.

Initial seedling densities varied considerably, with some quadrats containing up to 32 Red Tingle seedlings per m2 and up to 17 Karri seedlings per m2. Other quadrats did not contain any germinants of either species. Seedling numbers did not change appreciably between August and November, but since then many of the smaller seedlings have died, presumably due to water stress.

Both Red Tingle and Karri seedlings have exhibited best growth on the edges of ashbeds created where logs and fallen branches have burnt away. This confirms previous work on the regeneration of Karri which demonstrated enhanced growth on ashbeds. However, seedlings of both species germinated on a wide range of other seedbeds, including fallen logs and unburnt mineral earth. To date, some seedlings still survive on these microsites.

Monitoring of seedling numbers will continue on a monthly basis until August 1997, after which time the future of the study will be reviewed. Surviving seedlings will be measured periodically to determine their rate of height and diameter growth and the time required to reach sapling size.

lachie@manji.sid

Science

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ISS

contributed by Nicholas Lander

Paul Gioia has recently completed studies at the University of Western Australia towards a Post-graduate Diploma in Geography from which he has graduated with distinction. Paul has put an enormous amount of work into this course, especially his thesis entitled *The role of Geographic Inforamtion Systems and expert systems in developing catchment plans based on sustainable land use principles,* copies of have been placed in CALM libraries. Paul's research showed that the large number of datasets involved in the decision-making process provided a complexity that could only be effectively managed by employing GIS methodology. Many aspects of the planning process were able to be formalised within a GIS environment, such as as alternative or competing land-use priorities) so that multiple 'what-if' scenarios could easily be evaluated. The outcomes from this research are of potential benefit to stakeholders within the catchment planning process so that both conservation and economic requirements can be taken into account. A paper on this work presented at the *10th Annual ESRI and ERDAS Conference* is in press.

Alex Chapman and Paul Gioia were employed as consultants to advise the Botanic Gardens and State Herbarium of South Australia on developing their Plant Biodiversity Information System resulting in a substantial and far-reaching review of their systems and data management. This is the second such study carried out by Alex and Paul, the earlier one being a similar review of the Queensland Herbarium some years ago.

The Web interfaces to the WA Herbarium's Census, Specimen and Library databases have been substantially improved. In particular, considerable integration of the Census and Specimen databases has been achieved, and systems established whereby it is is now possible to call up relevant photographic images and images of protologues (first descriptions) of WA plant species. To test the latter point your WWW browser to

http://herbarium.calm.wa.gov.au/bin/texhtml?form=wacensus

or navigate to this form via

CALM Web / Divisions / SID / SID Corporate Databases / WACENSUS.

Enter the genus name *Banksia*, and click on 'View all Details'. Once the query report is displayed clicking on the thumbnails will bring up a photographic image, where avaiable. Similarly, clicking on PROTOLOGUE or DESCRIPTION will bring up the relevant details.

Our current preoccupations include work on the ANCA-funded Dieback Decision Support System and with the assessment of data audit methods associated with the Regional Forest Assessment project.

New LAN servers have now been installed at the Woodvale and Herbarium/Como sites along with upgraded versions of our LAN software. Despite some teething

problems, this equipment is now up and running with a decided improvement in performance and increased ease of maintenance. This is state-of-the-art equipment and is uniform with that adopted elsewhere in CALM. One of the old servers is shortly to be deployed in Bussleton in order to create a much-needed LAN at that centre.

nickl@calm.wa.gov.au

Database News *contributed by Michael Yung*

A Database named 'Prey Species Trapping DB System' was designed and implemented for the project Control and Ecology of the Red Fox in W. A. - native fauna response. We used fully relational database techniques, with properly Normalised tables. The software used was MS Access V2, whose Forms facilities provide a reasonable user friendly front-end for data entry and querying.

The beta testing of this system is now over and it has now been in production for eight months with stability. This proved to be a good example of ecological database for future reference.

mikey@calm.wa.gov.au

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Approved for Publication *contributed by Christine Farrell*

Keighery, G.J. A new subspecies of *Lambertia echinata* R.Br.(Proteaceae)

Keighery, G.J., Gibson, N., Keighery, B.J. Floristics of reserves and bushland areas in the Perth region. Part XV. Floristics of seabird bushland

Kingsford, R. T. and Halse, S.A. Waterbirds as the 'flagship' for the conservation of arid zone wetlands ?

Maslin, B. R. and McDonald, M.W. A key to useful Australian acacias for the seasonally dry tropics

McCaw, W.L. Live foliage moisture content of shrubs in south-western Australian mallee-heath

McDonald, M.W. and Maslin, B.R. *Acacia colei* var. *ileocarpa*, a new varietry of Acacia from the tropical dry-zone of north-west Australia

Patrick, S. The plants collected by JAL Preiss in 1839 from Mt Blakewell, an important remnant of natural vegetation in the York area

Patrick S. and Brown A. Declared rare and poorly known flora in Moora District

Pigott, J.P. Remnant vegetation at Yilliminning Rock

Rye, B.L. The Rhamnaceae of the Kimberley region of W.A..

Rye, B.L. A synopsis of the annual species of Cyperaceae from central and southern W.A

Rye, B.L. Three new annual species of *Schoenus* (Cyperaceae) from the south-west of W.A..

Rye, B.L. and Trudgen, M.E. A new species of *Dicrastylis* and notes on other Chloanthaceae in the Shark Bay area of W.A.

Ward, D.J. and Lamont, B.B. Probability of Balga Grass trees (*Xanthorrhoea preissii*) flowering after summer fires

Wheeler, J. Wildflowers of the south coast

Williams, A.J. Initial statistiscs from the Perth automated supernova search

Williams, A.J. and Martin, R. Teljoy telescope control software

christinef@calm.wa.gov.au

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Rock-Wallaby Population Genetics and the Caughley Paradigms

contributed by Jack Kinnear

The Scene

In 1978 when Michael Onus and I carried out a survey of the wheatbelt rock-wallaby (RW) populations, it soon became apparent that there was cause for concern. One population had recently become extinct and the remaining populations had declined. Three populations consisted of fewer than 10 animals.

My initial gut feelings focused on a nutritional hypothesis as the probable cause of the decline, but this soon became untenable. By then, the predation factor had become paramount and research on fox control dominated our activities. The outcome is well known and has endured over the years.

But despite this outcome, a worrying factor has kept surfacing over the years namely, the prevailing population genetics of these five RW population-isolates.

It all started with the book Conservation Biology: An Evolutionary-Ecological Perspective. (Ed. by Soulé and Wilcox, 1980) and the literature on this subject has continued unabated. Soulé and his bandwagon of apostles seem to have set themselves the task of alerting the world about the plight and dire consequences of small populations. A new and ominous acronym was coined — MVP i.e., minimum viable population. Initially, we were solemnly informed that at least 50 randomly breeding animals were needed to qualify as a MVP in the short term, and that, at least 500 individuals were necessary to prevent genetic deterioration in the long term.

Apparently, when these pronouncements reached down under, Soulé was conferred the status of an oracle by some unnamed Australian wildlife biologists (no doubt from the E. States). By phone they sought his opinion on a parrot sp. whose numbers had dwindled to 48. Could the sp be saved or should they forget about it? After all it was two short of the magic number. Really, sometimes I wonder...

According to the Soulé camp (Viable populations for Conservation. Ed. by Soulé, Cambridge Uni Press 1987) genetic damage occurs when populations collapse into a small heap and the longer they remain so, the greater the damage. The initial guess about a MVP necessary to maintain genetic integrity has now escalated and a new threat — "mutational meltdown" — has been uncovered (presumably on a blackboard; see Science Vol. 270; Oct. 1995, p. 31-2; and Lynch (1996) in: Conservation Genetics. Ed. Avise, J.C. & Hamrick, J.L.; Chapman & Hall).

Meltdown results from the accumulation of unpurged mildly deleterious mutations that become fixed leading eventually to extinction. To counter meltdown one needs an effective population size (Ne) of »1000 (which may mean that N should be 5000-10000). Really, someone should tell those 200-odd Barrow Island rock wallabies to shape up — they should have melted away by now, and likewise, for

the Salisbury Island population, and tammars on the Abrolhos.

Given this doomsday scenario, conserving RW (and other spp in our fragmented landscape) would seem to be a futile exercise according to the Soulé School and others. Presumably, bottlenecks would have occurred by now due to the low numbers caused by predation. Moreover, predation and habitat disturbance (agricultural) would have effectively ended gene flow between populations. Such a scenario raises these questions: Is there any variation left? And if so, are the populations different?

Early on, we tried to address these questions using allozymes (blood proteins) as markers, but no variability within and between populations was found. These results were hardly encouraging, but then the sensitivity of this technique was not great. This problem was resolved years later when we were able to attack the problem again using DNA based methods. And so as a result, we now know a great deal more about the genetic diversity of rock-wallabies, not only from the wheatbelt populations, but elsewhere as well — Barrow Island and Cape Range. These studies have been made possible through a collaborative effort on the part of: Graham Hall @"CALM equivalent" Tasmania; Mark Eldridge @MacQuarie; Peter Spencer (formerly @James Cook, now @Murdoch) and Julie King (@UWA Zool.).

The Big Picture

Looking firstly at the differences between the geographically isolated populations (i.e., Barrow I., Cape Range (Ningaloo) and the wheatbelt), all were found to be genetically distinct to varying degrees. This was not unexpected and Eldridge has estimated that these populations have been isolated for a period of ranging between 6-10k years — not a bad estimate at all, in view of the fact that Barrow was isolated about 8,000 years ago.

Cape Range exhibited the greatest variability followed by the wheatbelt populations with Barrow RW coming a very distance last for a very good reason — no differences were detected! Barrow Island rock wallabies appear to be carbon copies of each other.

What does this imply? It suggests that Barrow I individuals are so similar genetically, that they may well indeed accept skin grafts from other individuals (allografts) — not that this will be ever done. Africa has its famous bottlenecked-allograft-accepting Cheetahs [but see Caughley & Gunn (1996) in Conser Biol in Theory & Practice. Blackwell Sci. Inc.], and it might well be that WA has its equivalent in the form of Barrow rock-wallabies.

From a management viewpoint there is a message here. Barrow RW have presumably (but, see below about methodological limitations) lost their capacity to evolve and to adapt except by an improbable fortuitous mutation. Mark Eldridge sums up the situation by stating that, the population, in evolutionary terms, is "stuffed".

This presumed lack of genetic variation does not mean that the Barrow population is under threat. After all, they have persisted on Barrow for about 8,000 years, and presumably natural selection would have fine-tuned their adaptations to this island's environment. But because they now appear to lack the capacity to adapt,

Barrow Island rock-wallabies would be an illogical choice as a source population for translocation, or for outbreeding purposes.

The Wheatbelt Situation

The four wheatbelt populations have retained a surprising amount of variation and there are some intriguing inter-population differences. At this stage our samples still too small for definitive conclusions, but Mark believes the following interpretation will hold. He calculates that there has been no gene flow during the last 100 years or so. This estimate coincides with the arrival of the fox about 80 years ago and it is hard to imagine a migrating rock-wallaby surviving a journey between sites with so many foxes about. Moreover, because depredated populations typically exist at levels well below habitat carrying capacity, conditions that trigger emigration (presumably density dependent) would no longer occur.

One final comment about the wheatbelt situation: I was surprised to learn that the variability found for both Nangeen Hill and Sales' Rock was lower than Mt. Caroline or Tutakin. The latter two sites were carrying smaller populations (» 7-10 RW) when we arrived on the scene. This suggests that, in the past, both Nangeen and Sales may have experienced a more severe bottleneck, but a larger sample size needs to be analysed to confirm this.

Conservation and Population Genetics: The Caughley Paradigms

Caughley & Gunn (Ibid) challenged the Soulé establishment by asserting that "no instances of extinction by genetic malfunction has been reported". They went on to propose that we should recognise two distinct paradigms in conservation biology. The first is "the small population paradigm" where one should focus on the negative consequences inherent in being a small population. Here one needs to be concerned with environmental stochasticity and catastrophes, demographic stochasticity and genetic deterioration.

Caughley labeled his second approach "the declining population paradigm". This paradigm requires one to establish the cause of smallness and to find a cure. Smallness in this case is due to deterministic factors such as overkill, habitat destruction and fragmentation, impact of introduced spp and chains of extinction.

The Caughley view provoked a quick response from the Soulé camp (Hedrick et al. 1996; Conser. Biol. 10(5), 1312) who accused him of stirring i.e., of being divisive; of polarising the debate; of constructing a false dichotomy, and of simply being, too simplistic. Additional supporting papers (including the 48 parrot story) from the Soulé camp can be found in the same issue.

Who should we believe? My own view favours Caughley's pragmatic approach. His 'declining' paradigm seems to me to be just plain common sense. Its not an original idea as any student of Prof. Bert Main would acknowledge. Bert's message was this: Species become conservation problems when there is a change in the their distribution and abundance. These changes, which can be an increase, but more commonly a decline, are the key indicators and are causes for concern. The problem then becomes as Caughley aptly expresses it: "determine the cause(s) and find a cure" — if a cure is feasible of course.

Clearly, the message coming from conservation genetics is not to be ignored, but I believe the Soulé School in particular have overstated their case. In defending their case, they accuse Caughley of being divisive, and of fueling controversy when a united front is needed to promote conservation. There is irony here for their original blackboard message, which they trumpeted far and wide, was this: small populations are doomed to suffer genetic deterioration with irreversible and fatal consequences. If one accepts this view, then species conservation for many vertebrates in a fragmented landscape would seem to be a lost cause. But if this threat is so inevitable, and cause for so much immediate concern, then why do we still find small flourishing populations of macropods living on islands having done so for thousands of years? We can take some comfort from this.

It seems to me that we should continue to apply the Caughley paradigms by identifying causes and seeking cures where possible for this will arrest and hopefully reverse the decline. Then we should spread the risk by creating and fostering as many populations as possible.

But this strategy raises difficult questions about what do we do about genetic variation? Theory tells us that genetic impoverishment is inevitable and indeed, our DNA based markers may well signify the same. However this information may well be misleading because we do not at this stage understand what the molecular markers are really telling us. If for example, our molecular markers uncover a low level of heterozygosity, then this suggests that there has been a parallel loss of heritable variation. This would seem to be a reasonable inference, but there are exceptions as is the case of the endangered cotton-top tamarin. Genetically, it is another cheetah with little detectable variation, but it still exhibits a high level of heritability for body weight (Lynch 1996).

Nevertheless, despite this correlative lapse between molecular markers and a quantitative trait, one cannot help but feel more comfortable when our measuring techniques uncover variation in a population. But, it is still a matter of faith to use such information as a course of action; conservation genetics will become a predictive science, and a vital tool, when the marking system can truly measure the amount of adaptive-genetic variation for relevant traits of interest. In the final analysis, a species ability to respond to novel challenges is proportional to the existing additive genetic variance (VG) for any selected trait (Lynch 1996). We need to be able to measure VG.

Wheatbelt rock-wallaby Genetics: What to do?

My views and reasons are as follows:

Caughley says we first should identify the proximate cause of the decline and implement a cure. He argues that, its pointless to address the genetics, if you do not know the cause of the decline.

We claim we have i.e., predation — though he strongly disputed this.

We have partial cure at least — control predators.

Having done this, should we mix them up? Should we start tinkering with their genetics?

No, not yet.

Indeed, why not? Simply because all populations have increased in response to predator control. This signifies that all have retained an appreciable level of fitness.

Would fitness increase, or would long term survival be enhanced by mixing? Theory urges us to so, but experimentally, this would very difficult to test especially the latter benefit; we don't have a reliable crystal ball.

Moreover, mixing could well be counter-productive. If mixing is proposed, then it should be done using translocated individuals at new site. This approach would avoid any possibility of a genetic disaster resulting from genomic divergence. Lynch (1996) describes some of the potential pitfalls awaiting the intrepid advocate of gene flow.

To conclude, my understanding of the genetic scene leads me to recommend a cautious, conservative approach. Such an approach does not mean that we should ignore or dismiss this aspect of wildlife management. We should, however, disregard the small-numbers-doomsday-scenario and one hopes that in Australian management circles, that the gene responsible for the 48 parrot story has not become fixed in too many conservation organisations, or in the minds of scientific advisors.

Being cautious does not mean that we should not continue to determine and monitor the genetic constitution of our populations. From our first look at RW populations, we have acquired useful information. During our next census, we will gain a great deal more for a small investment on our part. In the field, thanks to PCR, its simply a matter of using an ear punch to collect a tiny disc of tissue for analysis.

I thank Dave Coates for his insightful comments and for his help and guidance regarding the literature.

jackk@calm.wa.gov.au