

2001 Fowlers Gap Research Report

The University of California Los Angeles Field Biology Quarter-Fowlers Gap 2002.

Investigators: Dan Blumstein and Peter Nonacs, Department of Organismic Biology, Ecology and Evolution, University of California Los Angeles

Fifteen students, two faculty instructors and two graduate teaching assistants spent 18 days in April and May 2002 at Fowlers Gap, the site of our field biology course. Students were simultaneously taking two courses: a field ornithology course and a field behavioural ecology course. While at Fowlers Gap they focused on independent projects which included: 1) a study of interspecific competition among insectivorous birds foraging at the locust trap, 2) a study of the effect of water availability on how ravens, apostlebirds, and crested pigeons influenced patch selection, 3) a test of the conspecific attraction hypothesis with galahs, 4) a study of the species-confidence hypothesis on spiny-cheeked honeyeaters, 5) a study of the mechanisms underlying the recognition of mobbing calls by apostlebirds, 6) a study on the effects of running speed and reactive distance on foraging efficiency in desert ants, 7) a study examining skew in vigilance in red kangaroos and euros at a drinking hole, 8) a study of the spatial distribution of ant lion larvae, 9) a study examining the foraging strategies of subordinate ants that allows coexistence with the dominant *Iridomyrmex* species, and 10) the effects of interspecific and intraspecific interactions on nest defence in a *Camponotus* (ant) species. We have deposited the term papers resulting from these studies in the Fowlers Gap library. Some of these are being currently revised for publication.

Wildlife Tourism with Rangeland Kangaroos: Product development and implementation

Investigators: David Croft, School of Biological, Earth and Environmental Sciences, UNSW

The objectives of the project are:

1. to research product designs for access ways, viewing platforms, interpretative materials and accommodation to create and support a high quality experience in wildlife tourism with kangaroos
2. to test market the products to clientele derived from education groups (Study Abroad), alumni and a local operator at Fowlers Gap and to trial some products with Sturt National Park visitors,
3. to assess patterns of usage and visitor satisfaction with the products,
4. to assess and apply remedial action to any adverse impact on wildlife or habitat through the tourism enterprise created around the products,
5. to create a model for wildlife tourism enterprises on public and 'private' lands in the rangelands
6. to promote the products to stakeholders from the National Parks and Wildlife Service, pastoral leaseholders, local and national tourism operators from the development site at UNSW arid zone field station, Fowlers Gap.

The project has completed most of the milestones for the second year with a lag of around a quarter for some activities as a consequence of delays in facility construction due to floods in 2000. Developments at Fowlers Gap have remained on schedule except for the construction of a campground. Station funds were applied to a substantial upgrade of ablutions in the

'shearer's quarters' after discussion with local tourism operators and the Broken Hill tourism development officer. They advised that a broader client base, especially from the international visitor and backpacker market in Broken Hill, would be attracted to private rooms with full facilities and the ambience of the homestead complex and its various novel activities. The swimming pool surrounds were landscaped and upgraded and the building air-conditioned to attract summer visitors.

A significant and expanding specialty market for Broken Hill and the surrounding region is art tourism, especially artists seeking to produce works in Outback landscapes. We are developing opportunities for this on Fowlers Gap and elsewhere with Dr Idris Murphy from the College of Fine Arts (UNSW). Thus part of the development of a strategy for tourism in the rangelands has been nature-based 'art' tourism. Artists require studio space and so we have been planning options at Fowlers Gap that could be applied more generally in the region. A major development proposal will be put to UNSW in 2002 to develop a multi-purpose space for art and interpretation and to embed this within a small botanic garden. The latter has been strongly endorsed by local graziers who see interpretation and knowledge about botanic resources as essential to promoting understanding of sustainable land use in the pastoral context.

The Tibooburra Area of NPWS has employed a Ranger to develop a tourism strategy for the Mt Wood Homestead complex in Sturt National Park in collaboration with UNSW and this CRC Tourism project. The Mt Wood complex comprises the historic homestead with major elements built in the 1880s, early and mid-1900s; the stone shearer's quarters; the shearing shed; an outdoor pastoral museum and a bush campground. The accommodations had been restored but not lived in and so a further plan of works was developed and executed to bring the complex up to a standard to accommodate guests. Particular attention was paid to the quality of amenities, the restoration of gardens and appropriate landscaping around buildings, and the meeting of standards relevant to OH&S requirements and public liability. A business plan, promotional literature and interpretative materials were developed for execution in 2002 and thus these activities are ongoing in the context of this report. The Far West Regional Development Board visited the complex and provided stakeholder input into appropriate development and management of the facility which has cultural values embedded in a landscape with high natural values. A local tourism operator, Gidgee Country Tours, has become established in Tibooburra (as recommended in the report on 'Rangeland Kangaroos: A world class wildlife experience'). The operator will assist in the development and expansion of the client base for tourism in Sturt National Park.

Publications:

Croft, D.B. (2001). Rangeland Kangaroos: A World Class Wildlife Experience. Wildlife Tourism Report Series: No. 16. (Cooperative Research Centre for Sustainable Tourism, Gold Coast).

Croft, D.B. and Leiper, N. (2001) Assessment of Opportunities for Overseas Tourism based on Wild Kangaroos. Wildlife Tourism Report Series: No. 17. (Cooperative Research Centre for Sustainable Tourism, Gold Coast).

Shallow overland flow: exploring the operation of a fundamental hydrologic mechanism in low-gradient dryland environments

Investigators: David Dunkerley

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Water delivered to low-gradient dryland environments drains toward rills or streams in the form of shallow overland flow. The properties and behaviour of these shallow flows are important because it is within them that much of the initial detachment and transport of soil particles, seeds, and organic litter particles commences. Furthermore, their speed, which is governed by the properties of the soil surface across which they must travel, affects the time during which the water either remains on the soil surface and perhaps infiltrates to the root zone, or alternatively escapes quickly to streams and is removed.

Shallow overland flows often have the appearance of 'sheetflow' but in fact are far from being as uniform as this term might suggest. Commonly, surface features locally modify the flow properties. These include the low sandy mounds or pedestals on which many long-lived shrubs sit, loose or embedded stones, plant litter and other detritus, and unevenness in the form of the soil surface itself. Some of this unevenness arises from colonies of microphytic plants such as lichens, that generate a coarsely-textured roughness with an amplitude of mm to cm.

In context ranging from croplands in the humid zone to rangelands in the dry interior, considerable effort has been put into understanding how land use might affect shallow overland flows. This effort has been motivated by the realisation that these flows do initiate soil loss and do determine, at least in part, whether water is retained in soils or is lost to streams. Consequently, soil compaction or disturbance, or the loss of crop or plant residues, or changes to the roughness of soil surfaces, all become more significant to local water balance and to the sustainability of land use than they might appear.

I have continued to work on aspects of the behaviour of shallow flows, partly in the field at Fowlers Gap and partly in the laboratory, using specimens of soil and plant litter collected from Fowlers Gap. All of this work has the aim of improving the level of technical understanding of shallow flows, and partly seeks to develop new ways to observe and record them. In particular, I have conducted both field and lab experiments targeting the nature of flows on stony and rocky slopes, where flow paths become very sinuous. Other experiments have targeted the role of organic litter in altering the depth and speed of shallow flows. A third series of experiments has addressed the role of subtle soil surface microtopography and the nature of flows involving very shallow rill or proto-rill flow.

The results show a series of complex effects of these various surface features on water flow. Stones commonly mantle the soils at Fowlers Gap, and it has become clear that on certain kinds of gentle slopes, these can locally increase the speed of shallow flows in comparison with those on a stone-free surface. This seemingly odd result can be accounted for by the influence of the submerged volume of the stones, which displaces flow depths upward and reduces the frictional drag that arises from the rough soil surface. If present, a litter of leaves, small twigs and flower parts on the other hand invariably slows the flow considerably. This effect is still being explored further, but may relate to the formation of menisci drawn up by surface tension along the very large edge length that can be present even when the litter is

only present at 0.5 - 1.0 t ha⁻¹. The storage of water in these menisci appears to reduce depths in the surrounding flow, and hence increase frictional drag there.

Ongoing work is exploring the role of surface microtopography in modifying flow properties. This has so far highlighted the departure of flow conditions from what is termed 'uniform flow' when filaments of deeper or faster flow follow low-lying tracks across the surface. In these more complex, non-uniform or 'varied' flows, increasingly detailed observations are needed to resolve the varying conditions within the flow. A new optical flow-speed measuring device has been developed to assist in this work, and a paper describing this is awaiting publication.

In the longer term, this work will result in a better understanding of which surface features most strongly modify flow properties, and the ways in which they do this. In turn, such knowledge should prove helpful in guiding the selection of hydrologically relevant criteria for range and land condition assessment, and for understanding how it is that our use of the landscape changes subtle but vitally important runoff and erosional mechanisms.

Publications:

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Dunkerley, D.L. 2002. Volumetric displacement of flow depth by obstacles, and the determination of friction factors in shallow overland flows. *Earth Surface Processes and Landforms* 27, 165-175.

The Western NSW Archaeological Program (WNSWAP) at Fowlers Gap

Investigators: Trish Fanning¹ and Simon Holdaway²

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The Western NSW Archaeological Program (WNSWAP) was initiated in 1995 to investigate Aboriginal stone artefact scatters in a landscape context. Techniques based around the close integration of archaeological and geomorphological data sets using electronic survey technology and Geographic Information System (GIS) software were developed over a four-year period at Stud Creek in Sturt National Park. We then moved to Fowlers Gap in order to apply these techniques to investigating the Late Holocene archaeological record in one location with a variety of landscapes as a way of assessing variation in Aboriginal occupation intensity, mobility and resource use. Pilot surveys in 1999 lead to the selection of six upland land systems for more detailed investigation in subsequent years.

The project involved a different approach to assessing the mid to late Holocene Aboriginal record of western NSW. Rather than conventional survey aimed at the location of archaeological 'sites' (i.e. clusters of artifacts interpreted directly as the remains of Aboriginal camps), we used the Fowlers Gap Land Systems as an initial strata from which to select locations for further investigation. We searched individual land systems for common erosional surfaces upon which, based on previous experience, we could be sure that artefacts would be exposed but would not have been subjected to severe horizontal movement. Thus, we confined our surveys to the residual and erosional land systems of the Western Lowlands

and Central Ranges physiographic regions of Fowlers Gap Station (after Mabbutt 1973) i.e. Mulga Dam (MD), Sandstone Tank (ST), Nuntherungie (NN), Nundooka (ND), Sandy Creek (SC), Faraway (FW) and the margins of the main through drainage along Fowlers Creek (FC). A total of 21,800 artefacts were surveyed and described from sample areas within these 7 land systems.

This emphasis on geomorphology resulted from our understanding of recent landform changes (Fanning 1999) as well as the more general characterisation of the Australian landscape as a place of dynamic landscape change (Fanning 2002). In turn, this inspired us to look at palaeoenvironmental reconstruction not in terms of a series of static vegetation communities, but as a reflection of surface stability, or rather, the lack thereof (Fanning & Holdaway 2001a, Fanning & Holdaway submitted). A key to determining a chronology of surface stability was the combination of direct dating of age of surfaces onto which artefacts were deposited with the dating of a large sample of heat retainer hearths (Fanning & Holdaway 2001b, Holdaway et al. 2002). At Fowlers Gap we are able to show that the age of geomorphic surfaces in large measure determines the age of the archaeological materials resting on these surfaces. Spatial propinquity is therefore no guarantee of contemporaneity; at Fowlers Gap surfaces separated by a few hundreds of metres can have radically different ages.

These findings have implications for the application of conventional settlement pattern analyses based on site survey data (Holdaway et al. 2000, Holdaway & Shiner submitted). Surveys that do not take into account the geochronology of the surfaces on which 'sites' are located run the risk of combining archaeological materials with markedly different ages into a single settlement system. Obtaining a radiocarbon determination from one of these hearths tells us about the date of a single event - obtaining determinations from a number of the hearths tells us a great deal more. It tells us about the chronological pattern of occupation of a place. At Fowlers Gap we obtained a sample of 53 radiocarbon determinations from heat retainer hearths that indicate a discontinuous record of hearth construction from 5243±164 y BP to European contact around 160 years ago. Although there are a large number of determinations dating to the last 1000 years, the determinations form multiple clusters rather than a continuous sequence. Thus, the chronology of occupation in the past seems to be patchy rather than continuous. Combined with the geochronology discussed above, our results suggest that the Holocene archaeological record is not spatially continuous either at the landscape level or through time at a single location.

Publications:

Fanning, P.C. (1999). Recent landscape history in arid western NSW, Australia: a model for regional change. *Geomorphology* 29, 191 - 209.

Fanning, P.C. (2002). *Beyond the Divide: A New Geoarchaeology of Aboriginal Stone Artefact Scatters in Western NSW, Australia*. Unpublished PhD Thesis, Macquarie University.

Fanning, P.C. & Holdaway, S.J. (2001a). Stone artifact scatters in western NSW, Australia: geomorphic controls on artifact size and distribution. *Geoarchaeology: an International Journal* 16(6), 667-686.

Fanning, P.C. & Holdaway, S.J. (2001b). Temporal Limits to The Archaeological Record in Arid Western NSW, Australia: Lessons from OSL And Radiocarbon Dating of Hearths and Sediments. In Jones, M. and Sheppard, P. (eds) *Australasian Connections and New Directions:*

Proceedings of the 7th Australasian Archaeometry Conference. Research in Anthropology and Linguistics 5, 91-111.

Fanning, P.C. & Holdaway, S.J. (submitted). Stone artifact exposure and visibility at open sites in western New South Wales, Australia: a geomorphic framework for survey and analysis. Submitted to Journal of Field Archaeology (received 14th January, 2002).

Holdaway, S.J., Fanning, P.C. & Witter, D.C. (2000). Prehistoric Aboriginal occupation of the rangelands: interpreting the surface archaeological record of far western New South Wales Australia. The Rangelands Journal 22, 44 - 57.

Holdaway, S.J., Fanning, P.C., Witter, D.C., Jones, M., Nicholls, G. & Shiner, J. (2002). Variability in the chronology of late Holocene Aboriginal occupation on the arid margin of southeastern Australia. Journal of Archaeological Science 29, 351-363.

Holdaway, S.J. & Shiner, J. (submitted). Hunter-gatherers and the archaeology of discard behaviour: an analysis of surface stone artifacts from Sturt National Park, western New South Wales Australia. Asian Perspectives submitted May 2002.

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Shiner, J., Holdaway, S.J., Allen, H. & Fanning, P.C. (in press). Understanding stone artefact assemblage variability in late Holocene contexts in western New South Wales, Australia: Burkes Cave, Stud Creek and Fowlers Gap. British Archaeological Reports.

Reptile Diversity in Different Habitats in the Australian Arid Zone

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This study investigated the effect of two different habitats (grazed and ungrazed) on the diversity, composition and abundance of reptile species in chenopod shrubland. Ninety six pitfalls were evenly spread over four study sites (two grazed, two ungrazed) and were checked over a four month period between end of October 2001 and end of February 2002. Ungrazed study sites were situated inside an enclosure (Emu Pen) and have remained free of sheep, goats and relatively free of rabbits since 1977, whereas kangaroos and emus were released from time to time for short periods since then.

A total of 393 reptiles, comprising of 19 species of the families Gekkonidae, Pygopodidae, Agamidae, Varanidae, Scincidae, Typhlopidae and Elapidae, was caught. Two species accounted for 75% of all captures: The skink *Ctenotus uber* accounted for 42% and the dragon *Tympanocryptus cf. tetraporophora* for 33% of all captures. Further species considered in detail were the geckos *Diplodactylus byrnei* and *D. tessellatus* (both accounting for 5% of all captures), as well as *Underwoodisaurus milii* (3%), the dragon *Pogona vitticeps* (3%) and the skink *Morethia boulengeri* (3%).

The effect of differences in vegetation and the availability of invertebrates were used to explain patterns of reptile occurrence. *D. byrnei* is known to favour open areas and showed a

significant preference for bare ground, and hence, grazed habitat. *D. tessellatus*, *T. cf. tetraporphora* and *M. bouleengeri* were the only species negatively affected by grazing in this study, but a potential effect on all other species caught is discussed.

Five species of mammals (*Planigale tenuirostris*, *Sminthopsis crassicaudata*, *S. macroura*, *Leggadina forresti* and *Mus musculus*) were caught. *Planigale tenuirostris* and *L. forresti* only occurred in ungrazed habitat. *Sminthopsis macroura* is rated as vulnerable in NSW and was significantly affected by grazing in this study, while *S. crassicaudata* showed a trend to prefer bare ground, that is grazed habitat, as confirmed by other studies.

This study, which was initially only conducted to detect differences in the diversity of reptiles in different habitats in the Australian arid zone, demonstrates that the establishment of the Emu pen definitely contributed to the conservation of biodiversity and it is hoped the results will promote further off-park conservation on private properties by building grazing free enclosures in Australia and elsewhere where grazing affects native wildlife in the same way.

An evaluation of factors leading to kangaroo-vehicle collisions in the arid zone of Australia

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In rural Australia the number of animals killed on highways or minor roads is enormous. The animal most frequently hit is certainly the kangaroo. Accidents leave the animals dead or fatally crippled, joeys orphaned and secondary collisions with carrion-eaters like foxes, feral pigs and wedge-tailed eagles are likely. Passengers of the vehicle might be injured and/or distressed by inadvertently killing an animal, and the vehicle is most likely to carry some damage if not heavily armoured against such impacts. The toll on kangaroo populations is no doubt substantial and the cost of human injuries and motor vehicle damage from impacts reaches tens of millions of dollars each year. Further costs arise in increased insurance premiums, road maintenance costs in carcass removal and a loss in economic benefit (tourism and hunting).

Although of major significance to the Australian public, surprisingly few officially published data on road kills of kangaroos are available. To fill this obvious lack of information on the numbers of animals hit, which species and age/sex classes, where and why they are hit, and how these incidences can be mitigated, a workgroup around Dr. David Croft and Dr Dan Ramp (School of Biological Science, UNSW) in coalition with government agencies (RTA: Australian Road and Traffic Authority, NPWS: National Parks and Wildlife Service) and animal welfare organizations (IFAW: International Fund for Animal Welfare, WIRES: Wildlife Information and Rescue Service) has planned and started a series of interlinked research projects that approach all of the above mentioned problems. At present captive trials on the effectiveness of reflectors of various colours and odour repellents are conducted and in cooperation with above listed governments agencies, local councils and wildlife authorities, spatial and temporal data on road kills throughout the state are collected, mapped and a broad-scale model developed.

In this context the research at Fowlers Gap is the first in a number of small-scale studies that investigate the relationship between road kills and a number of environmental characteristics to compliment the broad-scale model.

The aims of my study are:

to collect data on the number, species, sex and age of road killed kangaroos to investigate spatial patterns of road kills and thus identify possible hotspots of road kills for future targeting by abatement technologies to identify and explain temporal patterns in road kill frequency by evaluating the link between animal density, road traffic and environmental conditions with the likelihood of collisions.

The data sampling period is completed and data are currently analysed. Results will be reported in the next Fowlers Gap annual report.

The Feeding Ecology of Adult and Juvenile Red Kangaroos (*Macropus rufus*)

Investigators: Sarah MacFarland and Terry Dawson

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The relationship between an herbivore's rate of food intake and the food availability is called its functional response (Noy-Meir 1975). This relationship is important in determining the mechanisms used by herbivores to compensate for reduced intake rates caused by decreasing level of available vegetation. Furthermore, this response is valuable in its application to the management of wild herbivore populations (Caughley 1987).

This study determined the functional responses of adult and weaned juvenile red kangaroos (*Macropus rufus*) in the semi-arid region on Fowlers Gap Research Station. An intensive grazing trial comparable to that of Short (1985, 1986) and Bilton (1996) was carried out over a ten-day period. The diets and foraging behaviour of the two age groups were also compared throughout the trial.

The functional response of adult and juvenile red kangaroos cannot be described by a single function. The juvenile's functional response curve was best described by a linear function, while the adult's curve formed a power function. This indicates that the juveniles did not reach a maximum intake rate, while the adult's intake rates began to asymptote at high biomass levels.

Juvenile red kangaroos exhibited higher mass-specific intake rates than the adults over all vegetation biomass levels, while the total intake rates of adults were slightly higher than those of the juveniles. This suggests that juvenile kangaroos have higher mass-specific energy requirements than do adults, as they must maintain their growth rates to survive.

The adult kangaroos had a higher grazing efficiency than that of the juveniles, indicating that the adult kangaroos were more successful at maintaining food intake at low vegetation levels.

The level of vegetation biomass below which the juvenile kangaroos could no longer maintain body mass for survival in the short-term, was approximately 19 gDM.m⁻². The adult data for

maintaining body mass was too variable to determine the critical biomass level, suggesting that adult kangaroos can cope better with short-term reductions in available biomass.

The long-term survival and recruitment of juvenile red kangaroos requires available biomass levels in excess of 30 gDM.m⁻², as below these levels juveniles are unable to maintain their growth rates. Adult kangaroos need biomass levels higher than 45 gDM.m⁻² for long-term survival.

The diets of the adult and juvenile kangaroos showed considerable overlap throughout the trial, but overall, adult kangaroos were selecting for grass to a greater extent than were juveniles, which were selecting for the more digestible forbs. These dietary patterns are consistent with previous studies (see Ellis et al. 1977; Dawson and Ellis 1994; Watson and Dawson 1993).

The adult and juvenile red kangaroos also compensated for their reduced intake rates by increasing the amount of time spent foraging. Juvenile red kangaroos spent significantly more time foraging throughout the entire trial than did their adult counterparts. This may be related to the smaller digestive capacity in juvenile kangaroos.

The Sheep and Wool Production research program at Fowlers Gap

Investigators: Euan Roberts (Convener)

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Background of the Fowlers Gap ram breeding flock

Flock N1

For the last 30 years it has been based on South Australian blood lines with a 23-24 μ adult wool and 105% marking percentage [Average since 1984]

Flock N2

A plan for Fowlers Gap Elite Wool ram breeding nucleus.

600 ewe hoggets were classed by David Taylor of Pooginook into a mob of 400 with further culling of extra strong microns. These ewes have been joined to Pooginook and Toland rams selected for elite wool characters. When the progeny of these matings are adult [1st in December 2003 joining], mate selection as recommended under Elite wool breeding, will be implemented.

Flock N3

Dohne Fine wool Meat Merinos; Have they a place in Pastoral Grazing?

Fowlers Gap in conjunction with The Australian Dohne Association joined 5 Dohne rams to 300 flock ewes and 5 Fowlers Gap rams to another 300 ewes as controls. We have been offered a 4-year research grant by Meat and Livestock Australia to compare productivity from $\frac{1}{2}$ Dohne wether lambs for meat and wool and lambing performance of $\frac{1}{2}$ Dohne ewes. We will mate Dohne rams under a similar design, for 2003 and 2004 lambings.

Future Research:

BAA code

As part of the MLA Dohne project we propose to use "BAA code" to establish sires of all lambs by DNA technology to avoid expensive small paddocks, supplementary feeding or expensive AI.

Bioclip

We propose to investigate the practicality of Bioclip - the biological defleecing method as an alternative to shearing.

Field Energy Intake of Adult and Juvenile Red Kangaroos (*Macropus rufus*)

Investigators: Suzette Rodoreda and Terry Dawson

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The processes used for energy intake by adult and juvenile red kangaroos (*Macropus rufus*) were examined on free-living animals in western N.S. W. The constraints that affect the foraging strategies of the kangaroos were studied using the Linear Programming model (Belovsky, 1984, 1986).

Adults and juveniles differed in their strategies for obtaining energy from the environment. Juveniles foraged for 20% longer than the adults and rested less. The diets were not different between the age classes but juveniles were selecting more nutritious parts of the plants, while the adults consumed more fibrous portions. Juveniles were not foraging optimally under the conditions of this experiment, due to their digestive constraint as shown by the Linear Programming model. The juveniles had a faster rate of passage than the adults, which is generally optimal for animals consuming nutritious plants but under these conditions was not sufficient to allow a maximum energy production. The juveniles were consuming less grass than the optimal diet recommended. The adults were foraging optimally for an energy maximised diet. Under these conditions, this required the adults to consume similar proportions of grass and chenopods.

This experiment shows how difficult it was for juveniles to overcome their constraints and maintain an optimal level of energy intake in a pasture with a relatively high biomass. The high mortality rates of juvenile red kangaroos in times of drought are likely due to insufficient consumption of grass and therefore, the failure to maintain a sufficient level of energy production.