

1 Research Reports – 2007

1.1 *Guidelines for the kangaroo whisperer: ways to minimize disturbance during kangaroo observations by foot and car*

Investigators: Isabelle D Wolf and David B Croft

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Close encounters with unique animals in their natural environment have been recognized as key factors for determining visitor satisfaction with non-consumptive wildlife tourism experiences. Wild animals, however, perceive humans as potential predators, especially in non-captive settings, with no protective barriers and irregular visitation reducing the likelihood for habituation. Without physiological measurements (e.g. heart rate, stress hormone levels), behavioural changes are the first signs of reaction to tourism activities. Disturbed animals will assume vigilance behaviour to evaluate potential danger or to decide on evasive actions. Rarely, aggressive responses occur. The consequence is that less time can be spent on body maintenance through feeding and resting or on social interaction. Therefore, changes in key behaviour have been observed to result in long-term fitness-minimizing effects for individual animals, translating into consequences for populations and communities of species. As part of a more comprehensive study on nature tourism in arid Australia and its impacts on natural key tourism attractions, we have conducted manipulative experiments at Fowlers Gap with the goal to identify ways to minimize kangaroo disturbance during encounters with tourists. This will aid in capitalizing on any conservation benefits of tourism to kangaroos and maintain their welfare. Two kangaroo species, Red Kangaroos (*Macropus rufus*) and Euros (*M. robustus erubescens*), served as exemplars. Our experiment was divided into two parts: 1) we observed the behavioural repertoire and calculated the frequency of certain activities used by hiking or driving tourists in approaches towards real kangaroos and kangaroo dummies (a large stuffed toy), 2) we simulated the typical tourist behaviour to measure flight reactions (various distances) and behavioural time budgets (time spent in aversive *vs.* other behaviour) of kangaroos in relation to a suite of variables. These included: a) different access style (on-trail *vs.* off-trail) b) transport style (on-trail: driving *vs.* hiking; off-trail: hiking only) and c) approach style (on-trail: direct *vs.* stop-and-go; off-trail: direct *vs.* stop-and-go *vs.* stop-and-go plus talking *vs.* indirect/switchback) d) various modifying factors such as species, wind speed and time of day. Dummy observations prove to be a feasible method to increase sample size. However, some observations of real encounters should be conducted, so differences in the reactions of tourists can be identified. We segmented tourist behaviour into on- and off-trail approach and supplementary behaviour. We found 5 different on-trail and 3 off-trail approach styles. Examples of common supplementary behaviour included talking, pointing, leaving the car engine running and extending the stay on-site beyond the actual observation by performing extraneous activities such as taking landscape pictures. Surprisingly uncommon was the use of binoculars. The results for the kangaroo reaction showed a less pronounced flight response and changes in behaviour after approach for on-trail and driving and for stop-and-go approach, the latter only while hiking. Talking augmented the flight response. Observations in the evening in habitat with cover and during days with wind speeds of less than 10 km h⁻¹ triggered milder flight responses as well. Generally, Euros, females with pouch young (*vs.* females, males, females with young-at-foot) and single individuals (*vs.* grouped individuals) reacted less strongly to approach. Results will be evaluated from a tourism point of view and address the quality of the viewing experience achievable under the different approach regimes and modifying conditions.

1.2 *Personality traits in cooperatively breeding chestnut-crowned babblers*

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The study of behavioural syndromes or ‘personality’ in wild animals is a relatively new area of research and it is not yet fully understood why such behavioural variation exists among members of the same species. Cooperatively breeding species provide an ideal system in which to study personality differences. In cooperatively breeding societies, individuals typically follow one of several distinct life-history trajectories. They may either remain in their natal group, or disperse and potentially breed independently. Philopatric individuals must also choose whether to help rear the young of others in their group. These strategies are likely to involve very different selective regimes, potentially giving rise to adaptive personality differences among individuals. In order to test whether this is the case in chestnut-crowned babblers, I designed a battery of standardised behavioural assays that would enable behavioural differences among individuals to be measured. Specifically, I tested for differences in boldness, aggressiveness, exploration, risk-taking and sociability. A total of 80 birds from 31 groups were tested in purpose-built aviaries located at Fowlers Gap before being returned to their territories. Importantly, preliminary data analyses show that individuals differ consistently in their exploratory behaviour. The next step will be to test whether different behavioural traits covary. Finally, I will investigate if individuals that remain on the natal territory and help have different personality types to those that disperse.

1.3 *False feeding in cooperatively breeding chestnut-crowned babblers*

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In cooperatively breeding species individuals, in addition to the breeding pair, help to rear the offspring of a common brood. Given that evolution by natural selection is suggested to cause individuals to be selfish, this apparently altruistic behaviour is paradoxical. One way in which individuals could be selfish in such systems, is by cheating. False-feeding arises when individuals take food to the chicks, but then eat the food themselves. We examined the frequency and distribution of false-feeding using remote nest-cameras in our population of 85 breeding groups of chestnut-crowned babblers at the UNSW Arid Zone Research Station at Fowlers Gap. A total of 1500 feeds were observed. In decreasing order of abundance, prey items included invertebrate larvae, spiders, moths, crickets and lizards. Only 2% of feeds were false. False feeds were distributed randomly with respect to individuals and groups, as well as time of day, brood size and brood age. Moreover, false-feeding appeared to be associated with satiated chicks. In all cases that false-feeding was observed, the provisioning individuals attempted to feed the chicks the prey item, but chicks were not responsive despite repeated calls by the adult. Further, false-feeding occurred when chick begging calls were significantly lower or absent. Our results provide no evidence to suggest that false-feeding is a cheating strategy employed by group members, but occurs when chicks do not wish to receive the food offered.

1.4 Maternal effects in cooperatively breeding chestnut crowned babbler.

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Mothers are known to exert a strong influence on the growth, survival and reproductive capacity of offspring in adulthood. Similarly, sibling competition can also exert substantial effects, in extreme cases resulting in siblicide. Whether and, if so, how mothers reduce sibling competition and maximise their own fitness is largely unknown. We began an examination of maternal investment strategies in our population of chestnut-crowned babblers at the UNSW Arid Zone Research Station at Fowlers Gap. Mothers can do a number of things to reduce competition. They can change clutch size, egg size, hatching asynchrony and sex ratio. We collected data on these four parameters by removing clutches of eggs from 50 groups and hatching the eggs out in an incubator. This allowed us to collect detailed data on all parameters. In order to test experimentally the effect of each of these parameters on maternal fitness, we then cross-fostered out eggs into different nests from which they came, and in doing we manipulated all four parameters. This experiment is the first of its kind and will reveal unexplored ways in which mothers reduce sibling competition and maximise personal fitness.

1.5 Behaviour and ecology of the cooperatively breeding Apostlebird

Investigators: Jonathan Wright¹, Anahita Kazem¹, Andrew F Russell^{2,3}, Simon C Griffith³

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This long-term study of the apostlebird (*Struthidea cinerea*) population at Fowlers Gap has continued to progress. Over 275 birds have now been caught, individually colour-banded and bled (for genetic analyses of relatedness), representing approximately 75% of the birds in the core study area within ~5km of the station. We have succeeded in habituating 71% of these banded birds to the close presence of human observers, and the last remaining birds will be habituated in 2008. The ultimate aim here is to get all individuals in the core study area to stand on electronic balances on demand, so that we can measure short-term changes in body mass and hence assess state-dependence within- and between-individuals in their behavioural strategies. We now have 3 years data on the social structure, breeding group size and breeding success, including detailed GIS mapping of the creek habitat used for nesting. Detailed behavioural observations and experiments have begun on various topics, such as foraging, vigilance, mobbing, vocalizations and helping at the nest. Specific data on 'false-feeding' behaviour and individual provisioning strategies during nestling feeding have been collected during 2007 to compare with earlier data collected by Iain Woxwold (Univ. Melbourne) from another less arid site far to the southeast. Compared with populations further east, the social structure of the Fowlers Gap population of apostlebirds seems to be surprisingly fluid and rather flexible in terms of breeding group formation and reproductive effort, which both depend heavily on annual variation in environmental conditions. The large wide-ranging flocks seen during the winter at Fowlers Gap appear to constitute 'clans' of familiar and possibly related individuals. These non-breeding winter flocks fragment in the early spring and form smaller breeding groups of 3 to 15

individuals, and these breeding groups gradually join back together once breeding is over, reforming into the large winter flocks by the end of the summer. Birds often move repeatedly between breeding groups within a clan, sometimes between first and second breeding attempts, but most especially between breeding seasons. The more usual one-way long-distance dispersal (probably by females) also seems to occur between clans. There are some interesting implications here for variable patterns of familiarity and relatedness within and between breeding groups, which will form the basis of our study into the cooperative mating system and genetic structure of this population. In 2008, we therefore plan to extend the study area beyond the current habituated core groups in an attempt to obtain a larger and more spatially widespread sample of this population.

1.6 Regolith-Landform Mapping and Environmental Geochemistry at Fowlers Gap

Investigator: Steve Hill
University of Adelaide

In July 2007 over 70 students and staff from the University of Adelaide, as well as Ian Roach and some students from ANU attended Fowlers Gap Arid Zone Research Station for a week of reading the landscape. We commenced with a local orientation of the landscape and its main features and materials (the regolith), which included a field traverse between the station and eastwards towards the Fowlers Creek outwash. The following days were spent regolith-landform mapping in the northern parts of Gap Creek Paddock, particularly along Fowlers Creek upstream of the station. Leaves from river red gum (*Eucalyptus camaldulensis*) trees were also sampled for biogeochemical survey. Each student collected one sample from a tree along the creek, and staff collected a few extra tree samples downstream from the homestead. The river red gum biogeochemistry provided some interesting results that will be further investigated this coming year. Underlying geology as well as landscape setting within the catchment were major controls on the results. Gold values were regularly detectable from leaves upstream of the homestead area, particularly where quartz veins are abundant. While further downstream of the homestead, areas of Adelaidean basalts provided samples with elevated Ni, Mg and Cr contents.

Steve Hill and Ian Roach have continued to produce regolith-landform maps at 1:12,500 of many of the station paddocks. Recently completed maps have included: Hotel and Conners paddocks, which add to the already completed sheets for Sandstone, and South Sandstone paddocks.

The University of Adelaide student group plans to return in July 2008, with further mapping in the North Home Paddock and Strip Home Paddock areas.

1.7 Seepage losses during flood flows in Fowlers Creek

Investigators: DL Dunkerley and Lan Ngoc Hoang
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Victoria, Australia.

The survival of ecologically important red gums along drainage lines such as Fowlers Creek depends upon the additional store of water held in the bed and bank sediments. In suitable locations, pools of flood water can survive for months, but along most of the course of Fowlers Creek, the red gums draw on water stored within the pore spaces of channel margin sediments. This water store is only replenished during the ephemeral flows, and the process exhibits

important temporal and spatial variability. Near to the rocky hill country, which is the primary source of the flood waters, replenishment of stored water is more frequent than at locations far downstream, because the cumulative seepage losses, termed *transmission losses*, can completely consume the flood flows after only 5 km or 10 km of travel. The nature of the bed and bank sediments also influences the rate at which this replenishment occurs during the downstream passage of floodwaters. Upstream, the bed is dominated by sands, gravels, and cobbles, but the coarsest materials are progressively set down as transmission loss occurs, and downstream, the bed sediments become increasingly fine grained. Even pebbles become rare. Changes in the bank materials are less apparent. In this project, we investigated the capacity of bank sediments to take in flood waters, looking for trends along the course of Fowlers Creek and also with position on the bank. Our hypothesis was that entry of highly sediment-laden flood waters into the stream banks would lead to a clogging process, in which the pore spaces would become partially or completely blocked by muds. This clogging seemed likely to affect the lower parts of the bank more often than the upper parts, owing to the relatively commonness of small floods and the rarity of large ones.

We carried out more than 100 bank permeability tests, and analyses of the sediment particle sizes of bed and bank materials, along a 10 km study reach of Fowlers Creek. Test sites were set out in transects running from the stream bed to the top of the bank. The results showed that the bank sediments are coarsest at the top of the bank, and become progressively finer toward the bed. The pattern of permeability reflects this textural pattern. The bank permeability is highest near the top of the banks, and reaches a minimum near the base of the bank, just above the bed. Floods often leave a layer of mud on the bed and lower banks, and this can result in very low permeability until it dries out and cracks. However, the pattern of bank permeability appears to be a persistent one, since the internal pore spaces of the sediments have been blocked by muds entering with the seepage water. The presence of muds within the sediments was confirmed by direct observation using electron microscopy in the Monash Centre for Electron Microscopy (done by LNH), as well as by the textural analyses.

A computer model of seepage during floods of various sizes (depths and durations) was developed to explore the effects of these varying bank properties. This shows that the amount of replenishment of the bank water store varies with the depth reached by the flood, with greater amounts of replenishment occurring in floods that reach higher on the banks, even though the lower banks are submerged for a longer time during the flood. An interesting question not yet resolved is whether the bank clogging process has been exacerbated by an increased supply of fine sediments caused by soil erosion in the uplands areas. We speculate that an increased mud load in Fowlers Creek might be related to historic or ongoing landuse. If clogging is more widespread or more strongly developed because of soil erosion in the catchment, then the recharge of moisture upon which the red gums depend may itself have been reduced. This would add to the moisture stress caused by years of low rainfall. Spatial and temporal patterns of bank seepage seem likely also to have been modified by hydrologic changes attributable to landuse and climate change, and these possibilities warrant further study in order to build our understanding of important riparian ecosystems.

Publications:

Dunkerley D.L. 2008. Transmission losses in ephemeral dryland streams: role of mud clogging in channel margin sediments. Paper presented at the 13th conference of the Australian and New Zealand Geomorphology Group, Queenstown, Tasmania, February 2008.

- Dunkerley D.L. 2008. Flow chutes in Fowlers Creek, arid western New South Wales, Australia: evidence for diversity in the influence of trees on ephemeral channel form and process. *Geomorphology* doi:10.1016/j.geomorph.2008.05.004.
- Dunkerley D.L. 2008. Bank permeability in an Australian ephemeral dry-land stream: variation with stage resulting from mud deposition and sediment clogging. *Earth Surface Processes and Landforms* **33**, 226–243.
- Hoang Lan Ngoc. 2008. The Dynamic Nature of Transmission Losses in a Mud-Dominated Ephemeral Stream. BA (Honours) thesis, School of Geography and Environmental Science, Monash University, 115pp. plus Appendixes.

1.8 Rainfall events and the water balance of dryland shrubs at Fowlers Gap

Investigator: DL Dunkerley
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Water scarcity is one of the defining characteristics of drylands. In detail, rain is a highly complex phenomenon, arriving intermittently in storms of varying length and rainfall intensity. The proportion of the rain that becomes effective within a dryland ecosystem is more significant ecologically than the open-field rainfall recorded by a standard raingauge. However, the first stage in understanding the ecohydrology of dryland ecosystems is to understand the open-field rainfall environment.

Recording raingauges have been maintained at Fowlers Gap for some years in order to acquire storm data with high temporal resolution. The last 5 years of records show that the average day with rain receives 5.6 mm, and that only about 9% of days have measurable rainfall, or about 33 rain days per year, on average. But the effectiveness of rain depends on the amount of rain delivered, the intensity with which it falls, and on factors like the continuity of rain during the storm. In the local environment of a dryland shrub, very small storms may do little more than wet-up the foliage and branches, whilst more prolonged rain saturates the foliage and then drips to the ground. To analyse such phenomena, detailed rainfall records that allow rainfall to be recorded minute-by-minute are necessary, and these are being collected at Fowlers Gap.

When rain stops only briefly - perhaps for a few minutes - and then resumes, it is appropriate to count both periods of rain as a single storm. But as a gap in rainfall grows to many hours, perhaps with sunshine and drying winds during the gap, it makes more sense to tally two separate events. This process is customarily made rigorous by defining a *minimum inter-event time*, or MIT, which is a rainless period that must be reached or exceeded for two periods of rain to be counted as separate storms. There is a wide range of MIT criteria in use, but often it is set to about 6 hours.

Using such a definition, the Fowlers Gap rainfall record at Fowlers Gap shows that there are on average about 34 storms per year, that these typically last for 1 hour and 40 minutes, and that they deliver 2 mm of rain at an average intensity of 1.5 mm/h. These are not unusual properties for storm events. However, the low rainfall intensity and relatively short storm duration in an environment of low relative humidity mean that the drying of wet foliage will be a frequent event. Thus, the effective rainfall, the part that reaches the ground beneath a shrub, will be significantly reduced in comparison with the gauge rainfall.

Rainfall simulation has been used in experiments at Fowlers Gap in order to explore and document this phenomenon of *canopy intraception* more fully. Portable pumps and dripper systems were employed to create storm events of realistic intensity and duration, and collecting trays were arranged to collect the throughfall reaching the ground beneath various test shrubs. Results, described more fully in papers cited below, show that evaporation from wet foliage can occur at sustained high rates at Fowlers Gap, both during rain and afterwards, and that a dense shrub canopy incurs a substantial cost in terms of reduced effective rainfall. This is likely to be offset to some extent by reduced soil drying in the days following rain, owing to the shaded microclimate beneath the plant. A full analysis of the water balance of shrubs, including these and several other significant hydrological processes, has not yet been attempted, but will be developed as work at Fowlers Gap proceeds. These are ecologically important processes to understand, because it is widely foreshadowed that storm event properties will alter as regional and global environmental changes progress in coming decades. These changes will affect shrub water balance and effective rainfall in complex ways, and may allow us to understand likely ecosystem responses.

Publications:

- Dunkerley D.L. 2008. Intra-storm evaporation as a component of canopy interception loss in dryland shrubs: observations from Fowlers Gap, Australia. *Hydrological Processes* **22**, 1985 – 1995.
- Dunkerley D.L. 2008. Identifying individual rain events from pluviograph records: a review with analysis of data from an Australian dryland site. *Hydrological Processes*, in press.
- Dunkerley D.L. 2008. Rain event properties in nature and in rainfall simulation experiments: a comparative review with recommendations for increasingly systematic study and reporting. *Hydrological Processes*, **22**, in press. doi: 10.1002/hyp.7045.

1.9 Re-Cognising the Land Symposium – summary and outcomes

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POTENTIAL RESEARCH COLLABORATION BETWEEN ART, ARCHITECTURE AND SCIENCE- BASED AT THE UNSW FOWLERS GAP RESEARCH STATION

The Imaging the Land International Research Institute (ILIRI) is the initiative of Dr Idris Murphy, Ian Grant and Louise Fowler-Smith. Operating out of the School of Art at the College of Fine Arts, UNSW, ILIRI aims to promote new ways of perceiving the land in the 21st century. The ILIRI vision incorporates three functions of Education, Research, and the provision of Artists' Residencies at the Fowlers Gap Research Station north of Broken Hill.

For more information on ILIRI please go to:

<http://www.cofa.unsw.edu.au/research/researchcentres/iliri/>.

As Australia's only research institute concerned with the artistic interpretation of land, across all visual arts media, ILIRI is staking out a uniquely visible position at the forefront of one of the major concerns in the visual arts today.

Most of the research endeavours supported by ILIRI are carried out at the UNSW Arid Zone Research Station at Fowlers Gap near Broken Hill in western New South Wales. Fowlers Gap is itself located close to many significant Aboriginal sites including the famous sacred site at

Mutawinji National Park. For many years ILIRI has also conducted annual artistic field trips to Fowlers Gap and these Aboriginal sites.

Through the establishment of a Residential Art Centre at Fowlers Gap, ILIRI has created an internationally unique resource: the only residential art centre in the Australian desert.

In September 2007 ILIRI held a symposium at the Fowlers Gap Research Station. Titled '**Re-Cognising the Land- To See Anew**' the symposium brought together artists, architects, writers, scientists, environmental planners and indigenous elders from two quite different countries, to explore the issue of sustainability in the arid zone and how cultural perceptions of the land contribute to present land use.

This initiative began in 2006 when Louise Fowler-Smith was invited, as a Director of ILIRI, to attend a conference in the Netherlands, titled the Zangsporen Project. This project was collaboration between the Centre for Visual Art, Utrecht (CBK), the Utrecht School of the Arts (HKU) and the Aboriginal Art Museum, Utrecht (AAMU). The aim of the weeklong conference was to explore the rural area of De Venen, which is effected by rising water and is also being encroached upon by the surrounding cities.

The uniqueness of the project lay in its inclusion of artists to generate fresh insight into the development and future demands on Holland's 'Green Heart'.

ILIRI decided to reciprocate the invitation and was successful in receiving funding through the Contestable funding scheme at UNSW, which aims to promote and assist collaboration between UNSW and International 'sister' Universities.

Similar to the Zangsporen project, the ILIRI symposium aimed to foster educational and cultural outcomes, and was conceived as an exchange between Dutch artists and architects looking at problems of water management, land ownership and land habitation and their Australian counterparts who face different manifestations of these problems.

ILIRI's aim is to promote new ways of perceiving the land. As water becomes an increasingly precious commodity, strategies for dealing with climate change, water shortages and drought require lateral thinking.

The Australian exchange therefore had as its focus sustainability in the desert as a result of climate change and whether an interdisciplinary team could produce new solutions.

The Symposium ran from September 3 to 11, 2007 and was attended by a broad group of creative thinkers, across discipline and across cultures.

In all, more than 35 people traveled to **Fowlers Gap**, including seven Dutch artists and architects, **Annelou Evelein, Ida van der Lee, Gosia Siekanko, Ester van de Wiel, Willemijn Lofvers, and photographer Bob Negryn.** as well as the Netherlands **Consul General, Margarita Bot and Edmond Ruitenber.**

Australian participants included the author **Professor Paul Carter** from Melbourne University; Founder of the Social Ecology Degree at UWS **Professor Stuart Hill and Judy Pinn;** award-winning architect **Peter Stutchbury;** artists **Janet Laurence, Ian Howard (Dean/COFA), Lucienne Fontannaz, Idris Murphy, Terry O'Donnell, Louise Fowler-Smith, Peter Hill and**

sound artist Jane Ulman; Scientist and Director of Fowlers Gap Research Station, **Dr David Croft**; Director of the Broken Hill Art Exchange, Susan Thomas and Indigenous Elders **Mark Sutton**, Chairman of the Mutawintji Land Council and **Badger Bates**, artist and elder of the Barkanji Nation.

A group of COFA Post graduate students also attended.

Questions that arose from the symposium include:

- How can art contribute to ecological, cultural and economic sustainability in an increasingly arid and [stressed] environment?
- How can art become an intermediary between scientific endeavours and community involvement in, and acceptance of, change?
- Can art act as conduit between scientific research and community awareness?

The Potential Establishment of an Interdisciplinary Research Team

As a result of the symposium ILIRI is proposing the establishment of an interdisciplinary research team across the disciplines of Art, Science and Architecture.

According to the 2007 YASMIN_ADA Art and Climate Forum, sponsored by the Arts/Science Journal Leonardo, ‘Science could be considered to have a public relations problem. “In the book *Making Climate Forecasts Matter* the scientists Stern and Easterling admit, “...research addressed to questions framed by climate science is not necessarily useful to those whom climate science affects” (Easterling, 1999:3). Results from a UK poll published through the Guardian (July 2007) found that the public is highly informed about climate change, yet most people are still skeptical about the seriousness of the threat.... We have reached an impasse where there is a high level of public awareness about climate change, indeed an over saturation, yet there is no corresponding mass action or direction.’

There are already strong links between the arts (I use this term broadly to include architecture and design) and science. Art has been considered as a positive mediator between science and the general public, predominantly because the arts is capable of using a “language” that is more accessible to the public.

“Despite the fields of environmental conservation and the creative arts having much to offer each other, mechanisms for building meaningful bridges between them are still undeveloped” (D.Pritchard, *Art and Environment – Relating the creative arts to environmental conservation*. Landscape and Arts Network Online Journal, No. 38, August 2006).

Aim of potential Collaboration

Through a team of artists, architects and scientists the aim of this research investigation will be to develop and apply interdisciplinary, creative research to the design and implementation of ecologically sustainable and humanly sustaining (pleasing to the eye and the soul) semi-arid environments. This could form the basis of a ‘program’ that extends for a 5 year period and that funds a series of investigations that are logically related to each other and that demonstrably produces insights that can be generalised and applied elsewhere.

As UNSW owns the Fowlers Gap Research Station, an area of land could be set aside in this arid environment for the investigative team to conduct this research. This would become the “creative laboratory” where artists, architects, scientists, (agriculturalists, botanists, land use planners, geographers, anthropologists, ecologists, geologists, hydrographers etc) could collaborate in

projects that unite scientific exploration with architectural sustainability and cultural nourishment. The aim of the research team would be to research new ways of perceiving and ultimately living in an environment effected by drought.

Suggested projects

- Seeing green vs being green (European heritage / Indigenous culture)
- Adaptation vs exploitation (remove sheep; limit mining, reuse materials)
- Migration vs colonisation (rethink building; rethink imprint / footprint; ephemerality; nomadism)
- Sustainable living/sustainable building
- Reciprocity - napartji napartji (you give to me, I give to you)
- Geopietiy (reverence for land)

Issues might encompass energy production, its use and how it “sits” in the land, food production that requires limited water, a re-envisioning of the Australian garden, regenerative practices, pollution, water management, continuous cycles of materials use, fuel production and consumption [especially over long distances] ...

The first “model” could be take Broken Hill and would involve the Broken Hill community.

Significance

In the United Kingdom research has shown that interdisciplinary teams led by the Arts dealing with social regeneration initiatives are growing in number. Many of these are focused on the environment, including diversification of rural land-use, with research showing a direct benefit to local economies as a result of the creative input.

This model has yet to be thoroughly explored in Australia.

How we perceive and contemplate the land affects how we respond and live in the land.

Many Australians still perceive this land inappropriately as a result of their cultural heritage. This project will explore the aesthetics of our natural environment in order to understand what Australians value (and don't value) about it and why. It will also explore methods of living in the arid zone sustainably.

Outcomes

This project will establish new land-use models that can be taken to other communities that are sustainable as well as humanly sustaining.

It will draw on the creative arts to deepen our understanding of the environment, to inspire greater awareness and to explain the value of conservation in new ways.

It will promote links between culture and the environment and use a language that inspires people to act.

1.10 Barrier Ranges Sustainable Wildlife Enterprise Trial

Investigators: P Ampt¹, A Baumber¹, R Cooney¹, K Gepp²

¹Future of Australia's Threatened Ecosystems (FATE) Program, Institute of Environmental Studies, UNSW,

²Western CMA, Broken Hill

For three years the FATE Program has been working towards achieving multiple benefits by applying conservation through sustainable use (CSU) approaches to the kangaroo industry. A critical component is landholder involvement in kangaroo management that results in commercial gain. We are developing strategies for landholders to add value to the harvest at the same time as achieving better control of the impact that kangaroos can have on their land. We have sought close collaboration between members of the Barrier Area Rangecare Group (BARG), harvesters, processors and regulators to achieve this end.

The Barrier Ranges Sustainable Wildlife Enterprise Trial is part of a larger program funded by RIRDC to develop Sustainable Wildlife Industries (SWEs) in the rangelands. Progress on this trial to date includes:

- analysis of harvest data across collaborating BARG properties;
- discussions between stakeholders and other groups seeking similar outcomes;
- the commencement in May 2008 of a trial under the adaptive management provisions of the Kangaroo Management Program of the use of a General Licence for participating BARG properties and kangaroo harvesters, whereby harvest tags are allocated to the group rather than to individual properties. This trial involves 15 landholders and 16 harvesters and covers more than 900,000ha.
- Working with a steering committee to develop a business plan for an enterprise to manage harvest and chillers for the group;
- training of landholders in Landscape Function Analysis (LFA) and working with them to develop group environmental monitoring based on LFA to facilitate adaptive management by landholders.

Fowlers Gap is an integral part of this trial. We have conducted LFA training on Fowlers Gap and on neighbouring properties and will use several locations on FG as reference sites. For example Emu paddock inside the enclosure is a site which provides the upper level of a dynamic range for its land type. Also FG is included in the General Licence as a non-harvest zone, and David Croft is a member of the Steering Committee. As a result of this work we are developing and trialling a system that integrates kangaroo management with good land management for the benefit of the rangelands and rangeland communities.

Publications and theses 2000-2007

2000:

Croft DB (2000) Sustainable use of wildlife in western New South Wales: Possibilities and problems. *Rangeland Journal* **22**, 88-104.

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