



1 Research Reports – 2009

1.1 Behaviour and ecology of the cooperatively breeding Apostle bird

Investigators:

Prof. Jonathan Wright

Institute of Biology, NTNU, Trondheim, 7491 Norway

Dr. Claudia Wascher

Konrad Lorenz Forschungsstelle, Fischerau 11, 4645 Grünau, Austria

Dr. Andrew Russell

Department of Animal and Plant Sciences, University of Sheffield, S10 2TN, U.K.

Dr. Simon Griffith

Centre for the Integrative Study of Animal Behaviour, Macquarie University, Sydney, NSW 2109, Australia

Due to extreme weather conditions in 2009, this long-term study of the apostle bird (*Struthidea cinerea*) population at Fowlers Gap experienced the most unusual in a series of unusual years. Only 200 of the usual 400 birds were seen in the core study site (within 5km of the Station), with nearly all of the other groups in the outer area (i.e., between 5 and 25km of the Station) completely failing to reappear. Those social groups that did stay in the core area moved around much more than normal, and showed even more complex fission-fusion dynamics than we have observed in previous breeding seasons, including coalitions across apparent clan boundaries, which represents a novel observation for this system. Although there were a few breeding attempts and some data was collected on communal mud nest building behaviour in these groups, none of the 2009 nests succeeded during the usual breeding season of August. Nevertheless, with the help of field assistants Erin Morrison and Claire Wordley, more than 50 additional habituated birds were trained to stand on electronic balances in order to record within- and between-individual differences in body mass. Detailed social protocols were developed to assess the frequency of sociopositive and antagonistic interactions within groups during standardised feeding and during normal foraging sessions. Faecal samples were also collected this year (over 500 faecal samples from 91 individuals of 11 different groups), allowing non-invasive assessments of faecal glucocorticoid metabolites (i.e., CORT) by Dr. Claudia Wascher. All of this proved very timely given the massively increased levels of apostlebird aggression seen in 2009, which were associated with greater fission-fusion dynamics of these complex social groupings. Preliminary results show individual CORT to be significantly modulated by agonistic, but not affiliative, behaviours in this system, but having validated the methodology more work now needs to be done in this area. In the second half of the 2009 field season we also carried out experimental assessments of state-dependent mobbing using model snakes, and these data will constitute the masters project of NTNU student Erlend Berne. In the very near future, genetic data will be available from the lab of Dr. Simon Griffith on all of these birds in order to clarify the sex of focal individuals as well as relationship structure, which will then be included in statistical analyses of the CORT, focal behavioural data and the experimental mobbing data.

1.2 Ecohydrology of arid shrublands at Fowlers Gap

Investigator:

David Dunkerley, School of Geography and Environmental Science, Monash University.

Except very locally, water is a scarce resource across the drylands. Rain arrives in showers that vary greatly in intensity and duration, and follow rainless periods that may range from days to months. Thus, water availability generally exhibits marked temporal variability. In space, this variability may be increased or diminished by the processes of rainfall partitioning that occur at the ground surface. For instance, rock outcrops or patches of impermeable soil take in very little water, and allow a significant fraction of the rain to drain down-slope. This leaves these run-off source patches even drier, but the water may drain to permeable locations down-slope where the water augments the direct rainfall. In this way, the climatic aridity can locally be reduced by run-on water. To some extent, these ecohydrologic mechanisms are self-reinforcing, because a range of further processes operate. For instance, higher plant biomass supported by run-on water at favourable locations further boosts soil permeability through the action of burrowing soil fauna and through the improved soil structure that results from more abundant organic matter.

Work continues to understand both the rainfall climate of Fowlers Gap, and the rainfall partitioning processes that redistribute water in the landscape.

About seven years of continuous rainfall intensity data from Fowlers Gap are now available, collected by two tipping bucket rain gauges equipped with data loggers. An analysis has been made of how the intensity of the rain (which influences surface water partitioning) relates to the nature of the rainfall events themselves. In particular, it is known that run-off volume and behaviour, and the erosion and redistribution of soil materials, are both affected by relatively intense bursts of rain within longer storm events.

The analysis has revealed some surprising results. It is well established that average rainfall intensity declines with increasing storm duration. Thus, torrential downpours are relatively brief, but light rain may continue for hours. However, the new data analyses show that measures of intra-event rain rate (intensity) behave in a different way. This analysis used measures such as I_{30} , the highest rainfall intensity seen in any 30-minute interval within a longer rainfall event, and similar measures such as I_5 and I_{10} . It is now clear that at Fowlers Gap, and also in the uplands of Victoria where a second rainfall record has been analysed, these measures increase with increasing storm duration. In other words, longer storms are likely to have more intense rain intervals than are shorter events. This new finding has significant implications. In relation to water partitioning, for example, it is now clear that surface run-off will be produced in many long storms of lower average intensity, and not just in shorter storms of higher average intensity. Similar conclusions apply to soil erosion processes and the down-slope transport of soil materials including seeds and organic detritus.

In order to understand more of the rainfall partitioning process, experimental work continues on the nature of infiltration under rainfall of varying intensity. Experimental work is primarily carried out in Hotel paddock, using pumps and water application systems designed to reproduce the storm properties described in preceding paragraphs. This work has highlighted the very marked spatial variation in soil hydraulic properties, which can change dramatically over just a few metres. Comparison of infiltration capacity measurements made using standard ponded water tests (cylinder infiltrometry) and simulated rainfall tests has shown that it is essential to

employ simulated rain on many of the soils in Hotel paddock. Additional work will be carried out in 2010 before this work is published.

1.3 University of Adelaide's Fowlers Gap regolith and landscape studies in 2009

Investigators:

Steve Hill, David Chittleborough and Graham Heinson

Geology & Geophysics, School of Earth & Environmental Sciences, University of Adelaide SA 5005

The University of Adelaide's Regolith and Landscape Evolution 2nd year undergraduate field trip was held at Fowlers Gap between July 7-11, 2009. The objective of the field trip was to introduce the students to the excellent examples of regolith and soil materials and their close associations with landforms in the area. Students also gain first-hand experience in the field description and sampling for pedology, plant biogeochemistry and geophysics. Approximately 100 undergraduate students attended the field trip with 3 academic staff members supported by a group of demonstrators.

The first day of the trip included a field traverse from the Barrier Ranges to the Lake Bancannia Plains. This traverse commenced near the Fowlers Gap Station buildings and approximates the power-line towards the north-east and onto the plains. It then returns to the Station following the course of Fowlers Creek. Students use an evolving set of teaching notes and the recently published Connors and Hotel regolith-landform maps to highlight field "stations" along the traverse. The field stations indicate some of the key landscape features of the region and many sites included a field demonstration from a teaching staff member. Highlights of the traverse include:

1. Leopardwood trees and their links to palaeo-vegetation communities;
2. ferruginised regolith and chenopod shrubs;
3. Faraway Hills Quartzite and its association with ridgeline topography;
4. curly mallee and geobotanical associations with Adelaidean dolomite and basalt;
5. Devonian sedimentary rocks;
6. young tectonism, silcretes and Mesozoic marine sediments;
7. stream terraces along Fowlers Creek;
8. saline scalding near the Homestead Creek – Fowlers Creek junction; and
9. field demonstrations of soil pit descriptions, geophysical measurements and plant biogeochemistry sampling.

The remaining field days included regolith-landform mapping immediately west of the Station buildings and along Homestead Creek, as well as river red gum leaf sampling from trees along Homestead Creek. A series of soil pits were excavated and described across South Ridge in the mapping area. Field samples and mapping data form a major component of practical sessions held at the University during the following semester.

In 2010 it is planned to evolve the teaching notes accompanying the field traverse further, as well as to continue the mapping and soil pit programme across adjoining areas.

1.4 Does corticosterone modify the fine acoustic structure of begging calls in wild zebra finch nestlings?

Investigators:

Clémentine Vignal, Nicolas Mathevon, Emilie C. Perez

Université de Saint-Etienne & CNRS, UMR8195 ENES-CNPS, F-42023 Saint-Etienne Cedex 2, France.

Mylène Mariette, Simon Griffith

Department of Brain, Behaviour and Evolution, Macquarie University, Sydney, NSW 2109.

Christophe Soulage, Hédi Soula

Université de Lyon, Université de Saint-Etienne, ENES & CNRS 8620, France

As nestlings' needs vary over time depending on their metabolic rate, surrounding environmental conditions and their stage of development, young birds must communicate these needs to their parents in order to receive the appropriate level of resources at any one time. Although the prediction that the rate of begging-displays reflects nestlings' needs has received empirical support, the specific components of the signal driving parents' feeding is not well established. To the best of our knowledge, no study has ever addressed whether the nestlings' condition affects the acoustic structure of their begging calls. Whereas an increase in begging call rate enhances the risk of predation, fine variations in call structure may be less conspicuous. When nestlings are food-deprived, the level of circulating corticosterone (the main stress hormone in birds) increases and may be the physiological pathway that modulates call structure. Recent studies have demonstrated that corticosterone provokes fine call structure modulations in adult zebra finches (*Taeniopygia guttata*). Thus, we hypothesized that the acoustic structure of young birds' begging calls might also vary according to their levels of level.

We increased the level of corticosterone in wild zebra finch nestlings by administering additional quantities of this hormone orally to the chicks when they were 8 and 11 days of age. Begging calls were recorded before and after oral administration and the acoustic parameters were analysed. During the whole experiment, the chicks' behaviour in the nest was videotaped and morphometric measurements were taken.

We predicted that, if structural variations in begging calls are relevant in parent-offspring communication, parents will adjust their foraging and provisioning behaviour accordingly. Consequently, we tested parents' response to these signals using playback experiments. We also monitored parental provisioning using PIT tags attached to the birds' rings, and nest boxes equipped with a powered antenna and a PIT tag reader so that each visit of the parents to their nests would be recorded.

To date, previous work on parent birds' response to variations in nestlings' begging has generally been correlational. Our experimental approach, combined with a close monitoring of parent behaviour, will therefore significantly increase our understanding of the evolution of vocal signals in parent-offspring communication.

1.5 The breeding ecology and evolution of sociality in the zebra finch

Investigators:

Clémentine Vignal, Julie Elie

Université de Lyon, Université de Saint-Etienne, ENES & CNRS 8620, France

Neeltje Boogert

McGill University, Montreal, H3G 0B1, Canada

Mylène Mariette, Simon Griffith

Department of Brain, Behaviour and Evolution, Macquarie University, Sydney, NSW 2109

The plans for the field season (August – December) of work on the zebra finch (*Taeniopygia guttata*) ended up being derailed to a large extent by the ongoing drought conditions at Fowlers Gap. It had been intended that the team from France would continue and extend their work on acoustic communication between partners and offspring around the nest. In addition, a new collaborative partner (Neeltje Boogert) joined the team from McGill University (Canada) to work on the relationship between song performance and cognitive ability. This latter project was based on work previously conducted by Neeltje on domestic birds in Canada which had revealed that the complexity of an individual male's song is related to his ability to solve problems relating to foraging behaviour. Therefore, females discriminating on the basis of song performance will be able to target clever partners. In addition, this year was our sixth consecutive field season monitoring reproductive ecology at Fowlers Gap, and the final year for the collection of data towards Mylene Mariette's PhD research into the costs and benefits of aggregated breeding in the zebra finch. Unfortunately, despite the diversity of projects attempted, this year was the worst with respect to reproductive activity, following the almost complete lack of rain through to November. Breeding commenced later than in previous years and, in total, just 143 chicks were banded between August and the end of November.

Whilst the poor conditions did affect progress in the field, during this period we have had good success in publishing earlier work relating to the research conducted at, or based on birds collected from, Fowlers Gap.

Recent publications arising from the research conducted on the zebra finch by our group at Fowlers Gap:

- Elie J.E., Mariette M.M., Soula H.A., Griffith S.C., Mathevon N., Vignal C. (2010) Vocal communication at nest between mates in wild zebra finches: a private vocal duet? *Animal Behaviour*, 80,
- Griffith S.C., Holleley C.E., Mariette M.M., Pryke S.R., Svedin N. (2010) Low level of extra pair parentage in wild zebra finches. *Animal Behaviour*, 79, 261-264.
- Griffith S.C., Pryke S.R., & Mariette M.M. (2008) Nest box use by the zebra finch *Taeniopygia guttata*: implications for reproductive success and research. *Emu*, 108, 311-319.
- Mainwaring, M.C., Hartley, I.R., Gilby, A.J., Griffith S.C. (2010) Hatching asynchrony and growth trade-offs within domesticated and wild zebra finch. *Biological Journal of the Linnean Society*, 100.
- Pariser E.C., Mariette M.M., Griffith S.C. (2010) Artificial ornaments manipulate intrinsic male quality in wild-caught zebra finches (*Taeniopygia guttata*). *Behavioral Ecology*, 21, 264-269.

Tschirren B., Rutstein A.N., Postma E., Mariette M.M., Griffith S.C. (2009) Short- and long-term consequences of early developmental conditions: a case study on wild and domesticated zebra finches. *Journal of Evolutionary Biology*, 22, 387-395.

1.6 Does corticosterone modify fine acoustic structure of begging calls in wild zebra finch nestlings?

Emilie C. Perez, Nicolas Mathevon, Clémentine Vignal

Université de Saint-Etienne & CNRS, UMR8195 ENES-CNPS, F-42023 Saint-Etienne Cedex2, France

Mylène Mariette, Simon Griffith

Department of Brain, Behaviour and Evolution, Macquarie University, Sydney, NSW 2109 Australia.

Christophe Soulage, Hédi Soula

Université de Lyon, INSA, INSERM U870, Bat. IMBL, F-69621 Villeurbanne Cedex, France.

As their needs vary in time with metabolic rate, environmental conditions and development, young birds have to communicate their needs to their parents to receive the appropriate level of resources at any one time. Although the prediction that the rate of begging displays reflects nestlings' needs has received empirical supports, the specific components of the signal driving parents feeding is not well established. To the best of our knowledge, no study asked whether nestlings' condition affects begging calls acoustic structure. Whereas an increase in begging call rate enhances the risk of predation, fine variations in call structure could be less conspicuous. When nestlings are food deprived, the level of circulating corticosterone (the main stress hormone in birds) increases and may be the physiological pathway that modulates call structure. Recent studies demonstrated that corticosterone provokes fine call structure modulations in adult zebra finches (*Taeniopygia guttata*). Thus, we hypothesized that the acoustic structure of young begging calls could also vary according to stress level.

We experimentally increased circulating level of corticosterone in wild zebra finch nestlings by performing oral administration at 8 and 11 days of age. Begging calls were recorded before and after oral administration and acoustic parameters were analysed. During the whole experiment, chicks' behaviour in the nest was videotaped and morphometric measurements were taken.

We predicted that if structural variations in begging calls are relevant in parent-offspring communication, parents will adjust their foraging and provisioning behaviour accordingly. Consequently, we tested parents' response to these signals using playback experiments. We also monitored parental provisioning using pittags attached to the birds' rings and nest boxes equipped with a powered antenna and a pittag reader so that any visit of the parents to their nests will be recorded.

To date, previous works on parents response to variation in nestlings' begging has generally be correlational. Our experimental approach, combined with a close monitoring of parent behaviour, will therefore significantly increase our understanding of the evolution of vocal signals in parent-offspring communication.

1.7 Behaviour and ecology of the cooperatively breeding chestnut-crowned babbler

James Savage

Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK

Andy Russell

Centre for Ecology and Conservation, School of Biosciences, University of Exeter, Penryn TR10 9EZ, Cornwall, UK; Brain, Behaviour and Evolution, Macquarie University, Sydney NSW 2109, Australia

Chestnut-crowned babblers (*Pomatostomus ruficeps*) are small endemic Australian birds found in the semi-arid regions of North-Western New South Wales, Eastern South Australia and Southern Queensland. They reproduce in groups of up to fifteen, consisting of a single breeding pair that produces all the offspring and a number of helpers that assist by provisioning the chicks and breeding female. Large scale studies on the babblers have been running at Fowlers Gap since 2004, collecting data on breeding success and performing cross-fostering and other experiments on the population. In normal years our field site of 6400 hectares contains about 70 breeding groups of babblers, with an average of around 7 birds per group. In 2009, due to the prolonged drought and associated dust storms and poor habitat condition only 30% of the groups made an attempt to breed. Of these, only 60% managed to raise any chicks successfully to fledging age, compared to a success rate of around 85% for groups breeding in 2007 and 2008. When caught, the babblers were consistently found to weigh approximately 45g, around 10% less than their normal average weight. Assuming better conditions prevail in years to come, future work on the babblers will include testing our understanding of how individuals should invest optimally when breeding cooperatively, and the effects of hidden maternal investment and varying numbers of helpers on the dynamics of a cooperative system.

1.8 Function and diversity of vocalisations in a cooperatively breeding bird

Jodie Crane

Department of Animal and Plant Sciences, University of Sheffield, Western Bank, Sheffield, S10 2TN, UK

Andy Russell

Centre for Ecology and Conservation, School of Biosciences, University of Exeter, Penryn TR10 9EZ, Cornwall, UK; Brain, Behaviour and Evolution, Macquarie University, Sydney NSW 2109, Australia

In social species, the ability to distinguish between individuals may be important in maintaining social groups and maximising fitness. In birds, recognition is generally assumed to involve vocal signals, but these have rarely been investigated. This study aims to investigate the development and adaptive function of calls in the chestnut-crowned babbler (*Pomatostomus ruficeps*). During 2009 a number of methods were used to investigate the diversity and function of babbler calls in both adults and chicks. Adult chestnut-crowned babblers were found to have a repertoire of approximately twelve common and recognisable calls, with chicks and juveniles demonstrating an additional two. A number of rarer calls were also recorded. Adult calls consisted of two main categories: contact calls between individual babblers, giving information on a bird's whereabouts and actions, and alarm calls which inform other babblers of potential threats from outside the group. Preliminary work suggests that vocalisations within individuals are repeatable

and may therefore be used in recognition. This work is ongoing, with future aims including investigations into the development of vocalisations during the nestling period and after fledging, as well as further work on the adaptation of calls to social circumstances and the importance of vocalisations in recognition.

1.9 Social interactions at breeding nests of chestnut-crowned babblers

Fumiaki Nomano

Graduate School of Environmental Science, Hokkaido University, Sapporo, Kita-10, Nishi-5 Hokkaido, Japan.

Andy Russell

Centre for Ecology and Conservation, School of Biosciences, University of Exeter, Penryn TR10 9EZ, Cornwall, UK; Brain, Behaviour and Evolution, Macquarie University, Sydney NSW 2109, Australia

Breeding groups of chestnut-crowned babblers vary in size from 2 to 15, consisting of breeders and helpers who cooperatively provision offspring. The large group size of this species can be assumed to lead to a complex social structure. In 2009, provisioning and social interactions between group members around breeding nests were studied by observing the birds from a hide. Individual birds came to nests from various directions, but group members tended to visit in the company of other individuals: a substantial proportion of times individuals entered a nest within one minute of another bird (17-34%). Some individuals visited nest trees with others who were carrying food for chicks, but did not bring food or enter the nest themselves. In some cases, individuals did not go straight into the nest but remained on tree branches 20-30 meters from the nest for up to a minute with food items in their bill, whilst looking around the area. Aggressive interactions were recorded, but were not common. These observations suggest that individual decisions about the timing of nest visits are influenced by the behaviour of other individuals.

1.10 Comparative water and feed requirements of western grey kangaroos and sheep at Fowlers Gap Arid Zone Research Station

Investigators:

Adam J. Munn

Faculty of Veterinary Science, The University of Sydney, Sydney, NSW 2006

Chris Dickman

School of Zoology, The University of Sydney, Sydney, NSW 2006

Mike Thompson

School of Zoology, The University of Sydney, Sydney, NSW 2006

We investigated the field-metabolic rates (daily food/energy use) and water usage of western grey kangaroos (*Macropus fuliginosus*) and merino sheep (*Ovis aries*). Using a doubly-labelled water method, animal energy and water needs were measured over 8-10 days in a large (16 ha) enclosure. Preliminary results indicated that a standard (25 kg) western grey kangaroo had an average daily energy requirement equal to around 0.46 of that of a standard (45 kg), non-pregnant or lactating ewe. Water [use]/[consumption] by kangaroos also lower than that by sheep, values being around 2 L and 6 L d⁻¹ respectively.

This project was supported by an ARC Linkage Grant to A. Munn, C. Dickman and M. Thompson in collaboration with the NSW DECCW, NSW I&I, Western Catchments Management Authority, WA CALM and SA DEH, and supported two honours students.

1.11 Comparative water and feed requirements of western grey kangaroos and sheep at Fowlers Gap Arid Zone Research Station

Investigators:

Adam J. Munn

Faculty of Veterinary Science, The University of Sydney, Sydney, NSW 2006

Chris Dickman

School of Zoology, The University of Sydney, Sydney, NSW 2006

Mike Thompson

School of Zoology, The University of Sydney, Sydney, NSW 2006

We investigated daily feeding and other behaviour (grazing time, drinking frequency, resting times, movement) of western grey kangaroos (*Macropus fuliginosus*) and of merino sheep (*Ovis aries*). Direct observations of kangaroo and sheep behaviour were compared with data collected from animals that had been fitted with GPS radio-collars equipped with activity monitors and temperature data. Overall, collar-data was substantially in line with those recorded from direct observations of movement and activity times, with kangaroos moving around 4000 m d⁻¹, compared with around 6500 m d⁻¹ for sheep. This project was supported by an ARC Linkage Grant to A. Munn, C. Dickman and M. Thompson in collaboration with the NSW DECCW, NSW I&I, Western Catchments Management Authority, WA CALM and SA DEH, and supported two honours students. GPS collars were acquired with funding support from The National Geographic Society.

Recent publications deriving from research conducted by our group at Fowlers Gap 2007-2009

Munn, A.J., Dawson, T.J., McLeod, S. Feeding biology of two functionally different foregut-fermenting mammals, the marsupial red kangaroo (*Macropus rufus*) and the ruminant sheep (*Ovis aries*): how physiological ecology can inform land management. *Journal of Zoology*, London. *Accepted June 24, 2010*

Munn, A.J., Dawson T.J., McLeod, S.R., Croft D.B., Thompson, M.B., Dickman, C.R. (2009) Field metabolic rate and water turnover of red kangaroos and sheep in an arid rangeland: an empirically derived dry-sheep-equivalent for kangaroos. *Australian Journal of Zoology* 57(1): 23-28 (*Cover Image*)

1.12 An observational study of the behaviour of adult female kangaroos and their dependent young

Investigators:

Trudy Sharp, PhD student

University of Sydney, Sydney, NSW 2006

Dr. Steve McLeod, Supervisor

Industry & Investment NSW – Primary Industries

For many people in today's society the use and management of animals is acceptable provided that such management is humane and therefore does not cause unnecessary pain and suffering. The commercial harvesting of kangaroos is seen by many as an efficient, sustainable and environmentally-friendly industry. However, there is still significant concern that some aspects of kangaroo harvesting are not humane, particularly the euthanasia of pouch young and young-at-foot. This concern has been voiced by a range of stakeholders including animal welfare organisations and animal rights groups, as well as the general public.

Of particular concern is what happens to kangaroo joeys that become orphaned after their mother has been shot during shooting operations. The National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes describes methods for euthanizing kangaroo young and states that young-at-foot should be euthanized with a single shot to the brain or heart using a firearm. However this can be problematic since dependent young that are out of the pouch when their mother is shot may not be seen by the shooter or they may flee before the shooter can deliver an accurate shot. The fate of joeys that escape after the mother has been shot is unknown but it is thought that most die either by predation, dehydration, starvation or stress-related disease.

This pilot project is the first stage of a larger study to determine the fate of orphaned kangaroo young-at-foot that escape capture. The aim of the pilot study is to perform an intensive reconnaissance, or exploratory observation of females and their joeys. In-depth observation of behaviour such as eating, drinking, sleeping/resting, grooming and also interactions between mother and young will help to establish the typical levels and range of behaviour in natural surroundings. Obtaining a good knowledge of normal behaviour patterns will help us in future studies to identify behaviour that deviates from normal and might be indicative of distress or suffering.