2011 Fowlers Gap Research Report

The Response of Small Mammals to Seasonal and Annual Variations in Climatic Conditions

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This study will look at the long-term fluctuations in small mammal populations in response to climatic conditions. Very few studies into small mammal populations take a long-term perspective, being generally tied to the period of the research grant or the tenure of the student involved. It is hoped to continue this study for the next five years.

The Fate of Kangaroo Young-At-Foot Following Separation from their Mothers

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The fate of orphaned young-at-foot after their mother has been shot is perhaps the most controversial issue surrounding the commercial harvesting of kangaroos. The National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Commercial Purposes states that, after a female has been shot, any dependent young-at-foot must be euthanized with a "single shot to the heart or brain where it can be delivered accurately and in safety…". However it is not known what proportion of orphaned young-at-foot are actually euthanized. For surviving joeys there is no objective information on their fate after their mother has been killed. In this project we aimed to determine if orphaned young-at-foot suffer, what sort of suffering they may experience, and how any suffering can be minimised.

Does the Morphology of Foraging Pits of Soil-disturbing Vertebrates Affect Secondary Seed Dispersal by Ants?

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Since European settlement, Australia has experienced a mass extinction of medium-sized mammals in the critical weight range of 35 g to 5.5 kg, particularly in the arid and semi-arid areas. The loss of soil-disturbing, ground-foraging mammals and their widespread replacement by the exotic European rabbit (Oryctolagus cuniculus L.) have lead to a substantial declines in ecosystem functions such as soil nutrient production and infiltration. Soil-disturbing animals such as the short-beaked echidna (Tachyglossus aculeatus) and the burrowing bettong (Bettongia lesueur) are often referred to as ecosystem engineers and their foraging activities are important for promoting and maintaining fertile patches within arid ecosystems. While foraging for food, these animals create small depressions (foraging pits) on the soil surface, which accumulate organic matter over time and become favourable

microsites for germination. Foraging pits have been found to support higher seed germination than the surrounding nutrient-poor soil matrix. However, the extent to which pits provide a safe site for germinating plants varies among the pits produced by different vertebrates, and recent published work indicates that the pits of the exotic rabbit support a lower diversity of germinants than those of native animals such as the bettong.

Breeding Ecology of the Cooperatively Breeding Apostlebird

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Field Assistants: Aliza Sager (April & August-November), Nick Chandler (Sept-Oct)

The continued good ecological conditions in early 2011 meant that the apostlebird (Struthidea cinerea) population at Fowlers Gap bred as they sometimes do during March-April when breeding was monitored by MW and AS, who banded 9 juveniles. In April a number of unbanded birds were located by MW and AS that were juveniles and probably produced prior to the work in April (but after the end of the fieldwork that ended on 9 December 2010). In spring 2011, 25 young unbanded birds were identified with specific groups (MW and AS) and were then banded in September-October (JW and NC), and are assumed to include the juveniles from April. In addition, two adult immigrants were caught and banded.

Can the Bad Times Be Better Than the Good? Surprising Results From an 8-year Study of Chestnut-crowned Babblers

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Over the past eight years, Fowlers Gap has experienced some of the most extreme weather patterns recorded over the century. Against the long-term mean annual rainfall of 232.5mm, between 2004 and 2008 annual rainfall ranged from less than 100mm to just over 200mm, and during this period most rain fell in the winter months. In 2009, the winter rains failed, and severe dust storms were a near-weekly occurrence throughout the spring and early summer until the drought finally broke at the end of November. Since then, annual rainfall has been well above average with over 500mm in both 2010 and 2011, and a pattern of

rainfall throughout the year but with particularly good spring and summer rains. During the eight-year period since 2004, we have been closely monitoring a population of chestnut-crowned babblers (Pomatostomus ruficeps), a 50g bird only found in arid and semi-arid regions of south-eastern Australia. It is shy and difficult to see, but one of the most common resident species in the region. For example, in the 56km2 area of our field-site at Fowlers Gap, there are commonly up to 500 adult birds. Like many resident species in the area, it is a cooperative breeder, meaning that birds in addition to parents help to rear the offspring. This type of behaviour has been suggested to an adaptation to the unpredictable nature of arid environments: helpers reduce offspring starvation when conditions are poor, and free mothers from maternal duties when conditions are good, allowing mothers to produce more offspring within the year. Given this, we might expect babblers to have bred much more during the "good" times of recent years than during the "bad" times of 2004-2009. This is not the case. Between 2004 and 2008, every babbler group bred reliably between July and November, with years of additional spring rain facilitating second breeding attempts. Understandably, at the height of the drought, most babbler groups failed to breed in 2009, and 30% of babblers appeared to have died in that year's dust storms. However, very surprisingly, babblers have bred irregularly since 2009, even though the rains have been plentiful and primary production of vegetation has been excellent. In 2010 around 60% of groups bred; in 2011, most groups bred, but did so in late summer to early winter, and so far no groups have bred successfully between June 2011 and the end of the year. This complete absence of breeding during the spring is a first across the years of our study. Given the favourable conditions arising over the past three years, the obvious question is why have babblers not bred 2-3 times per year in response, or even as well as they did through the years of drought? The comparable lack of breeding appears not to be restricted to babblers, and we have found little evidence that any bird species has increased their breeding rate in response to the good weather. Is the fact that most of the rain in recent years has fallen during the summer rather than the winter a factor? Summer rain is more associated with grass growth, meaning that perhaps crickets/locusts will become the dominant food rather than caterpillars/ spiders/beetles which are more dependent on the flowers generated by winter rain. Are the plagues of mice a factor? It is conceivable that the invasive house mouse (Mus musculus) has reached such high densities that it is consuming all the food (seeds and insects), and potentially invading babbler nests as well, such that, paradoxically, there is a lack of food for the birds. Finally, were the dust storms of 2009 so severe that both the birds and their food are taking a long time to recover? The answer to these questions can only be determined through further research, but conclusion is already clear: high rainfall and plentiful grass does not necessarily result in the high productivity of local birds.

Predation, Social Aggregations and Lack of Breeding in the Zebra Finch

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The zebra finch (Taeniopygia guttata) is one of the classic 'boom and bust' species of the Australian arid zone and, given the conditions going into 2011, we had expected this year to be a very good year for the zebra finch at Fowlers Gap. However, surprisingly, this year was the first year since 2003 in which the birds have failed to have a single successful nesting attempt in the spring. To date we are still somewhat perplexed as to the cause of this, but the threat of predation is a strong candidate for causing the lack of breeding activity.

The number of birds in the different areas was not particularly high, but adults were present in most areas. Feeders were provisioned through the spring season, however the number of mice was still high early in spring and feeders were mounted on stakes to keep the food away from the mice. In early checks of the nest boxes, mice were found in many of them and apparently had no problem climbing up picket posts and entering nest boxes. Mice were probably quite capable predators of eggs and young chicks, and potentially were off-putting to the adults.

Investigating Acoustic Alarm Signalling in Wild Zebra Finches

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We investigated whether zebra finches (Taeniopygia guttata) utilise an acoustic signal cooperatively to avoid predation in the wild. Many social species have evolved an acoustic alarm call designed to warn conspecifics of an approaching predator and to induce an appropriate avoidance or escape strategy. The colonial social system of zebra finches and their dependence on water in an arid environment make them particularly vulnerable to predation, because their behaviours are predictable, with a daily routine of visiting social sites and water holes. Zebra finches also possess a broad vocal repertoire and we were interested in whether they communicate about an imminent threat with an acoustic signal.

Immune and Hormonal Variation in Relation to Life Stage in Native and Introduced Birds

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Most bird species must replace their feathers at least once annually to maintain their functionality for flight, thermoregulation, protection from the environment and sexual signalling. Feathers are non-living structures, which means that their physical quality depends on the nutritional status of a bird at the time of their synthesis. Because of their high protein content and high proportion of sulphur-rich amino acids, this places potential conflicts between moult and other nutrient-demanding activities in a bird's annual cycle. We are examining the extent to which immunological and endocrinological adjustments occur in species that segregate moult and reproduction (introduced species and native mesic species) compared to some native species showing moult/breeding overlap (several arid-zone

species). We are testing the hypothesis that stress sensitivity will be reduced during moult and that acute-phase immune responses will be down-regulated, while adaptive immune responses are up-regulated during feather replacement. We initiated our studies in late 2010 and have managed to get representative samples from three species at Fowlers Gap and several others in coastal Victoria. Results thus far indicate that Fowlers Gap birds have moderate, but seasonally invariant, stress sensitivity, whereas corticosterone secretion in seasonally breeding introduced species is highly variable, with reduced stress-sensitivity observed during moult. We are continuing these studies to examine the extent to which immune functions are seasonally modulated.

Suitability of Fowlers Gap for Ground-Based Gamma-Ray Astronomy At TeV (1012 eV) Energies

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In 2011 we continued our monitoring of the night sky at Fowlers Gap, aiming to characterise the night-time cloud cover. A number of infrared sensors were placed at locations around Fowlers Gap at the end of 2010, and some early data were retrieved in June 2011. Following analysis of these data we will make further enhancements to the detector design and performance during 2012.

Ecohydrology of Arid Shrublands at Fowlers Gap

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Field experiments in 2011 were carried out primarily to explore further the role of rainfall event structure in influencing infiltration, soil water uptake, and the production of overland flow. In arid ecohydrology research, as in much other hydrological and geomorphic research, rainfall simulation provides a key tool that allows the researcher to control the conditions on experimental plots, freed from a dependence on the arrival of natural storms. However, almost all experiments in these disciplines have used constant rainfall rates, for the practical reason that these can be conveniently delivered by pumps and nozzles working at fixed pressure. Experiments using sustained constant rainfall intensities fail to capture potentially important intra-storm intensity variations. For instance, summer convective storms are frequently most intense in their early stages, and show declining intensity as wetting and evaporation cool the land surface and weaken convection. This means that the heaviest rain strikes dry or wetting soil, whereas saturated surface soil late in a storm is only struck by less intense rain. These circumstances are potentially very relevant to the formation of drop-impact seals and crusts, which in turn affect the ability of dryland soils to take in water.

Do Nutritionally Poor Environments Promote Sociality? Testing a Long-standing Hypothesis in Socially Plastic Acacia Thrips

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Why individuals cooperate is an evolutionary puzzle. One longstanding theory is that nutritionally poor environments reduce individuals' chances of breeding independently, forcing cooperation with other individuals. The proposed project focuses on testing this in the field, using socially plastic species – i.e., insects that can be social or solitary: Acacia thrips (Thysanoptera) in the genus Dunatothrips, which facultatively cofound domiciles on Acacia aneura in the Australian arid zone. Working with Stephen Simpson at the University of Sydney, a pioneer in nutritional approaches to ecological questions, JG began testing, firstly, whether social behaviour occurs more often on nutritionally imbalanced food plants, and, secondly, whether experimentally imbalancing the nutritional composition of food causes previously independent breeders to decide instead to cooperate. If successful, this will open up a paradigm that has been theorised but never rigorously tested, representing a major contribution to social biology.