

Avian Pollination: Ecology of Vision and Colouration in a Co-evolved System

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Avian colour vision differs substantially from that of humans because many birds perceive UVA wavelengths (300-400nm), to which humans are blind, and have four types of cones in their retina, compared to only three in humans. Thus, to communicate with their pollinators, plants may use colour-based signals “hidden” from humans. With the objective of gaining insight into the function and evolution of colour-based signalling in avian pollination systems, we carried out a range of observations and experiments in the coastal heathlands of Royal National Park, Australia (figure 1).



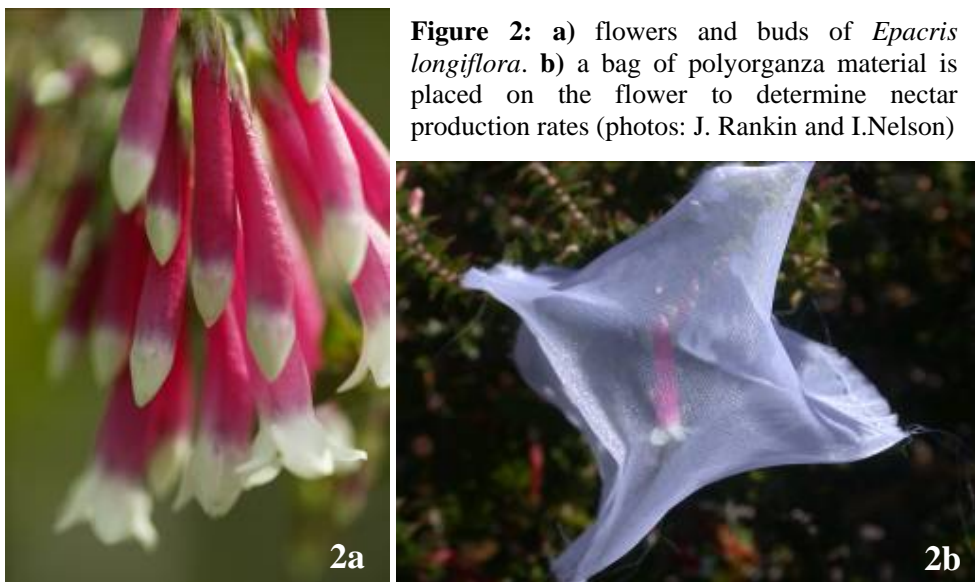
Figure 1: Our field-sites were located in Royal National Park (New South Wales, Australia), where I joined my supervisor, Isabel Nelson, from the University of Bristol (UK), for research on avian pollination between June and September, 2005. (photo: J. Rankin)

Our first aim was to investigate the pollination biology of the fuchsia heath *Epacris longiflora* (figure 2a). Twice a month, observations of flower visits were undertaken in plots of 50m² in 30-minute time-slots throughout the day. We found that while some birds legitimately visited the flowers, feeding through the corolla mouth and thus pollinating the plant, others robbed the nectar by tearing holes in the petals or feeding through such holes torn by previous visitors, not pollinating the plants. We recorded data which included the species of nectar-feeding bird visiting, the number of flowers visited per plant either legitimately or by robbing, and the number of intact

and robbed flowers per plant. Legitimate avian flower visitors included the Eastern Spinebill and the New Holland honeyeater. Robbers also included the New Holland honeyeater and Silvereyes.

Furthermore, to measure nectar rewards available from *Epacris longiflora*, we measured plant and flower density and floral display size. Therefore, we counted the number of plants in 25m² plots, the number of flowers and buds per plant in these plots, and the number of buds, intact, and robbed flowers on randomly selected plants. We measured nectar rewards per plant by removing the nectar with a micropipette and bagging flowers with polyorganza material for 24 hours (figure 2b) to obtain nectar production rates. We also took morphometric measurements of these flowers.

In addition, we conducted the following experiment to determine whether nectar-feeding birds could discriminate rewarding flowers before probing these: from half the flowers on a plant we first removed the nectar and then replaced it with twice the amount nectar, while from the other half of the flowers we removed the nectar and replaced it with its original amount, as a control for the manipulation. Video cameras were set up to record which flower treatments birds visited, as well as the approach direction of the bird relative to the plant and the sun.



Our second aim was to search for patterns of phenotypic clustering within the flowering plant community, and to determine whether two flower traits, namely colour and morphology, are correlated with pollinator types. Therefore, insects and birds were observed and caught to identify the pollen of which plants they carried (figure 3). The pollen grains collected from the pollinators will be identified by comparing them to a pollen database, which is to be constructed by collecting pollen directly from flowering plants at the field site.



Figure 3: Bird observations were carried out along transects, and birds were caught with mist nets. Pollen was then collected by stroking their bill and head with fuchsin gel, which stains the pollen grains sticking to it. The bird species were recorded and the birds were banded.

Insects were caught directly after observing them pollinate plants along transects, they were identified, and pollen was removed from their body with fuchsin gel. (photo: I. Nelson)

Further floral measurements have been undertaken on flowering plant species at the field site, including colour measurements. These were carried out by spectrometry over the UVA and human-visible ranges, which allows reflectances and light environments to be accurately assessed. Moreover, we started to set up a database on pollination systems in Australia, based on published and unpublished literature. Thus, we hope to increase understanding of signalling in Australian pollination systems.

I would like to thank the Explorers Club and my supervisor Isabel Nelson for giving me the opportunity to travel to Australia to undertake this project and attain many invaluable skills. In addition to learning the methodologies we employed to carry out our research, I gained much knowledge of experimental design and application. I realised how much thorough and strenuous work goes into organising and undertaking a research project based on fieldwork, but also how rewarding this can be (figure 4).

