Fickle bills of fare

IN SOME parts of the world, nectar-bearing flowers and the 'nectarivorous' birds that feed on them have a highly specialised relationship. For example, some flower shapes are accessible only by bird species with particular bill structures. Scientists have found that in the monsoonal north-west of Australia, however, the bird-flower relationship is more generalised.

Donald Franklin and Dr Richard Noske from the CRC for the Sustainable Development of Tropical Savannas, and the Northern Territory University, looked at the bill length and body weight of certain nectarivorous birds (including lorikeets and honeyeaters), and the flower structure of plant species on which the birds fed, to see if bird and flower morphology (structure) were linked.

They found that the most abundant and popular nectar sources included flowers from the families Myrtaceae (eucalypts and bloodwoods), Proteaceae (grevillea and banksia) and Loranthaceae (mistletoe). Eight flower shapes and three groups of birds were identified, depending on the flower shapes they used. But the scientists found a limited relationship between the size and bill-shape of the birds, and flower structure. Instead, the birds tended to use whatever flowers were available in their habitats. Variation between bird species in patterns of use of different floral structures primarily reflected the habitats occupied, rather than a shared or co-evolved morphology.

A combination of factors probably contributed to this generalised relationship: the abundance of mass-flowering myrtaceous trees, aridity during past glacials which may have removed specialists from the system, and the sharing of nectar sources with bats.

Fruit and blossom bats may have been a selective force in the evolution of vertebrate pollination relationships in the Australian tropics, and their prevalence may have mitigated against the evolution of highly specific bird-pollination relationships.

Franklin DC and Noske RA (2000) Nectar sources used by birds in monsoonal north-western Australia: a regional survey. *Australian Journal of Botany,* 48:461–474.

Wendy Pyper

Native foods need serious attention

AUSTRALIA'S native edible plants have the potential to provide a rich array of foods and flavourings, and in some cases, medicines, vitamins and cosmetics. Of the more than 700 known species of edible plants however, only 14 have achieved commercial significance.

A review of horticultural research relating to Australia's top 14 edible plants lists propagation, breeding, cultivation, nutritional value and the isolation of natural products as the main topics of investigation.

The quandong has received significant scientific attention, but a stronger research and marketing effort is need to realise the potential of Australian food species.

Dr Amani Ahmed and Dr Krystyna Johnson found that the quandong has had the greatest amount of scientific attention, primarily from CSIRO Plant Industry in South Australia. Propagation, germination and breeding work has led to the development of two commercial varieties.

Acacia seed is another major commercial species, used to flavour ice cream, baked goods and as a coffee substitute. Research into edible *Acacia* species has looked at nutrition and responses to irrigation and fertilisation, while pruning, propagation, breeding, cultivation and post-harvest techniques have been described for ornamental and some edible species.

Other edible native plants discussed in the paper include warrigal greens, Kakadu plum, bush tomato, native lime and rosella. Ahmed and Johnson observed, however, that research on these and other bush food species was insignificant compared with traditional food crops such as wheat, which dominates plant-breeding research in Australia.

This is unfortunate, as native plants provide a number of environmental benefits. 'There is the potential to help solve land degradation problems, while at the same time providing farmers with a commercial crop, and habitat for native animals,' Ahmed says.

Ahmed and Johnson say a successful native food industry relies on research in areas including cultivar development (genetic improvement), genetic conservation and management of natural diversity, toxicology, pests and diseases and harvesting and post-harvest requirements.

Ahmed and Johnson say the industry will also need to consider the spiritual and cultural significance of the plants to Aborigines, and to re-evaluate marketing strategies. 'Bush foods need a new name, such as 'native Australian foods' and the industry needs a new position in the market, to remove itself from images of survival in the wild and tourist gimmicks.'

Ahmed AK. and Johnson KA (2000) Turner Review No. 3: Horticultural development of Australian native edible plants. *Australian Journal of Botany*, 48:417–426.

Wendy Pyper

What rainforest is that?

RAINFOREST occurs in patches in every Australian state but South Australia, and in many territories, such as Christmas Island. Across this broad range, they vary significantly in structure and florisitic composition, and are subject to a range of formal definitions. To further complicate matters, forests that border rainforest may be called 'transitional' – in time, they will probably become climax rainforest communities. So where do you draw the rainforest boundary?

Not surprisingly, an all-encompassing definition of rainforest has proved elusive. This is a problem, given that accurate recognition of forest types provides a basis for development of forest management policies and strategies. The definition of rainforest has also been disputed legally and during formal enquiries.

Jasmyn Lynch and Dr John Neldner of Environment Australia decided to confront the problems and set about developing three options for a workable national definition of rainforest. Their goal was to come up with a definition that was generally applicable, yet regionally specific. It also needed to account for management implications and community values attributed to rainforest.

Full definitions are provided in the scientists' paper (see below). The first definition forms the core, with additional qualifying criteria included in the second and third definitions. Lynch and Neldner have also

constructed a simple key to enable people to systematically distinguish rainforest communities from other forest types, including mangroves. Their preferred definition, if widely adopted, should improve the consistency of management and conservation of our national rainforests.

Lynch AJJ and Neldner VJ (2000) Problems of placing boundaries on ecological continua – options for a workable national rainforest definition in Australia. *Australian Journal of Botany*, 48:511–530.

Steve Davidson

Tracking the bat pack

THE LITTLE bat, *Myotis moluccarum*, may only weigh about 10 grams, but it has big feet and, it seems, a big heart and good stamina. Also known as the large-footed myotis, this species has recently been the subject of a field study by scientists Robert Barclay, Bryan Chruszcz and Martin Rhodes from the University of Calgary and the University of Queensland.

The large-footed myotis is an interesting bat in that it forms harems in which the adult males each defend a roost-site occupied by several adult females. In southern Queensland, the females produce a pup in late October or early November and another in January or February. The females are pregnant while lactating with the first pup.

Barclay and his colleagues were interested in how the demands of the breeding season affect foraging behaviour in male and female bats. Would differences in the energy, time and nutrient demands of breeding females and males lead to differences in their foraging strategies?

By radio-tagging a number of bats at their roosting place in an abandoned railway tunnel and monitoring their behaviour during lactation and post-lactation periods, the scientists were able to monitor what the bats got up to.

They found that the bats typically undertook one or two foraging bouts a night, to a lake some 10 km away, to feed on insects and small fish. On average, the flight took 32 minutes each way and those bats that had a second feeding session roosted, and no doubt rested, back at the railway tunnel, for about 86 minutes, before the second outing.

Why return to the main roost-site between bouts? Apparently, the energetic benefits of a warm and stable communal roosting site outweigh the commuting costs. Or perhaps suitable roosting sites were simply not available near the foraging zone.

The bats tended to work a long, seven-hour shift, this being the average total foraging time per bat per night. Females, with their greater need for nutrients and energy, foraged for longer than male bats and this was achieved, not by more trips to the distant lake, but by a longer second foraging session.

Barclay RMR Chruszcz BJ and Rhodes M (2000) Foraging behaviour of the large-footed myotis, *Myotis moluccarum* (Chiroptera: Vespertilionidae) in south-eastern Queensland. *Australian Journal of Zoology*, 48:385–92.

Steve Davidson

Feed the plant meat

BACK IN 1878, Charles Darwin reported that when insectivorous sundew plants were denied insect prey they showed less vigorous growth, produced fewer flowers and set less seed than plants provided with insects. It is thought that carnivorous plants, often found on infertile acidic soils, with little competition from other plants, benefit from the nutrients in their prey.

Darwin, and more lately others, have hypothesised that the somewhat startling predatory behaviour of carnivorous plants should, therefore, prove more beneficial to plants growing in nutrient-poor soils than in fertile soils.

While some studies into various species have supported this view, others have not. Recently, scientists at the University of Western Sydney, Richard Jobson, Charles Morris and Shelley Burgin, conducted an experiment to determine whether the meat-eating bladderwort (*Utricularia uliginosa*), a rootless herb, responds to the presence or absence of prey, and to increased nitrogen when grown in pots.

This intriguing plant, found along the east coast of Australia and in South-east Asia, possesses small, spherical, water-filled traps or bladders that have a miniature trap-door and negative pressure within. If a very small invertebrate prey animal touches trigger hairs on the trap, the door is released and an influx of water carries the hapless victim into the bladder where it is 'digested' by enzymes.

Jobson and his colleagues manipulated nitrogen levels (control plus two treatments) by adding ammonium nitrate to the pots containing the plants. They controlled the prey supply by adding either *Euglena* (a motile single-celled organism) alone or *Euglena* plus tiny invertebrate animals (copepods, nematode worms and the like), known collectively as meiofauna.

They concluded that trapping of small invertebrates (meiofauna), in combination with *Euglena*, definitely conferred a growth advantage. The benefit gained by trapping meiofauna lessened as nitrogen level increased, as hypothesised. Unexpectedly, at the lowest nitrogen level, trapping of *Euglena* depressed plant growth, apparently because it competed with the bladderwort for nitrogen under these conditions – the prey here acting as a parasite.

On the whole, the researchers say their results indicate that bladderwort growth was not significantly affected by addition of nitrogen, but did benefit from carnivory. They suggest that, at low nitrogen levels, the carnivorous tendencies of the bladderwort allow it to overcome a nitrogen deficiency, ironically induced by *Euglena* prey, and deficiencies of other nutrients when nitrogen is more plentiful in the soil substrate.

Jobson RW Morris EC and Burgin S (2000) Carnivory and nitrogen supply affect the growth of the bladderwort *Utricularia uliginosa*. *Australian Journal of Botany*, 48:549–560.

Steve Davidson

VJ Neldner, Queensland Herbarium

Rainforest at Kroombit Tops, Central Queensland. New definitions of rainforests, if widely adopted, should improve the consistency of their management and conservation.