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Macleay's Swallowtail, Birralee - Photo: S. Lloyd

ClimateWatch volunteers needed to observe seasonal changes

Nick Fitzgerald Biodiversity Monitoring Section, DPIPWE

The timing of events such as bird migrations and the flowering of plants is often closely linked to climate. Historical records of phenology (the study of the timing of periodic phenomena in the life cycles of plants and animals) over decades or centuries have proven useful for reconstructing changes in seasons, particularly the arrival of spring. Moreover, with current rates of climate change it is increasingly important to understand the implications of phenological changes for our flora, fauna and ecosystems.

Nothofagus gunnii leaves changing colour at Cradle Mountain, May 2010

The most extensive phenological records come from Japan, where historical records for flowering of cherry trees have been collated into a dataset extending back to the 9th century; and in recent decades standardized observations of blossoming trees in the grounds of weather stations have been made by the national meteorological organisation. Another source of important historical records is the meticulous diaries of British naturalists such as Gilbert White and Richard Fitter.

Most long-term records for plant phenology from the Northern Hemisphere are consistent with observed recent climate change; that is an earlier arrival of Spring (typically 2-5 days earlier per decade) and a slight delay in Autumn phenophases such as colouring and leaf drop of deciduous trees (this has been referred to as 'season creep'). The consequent lengthening of the growing season is likely to change the stability and functioning of ecosystems, particularly when combined with other climate-driven phenomena such as migration of species and changes in rainfall and snowmelt patterns. Asynchrony in specific plant-pollinator relationships is one possible consequence of changed flowering times.

Trends are not consistent across species, and even within a species observed changes in phenology may vary between sites. Consequently it is necessary to collate a large number of observations over a long time to get a good picture of phenology.

Unfortunately, Australia has a very poor record of historical phenology. A citizen science project is now underway to collate phenological observations from around the nation. ClimateWatch, an initiative of the not-for-profit Earthwatch organisation, currently involves over 100 different exotic and native species from plants, to birds, frogs, mammals and reptiles.

This long-term project is aiming for hundreds of thousands of observations to be recorded so that it becomes Australia's leading data resource for environmental scientists studying the effects of climate change. To this end Climate Watch relies on observations from volunteers across the continent.

A similar program in the UK was launched over a decade ago and has now recorded over 3 million observations (www.naturescalendar.org.uk). In the USA, the National Phenology Network incorporates citizen science observations through 'Nature's Notebook' (www.usanpn.org).

Many of the ClimateWatch target species – such as London plane trees, honeybees and starlings – can be readily observed in urban areas. Tasmanian native species include Christmas bush, Flame Robin and Macleay's swallowtail (see photo front cover).

Registering as an observer on the ClimateWatch website allows you to submit observations of phenophases for the target species. For example, for the ghost fungus (*Omphalotus nidiformis*) you can record different stages of the fruiting body from button to mature to dried out. Other observations that can be submitted include the breeding activity of three of Tasmania's frog species and the presence of washed-up marine invertebrates.

In collaboration with DPIPWE's World Heritage Area climate change monitoring program managed by the Biodiversity Conservation Branch, Tasmania's two endemic *Athrotaxis* species, pencil pine and king billy pine, have recently been added to ClimateWatch. Public observations of the health, recruitment and seed production of these species will be a valuable addition to the long-term program established by DPIPWE to monitor the impact of climate change on these iconic conifer trees.

Another ClimateWatch species particularly relevant to Tasmania's wilderness areas is the deciduous beech or fagus (*Nothofagus gunnii*). Since this is Australia's only winter deciduous woody plant it will be interesting to see if the timing of seasonal events such as bud burst and leaves changing colour is shifting, as has been observed in many Northern Hemisphere deciduous trees. Certainly many Tasmanians keep a close eye on the 'turning' of the fagus; what we need is for these observations to be recorded via ClimateWatch.

Healthy pencil pines (*Athrotaxis cupressoides*)

Participation in ClimateWatch is easy – you can make regular observations from your backyard or another favourite location, or focus on a particular species of interest, or make opportunistic observations when out in the bush. The ClimateWatch website has descriptions of the target species including information on what features to observe. The website also provides the platform for submitting records, which is as simple as selecting the species and feature, entering the date and pinpointing the location on a map. For more information visit the website at climatewatch.org.au

Pencil pine dieback, 17 April 2011

Further reading

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Fungi - Sarah Lloyd - photos - Phil Collier

In May 2011 we invited Paul George (secretary of Fungimap Inc.) to lead several field trips.

It is always tempting to take visitors from the mainland straight to the rainforest where a colourful array of saprotrophic fungi perform the all important task of decomposing and recycling centuries-old logs and stumps and the deep layer of leaf litter.

However, as well as being the main decomposers in the ecosystem (along with invertebrates and bacteria) fungi have other important roles. Some are parasitic and get their nutrients from living plants or animals; others are mycorrhizal and enter into symbiotic (mutually beneficial) partnerships with plants.

It was with this last role in mind that we decided to leave the rainforest until the last day of Paul's visit and begin the weekend at the coastal heath at Rubicon Sanctuary where we listed approximately 50 species. The following day we documented a similar number of species in the wet forests at Erriba.

To remind ourselves of the importance of fungi in the environment I am reprinting the following article that first appeared in The Natural News in autumn 2004.

(References are on page 15)

Heathland plants – how do they survive?

Heathlands are characterised by a low growing impenetrable tangle of shrubs, sedges, rushes, herbs and orchids. They are especially beautiful in early spring when their colourful flowers attract numerous insects and a wide variety of birds. Australian heaths have a rich array of plant species that rivals the diversity of tropical rainforests. On the Kwongan sandplains of Western Australia, for example, there are 5710 species of which nearly 80% are endemic.

I have always wondered how heathland plants survive – let alone flourish - in the sandy soils that are considered so deficient in nutrients as to be "effectively lethal for domestic plants" (Kirkpatrick & Harris 1999). It wasn't until I purchased Mary White's book "Earth Alive: from microbes to a living planet" that I found an adequate explanation. This book outlines some of the strategies plants have evolved to extract the nutrients they need. A further, more detailed explanation was found in Fungi of Australia, as in many cases, it is an intimate association with fungi that enables their survival.

It is believed that when plants first colonised the land some 400 million years ago they had two options: either they could develop an extensive, fine root system of their own, or they could enter into a relationship with fungi and thereby increase their ability to obtain nutrients and water from soil via the fungal hyphae - the microscopic thread-like structures that are the living component of most fungi.

Some plants, including members of the saltbush family (Chenopodiaceae), cabbage family (Brassicaceae), sedges (Cyperaceae and Restionaceae) and rushes (Juncaceae) adopted the first strategy and rarely form mycorrhizal associations. However, the vast majority (80-90%) of plants, including ferns, liverworts, lycopods and most families of vascular plants opted for symbiotic partnerships with fungi; relationships that are especially important in nutrient deficient soils. There are several different types of mycorrhizal associations:

Ectomycorrhizae or (ectotrophic mycorrhiza) occur in about 3% of plant species and are common in conifers, eucalypts, and deciduous trees such as beech, oak and birch. In ectomycorrhizae the fungus does not penetrate the hosts' cells but forms both a filamentous sheath that envelopes the root and a net (known as the hartig net) consisting of tightly packed

hyphae between the outer 3—4 cell layers of the root. The fungi involved are occasionally ascomycetes but are usually basidiomycetes that produce the frequently seen mushrooms, puffballs, coral fungi and truffles from genera such as *Amanita, Russula, Cortinarius, Tricholoma* and *Boletus*.

Phlebopus sp. (brown)
Rubicon Sanctuary

Endomycorrhizae (or endotrophic mycorrhiza) occur in approximately 80-85% of plant species. The fungal hyphae penetrate into the root cells rather than forming an external sheath of mycelium. Unlike ectomycorrhizae, they generally do not produce large fruit bodies. There are three types:

1. **Arbuscular endomycorrhizae** (also called vesicular-arbuscular mycorrhizae or VAM) are the most common and widespread. They occur in natural environments such as tropical rainforests, alpine meadows and deserts and in agricultural systems including crops of cereals, grasses, legumes, citrus, coffee, cotton, oil palms, rubber, sunflower and tea. They are obligate parasites - i.e. they do not survive for long in the absence of their hosts. Arbuscular mycorrhizas penetrate the cells in the outer layer (epidermis) and cortex of the root and produce highly branched structures called arbuscles (derived from the Latin word for "little bush"). There is an extensive interface between the arbuscles and the hosts' cell membranes, which enables water and other substances to be the transferred between plant and fungus.

2. **Orchid endomycorrhizae** are formed in all members of the orchid family and in their natural habitats orchids cannot grow without their fungal partners. The fungus forms coiled structures in the cells of the root cortex and transfers carbon and other nutrients to the orchid. The fungus gets nutrients by either breaking down organic matter in the soil, or by becoming mycorrhizal on other plants. The underground orchid of Western Australia, for example, is linked via fungal hyphae to a *Melaleuca* species.

3. **Ericoid endomycorrhizae** are a group of fungi associated with members of the Ericaceae family of the Northern Hemisphere and their

Thelymitra antennifera
Narawntapu NP

closely related southern counterparts in the Epacridaceae family. Plants of this family are common in the nutrient deficient soils of coastal heaths and alpine bog ecosystems. They include heaths *Epacris* spp., swamp heath *Sprengelia* spp., pinkberry *Leptecophylla* spp. and beard-heaths *Leucopogon* spp. The fungi form extensive snake-like hyphal coils within the epidermal cells of the hair roots resulting in most of the cell volume being occupied by the fungus.

Sprengelia propinqua
Tyndall Range, Tullah

It is through these various mechanisms that an exchange of nutrients takes place between the organisms. Fungi, which are unable to photosynthesize, gain carbon compounds and probably also amino acids, vitamins and other nutrients from their host. The plant also provides the fungus with a habitat that is relatively free from other soil micro-organisms.

The plant benefits in several ways: the fine microscopic fungal hyphae that grow out from the infected plant can penetrate extremely small spaces, effectively extending its root zone. Thus the fungus supplies the plant with water and soil nutrients, particularly phosphorus and nitrogen.

Plants have evolved various other strategies to ensure their survival in harsh conditions:

Members of the Proteaceae family including banksias and prickly geebung have proteoid roots that consist of hundreds of densely packed extremely hairy rootlets that grow off the main roots. They perform a similar function to the mycorrhizal fungi in extending the root zone and increasing nutrient and water uptake.

Leguminous plants including the pea family (Fabaceae) and wattles (Mimosaceae) are especially prevalent in heaths. As well as having mycorrhizal associations, they have root nodules with special bacteria that are able to fix atmospheric nitrogen and make it available to the plant.

Insectivorous herbs such as sundews (*Drosera* spp.) abound on nutrient poor soils. Their sticky tentacles attract, capture and absorb small insects using digestive enzymes secreted from the glands. Fairy's aprons or bladderworts (*Utricularia* spp.), small herbs of wet places, capture tiny insects in intricate traps or bladders that resemble minute bubbles on threadlike segments of their leaves that lie at or below the soil surface.

Many heathland plants also have above-ground characteristics that enable them to withstand hot and dry conditions, namely sclerophyllous leaves, i.e. evergreen leaves that are small, hard, thick and leathery. However, their most important adaptations are hidden from view in that marvellous subterranean world that most of us seldom think about.

A selection of fungi from Rubicon Sanctuary - Photos : Phil Collier

Armillaria fumosa growing on roots of *E. ovata*

Clavulina sp.

ghoul fungus *Hebeloma aminophilum* in a typical situation near animal remains

The colour of *Hygrocybe graminicolor* ranges from green to brown

Gymnopilus sp.

Laccaria sp.

The birds come knocking! - Phil Collier

We live in a natural bushland setting. This brings some lovely moments, like when an echidna found the house was in its way, so it walked around right under our main living room window. We had more mixed feelings when a copperhead snake found the front door was in the way of its chosen path. And who knows what passes by when we're not looking. Close encounters with wildlife, going about their normal business, are a major benefit of living in a natural setting.

We also derived great pleasure from a welcome swallow nest under our eaves, in ready view of our outdoor eating. We watched them being fed, growing up and finally fledging with their parents' encouragement and urging. Then things took a less desirable turn. The young birds found our aerial a suitable perch for meals on wings, but the residue landed on our roof and then potentially into our water supply. So living with nature can be a mixed blessing.

Then the birds came knocking. Firstly, during the spring breeding season, we had a male superb fairy-wren spooking itself with its own reflection in our windows. Endless fluttering didn't seem to dislodge the "intruder". Our efforts to block access to a favoured window were fruitless: there are scary reflections in other windows too, and we couldn't block them all. But the situation resolved itself with the passing of the seasons, and the small wrens only knock lightly.

The knocking that came next startled us initially until we became used to it. As summer faded into autumn, a pair of grey shrike-thrushes was taking an interest in different scary reflections in our windows. The female was taking up the attack, with the male as a passive "supporter". Fairly quickly, the male bird lost interest in this fruitless exercise and disappeared, but the female has continued the attack now for several months.

On a typical day, the female bird appears as the sun rises. The first phase is to sing loudly in the typical shrike thrush way, while extending the neck and bill. This is the documented threat pose. Generally a similar call and display is performed at several windows, presumably in an effort to win the argument without physical confrontation. If this fails, which it inevitably does of course, the second phase starts. This involves flying up at a window. Once again this phase will inevitably fail to deter the "intruder" and phase three includes a new single-note call produced repeatedly while flying madly from window to window and fluttering at them in mid-flight. Eventually, the bird loses interest and disappears for a while, only to re-appear once or twice more later in the day, with the same routine repeated.

I have described a "typical" pattern of behaviour, and while the main focus is always the bird's own reflection in windows, there is one other diversion that is interesting. HANZAB volume 6 describes the response of male grey shrike thrushes to a speaker emitting the typical shrike thrush call. Many birds respond with calling and fluttering similar to that described above, while some male birds simply spend their time foraging near to the speaker. Our female, while mostly concentrating on the threat routine described, will also take the chance to forage at random opportunities in the midst of its threat behaviour. It reminds me of the multi-tasking behaviour of many young people today, juggling any task with answering SMSes that arrive.

Our response to many months of harassment by our female shrike thrush has been slow in coming but is now equally determined. Whenever the bird appears, we go outside and attempt to chase it off. Initially, we would be taken on a lengthy jaunt as it could fly onto the next scary window more quickly than we could intercept it. Gradually our technique improved and (hurrah) some days it did not appear at all. Now we seem to be an expected part of the "action". The bird appears, expects to see us, and flies back into its favourite tree, only to return as soon as we head indoors. Sometimes this behaviour repeats up to five times before we "win".

What is clear from this interaction with our female grey shrike thrush is that this bird is attempting to hold a territory right through the non-breeding season. While it may be at the extreme end of territorial behaviour it is most determined. It is a pity that it appears unable to learn that its current efforts are fruitless. At the time of writing it is not clear whether we can intervene and convince the bird that its efforts are better used elsewhere. Otherwise, we live in hope that food resources will become scarce during winter and it will have to spend all its time foraging and forget about our windows (forever!)

Ref: Higgins, P.J., & J.M. Peter (Eds) (2002) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 6: Pardalotes to shrike-thrushes.* Oxford University Press, Melbourne.

Female Grey Shrike-thrush at Rubicon Sanctuary

Snakes (mostly) alive! *by* Ron Nagorcka - photos -Sarah Lloyd

While most people interested in the observation of wildlife need to make frequent trips away from home "into the wild", or keep captive animals, Sarah and I have the great advantage of living in a place where wildlife can be observed closely and regularly in its own habitat.

This has always applied to our snake population. Most of our snakes are tigers (*Notechis ater*), but we have recorded all 3 Tasmanian snakes over the years. Unfortunately, no white-lipped snakes (*Drysdalia coronoides*) have been observed since a pair of kookaburras nested nearby some years ago. This particular avian invasion also occasioned the disappearance or drastic reduction in the populations of mountain dragons (*Rankinia diemensis*) and white's skinks (*Egernia whitii*). We have also noticed a casuarina skink (*Cyclodomorphus casuarinae*) being taken off by a kookaburra, a bird which does indeed (as popular opinion would have it) on occasion eat large snakes as the accompanying photo will attest. The knot puzzled us for a while, but observation of basking snakes confirms that a snake coiled up has often tied itself into just the loose sort of knot that a kookaburra might tighten during capture.

Laughing Kookaburra with a knotted tiger snake

A casuarina skink on the hothouse shelf

The 2010/11 summer has been exceptional for the abundance of tiger snakes, amongst many other things. One day in early summer there were no less than three basking on a hothouse shelf (along with a very brave if not suicidal casuarina skink – but maybe it knew they weren't hungry?) and outside next to the same hothouse were two more tigers happily coiled up with each other. One day I noticed that the snake on top was making regular jerking motions, and while it was hard to determine through the entanglement what was really going on, the explanation does seem obvious.

I must admit that I find most snake observation to be not all that interesting. After all, they do spend an inordinate amount of time lying quietly in the same spot. On cool sunny days, they flatten their bodies and stretch out to collect as much warmth as possible and look very large, while in cooler weather they will coil into a close spiral and look much smaller (and considerably cuter!). Sometimes even drizzly rain will not drive them into their inevitable nearby bolt-holes as they coil up and wait optimistically for more sunshine.

Things do get a little more interesting when they forage – especially around our many rock walls. This summer I made one fascinating observation as a foraging tiger snake suddenly leapt to pluck an object out of the air. Back on the ground I could see that something was protruding from each side of its mouth, but without binoculars I could not see what it might be, and did not manage to get close enough to confirm my suspicion that it was an insect. Observing the general area over the next few days, I conjectured that it was probably a dragonfly. Not only were they plentiful at the time, but they were the only insect in the area to hover long enough to be captured in such a way.

As the summer waned all but two of our tigers disappeared from their regular basking spots. One surprised me behind a gas bottle in mid-april as I went to change it over, but it disappeared permanently soon thereafter. Another one took up residence in a large old burnt out tree stump.

It was not the first over the years to do so as it is a sheltered spot that catches the autumn sun with a black heat-absorbing background and a perfect bolt-hole in the root system. And this snake seemed determined to bask forever. I noted it there on May 4th when the weather seemed reasonable and the thermometer nearby read 10°. After that the weather cooled more seriously, so it was surprising to see it reappear on May 14th after a cold snap with the temperature reading 8° and the radio telling us of snow to 500 metres (we are at 400). At this stage we were beginning to refer to it as "bonkers" rather than "snaky" but Sarah conjectured that it may have had a large late meal which it needed to digest before hibernating.

Mountain Dragon at Black Sugarloaf

Kookaburra with a casuarina skink

Snakes entwined near the hothouse

The mystery was solved (or maybe deepened) two days later when I noticed four small snake embryos in the basking spot. I immediately contacted David Bell who has kept tiger snakes since boyhood and who regularly joined CNFN walks in the 1990s. When he came to check the scene the next day we noticed that two more such embryos had appeared. David's opinion was that these were at least three to four weeks premature and also that this did not preclude the possibility that more mature live young may have been produced. (Tiger snakes generally have a litter of at least twenty.)

Three of the embryos were preserved in alcohol for future reference. The remaining embryos were quickly skeletonised by European wasps but soon even the skeletons disappeared. This attests to the drastic effects these ferocious invertebrate predators are undoubtedly having on the ecology of our forests.

Over the next few days, the snake reappeared to bask whenever the sun was shining. The last we saw of her was during the warm late morning of May 20th. However, after lunch, when it was even warmer and still quite sunny, she had disappeared, and we have not seen her since.

I would be most interested in the reaction of any herpetologists to the observations made in this article.

Two of the six embryos that appeared in May

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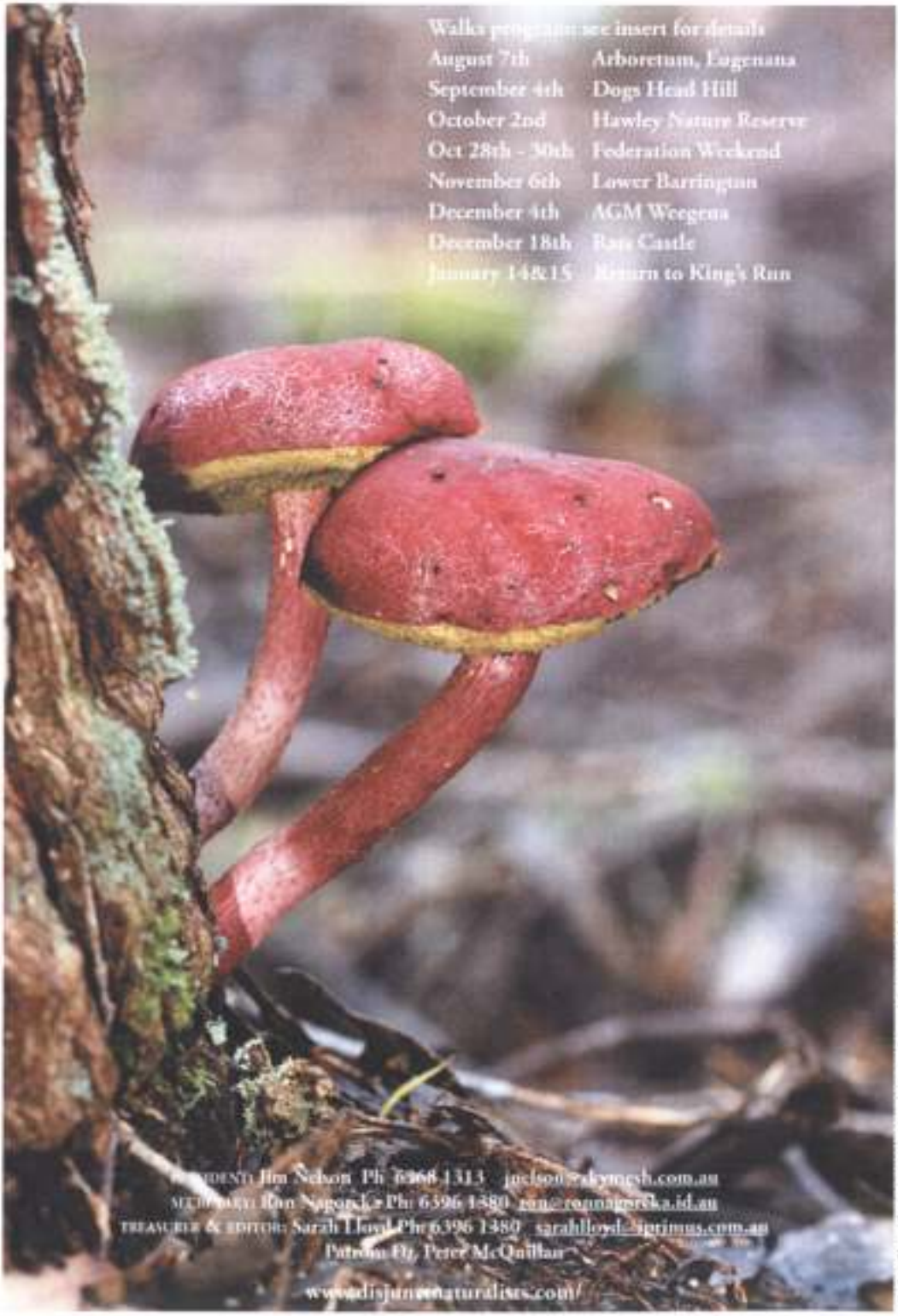
Many thanks to Robin Garnett and Phil Collier at Rubicon Sanctuary and Gail Hart and John Dennett at Erriba for allowing us to visit their properties, and to Paul George for sharing his extensive knowledge of fungi in such an enjoyable way.

Andrew Hingston showed the photo of the 'mystery object' (Issue # 48) to spider expert, Lynne Forster. It is thought to be a spider shelter made from plant material and silk, similar to that made by leaf-curling spiders. - Thanks Andrew and Lynne.



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Boletellus obscurecoccineus, Meander - Photo: S.Lloyd