MUDGUTS

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The dusty forestry road cuts through a scene of apparent devastation. As Marie Yee and I walk from the car, crow-bars and log-splitters in hand, all around us are the gaunt trunks of fire-blackened trees, testament to the intensity of the midsummer St Marys' - Scamander bushfire that swept through here just five months previously. No bird calls; the only sound is the crunch of dead leaves underfoot as we search for our quarry. We don't have to look far: there are plenty of logs to split around here, but looking at the state of them, is it worth the effort? Surely they are no more than carbonised hulks? One swing of the log-splitter gives us our answer: a gash of glorious orange-red in this otherwise monochrome landscape: we've struck mudguts! A substantial vein too – enough to scoop up in our hands, roll between the fingers and savour its spongy yet clay-like texture, and its earthy, musty aroma.

The no doubt erudite online *urbandictionary.com* defines mudguts as (1) a fat person, especially around the guts; and (2) a particular Western Australian hard rock/heavy metal band. To this we can add a third definition - one that might interest readers of this journal more than readers of the urban dictionary: (3) the red-brown clay-like material found in the heart of rotten trunks, branches and logs of many eucalypt species.

The origin of the term is unknown, but according to Bob Mesibov (pers. comm.) it is likely to have been in common parlance (in Australian forestry circles at least) for more than a hundred years. The classical view of mudguts is as the product of termite excavation of the heartwood of living trees, typically filling a central 'pipe' that may extend from a tree's roots up to its main branches. In a recent review of invertebrates and eucalypts, Majer *et al.* (1997) note that eucalypts are among the most susceptible trees worldwide to termite attack. Termites, of course, chomp through wood, and Greaves (1962) attributes mudgut to the workings of *Coptotermes* termites, describing it as a 'dense mixture of excreta and probably soil'. But other wet-wood termites can also form mudguts: Elliott and Bashford (1984) describe *Porotermes adamsoni* as causing similar formations in a range of Tasmanian eucalypt species, with the level of damage increasing with tree diameter (and hence with age). *Porotermes adamsoni* is a widespread species in Australia, extending from the tropics to Tasmania. It does not form large central colonies, but instead the termites live in many small independent groups or colonies in the heartwood. These colonies do not have a subterranean gallery system and often have no contact with the soil. Thus it is something of a mystery where the 'earthy' component of mudguts actually comes from.

Recently, through the postgraduate deadwoodological studies of Marie Yee, Kate Harrison, Lee Stamm, Anna Hopkins and others in the wet forests at Warra in southern Tasmania, we have begun to question whether termites are the whole story in the formation of mudguts. It now looks as though some of the larger prionine longhorn beetles may do their bit too, often in the absence of termites. Larvae of one species in particular, *Toxeutes arcuatus*, are commonly encountered in the heartwood of mature eucalypts (Figure 1), particularly where this wood already shows some discolouration and softening – a sign of the early stages of fungal decay. They have strong jaws and necessarily prodigious appetites (given the poor nutrient status of heartwood), enabling them to chew their way through large volumes of wood before they eventually pupate near the wood surface, in preparation for life as free-flying adults. In their wake they leave a trail of semi-digested, coarse-fibred, straw-coloured frass, which gradually rots down into a rather spongy form of mudguts. Intermediate stages in this process can be observed in logs years or decades after the larvae have had their fill.

Figure 1. Mature larva of the longhorn beetle *Toxeutes arcuatus* in discoloured heartwood of a *Eucalyptus obliqua* tree. Photo: Simon Grove.

Figure 2. Larva of the prostomid beetle *Prostomis atkinsoni* on a vein of mudguts in a decaying *Eucalyptus obliqua* log. The larva's last meal of mudguts is visible along the length of its gut. Photo: Simon Grove.

Mudguts, whether in living trees or in logs, can host a range of specialised invertebrates, as long as there are cracks or holes providing access from the outside world. These include the curiously flattened beetle *Prostomis atkinsoni*, which is often found (along with its similarly flattened larvae) feeding and tunnelling at the interface between the mudguts and the surrounding more solid wood (Figure 2).

One can scarcely imagine what it might be like to live one's entire life in such a confined, dark, low-oxygen space, and being forced to eat mudguts. At least one would be sheltered from the elements: mudguts must be one of the forest's better buffered environments,

where summer and winter, rain and shine may mean very little to its inhabitants. *Prostomis* shares this home with other beetle larvae, mites, giant springtails (Figure 3) and others. No doubt there are also specialised fungi and other micro-organisms here too. Though they may not initiate the formation of mudguts, these species must contribute to its expansion and, ironically, to its ultimate demise as the inexorable path of decay takes its course and the mudguts is incorporated into the soil humus.

Figure 3. An undescribed uchidanurine springtail commonly found in and around mudguts in logs in wet eucalypt forest, where it apparently feeds on slime moulds. Photo: Simon Grove.

Figure 4. Lee Stamm using a chainsaw to cut 'biscuits' of dead wood from a log at Warra. Mudguts is so much better for invertebrates than for chainsaws. Photo: Simon Grove.

A lexicon of terms has been coined through research at Warra to describe the process of wood decay in our local eucalypts. From discoloured heartwood, the path to mudguts can be direct if *Toxeutes* gets to work on it, producing frass that accumulates and gradually morphs into mudguts. If termites do so instead, then the wood may pass through an intermediate 'discoloured termite wood' stage: the heartwood becomes riddled with termite galleries, which gradually fill up with frass and thence mudguts. Alternatively, the heartwood may be decayed by fungi that appear to remove most of the cellulose but leave much of the lignin, resulting in a rotten wood type which we call 'red-brown blocky-fibrous'. This type readily breaks up into irregular blocks, and appears to be a favoured substrate for many beetles and other invertebrates, particularly where it abuts more solid wood. Through their workings, one can again end up with veins of mudguts, which sometimes coalesce into substantial deposits that resist attack by all but the hardiest of chainsaw operators (Figure 4).

Back to Scamander. Our interest in log-splitting was induced by a concern for the post-fire fate of mudguts and its cast of log-dwellers. In this area, the star attraction is the locally endemic giant velvet worm *Tasmanipatus barretti* (Figure 5).

We need not have worried. Mudguts is proving to be a particularly resilient microhabitat. Not only does it apparently survive for years or decades in the living tree, but for many years it can also continue to occupy the hearts of the logs that arise after the tree (or larger branch) dies and falls to the ground.

Figure 5. A giant velvet worm *Tasmanipatus barretti* emerging onto my finger from the moist mudguts hidden within a charred log near Scamander. Photo: Marie Yee.

In this context, the passage of a bushfire may cause some attrition, but it's not usually terminal. The resilience of mudguts may be due to the exceptional insulation properties of logs in general, and mudguts in particular. Often we would find that, while the outer ten millimetres or so of a log was indeed cooked, inwards from this zone life appears to have gone on as normal. The first giant velvet worm we found was in just such a setting, surrounded by healthy moist mudguts in which could be seen springtails, termites and other animate morsels that count as food for these predatory creatures. As I enticed it onto my finger, it did the onychophoran trick of spitting strands of glue at me from two glands at its front end. A delicate shade of fawn, and velvety in texture as its name suggests, it looked too clean to have just emerged from the mudguts, but their skin must have some peculiar non-stick properties as they always seem to look like this. Coupled with their fifteen pairs of stumpy, flowerpot-like legs, these characteristics gives velvet worms a very unearthly quality, which on this occasion was only enhanced by the incongruity of its moist mudgut habitat amid the stark, charred landscape (Figure 6).

What does the future hold for mudguts and its enigmatic inhabitants in our forests? Termites and wood-boring beetles have few friends, and trees whose heartwood has been converted to mudgut-filled pipes are not highly valued in the timber market. Silviculturists are hopeful that future commercial stands of regenerating native forest will be less

affected than current ones, in part because they will be harvested before the trees get old enough for piping and heart-rot to develop. In the absence of any mitigation measures, this sounds like bad news for mudguts, but there is still much we do not understand about it. Perhaps we need a new discipline, which I shall call chledenterology (it sounds so much more scientific in Ancient Greek than the English 'mudgutology'). Can young, suppressed trees in a regenerating stand succumb to termites, beetles and other mudguts precursors as they are out-competed by more vigorous trees? Can mudguts formation be initiated in logs or does it have to take place in living trees first? Are the typical inhabitants of mudguts, including giant velvet worms, totally dependent on this habitat or might we also find them in other rotten wood types that are more tolerant of our silvicultural practices, if only we looked harder?

Figure 6. Giant velvet worm habitat after the Scamander bushfire. The mad axeman in the background is the author. Photo: Marie Yee.

These are the kinds of issues that we hope to explore in coming years. We may not be able to expect the future forest to be quite as mudguts-friendly as the past and present forest. But let us not contemplate a future forest entirely devoid of the stuff, as there are many of us (well, some at least) who would mourn its passing. Our challenge is therefore to seek

innovative ways of ensuring that it continues to be around for the use of future generations of *Prostomis* and *Tasmanipatus* and the thrill of future generations of chledenterologists.

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REFERENCES

Elliott, H.J. & Bashford, R. (1984). Incidence and effects of the dampwood termite, *Porotermes adamsoni*, in two Tasmanian east coast eucalypt forests. *Australian Forestry* 47(1): 11-15.

Greaves, T. (1962). Studies of foraging galleries and the invasion of living trees by *Coptotermes acinaciformis* and *C. brunneus* (Isoptera). *Australian Journal of Zoology* 10: 630-651.

Majer, J.D., Recher, H.F., Wellington, A.B., Woinarski, J.C.Z. & Yen, A.L. (1997). Invertebrates of eucalypt formations. Pages 278-302 In J. Williams, and J. Woinarski, editors. Eucalypt Ecology: Individuals to Ecosystems. Cambridge University Press, Cambridge, UK.

Note. Some images shown as grey scale tones are also shown as full colour in the central pages of this volume.