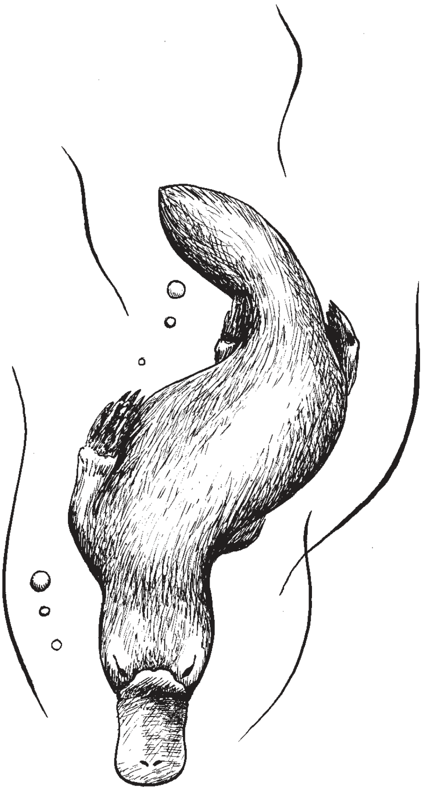
The Tasmanian Naturalist

Number 142
2020



Published by the
Tasmanian Field Naturalists Club Inc.

VOLUME 142 (2020) **ISSN 0819-6826**

TFNC

THE TASMANIAN NATURALIST

Contents

Views and opinions expressed in papers in the journal reflect those of the author(s) and are not necessarily those of the Tasmanian Field Naturalists Club Inc.

Unless otherwise stated, all images are by the authors.

Published annually by the Tasmanian Field Naturalists Club Inc., GPO Box 68, Hobart, Tasmania 7001

Printed by Monotone Art Printers using 100 gsm Digital Satin paper.

Hobart Waterworks during the Time of COVID-19

Eddie Gall
eddiegall@bigpond.com

March, April, and May 2020

The COVID-19 pandemic brings unprecedented social change throughout the world. In Tasmania, social distancing means everyone is required to stay home except for essential movement. Hobart's major roads have only an occasional vehicle, many shops have shut their doors, schools have closed, and drive-in COVID19 testing clinics have opened. Instead of working in offices, most people work from home. TFNC monthly excursions have been put on hold until July and meetings delayed until at least August.

One of the few activities allowed is daily exercise from the household. I live in South Hobart within easy walking access to the Waterworks, so it is obvious what my daily routine quickly came to include.

The Waterworks is part of Ridgeway Park, a valley and surrounding ridgetops nestled in South Hobart on the lower slopes of kunanyi / Mt Wellington. It is bounded to the north by Huon Road and to the south and west by Ridgeway Road and Chimney Pot Hill. It is one of those rare areas that includes relatively untouched native vegetation within walking distance of a city centre.

Hobart Town was originally located on the Hobart Rivulet due to its relatively reliable water supply. A combination of pollution, waterborne diseases and the demand on the water required a new clean, reliable supply. In 1858 it was decided to build a reservoir or a series of reservoirs on the Sandy Bay Rivulet capable of holding four months' supply without replenishment. Construction issues and seepage resulted in long-term continual works on the two dams with work finally being completed in 1895. The water supply was channelled from Browns River and Fork Creek on the south-eastern slopes of kunanyi / Mt Wellington. Sandstone quarried from a number of locations above the Waterworks is still visible in constructions on the Pipeline Track, including Gentle Annie Falls, where water used to emerge from the pipes and cascade down a cliff into a collection well. Some of the original buildings still stand, such as the Receiving House, which today has displays about the history of the Waterworks (Plate 1).

As well as mowing the lawns and maintaining picnic sites around the water reservoirs, the Hobart City Council actively manages the surrounding native vegetation by

Plate 1. The Receiving House

Plate 2. Sixpence Cave

removing weeds and undertaking controlled burns to reduce fire danger and manage species diversity. A burnoff on one of the slopes had been scheduled for autumn, but a wet March made conditions unsuitable and it was subsequently cancelled.

Like all infrastructure, the Waterworks require continual maintenance. As the pandemic begins, substantial work to strengthen the upper dam concludes. Heavy machinery moves off to work elsewhere.

My walk to the Waterworks includes an extension of the Pipeline Track from Romilly Street. This section meanders along the slopes above the Sandy Bay Rivulet. Early in the morning, Tasmanian Native Hens (*Tribonyx mortierii*) run and Pademelons (*Thylogale billardierii*) hop off the sides of the track. It is autumn so there are the bright yellows of poplars and willows, and the red berries of hawthorns. These introduced plants abruptly decrease on entering the Waterworks.

COVID-19 changed the use of the park. Barbecues were no longer allowed, and the children's playground was cordoned off. Sunday picnics and family outings with kids' joyful cries ceased. Instead, people walked around by themselves or in pairs, chatting. The 1.5 metre distancing rule showed wide acceptance. Even walking along some of the narrow bush tracks, walkers moved off the side to let others pass by at a distance. The start of the pandemic saw a huge increase in use of these tracks by walkers exercising. After a week or two, this was supplemented by a surge of mountain bikers using some of the trails higher on the surrounding hills.

The Waterworks is dominated by eucalyptus forests. The bluish open forests of silver peppermint (*Eucalyptus tenuiramus*) are confined to mudstones. Their forest is characterised by a combination of bare ground, heath understorey and low shrubs. White peppermints (*E. pulchella*) have fine leaves and smooth grey-and-white trunks. Their forest is on dolerite and often has a grassy understorey that is easy to pass through. Black peppermints (*E. amygdalina*) also have fine leaves but have rough bark on their trunk and lower limbs. Their forests are mostly on sandstone and the understorey is shrubby. Stringybark (*E. obliqua*) forests occur on wetter sites and the understorey can vary from scratchy scrub in drier sites to taller broad-leaved shrubs in wetter places such as along the Sandy Bay Rivulet above the dams. Tasmanian blue gums (*E. globulus*) are in the gullies and wetter areas. Their understorey has many large shrubs. Older trees have nesting hollows and their flowers are an important source of food for birdlife. There are some impressive specimens at the entry to the park.

Hidden in the sandstone areas are outcrops and small cliff lines. One of the cliff lines contains Sixpence Cave (Plate 2). It no doubt had extensive use by Tasmanian Aboriginal people. The local clan was the Muwinina and we are indebted to their long history of caring for and managing this land.

The Waterworks is noted for its birdlife. Twitchers can be spotted at all times of the year, and especially during the nesting time of spring and summer. Patience will reveal many species flitting around the branches close to the picnic areas including red, pink and flame robins (*Petroica* spp.), Superb Fairy-wrens (*Malurus cyaneus*), Grey Fantails (*Rhipidura albiscapa*) and various species of honeyeaters. Pardalotes (*Pardalotus* spp.) like to nest in the freestone retaining walls by the road. In March, Welcome Swallows (*Hirundo neoxena*) prepare to fly north for the winter. Masked Lapwings (*Vanellus miles*) and Tasmanian Native Hens roam the open grassy areas. Perched Laughing Kookaburras (*Dacelo novaeguineae*) scan the ground for reptiles and are not afraid to swoop in for someone's barbeque sausage. There is the mournful call of Forest Ravens (*Corvus tasmanicus*) flying overhead along with the distinctive calls of Black and Grey Currawongs (*Strepera fulignosa* and *S. versicolor*).

Green Rosellas (*Platycercus caledonicus*) and Yellow-tailed Black Cockatoos (*Calyptorhyncus funereus*) are frequently seen parrots. Large numbers of Sulphur-crested Cockatoos (*Cacatua galerita*) use the Waterworks as a roost in autumn. In the early morning they are raucous. My home is under flocks' flight path into the city. They first pass soon after sunrise on their way into the city. Perhaps they are on their way to raid suburban walnut and almond trees. They are just as noisy when they return in the late afternoon.

Waterfowl populate the reservoirs and the most common are the Australian Wood Duck (*Chenonetta jubata*), Pacific Black Duck (*Anas superciliosa*), Eurasian Coot (*Fulica atra*) and gulls (*Chroicocephalus novaehollandiae* and *Larus dominicanus*). Less frequently seen are cormorants (*Phalacrocorax* spp.), White-faced Herons (*Egretta novaehollandiae*)

Plate 3. Bennett's Wallaby

and Hoary-headed Grebes (*Poliocephalus poliocephalus*). A few years ago, a solitary Cape Barren Goose (*Cereopsis novaehollandiae*), well out of its range, took up residence for a few months. I sometimes wonder what became of it – whether it flew off and somehow found its fellow geese at Maria Island.

In October, the flora reaches its greatest vigour and heathy understoreys contain a myriad of colours. While autumn is a low point in the variety of species in flower, a few are flowering vigorously and some show an occasional flower: mats of native cranberry (*Astroloma humifusum*) give some red; native heath (*Epacris impressa*) supplies some pink; banksias (*Banksia marginata*), sunshine wattle (*Acacia terminalis*) and guineaflower (*Hibbertia* sp.) give splashes of yellow; and bearded heaths (*Leucopogon* spp.) and fairy waxflower (*Philotheca verrucosa*) add white. Autumn-flowering orchids such as the autumn bird orchid (*Chiloglottis reflexa*), small greenhood (*Pterostylis parviflora*), small mosquito orchid (*Acianthus pusilus*) and midge orchids (*Corunastylis* spp.) are scattered in various locations. Drooping sheoaks (*Allocasuarina verticillata*) flower on the ridges while the delightfully aromatic Tasmanian currajong (*Asterotrichion discolour*) flowers in the gullies.

Of the mammals, the most easily seen are the macropods. Soon after sunrise or on overcast days, Pademelons (*Thylogale billardierii*) can be seen grazing at the edges of lawns. On the lesser used tracks, both Pademelons and Bennetts wallabies (*Macropus rufogriseus*) bound away as you pass by (Plate 3). Towards the ridgetops an occasional Short-beaked Echidna (*Tachyglossus aculeatus*) can be spotted. At night, particularly on warm autumn nights, spotlighting reveals more variety including Eastern Bettongs (*Bettongia gaimardi*), Longnosed Potoroos (*Potorous tridactylus*) and Eastern Barred Bandicoots (*Perameles gunnii*). The eyes of Brushtail (*Trichosurus vulpecula*), Ringtail (*Pseudocheirus peregrinus*) and Pigmy possums (*Cercartetus* spp.) reflect the torchlight, giving them away. Occasionally, you encounter an owl. In the twilight, bats can be seen flitting around the treetops, feeding.

In March, the last hot days of summer bring out numerous species of insects. Cicadas and crickets call. Butterflies such as the Australian Admiral (*Vanessa itea*), Australian Painted Lady (*V. kershawi*), Meadow Argus (*Junonia vallida*), and the Common Brown (*Heteronympha merope*) flitter through the woodlands and barbeque areas. Damselflies and dragonflies search for mates in the reeds around the reservoirs. Searching through foliage or the forest litter reveals a large variety of spiders, beetles, bugs, and other insects (Plates 4 and 5). An unwelcome intruder is the European Wasp (*Vespula germanica*), which usually reaches peak numbers in autumn. It can disrupt barbeques and picnics, but with the ban on these activities, the wasps go largely unnoticed.

As autumn progresses, the visibility of insects and spiders decreases. Cooler temperatures mean some become less active or commence hibernation. Some species survive as eggs or larvae in the forest litter or underground.

Most years, fungi often do not emerge in great numbers in these dry forests before

Plate 4. Jewel bug (*Scutiphora pedicellata*)

Plate 5. Undescribed crab spider (Thomisidae family)

about May or June. 2020 had good rain in March and April, leading to an early start to the season and bringing up many species I had not previously seen. Many deeppurple *Cortinarius archeri* and greencoloured *C. austrovenetus* emerged along with boletes (*Boletellus obscureococcineus* and *B. emodensis*). On more open ground there were brightyellow *Lichenomphalia chromacea* and in mosses, *Rickenella* spp. became common.

June 2020

In the morning, the first frosts are on the lawns. Steam rises off the reservoirs, lit up by the early morning sun. The forests are at their quietest for the year, waiting for the first territorial bird calls as spring approaches. Sweet wattle (*Acacia suaveolens*) and brown-lip greenhood (*Pterostylis williamsonii*) have started flowering and the *Hibbertia* species are now flowering more strongly. Flower buds of other species are now appearing, waiting for the warmth of spring. Orchid leaves have emerged from underground, gathering energy for their spring flowering. May was dry and as the soil dried out, the variety of fungi slowly decreased. Hopefully with the next rain the diversity will pick up again. The number of Sulphur-crested Cockatoos has decreased as many have moved on to new overnight roosts.

The track around the upper dam has been temporarily closed for maintenance of water drains. Social distancing is still with us, but restrictions have started to be relaxed: family groups are now walking the tracks in increasing numbers. If anything, the use of the Waterworks is still increasing, and it is great seeing people out and about enjoying themselves. And then, due to the progress in reducing the incidence of the disease, restrictions are being eased further, two weeks ahead of schedule. The chatter and children's squeals of family picnics and social barbeques can recommence.

As a field naturalist, I like to explore a lot of different environments. Restrictions meant that I had to restrict myself to exercising in one area, but it resulted in me getting to know my local area much better and to understand its subtle seasonal changes more closely. Now that restrictions have further eased, I will again roam much further, but that will not stop me concentrating on the Waterworks for the next year to build further on what I have observed and learnt. Restrictions do not have to be a constraint: they can serve to enhance focus and perceptions.

kunanyi lockdown ramblings

Simon Grove
25 Taroona Crescent, Taroona, TAS 7053
groveherd1@bigpond.com

kunanyi looms large in the lives of those of us whose homes are sandwiched between the mountain and the river. kunanyi generates our weather – kuyanyi's weather. While those on the other side of the river bask in glorious sunshine, kunanyi harvests moisture from the westerlies and whips up clouds to blanket us all in gloom. Her advancing shadows curtail our summer evening barbecues. Her cold plateau radiates bone-chilling air that descends upon all who live in the gullies a kilometre below. Yet to dismiss kunanyi as harsh, moody and forbidding would be to miss much that there is to admire about our mountain. Over my decades of living under kunanyi's influence, familiarity has bred not contempt but respect and admiration. And the naturalist in me has missed her terribly during lockdown. But all has not been lost.

Plate 1: Peaty pooled plateau on kunanyi.

kunanyi has been there since before humans first gazed upon her, and she isn't going anywhere in a hurry. In the meantime, I have my memories and my imagination, and sitting here in my study I am free to dream up mountain encounters, real and confected (Plate 1).

Strangely, tuning into tinnitus gets me in the mood. I can either accept it as a burdensome high-pitched buzz, or I can be transported to kunanyi's high plateau on one of those dreamy summer days when the still air is filled with the tinnitus-like buzz-and-click serenading of countless mountain cicadas *Diemeniana hirsuta* (Plate 2). So today I've soared effortlessly over the summit and have put myself down in the treeless, trackless country which, while only a short hike from the Pinnacle, feels almost as remote and as unencumbered by modern life as the furthest reaches of the Southwest Wilderness whose sharp, crystalline peaks are visible in the distance. This is one of my favourite places, and I'm elated to find myself here again. It's a secret land where meandering hummocks of dry shrubland alternate with labyrinthine, sphagnum-lined runnels and dark, peaty pools; a land where walking in a straight line is neither desirable nor practical. Wedge-tailed eagles soar high overhead. The only birdsong is the occasional, staccato outburst of a striated field-wren uttered from a high perch before the cocky-yet-furtive songster dives again for cover. This is indeed a land where you can both lose yourself and find yourself in nature. Self-isolation? – not a problem up here.

Even on a day like today, under a blazing summer sun, this place continues to ooze water, drip-feeding the river far below that has long been a source of Hobart's drinking water. Up here, it makes life possible for the larvae of countless aquatic

Plate 2: Mountain cicada, *Diemeniana hirsuta*.

and damp-loving insects, from pesky march-flies to innocuous and largely unseen marsh-beetles, soldierflies and stoneflies. I conjure up one of my favourite hoverflies, *Austalis pulchella*, a native, charismatic relative of the suburban dronefly and a faithful denizen of this peaty-pooled country. I hear it before I see it – the high-pitched whine of a male's rapidly beating wings as he pauses momentarily, suspended in mid-air a few centimetres above one of the pools that make up his territory. I have just enough time to appreciate the tawny fly with metallic blue-green abdomen before he darts off in pursuit of some rival, real or perceived.

No matter, all this sphagnum moss had got me thinking about moss-bugs. I can't count the number of sphagnum hummocks that I've examined in minute detail while hunting for these elusive creatures; but I can count on one moss-stained finger the number of occasions on which my search was successful (in that case for *Hemiodoecellus fidelis*, one of two Tasmanian species) (Plate 3). Still, I am free to recall, to recreate, that moment of discovery any time I like, and now seems as good a time as any. The fact that I keep looking for moss-bugs is a measure of the high regard with which I hold them, not so much for their appearance (though they are quite endearing, in their own, tiny, sculpted saucer-like way) but for the stories of deep time that they unlock. Because they represent a tiny, relictual family (Peloridiidae) of true survivors with origins way back in the Permian period. That's well before the heteropteran bugs, and before the dinosaurs, in a time when the grey mudstones that form kunanyi's lower slopes were still being laid down under a cold sea. And it seems they've been doing their mossy thing ever since, transported in their emerald micro-habitat as Gondwana fragmented (signified by kunanyi's Jurassic dolerite

Plate 3: Moss-bug, *Hemiodoecellus fidelis*.

capping) and lingering on in the cooler, wetter parts of the southern continents and associated islands. In that regard, they're not alone on kunanyi, because this same boggy country hosts another insect marvel: the scorpionfly *Nannochorista maculipennis* (Plate 6). The lacewing-like adults flutter feebly in the summer breeze. I can see one now, ensnared in a spider's web strung between two clumps of pink swamp-heath. It shows no gratitude, only desperation, as I carefully untangle its four lacy, dark-spotted wings and liberate it to live another day. Nannochoristid larvae once lurked in the cold streams and bogs of Gondwana and, like the moss-bugs, were part of the diaspora of ancient plants and animals transported to today's southern continents. Though it doesn't look like a survivor, it must have something going for it, since nannochoristids have clung on since then in wet, cooler environments such as the boggy country stretching out before me today.

A tiny dark shape on the ground in front of me, nipping dexterously from one dolerite stone to the next, on closer inspection reveals itself as a male mountain peacock-spider *Maratus harrisi (*Plate 5). Now and then he stops for an instant, to wiggle his outrageously powder-blue abdomen in what must be a never-ending quest to lure and then woo a potential mate. He turns to gawp at me myopically through multiple alien eyes, waving his white-mittened pedipalps as I return his gaze. Suspicious of my intentions, he changes direction and in a single hop has disappeared into the prickly, impenetrable mini-forest of a clump of scoparia. This clump still boasts a few butter-coloured, fleshy flowerheads, and I am reminded that the plant's pollination success is boosted by an unusual arrangement with snow-skinks. I imagine one clambering effortlessly atop the spiky foliage and neatly nibbling off the tube-shaped flower's calyptra in order to lap up the sweet nectar pooling within the tube, improving access for pollinators in the process.

Something glints among the blinding, snow-white blossoms of a woolly tea-tree. It's a jewel-beetle, *Castiarina insularis* by the looks of it, feasting on pollen. Perhaps that's why it let me get this close – they're normally very jittery creatures. Its strikingly high-contrast, orange-and-purple elytra seem almost too flamboyant for this place; yet if it weren't for that reflective glint I might never have spotted it among the equally high-contrast sprigs of flowers, buds, old seed capsules and greenery.

Labouring upslope towards the Pinnacle, I spot one of my tinnitus-mimicking cicadas perched on a swamp-heath flower-spike. I take tentative steps towards it. These are smaller, darker and more hairy than most of their lowland congeners, and are unique to the Tasmanian high country. I don't stand a chance of a close encounter this time, as this most bug-eyed of bugs soon clocks me and launches into a frenetic, zig-zag flight low over the fragrant flowering shrubland, clicking as he goes and eliciting more clicks and buzzes from others of his kind in his path. He lands ten metres away from me, alert and ready for action, and I know that my efforts to stalk him again would be in vain.

Plate 4: Lichen darkling beetle, *Leaus tasmanicus.*

The one certainty about hot, sunny weather here is that it won't last. I've been studiously ignoring the advancing clouds of a herring-bone sky sweeping in from the western horizon, but now, suddenly, the sun is obscured, vibrant colours are muted and the air chills. The cicadas quieten down, though the tinnitus remains. It's time for my own zig-zag flight, but mine takes me down a steep path over the lip of the plateau towards the shelter of the snow gums below. Shelter is a relative term – this is still a harsh landscape of lichen-splashed dolerite boulders interspersed with dwarfed, twisted, gnarly gum trees. I can't imagine this country without hearing the evocative, nasal honking of black currawongs. Sure enough, as if from nowhere a small detachment of these emblematic mountain birds appears and courses overhead, its members calling excitedly to each other as they beat a hasty retreat from the plateau, anticipating the southerly that will soon be upon us. I pause for breath on a boulder beside the path, and ponder the lives of the lichens that bring splotches of muted colour to this mini-scene. Lichens may have been among the first colonists of the primordial land; they would have fundamentally altered and hastened the geochemical cycle; and they still have a supreme ability to eke out a living in the toughest of situations. But I soon discover that they do not have this particular boulder to themselves when what seems to be a patch of black-and-white lichen gets up and begins to wander off. This perfectly camouflaged beetle is *Leaus tasmanicus*, a species unique to this sort of environment in Tasmania and one whose behaviour and appearance defies its taxonomic position among the usually rather drab and retiring darkling-beetles. It raises its elytra and hesitantly unfurls its hind wings before thinking better of it, opting instead to sit out the plummeting temperatures hunkered down under a frost-shattered flake of dolerite.

Continuing downslope, taller gum trees close in as I ford a small rivulet in which mountain-shrimps *Anaspides tasmaniae* dart for cover at my approach. Despite looking rather like common rockpool prawns, these are yet more austral relics from the planet's distant past. They and their close relatives maintain a tenuous toehold in Tasmania's western tarns, trickles and subterranean pools. The species in front of me, once considered to be widespread, is now thought to be endemic solely to the south-eastern flanks of kunanyi, with a sister species on the mountain's western flanks.

The overhead branches are swaying now as cold, turbulent air pushes in and the sky is drained of colour. A few spots of rain are the advance guard for the front which will inevitably follow in a few hours. The cold suits many of kunanyi's inhabitants, but it's my cue to leave, reluctantly. Although change is in the air now – indeed, it's always in the air, I realise – I cling to a sense of being in a timeless place up here, out here … in here.

The pandemic teaches us something that those whose lives are governed by the mountain's moods have long understood, implicitly: life can be stolid, fickle, capricious even; but it also leaves room for moments of tranquillity, exuberance and sheer joy. While we may never see a cure for the virus, nature can be our cure for the mental maladies of lockdown, if we let her in and give our minds permission to wander, to ramble. For me, every living day in kunanyi's presence, every encounter, whether real or imagined, is a gift to be cherished. In time, we will be allowed back for real, to scramble up kunanyi's dank, forest-clad slopes, to clamber over her treacherous boulder-fields, to strike out across her immense, top-of-the-worldly plateau, to dip our toes in her cool streams and to immerse ourselves once again in her powerful and enduring presence. But for now, I turn my gaze from the window and fire up the computer again. I've got an article to write for *The Tasmanian Naturalist*.

Plate 5: Peacock spider, *Maratus harrisi.*

Plate 6. Scorpionfly, *Nannochorista maculipennis.*

Recent research on the ammonite pinwheel snail *Ammoniropa vigens* (Legrand, 1871)

Kevin Bonham[1] & Bruno Bell[2]
[1]Honorary Curator, Tasmanian Museum and Art Gallery
410 Macquarie St, South Hobart
k_bonham@iinet.net.au
[2]27 Giblin Street, Lenah Valley

Abstract

This paper provides an updated discussion of the distribution, identification, ecology and conservation of *Ammoniropa vigens* (Legrand, 1871), a critically endangered land snail now known to survive at four localities in the southern Hobart suburbs. *Ammoniropa vigens* has been found exclusively on dolerite, mainly under boulders in wet forest. Until 2020 this species was considered extremely rare and possibly very close to extinction, but results in 2020 indicate the species is at least locally fairly common within Truganini Conservation Area. The species is very cryptic, making it challenging to assess the condition of other populations or determine whether it survives at sites where only empty shells have been found.

Introduction

The ammonite pinwheel snail *Ammoniropa vigens* (Legrand, 1871) is the only Tasmanian land snail listed as threatened (critically endangered) on the schedules of the federal *Environment Protection and Biodiversity Conservation Act 1999,* and is one of eight land snails listed as threatened on the schedules of the Tasmanian *Threatened Species Protection Act 1995*, where it is listed as endangered. Perceived threats to the species include bushfires, habitat loss and fragmentation, predation by exotic invertebrates (especially *Oxychilus* snails), climate change, extreme weather events such as flash flooding, and stochastic extinction of small populations.

A previous paper (Bonham 2004) described the history of knowledge of the species to that time. As of 2004, three 19th-century and four modern localities were known, all of them within Greater Hobart, but the species had been found alive only at a site above the Pipeline Track near Romilly Street and Stoney Steps Road in South Hobart. A second living population was discovered at Knocklofty in 2008. The species was uplisted to Endangered at state level in 2010 and was then federally listed as Critically Endangered in 2014. The basis for the federal listing was that the species' distribution was assessed both as very limited and "precarious for the survival of the species". In particular, the species' distribution was assessed as very fragmented and it was inferred that the species' population would continue to decline.

Despite fifteen searches in suitable habitat, no live specimens were seen anywhere between 2011 and 2017, but in 2018 one live individual was observed at a new locality, Truganini Conservation Area, and another was recorded at the Romilly Street/Stoney Steps Road site. In 2020, nine live specimens were found at the previous Truganini site, while another six were recorded at other locations in or near the same reserve. Further searches resulted in one live specimen again being observed on Knocklofty, and a further live population being found in Taroona, while several dead specimens were also collected from soil in track and road cuttings at two other localities.

Plate 1. Adult and (inset) juvenile *A. vigens*, Truganini CA, 15 July 2020.

Plate 2. Dead adult *A. vigens*, Knocklofty, 25 May 2008, shell width 3.0 mm.

Identification and similar species

Ammoniropa vigens was formerly known as *Discocharopa vigens* but was transferred to a new genus by Bonham (2018). Identification of the species was summarised by Bonham (2004), noting the differences between *A. vigens* and species then assigned to *Allocharopa* (now placed in *Bonhamaropa* Stanisic 2018). In addition to the notes presented there:

- The protoconch of *A. vigens* lacks clearly defined spiral elements, although stress-fracture lines form in roughly spiral patterns on some specimens. In contrast, *Bonhamaropa* spp. generally have more clearly defined spiral lines on the protoconch as well as the dominant radials.

- Specimens from Truganini Conservation Area lack visible eye pigmentation and appear to be sightless (see Plate 1). Live animals from other locations have not yet been closely studied.

- There is variation in shell colour between populations. All specimens seen at Knocklofty have had distinctly yellowish shells (see Plate 2), but all specimens seen at Truganini CA have been white to greyish-white, except for one live specimen with a yellowish shell. At the Romilly Street/Stoney Steps Road site, a mix of these colours occurs.

- Although Legrand (1871) described and figured a specimen "0.14 of an inch" (c. 3.6 mm wide) with 4.5 whorls from "Mount Wellington", the largest modern specimen measured was the yellow specimen seen at Truganini CA on 28 August 2020. This specimen was 3.2 mm wide at 4.1 whorls.

A somewhat similar undescribed charopid (referred to informally as *Ammoniropa?* sp. "Romilly") has been found at the three localities where live *A. vigens* occur, including in cases sympatrically (under the same rock or adjacent rocks) with *A. vigens*. This species (Plate 3) also lacks visible eyes and occurs in the same microhabitats as *A. vigens*. It is smaller than *A. vigens*, with a tighter spire (1.8–2.1 mm wide at 3.8–4.3 whorls) and a greater height-to-diameter

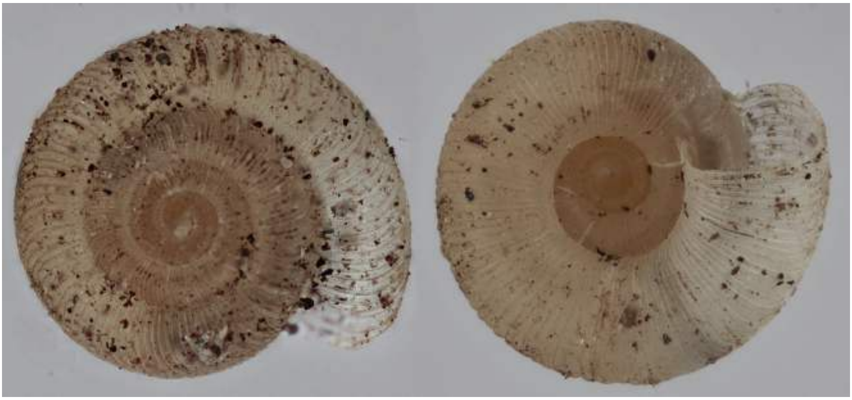


Plate 3. Undescribed species *Ammoniropa?* sp. "Romilly", Truganini CA, 7 August 2020, Shell width 2.0 mm. Photos: Simon Grove (edited by KB).

ratio, and has many more radial ribs on the protoconch, although the protoconch sculpture is otherwise similar. Because of damage to the top of the protoconch of many specimens of both species, a useful comparative measurement is the number of ribs on the last half-whorl of the protoconch. For *A. vigens* the mean rib count on the last half whorl of the protoconch is 31.8 +/- 3.0 ribs (range 27–39, n=21) whereas for *A?* sp. "Romilly" the rib count is 50.8 +/- 3.3 (range 47–55, n=4). More research is needed to determine whether this species belongs in the same genus as *A. vigens,* and to document other apparent differences in shell sculpture in further detail.

Two dead specimens previously recorded as *A. vigens* (Romilly St/Stoney Steps Road, 3 June 2010 and Knocklofty, 12 Jan 2014) have subsequently been reassigned to *Ammoniropa?* sp. "Romilly". During surveys in 2020, three live adult specimens of *A.?* sp. "Romilly" were found at Knocklofty, all of which were very battered, with extensive shell damage including partial loss of ribbing. One live adult specimen without any shell damage was later collected at Truganini Reserve, along with four dead specimens.

One further specimen with features compatible with *Ammoniropa?* sp. "Romilly" was collected at a site near Glaziers Bay in 1990, 35 km south-west of the species' known Hobart range. This specimen was found under a small log in disturbed *Acacia dealbata* forest with an understorey of *Beyeria viscosa,* on a mudstone substrate. However, the specimen is in fairly poor condition and it is not clear that it is the same species.

Results since 2004

This section updates the history of the species at each known locality since 2004. The type locality "Mount Nelson" (record attributed to Petterd by Brazier

Table 1. Summary of modern results at known localities as of 15 October 2020. "Mount Wellington" in this table excludes Romilly Street/Stoney Steps Road.

Location	First modern record	Live	Dead
Domain	None	0	0
Grass Tree Hill	26 May 1990	0	4
Hillgrove, Taronga	5 July 2004	0	1
Hobart Rivulet / Liverpool Cres	4 Aug 2020	0	3
Mount Wellington	None	0	0
Knocklofty	23 May 2008	3	8
Poimena Reserve	12 Dec 2003	0	1
Romilly St / Stoney Steps Rd	2 Nov 2002	3	13
Taroona (South)	10 Oct 2020	1	4
Truganini CA	22 July 2018	16	10

(1871)) is not included as it is considered likely to be equivalent to Truganini Conservation Area, although another possibility is the Lambert Rivulet gully, where there have been no modern records. A summary of modern search results at known localities is given in Table 1. Spreadsheets of records of all specimens assigned to *Ammoniropa vigens* or *Ammoniropa?* sp. "Romilly" are available on request from the lead author.

1. Domain

This is a historic site mentioned by Petterd (1879) from where a single specimen was reported. One search since 2004, mainly targeting areas considered likely to yield old shells, was unsuccessful.

2. Grass Tree Hill

There has been no further searching of this site since 2002, although it should be searched again with the benefit of new knowledge of the species' microhabitat preferences. Nearby Mt Direction has been searched without success three times, including a search on the relatively wet and less disturbed western slope.

3. Hillgrove, Taronga

Bonham (2004) expressed optimism about the chances of confirming a live population in this area, a historic site at which one dead shell had been found in 2004. However, further searches by the lead author on 26 August 2005 (75 minutes) and 26 August 2020 (45 minutes) found no more, so it remains unclear whether the species survives in this area. A 45-minute search of a newly opened section of the Alum Cliffs Track below the Shot Tower was also conducted without success on the latter date.

4. Hobart Rivulet/Liverpool Crescent

In August–September 2020, an old shell was found in a road cutting at Liverpool Crescent, followed by another two in a track cutting in the Hobart Rivulet council reserve about 100 metres away. The latter was the first record of any charopid species from the reserve, in which around eight hours of searching for native snails has previously been conducted. This is provisionally regarded as an extinct population.

5. Mount Wellington

This is an imprecisely located 19th century record. The species was collected at "Mount Wellington" (Legrand, 1871) but no further information is known or appears likely to become known concerning where precisely the species was found, and the locality "Mount Wellington" was used broadly by early writers. All searches on the lower slopes of kunanyi/Mt Wellington for this species have failed, including 13 searches targeting low-altitude dolerite between Fern Tree and Lenah Valley and another five such searches in Ridgeway Park. It is not certain that this locality is distinct from the Romilly Street/Stoney Steps Road locality (locality 8).

6. Knocklofty

The Knocklofty sites were discovered in 2008. Specimens have been found at two sites about 60 metres apart in a small south-facing wet gully. Five dead specimens were recorded at the lower site in 2008 but the species has not been seen there since. The upper site (Plate 4) produced one live and two dead specimens in 2008, and a further live specimen in 2010. Further searches by the lead author on 12 January 2014, 21 February 2017 and 19 May 2018 found no *A. vigens*, while a search on 7 June 2019 produced only one shell, which was very eroded in places and hence not clearly fresh. An additional survey on 27 March 2020 again failed to produce any specimens. The species was feared locally extinct following various possible impacts on the site including hot and dry summers, an unusual abundance of exotic slugs in 2017 and a flash flood through much of the upper site in 2018, but a single live juvenile *A. vigens* was found on 27 June 2020. Exotic carnivorous snails *Oxychilus cellarius* (Müller, 1774) and *O. draparnaudi* (Beck, 1837) occur more commonly around the lower site than the upper site.

Significant search effort has been undertaken by the lead author at this location with over 45 hours spent sampling sites across Knocklofty for land snails prior to finding the Knocklofty population. Further attempts to find *A. vigens* elsewhere on Knocklofty since 2008 have failed. The gully habitat in which the population has been found has not been burnt in recent decades, and was protected from a recent fuel reduction burn of the western and southern slopes of Knocklofty.

Plate 4. Mossy dolerite rocks at Knocklofty. Both *Ammoniropa vigens* and *Ammoniropa*? sp. "Romilly" have been found under the group of rocks shown.

Plate 5. Track cutting on Pipeline Track, Romilly Street/Stoney Steps Road site, where several dead specimens have been found in loose soil.

7. Poimena Reserve, Austins Ferry

No further specimens have been seen since the single dead shell found in 2003. Details of two failed searches in 2006 and 2017 were published by Bonham (2017).

8. Romilly Street/Stoney Steps Road

At the time of the Bonham (2004) paper this was the only locality where live specimens had been recorded since the 19th century. The site includes about four hectares of wet eucalypt forest, mostly on two private land blocks with a small public land section along the Pipeline Track. Only four searches were conducted between 2004 and 2019, three of these during commissioned surveys of proposed housing developments on private land blocks. A single live specimen was found in 2018, in the same location as the two recorded in 2002. In 2020, nine empty shells were found, mostly in loose soil in track cuttings on the uphill side of the Pipeline Track (Plate 5). The area over which shells have been found now extends along the track and on the uphill slope for approximately 170 metres (east-west).

9. Taroona (South)

A new population of the species was found on 10 October 2020 on private land managed for conservation in southern Taroona. One live and four dead specimens were recorded in a wet forest gully with sparse eucalypts. This was the first time this area had been searched, and all specimens were within 30 metres of each other, but a potentially large area of suitable habitat distant from housing and other disturbances exists.

10. Truganini Conservation Area

Ammoniropa vigens was first located at Truganini CA in July-August 2018 when two specimens, one live and one dead, were recorded, the dead specimen located at the top of the track cutting. This site was searched by both authors for over an hour on 3 July 2019 without success. However, in July 2020 nine live and four dead specimens were recorded at the site in about five person-hours of searching across two days. The species has now been found along a 40 metre stretch of a little-used walking track (Plate 6). All but the dead 2018 specimen have been located beneath rocks adjacent to the track.

The species was recorded at a second, nearby, site in August 2020, approximately 280 metres from the first, and adjacent to the main foot track through the reserve. This was in an area where previous searches had been unsuccessful. A total of ten (five live and five dead) specimens were recorded in about four person-hours of searching across three days. The linear extent of this population is at least 50 metres.

On 5 September 2020 a single live adult was recorded further up the main Truganini gully from the two earlier sites, 40 m outside the reserve boundary and approximately 510 m from the original site.

Prior to these finds, Truganini CA had been targeted in several searches for this species, including four searches since 2004. It was the nineteenth native

Plate 6. Habitat at Truganini Conservation Area (lower site).

Plate 7. Cracks in soil underneath dolerite rock at Truganini CA. At this site *A. vigens* is often found inside such cracks.

species recorded by the lead author in the reserve after over 20 hours of previous searching in several trips since the mid-1980s.

Most of Truganini CA was burnt in a bushfire in 1998. Both sites within the reserve are near the edge of the burnt area, but fire impact on them would have been relatively minor. The site outside the reserve was not burnt. Old *O. cellarius* shells are frequently seen at the lower site but no living specimens have been seen, although other introduced species (mostly *Vitrina pellucida* (Müller, 1774) and *Arion hortensis* (Férussac, 1819)) are present.

Microhabitats

Ammoniropa vigens was already known to mainly occur under dolerite rocks in mossy areas of wet forest, but during the 2020 searches at Truganini CA in particular, we were able to gain a better understanding of *which* rocks the species is most likely to occur under. The most success finding *A. vigens* has been from beneath relatively large rocks (often 30–60 cm wide) that are partially embedded in the ground. The soil under such rocks frequently contains many small cracks and hollows (Plate 7), and careful searching of this matrix sometimes produces specimens, occasionally visible deep within cracks. Conversely, smaller rocks that are easily turned seldom constitute habitat for this species.

Discussion

Between 1990 and 2019, the lead author had recorded only six live specimens of *A. vigens*, whereas between July and mid-October 2020, 17 were observed. This increased success rate can be partly attributed to the improved understanding of the species' microhabitat preferences. However, it is also possible that favourable soil moisture conditions following a wetter than normal autumn and early winter have provided conditions favourable to the snail, making it easier to find.

The locating of two sites within Truganini CA improves the species' outlook, as these sites occur within one of the largest reserves in the species' known range and are distanced from the nearest houses by at least 160 m and 340 m respectively. A high proportion of Truganini CA specimens have been alive, increasing confidence that the species is unlikely to become extinct at this location in the immediate future.

At both Knocklofty and Romilly Street/Stoney Steps Road, live specimens have so far only been recorded from a very small area, although empty shells have been found more widely. In view of the very cryptic nature of the species, it is possible that it occurs alive across larger areas at these sites, but more searching is required to determine this. For the time being there remains evidence of only very small and localised populations at these sites, both of which could be precariously threatened. In contrast, Truganini CA appears likely to support substantial populations of the species, and more sites there may be found with more surveying.

The species' association with soil cracks under boulders raises the possibility that many more specimens may occur in the soil layer than can be found under boulders. This requires investigation, especially at sites where populations appear to be very small.

The species' cryptic habitat preferences pose challenges for consultants surveying the species during impact assessments for proposed developments. Searches for live snails are best undertaken while soil moisture conditions are favourable and following rain, whereas dead specimens may be located at any time. While their presence could provide information about where live specimens might occur, empty shell finds might also represent extinct populations, which would then require a large (and potentially, in some cases, cost-prohibitive) survey effort to provide confidence that the species is no longer present.

Searching of private land, especially wet gullies above Taroona, remains a priority in conservation research for this species. With only four known living populations, two of which may be precarious, the reasons for listing the species as Critically Endangered continue to apply. However, if additional populations can be found, the status of the species may need to be reviewed. The authors are keen to survey wet forests on dolerite on private land in the Greater Hobart area, especially those that are in good condition and remote from housing.

Acknowledgements

We thank Otto Bell for extensive assistance with surveying, Simon Grove, Catherine Byrne and Kirrily Moore for assistance with specimen photography, Michael Vaughan for access to property and John Stanisic for assistance with SEM scanning.

References

Bonham, K.J. (2004). *Discocharopa vigens* (Legrand, 1871), a threatened Tasmanian charopid land snail. *The Tasmanian Naturalist* 126: 20–28.

Bonham, K.J. (2017). The declining native land snail fauna of Poimena Reserve, Austins Ferry, Tasmania. *The Tasmanian Naturalist* 139: 54–62

Bonham, K.J. (2018). *Ammoniropa* in Stanisic J., Shea M., Potter, D. & Griffiths, O. (2018). *Australian Land Snails Volume 2: A Field Guide to Southern, Central and Western Species*. Bioculture Press, Mauritius.

Brazier, J. (1871). Descriptions of ten new species of land shells, collected by Mr W. F. Petterd, of Hobart Town, Tasmania. *Proceedings of the Zoological Society of London*. 1870: 659–662.

Legrand, W. (1871). *Collections for a Monograph of Tasmanian Land Snails*. W. Legrand, Hobart.

Petterd, W.F. (1879). *A Monograph of the Land Shells of Tasmania*. Examiner, Launceston.

A case study of wind throw in a pure stand of southern sassafras (*Atherosperma moschatum*)

Trevor Olesen
6 Donald Street, Salisbury, SA, 5108
trevorolesen@gmail.com

Abstract

Canopy gaps in forests have been well studied, especially in relation to tree regeneration, species diversity and population structure. However, there is surprisingly little information on gap creation. Here I examine gap creation by wind thrown trees in a Tasmanian rainforest by monitoring a mapped site over time. The trees that were most prone to being wind thrown tended to be tall and had higher than average displacement of the crown location from the stem location; which is to say, were exposed to the wind and had large persistent turning forces associated with the crown displacement. However, when such trees fell they created little in the way of canopy gaps, perhaps because the displacement of the crown locations was phototropic and involved aversion to neighbours, and the trees fell in the direction of displacement. The one wind-thrown tree that did produce a large canopy gap failed for a different mechanical reason: the tree was split in two along the grain by turbulent winds acting on the forks of a steep crotch angle. The two parts fell approximately perpendicularly to the direction of crown displacement causing a cascade of tree falls. The paper also touches on other forest processes including the regeneration of the canopy gap, the decay of dead trees and the population structure of the dominant tree.

Introduction

Severe winds caused extensive damage to the forests around the now abandoned Lyrebird Nature Trail at Mt Field National Park, Tasmania (42°41' S, 146°21' E; 700 m above sea level) sometime between 2012 and 2015. The most likely timing of the event was 9 February 2014 when a violent storm, with wind gusts of 130 km/h, was recorded in Hobart by the Australian Bureau of Meteorology. Here I am able to describe some of the damage because I had mapped part of the forest in the mid-1980s and had repeatedly revisited the mapped site over subsequent years.

I initially became interested in the Lyrebird Nature Trail because of a small pure stand (with respect to angiosperms and gymnosperms) of southern sassafras (*Atherosperma moschatum*) that grew at the site. Sassafras is a shade-tolerant climax rainforest tree that grows in the wetter parts of lowland Tasmania. It also grows in Victoria and New South Wales. The stand was interesting because of its architectural simplicity, and because it was marginal in two respects: rainforests are poorly represented at Mount Field because the environment is somewhat severe, especially outside the wetter gullies; and the stand is located near the altitudinal limit of sassafras.

Materials and Methods

By 1986 I had mapped the locations of all the stems of sassafras ≥5 cm in diameter one metre above the ground in a 30 x 24 m quadrat; the diameters of the stems; the crown locations; and the tree heights. In 1996 I measured the stem diameters for a second time, and combined the results into an architectural and growth analysis of the stand (Olesen 2001).

In July 2019 I returned to the quadrat to assess the *circa* 2014 storm damage by remapping the stem locations and by tracing the fate of individual plants. The data from Olesen (2001) was used to describe the salient form of individual trees, because sassafras grows very slowly (e.g. the maximum increase in stem diameter between 1986 and 1996 was 3.5 cm, which was for a tree 41 cm in diameter in 1986) and because such data is very time-consuming and difficult to collect, as the canopy is closed and congested.

There is some guesswork to the reconstruction of events. A fallen tree, for example, in the path of a presumably wind-thrown tree is assumed to have been felled by the wind-thrown tree and not wind-thrown itself.

Results and discussion

Spatial patterns of sassafras

The stems of the sassafras trees are often clumped together (Fig. 1 and Olesen 2001) because the tree reproduces both vegetatively and from seed. The vegetative reproduction is typically from branches that develop near the base of the stem.

The distribution of the crowns is much more regular (Olesen 2001). The main reason for this appears to be phototropism, as the trees grow away from neighbours and towards the brightest part of the available sky (Olesen 2001). A consequence of this is that the displacement of the crown location from the stem location tends to be directed away from the mother clump. There is some aversion to neighbouring clumps too.

Structural stability of sassafras

The sassafras trees in the stand have a very high tree height safety factor (4.2; Olesen 2001). Part of this is intrinsic, but part of this also relates to the strong winds at the site, and to the turning forces generated by the displacement of the crown locations from the stem locations.

There were at least four trees in the stand thrown by the wind since 1986, one in 1988 and three *circa* 2014. All four trees were snapped at the base, not uprooted. These trees varied in height from 22 to 29 m in 1986, compared with a maximum tree height for the stand of 31 m. Only tall trees were affected because gale-force winds at the top of the canopy translate into wafting breezes near the forest floor.

Three of these wind throws were approximately in the direction of the crown displacement from the stem. The wind and possibly rain may have worked in unison with the structural turning force to cause the stems to break, given that the crown displacements of the thrown trees were larger than average (displacements of 5.7, 3.9 and 2.3 m for trees with diameters of 48, 35 and 31 cm, respectively, in 1986, compared with an average displacement of 1.8 m for trees with stem diameters >30 cm). However, the direction of fall was probably largely dictated by the centre of gravity.

The failure of the fourth tree was very different. The tree had a crown displacement of 1.5 m in 1986, and a diameter of 53 cm. The tree fall was almost perpendicular to the direction of crown displacement. This tree had a bad crotch angle (Plate 1, 2012, Tree B) and turbulent winds appear to have split the tree in two along the grain (Plate 1, 2019, Tree B) with both halves of the tree falling in approximately the same direction, perpendicular to the suture of the crotch.

Damage caused by falling trees

I found that only one of the four wind-thrown trees created a canopy gap. This result was similar to that of Senécal et al. (2018), who found that canopy height reduction associated with broken boles in Canadian temperate deciduous forests produced canopy gaps in only 40% of cases.

The low incidence of canopy gap formation at the Lyrebird Trail appeared to be related to the phototropic development of the tree crowns and to the nature of the mechanical failure of the trees, as I will explain below by considering the individual wind throws.

The tree that fell in the direction of crown displacement in 1988 was 48 cm in diameter in 1986, and 23 m high (location X=18 Y=20.4 in Fig. 1, falling approximately east). It felled no mapped trees in the quadrat and probably no trees with stem diameters ≥5 cm outside the quadrat because the fall of the tree was arrested by a large eucalypt log within the quadrat, so that the stem of the fallen tree was high above the ground outside the quadrat.

One of the two trees that fell in the direction of crown displacement *circa* 2014 was towards the southern perimeter of the quadrat, 31 cm in diameter in 1986 and 25 m high, and fell outside the quadrat (location X=13.6 Y=0.2 in Fig. 1, falling approximately west). It caused no damage to the mother clump. I have no specific information on the damage it caused outside the quadrat, but it did not create a significant canopy gap. This is Tree A in Plate 1.

The second of the two trees was 35 cm in diameter in 1986 and 22 m high. It fell entirely within the quadrat (location X=2.5 Y=26.7 in Fig. 1, falling approximately east-south-east). It caused minor damage in the mother clump, felling one tree that was 13 cm in diameter in 1986. It felled three trees away from the mother clump, with diameters of 10, 6 and 5 cm in 1986. The fall did not create a significant canopy gap.

The limited damage caused by trees falling in the direction of crown displacement appeared to be related to the phototropic habit, and the consequent aversion to neighbours. Limiting damage is a potential evolutionary driver. In this regard it is interesting to note that southern sassafras and other members of the Atherospermataceae have the unusual habit of abscising branches.

In contrast, the tree that split *circa* 2014, 53 cm in diameter in 1986 and 29 m high (Tree B in Plate 1) caused more damage, because it essentially devolved into four major tree falls: the two halves of the original tree, one of which felled an adjacent tree 45 cm in diameter in 1986, which in turn felled a tree 41 cm in diameter. The diameters of the trees felled by these four tree-falls were 21, 16, 14, 12, 9, 8, 8, 8, 7, 6 and 5 cm in 1986. All the damage caused by the wind throw was contained within the quadrat.

The location of the split tree in Fig. 1 is X=10.5, Y=3.4. The tree fell approximately to the north. It created a canopy gap approximately 16 x 8 m, obvious in the figure. The mother clump was largely destroyed in the wind throw, with one stem, 14 cm in diameter in 1986, to the south of the clump, left standing.

Other tree attrition and recruitment

Six of the originally mapped sassafras trees, with diameters of 45, 44, 12, 9, 8 and 8 cm in 1986, outside of the paths of the wind-thrown trees, had died by 2019. One of these is shown as Tree D in Plate 1. Although it was 45 cm in diameter in 1986 and 28 m high, it was surrounded by larger, taller trees, and almost certainly shared a root system with some of these trees. Thus it was probably at a competitive disadvantage to these other trees with respect to light, nutrients and water, given that branch experiments on other species have shown that the effects of shade on branch development tend to be greater than can be attributed to the effects of reduced light alone (Sugiura & Tateno 2013).

Tree D had a sparse canopy in 1986, was alive in 1987 (Plate 1, 1987), had little or no canopy by 1996, and was unequivocally dead by 2012 (Plate 1, 2012). By 2019 it was no more than a pile of fibrous sludge located at G in Plate 1, 2019.

The size distribution of the trees in 1986 is given in Fig. 2. In general, the number of trees in each size class decreased exponentially with increasing stem diameter. Sassafras is shade tolerant, and such a distribution is common for shade-tolerant species (Takahashi et al. 2018). Also shown in Fig. 2 are size distributions of: (1) the trees that either died by attrition or were felled below 1 m above the ground; and (2) the original trees from the 1986 mapping that still had living stems 1 m above the ground in 2019. Both distributions also had exponential declines with increasing stem diameter.

By 2019 five trees had advanced to the ≥5 cm stem diameter category, all with diameters of 6 cm.

The rotting of mature sassafras trees

Assuming that Tree D discussed above died around 1996, then it seems that a mature tree of sassafras takes about 25 years to rot to nothing at the site. This estimate is corroborated by the fate of the tree that was wind-thrown in 1988. There seemed to be a small trace of the tree in 2012, but no trace at all by 2019. The time-frame is similar to

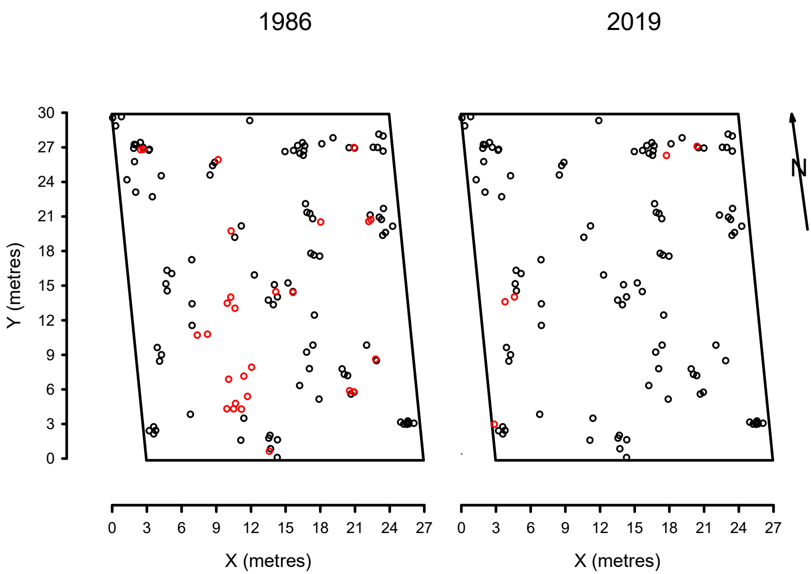


Figure 1. Mapped locations of *A. moschatum* at Mount Field National Park in 1986 and 2019. The locations are for trees ≥5 cm in diameter at 1 m above the ground. The direction of true north is to the right of the maps. The trees which had disappeared by 2019 are shown in red in the 1986 plot, and those which had been recruited since 1986 are shown in red in the 2019 plot.

the time-frame for the rotting of sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), and yellow birch (*Betula alleghaniensis*) in a North American hardwood forest (Johnson et al. 2014).

Canopy gap regeneration

The 16 x 8 m gap created by one of the wind throws has become a glade with a dense ground fern layer of *Hypolepis rugosula* and *Histiopteris incisa* with emergent stems of sassafras (Plate 1).

The sources of the sassafras stems are stems that survived the creation of the gap. Tree E in Plate 1, 2019, for example, was felled by the wind-thrown tree that created the gap, but had its trunk only partially broken, so that the canopy is still connected to its roots. The tree is establishing new central leaders from the surviving canopy (to the left of the letter) and from new branches at the base (to the right of the letter). Interestingly, tree F in the photograph was completely snapped by the wind-thrown tree, but failed to successfully produce new branches from the stump, perhaps indicating the importance of current photosynthate in successful vegetative reproduction.

In the absence of further disturbance the gap is likely to return to sassafras.

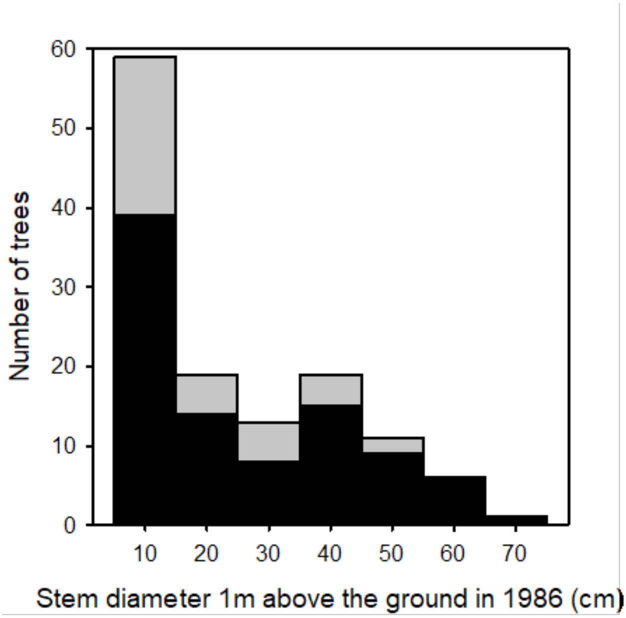


Figure 2. Size distributions of *A. moschatum* based on stem diameters in 1986, and 10 cm size classes starting at 5–15 cm. (1) Total heights of bars: tree numbers in 1986. (2) Black portions of bars: numbers of trees from 1986 still standing and alive in 2019. (3) Grey portions of bars: numbers of trees from 1986 either dead by 2019 or felled below 1 m above the ground but still alive.

1987

2012

2019

Plate 1. A clump of trees repeatedly photographed in 1987, 2012 and 2019. The 1987 photograph looks towards the north; the 2012 photograph towards the south-south-west; the 2019 photograph towards the east. Tree B was split in two and wind-thrown *circa* 2014. Tree A (only in the 1987 and 2012 photographs) was also wind-thrown *circa* 2014. Tree C was probably felled by the impact of tree B as it fell. Tree D was alive in 1987, dead in 2012, and a mound of fibrous sludge in 2019. In the 2019 photograph the original location of tree D is marked by the letter G. Letters E and F mark the locations of trees felled by the impact of tree B as it fell. The stem of tree E is horizontal but the stem was only partially broken, still connected to its roots, and alive. The stem of tree F was completely snapped, and the tree was dead.

References

Johnson, C. E., Siccama, T. G., Denny, E. G. et al. (2014). In situ decomposition of northern hardwood tree boles: decay rates and nutrient dynamics in wood and bark. *Canadian Journal of Forest Research* 44: 1515–1524.

Olesen, T. (2001). Architecture of a cool-temperate rainforest canopy. *Ecology* 82: 2719–2730.

Senécal, J.-P., Doyon, F. & Messier, C. (2018). Tree death not resulting in gap creation: an investigation of canopy dynamics of northern temperate deciduous forests. *Remote Sensing* 10: 121.

Sugiura, D. & Tateno, M. (2013). Concentrative nitrogen allocation to sun-lit branches and the effects on whole-plant growth under heterogeneous light environments. *Oecologia* 172: 949–960.

Takahashi, K., Ikeyama, Y. & Okuhara, I. (2018). Stand dynamics and competition in a mixed forest at the northern distribution limit of evergreen hardwood species. *Ecology and Evolution* 8: 11199–11212.

Jewels on fire! The Miena Jewel Beetle, *Castiarina insculpta* (Carter, 1934) (Coleoptera: Buprestidae), and the 2019 Great Pine Tier fire

Karen Richards and Chris P. Spencer
65 Sinclair Avenue, Moonah 7009
spenric@gmail.com

The narrow range Tasmanian endemic Miena Jewel beetle, *Castiarina insculpta* (Carter, 1934), has been scientifically recognised for less than a century; but during this period the species has experienced tumultuous changes of fortune. Originally described from a single female specimen collected near yingina / Great Lake by Critchley Parker in 1934, it was not until the 2000s that further specimens were obtained, with 5 specimens being found between 2004 and 2010. Each of these was located by different people under a range of circumstances. Three factors remained constant however: all specimens were female, were dead when found and came from the yingina / Great Lake area (Smith et al. 2004; Bowden 2010; Threatened Species Section 2020). The 2013 discovery of live *C. insculpta* by field naturalists caused entomological pulses to race and rapidly led to a significant increase in the collective knowledge of the species (Bonham et al. 2013; Spencer & Richards 2014; Richards & Spencer 2016, 2017).

Originally listed as extinct under the Tasmanian *Threatened Species Protection Act* (TSPA) in 1995, having not been 'knowingly' recorded since the type specimen was collected, it was later discovered that a specimen had been found in 1965 and is held in the South Australian Museum (Cowie 2001, Atlas of Living Australia database). The discovery of further *C. insculpta* specimens in the early 2000s led to a revision of the species' status. Despite the absence of live specimens at that time, the new records of dead individuals resulted in *C. insculpta* being downlisted from extinct to endangered on the TSPA in 2008. Over time, a number of surveys have been instigated, including by staff of both the Queen Victoria and the Tasmanian museum and art galleries, enthusiastic naturalists from Tasmanian Field Naturalists clubs and researchers from the University of Tasmania (Smith et al. 2004; Bonham et al. 2013; Spencer & Richards 2014; Richards & Spencer 2016, 2017). In 2018, mainly due to the significant increase in extent of occurrence and number of known subpopulations, the status of *C. insculpta* was again reviewed, resulting in its further downlisting to vulnerable on the TSPA.

However, the ensuing events of the 2018–19 summer, occurring within the range of the species and resulting in the decimation of a significant proportion of the beetles' habitat, warranted yet another review of the beetles' status. In 2020 the Tasmanian Scientific Advisory Committee considered the species again, this time leading to the species' status returning to endangered (Threatened Species Section 2020).

On 20 January 2019, a bushfire ignited by a dry lightning strike began in the vicinity of the Great Pine Tier on the Central Plateau. This fire coincided with weather conditions conducive to fire, and by 24 January was out of control, having already burnt approximately 20,000 ha (Tasmania Fire Service data). At this period, Liawenee, Miena, Shannon and Penstock Lagoon were being issued with "watch and act" warnings. After a frightening and hectic week for all concerned, during which the fire front also turned north toward Brandum, 31 January saw cooler conditions, tending to slow the progress of the fire, which now had a footprint of 50,000 ha and appeared likely to have consumed at least 50% of the known *C. insculpta* habitat within the beetle's range.

The progress of the fire was eventually halted in early February, leaving a 56,632.9 ha fire footprint with a

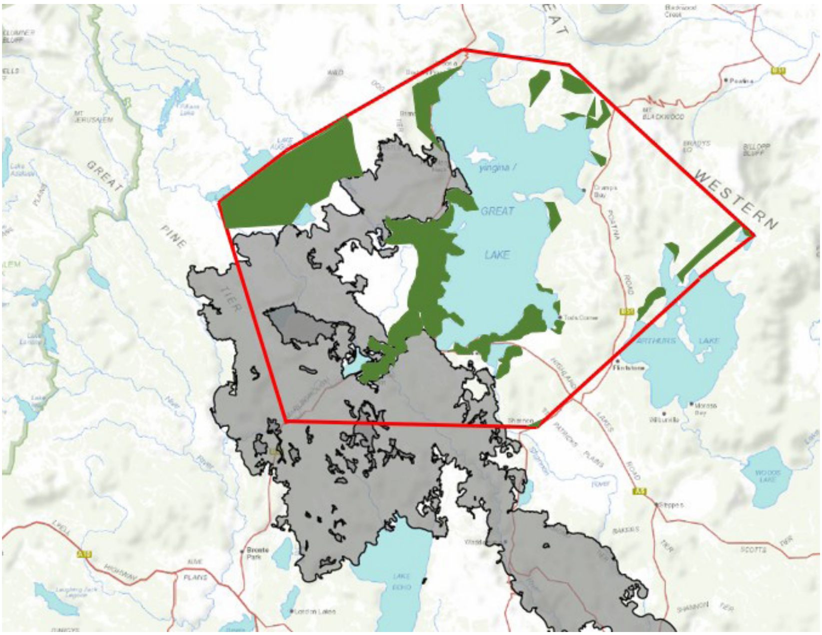


Figure 1. Map of the area burned in the January 2019 fire. Red polygon = *Castiarina insculpta* extent of occurrence, green = unburned *Ozothamnus hookeri*, light grey = the fire footprint (TFS data), darker grey = unburned areas within the fire footprint.

Plate 1. Marlborough Hwy, Skittleball Plains – before and after the January 2019 fire.

perimeter of 639 km (Tasmania Fire Service data; Figure 1). Despite the close proximity to several small settlements, no human lives were lost and damage to buildings was minimal. The firefighting effort was admirable, particularly as a number of major fires were concurrently burning across Tasmania at Mt Anne (Lake Pedder), Riveaux Road (Picton–Huon Valley), Gell River (Maydena–Florentine) and Moores Valley (west coast), and the limited resources available were being apportioned to fires considered higher priority due to heavy population and impending property loss.

Road closures and warnings across the Central Plateau during this time limited our ongoing research effort on this species over summer. Some safe locations remained accessible, however, and even as the fire burned the authors were recording range extensions for *C. insculpta* including near Gunns and Little lakes, (north of Arthurs Lake) and on Westons Road (north of Great

Plate 2. Lake Augusta Road burned area, showing fire intensity.

Lake). The Westons Rd location has extensive patches of *Ozothamnus hookeri* which were found to support a medium to high density of *C. insculpta*, as well as a medium density of *Castiarina rudis* (Carter, 1934) occupying the numerous patches of *Orites revoluta* scrub, the known food plant of this species (Richards & Spencer 2017).

The roads eventually reopened following the extinguishment of the fire, allowing a preliminary assessment of the damage to *C. insculpta* habitat. The first post-fire visit took place on 15 February 2019 when we surveyed the areas along the Marlborough Highway between Little Pine Lagoon and Miena, and from Miena to the northern end of Great Lake. Large areas of *Ozothamnus* and *Hakea* scrub along the Marlborough Highway, the western side of the road, surrounding the Ouse River Bridge, "Skittleball Plain", Little Pine Lagoon and Monpelyata Road were heavily burnt (Plate 1). Previously, these locations were known to support medium to high densities of *C. insculpta* (Spencer & Richards 2014).

Liawenee to Reynolds Neck and patches near Brandum Bay along the Highland Lakes Road were also significantly impacted, with the high intensity of the fire obvious at a number of sites, where little evidence of former dense stands of *O. hookeri* remained. The vast majority of the vegetation along the

Lake Augusta Road between Liawenee and Thousand Lakes Lodge (originally known as Bernacchi Lodge), north of the Ouse River, was also destroyed (Plate 2). The *O. hookeri* in this region previously supported a medium density population of *C. insculpta*.

Readers may recall that we have previously written about another jewel beetle, *C. rudis,* and the native cockroach, *Polyzosteria* sp. Burmeister, 1838, in the Central Highlands (Richards & Spencer 2017, 2019). While the fire will most certainly have heavily impacted the habitat and populations of these and many other species, so far it appears that only a few of our research sites were burned. On a positive note, our 2019 surveys extended the distribution of *C. rudis* along Westons Road, ensuring the persistence of the species in this area. We also confirmed that *C. rudis* is widespread across the Ben Lomond Plateau and an additional population was recorded on Mount Barrow.

Despite all of the devastation, a few vegetated remnants remain, including the area in the immediate proximity to the Ranger Station at Liawenee (a Tasmanian Field Naturalists *C. insculpta* research site), the greater part of which was unscathed. A one-hour survey of this location recorded 24 *C. insculpta* feeding and mating on *O. hookeri* blossom and a further 13 beetles in flight. Given that mid-February usually signals the end of the beetles' active period, it was remarkable to record a female *C. insculpta* ovipositing.

Adult *C. insculpta* regularly appear in elevated numbers biennially (Spencer & Richards 2014; Richards & Spencer 2016, 2017). Our observations both pre- and post-fire confirm that the summer of 2018–19 was a high (or positive) year for the species, implying that large numbers of adults must have been incinerated as well as lower numbers of half-term larvae destined to become the adult population in the subsequent summer (negative year). There is little doubt that local extinctions of *C. insculpta* sub-populations have occurred across much of the area resulting from the fire, however the extent of this impact remains to be fully investigated. It is expected that the impact of the fire on the habitat, and therefore *C. insculpta*, has been significant across the fire footprint. There are consequences, both in the short and longer term, for the species. As well as the existence of nearby beetles to colonise, repopulation will depend not simply on regeneration of the vegetation, but rather on the time needed for *O. hookeri* to develop the features required by the beetle to successfully breed. The authors have reported 13 mm diameter as being the smallest stem to show *C. insculpta* emergence holes (Spencer & Richards 2014); thus, we anticipate a period in excess of ten years before any *O. hookeri* regrowth will attain a suitable stem diameter for egg-laying and larval development.

Clearly, historical wildfires must have periodically negatively impacted *C. insculpta*, as have anthropogenic influences such as destruction of habitat, as well as grazing practices (Spencer

& Richards 2014). The reduction of heavy grazing allowed the food plant to flourish, providing the resource for the beetle to expand its area of occupancy. However, much of the incinerated *O. hookeri* was likely to have been of the same age cohort, and since it has a life expectancy of 30–50 years (Kirkpatrick et al. 2002), it may have been approaching senescence. The recolonisation of *C. insculpta* will be limited by the size and distribution of remnant habitat patches where the beetle has survived as well as the dispersal capability of adult *C. insculpta*. The recent disaster of the 2019 fire, though greatly limiting the available food and habitat resource for *C. insculpta*, will in turn offer a new opportunity for *O. hookeri*, a successional species, to germinate and re-establish, providing a future food resource for *C. insculpta*.

References

Bonham, K., Richards, K., Spencer, C.P., Grove, S., Reid, C., Byrne, C., Hird, D. & Throssell, A. (2013). Observations of the Miena Jewel Beetle *Castiarina insculpta* (Carter, 1934) in the summer of 2012–13. *The Tasmanian Naturalist* 135: 104–109.

Bowden, D. (2010). Fishing for a jewel beetle. *Forest Practices News* 10(2): 1–2.

Kirkpatrick, J.B., Bridle, K.L. & Wild, A.S. (2002). Succession after fire in alpine vegetation on Mount Wellington, Tasmania. *Australian Journal of Botany* 50: 145–154.

Richards, K. & Spencer, C.P. (2016). Observations of *Castiarina insculpta* (Miena Jewel Beetle) in 2016. *The Tasmanian Naturalist* 138: 66–67.

Richards, K. & Spencer, C.P. (2017). New distribution and foodplant observations for several Coleoptera species in the Tasmanian Central Highlands, summer 2017. *The Tasmanian Naturalist* 139: 99–106.

Richards, K. & Spencer, C.P. (2019). Notes on the ecology of the Tasmanian alpine cockroach *Polyzosteria* sp. Burmeister, 1838 (Blattodea: Polyzosteriinae) including parasitism by Gordian worms (Nematomorpha: Gordioida). *The Tasmanian Naturalist* 141: 27–33.

Smith, B.J., Reid, C. & Gordon, T. (2004). Rediscovery of the Miena jewel beetle (*Castiarina insculpta* Carter, 1934), formerly listed as extinct. *The Tasmanian Naturalist* 126: 31–34.

Spencer, C.P. & Richards, K. (2014). Did *Castiarina insculpta* (Miena Jewel Beetle) ride on the sheep's back? *The Tasmanian Naturalist* 136: 50–58.

Threatened Species Section (2020). *Listing Statement for* Castiarina insculpta *(Miena Jewel Beetle)*. Department of Primary Industries, Parks, Water and Environment, Tasmania.

Monitoring of Flame Robins (*Petroica phoenicea*) in June 2020 in south-east Tasmania

Els Wakefield[1] & Peter Vaughan[2]
[1]12 Alt-Na-Craig Avenue, Mount Stuart, Tasmania 7000
elswakefield@gmail.com
[2]Private Bag 55, School of Natural Sciences,
University of Tasmania
peter.vaughan@utas.edu.au

Introduction

There have been anecdotal reports of Flame Robins (Plate 1) declining in numbers around Tasmania. To investigate this, Els Wakefield and Bill Wakefield surveyed six selected routes in south-east Tasmania during the months of April to July from 2009 to 2014 to monitor Scarlet and Flame Robins (Wakefield & Wakefield 2016). The six routes were Blackbrush, Brown Mountain, Bruny Island, Runnymede, Tasman Peninsula and Tooms Lake.

In 2020, after a gap of six years, Els Wakefield repeated the survey using the same survey method during the month of June, a time when robins had been present on all routes during the previous years of sampling.

Although both Flame Robins and Scarlet Robins were counted during the June 2020 surveys, the main focus was to assess the number of Flame Robins. This is because Scarlet Robins tend to join

Plate 1. Flame Robin (*Petroica phoenicea*)

Flame Robins in small numbers, whereas Flame Robins habitually flock during the colder months, thus facilitating population counts before they disperse during warmer months. The number of Flame Robins seen along each transect was calculated along all routes travelled in June 2020. Occurrence frequencies were also extracted from the June data of all previous years sampled, to allow comparison of numbers of birds seen across years.

Results and Discussion

Flame Robins were most commonly observed on the Blackbrush and Runnymede routes in 2020 (Figure 1). While there was substantial variation in numbers encountered across routes, at least 25 individuals were encountered on each route (Figure 1). Counts in 2020 were consistently approximately half those observed in 2010 (Figure 2). However, the 2020 counts were higher than those observed at Tooms Lake, Runnymede and Blackbrush in the years subsequent to 2010.

There are several possible causes for the observed changes in numbers, including environmental factors, overall population change and site selection over time. Without wider or long-term, more consistent sampling it is impossible to determine the true cause of this pattern. However, it is still valuable to do further surveys. We plan to continue these surveys during June in future years to build on this data set.

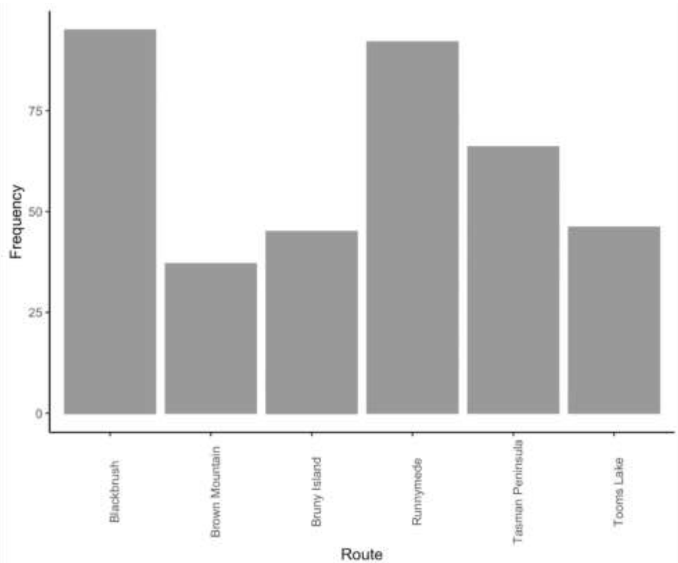


Figure 1. Frequency of Flame Robins (*Petroica phoenicea*) in June 2020 along six transects in Tasmania, Australia.

Reference

Wakefield, W.C. & Wakefield, E. (2016). Monitoring of flame robin (*Petroica phoenicea*) and scarlet robin (*Petroica multicolor*) flocks April to July 2009 to 2014, in southeast Tasmania. *The Tasmanian Naturalist* 138: 29–32.

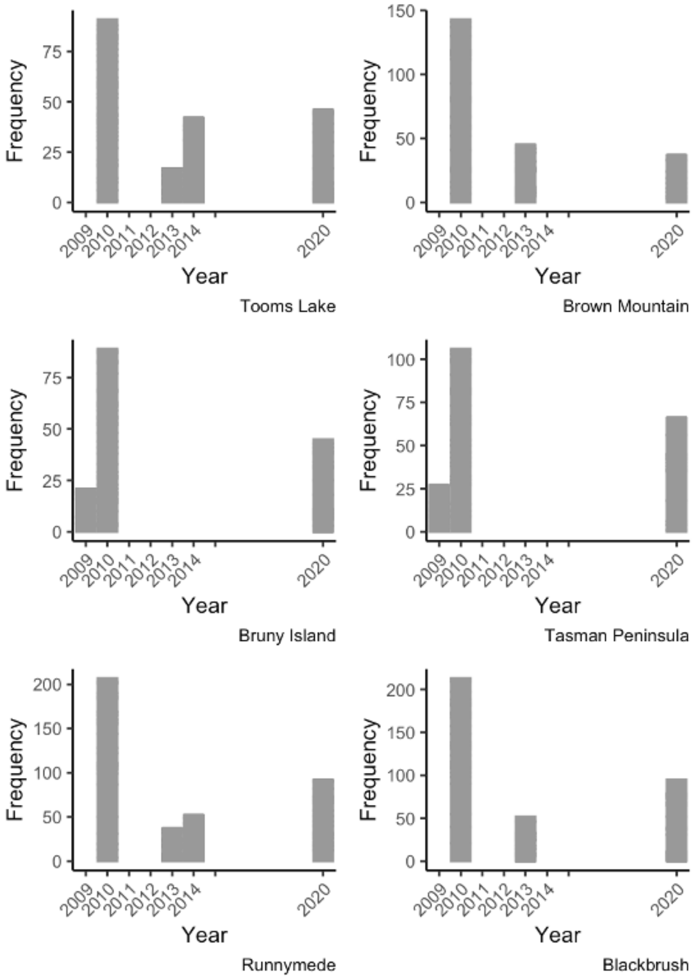


Figure 2. Frequency of Flame Robins (*Petroica phoenicea*) in June (2009–20) along six transects in Tasmania, Australia. Sampling was not done in the years 2011, 2012, and 2015–19.

Urban bushland reconnaissance survey: Havelock Street Reserve, Launceston

Maynard, D.[1], Pugh, K.[2], Fearn, S.[1], Douglas, J.[1], Bassnett, G[3]. and Denning, D.[2]

[1]Natural Sciences, Queen Victoria Museum and Art Gallery, PO Box 403, Launceston, 7250.
[2]Infrastructure and Assets Network, City of Launceston, 18-28 St John Street, Launceston, 7250.
[3]Tamar Natural Resource Management, 16-24 St John Street, Launceston, 7250
*Correspondence: David.Maynard@launceston.tas.gov.au

Introduction

As urban populations continue to grow so does the urban landscape, typically leaving behind a loose network of small, unplanned and disconnected remnant natural green spaces. These spaces do not have the profile of the larger national parks and reserves, and so do not gain the attention that they deserve. Yet, they are valued by the community, and valuable to the community, for various reasons, including 1) preserving local biodiversity and protecting important populations or rare species, 2) creating stepping stones or corridors for natural populations, 3) mitigating environmental changes, 4) connecting people with nature and providing environmental education, 5) providing ecosystem services, 6) fulfilling ethical responsibilities, and 7) improving human well-being (Dearborn & Kark 2009). Because of their small size, and being surrounded by housing, these green spaces are under extra pressure, including misuse or inappropriate management practices that can negatively impact species diversity. Part of the solution is to better understand their natural values, and educate users and land managers about their importance and benefits. In this paper we provide an example of a reconnaissance survey of a typical bushland reserve and the resulting increased understanding of its natural values.

Havelock Street Reserve

Havelock Street Reserve (HSR) is located approximately 4 km west of the Launceston central business district. The site is a partially-rehabilitated clean fill dump (closed 1994). The reserve is used primarily for passive recreational activities like walking, bike riding and dog walking. It was once part of a large, contiguous dry sclerophyll forest, however development of the surrounding suburbs from the 1960s to the 2000s has created an almost isolated bushland pocket with limited connectivity to neighbouring woodland to the north-west (Plate 1). All adjacent woodland to the north-east, south-west and south has been cleared since the 1950s and is now residential development. Occupying 8.6 ha, HSR is an excellent example of dry sclerophyll open forest on dolerite which is typical of much of the nearby Cataract Gorge, Trevallyn State Recreation Area and Kate Reed Nature Recreation Area. Small remnant woodlands like HSR provide a connective landscape link between the larger reserves.

The reserve's topography is mostly flat or gently undulating, and the soil is mostly gravelly clay loams over dolerite and related rocks. There are numerous small rocky outcrops throughout the reserve.

A previous flora and fauna assessment (AVK Environmental Management & Urban Bushland Management Consultants Pty Ltd 1997) identified one threatened flora species, the blue grass-lily, *Caesia calliantha*, within the reserve. The white gum grassy woodland and black peppermint open forest areas were identified as potential foraging habitat for the swift parrot (*Lathamus discolor*), a species that is listed as endangered under the Tasmanian Threatened Species Protection Act 1995 and critically endangered on the Commonwealth's Environment Protection and Biodiversity Conservation (EPBC) Act 1999 and the IUCN Red List. In the 1990s a small flock (20-30 birds) were known to be resident in Launceston between December and March (R. Brereton pers. comm.), however little active research has been done on this species in the Launceston

Plate 1. Aerial view of the Havelock Street Reserve: 1955 (left) and 2017 (right).

region in recent decades. The reserve was also identified as providing suitable habitat for eastern barred bandicoot (*Perameles gunnii gunnii*) (EPBC-listed status: vulnerable), the eastern quoll *(Dasyurus viverrinus)*, (EPBC-listed status: endangered) and the Tasmanian bettong (*Bettongia gaimardi*).

The assessment concluded that the vegetation is in good condition and the reserve is likely a valuable space for wildlife and native flora.

Survey methods

City of Launceston staff, including zoologists and a botanist were joined by experts in natural resource management and citizen scientists to generate a species list for the HSR. Nine people surveyed the park over about 44 person-hours between November 2017 and March 2018. An additional flora assessment was undertaken on 23 November 2018 to assess regeneration in fuel management units burnt in autumn 2018. This survey was timed to coincide with spring flowering for a number of threatened flora species likely to occur in the reserve.

Survey methodology included:

- active searches for invertebrate fauna, amphibians and reptiles (e.g. log and rock rolling, bark peeling);
- motion sensor cameras for mammalian fauna;
- binocular and auditory searches at early morning, dusk and during the middle of the day for bird fauna; and
- meandering transects for flora and opportunistic sightings of fauna.

Survey results

Prior to the survey 85 plants and two animals were known from HSR. Previous surveys in the reserve were limited to flora assessments and potential habitat for threatened fauna. Botanical surveys to support management planning and fire management planning were conducted in 1996, 1997and 2004 (unpub. data, C. Moore 2018). These assessments identified 73 native flora species and 12 introduced species. Two threatened flora species (*Brunonia australis* and *Caesia calliantha*), and four declared weeds (blackberry (*Rubus fruticosus* agg.), Spanish heath (*Erica lusitanica*), gorse (*Ulex europaeus*) and St John's wort (*Hypericum perforatum*) were known to occur in the reserve.

There was a single fauna observation recorded in the reserve prior to this survey: a millipede (*Tasmaniosoma anubis*) collected in 2014 (Atlas of Living Australia 2019). This observation is a vouchered specimen in the Queen Victoria Museum and Art Gallery (QVMAG) collection (QVM.23.53823). There is one observation of an eastern barred bandicoot as roadkill 400 m from the reserve on Peel Street West in 2007 (Natural Values Atlas 2020).

This current survey recorded 225 species, comprised of 54 plant, 35 vertebrate and 136 invertebrate species. A number of Tasmanian endemic species, undescribed invertebrates, and species of conservation significance were identified during the survey. Species lists are presented in tables 1-4.

Vegetation and flora

The botanical survey focussed on the dry sclerophyll open forest, which is dominated by *Eucalyptus amygdalina* in association with *E. viminalis*. The reserve has some tall shrubs including *Bursaria spinosa*, *Acacia dealbata* and *Banksia marginata*. These were mostly present in the lower section of the reserve. The understorey is variable ranging from grassy to shrubby and is largely a result of different soil moisture, soil depth and rock cover (Plate 2). The grassy areas contain a rich mix of ground covers, including a number of orchids, several of which could not be identified to species level during the survey. Further detailed survey work is recommended.

A few weeds are present, including the declared weeds listed above, and tulips (*Moraea* sp.). These weeds are sparse and generally scattered around the perimeter of the reserve.

Of the 54 flora species identified in this survey, 15 species were previously unrecorded in the reserve, including an additional threatened species, soft poa grass (*Poa mollis*) (Table 1). The majority of the new flora observations were collected during the spring 2018 survey, many of which were located in the areas burnt in autumn 2018. *Brunonia australis* was observed to be thriving in high density in the areas burnt as part of the fuel reduction program in autumn 2018 (Plate3).

No species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* were recorded during the survey.

Vertebrate fauna

A total of 26 bird, three marsupial, four reptile, and two frog species was recorded (Table 2). Three Tasmanian endemic species were recorded, the green rosella (*Platycercus caledonicus*), yellow wattlebird (*Anthochaera paradoxa*) and the Tasmanian tree skink (*Niveoscincus pretiosus*). No listed threatened fauna species were recorded

Plate 2. Dry sclerophyll forest with grassy understorey in the Havelock Reserve.

Plate 3. The threatened species *Brunonia australis* was found to be relatively common in Havelock Street reserve.

during the survey. Two introduced bird species were recorded; the ubiquitous common starling (*Sturnus vulgaris*) and common blackbird (*Turdus merula*). The mammal diversity is probably under-represented, and additional surveys using wildlife cameras at night would reveal new records. Similarly, reptiles and amphibians are very likely under-represented and further study is needed. Four charismatic species from this small reserve appear in Plate 4.

Invertebrate fauna

There were 28 arachnid and 108 insect species recorded (Tables 3 and 4, respectively).

Arachnids

The search for arachnids in the Havelock reserve occurred during daylight hours and concentrated on spiders which live under loose bark on eucalypt trees, and under logs, rocks and fallen bark on the ground. Orb-web spiders, of which only three species were found,

Plate 4. Some vertebrates photographed in the Havelock Street Reserve. Clockwise - lowland copperhead snake (*Australeps superbus*); brown tree frog (*Litoria ewingii*); red-necked wallaby (*Macropus rufogriseus*); a mixed-species breeding pair, (top right) green rosella (*Platycercus caledonicus*) and (bottom left) eastern rosella (*Platycercus eximius*).

are under-represented. This group are found more often after dark when they spin their webs; nocturnal searching would increase the species count.

Half of the 26 spider species were jumping spiders (Salticidae), comb-footed spiders (Theridiidae) and orb-web spiders (Araneidae). The remaining 13 species represented seven families. A number of spiders could not be identified and it is likely that some are new species. The non-spider arachnid species included one scorpion (Bothriuridae) and one harvestman (Triaenonychoidea).

Insects

The insect fauna dominated the species count. The survey recorded 108 species from about 45 families in nine insect orders. Beetles (Coleoptera) and ants, bees and wasps (Hymenoptera) accounted for 50% and 25% of species, respectively. Sixty seven of the 108 species could not be identified to genus or species.

Insect diversity and abundance is under-represented in our sample. This species list reflects the active sampling methods used in the survey, that is netting and hand collection of invertebrates on blossom, under logs and rocks, or under bark. Had passive trapping methods like pitfalls, light traps and malaise traps been employed the species diversity would have been much greater. For example, based on light trapping surveys of several sites in Launceston and the northern midlands by QVMAG, it would be anticipated that at least several hundred species of moths are likely to occur in HSR.

Discussion

Havelock Street Reserve is an important suburban native woodland that is made up of, and is home to, more than 270 plant and animal species. Prior to the current survey, just two fauna and 85 flora species were formally recorded in the reserve. The 2018 survey identified a total of 225 species, 214 of which were new records for this reserve. It must be noted that as this survey was undertaken as a pilot project, the methods employed were unsophisticated, not comprehensive, and temporally constrained, meaning that further work will greatly increase our knowledge of species diversity. Given the relatively low survey effort, the 225 species recorded in this survey is an underestimate of the assemblage. This shows that even relatively low levels of effort can reveal significant biodiversity, and also the benefits of investing in fieldwork targeting functional groups within an area, rather than single species sampling (Mesibov et al. 2002).

Of the 225 species listed above, 73 (or nearly one in three) are either undescribed to species level or unidentifiable using current taxonomic information. All 73 species are arthropods, either insects or spiders; groups that are poorly known (Yeates et al. 2003). Given the high level of endemism in Australian invertebrate fauna and the relatively low survey and research effort targeting these groups, this is an unsurprising result, but it highlights a significant gap in our understanding of the ecology of the reserve. Regardless, it is apparent that this sort of urban reserve supports surprising diversity, and by protecting them the resident and transient fauna can provide essential ecosystem services like pollination.

There are several threats to the biodiversity in this reserve: increased edge effects from existing and future urban development, removal of live and standing dead trees and shrubs for fire hazard reduction and general public safety, illegal removal of coarse woody debris, routine slashing of grassed areas, domestic animals in and adjacent to the reserve, weed incursions, fencing that inhibits wildlife movement, illegal vehicular traffic, off-track biking and walking, roadkill, and reduced water quality in the unnamed tributary of Dalrymple Creek, which is located in the north-west corner of the reserve.

This survey has demonstrated that high biodiversity levels can be found in small urban reserves with relatively little effort. These reserves become increasingly important in the landscape as habitats are fragmented or lost to development pressure. Recent research has found that small, isolated habitat fragments are important for biodiversity conservation; in some instances the loss of any small patch of vegetation leads to a significant (and potentially total) loss of suitable habitat for species confined to those patches, such as flightless invertebrates (New 2009, 2010). Thus, these patches have a high conservation value (Wintler et al. 2019). Habitat requirements for many invertebrates may involve very 'fine scale' considerations of specific microclimate tolerances, trophic needs and even mutualistic relationships. In addition, larval and adult forms of the same species can have very different resource requirements. Such conditions can be scattered or widely dispersed on both temporal and distance scales within reserves requiring effective dispersal through potentially unsuitable habitat (New 2009, 2010). A good example is the presence of the flightless, saproxylic, endemic stag beetle *Lissotes launcestoni* in the reserve. This species can only breed in fallen timber lying on the substrate with the correct moisture and fungal content (Hangay & De Keyzer 2017). Suitable logs are relatively scarce and widely spaced. Any removal, disturbance, or fire damage to such logs will seriously affect the long term persistence of such species, particularly in relatively small reserves isolated by unsuitable habitat, including roads. One Tasmanian study in north east Tasmania documented high levels of road kill in wandering flightless stag beetles (Spencer & Richards 2013).

Both native millipede and land snail populations have been found to fluctuate through time (including local extinctions) in Tasmanian reserves of a similar size to HSR due to temporal changes in microhabitats, as well as introduced predators and competitors (Bonham 2017; Mesibov 2017). In contrast, other invertebrate taxa displaying limited dispersal capabilities, but with long life cycles and relatively simple habitat requirements, such as burrowing spiders, can persist in small reserves indefinitely (Main 1987).

For more mobile species, multiple habitat fragments linked by connective corridors, or acting as stepping stones, will be important for persistence of meta-populations within a region. The protection of these urban reserves is therefore of often under-appreciated conservation significance.

Our understanding of species diversity in HSR could be further expanded by seasonal sampling and using other collection methods. Similar surveys are required in other urban green spaces, and citizen scientists can play an important role by recording their observations on platforms like *iNaturalist Australia* .

References

Atlas of Living Australia (2020). *Tasmaniosoma anubis.* Accessed 11 August 2020.

AVK Environmental Management & Urban Bushland Management Consultants Pty Ltd (1997). Fire Management Plan Havelock Reserve. City of Launceston.

Bonham, K. (2017). The declining native land snail fauna of Poimena Reserve, Austins Ferry, Tasmania. *The Tasmanian Naturalist* 139: 54-62.

Dearborn, D.C. & Kark, S. (2009). Motivations for conserving urban biodiversity. *Conservation Biology* 24 (2): 432-440.

Hangay, G. & De Keyzer, R. (2017). *A guide to stag beetles of Australia*. CSIRO Publishing. Melbourne.

Main, B. Y. (1987). Persistence of invertebrates in small areas: case studies of trapdoor spiders in Western Australia. In: *Nature Conservation: The Role of Remnants of Native Vegetation.* Eds. D.A. Saunders, G. W. Arnold, A. A. Burbidge.

Mesibov, R., Bonham, K.J., Doran, N., Meggs, J., Munks, S., Otley, H. & Richards, K. (2002). Single-species sampling in Tasmania: an inefficient approach to invertebrate conservation? *Invertebrate Systematics*, 16: 655-663.

Mesibov, R. (2017). A note on the millipedes of Reid Street Reserve, West Ulverstone. *The Tasmanian Naturalist* 139: 71-72.

Natural Values Atlas (2020). Eastern barred bandicoot (*Perameles gunnii gunnii*). Accessed 27 August 2020.

New, T. R. (2009). *Insect Species Conservation.* Cambridge University Press, Cambridge.

New, T. R. (2010). *Beetles in Conservation.* Wiley-Blackwell, Oxford.

Spencer, C. P. & Richards, K. (2013). Are invertebrate pedestrians threatened? Observations of *Hoplogonus simsoni* from road line transects in northern Tasmania. *The Tasmanian Naturalist* 135: 28-40.

Wintle, B.A., Kujala, H., Whitehead, A., Cameron, A., Veloz, S., Kukkala, A., Moilanen, A., Gordon, A., Lentini, P.E., Cadenhead, N.C.R. and Bekessy, S.A. (2019). Global synthesis of conservation studies reveals the importance of small habitat patches for biodiversity. PNAS 116 (3) 909-914.

Yeates, D.K., Harvey, M.S. & Austin, A.D. (2003). New estimates for terrestrial arthropod species-richness in Australia. *Records of the South Australian Museum Monograph Series* 7: 231–241.

Table 1: Flora species recorded in Havelock Reserve in this survey

Dicotyledonae		
Asteraceae	Cutleaf daisy*	*Brachyscome rigidula*
	Everlasting daisy	*Chrysocephalum semipapposum*
	Common billybuttons*	*Craspedia glauca*
	Twiggy daisybush*	*Olearia ramulosa*
Casuarinaceae	Black she-oak	*Allocasuarina littoralis*
	Sheoak	*Allocasuarina verticillata*
Dilleniaceae	Erect guinea-flower	*Hibbertia riparia*
	Thyme guinea-flower	*Hibbertia serpyllifolia*
Droseraceae	Sundew	*Drosera* sp.
Ericaceae	Native cranberry	*Astroloma humifusum*
Fabaceae	Silver wattle	*Acacia dealbata*
	Blackwood*	*Acacia melanoxylon*
	Narrow-leaved wattle	*Acacia mucronata*
	Creeping bossiaea	*Bossiaea prostrata*
	Hop bitter-pea	*Daviesia latifolia*
Goodeniaceae	Blue pincushion^	*Brunonia australis*
Linaceae	Native flax*	*Linum marginale*
Myrtaceae	Lemon bottlebrush	*Callistemon pallidus*
	Black peppermint	*Eucalyptus amygdalina*
	White gum	*Eucalyptus viminalis*
Pittosporaceae	Prickly box	*Bursaria spinosa*
Polygalaceae	Love creeper	*Comesperma volubile*
Proteaceae	Silver banksia	*Banksia marginata*
	Small fruit hakea	*Hakea microcarpa*
Ranunculaceae	Clematis*	*Clematis clitorioides*

Table 1 continued

Monocotyledonae		
Asphodelaceae	Golden lily	
Colchicaceae	Milkmaids	
	Early Nancy*	*Wurmbea dioica*
Colchicaceae	Oneflower early Nancy*	*Wurmbea uniflora*
Cyperaceae	Sedge	*Carex iynx*
	Cutting Grass	*Lepidosperma ensiforme*
	Variable Sword Sedge	*Lepidosperma laterale*
Hemerocallidaceae	Blue flax lily	*Dianella revoluta*
Iridaceae	Butterfly flag iris	*Diplarrena moraea*
Laxmanniaceae	Chocolate lily	*Arthropodium strictum*
Orchidaceae	Spider orchid	*Caladenia sp.*
	Tiger orchid*	*Diuris sulphurea*
	Great sun orchid*	*Thelymitra aristata*
Poaceae	Spear grass	*Austrostipa sp.*
	Soft poa grass*^	*Poa mollis*
	Tussock grass	*Poa rodwayi*
	Kangaroo grass	*Themeda triandra*
Xanthorrhoeaceae	Basket rush	*Lomandra longifolia*
Ferns & allies		
Adiantaceae	Maidenhair fern	*Adiantum aethiopicum*
Dennstaedtiaceae	Bracken fern*	*Pteridium esculentum*
Dicksoniaceae	Tree fern*	*Dicksonia antarctica*

* Previously unrecorded in Havelock Reserve;

^ listed as rare under the Threatened Species Protection Act 1995

Table 2: Vertebrate animal species recorded in the Havelock Reserve in this survey

Birds	Brown thornbill	*Acanthiza pusilla*
	Eastern spinebill	*Acanthorhynchus tenuirostris*
	Little wattlebird	*Anthochaera chrysoptera*
	Yellow wattlebird*	*Anthochaera paradoxa*
	Fan-tailed cuckoo	*Cacomantis flabelliformis*
	Pallid cuckoo	*Cacomantis pallidus*
	Shining bronze-cuckoo	*Chrysococcys lucidus*
	Grey shrike-thrush	*Colluricincla harmonica*
	Black-faced cuckoo-shrike	*Coracina novaehollandiae*
	Forest raven	*Corvus tasmanicus*
	Grey butcherbird	*Cracticus torquatus*
	Australian magpie	*Gymnorhina tibicen*
	Welcome swallow	*Hirundo neoxena*
	Superb fairy wren	*Malurus cyaneus*
	Spotted pardalote	*Pardalotus punctatus*
	Striated pardalote	*Pardalotus striatus*
	New Holland honeyeater	*Phylidonyris novaehollandiae*
	Green rosella*	*Platycercus caledonicus*
	Eastern rosella	*Platycercus eximius*
	Grey fantail	*Rhipidura albiscapa*
	Beautiful firetail	*Stagonopleura bella*
	Grey currawong	*Strepera versicolor*
	Common starling†	*Sturnus vulgaris*
	Common blackbird†	*Turdus merula*
	Masked lapwing	*Vanellus miles*
	Silvereye	*Zosterops lateralis*
Marsupials	Bennett's wallaby	*Macropus rufogriseus*
	Brushtail possum	*Trichosurus vulpecula*
	Ringtail possum	*Pseudocheirus peregrinus*

Table 2 continued

Reptiles	Copperhead snake	*Austrelaps superbus*
	Delicate skink	*Lampropholis delicata*
	Metallic skink	*Niveoscincus metallicus*
	Tasmanian tree skink*	*Niveoscincus pretiosus*
Frogs	Common froglet	*Crinia signifera*
	Brown tree frog	*Litoria ewingii*

*endemic species; † introduced species

Table 3: Spider species recorded in the Havelock Reserve in this survey

Araneidae	Orb-web spiders	Undescribed species
		Eriophora pustulosa
		Plebs bradleyi
Gnaphodisae	Ground spiders	*Encoptarthria*
		Intruda signata
Hahniidae	Dwarf spiders	*Scotospilus bicolor*
Lamponidae	White-tailed spiders	*Lampona* sp.
		Lamponova wau?
Miturgidae	Prowling spiders	*Mituliodon tarantulina*
		Miturga agelenina
Salticidae	Jumping spiders	*Holoplatys planissima*
		Ocrisiona jovialis
		Sandalodes superbus
		Servaea incana
		Jotus sp.
Sparassidae	Huntsmans	*Delena cancerides*
Theridiidae	Comb-footed spiders	*Cryptachaea veruculata*
		Euryopis sp.
		Steatoda grossa
		Parasteatoda decorata

Table 3 continued

Thomasidae	Crab spiders	*Stephanopis cambridgei*
Trochanteriidae	Trochanterid spiders	*Trachycosmus sculptilis*
		Hemicloea tasmani
Unidentifiable spiders		unidentified sp.
Other arachnids		
Bothriuridae	Scorpion	*Cercophonius squama*
Triaenonychoidea	Harvestman	*Callihamus badius*

Table 4: Insect species recorded in the Havelock Street in this survey

Blattodea	**Blattidae**	Cockroach	*Platyzosteria biglumis*
			Platyzosteria melanaria
	Ectobiidae	Cockroach	*Balta* sp. nov.
			Choristima sp.
	Termopsidae	Damp wood termite	*Porotermes adamsoni*
Coleoptera	**Unidentifiable beetles**		6 unidentified spp.
	Cantharidae	Soldier beetle	*Chauliognathus lugubris*
	Carabidae	Predacious ground beetle	*Agonocheila* sp.
			Demetrida sp.
			Prosopogmus sp.
			Sarothrocrepis corticalis
			Sarothrocrepis sp.
			unidentified sp.

Table 4 continued

Coleoptera cont.	Cerambycidae	Long horn beetle	*Omophaena taeniata*
			Phlyctaenodes pustulosus
			Porithodes sp.
	Chrysomelidae	Leaf beetle	*Calomela maculicollis*
			Paropsis aegrota elliottii
			Paropsisterna lineata
	Cleridae	Clerid beetle	*Eleale sp.*
			Lemidia sp.
			Pylus fatuus
	Coccinellidae	Ladybird	unidentified sp.
	Curculionidae	Weevil	*Gonipterus sp.*
			3 unidentified sp.
	Elateridae	Click beetle	*Agrypnus sp.*
			Conoderus sp.
			Crepidomenus sp.
			Elatichrosis trisulcata
			Toorongus sp.
			unidentified sp.
	Lucanidae	Green and gold stag beetle	*Lamprima aurata*
		Stag beetle	*Lissotes launcestoni*
	Melyridae	Soft-winged flower beetle	unidentified sp.
	Ptinidae	Spider beetle	*Ptinus sp.*
	Scarabaeidae	Dung beetle	*Onthophagus australis*
		rhinoceros beetle	*Cryptodus tasmannianus*
	Staphylinidae	Rove beetle	*Creophilus erythrocephalus*
			Scaphidium alpicola

Table 4 continued

	Tenebrionidae	Darkling beetle	*Adelium abbreviatum*
			Adelium sp.
			Adelium tenebroides
			Atoichus sp.
			Coripera deplanata
			Meneristes australis
			Promethis angulata
			3 unidentified spp.
Dermaptera	Anisolabididae	Earwig	unidentified sp.
	Spongiphoridae	Earwig	*Nesogaster sp.*
Diptera	Asilidae	Robber fly	*Cerdistus-neoitamus complex*
	Culicidae	Mosquito	unidentified sp.
		Fly	unidentified sp.
		Fly	unidentified sp.
	Tipulidae	Crane fly	2 unidentified spp.
Hemiptera	Alydidae	Bug	*Mutusca brevicornis*
	Cicadellidae	Leaf hopper	2 unidentified spp.
	Cicadidae	Red-eye cicada	*Psaltoda moerens*
	Cixiidae	Bug	unidentified sp.
	Coreidae	Bug	*Amorbus obscuricornis*
	Cydnidae	Bug	*Adrisa sp.*
	Flatidae	Bug	*Siphanta sp.*
	Pentatomidae	Bug	*Oncocoris geniculatus*
	Reduviidae	Assassin bug	*Nebriscus sp.*
			Ptilocnemus sp.
			unidentified sp.

Table 4 continued

Hymenoptera	Apidae	Bumble bee	*Bombus terrestris*
		Honey bee	*Apis mellifera*
	Formicidae	Ant	*Polyrhachis sp.*
			Rhytidoponera tasmaniensis
			Rhytidoponera victoriae
			4 unidentified spp.
		Bull ant	*Myrmecia forficata*
		Jack jumper ant	*Myrmecia fulvipes*
			Myrmecia pilosula
			Myrmecia urens
		Sugar ant	*Camponotus claripes*
			Camponotus consobrinus
			Camponotus hartogi
		Vampire ant	*Amblyopone australis*
	Ichneumonidae	Parasitic wasp	4 unidentified spp.
	Mutillidae	Velvet ant	unidentified sp.
	Pompilidae	Spider hunting wasp	unidentified sp.
	Tiphiidae	Blue bottle	*Diamma bicolor*
	Vespidae	German wasp	*Vespula germanica*
Lepidoptera	Zygaenidae	Blue forester moth	*Pollanisus* sp.
		Moth	4 unidentified spp.
Odonata	Coenagrionidae	Damsel fly	*Xanthagrion* sp.
Orthoptera	Tettigoniidae	Cricket	*Coptaspis lateralis*
			Zaprochilus australis
	Trigonidiidae	Cricket	*Balamara albovittata*

Impact of the jewel beetle *Cyrioides imperialis* (Fabricius, 1801) (Coleoptera: Buprestidae) on *Banksia marginata* revegetation at Seymour, Tasmania

Karen Richards[1], Chris P. Spencer[1], David Quon[2] & Cheryl Quon[2]
[1]65 Sinclair Avenue, Moonah, Tasmania 7009
[2]"Templestowe" 48 Macquarie Street, Seymour, Tasmania 7215
spenric@gmail.com

Cyrioides imperialis (Fabricius, 1801) is the largest jewel beetle occurring in Tasmania. The species is widespread across the Australian eastern region where it is reported to be host-specific to the *Banksia* genus, earning it the vernacular name banksia borer (Tepper 1887, French 1900). Records do, however, exist of the species utilising *Leptospermum* spp. (Williams 1977; Williams & Williams 1983 in Hawkeswood 2007). The beetle is black and boldly patterned with yellow transverse bands and/or patches. This apparently aposematic colouring, though striking, serves as a surprisingly effective camouflage amongst banksia foliage. As with the majority of Tasmanian jewel beetles, activity of adult *C. imperialis* is limited to the warmer months, December to March, peaking on calm sunny days in January and February when emergent beetles fly to, and feed on, *B. marginata* leaves and shoots. Mating takes place amongst the foliage, then fertilised females descend and oviposit in bark fissures on the lower trunk or root bole (Plate 1).

In Tasmania, the effect of *C. imperialis* on sapling *B. marginata* has been reported by Richards & Spencer (2018); that study presented a detailed account of larval activity and evidence that a single larva may kill a juvenile tree, but it also noted that more mature trees appear unaffected, despite the presence of multiple larvae. In his 1900 book *A Handbook of the Destructive Insects of Victoria*, Charles French, the government entomologist of the period, portrays *C. imperialis* [as *Cyria*] as a destructive pest and advocates for control measures (French 1900). However, his suggested control method was to treat the tree with a poisonous substance via the hole from which the beetle had emerged, clearly an ineffective practice!

This study reports the impact of *C. imperialis* on 10–13-year-old *B. marginata* revegetation on "Templestowe", a 100-acre former sheep grazing property at

Plate 1. Ovipositing female *Cyrioides imperialis.*

Seymour, on Tasmania's east coast. In 2003 the land was purchased by David and Cheryl Quon, who had a conservation covenant applied to the property and undertook a revegetation project with the aim of providing a wildlife corridor connecting the Douglas-Apsley National Park to the reserve on Seymour Point, via Doctors Creek and "Templestowe". Planting commenced in 2005 with the establishment of 800–1000 saplings, mainly eucalypt species, planted at 2 m intervals on the south-western property boundary. A grant obtained in 2007 allowed the planting of a further 4000 trees, 250 of which were *B. marginata,* by conservation volunteers; this effort was repeated in 2008. Additional planting of 1500 assorted tree species was continued by the owners over the subsequent years. Plants were tube stock grown by Pulchella Nursery, generally from seed of local provenance, apart from the initial planting of eucalypts which were sourced from the former Forestry Tasmania's Perth nursery.

"Templestowe" was surveyed in early January 2020 by Janet Smith and Karen Richards for the Department of Primary Industries, Parks, Water and Environment's Private Land Conservation Program, which involves ongoing monitoring of wetland vegetation communities on covenanted land. Karen augmented the survey with an invertebrate inventory and alerted the owners to the presence of damage caused by *C. imperialis*.

On the day of the survey it was still, 23°C and overcast with smoke haze from a nearby bushfire. Immediately inside the property gate KR noted and photographed a dead 20 cm diameter

B. marginata (Plate 2) containing at least 13 *C. imperialis* emergence holes on the lower trunk and an exposed root; an adjacent banksia also had 8 emergence holes on the trunk and was dying. There were additional dying *B. marginata* trees that did not display emergence holes. *Cyrioides imperialis* were active and within 10 minutes, 6 individuals were observed on 3 trees in close proximity to the gate, including multiple ovipositing females.

Upon consultation, David and Cheryl recalled first noticing dead *B. marginata* in 2018 near the main gate, in an area containing 12 banksias with average trunk diameters of 20 cm. By May 2020, 30% of these 13-year-old trees were dead and displayed 4–13 emergence holes. One dead tree, however, had no holes and was obviously not the victim of beetle attack and more likely to have died from disease or lack of water. A monitoring project aimed at better assessing the impact of beetle infestation on *B. marginata* regeneration at "Templestowe" was initiated by KR and CS in June 2020, the main results of which will be reported separately.

Of the 400–500 *B. marginata* planted on the property, approximately 50% had visible emergence holes of *C. imperialis* and the cerambycid *Tragocerus spencii* Hope, 1834. Most of these trees had three or fewer *C. imperialis* emergence

Plate 2. Dead *Banksia marginata* on the "Templestowe" property.
Insert: *Cyrioides imperialis* emergence holes.

holes, but some trees displayed as many as 20 on their lower trunk and exposed root surfaces. Despite the beetle activity, the majority of the trees appeared healthy and were not exhibiting signs of stress e.g. foliar yellowing.

Previous research at Cleveland (Richards & Spencer 2018) suggested that *C. imperialis* favoured younger banksias, while the large cerambycid *Paroplites australis* (Erichson, 1842) typically infested dead or dying mature trees. The observations at Seymour appear to support these findings. While *T. spencii* also appears to favour younger trees, and may be a contributing factor in banksia decline, it is less likely to cause tree death as it attacks the upper stem or branches and not the lignotuber (Richards & Spencer 2019).

The nearest naturally occurring stand of banksia trees is along the eastern boundary of the property. In this stand the trees are mature, several with trunk diameters approaching 70 cm. Many of the trees exhibit emergence holes of *P. australis* (Plate 3) and *C. imperialis*; however, the latter are all very old and disfigured by trunk growth, indicating that the species is no longer active at the site. Approximately 100 *B. marginata* were planted near this location in 2007–8 and all remain healthy, with no obvious emergence holes. This sector of "Templestowe" adjoins the coastal strip of the Seymour Conservation Area and Seymour Swamp; both areas have numerous healthy mature *B. marginata,* many of which also show evidence of attack from the beetles, but few trees are senescing. Despite the age and overall health of these trees, no natural banksia regeneration was recorded and evidence of fire, thought essential for banksia regeneration, was not observed at these locations.

Cyrioides imperialis are heavy, cumbersome flyers and are not manoeuvrable; consequently they tend to mostly visit trees on the outer edge of plantings leaving internal banksias untouched. Unfortunately, many of the banksia trees inside the new stands are now heavily overshadowed by vigorously growing

Plate 3. Emergence holes of *Paroplites australis* (left); Cyrioides *imperialis* (centre); *Tragocerus spencii* (right). Scale button = 10 mm.

eucalypts and are succumbing to a lack of light. Additionally, the mature banksias adjacent to "Templestowe", while currently mostly healthy and not impacted by *C. imperialis*, are of a similar age; they will become senescent in the near future, and the stands will disappear without intervention to ensure regeneration in these areas.

At first it seemed likely that the density of *C. imperialis* on the property might prove to be a barrier to the establishment of *B. marginata* plantings; however, it now appears that many of the surviving banksias are approaching a size where they are less attractive to ovipositing *C. imperialis*, and indeed many of the trees are already past this point. Any future planting of *B. marginata* in the Seymour area is likely to be impacted by these insects but, as with the "Templestowe" plantings, trees planted in optimal conditions will grow quickly and the majority will survive the insect attack.

References

French, C. (1900). *A Handbook of the Destructive Insects of Victoria, with Notes on the Methods to be Adopted to Check and Extirpate them.* Part III. Government Printer, Melbourne.

Hawksewood, T. (2007). A review of the biology and a new larval host plant for *Cyrioides imperialis* (Fabricius, 1801) (Coleoptera: Buprestidae). *Calodema Supplementary Paper* No. 25 (2007): 1–3.

Richards, K. & Spencer, C.P. (2019). A new larval host plant for *Tragocerus spencii* Hope, 1834 (Coleoptera: Cerambycidae) in Tasmania. *The Tasmanian Naturalist* 141: 120–124.

Richards, K. & Spencer, C.P. (2018). Exploitation of sapling *Banksia marginata* by *Cyrioides imperialis* (Fabricius, 1801) (Coleoptera: Buprestidae) in Tasmania. *The Tasmanian Naturalist* 140: 27–32.

Tepper, J.G.O. (1887). *Common Native Insects of South Australia. A Popular Guide to South Australian Entomology.* Part 1. Coleoptera or beetles. E.S. Wigg & Son, Adelaide.

Williams, G.A. (1977). A list of Buprestidae (Coleoptera) collected from *Leptospermum flavescens* Sm. at East Minto, New South Wales. *Australian Entomological Magazine* 3: 81–82.

Williams, G.A. & Williams, T. (1983). A list of Buprestidae (Coleoptera) of the Sydney basin, NSW, with adult food plant records and biological notes on food plant associations. *Australian Entomological Magazine* 9: 81–93.

Buchwaldoboletus hemichrysus in Tasmania: A golden dilemma

Richard Robinson[1] & Genevieve Gates[2]

[1] Seven Mile Beach, Tasmania
richardrobinsonrmr@hotmail.com
[2] Tasmanian Institute of Agriculture, Private Bag 98, Hobart 7001

Abstract

A large yellow bolete has been fruiting in large numbers on the edge of a pine forest in Seven Mile Beach for several years. Fruit bodies were collected over the period 2018–20 and identified as a species of *Buchwaldoboletus*, namely *B. hemichrysus*. This is the first record for the genus in Tasmania and for this species in Australia. However, a more thorough examination including molecular sequencing is needed to fully verify the identification of several similar species of *Buchwaldoboletus*, including the species found at Seven Mile Beach.

Introduction

Buchwaldoboletus is a small genus of about 12 known species distributed worldwide (Ortiz-Santana & Both 2011). Species of *Buchwaldoboletus* are saprotrophic (Pilát 1965 in Ortiz-Santana & Both 2011; Rinaldi et al. 2008) and their native habitat is coniferous forests. Therefore, they occur naturally predominantly in the Northern Hemisphere and with introduced trees and pine plantations in the Southern Hemisphere, including Australia and New Zealand. The only known native Australian species is *B. spectabilis*, described from a rotting Bunya pine (*Araucaria bidwillii)* stump in southeast Queensland (Watling & Gregory 1988). The only previously published records of *Buchwaldoboletus* in Australia were of *B. sphaerocephalus,* originally described from Europe, and reported from Western Australia in association with radiata pine (*Pinus radiata*) stumps (Watling & Gregory 1988; Watling & Li 1999) from collections made in the early 1970s near Mundaring and Kalamunda. Watling and Gregory (1988) used the name *Buchwaldoboletus sulfureus* for *B. sphaerocephalus*, but later Watling and Li (1999) adopted B. sphaerocephalus, which is the nomenclaturally correct name (Watling 2004). More recently, several collections identified as *B. sphaerocephalus* have been made in southeast Queensland, associated with pine stumps and coniferous wood and litter (ALA 2020). *Buchwaldoboletus hemichrysus* has been recorded on radiata pine in New Zealand (Landcare Research 2020) and *B. xylopilus* on an old *Araucaria* stump on Norfolk Island (ALA 2020; Landcare Research 2020).

Site details

In February 2018, 2019 and 2020, a robust golden-yellow bolete was found fruiting profusely in the disturbed roadside strip adjacent radiata pine trees within the Pittwater plantation near Seven Mile Beach. The disturbance resulted from the harvesting of a strip of trees in 2017 to develop a new road through the plantation to link the airport with Seven Mile Beach village. The plantation was initially established between 1929 and 1935 (Gilbert & Miller 1952). The existing trees were naturally regenerated following harvest and are about 30 years old (S. Hetherington, Norske Skog, pers. comm.). The soil is very sandy, covered with a layer of mulched and woody pine tree debris. The plantation was also the original location for the first incursion of the sirex wasp (*Sirex noctilio*) in Australia at some time before 1952 (Gilbert & Miller 1952).

Materials and Methods

Several specimens were collected in 2018 and 2019. Fruit bodies were photographed in situ (Plate 1), collected and described macro- and microscopically. Morphological descriptions were made from the fresh specimens which were then air dried at about 25 °C. Microscopic examination was conducted on rehydrated material from the dried specimens. Colour codes referred to are from the Online Auction Colour Chart™ (oac) (2004). The description for this species was then compared with information and descriptions published for Australian specimens (Watling & Li 1999) and published descriptions of similar Northern Hemisphere species (Bessette et al. 2000; Ortiz-Santana & Both 2011). The collections have been lodged at the Tasmanian Herbarium (HO).

Results

Description: Pileus 55–120 mm diam., circular to irregularly circular in top view, convex (may be humped) becoming broadly convex, sometimes plane, surface dry, minutely floccose (woolly) with powdery coating, viscid when wet, becoming rimose (cracked) with age, golden yellow (oac855–856) or dirty yellow, margin inrolled, sometimes wavy, smooth or appendiculate when mature; pore surface bright yellow (oac854) becoming dirty yellow (oac856), generally with reddish colouring close to stipe at first but then extending across the pore surface, pores circular or oval-shaped, 3–4 per mm but larger and angular (~1 mm broad) in old specimens, bruising blue, tubes adnate to subdecurrent, 5–10 mm deep, yellow, faint bluing when exposed; stipe 50–100 mm long, 30–45 mm broad in middle, central, ventricose (swollen), tapering at base, surface dry, yellowish (same as pileus) with red tinges and sometimes a fine rib-like pattern at apex

Plate 1. Fruit bodies of *B. hemichrysus* from Seven Mile Beach. *Top left*, showing yellow pore layer and dry rimose pileus surface and inrolled margin. *Top right*, blue staining of flesh in pileus and stipe. *Bottom left*, inrolled margin of young fruit bodies and blue staining of pore surface. *Centre left*, young pore layer and red colouring of stipe apex. *Bottom right*, spores (bar = 10 µm).

and dark red-brown striated colouring at base, stains blue when handled. Context solid, golden yellow directly under pileus surface then mainly light yellow, some red tints near the surface at the base of the stipe, stains blue on exposure except in base of stipe and in a 1–2 mm zone directly under the pileus surface. Basal mycelium yellow (encrusted with soil), a thick, matted mass with root-like hyphal extensions radiating into substrate. Spores 6–7 x 3–4 µm, ellipsoid, smooth, pale yellow brown under microscope (Plate 1). Cystidia (cheilocystidia) lanceolate, numerous.

Habit and habitat: Gregarious or caespitose in mulched and woody radiata pine (*Pinus radiata*) tree debris, adjacent to radiata pine plantation.

Collections examined: Tasmania, Seven Mile Beach, Grueber Avenue, Pittwater pine plantation, 20 March 2018, R.M. Robinson, HO 596194. Same location, 3 March 2019, R.M. Robinson, HO 595608.

Discussion

The morphological characters of the specimens from Seven Mile Beach matched very closely two species first described from the Northern Hemisphere, *B. sphaerocephalus* and *B hemichrysus*, as well as the Australian *B. spectabilis* (Table 1). *Buchwaldoboletus sphaerocephalus* and *B. hemichrysus* are very similar but are distinguished on morphological characters including a pulverulent (powdery) coating on the pileus surface of *B. hemichrysus* (Watling & Li 1999) and colour variation of the pore surface and stipe (Bessette et al. 2000) (see Table 1). *Buchwaldoboletus sphaerocephalus* and *B. hemichrysus* occur naturally throughout the Northern Hemisphere (Kallio & Heikkilä 1978; Bessette et al. 2000; Nabe & Nagasawa 2017). *Buchwaldoboletus spectabilis* is also considered to be closely related to *B. hemichrysus* but differs in spore size and host species (Watling & Gregory 1988).

The specimens collected at Seven Mile Beach were growing on radiata pine debris. The pileus was slightly viscid

Table 1. Distinguishing characters of Buchwaldoboletus species (compiled from Bessette et al. 2000; Ortiz-Santana & Both 2011; Watling & Gregory 1988; Watling & Li 1999).

***B. hemichrysus* from Seven Mile Beach**	***B. sphaerocephalus* (as *B. sulfureus* in Watling and Gregory 1988)**	***B. hemichrysus***	***B. spectabilis***
Pileus dry (slightly viscid when wet), minutely floccose, powdery, rimose with age, golden or dirty yellow, margin inrolled, sometimes appendiculate.	**Pileus** dry to slightly viscid, subtomentose, rimose with age, yellow to yellow-fulvus, margin inrolled then becoming appendiculate.	**Pileus** dry, floccose-scaly to sub-velutinous, rimose with age, bright golden yellow, coated with yellow powder.	**Pileus** smooth, dry, sticky when moist, luteous (orange yellow) with powdery lemon-chrome coating.
Pore surface bright yellow then dirty yellow, red to reddish brown near stipe extending with age, adnate.	**Pore surface** yellow at first, then dull yellow to brownish yellow, depressed near the stipe.	**Pore surface** reddish brown, sometimes yellow at first, adnate, slightly decurrent.	**Pore surface** lemon-chrome.
Stipe dry, yellow, red-dish near apex and red brown near base.	**Stipe** dry, appressed fibrillose, yellow.	**Stipe** dry, yellow overlaid by brick-red to orange-red tints.	**Stipe** rusty, tawny, yellow at apex near pores.
Spores 6–7 x 3–4µm, ellipsoid, smooth.	**Spores** 7–9 x 3–4µm, oblong to ellipsoid, smooth.	**Spores** 6–9 x 2.5–4µm, ellipsoid to subfusoid, smooth.	**Spores** 5.5–6.7µm, ovoid to broadly ellipsoid.

when wet and had a powdery covering, the pileus margin was appendiculate in mature specimens and the pore layer was yellow with red-brown in the centre surrounding the stipe but extending to cover most of the poroid surface in older specimens. The stipe also displayed strong reddish colouring at the apex and base. The spore size was between that of *B. sphaerocephalus* and *B. hemichrysus*. The presence of a yellow powdery covering appears to be the important character for *B. hemichrysus* (Watling & Li 1999). Based on the powdery pileus and red colouring of the pores and stipe we suggest the specimens collected at Seven Mile Beach are best referred to as *B. hemichrysus*. This is the first record of *B. hemichrysus* in Tasmania, and for Australia. *Buchwaldoboletus hemichrysus* has been recorded on radiata pine in New Zealand and has sequences that match herbarium collections of *B. hemichrysus* from both the USA and Sweden (Landcare Research 2020).

The taxonomy and nomenclature of *Buchwaldoboletus*, especially that of *B. hemichrysus* and *B. sphaerocephalus*, is confusing. Both were originally described in the genus *Boletus*, as *Boletus hemichrysus* Berk. & M.A. Curtis (1873) from North America, and *Boletus sulfureus* Fr. (1838) from Europe, respectively. However, *Boletus sulfureus* was an illegitimate name and was consequently changed to *Boletus sphaerocephalus* Barla (1859) (see Index Fungorum website at www.indexfungorum.org/ for full synonymy). Later both were treated as synonyms, but included in the genus *Phlebopus*, as *P. sulphureus* (Singer 1947). Singer then transferred *Phlebopus sulfureus* to *Pulveroboletus* (Singer 1961). In 1969 the genus *Buchwaldoboletus* was proposed to accommodate the saprotrophic species *Pulveroboletus lignicola* and *Boletus hemichrysus* (Pilát 1969). In 1988 Watling described *Buchwaldoboletus spectabilis* Watling from Queensland and proposed the new combination *Buchwaldoboletus sulfureus* (Fr.) Watling [as '*sulphureus*'] to include the collections of *Buchwaldoboletus* from Western Australia, *Boletus sphaerocephalus* Barla and *Buchwaldoboletus hemichrysus* (Berk & M.A. Curt.) Pilát as synonyms (Watling & Gregory 1988). Later, Watling questioned the synonymy and after examining several North American collections he demonstrated that *Boletus sphaerocephalus* Barla and *Buchwaldoboletus hemichrysus* (Berk. & M.A. Curtis) Pilát could be identified as different and both occurred in North America (Watling & Li 1999). However, *Buchwaldoboletus sulfureus* (Fr.) Watling was an illegitimate name, so *Boletus sphaerocephalus* Barla was transferred to *Buchwaldoboletus* and, along with the Western Australian collections, was given the new name *Buchwaldoboletus sphaerocephalus* (Barla) Watling & T.H. Li (Watling & Li 1999; Watling 2004). However, it is obvious that the three species discussed above are closely related and difficult to separate on morphological characters and the riddle will not be solved unless a detailed molecular comparison is undertaken.

Why this species has not been recorded previously remains a mystery. Several hundred fruit bodies had developed within 12 months of the site being created and similar numbers have fruited in each of the following two years. They appear in early March when it is relatively dry, which is unusual, especially for a saprotrophic species. It is likely that the species may have fruited in low numbers following harvesting of the pines many years ago and was not observed then or seen as unusual. The recent disturbance may simply have been a trigger for the species to fruit abundantly now. It will be interesting to see if this behaviour continues and for how long.

Acknowledgements

The authors wish to thank Dr Tom May of the Royal Botanic Gardens, Melbourne, for reviewing the manuscript and offering constructive comments that improved the final draft.

References

ALA (2020). Atlas of Living Australia *Buchwaldoboletus.* Accessed online 4 April 2020.

Bessette, A.E., Roody, W.C. & Bessette, A.R. (2000). *North American Boletes. A Color Guide to the Fleshy Pore Mushrooms*. Syracuse University Press.

Gilbert, J.M. & Miller, L.W. (1952). An outbreak of *Sirex noctilio* F. in Tasmania. *Australian Forestry* 62: 63–69.

Kallio, P. & Heikkilä, H. (1978). The boletes of Finland 1. Genus *Boletus. Karstenia* 18: 1–19.

Landcare Research (2020). *New Zealand Fungi*. Accessed online 4 April 2020.

Nabe, M. & Nagasawa, E. (2017). The occurrence and distribution of *Buchwaldoboletus sphaerocephalus* in Japan. *Reports of the Tottori Mycological Institute* 47: 16–23.

Online Auction Colour Chart (2004). *The Online Auction Colour Chart Company.*

Ortiz-Santana, B. & Both, E.E. (2011). A preliminary survey of the genus *Buchwaldoboletus*. *Bulletin of the Buffalo Society of Natural Sciences* 40: 1–14.

Pilát, A. (1969). *Buchwaldoboletus* genus novum Boletacearum. *Friesia* 9: 217–218.

Rinaldi, A.C., Comandini, O. & Kuyper, T.W. (2008). Ectomycorrhizal fungal diversity: separating the wheat from the chaff. *Fungal Diversity 33*: 1-45.

Singer, R. (1947). The Boletoidae of Florida. *The American Midland Naturalist* 37: 1–135.

Singer, R. (1961). Diagnoses Fungorum novorum Agaricalium II. *Sydowia* 15: 45–83.

Watling, R. (2004). New combinations of *Boletaceae* and *Gomphidiaceae* (*Boletales*). *Edinburgh Journal of Botany* 61: 41–47.

Watling, R. & Gregory, N.A. (1988). Observations on the boletes of the Cooloola Sandmass, Queensland and notes on their distribution in Australia. Part 2B: Smooth spored taxa of the Family Gyrodontaceae and the Genus *Pulveroboletus*. *Proceedings of the Royal Society of Queensland* 99: 65–76.

Watling, R. & Li, T.H. (1999). *Australian Boletes. A preliminary survey*. Royal Botanic Garden, Edinburgh.

A new look for Tasmania's terrestrial amphipods (sandhoppers, beachfleas and landhoppers)

Alastair Richardson
Bookend Trust & Biological Sciences,
School of Natural Sciences, University of Tasmania,
Private Bag 5, Hobart 7001
alastair.richardson@utas.edu.au

The Rev. T. R. R. Stebbing, who wrote major works on the Amphipoda around the turn of the 19th century, had no illusions about their popular appeal: 'No panegyrist of the Amphipoda has yet been able to evoke anything like popular enthusiasm in their favour. To the generality of observers they are only not repelled because the glance which falls upon them is unarrested, ignores them, is unconscious of their presence' (Stebbing 1899). While the readership of *The Tasmanian Naturalist* might not be quite so unmoved, there's no doubt that freshwater and terrestrial crustaceans do not figure as highly in the invertebrate natural history stakes as the insects. Most Tasmanian naturalists are aware of freshwater crayfish, and land slaters (woodlice, roly-polies, tiggy-hogs, parson's pigs, grammersows …) are generally recognised (if only the introduced European species). But terrestrial amphipods, or landhoppers (Plate 1), move off so quickly from under that flowerpot in the garden, or in forest leaf litter, that there's little opportunity to observe them closely, or take a photograph, and so their public profile remains sadly low.

Plate 1. *Mysticotalitrus tasmaniae*, a common landhopper from wet sclerophyll forest in southern Tasmania.

Photograph: Maria Moore).

Plate 2. *Hermesorchestia alastairi*, an unusual sandhopper found at the very highest levels of sandy beaches from South Bruny to Three Hummock Island. The enlarged flanges on the back legs of mature males are only found in a few sandhopper species. Their function is unknown.

And yet landhoppers, and their seashore relatives the sandhoppers and beachfleas, are ecologically important, and they have a fascinating story to tell about how a group of fundamentally marine animals made the move onto land. For a relatively large (up to 10–12 mm long) member of the forest leaf-litter fauna, landhoppers can be remarkably abundant: up to 10,000 have been recorded in a square metre of litter in wet gullies in Tasmania's east coast forests (Friend & Richardson 1986). Their impact on leaf litter breakdown is significant, as is the same role played by sandhoppers in breaking down kelp accumulations on beaches. For all that, terrestrial amphipods have also been largely ignored by zoologists, certainly in comparison to the attention given to their fully marine and freshwater relatives.

Aquatic marine amphipods have been called 'the insects of the sea' because of their diversity, especially in and around kelp and seaweed beds, and they have been well-studied. They range from deep sea (where the largest species are found, exceeding 30 cm in length: Barnard & Ingram 1986), through pelagic habitats, to the coastal zone, where they are common in rock pools at the very edge of the sea. It's likely that an ancestor from something like the modern family Hyalidae made the first transition onto land in saltmarshes or mangroves on the shores of east Gondwana sometime during the Jurassic. From there they colonised wet forests and grasslands, and probably moved back towards the sea as sandhoppers, which needed special adaptations for life in and on sand.

Tasmania has a diverse fauna of terrestrial amphipods. Landhoppers can be found in all but the driest forests, living in leaf litter on the ground, or even in moss and litter perched in trees. One landhopper, *Albidiator albidus*, has become a burrower, living in clay soils under rainforest (Friend 1987). The lifestyles of terrestrial amphipods can be divided into those that are 'substrate-modifying' or 'non–substrate-modifying', i.e. whether they are adapted for digging into soil or sand, or whether they just push their way under leaf litter or seaweed without burrowing (Bousfield 1982). Burrowing requires special adaptations, so sandhoppers are readily recognisable by their relatively large size, robust bodies and spiny appendages. The mature males of one Tasmanian sandhopper, *Hermesorchestia alastairi*, from the highest levels of sandy beaches in the south and west have large wing-like appendages on their rear legs (Plate 2). Their function is unknown, but they may be involved in holding the female while mating in a sand burrow.

A very small number of landhoppers and sandhoppers were recognised and described by Australian zoologists in the 19th and early 20th centuries, but the first thorough examination of Tasmanian landhoppers was by Tony Friend, who in 1987 added 13 new species to the two previously described. The sandhoppers and beachfleas have had to wait longer; apart from three species described in the 1990s (Richardson 1993, 1996) only one new Tasmanian species has been described this century (Hughes et al. 2017), despite a recognised diversity. There are probably a few more Tasmanian landhoppers awaiting

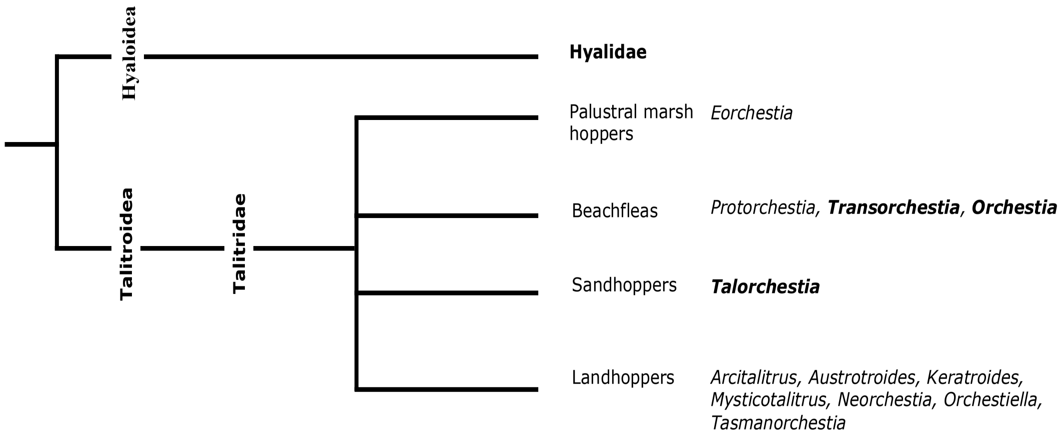


Figure 1. The classification of the higher groups of terrestrial amphipods as understood in the early 2000s, showing the genera found in Tasmania. Genera in bold are found in the Northern Hemisphere.

description, and two papers by Lauren Hughes (Natural History Museum, London) describing new sandhoppers and beachfleas will be published in 2021.

As well as simply naming and describing new species, there is the problem of what genus to place them in. The earliest landhoppers and sandhoppers were placed in genera created to contain European species, rather in the same way that Australian birds were given common names that belonged to completely unrelated Northern Hemisphere species. So Australian landhoppers found themselves in the same genus as completely different sandhoppers from Atlantic shores.

The same problem arises with any higher-level arrangements. All the species we've been talking about were originally placed in the Family Talitridae, but it has been clear for some time that within the family there are groupings of species with different lifestyles. The late Ed Bousfield, a Canadian amphipodologist, suggested four what he called 'eco-morphological' groups, i.e. species grouped together because they have similar lifestyles and similar body forms (Bousfield 1984). There were a) the palustrals, or marsh hoppers living in saltmarshes and mangroves, b) the beachfleas, non–substrate-modifying species living on various types of seashore, c) the sandhoppers, confined to sandy beaches and strongly adapted for digging, and d) the landhoppers, living in fully terrestrial habitats.

Ideally, we would like such groupings to reflect the evolutionary relationships between the species, but just because animals look like each other does not necessarily mean that they are related. This is because when animals live in similar habitats and face similar challenges, natural selection tends to produce similar answers, such as the well-known convergence between the thylacine and the completely unrelated coyote. In the same way there is at least one Tasmanian beachflea that has colonised sandy beaches and acquired many of the characteristics of a sandhopper. Convergences like these present great problems for zoologists trying to work out which characteristics are recent adaptations to their environment, and which indicate their ancestral relationships.

To unpick this tangle requires a lot of data from a lot of species and a very careful analysis to work out which characters are useful to indicate relationships. After a career doing just that with a huge range of amphipods from all over the world, Jim Lowry (now retired from the Australian Museum) and his colleague Allan Myers from the University of Cork in Ireland have recently published a new arrangement or classification of the terrestrial amphipods that overturns what little understanding we used to have and gives us a new model to work on (Myers & Lowry 2020). Figure 1 shows the previous picture: the super-family Talitroidea with a single family, Talitridae, and within it, the four eco-morphological groupings of genera. Figure 2 is the new Myers and Lowry classification, which has much more structure! The first thing to notice is that Talitroidea is split into two 'epi-families',

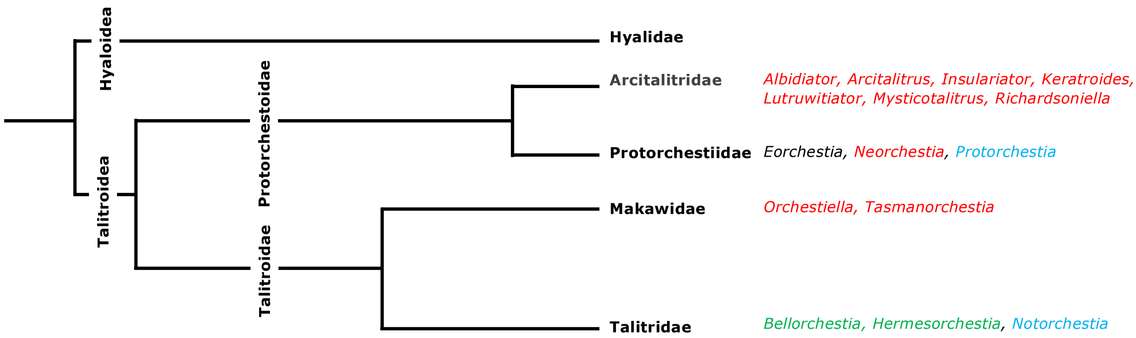


Figure 2. The classification of Tasmanian terrestrial amphipods as proposed by Myers & Lowry (2020). The genera are coloured by their eco-morphological groupings (Bousfield 1982): black: palustral marsh hoppers, blue: beachfleas, green: sandhoppers, red: landhoppers.

Talitroidae and Protorchestoidae, and landhoppers are found in both of these. Each of the epi-families has two families; the Protorchestiidae includes marsh hoppers, beachfleas and *Neorchestia*, a genus of landhopper, while the majority of the landhopper genera are placed in the Arcitalitridae. On the other branch, the Talitroidae has two families: the Talitridae with all the sandhoppers and one beachflea genus, and the Makawidae with two landhopper genera. So, Ed Bousfield's eco-morphological groups are not sets of closely related species, but rather they show what natural selection can do to any ancestral stock that has to adapt to a particular set of conditions. Table 1 is a checklist of all 23 talitroideans now known from Tasmania; note that the number of talitrids is likely to increase with the publication of Lauren Hughes's work in 2021.

All this may seem more than a bit academic, and it's important to stress that these arrangements are always hypotheses (as indeed are new species descriptions), i.e. they are suggestions put up to be tested, then rearranged or rejected if necessary. And you may already have thought that DNA-based techniques would be one way of bringing a different type of data to bear on the problem. It certainly would, but it will be no small task to collect together material from all the groups involved, since the Myers and Lowry study extends worldwide and includes many more groups than just the ones represented in Tasmania.

And it is perfectly legitimate to ask, why bother? What use is this sort of analysis and classification? I might retort that it's more directly relevant than a lot of astronomical research, but it's better to say that at a fundamental level we need to sort and classify everything, including life forms. And when we do this we find that Tasmania (and New Zealand) are hotspots of biodiversity in these animals, with a range of species from something like the earliest land colonisers to some of the most specialised forms. That means that we have on our doorstep the material to study how this group of animals adapted to terrestrial life. And what's more, in Tasmania we still have some intact coastal habitats where the marine to terrestrial transition supports a series of species occupying the steps from sea to land (e.g. at Lutregala Marsh at the Bruny Island Neck: Richardson & Mulcahy 1996). Although these species are not the actual evolving forms, they may give us clues about how the original colonisers lived at each stage.

That is just of academic interest, of course, but meanwhile the landhoppers, beachfleas and sandhoppers are busy chewing up leaves and kelp, providing yet another unsung ecological service. I think they deserve a little study.

Table 1. Checklist of talitroidean amphipods (sandhoppers, beachfleas and landhoppers) found in Tasmania, following Myers & Lowry (2020). Stars indicate the habitat and lifestyle: * landhopper, **marsh hopper, ***sandhopper (substrate-modifying), ****beachflea (non–substrate-modifying).

Superfamily Talitroidea Rafinesque, 1815
Epifamily Protorchestoidae Myers & Lowry, 2020

F. Arcitalitridae Myers & Lowry, 2020
- *Albidiator* Lowry & Myers, 2019a
  - *A. albidus** (Friend, 1987)
- *Arcitalitrus* Hurley, 1975
  - *A. bassianus** (Friend, 1987)
  - *A. sylvaticus** (Haswell, 1879)
- *Insulariator* Lowry & Myers, 2017
  - *I. cryptus** (Friend, 1987)
- *Keratroides* Hurley, 1975
  - *K. angulosus** (Friend, 1979)
  - *K. pyrensis** Friend, 1987
  - *K. rex** Friend, 1987
  - *K. vulgaris** (Friend, 1979)
- *Lutruwitiator* Lowry & Myers, 2019a
  - *L. longicornis** (Friend, 1987)
  - *L. leptomerus** (Friend 1987)
- *Mysticotalitrus* Hurley, 1975
  - *M. tasmaniae** (Ruffo, 1949)
- *Richardsoniella* Lowry, Myers & Nakano, 2019
  - *R. maritima** (Friend, 1987)

F. Protorchestiidae Myers & Lowry, 2020
- *Eorchestia* Bousfield, 1984
  - *E. palustris*** Richardson, 1993
  - *E. rupestris*** Richardson, 1993
- *Neorchestia* Friend, 1987
  - *N. plicibrancha** Friend 1987
- *Protorchestia* Bousfield, 1982
  - *P. lakei*** Richardson, 1996

Table 1 continued

Epifamily Talitroidae Rafinesque 1815
F. Makawidae
Orchestiella Friend, 1987
*O. neambulans** Friend, 1987
*O. quasimodo** Friend 1987
Tasmanorchestia Friend, 1987
*T. annulatus** Friend, 1987

F. Talitridae Rafinesque 1815
S-F. Talitrinae Rafinesque 1815
Bellorchestia Serejo & Lowry, 2008
*B. pravidactyla**** (Haswell, 1980)
Hermesorchestia Hughes & Lowry, 2017
*H. alastairi**** Hughes & Lowry, 2017
Notorchestia Serejo & Lowry, 2008
*Notorchestia australis***** (Fearn-Wannan, 1968)

Incertae sedis
Protaustrotroides Bousfield, 1984
*P. victoriae** Bousfield, 1984

References

Barnard, J.L. & Ingram, C.L. (1986). The supergiant amphipod *Alicella gigantea* Chevreux from the North Pacific Gyre. *Journal of Crustacean Biology* 6, 825–839.

Bousfield, E.L. (1982). The amphipod superfamily Talitroidea in the Northeastern Pacific region. 1. Family Talitridae: systematics and distributional ecology. National Museums of Natural Science, Ottawa, Publications in Biological Oceanography 11, 1–73.

Bousfield, E.L. (1984). Recent advances in the systematics and biogeography of landhoppers (Amphipoda: Talitridae) of the Indo-Pacific region. In: *Biogeography of the Tropical Pacific*. Eds. F.J. Radovsky, P.H. Raven & S.H. Sohmer. Honolulu, Association of Systematic Collections & the Bernice P. Bishop Museum. No. 72, 171–210.

Friend, J.A. (1987). The terrestrial Amphipods (Amphipoda: Talitridae) of Tasmania: systematics and zoogeography. Records of the Australian Museum, Supplement 7, 1–85.

Friend, J.A. & Richardson, A.M.M. (1986). The biology of terrestrial amphipods. *Annual Review of Entomology* 31, 25–48.

Hughes, L.E. & Lowry, J. (2017). *Hermesorchestia alastairi gen. et sp. nov.* from Australia (Talitridae: Senticaudata: Amphipoda: Crustacea). *Zootaxa* 4311(4), 491–506.

Myers, A.A. & Lowry, J. (2020). A phylogeny and classification of the Talitroidea (Amphipoda, Senticaudata) based on interpretation of morphological synapomorphies and homoplasies. *Zootaxa* 4778(2), 281–310.

Richardson, A.M.M. (1993). Tasmanian intertidal Talitridae (Crustacea: Amphipoda). Palustral talitrids: two new species of *Eorchestia* Bousfield 1984. *Journal of Natural History* 27, 267–284.

Richardson, A.M.M. (1996). *Protorchestia lakei,* new species (Amphipoda: Talitridae) from Maatsuyker Island, Tasmania, with a key to the genus and notes on the diversity of Tasmanian Talitridae. *Journal of Crustacean Biology* 16(3), 574–583.

Richardson, A.M.M. & Mulcahy, M.E. (1996). The distribution of talitrid amphipods (Crustacea) on a saltmarsh in southern Tasmania, in relation to vegetation and substrate. *Estuarine, Coastal and Shelf Science* 43, 801-817.

Stebbing, T.R.R. (1899). Amphipoda from the Copenhagen Museum and other sources. Part II. *Transactions of the Linnean Society of London (Series 2), Zoology* 7, 395-342.

Two fireweeds back from the dead: the rediscovery of *Senecio longipilus* and *Senecio extensus* from the Tasmanian Central Highlands

Mark Wapstra[1], Grant Daniels[2] & Richard White[2]

*[1] Environmental Consulting Options Tasmania,
28 Suncrest Avenue, Lenah Valley, Tasmania 7008
Email: mark@ecotas.com.au
[2] North Barker Ecosystem Services, Hobart, Tasmania 7000*

Abstract

Senecio longipilus I.Thomps. and *Senecio extensus* I.Thomps. have been rediscovered from the Tasmanian Central Highlands in late December 2019 and early January 2020, respectively. Within Tasmania, *Senecio longipilus* was previously known only from a collection near Perth on the South Esk River (mid to late 1800s) and near Kingston in 1929, and *Senecio extensus* only from a single collection at Mackenzie Tiers from 1984. Both species were immediately nominated for listing on the Tasmanian *Threatened Species Protection Act 1995* (both previously unlisted).

Introduction

In the early to mid-2000s, a series of taxonomic papers reviewing Australian *Senecio* were produced (e.g. see Thompson 2006, 2015 and references therein). This resulted in the recognition of thirty-seven native taxa (including infraspecific taxa) and four exotic taxa in Tasmania (de Salas & Baker 2019), which is significantly more than the eighteen recognised in *The Student's Flora of Tasmania* (Curtis 1963). In response to the considerable taxonomic and nomenclatural changes, a State-based key was developed (Wapstra et al. 2008). This key included notes on several poorly-known species, several of which have been the subject of specific papers including *Senecio psilocarpus* (Wapstra 2010a), *Senecio georgianus* (Wapstra 2010b), *Senecio campylocarpus* (Wapstra 2011) and *Senecio velleioides* (Wapstra 2012). The first three of these species are now listed as threatened on the Tasmanian *Threatened Species Protection Act 1995*, and the latter species now delisted.

This paper continues the review of Tasmanian *Senecio*, reporting on the collecting history and re-discovery of two more of the poorly known and presumed extinct species.

Senecio longipilus

Senecio longipilus (Plates 1-3) was described as part of the suite of disciform species (Thompson 2004). At the time of description, its distribution was described as "occurs in far south-eastern New South Wales in the Kiandra area, and in northern Tasmania near Perth" and its habitat as "sand or loam soils in grassland, herbfields, shrubland and woodland, mostly at elevations over 1000 m but sometimes lowland". The only cited Tasmanian specimen was "near Perth, South Esk R., *R.C. Gunn 767* (MEL)".

Plate 1. Flowering and seeding heads of *Senecio longipilus*

Plate 2. Root system of *Senecio longipilus* showing the obscure taproot and fleshy secondary roots and ascending branches.

Plate 3. Mature achenes of *Senecio longipilus*

In late 2019 as part of ecological surveys in the St Patricks Plains area, an unusual *Senecio* was collected and identified as *Senecio longipilus*. This prompted further surveys in early 2020, resulting in further patches being discovered. The habitat is herb-rich native grassland on Tertiary basalt at about 850-900 m a.s.l. with extensive regolith and small outcrops of basalt, with which the species appears to be locally associated (Plates 4 & 5).

Senecio longipilus is one of the more distinctive disciform species in Tasmania. It has an erect to ascending habit (Plate 2) and is strongly fragrant, but not malodorous. The stems are densely coarse-hairy, sometimes with a cottony overlay, with indumentum density reducing upwards, and becoming predominantly appressed-cobwebby near the summit. The specific epithet and the vernacular name of "longhair fireweed" relate to the coarse hairs that are present on stems, leaves and bracts.

The rediscovery of the species prompted database searches and it is now known that the species is represented in Tasmania by just two previous collections. The earliest collection is represented by two collections held at MEL, both now attributed to C. Stuart without a date but allocated to collecting number "767", which is one of the Ronald Campbell Gunn collecting series (Buchanan 1988). Thompson (2004) gave the location as "near Perth, South Esk River" and attributed the collection to R.C. Gunn 767. Information from the *Atlas of Living Australia* indicates that MEL 0022534A & MEL 0022535A are likely duplicates, collected by Stuart and added to Gunn's herbarium. MEL 0022534A is labelled "Woodhall", which is a property on the eastern side of the South Esk River, about 3.75 km upstream of the current bridge over the South Esk River at Perth. The later collection (CANB 8429.1) post-dates the work of Thompson (2004) and is attributed to Leonard Rodway on 20 October 1929, labelled "Kingston". Both collections were strongly suggestive of a lowland occurrence in Tasmania, possibly from poorly-drained sites associated with the larger river systems.

As a consequence of the rediscovery, the species was nominated for listing on the Tasmanian *Threatened Species Protection Act 1995*. It was only previously informally presumed extinct, although not specifically noted as such in de Salas & Baker (2019 and previous versions of *A Census of the Vascular Plants of Tasmania, including Macquarie Island*) because the Tasmanian Herbarium held no collections. This has now been rectified.

Plate 4. Native grassland on basalt habitat of *Senecio longipilus* (circled) .

Plate 5. *Senecio longipilus* habitat within shrubby grassland associated with basalt outcrops .

A map of the novel sites of *Senecio longipilus* is not provided to maintain privacy and security for the private property. However, readers are alerted to the description of potential habitat, which is widespread across central Tasmania, meaning the possibility of detecting further populations must not be discounted.

Senecio extensus

Like *Senecio longipilus*, *Senecio extensus* (Plates 6 & 7) was described as part of the suite of disciform species (Thompson 2004). At the time of description, its distribution was described as "occurs in south-eastern Australia from Kiandra in far south-eastern New South Wales south-west to Howitt Plains in eastern Victoria with a disjunct occurrence in north-eastern New South Wales at Barrington Tops (Tasmania was not mentioned but a specimen was cited)" and its habitat as "grasslands/herbfields or open shrublands in subalpine areas". The only cited Tasmanian specimen was "Mackenzies Tier, *A. Moscal 6394,* 22.ii.1984 (HO)".

Plate 6. Native grassland on basalt habitat of *Senecio longipilus* (circled)

As a result of the late December 2019 rediscovery of *Senecio longipilus* in the Central Highlands, a targeted expedition to Mackenzies Tier was undertaken by two of us (MW, GD), to rediscover *Senecio extensus*. Armed with a ± 100 m grid reference translated from an original 1:100,000 Tasmap (pre-GPS

Plate 7. Left: Flowering head of *Senecio extensus* showing the dark-tipped calycular bracteoles (circled, left middle and bottom right) and the dark-tipped phyllaries (circled, top right); Middle: Flowering head showing phyllaries and pappus; Right: Rhizomatous growth habit.

days), and a good habitat description (because Tony Moscal's collections are usually well-annotated), we tracked across Top Marshes, finding our target almost immediately in habitat that nearly matched the original description i.e. Restionaceae- and herb-rich grassland-sedgeland-rushland (Plate 8). Crossing through a band of unsuitable *Eucalyptus coccifera* forest on dolerite, we emerged into another swathe of suitable habitat. Probably within metres of the nominal location of the 1984 collection, we found a small patch of infertile plants. The habitat (Plate 9) matched Moscal's precisely: "within sward of *Astelia alpina*, grass, sedge plain, *Restio australis*, *Poa labillardierei*, *Lepidosperma filiforme*, *Calorophus lateriflorus*, *Epacris gunnii*, *E. lanuginosa*, *Carpha alpina*". We searched another few kilometres of superficially similar habitat with no success.

Senecio extensus is recognisable by a combination of features, including its rhizomatous growth habit and relatively long calycular bracteoles (Plate 7), although these are less extended in Tasmanian material than mainland Australian material (Thompson 2004). It co-occurs with *Senecio gunnii*, which has a different growth habit and leaf morphology/indumentum. It resembles *Senecio glomeratus*; however, the latter differs in being erect, strongly tap-rooted, with shorter capitula and hairy achenes.

Now known from two patches and perhaps 50-150 individuals over about 0.5 ha (whole extent not surveyed as yet), *Senecio extensus* has also been nominated for listing on the Tasmanian *Threatened Species Protection Act 1995*. Voucher specimens were provided to the Tasmanian Herbarium.

A map of the locations is not provided because the species occurs partly on private land and partly within a reserve. The land tenure was not known to us at the time of survey, an oversight on our part.

Plate 8. Habitat of *Senecio extensus* at the novel site at the southeastern edge of Top Marshes.

Plate 9. Habitat of *Senecio extensus* at the putative original site of collection on Mackenzies Tier, where the species was confirmed in Jan. 2020.

Discussion

With the rediscovery of *Senecio longipilus* and *Senecio extensus* from central Tasmania, two more species are saved the ignominy of being added to the list of presumed extinct species. In the case of *Senecio longipilus*, the missing period was 90 years (1929 to 2019), previously much longer (Stuart probably collected the "Woodhall" specimen in the mid-1840s). However, it is clear that it was always there to be rediscovered, providing optimism that it is more widespread. In the case of *Senecio extensus*, the missing period was only 36 years but had we not gone on a special expedition to rediscover the species, it may have reached the dreaded 50 years of not being seen in the wild and becoming presumed extinct. Again, however, the species was there to be rediscovered, in its case perhaps not more than tens of metres from the original site.

Wapstra et al. (2008) were circumspect about immediate listing of the then suite of new or redescribed, and hence poorly-known, *Senecio* species, suggesting familiarity and further surveys may result in rediscoveries. However, over a decade has passed since the State-based key was made available and extensive surveys of much new ground has been undertaken for large-scale projects such as wind farms and irrigations schemes, often including much speculatively "good" potential habitat of these species. Fortunately, in recent times, several other presumed extinct species have "risen from the dead" (e.g. Bonham 2008; Wapstra et al. 2006) and this provides some hope that other long-lost *Senecio* species may be added to this list. These species include *Senecio georgianus* and *Senecio macrocarpus* (both listed as presumed extinct on the Tasmanian *Threatened Species Protection Act 1995*) and *Senecio tasmanicus*, an endemic species known from just one collection (Thompson 2004) and recently nominated for addition to the Tasmanian *Threatened Species Protection Act 1995*.

Acknowledgements

Ian Thompson kindly received specimens and confirmed identifications. Private landowners provided permission to enter land at St Patricks Plains.

References

Bonham, K. (2008). Rediscovery of *Corunastylis nudiscapa* (Hook.f.) D.L.Jones & M.A.Clem. in Tasmania. *The Tasmanian Naturalist* 130: 100–102

Buchanan, A.M. (1988). *The Tasmanian Collecting Localities of Ronald Gunn & Joseph Milligan*. Tasmanian Herbarium Occasional Publication No. 1. Tasmanian Herbarium, Hobart.

de Salas, M.F. & Baker, M.L. (2019). *A Census of the Vascular Plants of Tasmania, including Macquarie Island*. Tasmanian Herbarium, Tasmanian Museum and Art Gallery. Hobart.

Thompson, I.R. (2004). Taxonomic studies of Australian *Senecio* (Asteraceae): 1. the disciform species. *Muelleria* 19: 101–214.

Thompson, I.R. (2006). A taxonomic treatment of tribe Senecioneae (Asteraceae) in Australia. *Muelleria* 24: 51–110.

Thompson, I.R. (2015). *Senecio*. IN: *Flora of Australia* (Ed. A.J.G. Wilson): 37: 209-211.

Wapstra, M. (2012). Comments on the conservation status of *Senecio velleioides* (forest groundsel) in Tasmania. *The Tasmanian Naturalist* 134: 27–31.

Wapstra, M. (2011). Collecting history, distribution, habitat and conservation status of *Senecio campylocarpus* (bulging fireweed) in Tasmania. *The Tasmanian Naturalist* 133: 68–73.

Wapstra, M. (2010a). Collection history of *Senecio psilocarpus* (swamp fireweed) in Tasmania. *The Tasmanian Naturalist* 132: 2–8.

Wapstra, M. (2010b). The status of *Senecio georgianus* (grey fireweed) in Tasmania. *The Tasmanian Naturalist* 132: 9–14.

Wapstra, M., Duncan, F., Buchanan, A. & Schahinger, R. (2006). Finding a botanical Lazarus: tales of Tasmanian plant species 'risen from the dead'. *The Tasmanian Naturalist* 128: 61–85.

Wapstra, M., Thompson, I.R. & Buchanan, A.M. (2008). An illustrated and annotated key to the Tasmanian species of *Senecio* and allied taxa (Asteraceae). *Kanunnah* 3: 49–90.

Sap flow feeding by adult golden stag beetles *Lamprima aurata* (Scarabaeoidea: Lucanidae) in northern Tasmania

Simon Fearn
Natural Sciences, Queen Victoria Museum and Art Gallery
PO Box 403, Launceston, Tasmania 7250
Simon.Fearn@launceston.tas.gov.au

Introduction

The feeding ecology of adult stag beetles (Lucanidae) is poorly understood for the majority of the >1400 described species. The best known are larger species of European, North American and Asian genera (*Lucanus*, *Aegus*, *Cyclommatus*, *Dorcus*, *Hexarthrius*, *Odontolabis*, *Prosopocoilus*) that have been recorded gathering at sap flows on damaged tree trunks as well as rotting fruit on the forest floor (Bosuang et al. 2017; Eunjoong et al. 2017; Fremlin & Hendriks 2011; Kawano 2003; Okada et al. 2008; Padmamabhan & Chaudhury 1989; Ulyshen et al. 2017). In South America sapflow feeding has been documented in *Chiasognathus* (Paulsen & Smith 2010) and *Leptinopterus* (Julio 2010), and in Africa, in *Homoderus* (Bouchard 2014).

Adult trophic ecology of the 95 species of Australian Lucanidae is mostly unknown (Hangay & De Keyzer 2017). Like its Asian relatives, the north Queensland *Prosopocoilus torresensis* has been recorded gathering at sap flows on trees (J. Hasenpusch in Hangay & De Keyzer 2017). Both *Cacostomus squamosus* and *Phalacrognathus muelleri* have been recorded feeding on tree sap flows and blossom (Hangay & De Keyzer 2017) and the tropical *Dorcus wickhami* has been recorded coming to overripe mangoes to feed (J. Hasenpusch in Hangay & De Keyzer 2017). For many species, the lifespan of adults in the wild is unknown and hence, whether feeding occurs at all. For example, there are no field records of adult feeding for the 29 species of *Lissotes*, many of which are endemic to Tasmania. However, Richards & Spencer (2018) record captive *L. obtusatus* feeding on a ripe strawberry and burrowing into a carrot, and Hangay & De Keyzer (2017) document captive *L. darlingtoni* eating ripe nectarine.

The most comprehensive knowledge of the trophic ecology of an adult Australian lucanid is for the golden stag beetle *Lamprima aurata* (Latreille, 1817), specifically Tasmanian populations. Male *L. aurata* use their mandibles to cut vegetation, primarily shoot tips, to stimulate sap flow. This sap flow appears to attract females, and mating pairs will remain feeding at one severed shoot tip for up to a week. Males guard cut shoot tips and guard the attendant females from rival males and, if evenly matched, combat bouts will occur (Fearn 1996, 2016). Sexual aggregations and feeding of adult *L. aurata* in Tasmania have been recorded on four species of *Eucalyptus* (*E. viminalis*, *E. globulus*, *E. ovata*, *E. regnans*), drooping she-oak (*Allocasuarina verticillata*), coast everlasting (*Ozothamnus turbinatus*), native vine (*Clematis decipiens*), ornamental redleaf photinia (*Photinia* sp.), apricot (*Prunus armeniaca*) and the native grass (*Lomandra longifolia*)

Plate 1. Small sapling of *Acacia sophorae* growing in coastal scrub on which adult *Lamprima aurata* were feeding on sap flows. (Photograph: S. Fearn)

(Fearn 1996, 2015, 2016, 2017; Fearn & Maynard 2018). Mainland populations of adult *L. aurata* have been recorded feeding on *Eucalyptus*, *Acacia*, *Allocasuarina* and *Melaleuca* but precise host species and method of feeding are rarely documented (Hangay & De Keyzer 2017). The closely related New Guinea species, *L. adolphinae*, feeds in a similar manner to Tasmanian *L. aurata* on unidentified low, weedy shrubs that grow in profusion after burning in traditional slash-and-burn rainforest gardens (Suzuki 1995).

No *Lamprima* species have ever been recorded gathering at and feeding on naturally occurring sap flows from the stems of plants and trees, as opposed to sap flows created by a male.

This work documents the first record of *L. aurata* feeding and mating at a natural sap flow on the stem of a coast wattle or boobialla, *Acacia sophorae*.

Field observations

On 27 December 2019 at the Bridport Wildflower Reserve (GDA 94: 0532461mE, 5462872mN) in north-east Tasmania, three adult *L. aurata* were observed on the stems of a small sapling of *A. sophorae* approximately 1.2m in height growing beside a walking track (Plate 1). Initially, an adult male and female were observed *in copulo* on a sap flow among the upper twigs (Plate 2), and a lone male on a smaller sap flow was observed on a limb closer to the ground. All three were collected as vouchers and lodged in the entomology collections of the Queen Victoria

Plate 2. Adult male (upper) and female *Lamprima aurata* mating at site of sap flow on the stem of *Acacia sophorae*. Female is imbibing sap in this image. (Photograph: S. Fearn)

Museum and Art Gallery (QVMAG) (QVM.2020.12.0001-0003). The sap flows had also attracted unidentified ants and jack-jumper ants (*Myrmecia pilosula*) (Plate 2), but the activity of these insects did not appear to disturb the *L. aurata*, the female of which was actively imbibing the sap when initially observed. After the beetles were collected, the stem was examined and there was no sign of mechanical damage consistent with the mandibles of *L. aurata* and the source of the flow was not obvious to the naked eye.

Discussion

The flexible and apparently opportunistic nature of Tasmanian adult *L. aurata* trophic ecology has been previously documented (Fearn 2017). Sap flows are commonly observed on trunks and stems of a wide range of trees and shrubs in Tasmanian bushland and this food source may be utilised by local Lucanidae more often than is currently recognised. Feeding at sap flows appears to be a common strategy for the larger, longerlived Lucanidae the world over (See citations in Introduction). Beetles are not only attracted to sap flows but some species are known to actively attack the bark of trunks and stems of host trees with their mandibles to promote sap flows (Eunjoong et al. 2017; Okada et al. 2008; Padmanabhan & Chaudhury 1989).

Tasmania is home to 33 recognised species of Lucanidae in 5 genera (Maynard et al. 2019). Only the adult food habits of *L. aurata* are known in detail. Some species appear to be shortlived and may not feed at all, such as the nocturnally active *Syndesus cornutus* which emerges *en masse* over a few warm, moonless nights in late summer but is not seen at any other time (S. Fearn and D. Maynard unpublished data). The endemic, brachypterous *Hoplogonus* and *Lissotes* spp. appear to be able to live for more than a year both in captivity and the field (Richards & Spencer 2018), which strongly suggests that they must be feeding on something. As most of these species are mainly nocturnal, cryptic in habits and relatively small, it is perhaps not surprising that field observations of adult feeding have not been documented. The propensity for these species to eat ripe fruit in captivity (Richards & Spencer 2018; Hangay & De Keyzer 2017) indicates that sugar-rich, sappy exudates on the lower trunks of trees and shrubs may be exploited. Both *Lissotes obtusatus* and *L. launcestoni* have been collected diurnally climbing on living and dead trees and, in addition, both these species have been collected under exfoliating bark on living *Eucalyptus viminalis* and *E. ovata* at several locations in northern Tasmania (S. Fearn and D. Maynard unpublished data). Both these eucalypts commonly display sap flows from insect and other damage.

In conclusion, the mandibles of *L. aurata* are ideally suited to snipping off the relatively soft terminal shoots of favoured host trees and shrubs but there is no indication that they actively attack the bark of woodier stems to initiate sap flow. It is also interesting to note that in 40 years of entomological field work in coastal Tasmania, including hundreds of hours collecting off *Acacia sophorae*, the author has never observed *L. aurata* to feed on this common shrub in the normal way, that is by cutting shoot tips to initiate sap flow. Until the observations recorded above, the only other instance of *L. aurata* feeding on plant exudates other than from male-cut shoot tips was for a mating pair (deposited in the entomology collection of the Queen Victoria Museum and Art Gallery (QVM:2020:12:0004)) collected by the author deep inside a dense inflorescence of the small native tree *Bursaria spinosa*. These specimens appeared to be feeding on nectar.

The observations in this work show that *L. aurata* is capable of detecting and exploiting a sap flow not initiated by the beetle itself.

Acknowledgements

Thanks to the zoology editor of *The Tasmanian Naturalist* and David Maynard (QVMAG) for reviewing the manuscript. Specimens of *Lamprima* were collected under Department of Primary Industries, Parks, Water and Environment (DPIPWE) Permit Authority FA 19158.

References

Bouchard, P. (Ed.) (2014). *TheBbook of Beetles: a Life-sizeGguide to Six Hundred of Nature's Gems*. Ivy Press, UK.

Bosuang, S., Chung, A.Y.C. and Chan, C.L. (2017). *A Guide to Beetles of Borneo*. Natural History Publications (Borneo), Sabah, Malaysia.

Eunjoong, K., Park, J. and Park, J.K. (2017). Taxonomic study on the subspecies of *Cyclommatus metallifer* (Boisduval, 1835) from Indonesia (Coleoptera: Lucanidae). *Journal of Asia-Pacific Biodiversity* 10(4): 519–526.

Fearn, S. (1996). Observations on the life history and habits of the green and gold stag beetle *Lamprima aurata* Latreille (Scarabaeoidea: Lucanidae) in Tasmania. *Australian Entomologist* 23(4): 133–138.

Fearn, S. (2015). A new adult host tree record for the green and gold stag beetle *Lamprima aurata* (Scarabaeoidea: Lucanidae) in Tasmania. *The Tasmanian Naturalist* 137: 2–4.

Fearn, S. (2016). New ecological and behavioural observations on the green and gold stag beetle *Lamprima aurata* (Scarabaeoidea: Lucanidae) in coastal Tasmania. *The Tasmanian Naturalist* 138: 53–57.

Fearn, S. (2017). Two novel adult food plants for the green and gold stag beetle *Lamprima aurata* (Scarabaeoidea: Lucanidae) in coastal Tasmania. *The Tasmanian Naturalist* 139: 74–78.

Fearn, S. & Maynard, D. (2018). A new eucalypt host plant and ecological notes for adult green and gold stag beetle *Lamprima aurata* (Scarabaeoidea: Lucanidae) in North West Tasmania. *The Tasmanian Naturalist* 140: 82–86.

Fremlin, M. & Hendriks, P. (2011). Sugaring for stag beetles – different feeding strategies of *Lucanus cervus* and *Dorcus paralellipipedus*. *Bulletin of the Amateur Entomologists Society* 70: 57–67.

Hangay, G. & De Keyzer, R. (2017). *A guide to stag beetles of Australia*. CSIRO Publishing, Victoria.

Julio, C.A. (2010). *Methods for catching beetles*. Naturalia Scientific Collection, Montevideo-Asuncion.

Kawano, K. (2003). Character displacement in stag beetles (Coleoptera: Lucanidae). *Annals of the Entomological Society of America* 96(4): 503–511.

Maynard, D., Fearn, S. & De Keyzer, R. (2019). Rediscovery of the endemic Tasmanian stag beetle *Lissotes crenatus* (Westwood, 1855) (Scarabaeoidea: Lucanidae: Lucaninae): collection history, distribution and ecological notes. *Record of the Queen Victoria Museum and Art Gallery* 119.

Okada, Y., Fugisawa, H., Kimura, Y. & Hasegawa, E. (2008). Morph-dependant form of asymmetry in mandibles of the stag beetle *Prosopocoilus inclinatus* (Coleoptera: Laucanidae). *Ecological Entomology* 33: 684–689.

Padmanabhan, S. & Chaudhury, R.G. (1989). The stag beetle *Prosopocoilus spencei* (Hope) (Lucanidae: Coleoptera) recorded as a pest of *Citrus*. *Indian Journal of Hill Farming* 2(1): 97–98.

Paulsen, M.J. & Smith, A.B.T. (2010). Revision of the genus *Chasiognathus* Stephens of southern South America with the description of new species (Coleoptera, Lucanidae, Lucaninae, Chiasognathini). *Zookeys* 43: 33–63.

Richards, K. & Spencer, C.P. (2018). Aspects of the biology and habits of the broad-toothed stag beetle, *Lissotes latidens* (Westwood, 1871) (Coleoptera: Lucanidae) an endemic Tasmanian species. *The Tasmanian Naturalist* 140: 98–106.

Suzuki, T. (1995). Some ecological notes of *Lamprima adolphinae* in Papua New Guinea. *Gekkan-Mushi* 288: 20–26.

Ulyshen, M.D., Zachos, L.G., Stireman, J.O., Sheehan, T.N. & Garrick, R.C. (2017). Insights into the ecology, genetics and distribution of *Lucanus elephus* Fabricius (Coleoptera: Lucanidae), North Americas giant stag beetle. *Insect Conservation and Diversity*. doi: 1111/icad.12229

Fieldwork of a bird illustrator in Tasmania

Joris De Raedt
Molenveldlaan 19
2650 Edegem
Belgium
info@jorisderaedt.com

Linde Muyshondt and I are a Belgian couple who are mainly interested in birding and freediving. We've picked a strange year to visit Australia. That's the least you could say!

We went from detouring to avoid bushfires to staying in lockdown for over three months on the east coast of Tasmania. While Linde looked for seasonal work here and there, I worked freelance as a scientific illustrator.

I aim to observe my subjects in their natural habitat as much as possible. Exploring new terrain and nature journalling along the way for me is one of the most important aspects of my work. If you want to capture the essence of a bird in a scientific painting, you need to be familiar with its characteristics and natural behaviour.

Here I share with readers of The Tasmanian Naturalist some of my journal entries on our Tasmanian travels and samples of my illustrations.

A garden full of birds

Linde found a job on Bruny Island, a chance we couldn't let pass as the island is a popular birding site and has good diving opportunities as well. The garden of the farmhouse itself was a great birding spot. Dusky Robins, Silvereyes and Yellow-rumped as well as Tasmanian Thornbills were among the many species to be seen. Swift Parrots in the evenings and a large group of noisy Yellow-tailed Black Cockatoos came to feed in the pines across the road. Thanks to some tips from Els Wakefield, whom we met in Hobart, we had great sightings of the Forty-spotted Pardalotes. On Linde's free days, we would often go to a different spot on the coast. When she was in the water I was making studies of the birds. Pacific Gulls are my favourite of all the gulls I've observed in the world so far. They are less like scavengers than any other gull I've seen and their huge bills and characteristic expression make them interesting to draw. At Cockle Creek we saw a bird hunting down a baby draughtboard shark in shallow water and eating it on the beach. The Pacific Gull illustrated was a moulting bird on Cloudy Bay.

A quarter of a year at Lisdillon

When COVID-19 restrictions were kicking in on Tasmania, we were preparing to do the Overland Track. As the South Coast Track was an unforgettable experience, we were keen for more. Unfortunately, all overnight tracks were closed a few days before we planned to head off. The camp site where we were staying was also going to shut down. Linde found an apple picking job where we could camp in the orchard. So off we went. This wasn't a very COVID-safe environment though. We started looking for places where we would be able to self-isolate for a while. The Lisdillon vineyard ended up being the perfect place! A huge private beach, good diving and, most important, lots of birds. A family of White-bellied Sea-Eagles was always around. We were able to observe them with the spotting scope from inside our little retreat. Cormorants, grebes, oystercatchers and the occasional Common Greenshank were also to be seen near the river. A short walk to the beach gave a great view onto Mitchells Reef. The dune on its base is a popular resting spot for plovers. About 45 Double-banded Plovers could be seen alongside Hooded Plovers and Red-capped Plovers. By the end of June many of the male plovers were already showing their beautiful summer plumage. It was very interesting to follow this on a daily basis. In total I recorded 54 species at Lisdillon, with a few additional dead species that were washed ashore. Among them were a Soft-plumaged Petrel, an Australian Gannet, a Little Penguin and a no longer identifiable albatross.

Feathers from up close

Sadly, we encountered a lot of roadkill while travelling through Tasmania. It's something we are used to from Belgium but therefore no less devastating to see. Near Southport a Superb Lyrebird sat in the middle of the road, still alive but with crushed toes. Freshly dead birds can still be of great value to a wildlife artist though. I would often make measured drawings and colour notes of the birds on the spot. Bills and toes especially tend to lose their colour, as you can see in museum specimens. I found several Noisy Miners on the A3. Near Orford a female Brown Goshawk was hit as well. I recently saw some actions passing through my Facebook feed from the Tasmanian Wildlife Forum to tackle these issues. Hopefully this will help!

Albatross encounters

The pelagic trips from Eaglehawk Neck, organised by Paul Brooks, were a dream come true. Many birders in the Northern Hemisphere fantasise to one day be able to join in on such an experience. So now was the time. Twice I joined a group of fellow bird enthusiasts to encounter these fascinating birds from close by. Struggling not to get sick (this didn't totally work the second time), sketching on the boat was not possible. I took lots of pictures instead and tried to separate out the different species. The more experienced birders on the vessel were often identifying by 'jizz', which will take a few more trips for me to learn. Making some studies afterwards did help to make it a bit easier the second time.

Australia's most endangered bird

Tackling the South Coast Track and observing the Orange-bellied Parrots in Melaleuca was definitely one of the highlights of our stay in Tasmania. Heading off with Par Avion we flew over Bruny Island and had a magical flight through the clouds before landing at Melaleuca. We had the chance to observe the parrots from different hides and witnessed how researchers carefully measured and banded some chicks. The hike to Cockle Creek was an epic experience. Magnificent scenery and birds like the Eastern Ground Parrot, Southern Emu-wren and Striated Fieldwren made it very much worth the effort!

The journey ahead

Planning your journey is always a good idea. These days, however, this is very challenging. The COVID-19 restrictions keep changing on a daily basis. We are heading back to Queensland, where I will be giving a workshop on sketching birds in the field. We will have a spot in Canberra along the way for another workshop on scientific illustration. That is if it can still go ahead. Later we hope to continue our travels around the mainland. Whether this will be possible remains to be seen.

See more illustrations and follow our journey on:

Website: *www.jorisderaedt.com*

Instagram: *@jorisderaedt* or *@li.go.explore*

Nature's undertakers: the insects that dispose of animal corpses in the Tasmanian bush

Simon Grove
Tasmanian Museum and Art Gallery Collections and Research Facility, 5 Winkleigh Place, Rosny, TAS 7018
simon.grove@tmag.tas.gov.au

A hundred and fifty years ago, the musical scores for *Danse macabre* were penned by French composer Camille Saint-Saëns. The piece was conceived to evoke a popular notion of the Romantic era, that death is the great social equaliser: no matter what your station in life, death comes to us all. It has since become the go-to classical music for film and radio producers, who employ it to signify, in a somewhat light-hearted way, how we are all eventually reduced to a pile of bones. But I have a bone to pick with this rather nihilistic view of death: had the philosophers and composers of the day considered what happens to our bodies *after* death, they might have had cause to change their tune. Because among the undertakers, efficiently seeing to the disposal of the deceased, a strict hierarchy prevails. Of course I'm talking insect undertakers here, rather than the berobed and behatted human variety. And while undertakers in our society are of impeccable character, their insect equivalents undertaking the disposal of deceased animals engage in rampant acts of necrophagy, cannibalism and predation. This is their story.

All flesh-and-bones animals must one day die. In Tasmania, many will become an instant meal for hungry predators – quolls, owls, falcons and so on. Others are 'predated' by cars and trucks and become roadkill, to be noisily fought over by Tasmanian devils or silently picked over by ravens and other scavengers. But for those who escape total consumption when death beckons, the insect undertakers come calling. How insects mete out the meat in their own slow-motion *danse macabre* is one of nature's abiding acts of orchestra.

Imagine, if you can bring yourself to, a happy, hoppy pademelon consumed by the age-old delusion that the grass is greener on the other side of the road. The only obstacles in her path are the strange, growling metallic predators with shining white eyes that stalk the barren strip of land in front of her. Half-way across the road, a moment of indecision and our pademelon shuffles off this mortal coil in a blur of bright headlights and screeching tyres, to be dumped unceremoniously in the ditch. Blood oozing from the nostrils is the only external sign of the massive trauma suffered by her internal organs. Her gut flora, liberated from its intestinal confines, immediately begins to rise to the challenge of life among a vast new source of fats and proteins, and by sunrise traces of the chemical by-products of their feeding begin to escape the corpse through its various orifices. A slight breeze carries the odours, indiscernible at this stage to the human nose, out into the surrounding bush.

Minutes later, the antennae of pregnant blowflies resting in the undergrowth up to a kilometre away start twitching; and as soon as the air is warm enough for flight, these first undertakers follow the trail of chemical breadcrumbs back to its source. Even as a blowfly heads upwind, her eggs are hatching internally, in their mother's ovisac. Once she lands on a carcass and finds the best spot for her offspring – that bleeding nostril, or maybe the anus – she deposits a batch of perhaps fifty live larvae, ejecting them in quick succession at a rate of one per second. The carcass is now officially fly-blown, and the tiny larvae tunnel into their new home and commence feeding. Fly larvae can't chew but they can drink, so they do best where the food is pre-liquidised, for instance by putrefying bacteria. Putrid flesh is so nutritious that the larvae can mature in under a week, at which stage they suddenly find the outside world strangely attractive as they wander off to pupate somewhere a bit more convivial than the inside of a dead pademelon. In warm conditions, adult flies may emerge only a week later.

Blowflies (family Calliphoridae) are classed as primary necrophages, literally consumers of corpses. In the undertaker hierarchy, they're the elite rapid-response team, and no doubt view fresh corpses as their birth-right. There are quite a few species in Tasmania, differing in their habitat, feeding preferences or reproductive strategies. Among the native species of *Calliphora*, three (*C. augur*, *C. maritima* and *C. nigrithorax*, Plate1) are ovoviviparous, laying fresh-hatched larvae as in the scenario described above; *C. maritima* has a predilection for feeding on beached carrion. Three further species, *C. fulvicoxa*, *C. hilli* and *C. stygia* (Plate 2), are oviparous (egg-layers). There is also the diminutive, metallic-green, oviparous *Chrysomyia rufifacies*, which favours larger carcasses and is not averse to infesting wounds on live animals. You could call these characters pre-emptive undertakers, making sure that the business of dealing with the corpse comes their way by getting things going at the 'not-quite-dead-yet' stage. Farmers call the condition fly-strike, while entomologists use the fancy term myiasis. These days, our natives have three loutish and belligerent blow-in blowfly competitors, all of them oviparous: blue-bottle *Calliphora vicina* (Plate 3), sheep blowfly *Lucilia cuprina*, and green-bottle *Lucilia sericata* (Plate 4).

Blowflies are unable to maintain an exclusive primary undertaking cartel, because there are members of other fly families that also like a nice piece of flesh,

Plate 1. *Calliphora nigrithorax*

Plate 2. *Calliphora stygia*

Plate 3. *Calliphora vicina*

and insist on job-sharing. Chief among these are the aptly named flesh-flies in the family Sarcophagidae, subfamily Sarcophaginae (the name means 'flesh-eater'). All are ovoviviparous. Though equally quick off the mark, their tastes are a little more catholic than blowflies, since they will also deposit their larvae in the dung of carnivores (and omnivorous humans). Our native species comprise *Oxysarcodexia varia*, *Tricharaea brevicornis* and three species of *Sarcophaga* (Plate 5): *S. assimilis* (a Tasmanian endemic), *S. impatiens* and *S. sigma*.

Both blowflies and flesh-flies conform well to the maxim 'first in, best dressed': they are the first to colonise a carcass, and they are surprisingly well dressed (for flies). Native *Calliphora* blowflies mostly sport golden hairs, sometimes extensively covering much of the body surface and sometimes just as crinkly tufts above the wing-bases; other blowflies are sparsely haired with metallic blue or green reflections; while flesh-flies have alternating streaks of black and white along the dorsal surface of the thorax, with the abdomen chequered in similarly contrasting tones.

Plate 4. *Lucilia sericata*

Plate 5. An unidentified species of *Sarcophaga*

In comparison, other flies colonising at this early stage in the proceedings are usually 'also-rans' and subordinate to the blowflies and flesh-flies, although in some situations they have the advantage. At least two locally occurring species of scuttle-fly (family Phoridae) specialise in carrion-feeding and, on account of their small size, can scuttle their way through small wounds and orifices to lay egg-batches in spots inaccessible to larger flies. The scuttle-fly genus *Megaselia* is one of the most speciose genera on the planet, with over sixteen hundred described species (ninety in Australia and counting). Thuggish in appearance, they are, in my opinion, the archetypal 'horrid phorids', but fascinating nonetheless in that within a single genus there are species that operate at every feasible trophic level: predators, parasitoids, kleptoparasites, decomposers and scavengers of various sorts. *Megaselia scalaris* is a cosmopolitan species sometimes known as the coffin-fly because of its ability to find its way through the smallest chink in a coffin to reach the cadaver within – even when the coffin is buried six feet under. *Sciadocera rufomaculata* is a better-looking fly, with oversized orange antennae and (in the male) a brownish spot on its wing apices; it, too, is primarily a carrion-feeder. It belongs to a relictual subfamily (Sciadocerinae) whose only other extant member is found in southern South America, though there are fossils known from Canadian amber. Meanwhile, in the house-fly family (Muscidae) we have a facultative carrion-feeder, the false stable-fly *Muscina stabulans*, a cosmopolitan species which is also associated with dung, dead slugs and other nutrient-rich decomposing matter. The lesser house-fly *Fannia canicularis*, in the allied family Fanniidae, has similar tastes, tendencies and distribution.

Our pademelon has now been 'resting' out in the elements for a week or two, and is performing well in its *post-mortem* role as a nursery for all these various flies. The stench of putrefaction is now evident even to the insensitive human nose; and this aspect, coupled with the fact that the pademelon's body now hosts a seething mass of maggots beneath its unnervingly rippling skin, will stop all but the most curious or strong-stomached of human observers in their tracks. But let's be curious and park our innate sense of revulsion, because it's worth witnessing this stage in the undertaking process. There's lots to see, even if one averts one's eyes from the writhing mess, because there are all sorts of flies occupying perches around the periphery. Some, like us, are merely curious bystanders; others are the first generation of carrion-feeders, freshly emerged from their puparia, or opportunistic predators thereof. Black carrion-flies *Australophyra rostrata* also appear at this time. These housefly relatives have arrived to lay their eggs among the carrion-feeding fly larvae. Their own larvae will feed amongst, and probably on, these carrion-feeders. There are also hordes of smaller, glossy-black flies with narrow waists, sitting around on nearby foliage, waving to one another with their black-tipped wings like animated flags. These are ensign-flies (family Sepsidae), most likely *Parapalaeosepsis plebeia* (Plate 6). The purpose of their signalling is not clear, but it's a fair bet that it has something to do with getting everyone in the mood for sex. Though they will breed in cow pats and other wet dung, a malodorous mass of carrion is even better, and acts like a megastimulus to all the ensign-flies in the vicinity to come on down and hang out together.

The European dronefly *Eristalis tenax* (Plate 7) is a species of hoverfly (family Syrphidae) that is at least an order of magnitude larger than these diminutive sepsids. When feeding innocently on nectar or pollen, it is readily mistaken for a honeybee; but its breeding habits are much darker, which is why it can be seen and heard buzzing around dead pademelons. These days its usual larval haunts are septic tanks, slurry pits and blocked drains; but in times past its principal food-source would have been large, putrifying carcasses. A pademelon is a bit small for it, because the dronefly's larva, known as a rat-tailed maggot, is really only competitive in deeper pools of anaerobic liquid nutrition, where its long 'rat-tail' snorkel enables it to keep drawing oxygen down from the air above. On the other hand a dead lion would be prime real estate, as Samson may have been eluding to in the biblical narrative in which he observes honey and bees in the carcass of the lion that he had earlier slain. If one strips the layers of allegory and myth from Samson's riddle, it's perhaps more likely that it was a reference to what the ancients considered to be a sure sign of spontaneous generation of life, when 'bees' were seen emerging from carcasses. In all likelihood, those

Plate 6: *Parapalaeosepsis plebeia*

Plate 7. *Eristalis tenax*

Plate 8. *Creophilus erythrocephalus*

Plate 9. An unidentified species of *Saprinus*

Plate 10. *Ptomaphila lacrymosa*, adult

bees were actually *Eristalis tenax*. This interpretation was probably lost on Abram Lyle, the Victorian-era inventor of golden syrup, who appropriated the biblical text 'Out of the strong came forth sweetness' as part of his company's trade-marked motif. Lyle's were the first company to 'brand' their product in this way. And, let's face it, how many other food products can boast an image of a festering lion carcass on the front of the tin?

All our undertakers to date have been dipteran; but it's at this later stage that the beetles begin to move in, too. Some of the first arrivals aren't that bothered about corpse disposal; they're more intent on disposing of the disposers, since they're predators with a particular taste for carrion-feeding fly larvae. Thus they are necrophils (corpse-lovers) rather than necrophages (corpse-eaters). Most noticeable in this regard are our two species of devil's coach-horse *Creophilus erythrocephalus* (Plate 8) and the very similar *C. lanio*, which are among our largest representatives of the rove-beetle family (Staphylinidae). The generic name means 'lover of flesh', but really they're only here for the fly larvae, which both the adults and their active larvae hunt. Though the adults were stimulated to fly towards the carcass by the smell of putrefaction, on arrival they fold their wings neatly under their strangely foreshortened elytra and proceed on foot. Devil's coach-horses are visual hunters with keen eyesight. Get too close to one and it is likely to bare its mandibles at you and raise its tail threateningly, wafting noxious fumes from glands near its rear end as it does so. It would probably also want you to bear in mind that the specific name *lanio* translates as 'I mutilate'. The common name of these beetles is a borrowing from England, where it applies to a rove-beetle species with similar habits: the name, or variants of it, has been in use since the Middle Ages and has cognates in other European languages, no doubt reflecting the insect's morbid tastes. The beetle's association with the Devil (it was said to have eaten the core of Eve's apple) puts it in apposition to ladybirds, which were associated with the Virgin Mary. For the record, crushing a devil's coach-horse was said to bring you God's forgiveness for seven sins; while the seven spots of the ladybird were said to signify Mary's seven joys and seven sorrows.

Strangely beautiful, dumpy little metallic-blue hister-beetles (family Histeridae) in the genus *Saprinus* (Plate 9) also put in an appearance at this stage, and for the same reason as the devil's coach-horse – though they prey on much smaller fly larvae. Our usual species is *S. australis*, but *S. cyaneus* and *S. laetus* are also part of this fauna. Should the maggot supply run dry before the larvae reach maturity, they're not averse to turning to cannibalism instead.

Another few days, and what remains of our pademelon is looking bedraggled and sunken, having lost most of its flesh. The blowflies and flesh-flies have buzzed off in search of more easy meat. They might look down their probosces at the trifling scraps that are left, but there's plenty of life in the old girl yet, and this time it's the underdog undertaker beetles that do much of the disposal. These scraps, for them, represent the delicious main course. Most prolific are the larvae of the aptly named carrion-beetle *Ptomaphila lacrymosa*. The adult beetle (Plate 10) is quite striking in appearance: large (3-4 cm) and pie-dish shaped, fawn-coloured and with black, raised spots on the elytra. They are strong flyers, and because they are attracted to light as well as to the smell of meat, they sometimes turn up uninvited at barbecues. Anyone tempted to pick one up for a closer look is likely to be rewarded with a regurgitated meal of liquefied and part-digested carrion. In the absence of artificial light and barbecues, they home in on carrion quite early in its decomposition, and lay large numbers of eggs under the pelt, on exposed sheets of connective tissue or on strands of sinew. The eggs take a few days to hatch, and at first the tiny black, trilobite-like larvae are outnumbered by those of the flies. But they're in it for the long haul, and in this later stage of decomposition, once they have undergone a couple of moults (Plate 11), their size, gregarious nature and perpetual hyperactivity make them hard to miss. Unlike fly larvae, they have jaws for consuming solid food, which is why they thrive at this stage when the more liquid components of a carcass have already been slurped up by fly larvae. Over the space of a few days, they are quite capable of stripping a carcass until it's little more than hide, fur and bone.

As for that hide and fur, the job of consuming this tougher material is

Plate 11. *Ptomaphila lacrymosa*, larvae

Plate 12. *Dermestes maculatus*

Plate 13. *Anthrenus verbasci*, adults and larval skin

Plate 14. *Omorgus australasiae*

largely the bailiwick of beetles in the family Dermestidae. Chief among these is the hide-beetle *Dermestes maculatus* (Plate 12), a cosmopolitan species that has a clever trick for monopolising suitable food-sources: the males give off a pheromone that attracts others of the same species to join in the melee. They have a characteristic, jerky movement as they investigate all the nooks and crannies within, underneath and on top of what's left of the hide. Their ability to live happily in dense aggregations has endeared them to the preparators of skeletons for natural-history collections, and dermestid colony starter-packs are now readily available for purchase online. Another cosmopolitan dermestid, *Attagenus pellio*, is to fur what *Dermestes maculatus* is to hide. Its larvae are able to do what others cannot, obtaining sustenance from keratin, the main fibrous structural protein in fur. One common name for these tough little beetles is the two-spotted carpet-beetle, because their larvae (known as woolly bears) can also eke out a living consuming woollen carpets as well as the chitinous remains of insects that can accumulate among the piles of a carpet or rug. One further cosmopolitan dermestid species, the daintily pastel-blotched *Anthrenus verbasci* (Plate 13), sometimes joins the others in tidying up the tough bits of hide and fur as well as the shed remains of carrion-feeding insect larval or pupal skins. Their fondness for dead insects has earned them a reputation as a destructive pest of museum insect collections, as well as the common name of museum beetle whose very utterance engenders a sense of dread among entomology curators worldwide.

Members of a second family (Trogidae), confusingly also known as hide-beetles, play their part here too. The usual species in Tasmania is *Omorgus australasiae* (Plate 14), but three further species in the genus, *O. alternans*, *O. costatus and O. tasmanicus*, are also around. Built like tanks, with a hard, knobbly exoskeleton that quickly collects dirt as camouflage, they plough through dislodged piles of fur and skin until they find a soft, moist spot of soil beneath the carcass. Here a female digs down and lays her eggs, so that when the larvae hatch, they will have ready access to a concentrated food-store immediately overhead. This behaviour is not unlike that of some dung-beetles, which is a collective term for various beetles in the superfamily Scarabaeoidea (trogids are in this superfamily, too). Indeed, various species of dung-beetle, including local species of *Onthophagus* and *Acrossidius* (both in the family Scarabaeidae) will feed opportunistically on carrion as well as dung. In the far north-east of Tasmania, an as-yet unidentified species of *Liparochrus* (family Hybosoridae) also belongs in this category of facultative scarabaeoid necrophages.

Completing our line-up of coleopteran undertakers are two atypical but cosmopolitan members of a family of usually predacious beetles, the Cleridae. Commonly known as ham-beetles, *Necrobia rufipes* (red-legged) and *N. ruficollis* (red-shouldered) are typically latecomers to the funereal proceedings, cleaning up after the main party is over. Their common name gives an indication of their dietary preferences, since they have long been considered pests of traditionally dried meats when these were strung up to cure, suspended below the homestead ceiling. In nature, they get to work on the tough, desiccated strands of tendon and ligament that remain attached to the bones of carcasses when all the easier flesh has already been stripped away; they are also partial to the remains of dead carrion-feeding insects. As an interesting aside, the red-shouldered ham-beetle is credited with saving the life of an eighteenth-Century French entomologist, Pierre Latreille, who was imprisoned for failing to swear allegiance to the state. When it became apparent to his jailers that he was a well-known and respected scientist, having recognised and identified one of these beetles on the floor of his dungeon cell, he was released and saved from the guillotine.

After four to six weeks of undertaker activity, our pademelon is now little more than a pile of whitened bones. How ironic that the grass really is greener here now: verdant, well-nourished and as-yet un-nibbled shoots poke out between her ribs. But there is one final food-source that has escaped the attention of the previous undertakers: bone-marrow. This is the domain of one of the more remarkable fly families, the bone-skippers (family Piophilidae). Just as the hide-beetles and ham-beetles are polishing off the last of our pademelon's visible flesh, male bone-skipper flies arrive to defend mini-territories on tempting-looking leg-bones. It's not that they're bone-idle in not getting here sooner; it's more that they can't abide mixing with the thronging hordes of blowies and their ilk. Once mated, a female bone-skipper will then seek out the pores in a bone through which blood once entered and left the marrow within, and lays her eggs there. The larvae will worm their way into the marrow, where they have the moist, fatty, proteinaceous deposits to themselves. However, the interior of a bone isn't the best place to pupate, so when they have had their fill, they emerge to seek somewhere a bit more spacious and hygienic. This is where they get their common name, because the larva has the ability to curl itself up into a c- or o-shape and then rapidly flex its body in the opposite direction, pinging itself up to 15 cm away from the bone and into the surrounding vegetation. Three species of bone-skipper are known from Tasmania: the gaudy, black-and-orange *Piophilosoma antipodum* and *P. palpatum* (Plate 15), and the dowdier *Piophila casei*. While the first two are Australian specialities, the last is a cosmopolitan species more usually known as the cheese-skipper. When you think about it, fresh cheese is similar to marrow – at least, if you're a cheese-skipper. These little flies have taken to artisanal cheeses in a big way. In most situations they are considered a pest, but their larvae are also revered as an integral part of the gustatory experience for consumers of the Sardinian delicacy known as *casu marzu*. But lest you think that myiasis is something that only sheep get, it's worth noting here that the larvae of cheese-skippers are a chief cause of intestinal myiasis in humans. For cheese aficionados wishing to avoid this fate, the *casu marzu* on one's open sandwich can be consumed slowly, giving the maggots time to skip away; or it can be

Plate 15. *Piophilosoma palpatum*

left in an airtight container for a while, until the pitter-patter of skipping fly maggots subsides as they are starved of oxygen and die. The cheese is then 'safe' to eat.

Now that I have fleshed out the bare bones of this *danse macabre*, it's worth considering just how fundamental these insect undertakers are to ecological health: not only do they dispose of unsightly, malodorous and downright hazardous carcasses, but in doing so they return the nutrients back into living food-webs and into the soil. Lose the carrion, or the animals destined to become carrion, and we would lose not only these fascinating insects but also their important ecological services.

On a more practical note, it's also worth remembering that observations such as these are behind the science of forensic entomology, in which the timing and place of death of a corpse can be deduced with some accuracy from the community of insects found at the scene. Besides the hierarchy that I've described above, there are other behavioural or physiological facets to consider: some insect undertakers like it hot, some cold; some wet, some dry; some sunny, some shady. And besides the flies and beetles that I've mentioned, there are also more-opportunistic ants, wasps (Plate 16) and many other insect undertakers that come and go during this macabre succession, all with something to contribute to a forensic case. Put all this information together and you have a rich source of information for forensic investigation.

Or you can just enjoy the story and marvel at the intricacies of nature's solutions to the macabre task of corpse disposal.

Plate 16. *Vespula germanica*

Acknowledgements

I thank Dr Philip Barton for helpful comments on an earlier version of this article.

Suggestions for further reading

Archer, M.S. (2004). Annual variation in arrival and departure times of carrion insects at carcasses: implications for succession studies in forensic entomology. *Australian Journal of Zoology* 51(6): 569 – 576.

Archer M.S. & Elgar, M.A. (2003). Yearly activity patterns in southern Victoria (Australia) of seasonally active carrion insects. *Forensic Science International* 132(3): 173-176.

Barton, P., Evans, M., Pechal, J. et al. (2017). Necrophilous insect dynamics at small vertebrate carrion in a temperate eucalypt woodland. *Journal of Medical Entomology* 54 (4): 964-973.

Barton, P. & Evans, M. (2017). Insect biodiversity meets ecosystem function: differential effects of habitat and insects on carrion decomposition. *Ecological Entomology* 42 (3): 364-374.

Fuller, M.E. (1934). The insect habitants of carrion: a study in animal ecology. *CSIRO Bulletin* 82: 1-62.

Gunn, A. (2016). The colonisation of remains by the muscid flies *Muscina stabulans* (Fallén) and *Muscina prolapsa* (Harris) (Diptera: Muscidae). *Forensic Science International* 266: 349-356.

Kavazos C. R. J., Meiklejohn K. A., Archer M. S. and Wallman J. F. (2011). Carrion Flies of Australia. Institute for Conservation Biology and Environmental Management, University of Wollongong.

Lang, M.D., Allen, G.R. & Horton, B.J. (2006). Blowfly succession from possum (*Trichosurus vulpecula*) carrion in a sheep-farming zone. *Medical and Veterinary Entomology* 20: 445-452.

What is the life span of a Silver Gull?

Els Wakefield
12 Altna-Craig Avenue, Mt Stuart, Tasmania 7000
elswakefield@gmail.com

The Silver Gull, *Chroicocephalus novaehollandiae* (Plate 1) is the most commonly found gull in Tasmania and is the only small gull that naturally occurs in Australia. Silver Gulls vary across Australia but there are no recognised subspecies. However, in the southeast of Australia and especially in Tasmania, the Silver Gull has more extensive mirrors or white areas on the primaries which give it a different appearance from the gulls in the rest of its range.

Like most gulls, the Silver Gull is an opportunistic scavenger. This behaviour can cause problems where people are enjoying an outdoor meal and it can also cause health problems for the birds. Although the numbers of Silver Gulls fluctuate around the Hobart area, the popular perception is that they are increasing, especially in areas where the gulls roost in large groups.

Calling Silver Gulls "the rats of the

Plate 1. Silver Gull

sky" and other negative comments demonstrates a lack of understanding of these birds. I sometimes ask people if they know what the life span of a Silver Gull is. Many reply that it might be 6 to 10 years, perhaps implying that Silver Gulls are short-lived, opportunistic feeders and breeders that die young and are expendable.

From 1974 until his death in 2011, Dr Bill Wakefield did extensive research on the gulls in Tasmania including the Silver Gull. Visiting the breeding colonies, including those on the offshore islands, he banded the chicks and occasionally some older birds. Bill and I worked together on his research during the final 10 years of his life and I now continue to receive the recovery reports of those banded birds.

During the past two years I have received some amazing recovery details regarding Silver Gulls. The most recent was of a Silver Gull with band number 082-89285 that had been recovered on 30 March 2019 at Dunalley, Tasmania. It was found sick or injured and was alive in captivity with a band. It had been banded as a nestling, sex unknown on 27 December 1992 at Spectacle Island in Frederick Henry Bay. The time between banding and recovery was 26 years 4 months 3 days. The bird had moved a distance of 16 km. Madeleine Harwood, the project officer of the Australian Bird and Bat Banding Scheme's (ABBBS) office at the Australian Government's Department of Environment and Energy in Canberra commented: "It's near the top of the list for the oldest known Silver Gull in Tasmania."

Amazingly, that Silver Gull record had already been superseded by the previous report of a Silver Gull with band number 082-31722 that was recovered on 28 November 2018 at Stanley Street, South Brisbane, Queensland. This bird was trapped because it had been tangled in fishing gear. It was rehabilitated and released alive with the band. The male bird had been banded by Bill on 10 December 1988 at Spectacle Island, Frederick Henry Bay, Tasmania, when it was two years old or older. The time between banding and recovery is 29 years 11 months and 18 days. The bird had moved a distance of 1280 km with a bearing of 18 degrees. As it was already about two years old when banded, this bird was about 32 years old when caught and is still alive, making it the oldest known live Silver Gull in Australia.

On making some enquiries through Naomi Clarke, the Senior Project Officer at the ABBBS, I discovered that a well-known pair of twins had rescued and released the gull and that they regularly reported sightings of banded birds. I phoned the twins to thank them for their efforts and for their invaluable contribution to science.

I hope that this knowledge of how far these Silver Gulls can travel, and of how long-lived these small gulls can be, will give us a greater understanding and appreciation of this native bird.

First record of a blue *Lamprima aurata* Latreille, 1817 (Coleoptera: Lucanidae) from Tasmania

Karen Richards & Chris P. Spencer
65 Sinclair Avenue, Moonah 7009
spenric@gmail.com.au

The spectacular Australian endemic golden stag beetle, *Lamprima aurata* Latreille, 1817 (colloquially known in Tasmania as the Christmas beetle), is one of five species attributed to the Australopapuan genus (Reid et al. 2018) and is the only one found in Tasmania, where it is widely distributed across lowland and coastal areas. This species presents in a broad spectrum of metallic colour, including copper-red, golden yellow-green through to bronze-green, purple and occasionally almost black in some coastal individuals (Fearn 2016; Hangay & De Keyzer 2017). In Tasmania, purple-black specimens are mostly confined to coastal areas in the north and upper east where they co-occur with gold-green specimens (Fearn 2016). Evidence of further *L. aurata* colour morphs on the Australian mainland are presented in Bartolozzi et al. (2017), where dark blue specimens from Victoria, NSW, Queensland and Western Australia are pictured, while images showing blue specimens of other *Lamprima* species including *L. aena* (Fabricius, 1792) from Norfolk Island and *L. insularis* Macleay 1885 from Lord Howe Island are also depicted.

Tasmanian specimens of *L. aurata* have been found in most of the colour morphs outlined above (Spencer-Richards pers. collection) (Plate 1). Recently, two purple female *L. aurata* were collected at Neck Beach Bruny Island (Feb 2020) and a further dark purple female was recorded in a Huonville garden (coll. B. Richards, Dec. 2019). A headless female specimen, from Collinsvale, rescued from the beak of a Tasmanian native hen (*Tribonyx mortierii* du Bus de Gisignies, 1840) in 2014, was dark olive-black, a colour not previously recorded by us (Plate 2). Despite the colour variation displayed in Tasmania, no true blue form has previously been recorded in the state (S. Fearn pers. comm. 2018); although exoskeletal fragments exposed to full sunlight for a protracted period may turn blue (S. Fearn pers. comm. 2020).

The first evidence of any blue form of the species in Tasmania, collected by the authors, was from the central Midlands in 2013; this specimen consisted of the left elytron and both hind legs. The second was located on a Midlands property southeast of Campbell Town in 2014 and consisted of both elytra, both forelegs and a single hind leg.

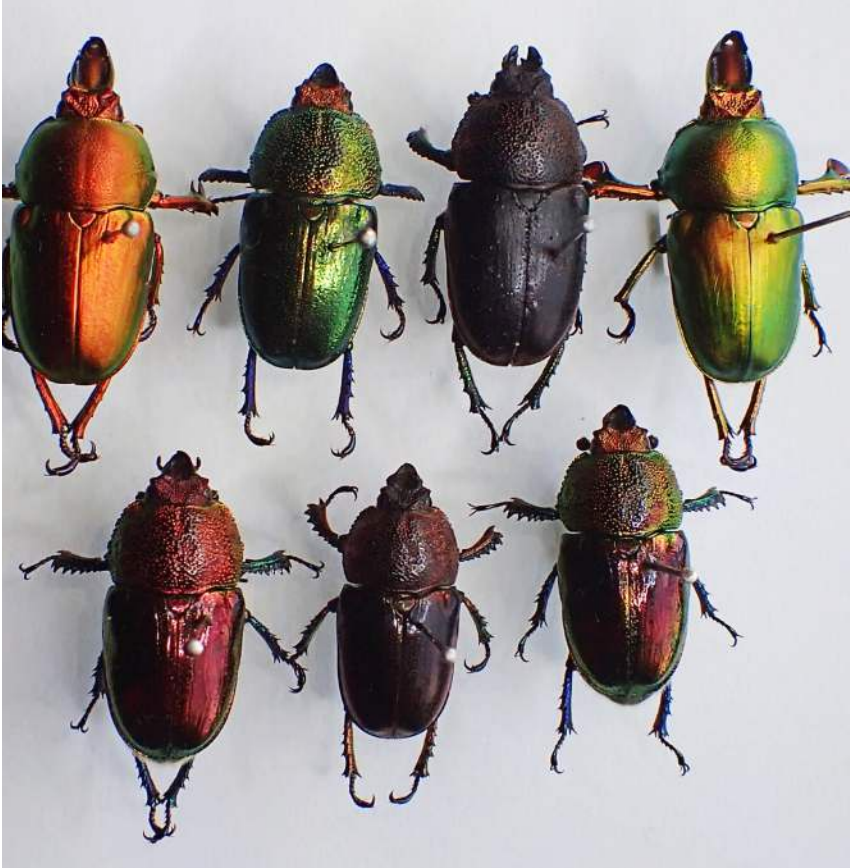


Plate 1. Selection of Tasmanian *Lamprima aurata* colour variations

Further evidence came in the form of a complete thorax from Goulds Country in 2017, which was located on top of a large log. Each of these fragments was of a bluish-green hue but we were unable to ascertain how long they may have been exposed to harsh sunlight; however, the fragments were retained (Plate 3). Despite our best efforts over the period 2013–17, visiting an extensive area across Tasmania and observing many *L. aurata,* no further blue material was located.

The breakthrough came in January 2018, when an active female, definitely blue, was collected at Valley Rd, Collinsvale (Plate 4). This very handsome specimen was walking across our gravel driveway on a sunny 21°C afternoon. The elytra, thoracic section and legs are deep blue, head is golden-green and the ventral surface is blue-green. This is the first definitive record of a true blue morph *L. aurata* from Tasmania. While there remains uncertainty as to the 'living' colour of the beetle fragments previously

Plate 2. Headless olive-black *Lamprima aurata* from Collinsvale

Plate 4. Blue *Lamprima aurata* specimen from Collinsvale

Plate 3. Blue-green *Lamprima aurata* fragments: Goulds Country (left), Tasmanian Midlands (centre & right)

recorded, given the collection locality of the live specimen and the three previous discoveries, it might imply that the blue morph may be scarce, but potentially widespread, in Tasmania.

Acknowledgements

The authors wish to thank Brian Richards for provision of the Huonville *Lamprima* specimen and Simon Fearn for correspondence on the species.

References

Bartolozzi, L., Zilioli, M. & De Keyzer, R. 2017. *The stag beetles of Australia New Zealand New Caledonia and Fiji*. TAITA publisher, Czech Republic, 2017 176pp.

Fearn, S. 2016. New ecological and behavioural observations on the green and gold stag beetle *Lamprima aurata* (Scarabaeoidae: Lucanidae) in coastal Tasmania. *The Tasmanian Naturalist* 138, 53-57.

Hangay, G. & De Keyzer, R. 2017. *A guide to stag beetles of Australia*. CSIRO publishing 243pp.

Reid, C.A.M., Smith, K. & Beatson, M. (2018) Revision of the genus *Lamprima* Latrielle, 1804 (Coleoptera: Lucanidae). *Zootaxa* 4446 (2): 151-202.

Investigating a lacustrine herbland at Musselroe Bay, North-East Tasmania

Louise Brooker
20 Edward Street, Bridport
louise.brooker49@gmail.com

Introduction

A Management Plan for Musselroe Bay was put together by Bushways Environmental Services (2011) in conjunction with NRM North and Dorset NRM. I was lucky enough to read a copy of this document as I planned an outing there for the North East Field Naturalists.

In the plan, along with notes about Aboriginal heritage, threatened flora and management issues, there was a very thorough account of the vegetation types to be found there. These included one I hadn't heard of before: lacustrine herbland.

The official description is:

> *Lacustrine herbland includes marsupial lawns and herbfields, which occur in areas that are subject to short periods of inundation. They consist of species less than 20 cm in height, and are commonly less than 5 cm in height. Some communities of herbfield marginal to wetlands can be very species-rich with upwards of 20 species in a square metre. As a general rule the species diversity decreases as salinity increases* (Kitchener & Harris 2013).

The TASVEG mapping system classifies the non-forest vegetation communities into six categories. Each one has a code. These are: Freshwater Aquatic Herbland (AHF), Freshwater Aquatic Sedgeland and Rushland (ASF), Saline Aquatic Herbland (AHS), Succulent Saline Herbland (ASS), Saline Sedgeland/ Rushland (ARS) and Lacustrine Herbland (AHL).

Using the TASVEG overlay on the Land Information Tasmania (theLIST) map, I see occurrences of lacustrine herbland dotted about the island, from alpine to coastal areas varying in size up to large patches covering several hectares, often on the margins of wetlands, lagoons, lakes and waterways.

They may also develop near dune swales, on the back of beaches above the strand line and on the leading edge of dunes above erosion scarps.

They seem to be more common in the central east of the state and there are quite a few small patches in the north-east, especially near the coast. There is a large patch inland, in the Ringarooma

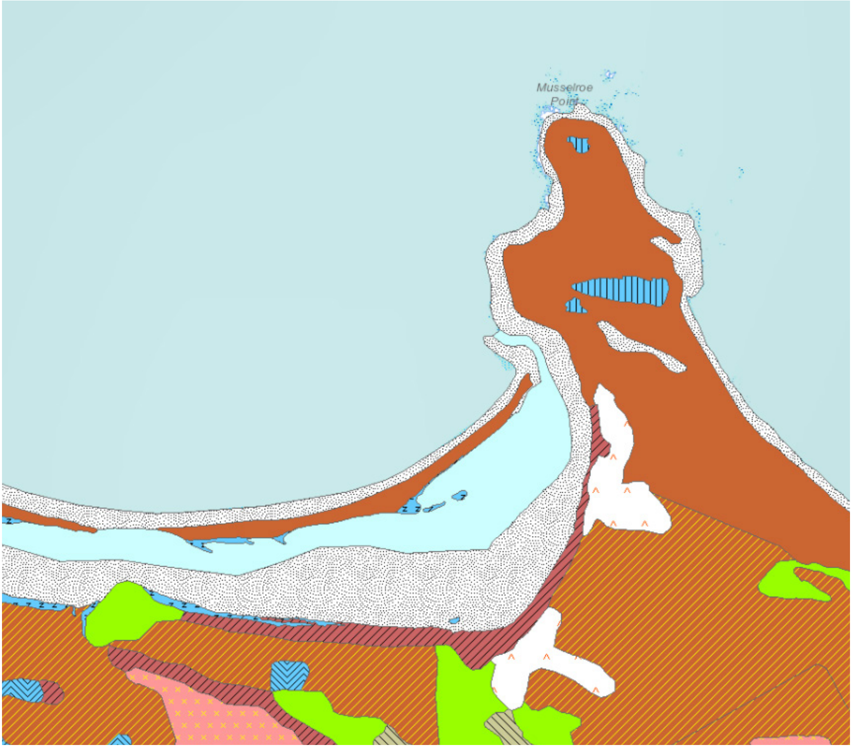


Figure 1. TASVEG overlay of LISTmap: The lacustrine herbland at Musselroe Bay is represented by vertical blue stripes. It consisted predominantly of *Lilaeopsis*.

Ramsar Site, though it is difficult to access on foot.

Lacustrine herbland is also mentioned as a unique feature of the Tasmanian Wilderness World Heritage Area:

> *Another characteristic component of the wet coastal vegetation of southwest Tasmania is short coastal herbfield known as marsupial lawn. These communities are an unusual type of salt marsh which are closely grazed and lie just above the high-water mark in sheltered bays and estuaries. Succulents are absent and the major dominants are small mat forming sedges and forbs. Superlative examples of these communities are found within the TWWHA. No record was found in the scientific literature for such short wet herbfields occurring in coastal regions elsewhere in Australia or the world (Harris 1991, van der Maarel 1993ab). They have international significance because they are thought to have no analogue elsewhere and are the habitat of both rare and restricted endemic species."* (Balmer et al. 2004).

Whereas almost all the other 150 vegetation communities in the TASVEG mapping system consist of layers of species, it seems that the many species in a lacustrine herbland are all in the horizontal plane, little taller than 5 cm in height. The community is variously made up of herbs and orchids, tiny grasses, lilies and sedges, and some mosses and lichens. There are approximately forty species in the list that may be present in these herbfields – all herbaceous, that is, without a woody stem (see Appendix).

Investigation at Musselroe Point

On our walk around the headland, we encountered a little soak on the way south from Musselroe Point (Figure 1) that attracted a lot of close attention. This is how one of our members described it: "an unusual upper intertidal habitat in a flat area surrounded by big rocks, possibly with a mud-soil substrate; a carpet-like assemblage of plant species". The plant of most interest there, and hitherto not noticed on any of our previous outings, was *Lilaeopsis* (Plate 1). In fact, *Lilaeopsis* was the predominant plant species here, forming a floristic community in its own right.

Plate 1. Field naturalists examining the *Lilaeopsis* community (photo: Carolyn Joyce).

The lacustrine herbland is sometimes referred to as marsupial lawn, its name indicating its popularity for grazing by the big five: Forester kangaroo, Bennett's wallaby, pademelon, brushtailed possum and common wombat. It is also grazed by black swans and native hens. Lawn soils have a higher moisture content than those of the surrounding scrub, the water table being at, or very close to, the surface. This ensures quick regrowth after grazing.

This constant grazing may be what stops the invasion of woody species. In her PhD thesis, Cynthia Roberts set out to investigate, among other factors, the role played by grazers in the maintenance of marsupial lawns (Roberts 2009).

It was hypothesised that woody species might also be prevented from colonising a marsupial lawn by its occasional inundation by salt water.

Invertebrates such as crickets and grasshoppers are known to reduce the herbland biomass by an amount similar to that of vertebrate grazers. There would be beetles, bugs, flies, micro-wasps and butterflies sucking the sap from the vegetation and pollinating the flowers. There are, for example, in the family Chloropidae, insects called florivores, which eat flowers. Very few studies have investigated the role that the invertebrates may play in maintaining these marsupial lawns.

Plate 2. *Lilaeopsis polyantha* – jointed swampstalks.

Plate 3. *Triglochin minutissima* – the tiny arrow grass.

The plants populating the marsupial lawns, you could say, are in the second line – not actually plants of the saltmarsh where they are inundated by salt water twice a day, but plants which like a slightly less salty habitat. One of the indicator species of a tolerance for a more saline situation is *Selliera radicans*.

Later in the day I notice we are standing in another patch of the lacustrine herbland beside the Musselroe River. It is flat; the soil is a deep peat; the herbs are only about 1 cm high, yet there are flowers.

Down we go onto our knees again. It takes some time for our eyes to adjust to the minute size of these flowers.

Here it is again – *Lilaeopsis polyantha* (Plate 2). As well as being known just as lilaeopsis, it is also known as the creeping crantzia [the name of its former genus]. The species name implies many flowers, but it doesn't live up to its name here beside the Musselroe River. It reproduces with a creeping rhizome and can form dense colonies, as we saw out on the coast. Here it is in shallow water and wet mud close to the water. Its leaves are eaten by waterbirds. They are succulent and cylindrical, sometimes erect but here they are flat on the ground.

It can be seen in other parts of Tasmania, but is more common here on the north-east coast and in the Furneaux Group.

Present also in this patch is *Triglochin minutissima* (Plate 3) – the tiny arrowgrass, though it is not really a grass, but a waterribbon (family Juncaginaceae) and named so because the mature fruit has short spurs at the base. Its larger cousin *Cycnogeton procerum* is the frequently seen water ribbons.

Though *T. minutissima* is found in other states, in Tasmania it is listed as 'rare' under the Tasmanian *Threatened Species Protection Act 1995*. It is found in various places in the north-east. Its bulbs or rhizomes are permanently underwater. Wapstra et al. (2010) explain the name: *treis* – three, *glochis* – projecting point, which alludes to the segments of the fruits that have a protruding tip. This plant can be exceedingly small, as is the case here.

Leptinella longipes or coast buttons (Plate 4) is also found here on the river bank. Formerly called *Cotula* and still called that by some, it has prostrate rooting branches. Its fleshy leaves have noticeably indented leaf margins. Its flower head of less than a centimetre across is button-shaped and has no petals. It is quite common in the less saline coastal environment.

Plate 4. *Leptinella longipes* – coast buttons.

Selliera radicans (Plate 5) loves the more saline situation. Its leaves are what distinguishes it from *Scaevola hookeri*, a plant whose flower looks similar. These leaves are succulent and bulging towards the tip. As well as being called the shining swampmat, it is called bonking grass – I have no idea what that means!!

Plate 5. *Selliera radicans* – shining swampmat.

These are the plants that were seen on the day of the North East Field Naturalists' outing to Musselroe Bay. The Appendix contains a list of other species that may be observed in what is a little-studied vegetation type and there are good references available on the plants in this and related vegetation communities (e.g. Prahalad 2014).

A brief account of the excursion has been written by the author and published in the *North East Naturalist,* March 2020.

Acknowledgements

Thanks to Alex Buchanan, who sparked my interest in the plants and whom I find always willing to share his knowledge.

Thanks to Carolyn Joyce for permission to include her photo.

References

Bushways Environmental Services (2011). Management Plan for Musselroe Bay.

Kitchener, A. & Harris, S. (2013). From Forest to Fjaeldmark: Descriptions of Tasmanian's Vegetation (2nd. Edition). Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania.

Balmer, J., Whinam, J., Kelman, J., Kirkpatrick, J.B. & Lazarus, E. (2004). *A Review of the Floristic Values of the Tasmanian Wilderness World Heritage Area.* Nature Conservation Report 2004/3. Department of Primary Industries, Water and Environment, Tasmania.

Roberts, C.M. (2009). *Marsupial Grazing Lawns in Tasmania: Maintenance, Biota and Effects of Climate Change*. PhD thesis, University of Tasmania, Hobart.

Wapstra, M., Wapstra, A. & Wapstra, H. (2010). *Tasmanian Plant Names Unravelled.* Fullers Bookshop, Launceston.

Prahalad, V. (2014). *A Guide to the Plants of Tasmanian Saltmarsh Wetlands* University of Tasmania and NRM North.

Appendix

The following list is from the DPIPWE website and is a guide to what species might be found in a lacustrine herbland.

Centella cordifolia, swampwort

Elatine gratioloides, waterwort

Eryngium vesiculosum, prickfoot

Gonocarpus micranthus, creeping raspwort

Goodenia humilis, swamp native-primrose

Hydrocotyle muscosa, mossy pennywort

Isotoma fluviatilis, swamp stars

Leptinella reptans, creeping buttons

Lilaeopsis polyantha, jointed swampstalks

Limosella australis, southern mudwort

Mazus pumilio, swamp mazus

Mimulus repens, creeping monkeyflower

Myriophyllum spp., watermilfoil

Neopaxia australasica, white purslane

Pratia pedunculata, matted pratia

Ranunculus amphitrichus, river buttercup

Selliera radicans, shiny swampmat

Utricularia spp. bladderwort

Villarsia reniformis, running marshflower

Wilsonia backhousei, narrowleaf wilsonia

Wilsonia rotundifolia, roundleaf wilsonia

Eleocharis acuta, common spikesedge

Juncus holoschoenus, jointleaf rush

Juncus pallidus, pale rush

Juncus pauciflorus, looseflower rush

Lepidosperma laterale, variable sword sedge

Eleocharis pusilla, small spike sedge

Schoenus fluitans, floating bog sedge

Schoenus nitens, shiny bog sedge

Schoenus tesquorum, soft bog sedge

Ehrharta stipoides, weeping grass

Lachnagrostis aemula, tumbling blowngrass

Austrodanthonia spp., wallaby grass

Centrolepis spp., bristleworts

Centrolepis strigosa, hairy bristlewort

Isolepis cernua, nodding club sedge

Isolepis marginata, little club sedge

Isolepis platycarpa, flatfruit club sedge

Poa spp., tussock grass

Highlights of pelagic birding from Eaglehawk Neck 2019/2020

Els Wakefield
12 Alt-Na-Craig Avenue, Mount Stuart, Tasmania 7000
elswakefield@gmail.com

This is the ninth in a continuing series of articles summarising the highlights of pelagic seabirding off Tasmania's coast (e.g. Wakefield 2019).

From July 2019 to June 2020 there were 30 pelagic trips leaving from Pirates Bay on the Tasman Peninsula on the MV *Pauletta* skippered by John Males and Michael Males. Deckhands included Adam Mackintosh and Craig Hansen.

The first trip for the financial year on Sunday 7th July was an extremely pleasant day out on the water with a slow but steady trickle of bird sightings. Mona Loofs-Samorzewski managed the trip for the day and compiled the report as Paul Brooks, the organiser, was unable to attend. There was an interesting selection of large albatross, two of which were banded. Photos were sent to Sandy Taylor of the Australian Bird and Bat Banding Scheme (ABBBS), who contacted the banding coordinator of Gibson's Albatross on Adams Island, and one albatross was identified as a Gibson's Wandering Albatross (*Diomedea antipodensis gibsoni*) banded as a chick on 20th December 1996 on Adams Island (part of the Auckland Islands group). This bird was also banded with an alphanumeric band Orange 214 (since faded to pinkish-white). Our bird was thus 23 years old. Sandy thanked us for reporting the sighting, adding that it is always nice to know that some of these long-lived birds are surviving. Other highlights on the day included two Blue Petrel (*Halobaena caerulea*) and two White-headed Petrel (*Pterodroma lessonii*).

Karen Dick led the following pelagic on Saturday 27th July. Karen reported a total of only 17 species including one Southern Royal Albatross (*Diomedea epomophora*), 16 Great-winged Petrel (*Pterodroma macroptera*) and 36 Grey-faced Petrel (*Pterodroma gouldi*), two Providence Petrel (*Pterodroma solandri*) and five Cape Petrel (*Daption capense*) on an otherwise quiet day.

On the weekend of 10th and 11th August, Rob Morris led two pelagics and I was fortunately able to attend both days. On the Saturday John Males, the skipper, had serious misgivings about the trip going ahead and drove up to the viewing point from the top of the blowhole to make a final assessment of conditions before deciding to see how far we could go. Seas were over 3 m and wind speeds from the SW were 25 knots forecast to increase. We set off, heading out slowly straight for the shelf, enjoying rainbows as showers lashed the boat and obscured the distant coastline. We were expecting to return at any time but conditions improved and we were rewarded with some fantastic bird sightings: a juvenile Northern Royal Albatross (*Diomedea sanfordi*), two immature Grey-headed Albatross (*Thalassarche chrysostoma*), a distant pass of a Sooty Albatross (*Phoebetria fusca*), two or three Blue Petrel, three Grey Petrel (*Procellaria cinerea*) flying around together, about 20 White-headed Petrel and a Providence Petrel.

On the Sunday, 11th August, conditions were forecast to deteriorate even further with increasing SE winds to add to the confusion of the SW swell. However, the skipper was happy to try again, this time heading further south towards the Hippolytes before going to the Shelf at a low speed. Winds increased at times to 25-30kts and the seas to 3.5m but luckily, as on the previous day nobody was injured. This trip turned out to be one of the wildest but most exciting trips I have ever done as we were rewarded with highlights of two Southern Royal Albatross, a Northern Royal Albatross, three Grey-headed Albatross (two adult and one immature), a Sooty Albatross, 15 Blue Petrels, one Grey Petrel, three Cape Petrel, 12 White-headed Petrel, one Manx Shearwater (*Puffinus puffinus*), one Providence Petrel, two Broad-billed Prion (*Pachyptila vittata*) (subject to BARC submission), two Slender-billed Prion (*Pachyptila belcheri*) and Antarctic Prions (*Pachyptila desolata*). The Manx Shearwater was photographed by Jodi Osgood and after BARC approval this was officially accepted as the first live sighting for Australia. Sean Dooley recalled that a dead, banded bird was found in South Australia about 60 years ago. After reporting the sighting to Naomi Clarke at ABBBS, she found the record of that bird, which had been banded by the British Trust for Ornithology (BTO) at Skokholm Island in Wales UK aged +1 on 9th September 1960 and had flown an amazing 16208 km before being found dead, cause unknown, on 22th November 1961 at Venus Bay South Australia.

Plate 1: Manx Shearwater

Photograph: Jodie Osgood

Peter Vaughan led a trip on Sunday 25th August. There were fresh southerly winds all day with a high but regular swell that was thankfully not as rough as the previous trips. The highlights included a distant Arctic Tern (*Sterna paradisaea*) that was later identified from photos that showed a clean white rump, long wings and a well-demarcated, long trailing edge on the primaries. The other highlights were a Northern and a Southern Royal Albatross, two Antarctic Prion (*Pachyptila desolata*), a White-headed Petrel and a Grey Petrel. Towards the end of the trip I photographed a Black-browed Albatross (*Thalassarche melanophris*) that I later discovered to be banded. Unfortunately, the band was too worn for any numbers to be identified.

Mona Loofs-Samorzewski led the trip on 1st September and compiled the report. We started with sunny skies but a surprisingly cool wind and the weather gradually deteriorated to cloudy with light rain. Highlights of the day included a Northern Royal Albatross, an Antarctic Prion, 35 White-headed Petrel, six Providence Petrel and a Soft-plumaged Petrel (*Pterodroma mollis*). In her report, Mona commented that although 35 White-headed Petrel is not a record for an Eaglehawk pelagic, this is only the third time such high numbers have been recorded on eBird, with the record being over 100 seen in September 2013 and 38 counted in May 2018.

Peter Vaughan led two consecutive trips during the week on 3rd and 4th September. On the Tuesday, the standout bird was a magnificent leucistic putative Southern Giant Petrel (*Macronectes giganteus*) that caused quite a stir on board. Flying to the back of the boat, it was obviously very hungry and immediately downed many servings of berley. The pure white bird had brown eyes so it was not an albino and it showed subtle shades of cream and yellow, especially around the fanned out tail. The bill was a light pink colour so the bird may have been a leucistic Northern Giant Petrel but whatever it was, it was very impressive. It stayed around for a while even after having eaten its fill, eventually picking up and dropping pieces of berley to demonstrate its loss of appetite. There were also some close views of three Providence Petrel.

On Wednesday 4th September there was a young Salvin's Albatross (*Thalassarche salvini*), which Peter confirmed from photos: '... the combination of dark hood, "messy" underwing, silvery (not white) underside of primaries, dusky rump and overall size and shape (in comparison to Shy Albatross) point to a juvenile or 1st year Salvin's ... also the bill was more thin and Salvin's like when compared to Shy.' There was also a beautiful Snowy Albatross (*Diomedia exulans*), good views of eight Providence Petrel and 75 Common Diving Petrel (*Pelecanoides urinatrix*) that seemed a high number and many on board rose to the challenge of obtaining photographs as they dashed past. This winter I have noticed that Diving Petrels have been observed out beyond the shelf, whereas they are more commonly seen further inshore. On the return trip we watched a high-flying bird heading rapidly towards the Tasman Peninsula. Photographs revealed it to be a Black-faced Cuckoo-Shrike (*Coracina novaehollandiae*) that was probably returning to Tasmania for the breeding season.

On 8th September, Peter Vaughan submitted an eBird checklist for a trip led by Lauren Roman. This trip was organised for a group of Chinese photographers to investigate making a film in the area. The swell was very large, about 4 m, but with very long amplitude and with no chop on top, along with hardly any wind, so quite unusual conditions. The highlights included a Salvin's Albatross (*Thalassarche salvini*), a Snowy form of the Wandering Albatross (*Diomedia* exulans) and a Blue Petrel.

On the weekend of 14th and 15th September, Rohan Clarke led two pelagics. The weather forecast had been for huge swells and galeforce winds but for the Saturday trip Rohan reported a surprisingly pleasant day with relatively few bumps and little spray. Only 22 species of seabirds beyond Pirates Bay were recorded, which was below average for Tasmanian pelagics. The highlights were a Soft-plumaged Petrel that provided a couple of fly-bys and some close approaches by Southern Royal Albatross, of which there were two adults and one juvenile at the first berley stop.

After the trip on the Sunday, Rohan commented: 'We had this young Buller's Albatross off Eaglehawk Neck, Tasmania today. I must have logged over 1000 Buller's off Tassie by now and this is the first individual that I've encountered off here that wasn't a sharp-looking adult. In the field it looked small with a notably rounded head – at first I was wondering if it was a hybrid but I think it otherwise checks out as a Buller's Albatross' (*Thalassarche bulleri*). This was later confirmed in Rohan's report, which mentioned other highlights as a Salvin's Albatross and up to 100 Shy Albatross(*Thalassarche cauta cauta)* behind the boat.

On 13th October a Chinese film crew were accompanied by Karen Dick, Peter Vaughan and two others as observers. Highlights of the trip were a Salvin's Albatross, a Northern Royal Albatross and a single Westland Petrel (*Procellaria westlandica*) that followed the boat out to the shelf and circled close by for the duration of the stop. This trip also reported 350 Short-tailed Shearwaters (*Ardenna tenuirostris*), the first sightings of the season. As the earliest sightings for the season, their arrival in mid October rather than mid September was unusually late this year after reports of mass mortalities in their northern feeding grounds.

The following day, 14th October, Karen Dick was the guide on an Inala trip and possibly the same Westland Petrel from the previous day was the highlight of this trip as well.

Three days later, on 17th October, Karen was the guide on another Inala trip when a Fiordland Penguin (*Eudyptes pachyrhynchus*) was observed moulting along the cliffs. A Northern Royal Albatross was also a highlight on the day.

On 31st October Karen Dick was the guide on a very exciting Inala pelagic that featured a Northern Royal Albatross, two Black-bellied Storm-Petrel (*Fregetta tropica*), a Soft-plumaged Petrel, a White-headed Petrel, a Mottled Petrel (*Pterodroma inexpectata*) and an Antarctic Prion.

Karen Dick led a pleasant pelagic on 3rd November, with quiet and calm conditions that gave us some good opportunities for photographing the birds. Two juvenile White-bellied Sea Eagles (*Haliaeetus leucogaster*) perched on a tree were a nice start as we left the harbour. A total of 23 species were observed but numbers of each were low. As we left port all on board were excited to see large rafts of shearwaters on the water and big flocks in the air. There were three Sooty Shearwaters (*Ardenna griseus*) amongst the flock of about 7000 Short-tailed Shearwater. At Hippolyte Rock, the skipper kept the boat out wide to allow us to count the two Australasian Gannet (*Morus serrator*) colonies forming there. My photos revealed 15 birds on the site above the lower cliffs and 25 on top of the island. Highlights further out at sea included good views of four Providence Petrel, one Southern Royal Albatross, two Black-browed Albatross, two Campbell Albatross (*Thalassarche impavida*) and two White-chinned Petrel (*Procellaria aequinoctialis*). The two young Sea Eagles were there again to welcome us back to the harbour.

Craig Geer organised a private trip on 8th November and the outstanding highlight was about 30 Long-finned Pilot Whales. The skipper, John Males, later told me that through the window of the cockpit, it had been the best view he had ever enjoyed of these creatures as they stood high in the water, close to the boat and at his eye level. One individual made eye contact with John and he imagined he could see its curiosity.

On Sunday 10th November Paul Brooks led a trip which almost did not leave and then nearly turned back at the Hippolytes. The wind topped 40 knots with up to 5+ m waves and even the occasional 6+ m wave. As we pressed on, we were rewarded with some nice birds out wide as we trolled rather than drifted in rough seas. Highlights included a Black-bellied Storm-Petrel, a Southern Giant Petrel and a Mottled Petrel, which was over just 80 fathoms in the afternoon. Despite those conditions, only one of us was seasick.

During early November many people commented on the large numbers of gulls and terns that followed the MV *Pauletta* out to the shelf. Pacific Gulls usually returned to shore after we passed the Hippolytes but the others circled the boat and were obviously hungry. Many were in breeding plumage and it was a good opportunity to photograph them in flight, but having so many gulls in the air made it tricky to spot and identify the other birds.

Bernie O'Keefe led two trips for the weekend of 16th and 17th November and I was fortunate to be invited on both. The weather was challenging with strong westerly winds and a high swell. The highlight for the day was a close fly-by of a Black-bellied Storm-Petrel and an adult Salvin's Albatross. As we headed back we followed the shore below the spectacular cliffs. Here an adult Sea Eagle attacked one of many White-chinned Petrels following the boat. The petrel fought back, biting the leg of the eagle, which dropped it to the water but the raptor repeatedly tried to catch it, to no avail until another White-chinned Petrel took its attention, but that bird also managed to escape. It was a most dramatic end to the trip.

Bernie's trip on Sunday 17th November started with spectacular views of two Humpback Whales that first showed with high blows out at the horizon but soon swam toward the boat, breaching and flapping their fins on the water repeatedly, before passing the stern. While still near the boat, both whales did a couple of complete breaches before disappearing from view. This time we also had a high swell with 25 to 40 knot south-westerly winds that increased as we approached the shelf. At that stage the highlight was a brief view of an Antarctic Prion. Soon after a front approached from the south blowing in an incredibly large number of prions and other small birds, but there was little chance for photography as conditions forced us to retreat inshore towards calmer waters. A total of 22 species were observed including an immature Salvin's Albatross, a White-headed Petrel, a Southern Giant Petrel and about 10,000 Short-tailed Shearwater. In addition, an Auckland 'White-capped Albatross' (*Thalassarche cauta steadi*) was observed, the New Zealand subspecies of the Shy Albatross.

The following day, Monday 18th November, Karen had organised a trip for a couple visiting from Sweden and I was invited to join the group. After the weekend, the wind had dropped to a steady westerly breeze. Possibly three Parasitic Jaeger (*Stercorarius parasiticus*) were seen chasing other birds. Additional highlights included a young Indian Yellow-nosed Albatross (*Thalassarche chlorhynchos carteri*), three Northern Royal Albatross, seven Wandering (Gibson's) Albatross and no less than four White-bellied Sea-Eagles.

Paul Brooks organised the pelagic for Sunday 1st December but in his absence, Mona Loofs-Samorzewski kept the notes, reporting the trip as a quiet one with no outstanding highlights apart from the reassuring sight of two Southern Giant Petrels, one younger and one older. This is a species that is being seen in smaller numbers lately. We also had a Northern Royal Albatross. I have noticed over the last few pelagics that large numbers of gulls follow the boat all the way beyond the shelf, but the Pacific Gull (*Larus pacificus*) usually returns to shore well before the shelf. However, on this occasion a Pacific Gull also followed the boat out to pelagic waters which I have never observed before. All on board commented on the lack of smaller species with only one White-chinned Petrel, no Prions, Storm-Petrels or Diving Petrels seen all day. Perhaps conditions were too benign. On our way back we watched three White-bellied Sea-Eagles including two adults and one immature flying around the Hippolytes.

Only a week later, Saturday 7th December was a very windy day for our first of two pelagics run by Rob Morris. At first the skipper was doubtful we would make it to the shelf but as we headed north, the swell dropped and we were rewarded with a good variety of birds in contrast to the previous weekend. Two Arctic Jaegers flying together was the first highlight soon after we left the jetty and fifteen minutes later there was a third Arctic Jaeger that flew past close to the boat. Unlike the previous pelagic, there was a Diving Petrel, two Grey-backed Storm-Petrel, six Wilson's Storm Petrel and a single Black-bellied Storm-Petrel. Others saw a Mottled Petrel that everyone was hoping to see but I missed it. However, I did see the distant Cook's Petrel (*Pterodroma cookii*). Other highlights were a Northern Royal Albatross which had a slight staining around the neck, something that the literature tells us is indicative of a Wandering Albatross and would exclude Royals. However, this bird was definitely a Northern Royal. There was a beautiful adult Salvin's Albatross that stayed around the boat and preened on the water. One Wandering Albatross had a large area of neck stain that completely circled the back and sides of the neck which was quite unusual. Rohan Clarke later commented on my photos to say that he had not seen staining as extensive as this. He added that 'the bird also looks to be in worn plumage or perhaps some of the stain has also been spread to the back and upper-wings' (noting some of those marked feathers).

Sunday 8th December was calmer than the previous day but still quite cold.

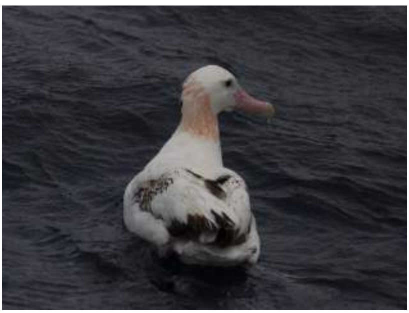


Plate 2: Wandering Albatross with staining

As we boarded, Rob noticed a banded Silver Gull perched on the jetty and after alerting me, we took photos of the bands before the bird disappeared, but both of us missed the first three numbers on the band. Beyond the Hippolytes an Arctic Jaeger, two Northern Royal Albatross, two Arctic Terns and a series of up to 10 Cook's Petrel were the highlights of the day. This time I managed to photograph a Cook's Petrel that flew a little closer to the boat. On our way back from the shelf, a large flock of Prions was on the surface of the water and one solitary Antarctic Prion circled the boat for some time. Amongst the 35 to 40 White-chinned Petrels were two individuals that were interacting opposite each other on the water, making curious bell like sounds, their bills wide open.

At my request, Paul Brooks organised and led the pelagic on 11th January when Isabelle Jollit, the wellknown birding guide from New Caledonia, visited Tasmania with her husband and their three-year-old son. Isabelle had guided Hazel Britton and me in mid-2019 when we visited New Caledonia and when we invited her to visit Tasmania and explore our birds, including our pelagic birds. Unfortunately the boat trip soon ran into gale-force winds so we were forced to seek shelter behind the Hippolytes before returning along the shoreline to avoid the wind. Despite these conditions, a good range of birds was observed including a dark morph of Parasitic Jaeger and a variety of albatross including a Southern Royal. Seven Northern Giant Petrel (*Macronectes halli*) were an unusually high number. Of the three Fluttering Shearwater (*Puffinus gavia*), one bird lacked saddlebags and had dusky underwings and flanks, but fresh juvenile plumage at this time of year ruled out Hutton's Shearwater. There were no clear highlights for the day; however, we all felt that this 'inshore pelagic' had been worthwhile with an unexpectedly wide variety of pelagic seabirds so close to shore.

Rohan Clarke organised two pelagics for 1st and 2nd February. Due to a last minute cancellation for the Saturday, I was fortunate to go on both trips and it was interesting to see how different they were. Saturday was warm to hot after one of the hottest days on record for Hobart on Friday. There was a 2 to 3 m short interval swell. We had 34 species of seabirds for the day, which Rohan commented in his report to be well above average species richness for a Tasmanian pelagic. The bird of the day was a dark-morph Soft-plumaged Petrel that stayed around the boat for about 5 minutes, followed by a typical pale morph. Other highlights were four Buller's Shearwaters (*Ardenna bulleri*), two White-headed Petrel, a Providence Petrel, one Cook's Petrel and one Gould's Petrel (*Pterodroma leucoptera*)! In addition, there were 18 Wedge-tailed Shearwater (*Ardenna pacificus*), which Rohan described as an exceptional count given the species was a major rarity in Tasmania only approximately five years ago. Thirty Fluttering Shearwater was also a high number and throughout the day there was a typical Tassie albatross diversity. In fact, Rohan told me that it was one of the best pelagics he had ever experienced off Eaglehawk Neck due to the wide range of species.

On Sun 2nd February, the weather was windy building to 30 knots with a low swell building to a messy 1 to 2 m sea. On our way to the shelf, we circumnavigated the Hippolytes where Rohan demonstrated his keen observation skills by identifying three White-fronted Tern (*Sterna striata*) and my photos later revealed a total of four, sheltering on the rock among masses of Crested Terns. Further highlights included a Wedge-tailed Shearwater inshore and three offshore, plus a total of 36 Fluttering Shearwater throughout the day, many staying around the boat for long periods. A Pomarine Jaeger (*Stercorarius pomarinus*) flew by in the distance, which Rohan felt was a good bird for this area.

For the 7th February pelagic Paul Brooks reported benign conditions with a good number of storm petrels in the slick and a nice array of great albatross, including Northern and Southern Royal and four Antipodean Albatross, all *gibsoni* but no *Pterodroma* petrels.

Paul Brooks organised the pelagic on Sunday 23rd February but was unable to attend, so Mona Loofs-Samorzewski wrote the report. The skipper was Michael Males as his father John was recovering from ankle surgery. We had excellent sunny, mild conditions, a low 1 to 2 m swell and mild 10 to 12 knot northerly winds. Despite this, a total of 24 species were observed with a good range of albatross including the day's highlight, a Northern Royal and a beautiful, mottled Wandering Albatross

(Snowy). A Southern Giant Petrel, a total of 16 White-chinned Petrel and some closeup views of three Fluttering Shearwater were nice additions to the day which finished off with the regular Peregrine Falcon(*Falco peregrinus*) flying above the Hippolytes.

On Sunday 15th March the pelagic was organised by Paul Brooks to include two visiting birders, Joris de Raedt and his friend Johan, both from Belgium. Paul compiled the report. Michael Males, our skipper, is to be congratulated for his excellent seamanship during a fairly rough trip with a few big waves. The first highlight of the day was an Arctic Tern in breeding plumage, a first record of this species in March for an Eaglehawk pelagic and a first for many on board. The bird hovered over the slick and did a lap of the boat before heading off. This was followed by two Soft-plumaged Petrel, the first one frequently approaching the boat and the second one making a close fly-by. Other highlights were a Southern Giant Petrel, a distant Gould's Petrel and a White-headed Petrel.

On the drive back to Hobart, some of us stopped at the start of Sommers Bay Road in Murdunna to check for the Nankeen Night-Heron (*Nycticorax caledonicus*) that often roost in the trees around a house behind the shop. As our group approached the property, the owners emerged to welcome us and took us onto their land to point out three birds trying to hide among the branches. This has been a regular roost for many years now and we were told that there have been up to 15 birds present at one time.

Little did anyone suspect that this would be the final pelagic for the financial year, due to the COVID-19 pandemic.

Acknowledgements

I would like to thank Paul Brooks for his assistance with this report. Also thanks to the many trip leaders, to Adam Mackintosh the deck hand, and a special thanks to both our skippers, John Males and his son Michael, whose father taught him well!

Reference

Wakefield, E. (2019). Highlights of pelagic birding from Eaglehawk Neck 2018/2019. *The Tasmanian Naturalist* 141: 145–156.

Bird species list pelagic highlights 2018/2019 IOC taxonomy

Spheniscidae, Penguins

Fiordland Penguin (*Eudyptes pachyrhynchus*)

Diomedeidae, Albatross

Wandering Albatross (*Diomedia exulans*)

Gibson's Wandering Albatross (*Diomedea antipodensis gibsoni*)

Northern Royal Albatross (*Diomedea sanfordi*)

Southern Royal Albatross (*Diomedea epomophora)*

Sooty Albatross (*Phoebetria fusca*)

Black-browed Albatross (*Thalassarche melanophris*)

Campbell Albatross (*Thalassarche impavida*)

Shy Albatross (*Thalassarche cauta cauta)*

Shy Albatross (*Thalassarche cauta steadi*)

Salvin's Albatross (*Thalassarche salvini*)

Grey-headed Albatross (*Thalassarche chrysostoma*)

Buller's Albatross (*Thalassarche bulleri*)

Procellariidae, Petrels, Shearwaters

Southern Giant Petrel (*Macronectes giganteus*)

Northern Giant Petrel (*Macronectes halli*)

Blue Petrel (*Halobaena caerulea*)

Antarctic Prion (*Pachyptila desolata*)

Broad-billed Prion (*Pachyptila vittata*)

Slender-billed Prion (*Pachyptila belcheri*)

Antarctic Prion (*Pachyptila desolata*)

Grey-faced Petrel (*Pterodroma gouldi*)

White-headed Petrel (*Pterodroma lessonii*)

Providence Petrel (*Pterodroma solandri*)

Soft-plumaged Petrel (*Pterodroma mollis*)

Mottled Petrel (*Pterodroma inexpectata*)

Gould's Petrel (*Pterodroma leucoptera*)

Cook's Petrel (*Pterodroma cookii*)

Great-winged Petrel (*Pterodroma macroptera*)

Grey-faced Petrel (*Pterodroma gouldi*)

Grey Petrel (*Procellaria cinerea*)

White-chinned Petrel (*Procellaria aequinoctialis*)

Westland Petrel (*Procellaria westlandica*)

Cape Petrel (*Daption capense*)

Manx Shearwater (*Puffinus puffinus*)

Wedge-tailed Shearwater (*Ardenna pacificus*)

Buller's Shearwater (*Ardenna bulleri*)

Short-tailed Shearwater (*Ardenna tenuirostris*)

Sooty Shearwater (*Ardenna griseus*)

Fluttering Shearwater (*Puffinus gavia*)

Hutton's Shearwaters (*Puffinus huttoni*)

Hydrobatidae, Storm Petrels

Black-bellied Storm-Petrel (*Fregetta tropica*)

Pelecanoididae, Diving Petrels

Common Diving Petrel (*Pelecanoides urinatrix*)

Laridae, Terns

Pacific Gull (*Larus pacificus*)

White-fronted Tern (*Sterna striata*)

Arctic Tern (*Sterna vittata*)

Bird species list pelagic highlights 2018/2019 IOC taxonomy (continued)

Suliformes

Australasian Gannet (*Morus serrator*)

Stercorariidae, Skuas

Pomarine Jaeger (*Stercorarius pomarinus*)

Parasitic Jaeger (*Stercorarius parasiticus*)

Accipitridae, Eagles

White-bellied Sea Eagle (*Haliaeetus leucogaster*)

Falconidae, Falcons

Peregrine Falcon (*Falco peregrinus*)

Campephagidae, Cuckoo-shrikes and Trillers

Black-faced Cuckoo-Shrike (*Coracina novaehollandiae*)

Ardeidae, Herons and Bitterns

Nankeen Night-Heron (*Nycticorax caledonicus*)

The Tasmanian Flora Network – Publicising changes to vascular flora and threatened species lists 2019–2020

Wendy Potts
Threatened Species Section,
Department of Primary Industries, Parks, Water and Environment
email wendy.potts@dpipwe.tas.gov.au

The Tasmanian Flora Network is an informal group of email recipients (approximately 210 at the time of publication) that is maintained by the Threatened Species Section of the Department of Primary Industries, Parks, Water and Environment (DPIPWE). Emails are sent to the group up to several times a year to inform members of news pertaining to Tasmanian flora, with a focus on vascular and threatened flora. Changes to threatened fauna listings are also provided. Members are encouraged to forward the emails to colleagues and others who may be interested, and requests for additions to or removal from the mailing list can be made by email to:

wendy.potts@dpipwe.tas.gov.au

The following is a summary of information sent in the year prior to mid-October 2020.

(1) Changes to Schedules of the *Threatened Species Protection Act 1995*

(* = species listed on the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act))

A *Threatened Species Protection Order* is anticipated for gazettal in late 2020 with the following schedule changes. These proposed changes have been flagged as pending in the Natural Values Atlas, on the Threatened Species Link and on the DPIPWE webpages:

Status changes from public nominations

Flora

Delist *Juncus amabilis* from Schedule 5 (rare)

Delist *Rytidosperma indutum* from Schedule 5 (rare)

Status changes from direct recommendations from the Scientific Advisory Committee (SAC)

Flora

List *Ozothamnus floribundus* on Schedule 3.1 (endangered and extant)

List *Prasophyllum abblittiorum* on Schedule 3.1 (endangered and extant)

Uplist *Thelymitra mucida* from Schedule 5 (rare) to Schedule 3.1 (endangered and extant)

Downlist **Pomaderris pilifera* subsp. *talpicutica* by omission from Schedule 3.1 (endangered and extant), and addition to Schedule 4 (vulnerable)

Notesheets or revised Listing Statements for the above species are now available online in the Natural Values Atlas, Threatened Species Link and the DPIPWE webpages.

Fauna

List *Antechinus vandycki* (Tasman Peninsula dusky antechinus) on Schedule 4 (vulnerable)

Uplist *Smilasterias tasmaniae* (Bruny Island seastar) from Schedule 5 (rare) to Schedule 3.1 (endangered and extant)

Uplist *Castiarina insculpta* (Miena jewel beetle) from Schedule 4 (vulnerable) to Schedule 3.1 (endangered and extant)

Changes to scientific names

Old scientific name	New scientific name	Authority for New Name
Flora		
Calystegia sepium	*Calystegia sepium* subsp. *sepium*	(L.) R.Br.
Melanelia piliferella	*Austromelanelixia piliferella*	(Essl.) Divakar, Crespo & Lumbsch
Fauna		
**Tasmanipatus anophthalmus*	*Leucopatus anophthalmus*	(Ruhberg, Mesibov, Briscoe & Tait)

Family classification changes

The family name of the four listed *Lepilaena* species has also been updated to Potomogetonaceae in the Schedules to be consistent with the classification now used in the annual Tasmanian Herbarium's census of vascular plants.

(2) Rejection of public nomination

The Minister decided on 5 March 2020 to accept the SAC's final recommendation to retain the conservation status of **Conospermum hookeri* on Schedule 4 (vulnerable) upon reassessment following receipt of a public nomination to downlist the species. The revised Listing Statement is now available online in the Natural Values Atlas, Threatened Species Link and the DPIPWE webpages.

(3) Changes under consideration to the threatened species schedules of the *Threatened Species Protection Act 1995*

Final recommendations (public nominations)

Retain *Plantago debilis* as rare (the nomination was to delist the species)

Delist *Epilobium pallidiflorum* from rare

Delist *Hierochloe rariflora* from rare

List *Chiloglottis valida* as endangered

List *Senecio extensus* as endangered

List *Senecio longipilus* as vulnerable

List *Senecio tasmanicus* as extinct

The Minister is now considering the above final recommendations from SAC. Notesheets for the four species under consideration for listing have been prepared and are now available online in the Natural Values Atlas, Threatened Species Link and the DPIPWE webpages.

Please consider nominating species for listing or a change of status by either completing a nomination form available at

https://dpipwe.tas.gov.au/conservation/threatened-species-and-communities/process-for-listing-threatened-species

or sending a draft Listing Statement to the Threatened Species Section.

(4) SAC priorities for assessment of the conservation status of watchlist flora species

*Cryptandra exilis**

Coronidium gunnianum

Craspedia paludicola

Leionema oldfieldii

Arthropodium pendulum

Billardiera ovalis

Milligania stylosa

Notogrammitis garrettii

Viola serpentinicola

Notogrammitis gunnii

*Notesheet available on the NVA, Threatened species link and DPIPWE webpages.

The Threatened Species Section will collate available information on the above species for the SAC to consider at future meetings. Please send any comments you have relevant to the assessment of the conservation status and any observation data you have for submission to the Natural Values Atlas on these species to:

wendy.potts@dpipwe.tas.gov.au

(5) IUCN Red List assessments of Australian eucalypt species

The Threatened Species Recovery Hub has released a factsheet detailing the preliminary findings of the assessments of all of Australia's 822 eucalypt species (infraspecies not assessed) using the IUCN Red List listing criteria, with 193 species meeting the criteria for listing as Critically Endangered, Endangered or Vulnerable See *http://www.nespthreatenedspecies.edu.au/*

Four Tasmanian species qualified, not surprisingly *Eucalyptus morrisbyi* as Critically Endangered, and *Eucalyptus risdonii* as Vulnerable (rare on the Tasmanian legislation). However, *Eucalyptus gunnii* qualified as Endangered and *Eucalyptus ovata* as Vulnerable due to decline since European settlement (both species are not listed on Tasmanian legislation or on the EPBC Act). The assessments will be made available to the Commonwealth and State and Territory governments in due course.

(6) Declines due to drought

We have received reports of substantial declines due to the recent extremely dry conditions for a number of listed flora species including **Conospermum hookeri* at Freycinet and **Pomaderris pilifera* subsp. *talpicutica* at East Risdon, and many eucalypt species have suffered. Please let us know of substantial declines that you have noted for listed or possibly threatened species, at least for species that may struggle to recover.

(7) Wild Orchid Watch (WOW) launched

Wild Orchid Watch (WOW) is a national orchid data collection project. The Wild Orchid Watch is a project within iNaturalist, a joint initiative of the Californian Academy of Sciences and National Geographic, and a highly successful online citizen science platform. An Australian WOW team have developed an app and website to enable orchid enthusiasts to collect, record, identify and share information about Australian native orchids. Ecologists at the University of Adelaide, in collaboration with members of the Australasian Native Orchid Society (ANOS), have established **agreed methods** for data collection via the WOW app and website. This **online resource** utilises the iNaturalist platform, and will act as a central hub for orchid enthusiasts to record and store orchid observations, seek orchid identification and share information with trusted users. The **WOW app** has been developed in-house at the University of Adelaide to be fit for purpose. The app will guide users to **collect data**, take a series of photographs and answer questions about variables such as habitat, landform, pollinators observed, and site disturbances. Location data will be recorded using the phone's GPS. **Data sharing** with trusted users (ecologists and taxonomists) will enable critical research into orchid distribution, abundance, phenology and as indicators of environmental change. The custom-built WOW app will feed data to iNaturalist where WOW data will be securely stored along with millions of other observations of living organisms submitted via the iNaturalist app.

After two years of development, testing and collaboration between citizen scientists, orchid enthusiasts and scientists the WOW app is ready to use! You can access the WOW app by going to the internet browser on your mobile device and typing in:

www.app.wildorchidwatch.org

Wild Orchid Watch Australia is a project within iNaturalist and all photos and data collected using the WOW app will be stored, collated and identified on the iNaturalist platform. If you already have an iNaturalist account you can use it to log in to the WOW app, and if not, it is very easy to create one. WOW app frequently asked questions (including details about the WOW app, photo and data copyright, privacy policy and terms of service) can be found on our website here:

https://www.wildorchidwatch.org/faqs

For guidance on signing up and getting the most out of the WOW app please see the WOW App Instructional Videos.

It is anticipated that research grade WOW data will be imported into the Natural Values Atlas on a regular basis along with other records from iNaturalist. However, as there may be a delay in importing the observations into NVA or updating any redeterminations made in iNaturalist, we would still appreciate direct entry of your observations into NVA.

(8) Issue with NVA data delivery via LIST Web Services

From the NVA team: It came to light in January, that the ArcGIS based server system, which LIST uses to deliver NVA data to clients, was having an issue with the 'null dates' in the NVA database. Null date (no date) records on the NVA have historically been entered as 01-01-0001, and are actually displayed on the NVA's web interface as an empty, missing date. It has become apparent that ArcGIS does not recognise this date as valid, and therefore LIST Services have not been delivering any records which had that date to clients. We are unsure how long this situation has been going on, as the system apparently did not feedback any errors to LIST Services staff; it just did not deliver the 'problem' records. The upshot is that it is possible that some threatened species records on the NVA may not have been showing up on the systems of those of you who directly consume NVA data via LIST services. That being the case, it would be prudent for users of LIST Services to check any recent data relating to development proposals etc., to make sure no important NVA species records have been missed. Note that, to work around this issue, we have temporarily changed the null dates in the NVA to be 01-01-1900, so that ArcGIS will not reject them. We are working on a more long-term fix for this issue with LIST, and the overall date issue has also been raised with ESRI.

(9) New location for Critically Endangered plant on Macquarie Island **(* = EPBC Act listed species)**

A Critically Endangered perennial herb species endemic to Macquarie Island has been identified at a new location on the island, in what is one of the most significant botanical observations since the completion of the Macquarie Island Pest Eradication Project (MIPEP). The positive identification of a new **Galium antarcticum* population on the western shoreline of Major Lake is a significant find as it was previously known to only occur in one locality at Skua Lake, about 7 kilometres away. The quality of the habitat in which the herb grows is likely to have been impacted by feral rabbit activity prior to the MIPEP undertaken by the Tasmanian Parks and Wildlife Service (PWS) between 2007 and 2014 – the world's largest island eradication project to remove all rabbits, ship rats and mice. PWS Macquarie Island Ranger in Charge Chris Howard located the plant by chance during a routine patrol as he was heading south to check on Wandering Albatross chicks. The herb had previously been found in 2013 on the northern edge of the shore of the Skua Lake, after it was believed to have become extinct in the early 1980s. 'Finding this new site during the tenth anniversary of the beginning of MIPEP makes it even more significant', Mr Howard said. 'I've been in the box seat, so to speak, to document the recovery of many of the island's plant species including a very small tassel fern (*Huperzia australiana*) and equally as small endemic helmet orchid species (**Corybas dienemus*), but finding the new *Galium* site is certainly an "up there moment".' The *Galium antarcticum* population is currently growing in a 300 m section of the western foreshore of the lake edge, with two additional populations about 250 m to 350 m further to the southwest. There are plans to commence surveying similar habitats to see if any other populations can be located. Having spent the last couple of winters as ranger in charge on the island, Mr Howard said he had been fortunate to witness the recovery first hand. "This is really an acknowledgement of time, money and importantly the collective energy of all those that worked together to make MIPEP happen," he said.

(10) New edition of the Tasmanian Herbarium's Census of the Vascular Plants of Tasmania (available on the TMAG website)

– from Miguel de Salas

The 2020 edition of the *Census of the Vascular Plants of Tasmania, including Macquarie Island* is available at:

https://flora.tmag.tas.gov.au/resources/census/

The *Census* is the complete list of all vascular plant taxa that the Herbarium considers part of Tasmania's flora: this includes all native taxa (species, subspecies, varieties and forms), including extinct ones, plus all exotic taxa that we consider naturalised in the state (i.e. they form self-sustaining populations in Tasmania without human assistance). Each entry contains the correct name for the taxon, plus details of its publication, and any previous names commonly used in the past (synonyms and misapplications).

The 2020 edition of the *Census* includes six new species added to the state's flora: *Pterostylis straminea*, which replaces *P. plumosa* in Tasmania; *Pseudanthus divaricatissimus*, a population of which was mistakenly called *P. ovalifolius* in previous editions; three new *Lagenophora* species split from existing ones; and *Acacia acinacea*, recently discovered as a healthy population on Bruny Island. The names of seven taxa have changed since the previous edition. *Xerochrysum bracteatum* has had its status changed from native to naturalised since the previous edition. Seven taxa are no longer considered part of the

Tasmanian flora. Four of these were previously considered naturalised, although no evidence exists that they have ever formed self-sustaining populations.

The Wapstra family have kindly suggested common names for the new native taxa, with their suggestions now included in the Natural Values Atlas.

(11) New or reapproved Listing Statements and updated Notesheets

(available online in the Natural Values Atlas, Threatened Species Link and the DPIPWE website)

Listing Statements for the species below were approved by the Secretary of DPIPWE on 4 September 2020 replacing Notesheets for the species.

Bossiaea heterophylla

Thelymitra inflata

Thelymitra lucida

Veronica notabilis

Revised Listing Statements for the species below were approved by the Secretary of DPIPWE on 4 September 2020 replacing earlier versions.

**Conospermum hookeri*

**Eucalyptus morrisbyi*

Notesheets for the species below have been updated.

Schoenoplectus tabernaemontani

(12) Range changes for threatened flora as a result of new observations entered into DPIPWE's Natural Values Atlas (NVA) since mid-September 2019

(* = EPBC Act listed species)

Once again, thanks to all those providing **species observations for entry into NVA**. Please keep sending them in, particularly for threatened species and those that may qualify for listing. Please consider collating species observation data from any group field trips as well as your personal observations. Essential fields include species name, eastings and northings (GDA94), location accuracy in metres, observer name and date of observation (preferably accurate to the day). A description of the location is also useful as a check. For threatened species we also ask for notes on abundance (number of individuals and area occupied), disturbance and threats at the site, with many other fields to choose from. You can enter your observations directly into NVA (observation entry spreadsheets can be downloaded from the NVA 'Data Entry/ Create Workbook' page) or you can send data in to DPIPWE (to Wendy Potts for threatened flora), preferably in spreadsheet format. *Please also note whether any records are from non-native occurrences.* A special thankyou to those who have been entering records of non-threatened species as well as threatened species.

Many of the following changes were made from redeterminations and new records from updates of the Tasmanian Herbarium's database in July 2020 and as well as imports of research grade records from iNaturalist (with links to images held in iNaturalist – so please let us know if you find any identification issues while browsing!).

Extended range/significant infill

Argyrotegium poliochlorum (Whitehorse Hill, Hydro Creek)

**Barbarea australis* (Guide River, Bull Creek near where it enters Lake Cethana – new catchment)

Calandrinia granulifera (Trousers Point)

Drosera glanduligera (Musselroe windfarm)

Galium antarcticum (Macquarie Island)

**Lepidium hyssopifolium* (Tamar Island)

Myriophyllum integrifolium (Mount William)

Plantago glacialis (Western Tiers)

Pomaderris intermedia (Barnes Hill)

**Prasophyllum robustum* (West Launceston)

Ranunculus jugosus (Western Tiers?)

Scleranthus diander (5 km WSW of Cleveland)

Scleranthus fasciculatus (Constable Creek)

Senecio campylocarpus (Blackman River)

Stackhousia pulvinaris (Surrey Hills)

Stackhousia subterranea (5 km WSW of Cleveland)

Stuckenia pectinata (Macquarie River S of Ross)

Stylidium despectum (Rattys Track, Nettly Bay, Bluff Hill Point)

Viola curtisiae (Whitehorse Creek, Quamby Bluff, Bumbys Creek, Little Split Rock)

Vittadinia muelleri (Arthur Hwy–Boomer Road intersection)

Slight increase or infill

Argyrotegium poliochlorum

Bolboschoenus caldwellii

Brachyscome rigidula

Caladenia filamentosa

Calocephalus lacteus

Carex capillacea

Cyathodes platystoma

Gratiola pubescens

Leucopogon virgatus var. *brevifolius*

Liparophyllum exaltatum

Micrantheum serpentinum

Muehlenbeckia axillaris

Parietaria debilis

**Prasophyllum crebriflorum*

Schoenoplectus tabernaemontani

Scleranthus fasciculatus

Triglochin minutissima

Decreased range/significant defill

Caladenia caudata (Rocky Cape) – HO redetermination

Pterostylis falcata (Lake St Clair) – HO redetermination

Obituary

Catadromus lacordairei - 28 October 2020

Many of you will be aware of the research we have been conducting on *Catadromus lacordairei* (green-lined ground beetle) over the past few years. After locating her as an egg and successfully hatching and rearing her to adulthood, we bred and released several clutches of this threatened species back to the wild. All this research was new to science, but sadly the captive work is now at an end and it is with heavy hearts that we say farewell to our female beetle, affectionately called 'Cat lac', who has passed on after six years and seven months of exciting and stimulating company. Her final resting place will be in her own special position in the TMAG invertebrate collection and the knowledge we have gained will soon immortalise her in scientific literature.

Chris Spencer and Karen Richards

RIP Cat lac.

Juvenile Cat lac

Cat lac in her prime.

Book Reviews

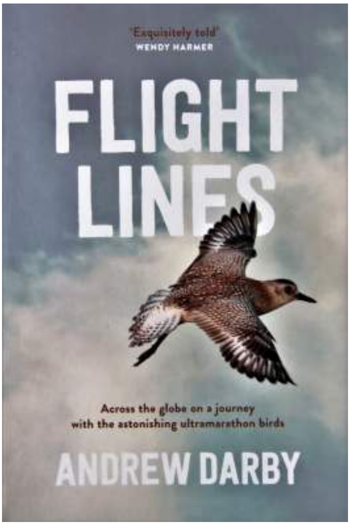
Flight Lines: Across the globe on a journey with the astonishing ultramarathon bird

by Andrew Darby

Allen & Unwin, 2020 Softback, 315 pages

ISBN 978 1 76029 655 1

Reviewed by: Amanda Thomson
holsum6@bigpond.com



Andrew Darby has been a journalist and correspondent for The Age and the Sydney Morning Herald; his interests have focused on Tasmania, the Southern Ocean and Antarctica. He has also written *Harpoon: Into the heart of whaling*.

This book is an unveiling of the secrets of a 'dovish wallflower' of a bird which ribbons its way from one side of the world to the other, linking with ecosystems along the way. Many birds migrate but these are extreme, flapping, non-stop, 7000-km marathon stints from Australia to China, feeding up, then continuing.

Not just writing from research, Andrew Darby joins the dedicated volunteers, enthusiasts and scientists who follow the 'flight lines' or migratory routes of these shorebirds into distant and remote destinations. Their collection of data forms an essential body of knowledge which enables support for these birds. That they congregate in feeding grounds allows them to be counted, in contrast to forest birds, which are far more difficult to assess and on which there is not the same kind of database to assess their numbers.

Throughout the book many different shorebird species and their flight lines are discussed. However, the main focus is on the Grey Plover, Pluvialis squatarola, a fairly inconspicuous 'wallflower' bird which makes round trips of around 40 000 km along the East Asian–Australasian Flyway (EAAF) and back, from Thompson Beach in Victoria to Wrangel Island in the Russian Arctic.

Finding their flight lines, their feeding grounds and ultimately their nesting grounds is the quest. I was fascinated by the history of tracking technologies – the means with which they do this. Originally banding was done with small metal leg rings, but now satellites and geolocation are used, eliminating the need to re-catch the birds.

There are many layers woven throughout this story. Searching difficult landscapes, tracking developments, insights and comparisons to other shorebird species and the trials these birds endure. Finding food to nourish and sustain these endurance flights is becoming more and more difficult. Man's encroachment on the natural world is reducing their feeding grounds through pollution, natural disasters, global warming, predation, rising sea levels, and the list goes on and on. These factors have resulted in enormous losses of both natural ecosystems and the birds who feed on them.

Natural impediments like weather changes, temperature, winds and storms are all somehow calculated and timed by these birds, who leave and arrive when their food source is plentiful on the other side of the world.

Over these issues lies another layer, one which in many ways brings it all together: the author Andrew Darby's cancer diagnosis. Andrew uses the strength of this bird's efforts to inspire his fight to survive. There are many parallels: the precariousness of existence, the journey, fears, battles, persistence, survival and through the deep, dark despair, hope.

Hope exists while these birds fight on, showing signs of adaptation to their changing landscape. Global cooperation is needed to ensure the security of flight paths and access to feeding grounds. There are positive signs with some proposed World Heritage listings. There are also many dedicated birders prepared to fight on to protect these amazing avian travellers.

Much is to be gleaned from this book, not only about the endurance flights, but also about all the factors impacting these birds' lives – natural disasters, man-made obstacles, global warming, environmental degradation and human encroachment. There are implications for all of us – made even more real by the events of 2020. This is a book bound to appeal to anyone interested in birds, science, ecology and evolution. It is an evolutionary tale of survival.

*****

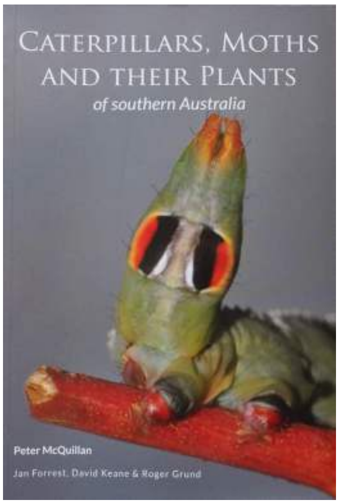
Caterpillars, Moths and their Plants of Southern Australia

by Peter McQuillan, Jan Forrest, David Keane & Roger Grund

Butterfly Conservation South Australia Inc (2019)

ISBN 978-0-646-80648-8

Reviewed by Margaret Warren
mawarren@optusnet.com.au



If you have ever come across an unusual caterpillar and wondered just what kind of butterfly or moth it would turn into, this is your book. There are many books on butterflies and moths, but most concentrate on the beauty of the adult insect and the caterpillar is scarcely mentioned or described. This new book puts caterpillars and their food sources into the spotlight.

Peter McQuillan is a Senior Lecturer at the University of Tasmania and is passionate about insects. He and his co-authors, Jan Forrest, David Keane and Roger Grund, have produced an excellent insight into the world of moths and caterpillars while highlighting their importance to the ecosystem.

The book contains over 650 colour photographs and covers 280 species of moths that are most commonly found in southern Australia; the majority of them also occur in Tasmania. It commences with a detailed description of the life cycle of moths with illustrations and photos. This section also covers their habitat, food plants and strategies for survival, along with notes on collecting and conservation.

The cover of the book features a striking photograph of a *Hylaeora dilucida* (ochre rough head) caterpillar. Its posterior is raised in a defensive posture to display two brightly coloured patches resembling large eyes. The moths and caterpillars featured in the book have been photographed from live rather than dead specimens, which provides a more accurate indication of their colour and form.

Moths and caterpillars have always been a rich food source for the Aboriginal people and are widely depicted in their artwork. The European settlers avidly collected specimens to send to overseas natural history museums as well as studying their impact on the food crops being grown in the new colony. Short cameos on some of these early entomologists make interesting reading.

The book then gets down to business with a comprehensive list of the moth families, together with photos showing the distinctive characteristics of the moth and caterpillar from each family. This is followed by detailed descriptions of individual moths, with numerous colour photographs and an all-important distribution map. The size of the caterpillar and wingspan of the moth, along with the flight period and food sources, are also noted.

Most people are familiar with the movement of looper or inchworm caterpillars from the Geometridae family, the name of which is derived from the Greek, meaning ‘to measure the earth’. I was amused, however, to read that caterpillars from the subfamily Hypertrophinae walk with a distinctive waddle, while caterpillars from the subfamily Pyraustinae are capable of rapidly running backwards!

With our current awareness of the decline in the insect population, it was alarming to learn that during the breeding season adult birds will feed their chicks around 300 caterpillars and insects each day; three small birds will consume more than 4200 insects while in the nest. The survival of many other creatures also relies on moths in egg, lava or pupal forms while, in return, moths pollinate flowers that only open at night. It is therefore vitally important that we preserve the insect habitat by growing native plants and even weeds, which provide food and shelter to enable insects to reproduce. To quote from the book, "habitat loss is the single most significant reason for the decline of invertebrate species in Australia".

At the end of the book we find a comprehensive glossary and an index of larval food plants, together with an index of both common and scientific names. There is also a list of suggested further reading and associated websites.

In all, this is a very interesting and informative book, a must-have addition to the library of both amateur and experienced moth enthusiasts.

*****

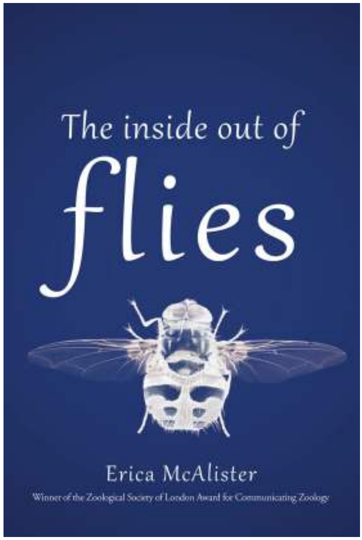
The Inside out of Flies

by Erica McAlister

published in the UK by the Trustees of the Natural History Museum and in Australia and New Zealand by CSIRO Publishing, 288 pages.

Reviewed by Simon Grove

simon.grove@tmag.tas.gov.au



Erica McAlister is Senior Curator of Diptera (flies) at the Natural History Museum in London. She is much admired for her outreach on UK radio and through social media, and has been honoured with the Zoological Society of London Award for Communicating Zoology. Yet, as much as I share her love of flies, I began reading this enticingly titled book with a sense of trepidation. Its 2016 predecessor, The Secret Life of Flies, had both enthralled me as an entomologist, and severely tested my lexicological sensibilities. It was as though the book's publishers (the Trustees of the NHM, no less) had seemingly gambled that it needed neither science- nor copy-editing. It badly needed both.

So how does this second offering stack up? The author is, of course, helped by the universally fascinating nature of the topic, which explores how fly anatomy allows the owners to possess such remarkable abilities in all manner of life skills: growing up from egg through maggot to adult, seeing, hearing, smelling, feeding, breathing, flying, communicating, walking on ceilings, vying for mates and reproducing – all while avoiding getting swatted. The intended tone is conversational, and this usually serves her well, as does the choice of photos of flies doing their thing. Each chapter is devoted to a particular set of fly features, starting at the front end (antennae, head, eyes) and ending at the rear end (genitalia), and the book is replete with well-researched vignettes on these themes. That said, at times her style lurches uncomfortably between somewhat arcane (when describing standard anatomical features such as musculature or chaetotaxy) and jauntily flippant (for instance, the extra-wide abdomen of a particular species of soldierfly is compared with Kim Kardashian's "famously large" rear end). Nevertheless, by the time I had worked my way through the entire book, I came to appreciate that I had learnt quite a lot about these wonderful creatures. I didn't know, for instance, that a female mosquito stores consumed blood in her stomach purely as a resource for growing her eggs, while nectar is stored in a separate crop for fuelling her own energy needs; nor that there was such a range of bizarre morphological adaptations setting the tone for the dating and mating game among different fly species. I hadn't appreciated that, when viewed head-on, the patterned wings of some otherwise defenceless picture-winged flies endow their owners with the looks of a predatory jumping-spider; nor that adult male New Zealand bat-flies call out ("zizz") when they sense an external threat to the adults and larvae comprising their communal groups – one of very few examples of paternal care in the insect world.

But have the publishers upped their game since The Secret Life of Flies? Alas, they haven't. I don't believe I have ever read such a poorly presented book in the 'popular science' mould. Science communication is meant to present an easily digestible narrative that gently guides its readers through the subject's complexities so that stuff is learnt, and concepts assimilated, almost without effort. It is meant to delight in precision of expression, in logical flow. Literary clumsiness, tautology, poor punctuation and typos are meant to be banished. Yet this book is riddled with all of these deficiencies and many more besides, and I can't fathom how it made it through to publication in its present, apparently unfinished, form. To be fair, in the Acknowledgements section the author does admit to putting her two reviewers and editors (I suspect unpaid) through torture. I'm just glad I wasn't one of them.

I spotted my first typo (an omitted word) on the first page, and things went downhill from there. Ungainly sentence construction; non-sequiturs, malapropisms; inappropriate punctuation; random and discombobulating apposition of singular and plural nouns, pronouns and verb-endings; mismatched or loosely worded captions; typos – this book has them all and would make an excellent case-study in their misuse. Admittedly I am a bit of a pedant when it comes to such matters (and I seldom attain my own high standards). But something's lacking in a popular science book if one has to reread a paragraph multiple times to work out what it is trying to say; sometimes I never quite worked it out. Here's a not-atypical opening sentence: "Being able to breathe, either in freshwater, the sea or on land, is a fundamental process and, I think that the adaptation in spiracles or breathing holes across the flies are truly extraordinary". Or this: "There are two distinct methods of attachment that have evolved in insects – smooth pads, or the hairy (setose) surfaces, the latter are found on flies' feet". Hmmm.

But back to the science part of science communication. Of course it's always easier to critique someone else's works than to craft one's own. But then again, first impressions count for a lot – and the sprinkling of taxonomic untruths and poor use of scientific nomenclature that I spotted throughout the text left me wondering about the quality of what I was learning. For instance, I would expect a Senior Curator of Diptera at the NHM, one of the most august taxonomic institutions on the planet, to know that flies comprising the family Ceratopogonidae are the biting (rather than the non-biting) midges. I would also expect such a person to know the usage difference between larva (singular) and larvae (plural); ditto pupa/pupae, trachea/tracheae, ovum/ova, antenna/antennae, tarsus/tarsi and a host of other Latinate terms in a similar vein. And yes, I do feel that a professional dipterist worth their salt should have a basic proficiency in knowing when to capitalise taxonomic terms (for example, Diptera rather than diptera, but dipterans rather than Dipterans; ditto Arthropoda but arthropods) and how to spell them (Muscomorpha rather than Muscamorpha; phlebotomines rather than phlebotimines); yet this book uses these terms and others like them interchangeably – sometimes in the same sentence. Here's a taster, taken from the Introduction: "The order diptera, the true flies, is in the Class Insecta, which forms part of the phylum Arthropoda".

I have no doubt that the author is a passionate enthusiast for her beloved flies; and I can well imagine that she does an awesome (one of her favoured words) and entertaining job of sharing her enthusiasm through her radio and other media appearances. But I do wonder how she got to turn her hand to the written word with such little apparent editorial support or oversight from the publishers. Popular science writing is hard enough for full-time writers, let alone for the rest of us with day-jobs – so all credit to those who step forward. But if publishers want the best from their authors, and for their readership, they need to step up to the mark too.

So do I commend this book to you? Well, yes, sort of, if only for the topic: you will learn interesting stuff about flies. And you may not get so hung up along the way about the book's shortcomings as I did. But be warned: this is not an easy read, and it's certainly not the book to pick up expecting to learn about how to do science communication.

Child of Gondwana: The geological making of Tasmania

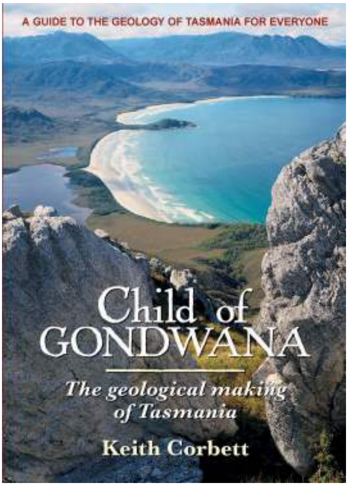
by Keith Corbett

Forty South Publishing Pty Ltd (2019)

Hardback , 197 pages, fully illustrated.

ISBN 9780648675747

Reviewed by Stewart Nicol and by Andrew McNeill



Review by Stewart Nicol

s.c.nicol@utas.edu.au

Field naturalists study plants and animals in their natural surroundings and this book provides a wonderful insight into the geological processes that have shaped the unique flora and fauna of Tasmania. When I taught a university course on Tasmanian fauna, I asked students to keep in their minds the following questions: Why are these animals in Tasmania? Where are these animals in Tasmania? Or, more formally, "What processes, past and present, have determined the make-up and distribution of the Tasmanian fauna (and flora)?" Most of the answers to these questions lie in Tasmania's geological history and current geology, and Keith Corbett's book provides a comprehensive and highly readable insight into both.

One of the most significant biogeographic divides in Tasmania is between east and west. Eastern Tasmania is dominated by dry sclerophyll forest and woodland, while in the west temperate rainforest, wet sclerophyll and moorland/sedgeland vegetation communities dominate. Lake chemistry, and vegetation, all change quite abruptly at what has been called "Tyler's Line", named after limnologist Peter Tyler, which roughly coincides with the 146th meridian. There are faunal changes from west to east: for example, the landhopper Neorchestia plicibrancha and the flightless grasshopper Truganinia bauerae only occur west of the line, while the frog *Litoria burrowsae* occurs west of the line, with a different species, *L. raniformis,* to the east. These and many other floral and faunal differences between west and east are due to the fact that the west is more mountainous, wetter, and has different rocks and thus different soils from the east. And the reasons for all of these things that contribute to making Tasmania so fascinating for the field naturalist lie in its geological history. The west of Tasmania is wetter because it sits in the path of the of the Roaring Forties, the strong westerly winds between 40 and 50 degrees south. Tasmania did not always sit at its current latitude – it is part of the fastest-moving tectonic plate in the world, the Australian crustal plate, which is moving north-west at about 6–7 cm each year. Corbett's book explains how and when Tasmania got to its current position. The Roaring Forties drop their moisture on the west coast because of its many mountains, which are the result of a complex series of mountain-building events – uplift, erosion, further faulting, and glaciation, all of which are clearly described and explained. Corbett skilfully draws together the many threads of the story of the geological making of Tasmania to provide a deeper insight into what we see today.

The book comprises seven chapters; the first chapter provides an overview of the physical geography of Tasmania, and gives Corbett's own story, his childhood and his pathway into studying geology at the University of Tasmania and transformation into a working geologist. This chapter ends with an overview of Tasmania's geology, illustrated by a large-scale map and some very instructive cross sections across the state.

Chapter 2 is subtitled "The big picture" and introduces plate tectonics, describing how continents continually move, and how this contributes to the distribution of rock types and, very importantly, mountain building, or orogenesis. We learn about Tasmania's early beginnings wedged between North America and Antarctica, and, subsequent to that break-up, of its long attachment to Antarctica, and its incorporation into Gondwana. Throughout the book Corbett links these big events to specific rocks and structures we can see outcropping across the state. This chapter also introduces one of the largest igneous events in earth history, the intrusion of massive volumes of dolerite magma into parts of Gondwana that would eventually become Africa, Antarctica and Australia. Although there are no large intrusions of dolerite in mainland Australia, Tasmania has the largest exposure of dolerite in the world, and its characteristic columnar jointing is seen on the majority of mountain peaks in central and eastern Tasmania. A fascinating section of this chapter deals with the formation of Tasmania as Gondwana was slowly pulled apart, and Corbett's explanation of how granite ridges maintained Tasmania's attachment to the rest of Australia and prevented it moving south with Antarctica.

The next four chapters take us through more detail on the history and we learn that there is also an east–west divide in the rocks – the oldest rocks (1400 million years) and original foundations of Tasmania are in the west. Chapter 3, "The old folded rocks", includes a discussion of the Mt Read Volcanics, a mineralised Cambrian volcanic belt that contains most of western Tasmania's productive mines, and whose complex geology Corbett had a major role in unravelling. Chapter 4, "The middle-aged rocks", discusses the rocks which dominate central and eastern Tasmania – mudstones, sandstones and dolerite – with some very interesting discussion of the search for oil, which over the years seems to have attracted a number of rather dubious entrepreneurs. Chapter 5, "The young rocks", includes a discussion of the Tertiary basalts, which develop soils that are so important to Tasmanian agriculture. Chapter 6, "The youngest rocks", deals with the Pleistocene glacial phases and the shaping of the current landscape and vegetation. Most people would not be aware of the role of the cold, dry, windy climate at the Last Glacial Maximum in producing the numerous small lagoons and lakes with characteristic sand dunes in the Midlands. Lake Dulverton was formed by wind erosion during this period, and near Cleveland wind-blown, loess-like Pleistocene sand is now quarried. The final chapter provides a useful summary and overview and concludes with the arrival of Aboriginal Tasmanians, and then Europeans.

The book is completed by an appendix with a checklist of Tasmanian mountains and their geology, which was prompted by Corbett's frustration at completely inaccurate and fanciful descriptions such as the conglomerate of Mt Roland being described as a dramatic thrust of basalt, and the quartzite Western Arthurs as granite.

Tasmania, and the rest of Australia, has moved nearly 4 metres to the north-east since I enrolled as a Zoology and Geology student at the University of Tasmania with the thought that I might be a palaeontologist. As it happens, I opted for the study of live animals, and I have forgotten much of my geology, but you don't need a geological background to enjoy this book, which provides a wonderful insight into the geological basis for Tasmanian nature. The book is also remarkably free of typographical errors, and as far as I can tell, of factual errors. I did think that I had found an error in a brief reference to "a wombat-like mammal (*Wynyardia bassensis*)" from Fossil Bluff (Wynyard). *Wynyardia* is one of the oldest mammal fossils known from Australia and has long been considered to be a relative of the possums, but the discovery of related fossils on the mainland has led to the conclusion that it is probably closer to the wombats. Its species name is *bassiana,* however. The figures are clear and helpful, although the reproduction of some of the colour photographs is a little disappointing. I unreservedly recommend this book to all Tasmanian Field Naturalists.

*****

Review by Andrew McNeill

Andrew.McNeill@stategrowth.tas.gov.au

In *Child of Gondwana*, Keith Corbett has set out to produce a guide to the geological history and evolution of Tasmania for non-specialists. In this he has succeeded, with this well illustrated and up to date overview of the geological history of the state, which will be valuable for anyone with an interest in developing a deeper understanding of our natural history.

After an introductory chapter ranging over Keith's life story, the physiography and major geological events in the evolution of Tasmania, most of the book (chapters 3 to 7) is a concise geological history, from the oldest to youngest rocks, of our island. These chapters are supported by useful end matter including a glossary, reference list and further reading guide.

However, the highlight is chapter 2, which commences with an introduction to plate tectonics and deep time, and then sets out Tasmania's geological history in a global tectonic context, something that has not been done well, or at all, in previous guide books. Keith has incorporated new research, some of which has been published only in the last two or three years, and has wisely avoided some still controversial ideas, to produce an easy to read, up to date and coherent summary of the state of our knowledge.

Child of Gondwana is not, to me, a guide book for use in the field. There are other publications that cover the detail of specific localities or important geological sites and these are listed in the further reading section (to which I would add Clive Claver's recent geological guides to King Island). Rather, this volume is a good overview of the geological history of the state, which can help place particular sites in their wider context.

It is to be hoped that this book contributes to making Tasmanian geology more accessible, and assists in improving the quality of information provided to the general public by tour guides and in other publications.

Sponsorship

The Tasmanian Naturalist is published annually, with printing and distribution costs sourced directly from membership fees. With ever increasing costs to production and the Club's recent shift to a higher quality presentation of the journal, which includes perfect binding, better quality paper and full colour, the Club now looks for support to offset the higher costs of production each year.

As well as the printed version of The Tasmanian Naturalist, electronic copies of every edition since inception are available on our website at:

https://tasfieldnats.org.au/naturalist/

Any individuals or organisations seeking to support the Tasmanian Field Naturalists Club Inc. through sponsorship of its annual scientific journal, should contact the Editor in the first instance. All sponsors are acknowledged in the Editorial Note at the beginning of the issue and in this sponsor statement (usually with a link to the sponsor's website), and receive hard copies of the journal for their own promotion.

Advice to contributors

The Tasmanian Naturalist publishes articles on all aspects of natural history and the conservation, management and sustainable use of natural resources, with a focus on Tasmania and Tasmanian naturalists. These can be either in a formal or informal style. Articles need not be written in a traditional scientific format unless appropriate for the content. A wide range of types of articles is accepted. For instance, the journal will publish articles that:

- summarise or review relevant scientific studies, in language that can be appreciated by field naturalists;
- stimulate interest in, or facilitate in identifying, studying or recording particular taxa or habitats;
- record interesting observations of behaviour, phenology, natural variation or biogeography;
- stimulate thinking and discussion on points of interest or contention to naturalists;
- put the study of natural history today into context through comparisons with past writings, archives, etc.;
- review recent publications that are relevant to the study of Tasmanian natural history.

Book reviews, web site reviews, poetry and prose and other informal natural-history related content are also accepted. If you are thinking of submitting such material, please check with the Editor first, to avoid duplication of items such as book reviews and for appropriateness of content.

Submission of manuscripts

Manuscripts should be emailed to the editor at editor@tasfieldnats.org.au or to the Club's address. Contact the Editors (see the Club's website for current contact details) prior to submission if you have any issues to discuss. Formal articles should follow the style of similar articles in recent issues and include an abstract. Informal articles need not fit any particular format and need not have an abstract. Unless otherwise stated, all images are by the author(s). All articles will be reviewed by the editors and/or external referees. Responsibility for accuracy and currency of taxonomic nomenclature rests with the author(s). The editors use the *Macquarie Dictionary* and *The Style Manual for Authors, Editors and Printers* as standard reference texts. It is important to refer to the Guidelines for Authors, available on the Club's website.

Submissions should be provided electronically in standard files. Images, tables and diagrams should be submitted in separate files. They must be of high resolution and suitable to be published at A5 size.

Articles must be submitted by 31 August to meet publication schedules.