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PHILIP MILNER ~ OF ANCIENT ORIGINS: THE FAMILY PROTEACEAE

RICHARD ASHEY ~ HIBBS PYRAMID

SARAH LLOYD ~ *TASMANIOMYXA UMBILICATA*, A NEW GENUS OF MYXOMYCETE

Alloxylon pinnatum Dorrigo Waratah

Of Ancient Origins: The Family Proteaceae

Text and photos Philip Milner

Introduction

The Proteaceae family is such an important and prominent component of the Australian flora that it is likely that most members will be familiar with numerous species and varieties including *Banksia*, *Grevillea*, *Hakea* and *Telopea*, and the South African genera *Protea*, *Leucodendron* and *Leucospermum*.

Plant families are named after the first species of plant that was discovered, described and named and which then represents a group of related plants, i.e. the 'Type Genus'. In this case the type genus was a species of *Protea* from South Africa that was named by Carl Linnaeus in 1735 after the Greek sea-god 'Proteus' who could change his shape at will. Although the definition fits the family exceedingly well, given its diversity of form and the number of species within it, Linnaeus did not name the family. The botanist Robert Brown first advocated and published its name in 1809, in the presentation of his paper to the Linnean Society of London "On the natural order of plants called Proteaceae".



Current distribution of the Proteaceae family.

From: Morley & Toelken 1983

The evolutionary history and ancient origins of the family are fascinating as is the diversity within the family today. There are about 75 genera and more than 1700 species, mainly in the southern hemisphere. The two recognised

centres of diversity today are the Fynbos of South Africa and the Kwongan heathlands of the south-west of Western Australia, but the family's actual origins lie elsewhere in the ancient great southern continent of Gondwana.



Gondwana and the location (marked with circle) where it is presumed flowering plants originated.

From: White 1986

Origins

The Proteaceae originated in the western part of Gondwana during the Cretaceous Period (144 to 66.4 million years ago - mya), probably during the mid to late Cretaceous about 125 mya along with the other ancient flowering plant families such as Winteraceae, Magnoliaceae, Nothofagaceae, Nymphaeaceae, Aquifoliaceae, Palmae and Monimaceae. Western Gondwana was somewhere near what is now the rift valley between the hump of Africa and the northeast of South America. (see map)

Pollen, including pollen fossils, have been likened to fingerprints, in that they are all distinctly different and are particularly useful for identifying groups of plants. The fossil pollen rather than macrofossils has mainly determined the earliest plant family groupings.

The first primitive proteaceous pollen was evident prior to 65 mya when the family was beginning to evolve into more 'modern' forms



Orites milliganii Tyndall Range



Persoonia gunnii Cradle Mt.

such as early *Banksia*. The fossil pollen record for the Late Cretaceous shows a high proportion of conifer pollen and small amounts of pollen from primitive Proteaceae and other primitive families such as Winteraceae.

Primitive Proteaceae in Australia & Tasmania

The rainforests of Tasmania and the subtropical, warm temperate and higher altitude rainforests of northern NSW and Queensland are closest in form and structure to the original Gondwanan forests that were widespread across the continent during the Gondwanan and post Gondwanan periods when the climate was warm wet and humid. These forests contain many relict species with ancient lineages including numerous species in the Proteaceae family, but they are now tiny remnants, a result of the changing climate over millenia and further reduced by human activities, particularly since white settlement.

The fossil record in Australia

Cenarrhenes and *Agastachys* pollen and macrofossils were found in the Regatta Point deposits near Strahan from the early Pleistocene Epoch (1.6 mya), as well from the late Paleocene 66 – 56 mya. There is no fossil evidence that they ever occurred outside Tasmania. There is macrofossil evidence of the

genera *Athertonia* and *Eidothea* in Tasmania, and species of both genera still occur in NSW and north Queensland.

Leaf, flower and fruit fossils of ancient Proteaceae dated at 50 million years old have been unearthed and studied from sites near Anglesea in Victoria, near Adelaide and on the south coast of NSW. *Lomatia* fossil pollen and fruit dated at 80 million years has also been identified. The earliest positive evidence of *Banksia* in Australia is fossilised cones from the late Eocene about 50 mya that were unearthed in the Kennedy Range in WA.

Evolution and plate tectonics

The family is characterised by its limited capacity for long distance seed dispersal, so it could only have dispersed via land connections. Therefore, it is an ideal family to support the now well accepted theory and principles of continental drift and plate tectonics.

Compare that with the daisy family Asteraceae, and the dispersal ability of weedy plants such as the Spear Thistle.

Today's relict Proteaceae

The members of the family that exist today and still retain their primitive characteristics, i.e., those species with the closest link to their ancestors, are found in Tasmania in rainforests

and some subalpine and alpine communities. They are also found in the warm temperate, subtropical, tropical and highland rainforests of NSW and Queensland, as well as in South America and New Zealand. These are known as the palaeoendemic species, and include genera such as *Bellendena*, *Agastachys*, *Cenarrhenes*, *Orites* and *Lomatia* from Tasmania.

Notable examples from Australia's north include *Oreocallis* (now *Alloxylon*) *Placospermum*, *Cardwellia*, *Darlingia*, *Hicksbeachia*, *Eidothea* and *Macadamia*.

Species of *Alloxylon*, *Orites* and *Lomatia* are (or were) known from eastern Australia and western South America. There was a species of *Persoonia* in New Zealand but this now has its own generic name of *Toronia*. *Orites* has representatives in Australia, including Tasmania, and there are three species in South America including along the Andes.

Persoonioideae is considered to be the most primitive subfamily along with Bellendenioidae with just one species, the Tasmanian Mountain Rocket *Bellendena montana*, which has no close relatives and its evolutionary path is undetermined.

Eastern Australian rainforests contain the greatest concentration of primitive plant families in the world including Proteaceae. They are the families that have undergone the least evolutionary change over the millennia.

New Zealand and the Lord Howe Island Rise separated from Gondwana with the opening of the Tasman Sea about 80 – 60 mya. The family is now an inconspicuous part of NZ flora with 2 species, *Knightia excelsa*, and *Toronia toru*. There used to be more diversity as demonstrated by the fossil record.

New Caledonia is also a fragment of the original Gondwana and has many relict species of plants, including Proteaceae. Madagascar was wedged between Africa and India until the separation and it has a few ancient Proteaceae.

The very last Gondwanan linkage was the



Agastachys odorata Little Henty River

southern tip of South America and south-eastern Australia conjoined through the Antarctic continent, a theory that is supported botanically with the genera *Orites* and *Lomatia* that Australia still shares with South America.

The Proteaceae family today

The family evolved, diversified and radiated out from those rainforest ancestors into the drier environmental and habitat niches as Australia and other southern continents dried with the changing climate. The great diversity in the family today is attributed to those ancient species that become more sclerophyllous in order to adapt to the drier conditions and the impoverished infertile soils of today's Australia. It appears that genera such as *Lomatia* and *Persoonia* were some of the first plants to diversify and adapt to drier more open habitats, given the current vegetation communities where



Bellendena montata Vale of Belvoir

species within the two genera are now found.

The greatest diversity in the family today is found in the most impoverished and infertile soils such as the Kwongan sandplains of south-west Western Australia, the sandstones of the Sydney basin, along the eastern coast of NSW, and the area in South Africa known as the Fynbos. A number of South African species are well established in cultivation, particularly *Protea*, *Leucadendron* and *Leucospermum*, and many are often erroneously categorised as Australian natives in the florist industry. Interestingly the tribe Proteae to which each of these genera belong is wholly confined to Africa which indicates its early separation from Gondwana and the diversification that occurred on that continent in isolation from the other land masses.

Family tree

The Proteaceae family tree is based on the classification by Briggs and Johnson in 1975. I believe it is still widely accepted but is subject to change over time. This version includes a number of changes and updates from the original.

The family tree illustrates the diversification of the family, the branches within the family and to show the genera that are considered to be more closely allied to each other and have a common ancestor.

Tribes are not commonly considered outside of taxonomic circles but they are very useful in demonstrating the various evolutionary paths that the family has taken as it has evolved, diversified and dispersed across Gondwana originally and then within each of the continents after they broke apart.

Where to see in Tasmania

C. nitida, *A. odorata* and *O. diversifolia* are found in rainforests in western Tasmania, and the other three species of *Orites* and *B. montana* occur in alpine and subalpine habitats.

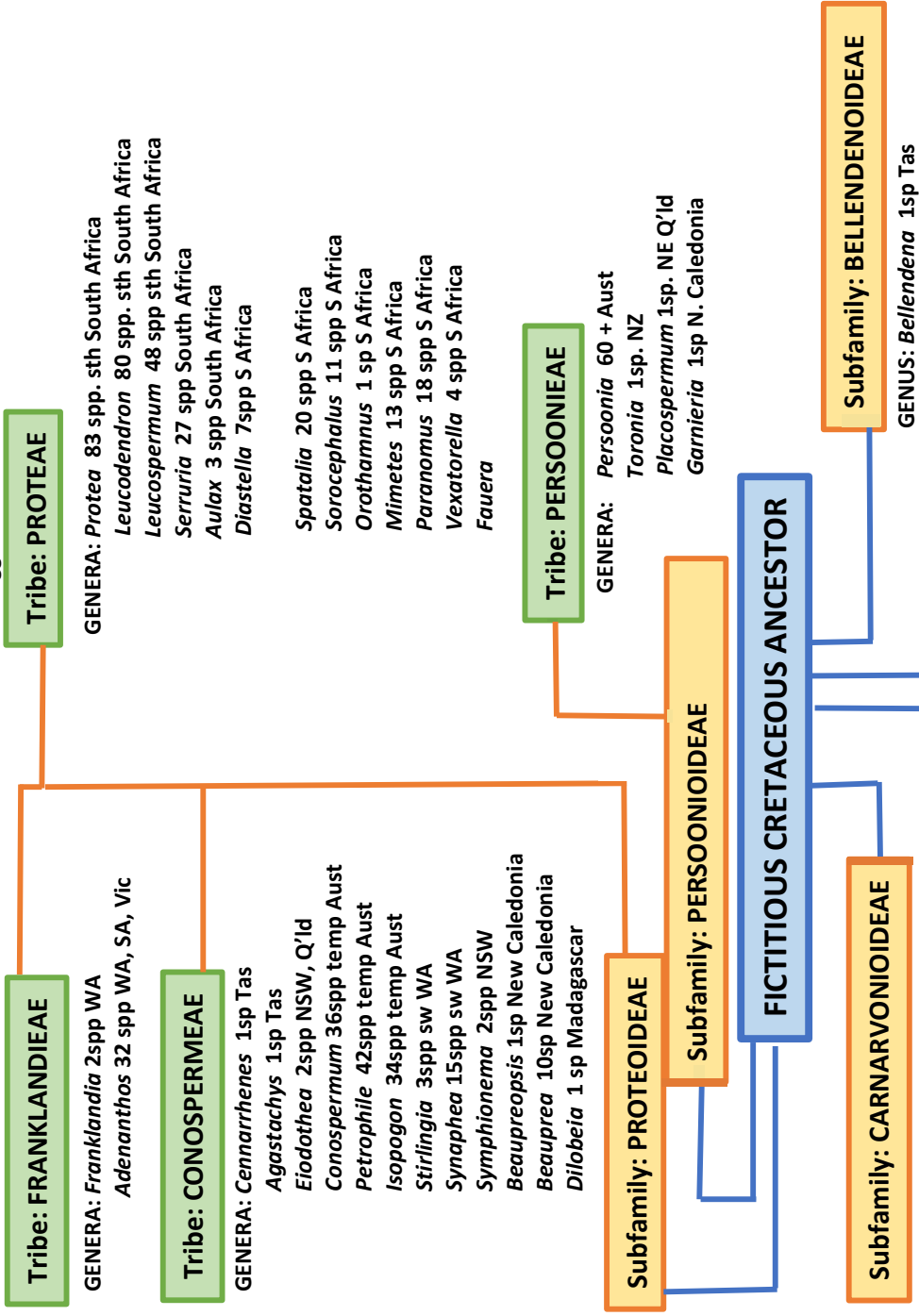
Tasmanian Waratah *Telopea truncata* is also found in a range of habitats.

The 3 Tasmanian species of *Lomatia* can be seen in a range of usually open habitats and a range of altitudes. The rarest is *L. tasmanica* which is restricted to a localised area in the deep south-west. I believe it is under cultivation, with some difficulty, at the Royal Tasmanian Botanical Gardens. Its flower is similar to the South American species *L. ferruginea*. *Persoonia* (4 spp) are also plants of varying habitats and altitudes in Tasmania.

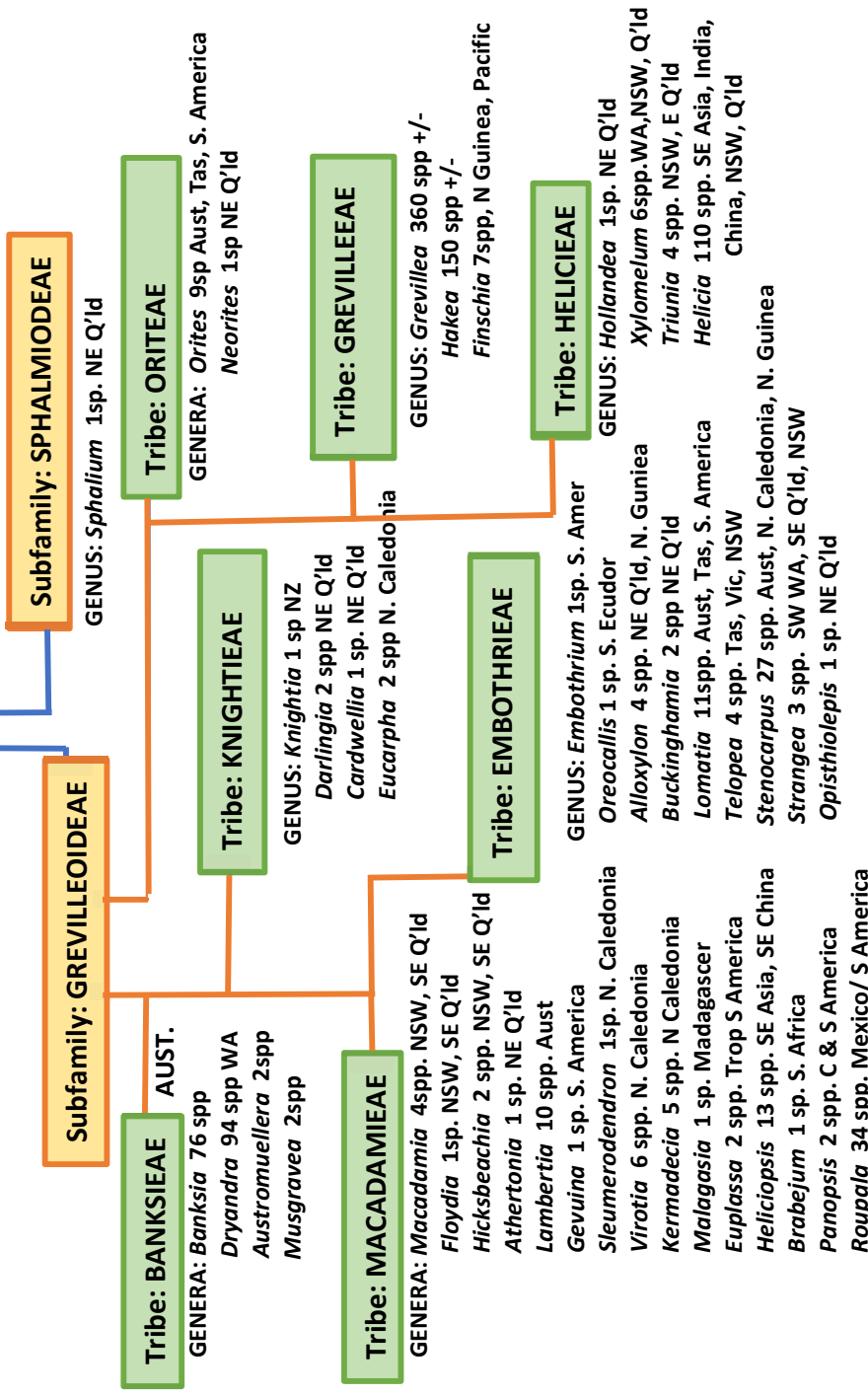
The following species are in cultivation in the Tasmanian Arboretum at Eugenana, *Knightia excelsa*, *Lomatia ferruginea*, *L. hirsuta*, *L. tinctoria*, *L. polymorpha*, *L. arborescens*, *Cenarrhenes nitida*, *Embothrium coccineum*,

PROTEACEAE: FAMILY TREE

Based on Johnson & Briggs 1975.



GENUS: *Carnavornia* 1sp. NE Q'ld



Subfamily: SPHALMIODEAE

GENUS: *Sphalium* 1sp. NE Q'ld

Tribe: ORITEAE

GENERA: *Orites* 9sp Aust, Tas, S. America
Neorites 1sp NE Q'ld

Tribe: KNIGHTIEAE

GENUS: *Knightia* 1 sp NZ
Darlingia 2 spp NE Q'ld
Cardwellia 1 sp. NE Q'ld
Eucarpha 2 spp N. Caledonia

Tribe: GREVILLEEAE

GENUS: *Grevillea* 360 spp +/-
Hakea 150 spp +/-
Finschia 7spp, N Guinea, Pacific

Tribe: EMBOTHRIEAE

GENUS: *Embothrium* 1sp. S. Amer
Oreocallis 1 sp. S. Ecuador
Alloxylon 4 spp. NE Q'ld, N. Guinea
Buckinghamia 2 spp NE Q'ld
Lomatia 11spp. Aust, Tas, S. America
Telopea 4 spp. Tas, Vic, NSW
Stenocarpus 27 spp. Aust, N. Caledonia, N. Guinea
Strangea 3 spp. SW WA, SE Q'ld, NSW
Opisthiolepis 1 sp. NE Q'ld

Tribe: HELICIEAE

GENUS: *Hollandia* 1sp. NE Q'ld
Xylomelum 6spp. WA, NSW, Q'ld
Triunia 4 spp. NSW, E Q'ld
Helicia 110 spp. SE Asia, India, China, NSW, Q'ld

Subfamily: GREVILLEOIDEAE

Tribe: BANKSIEAE

AUST.
GENERA: *Banksia* 76 spp
Dryandra 94 spp WA
Austromuellera 2spp
Musgravea 2spp

Tribe: MACADAMIEAE

GENERA: *Macadamia* 4spp. NSW, SE Q'ld
Floydia 1sp. NSW, SE Q'ld
Hicksbeachia 2 spp. NSW, SE Q'ld
Athertonia 1 sp. NE Q'ld
Lambertia 10 spp. Aust
Gevuina 1 sp. S. America
Sleumerodendron 1sp. N. Caledonia
Viotia 6 spp. N. Caledonia
Kermadecia 5 spp. N Caledonia
Malagasia 1 sp. Madagascar
Euplassa 2 spp. Trop S America
Heliciopsis 13 spp. SE Asia, SE China
Brabejum 1 sp. S. Africa
Panopsis 2 spp. C & S America
Roupala 34 spp. Mexico/ S America



Lomatia ferruginea Tasmanian Arboretum



Lomatia tinctoria Knole Plains

Bellenden montana, *Orites diversifolia*, *Telopea truncata*, *Persoonia juniperina*, *Stenocarpus reticulatus* and *S. salignus*.

Alloxylon pinnatum from the rainforests of the Dorrigo Plateau in northern NSW has established and flowers well on my property at Lower Barrington. *C. nitida* flowers and fruits in my sheltered woodland and *Macadamia integrifolia* is also growing well here and there are mature fruiting trees along the north-west coast.

Conclusion and Conservation

The rainforests where most of the relict species of the Proteaceae family now largely occur in Australia are mere fragments of the original vegetation that was once extensive across our continent. Many of those remnants have been lost to land clearing and forestry since white settlement although some enlightenment over recent decades has recognised their conservation significance with much needed protection by way of the declaration of World Heritage areas and National Parks.

There are however still important areas of remnant rainforest and other vegetation communities containing ancient Proteaceae and other primitive Gondwanan plants that remain unprotected and at risk including important areas of western Tasmania, such as

the middle reaches of the Wilson River north of the Pieman hydro impoundment.

Once lost, these areas are gone forever, and it is critical that important remnant Gondwanan vegetation—wherever it occurs—receives formal reservation and protection.

References and further reading

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Hibbs Pyramid

Richard Ashby

The second Atlas and its natural progeny Birddata, have been going for 25y. Sizeable portions of Tasmania are remotely montane, heavily forested or roadless and trackless wilderness. This provides serious obstacles to Birddata surveyors so that there are many poorly documented areas and a few gaping holes. One of these is the southwest coast between Cape Sorell at MacQuarie Harbour and the northern part of Port Davey, a 137 km (as the crow flies) section of sometimes unforgiving topography. There are few places that a motor vessel can safely pull ashore when the swell is at its normal 3 or 4 m and winds are light. It's pleasing to note that in the southern half of this button grassy heathland bird observers have been filling in some of the gaps. Some of them may be Parks and Wildlife volunteers weeding in the SW World Heritage Area and may have had the good fortune to have been dropped in by helicopter. They will be on first name terms with Ground Parrots, Southern Emu Wrens and Beautiful Firetails, possibly even Orange-Bellied Parrots in migration season. Out to sea, someone with good pelagic ID skills has been busy.

I've been considering helicopters and seaplanes out of Strahan for a couple of years but recently opted to fork out \$1600 for a shark cat to cart two of us with kayaks and a pile of gear down to Hibbs Pyramid, which approximately centres on one of these gaping holes, 46km from Gorge Point to High Rocky Point. A third 'member was keen to join us' and further defray costs but wasn't available in March. The weather in Tasmania in March seems, from experience, to be often friendlier, with less wind, less rain and, at the end of summer, the bush less waterlogged. With open fetch from this point south to Antarctica and west to Argentina a benign countenance on the meteorological front is much to be desired.



The Gerrity brothers of SW Expeditions in Strahan carted us down in a 7-8m shark cat. This vessel hoons along at 40 knots on the relatively quiet waters of MacQuarie Harbour and at 30 knots on the 3-5 m swells of the open ocean. This was a novel experience for me, flying on a cushion of air trapped between the twin hulls and slamming brutally onto the back of the next wave. Being very tall, I kept hitting my head on the roof in the aerial phases until sent further astern. I managed to yank one of my shoulders, partly tearing a supraspinatus tendon.

Short-Tailed Shearwaters in their thousands skimmed all around us, getting ready to abandon their chicks and head back to the North Pacific and Bering Sea. Shy Albatrosses were mixed in in substantial numbers and I hoped to find new pelagic species even if only beach-washed.

A sheltered and cosy campsite with a water-logged natural lawn presented itself in the bay behind Hibbs Pyramid. My old maps called this Sanctuary Cove but the fishermen refer to it as DeVries Cove. We wondered if this lawn was entirely natural or a result of ancient aboriginal burning practices.

Forty Birddata surveys (mainly 2 ha/20 min) at 7 sites over 7 days threw up 38 species, dominated by Crescent Honeyeaters, Eastern Spinebills, Forest Ravens and Black Currawongs in the bush and Pacific, Kelp and Silver Gulls on the shore. Small numbers of Great and Black-Faced Cormorants were able to make a living and on the second day schools of fish disporting themselves on the surface close inshore attracted a bevy of Shy and Black-Browed Albatrosses, Gannets and Crested Terns. A pair of White-Bellied Sea Eagles, roosted just to the southwest of our camp and on my first visit out to Hibbs Pyramid two immatures joined them, circling about the peak.

A couple of hundred Fur Seals lolloped about on the steep boulder beach, on adjacent rocks and in amongst the kelp. Nigel Brothers, lead author of 'Tasmania's Offshore Islands : seabirds and other natural features', 2001, estimated there to be 820 breeding pairs of Little Penguins here and 9055 breeding pairs of Short-Tailed Shearwaters. Kelp Gulls had yet to arrive at the time of writing.

I found that I could paddle in a compromised fashion with no wind or wave action other than the ground swell. I did not attempt to land on the rocky beach as even in light surge there was a real risk of exacerbating my shoulder injury. Next day my colleague, Ian, managed to leap nimbly off his sit-on-top`.

Every bay and beach here is festooned with the bones of seals, dolphins and Long-Finned Pilot Whales – skulls, vertebrae, ribs, scapulae, sternums and a depressing quantity of human trash, obviously off fishing boats. Ian found an albatross skull whose form and measurements matched those in my beak guide of a Shy.

Small flocks of Green Rosellas were common and Yellow-Tailed Black and Sulphur-Crested Cockatoos flew by every day. Eastern Spinebills called frequently but Yellow-Throated Honeyeaters infrequently and I was quite surprised not to see or, more likely, hear, an Olive

Whistler. The dense Melaleuca all around our campsite seemed ideal habitat. Tasmanian Thornbills were shy and Tasmanian Scrubwren numbers even thinner than expected. Silveryeyes abounded but Superb Fairy-Wrens were heard but seldom seen. No robins showed up. We had hoped to make our way inland onto the more open button Grass and find Ground parrots and Southern Emu Wrens but our ancient bodies were no match for the wiry and unyielding scrub. The salt-etched limestone rocks on the littoral were made of razor blades! We both walked this whole coast 50 y ago and had not forgotten what hard country it is.

A small flock of Hooded Plovers to our north in Meerim Bay had an immature, and Sooty Oystercatchers found adjacent rocks to their liking. A solitary immature Pied Oystercatcher patrolled the next bay south.

No night birds called whilst either of us was awake but there was also no big timber or open woodland in the immediate vicinity.

A single tiny leech wobbled into the campsite. No mosquitoes, gnats, midges or march flies tormented us but the Tasmanian Devils were bold and a nuisance. None of the specimens we saw had any evidence of Devil Facial Tumour Disease. Nodding off, I shouted at one I thought was in my tent vestibule but it was just the animal's shadow cast on the fabric by the flames of our dying fire! This piece of coast is outside the SW National Park and World Heritage Area and fires are permitted with the usual common-sense caveats and respect for the environment.

Ian, a talented hunter/fisher/shooter/trapper, levered limpets off rocks and used them as bait to catch wrasse with apparent ease. The fish were killed and tied onto his crayfish net with a ring made of boobyalla root and cable ties with my water bottle as a float. He moved the trap around the bay a number of times and regularly placed fresh bait but, much to his disgust, no crayfish took up the challenge.

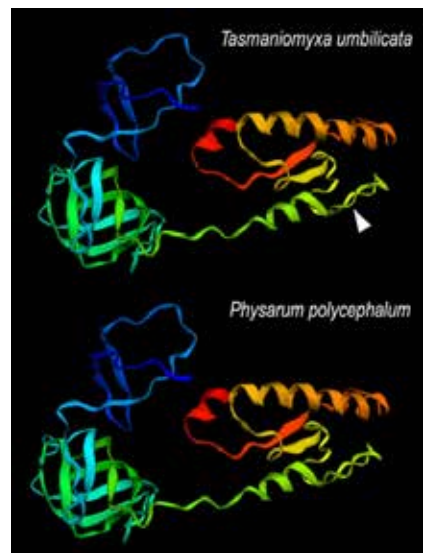


Tasmaniomyxa umbilicata a new genus of slime mould (myxomycete) Sarah Lloyd

Genetic sequencing is rapidly changing how ‘new’ species of slime moulds are identified. Four hitherto undescribed species have been found at Black Sugarloaf since 2010, with sequencing showing that 3 *Lamproderma* spp. are different to their northern hemisphere ‘twins’, and are currently being described.

The paper describing *Tasmaniomyxa umbilicata* will soon be published, but the full story of its discovery and the road to its identification and naming will be included in TNN 86.

Meanwhile, the illustration (right) captures “a model of the studied fragment of the eukaryotic elongation factor 1a molecule, based on a single sequence obtained from *Tasmaniomyxa umbilicata* in comparison with the same fragment, based on the annotated EF1a gene sequences of *Physarum polycephalum*. A white arrow points to the one area where the two modelled topologies differ. Co-author of the paper, Prof. Dmytro Leontyev constructed the model to confirm that *Tasmaniomyxa* really is a slime mould!



Walks and other events

All walks are scheduled for the first Sunday of the month unless otherwise stated. Meeting time is usually 10am. There are more details in the e-news.

Bring food, water, clothes for all weather, hand lens, binoculars, note book & curiosity.

August 6th – AGM – Banksia Centre, Port Sorell

September 3rd – Black Sugarloaf looking at birds and slime moulds. **Leaders:** Sarah Lloyd and Ron Nagorcka (Mob - 0474 175 162; Landline: 6396 1380)

October 7 Rubicon Reserve **Leader** Phil Collier 0456 418 020

November 4 & 5 Weekend at Scamander **Leader** Mary McConnell (0409 900 476) or a local walk to Fern Glade Reserve, Burnie.



The fruit (a drupe) of *Cenharrenes nitida*. Brassey Hill

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