

THE NATURAL HISTORY OF UPPER STURT, SOUTH AUSTRALIA PART I: VEGETATION HISTORY, FLORA AND MACROFUNGI OF A MESSMATE STRINGYBARK FOREST

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ABSTRACT:

An area of *Eucalyptus obliqua*, Messmate Stringybark Forest in Upper Sturt, Mt Lofty Ranges, South Australia was studied over a 38 year period. The land use history since the area was first settled by Europeans in 1843, to the present day is summarized. The area is now known to support 249 species of plants of which 105 species are introduced and 64 species of macrofungi of which at least 3 are introduced. Although the area has undergone many changes since European settlement it remains an important area of remnant native vegetation. There are ongoing challenges from weed invasion, overgrazing by over-abundant kangaroos and introduced koalas and from potential damage by severe wildfire

KEY WORDS: Upper Sturt, land use history, forest, flora, fungi, vegetation

INTRODUCTION:

This is the first of three papers describing revegetation of cleared land adjacent to areas of relatively natural remnant native vegetation. In this paper, elements of the vegetation, flora and fungi are described in a study area at 16 Pole Road, Upper Sturt in the Mt Lofty Ranges. The second paper describes the vertebrate and invertebrate fauna of the area, while the third paper provides results of fauna and vegetation monitoring in sample sites established in both the re-vegetated area and the remnant natural vegetation in the Upper Sturt study area. A second series of three papers will cover the flora and fauna and a more extensive revegetation program on a study area on the western end of Kangaroo Island (in prep.).

LOCATION AND HABITAT:

At the time of European settlement of South Australia the forest-covered hills in and around Upper Sturt were known as *The Tiers*. The area was inhabited by axe men from Tasmania who were apparently a rough, hard-living lot and the district up to Crafers had a doubtful reputation (McCarthy 1965). Permanent settlement at Upper Sturt began around 1843-44, and by 1860 a small wooden church had been built to serve the growing community which numbered 200 people by 1885 (McCarthy 1965).

The area covered by this study includes an area now known as Lot 100, Part Section 357 (7964 m²) containing House 1 and Lot 101, Part Section 972 (5337 m²) containing House 2, Hundred of Adelaide. The total area is 0.88 ha and is on the corner of Upper Sturt and Pole Roads, Upper Sturt. (**Fig. 1**). This area was part of a much bigger parcel of land first purchased on 5 April 1865 by Edward Tidemann of Adelaide for £262 10s. At that time it covered 75 acres and was mortgaged to Thomas Berrill, Police Trooper. On 18 August 1884 2 acres and 29 perches in Section 357 was transferred to Hedley Robert Carter possibly for the purpose of constructing a house (original House 1 in Fig.1).



Fig. 1: Location of the Upper Sturt study area showing Section numbers (red), location of the two houses we have lived in (yellow) and the location of the two sample quadrats (blue).

Sometime after this a two-roomed stone house with a rough Stringybark timbered lean-to on the back serviced by a large brick-lined underground water tank was constructed adjacent to Upper Sturt Road. There were a number of changes of ownership over the subsequent years until the authors purchased this house (House 1) and land on 3 February 1976. On 24 August 1978 we also purchased a narrow part of Section 972 between our original house title and the edge of Pole Road which was covered in relatively natural vegetation.

In 1997 we re-subdivided the two Lots to create the Lot boundaries shown in Figure 1. and in 1997 we built an earth-sheltered house (House 2) adjacent to the dam in the downhill Lot 101. We moved into this house in January 1998 and still live there. Our knowledge of the natural history of Upper Sturt therefore now covers 38 years and spans our two properties plus the surrounding areas of natural vegetation shown in Figure 2.

The first aerial photography to cover the study area was taken in 1949 and this, together with coverage from 1968, 2001 and 2016, is compared in Figure 2. It can be seen that in the 1940s, the land use in this part of Upper Sturt was very different from what it is today. There had been extensive fruit orchards and, at least along Sturt Creek, market gardens irrigated from the creek. This was changing by the early 1950s. There are still some old orchard areas visible on the 1949 photo, but the most obvious land use is rough grazing of sheep and cattle on the steep hill slopes and wood cutting in what was left of the forest indicated by the extensive wood cutters tracks, particularly off Hilltop Drive. Much of this timber was used to fire the brick kilns at Littlehampton. The next photo, 19 years on in 1968, shows significant regeneration of these cut over areas of native forest, and the appearance of additional housing along



Fig. 2A: 9th January 1949



Fig. 2B: 15th November 1968



Fig. 2C: 15th November 2001



Fig. 2D: 1st July 2016

Figure 2: Changes to the vegetation and land use in the Upper Sturt area 1949-2016. 1949, 1968 and 2001 photography Mapland, Department for Environment and Water. 2016 imagery from Google Earth.



Fig. 3A: *Eucalyptus obliqua*,
Messmate Stringybark Forest



Fig. 3B: *Eucalyptus cosmophylla*,
Cup Gum Woodland

Upper Sturt Road. Thirty three years on in 2001, there has been more forest regeneration, but also a significant increase in houses, particularly following the subdivision of blocks along Hilltop Drive. By 2016 the forest canopy is thicker still but no new houses have been constructed.

This area now supports a significant block of regenerated native forest stretching from Upper Sturt Road down the steep hill slopes to Sturt Creek. It is separated from Belair National Park by Upper Sturt Road, and also contains a number of private houses, but it is one of the larger forest remnants in this part of the Mt Lofty Ranges. There has been no fire in this remnant since the 1960s and, being in one of the highest fire risk areas in the whole Mt Lofty Ranges, it is well overdue for a major wildfire.

There are two basic vegetation communities in the study area. South-facing slopes and deep gullies support Messmate Stringybark Open Forest, described and mapped in Armstrong *et al.* (2003) as *Eucalyptus obliqua*, +/- *E. baxteri* +/- *E. fasciculosa* Open Forest over *Pultenaea daphnoides*, *Acacia myrtifolia* (Fig. 3A). The drier north-facing slopes support a Cup Gum Woodland, described and mapped in Armstrong *et al.* (2003) as *Eucalyptus obliqua*, +/- *E. cosmophylla*, +/- *E. fasciculosa* Woodland (Fig. 3B).

METHODS:

The range of flora and vegetation described in this paper results from our 38 years of general observation both on our two properties and in the surrounding areas of natural vegetation stretching from Upper Sturt road down to the Sturt River. In addition we have sampled two standard Biological Survey of South Australia sample sites (Heard and Channon 1997, Owens 2000), The sites were first established in November 2000 as a part of the Biological Survey of the Southern Mt Lofty Ranges

(Armstrong *et al.* 2003). One site, (NOA00101, 35° 1' 34.01" S, 138° 40' 16.68" E) was in the regenerating natural vegetation and the second (NOA01002, 35° 1' 37.37"S, 138° 40' 15.77" E) was in the cleared paddock which was then progressively revegetated, with the first plantings in 1995. This has resulted in a change in the value of this revegetated area as wildlife habitat and this is described in the third paper in this series.

From 2001 to 2010 these sites were sampled twice a year in March and November, and then annually in November until 2016. This has therefore covered 28 four night trapping periods resulting in a total of 2800 Elliot trap nights, 56 cage trap nights and 1120 Pitfall trap nights for both the natural vegetation (Site 1) and the revegetation (Site 2) sample quadrats, (see Figure 1).

Taxonomic treatment of the plants follows the Census of South Australian Plants Algae and Fungi (State Herbarium of South Australia 2015).

All species of plants found in the general study area have been recorded and voucher collections of most of them have been lodged in the State Herbarium.

Fungi were only surveyed opportunistically in the study area, with the exception of Lot 100 (see location Fig. 1), which was not surveyed. In the absence of a current Australian checklist, **Table 2** lists fungi according to their morphogroups (i.e. according to similarity in form), a practice commonly used in Australian field guides and in the format to be used for '*Fungi Down Under*' 2nd edition (P. Catchside pers. comm.). Genus and species names follow the CABI Bioscience Database Index Fungorum Partnership (2004), other than *Oudemansiella gigaspora* which follows current Australian usage. Common names, where they are known, use the *Atlas of Living Australia* or *Fungi Down Under* 2nd edition (in prep.).

RESULTS:

The annual and mean monthly rainfall record for the study area is shown in **Fig. 4**. The graphs show a typical Mediterranean climate with wet winters with the highest mean rainfall of 134.7 mm in July and relatively dry summers with the lowest mean rainfall of 19 mm in January. The total annual rainfall varies considerably between years, ranging from 1407 mm in 1992 down to 504 mm in 1990. The 38 years of this study has therefore included a significant range of variability in productivity in this study area from the drought years of the late 1980s and the mid-2000s to the very wet years of the early and late 2000s.

Vascular Plants

In 38 years of searching the bush and more disturbed land in the study area we have recorded 249 species of plants (**Table 1**). Of these 105 are introduced, but only 33 of these are found in the native vegetation, the remainder being confined to cleared land, gardens and the weedier areas along the Sturt River. In addition to weed problems, the root parasite *Phytophthora cinnamomi* is thought to be present in the natural vegetation here as there have been significant deaths of the grasstrees (*Xanthorrhoea semiplana*) over the years that we have been observing. While some of these deaths may have been due to drought, *Phytophthora* seems a more likely explanation, even though its presence has not been confirmed by a soil test. More details of our efforts to control bushland weeds will be discussed in the third paper in this series, but, as in many parts of the Mt Lofty Ranges, the major bushland weeds in the study area include: Portuguese heath, olive, sweet pittosporum, cotoneaster, hawthorn, dog rose,

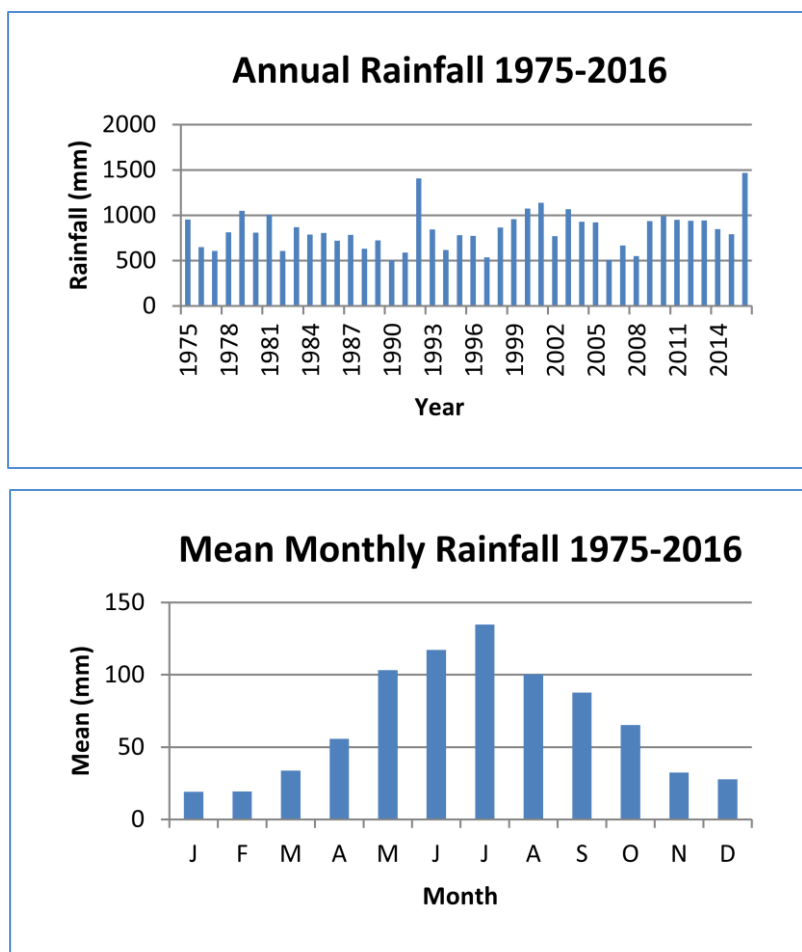


Fig. 4: Annual and mean monthly rainfall records for the Upper Sturt study area 1975-2016.

blackberry, coastal wattle, English broom, Montpellier broom, St John's wort, boneseed, three-corner garlic, harlequin flower, large quaking grass and small quaking grass.

Examples of some of the native plants found in the area are shown in **Figs 5 and 6**. Almost all are common and widespread in the remnant areas of stringybark forest through the southern Mt Lofty Ranges, but two species of orchids have a conservation rating in South Australia:

Tall Greenhood, *Pterostylis mellagramma* (Fig. 6E)

Classified Endangered in South Australia, a population of ten to twenty of this species was found in most years on the road verge at the junction of Upper Sturt Road and Hilltop Drive, but it has not been searched for in recent years and the present status of this population is unclear

Giant Sun-orchid, *Thelymitra grandiflora* (Fig 6F)

Classified as Rare in South Australia, a single plant was seen only once in cup gum woodland NW of Hilltop Drive.



Fig. 5A: common maidenhair
Adiantum aethiopicum



Fig. 5B: necklace fern,
Asplenium flabellifolium



Fig. 5C: slaty sheoak, *Allocasuarina muelleriana* ssp. *muelleriana*



Fig. 5D: scented sundew,
Drosera whittakeri



Fig. 5E: Mt Lofly daisy bush,
Olearia grandiflora



Fig. 5F: pink ground berry,
Acrotriche fasciculiflora

Figure 5: Plants from the Upper Sturt study area



Fig. 6A: erect guinea flower,
Hibbertia riparia



Fig. 6B: peach heath,
Lissanthe strigosa ssp. *subulata*



Fig. 6C: creeping bossiaea
Bossiaea prostrata



Fig. 6D: Blue squill, *Chamaescilla*
corymbosa var. *corymbosa*



Fig. 6E: tall greenhood,
Pterostylis mellagramma



Fig. 6F: giant sun-orchid,
Thelymitra grandiflora

Figure 6: Plants from the Upper Sturt study area

Table 1: Non-vascular and vascular plant list for the Upper Sturt study area, compiled between 1976 and 2018. Introduced species are marked with an asterisk*.

FAMILY	SCIENTIFIC NAME	COMMON NAME	VALLEY & SLOPES	DRY HILLSIDES	STURT RIVER	CLEARED LAND	DAM & EDGES	GARDEN WEEDS	PLANTED	ROAD VERGE
SELAGINELL- ACEAE	* <i>Selaginella krausiana</i>	garden selaginella			X					
DENNISTAED- TIACEAE	<i>Pteridium esculentum</i>	bracken	X							
ADIANTACEAE	<i>Adiantum aethiopicum</i>	common maiden-hair fern	X							
	<i>Cheilanthes austrotenuifolia</i>	rock fern	X							
ASPLENI- ACEAE	<i>Asplenium flabellifolium</i>	necklace fern	X							
PINACEAE	* <i>Pinus radiata</i>	radiata pine	X							X
CASUARIN- ACEAE	<i>Allocasuarina muelleriana</i> ssp. <i>muelleriana</i>	slaty sheoak	X							
	<i>Allocasuarina verticillata</i>	drooping sheoak	X			X			X	
PROTEACEAE	<i>Grevillea lavandulacea</i>	lavander grevillea		X						
	<i>Hakea carinata</i>	hakea	X							
	<i>Hakea rostrata</i>	beaked hakea	X	X						
	<i>Isopogon ceratophyllus</i>	cone-bush		X						
	<i>Persoonia juniperina</i>	prickly geebung	X							
SANTAL- ACEAE	<i>Exocarpus cupressiformis</i>	native cherry	X							
LORANTH- ACEAE	<i>Amyema pendulum</i> ssp. <i>pendulum</i>	drooping mistletoe	X							
	<i>Amyema preissii</i>	wire-leaved mistletoe	X							
POLYGON- ACEAE	* <i>Acetosella vulgaris</i>	sorrel				X				
	* <i>Persicaria decipiens</i>	slender knotweed					X			
	* <i>Polygonum aviculare</i>	wireweed				X		X		
	* <i>Rumex conglomeratus</i>	clustered dock			X					
CARYOPHYLL- ACEAE	* <i>Cerastium glomeratum</i>	broad-leaved mouse-ear chickweed				X		X		
	* <i>Stellaria media</i>	chickweed								X
CHENOPODI- ACEAE	* <i>Chenopodium album</i>	fat hen				X		X		
	* <i>Chenopodium pumillum</i>	clammy goosefoot				X		X		
AMARANTH- ACEAE	<i>Alternanthera denticulata</i>	lesser joyweed					X			
LAURACEAE	<i>Cassytha glabella</i> forma <i>dispar</i>	snotty-gobble	X	X						
RANUNCUL- ACEAE	<i>Clematis microphylla</i>	old man's beard								X
	<i>Ranunculus lappaceus</i>	common buttercup	X							

FAMILY	SCIENTIFIC NAME	COMMON NAME	VALLEY & SLOPES	DRY HILLSIDES	STURT RIVER	CLEARED LAND	DAM & EDGES	GARDEN WEEDS	PLANTED	ROAD VERGE
	<i>*Ranunculus parviflorus</i>	small-flowered buttercup				X				
DILLENIACEAE	<i>Hibbertia exutiacies</i>	guinea-flower	X	X						
	<i>Hibbertia riparia</i>	erect guinea-flower	X	X						
GUTTIFERAE	<i>*Hypericum perforatum</i>	St John's wort	X			X				
DROSERACEAE	<i>Drosera auriculata</i>	tall sundew	X							
	<i>Drosera macrantha</i>	climbing sundew		X						
	<i>Drosera whittakeri</i> ssp. <i>whittakeri</i>	scented sundew	X	X						
FUMARIACEAE	<i>*Fumaria capreolata</i>	white fumitory				X				
	<i>*Fumaria muralis</i>	wall fumitory				X				
CRUCIFERAE	<i>*Rapistrum rugosum</i>	short-fruited wild turnip				X		X		
	<i>*Rorippa officinale</i>	watercress				X		X		
PITTOSPORACEAE	<i>Billardiera cymosa</i>	sweet apple-berry		X						
	<i>Bursaria spinosa</i> var. <i>spinosa</i>	sweet bursaria	X							
	<i>Cheiranthra alternifolia</i>	hand flower		X						
	<i>*Pittosporum undulatum</i>	sweet pittosporum	X	X						
ROSACEAE	<i>Acaena echinata</i>	sheeps burr	X							
	<i>Acaena novae-zelandiae</i>	bidgee-widgee	X			X				
	<i>*Cotoneaster pamosus</i>	cotoneaster	X							X
	<i>*Crataegus monogyna</i>	hawthorn								X
	<i>*Malus sylvestris</i>	apple								X
	<i>*Rosa rubiginosa</i>	dog rose	X			X	X			
	<i>Rubus parvifolius</i>	small-leaved raspberry					X		X	
	<i>*Rubus ulmifolius</i>	blackberry	X	X	X	X	X			X
MIMOSACEAE	<i>Acacia acinacea</i>			X						
	<i>*Acacia longifolia</i> var. <i>longifolia</i>	coastal wattle	X	X						
	<i>Acacia melanoxylon</i>	blackwood	X						X	
	<i>Acacia myrtifolia</i> var. <i>myrtifolia</i>	myrtle wattle	X	X					X	
	<i>Acacia paradoxa</i>	kangaroo thorn	X	X					X	
	<i>Acacia pycnantha</i>	golden wattle	X	X						
	<i>Acacia retinodes</i>	swamp wattle				X	X		X	
	<i>Acacia verniciflua</i>								X	
	<i>*Paraserianthes lophantha</i>	Cape Leeuwin wattle								X
FABACEAE	<i>Bossiaea prostrata</i>	creeping bossiaea		X						
	<i>*Cytisus proliferus</i>	tree lucerne								X
	<i>*Cytisus scoparius</i>	English broom	X							
	<i>Daviesia leptophylla</i>	bitter-pea								

FAMILY	SCIENTIFIC NAME	COMMON NAME	VALLEY & SLOPES	DRY HILLSIDES	STURT RIVER	CLEARED LAND	DAM & EDGES	GARDEN WEEDS	PLANTED	ROAD VERGE
	<i>Daviesia ulicifolia</i> ssp. <i>incarnata</i>	gorse bitter-pea	X	X						
	<i>Dillwynia hispida</i>	red parrot-pea		X						
	* <i>Genista monosperulana</i>	Montpellier broom	X	X						X
	<i>Hardenbergia violacea</i>	native lilac				X			X	
	<i>Indigofera australis</i> var <i>australis</i>	Austral indigo				X			X	
	<i>Kennedia prostrata</i>	running postman		X					X	
	<i>Platylobium obtusangulum</i>	common flat-pea		X					X	
	* <i>Lathyrus tingitanus</i>	Tangier pea								X
	* <i>Medicago polymorpha</i> var. <i>polymorpha</i>	burr-medic				X		X		
	<i>Pultenaea acerosa</i>	bristly bush-pea		X						
	<i>Pultenaea daphnoides</i>	large-leaved bush-pea	X	X						
	<i>Pultenaea largiflorens</i>	twiggy bush-pea		X						
	<i>Pultenaea pedunculata</i>	matted bush-pea	X							
	* <i>Trifolium campestre</i>	Hop clover				X				
	* <i>Trifolium dubium</i>	suckling clover				X		X		X
	* <i>Trifolium repens</i>	white clover				X		X		X
	* <i>Trifolium subterraneum</i>	subterranean clover				X				
	* <i>Ulex europaeus</i>	gorse	X	X						X
	* <i>Vicia hirsuta</i>	hairy vetch				X		X		
	* <i>Vicia sativa</i> ssp. <i>sativa</i>	field pea						X		
	* <i>Vivia sativa</i> ssp <i>nigra</i>	common vetch	X			X				X
OXALIDACEAE	* <i>Oxalis incarnata</i>	one o'clock								X
	<i>Oxalis perrenans</i>	native oxalis	X							
	* <i>Oxalis pes-caprae</i>	soursob				X		X		
GERANIACEAE	* <i>Geranium dissectum</i>	cutleaf cranes bill				X				
	* <i>Geranium solanderi</i>	Australian cranes bill	X							
	* <i>Geranium yoei</i>	rose geranium								X
LINACEAE	* <i>Linum trigynum</i>	french flax				X				
EUPHORBIACEAE	* <i>Euphorbia peplus</i>	petty spurge				X		X		
TREMANDRACEAE	<i>Tetradlea pilosa</i> ssp. <i>pilosa</i>	pink-eyed susan	X	X						
STACKHOUSIACEAE	<i>Stackhousia aspericocca</i>	candles	X							
RHAMNACEAE	<i>Spyridium parvifolium</i>	dusty miller	X							
MALVACEAE	* <i>Malva parviflora</i>	small-flowered marshmallow						X		
THYMELEACEAE	<i>Pimelea humilis</i>	common riceflower		X						
	<i>Pimelea linifolia</i>	slender riceflower	X							
VIOLACEAE	<i>Viola hederacea</i>	ivy-leaved violet	X							

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LYTHRACEAE	<i>Lythrum hyssopifolia</i>	lesser loosestrife	X			X	X			
MYRTACEAE	<i>Eucalyptus cosmophylla</i>	cup gum		X					X	
	<i>Eucalyptus fasciculosa</i>	pink gum	X	X						
	<i>Eucalyptus obliqua</i> var. <i>obliqua</i>	mesmate stringybark	X	X					X	
	<i>Eucalyptus viminalis</i> ssp. <i>viminalis</i>	manna Gum			X				X	X
	<i>Leptospermum continentale</i>	prickly tea-tree	X	X					X	
ONAGRACEAE	<i>*Epilobium ciliatum</i>	willow-herb	X			X	X			
	<i>*Epilobium hirtigerum</i>	Hairy willow herb				X				
HALORAG-ACEAE	<i>Gonocarpus tetragynus</i>	common raspswort	X							
APIACEAE	<i>*Berula erecta</i>	lesser water-parsnip			X					
	<i>Hydrocotyle hirta</i>	hairy pennywort	X							
PRIMULACEAE	<i>*Anagallis arvensis</i>	pimpernel	X			X		X		X
ERICACEAE	<i>*Erica arborea</i>	portuguese heath	X							
EPACRID-ACEAE	<i>Acrotriche fasciculiflora</i>	pink ground-berry	X							
	<i>Acrotriche serrulata</i>	honeypots	X							
	<i>Astroloma conostephioides</i>	flame heath		X						
	<i>Epacris impressa</i>	common heath	X	X						
	<i>Leucopogon virgatus</i>	common bearded-heath		X						
	<i>Lissanthe strigosa</i> ssp. <i>subulata</i>	peach heath	X							
OLEACEAE	<i>*Olea europaea</i> ssp. <i>europaea</i>	olive	X							X
GENTIAN-ACEAE	<i>*Centaurium tenuiflorum</i>	branched centuary	X			X				
APOCYN-ACEAE	<i>*Vinca major</i>	periwinkle				X				
ASCLEPIAD-ACEAE	<i>*Gomphocarpus cancellatus</i>	milk bush								
RUBIACEAE	<i>*Gallium aparine</i>	cleavers	X			X				X
CONVOLVUL-ACEAE	<i>Dichondra repens</i>	tom thumb	X							
BORAGIN-ACEAE	<i>*Echium plantagineum</i>	salvation jane				X				
	<i>*Heliotropium europaeum</i>	potato weed				X		X		
	<i>*Stachys arvensis</i>	stagger weed						X		
VERBEN-ACEAE	<i>*Verbena bonariensis</i>	purple top			X					
LABIATAE	<i>*Melissa officinalis</i>	lemon balm			X					
SOLANACEAE	<i>*Solanum aviculare</i>	kangaroo apple	X							X
	<i>*Solanum nigrum</i>	black nightshade	X			X		X		
SCROPHULAR-IACEAE	<i>*Kicksia elatine</i>	woolly toadflax						X		

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	* <i>Verbascum virgatum</i>	twiggy mullein				x				
PLANTAGIN- ACEAE	* <i>Plantago lanceolata</i>	ribgrass				x	x	x		
	* <i>Veronica persica</i>	field speedwell				x		x		
CAMPANUL- ACEAE	<i>Wahlenbergia stricta</i>	tall bluebell	x							
GOODENI- ACEAE	<i>Brunonia australis</i>	blue pincushion	x	x						
	<i>Goodenia blackiana</i>	native primrose	x							
	<i>Goodenia ovata</i>	hop goodenia	x							
	<i>Scaevola albida</i>	fanflower	x							
STYLIDI- ACEAE	<i>Stylidium graminifolium</i>	grass trigger- plant		x						
COMPOSITAE	* <i>Arctotheca calendula</i>	cape weed				x				x
	<i>Bracteantha bracteata</i>	golden everlasting	x							
	* <i>Carduus tenuiflorus</i>	slender thistle	x			x				
	* <i>Chrysanthemoides monilifera</i>	boneseed	x	x						x
	<i>Chrysocephalum apiculatum</i>	common everlasting		x						x
	* <i>Cirsium vulgare</i>	spear thistle				x				
	* <i>Conyza bonariensis</i>	fleabane								x
	<i>Coronidia scorpioides</i>	button everlasting	x							
	<i>Craspedia glauca</i>	batchelors buttons	x							
	* <i>Crepis capillaris</i>	smooth hawksbeard				x		x		
	<i>Euchiton gymnocephalum</i>	creeping cudweed	x							
	<i>Euchiton involucratum</i>	star cudweed					x			
	<i>Coronidium scorpioides</i>	button everlasting	x							
	* <i>Helminotheca echioides</i>	ox-tongue			x					
	* <i>Hypochoeris radicata</i>	deep-rooted catsear	x			x	x			x
	<i>Ixodia achillaeoides</i> ssp. <i>alata</i>	fireweed	x	x						
	* <i>Lactuca seriola</i>	prickly lettuce				x				
	<i>Lagenophora stipitata</i>	common lagenifera	x							
	<i>Microseris lanceolata</i>	yam daisy	x							
	<i>Olearia grandiflora</i>	Mt Lofty daisy- bush	x							
	<i>Olearia tubuliflora</i>	cypress daisy- bush	x							
	* <i>Senecio mikanioides</i>	Cape ivy	x			x				
	<i>Senecio picridioides</i>	senecio	x			x				
	* <i>Senecio pterophorus</i>	African daisy	x	x						x

FAMILY	SCIENTIFIC NAME	COMMON NAME	VALLEY & SLOPES	DRY HILLSIDES	STURT RIVER	CLEARED LAND	DAM & EDGES	GARDEN WEEDS	PLANTED	ROAD VERGE
	<i>Senecio quadridentatus</i>	cotton senecio	X							
	* <i>Senecio vulgaris</i>	common groundsel				X		X		
	* <i>Sonchus oleraceus</i>	sow thistle	X			X		X		
	* <i>Reichardia tingitana</i>	false sow-thistle				X		X		
	* <i>Taraxacum erythrospermum</i>	dandelion				X		X		
POTAMOGETONACEAE	<i>Potamogeton ochreatus</i>	fennel pondweed					X			
LILIACEAE	* <i>Allium triquetrum</i>	three-corner garlic	X			X				X
	<i>Arthropodium strictum</i>	vanilla-lily	X							
	<i>Bulbine bulbosa</i>	bulbine lilly	X							
	<i>Burchardia umbellata</i>	milkmaids	X							
	<i>Caesia caliantha</i>	blue grass-lily	X							
	<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>	blue squill	X							
	<i>Dianella revoluta</i> var. <i>revoluta</i>	black-anther flax-lily	X							
	<i>Lomandra multiflora</i> ssp. <i>dura</i>	stiff iron-grass	X	X						X
	<i>Thysanotus pattersonii</i>	twining fringe-lily	X	X						
	<i>Tricoryne elatior</i>	yellow rush-lily	X							
	<i>Xanthorrhoea semiplana</i> ssp. <i>semiplana</i>	yacca	X	X						
IRIDACEAE	* <i>Freesia hybrid</i>	freesia	X							
	* <i>Homeria flaccida</i>	one-leafed cape tulip								X
	* <i>Romulea rosea</i>	Guildford grass				X				
	* <i>Sparaxis bulbifera</i>	harlequin flower	X			X	X			X
	* <i>Watsonia pyramidata</i>	rosy watsonia								
JUNCACEAE	<i>Juncus australis</i>	leafless rush				X				
	<i>Juncus bufonius</i>	toad rush				X				
	<i>Juncus holoschoenus</i>	joint-leaved rush	X			X				
	<i>Juncus pallidus</i>	pale rush	X							
	<i>Juncus subsecundus</i>	fingered rush	X			X	X			X
	<i>Luzula meridionalis</i>		X							
GRAMINAE	* <i>Aira elegantissima</i> ssp. <i>elegantissima</i>	delicate hair-grass				X				
	* <i>Arrhenatherum elatius</i>	false oat					X			
	* <i>Avena barbata</i>	bearded oat				X		X		
	* <i>Briza maxima</i>	large quaking grass	X	X		X				
	* <i>Briza minor</i>	small quaking grass	X			X				
	* <i>Bromus diandrus</i>	jabbers				X				
	* <i>Bromus hordeaceus</i> ssp. <i>hordeaceus</i>	soft brome				X		X		
	* <i>Bromus madritensis</i>	compact brome				X				

FAMILY	SCIENTIFIC NAME	COMMON NAME	VALLEY & SLOPES	DRY HILLSIDES	STURT RIVER	CLEARED LAND	DAM & EDGES	GARDEN WEEDS	PLANTED	ROAD VERGE
	<i>Cynosurus echinatus</i>	rough dog's-tail grass	x			x				
	<i>Deyeuxia quadriseta</i>	reed bent-grass	x							
	<i>Dichelachne crinita</i>	long-hair plume grass	x							
	<i>Dichelachne inaequalis</i>		x							
	* <i>Digitaria sanguinalis</i>	umbrella grass						x		
	* <i>Echinochloa crus-galli</i>	barnyard-grass						x		
	* <i>Holcus lanatus</i>	yorkshire fog				x		x		
	* <i>Lolium perenne</i>	perennial rye grass				x		x		
	* <i>Lolium rigidum</i>	annual rye grass				x				
	<i>Microlaena stipoides</i>	weeping rice grass	x			x	x			
	* <i>Poa annua</i>	winter grass						x		
	<i>Poa clelandii</i>		x							
	<i>Rytidosperma caespitosum</i>	white top	x			x				
	<i>Rytidosperma setaceum</i>	bristly wallaby-grass				x				
	* <i>Setaria verticillata</i>	whorled pigeon-grass						x		
	<i>Themeda triandra</i>	kangaroo grass				x				x
	* <i>Vulpia bromoides</i>	squirrel-tail grass				x				
ARACEAE	* <i>Arum italicum</i>	arum lily	x		x	x				
TYPHACEAE	<i>Typha orientalis</i>	bullrush					x			
CYPERACEAE	* <i>Cyperus tenellus</i>	tiny flat-sedge				x				
	<i>Isolepis inundata</i>	swamp club-rush			x					
	<i>Lepidosperma laterale</i>	variable sword-sedge	x							
ORCHIDACEAE	<i>Acianthus caudatus</i>	mayfly orchid	x							
	<i>Cyrtostylus reniformis</i>	gnat orchid	x							
	<i>Phelidenia deformis</i>	blue fairies		x						
	<i>Caladenia carnea</i>	pink fingers		x						
	<i>Phelidenia deformis</i>	blue fairies		x						
	<i>Caladenia leptochila</i> ssp. <i>leptochila</i>	soldier spider-orchid		x						
	<i>Caladenia tentaculata</i>	king spider-orchid	x							
	<i>Calochilus robertsonii</i>	common beard-orchid		x						
	<i>Corybas diemenicus</i>	veined helmet-orchid	x							
	<i>Dipodium roseum</i>	hyacinth orchid	x	x						
	<i>Diuris orientis</i>	bulldogs	x							
	<i>Diuris pardina</i>	common donkey-orchid	x							
	<i>Glossodia major</i>	purple cockatoo	x	x						
	<i>Microtis uniflora</i> complex	common onion-orchid	x							

FAMILY	SCIENTIFIC NAME	COMMON NAME	VALLEY & SLOPES	DRY HILLSIDES	STURT RIVER	CLEARED LAND	DAM & EDGES	GARDEN WEEDS	PLANTED	ROAD VERGE
	<i>*Disa bracteata</i>	monodenia				X				X
	<i>Orthoceras strictum</i>	horned orchid		X						
	<i>Pterostylis melagramma</i>	tall greenhood		X						
	<i>Pterostylis nana</i>	dwarf greenhood	X							
	<i>Pterostylis pedunculata</i>	maroon hood	X							
	<i>Pterostylis plumosa</i>	bearded greenhood		X						
	<i>Pterostylis sanguinea</i>	banded greenhood	X							
	<i>Thelymitra albiflora</i>	white slender sun-orchid	X							
	<i>Thelymitra grandiflora</i>	giant sun-orchid		X						
	<i>Thelymitra nuda</i> complex	scented sun-orchid	X							

Fungi

The 64 species of macrofungi recorded, i.e. those that can be seen with the naked eye are listed in **Table 2**. They represent only a portion of the fungi likely to occur on the site and were primarily those most easily identified. Some morphogroups, e.g. the resupinate fungi that usually appear as a thin splash of colour on the underside of rotting logs, were never recorded and the tough pored fungi rarely collected. For these morphogroups both the collection of spores and their identification can be problematic.

Two probably introduced species were found on the property. The striking, mauve *Lepista nuda*, the wood blewit, was recorded twice, once in the remnant roadside vegetation and once in the deep litter beneath a grove of planted blackwoods (*Acacia melanoxylon*). Specimens of the *Agrocybe praecox* complex were found in the previously cleared areas.

The introduced *Agaricus xanthodermus*, the yellow stainer, was first recorded very close to the road edge of Pole Road, adjacent to our driveway, in May 2013. Since then this species has been seen annually and is spreading both down the edge of the driveway and down the slope through the remnant native vegetation alongside the road. It has yet to be found in the larger area of native forest to the south of the house. This species is one of the most common mushrooms involved in poisonings in Australia (Southcott 1996).

Table 2: A list of macrofungi recorded from the Upper Sturt study area, compiled between 1976 and 2018. Introduced species are marked with an asterisk*.

¹Life mode

S = Saprotrophic – breaks down plant and animal material

M = Mycorrhizal – has a symbiotic relationship with a living plant

P = Parasitic – takes nutrients from a living plant or animal

Life mode information from Brundrett et. al. (1996) & Hubregtse (2017)

MORPHO- GROUP	SCIENTIFIC NAME	COMMON NAME	NATIVE BUSH	CLEARED LAND	LIFE MODE ¹
BASIDIOMYCOTA	Spores borne externally on a basidium				
Gilled Fungi	* <i>Agaricus xanthodermus</i>	yellow stainer	X	X	S
	<i>Agaricus sp.1</i>			X	S
	<i>Coprinus sp.</i>			X	S
	<i>Lepiota sp. 1</i>			X	S
	<i>Lepiota sp. 2</i>		X		S
	<i>Leucocoprinus birnbaumii</i>	plantpot dapperling		X	S
	<i>Macrolepiota clelandii</i>	bush parasol	X		S
	<i>Amanita luteolovelata</i>			X	M
	<i>Amanita ochrophylla</i> complex			X	M
	<i>Amanita xanthocephala</i>	vermillion grisette	X		M
	<i>Cortinarius microarcheri</i>		X		M
	<i>Cortinarius rotundisporus</i>	elegant blue webcap	X		M
	<i>Cortinarius splendidus</i>		X		M
	<i>Cortinarius subarcheri</i>		X		M
	<i>Laccaria lateritia</i>			X	M
	<i>Laccaria sp. B</i>			X	M
	<i>Hygrocybe astatogala</i>	blackening wax cap	X		M
	<i>Lichenomphalia sp.</i>			X	?
	<i>Crepidotus nephrodes</i>		X	X	S
	<i>Crepidotus sp. 2</i>		X		S
	<i>Marasmius crinis-equi</i>			X	S
	<i>Cruentomycena</i> <i>viscidocruenta</i>			X	S
	<i>Mycena sp.1</i>			X	S
	<i>Mycena albido fusca</i>		X		S
	<i>Mycena kuurkacea</i>			X	S
	<i>Mycena subgalericulata</i>		X		S
	<i>Mycena subvulgaris</i>		X		S
	<i>Mycena vinacea</i>		X	X	S
	<i>Rhodocollybia butyracea</i>			X	S
	<i>Oudemansiella gigaspora?</i> group	rooting shank		X	S
	<i>Hohenbuehelia sp.</i>		X		S
	<i>Coprinellus disseminatus</i>			X	S
	<i>Coprinellus truncorum</i>			X	S
	<i>Panaeolus sp. 1</i>		X		S
	<i>Psathyrella sp. 1</i>		X	X	S
	<i>Lactarius clarkeae</i>		X		M

MORPHO- GROUP	SCIENTIFIC NAME	COMMON NAME	NATIVE BUSH	CLEARED LAND	LIFE MODE ¹
	<i>Russula purpureo-flava</i>		X		M
	<i>Schizophyllum commune</i>	splitgill		X	S
	<i>Austropaxillus infundibuliformis</i>		X		M
	<i>Agrocybe praecox complex</i>	spring fieldcap		X	S
	<i>Gymnopilus junonius</i>	giant flamecap	X		S
	<i>Hypholoma fasciculare</i>	sulphur tuft		X	S
	<i>Leratiomyces ceres</i>			X	S
	<i>Pholiota communis</i>		X		S
	<i>Pholiota squarrosipes</i>		X		S
	<i>Psilocybe stercicola</i>		X	X	S
	<i>Pseudomerulius curtisii</i>		X		S
	<i>Clitocybe sp.</i>		X		-
	<i>Lepista nuda</i>	wood blewit		X	S
Corals	<i>Clavulina cinerea</i>	grey coral		X	M
Smooth/wrinkled fungi	<i>Stereum hirsutum group</i>	hairy curtain crust		X	S
Jellies	<i>Calocera guepinoides</i>	scotsman's beard		X	S
	<i>Heterotextus miltinus</i>	golden jelly bells	X		S
	<i>Tremella fuciformis</i>	white brain	X		P
	<i>Tremella mesenterica group</i>	yellow brain	X		P
Earthballs	<i>Pisolithus arhizus</i>	horse dung fungi		X	S
Puffballs	<i>Lycoperdon glabrescens</i>			X	M
	<i>Scleroderma sp.</i>			X	M
Tough Pore Fungi	<i>Coltricia cinnamomea</i>		X	X	S
	<i>Pseudoinonotus dryadeus</i>		X		S
	<i>Pycnoporus coccineus</i>		X		S
	<i>Trametes versicolor</i>	rainbow bracket		X	S
Earthstars	<i>Geastrum triplex</i>	collared earthstar		X	S
ASCOMYCOTA	Spores enclosed in an ascus				
	<i>Leotia lubrica</i>	jellybaby	X		S

Although there were similar numbers of fungi species found in the revegetated and native vegetation areas (**Table 2**), there was little overlap in the species' composition; only five species were found in both areas.

However, the close proximity of the remnant roadside vegetation to the cleared area meant that mycorrhizal species, such as specimens of the *Amanita ochrophylla* complex (**Fig. 7A**) and *A. luteolovelata*, may well have been associated with the roots of the remnant Eucalypts. The distribution of species probably reflects a natural progression of fungal species.



Fig. 7A: *Amanita ochrophylla* complex



Fig. 7B: *Cortinarius subarcheri*



Fig. 7C: *Hypheloma fasciculare*



Fig. 7D: *Mycena vinacea*



Fig. 7E: *Pseudomerulius curtisii*



Fig. 7F: *Tremella mesenterica*

Figure 7: Fungi from the Upper Sturt study area

DISCUSSION:

Over the 38 years we have lived in Upper Sturt, a variety of introduced weed species have increased significantly in the more disturbed areas of bushland, and, even in the small area where we try and control them there is constant re-invasion from the large areas around us where no weed control is occurring. Seven of these major weeds have fleshy fruit which is readily spread by foxes and many birds that move through the area in search of this food, particularly in the autumn when other food is becoming less available.

In spite of the ongoing challenge from weeds and *Phytophthora*, the bush in the study area has clearly improved in both structure and condition of the understorey in the time we have been following it. As shown in **Fig. 2**, most of the larger stringybarks were cut from this area early in the period of European settlement for timber and firewood. In the study area there are many stumps over 1m in diameter which now have one or two stems growing from the lignotuber below. This produces a much weaker tree than one growing from a seed and many of these trees have fallen in the time we have been here. In addition, a lot of the smaller saplings have died from shade or root competition, and these 10-20cm diameter trunks are also falling regularly. This has not only reduced the number of trees per unit area, but is beginning to provide a bit more habitat complexity in the understorey as the fallen logs begin to rot away. The majority of this regrowth forest is now between 1.2-1.4m diameter at breast height (dbh) and 11-15m tall. A typical example of this range of size is shown in **Fig. 3A**. The mean height of the forest stringybarks has increased from 6 to 14m between 2000 and 2016 (**Fig. 8**). Some idea of the potential for more growth can be seen from one of the few examples of an original pre-European settlement messmate stringybark in the Upper Sturt district (**Fig. 9**). This tree is on our original property on Lot 100, 10m NE of House 1. It stood beside the original alignment of Upper Sturt Road and may have been left as a shade tree. It has a spreading form, rather different from the regrowth forest form, and now has a dbh of 1.8m and is over 18m tall and presumably still growing. Even at this size it has not yet developed any hollows but it is still an impressive habitat tree for this part of the hills and an indication of the potential of this regrowth forest in the unlikely event that it escapes severe wildfire for another 100 or so years.

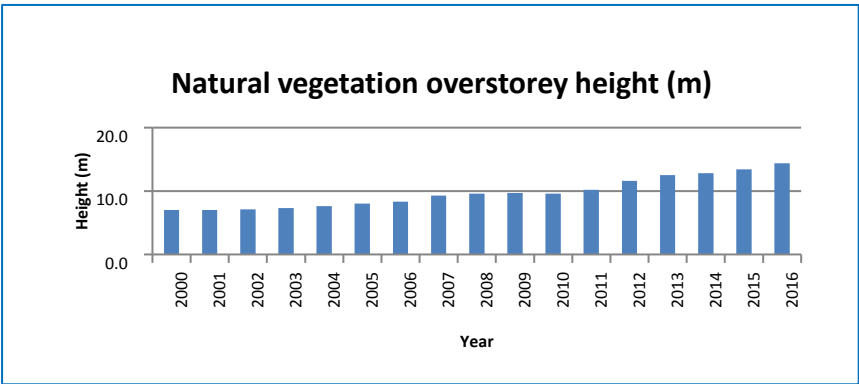


Fig. 8: Increase in the mean height of the messmate stringybark trees within quadrat NOA01001 in the natural vegetation on the study area from 2000-2016.



Fig. 9: Original pre-European settlement messmate stringybark (*Eucalyptus obliqua*) on Upper Sturt Road. The original alignment of Upper Sturt Road went to the left of this tree and the present road position can be seen in background to the right.

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