

Memoirs of the Queensland Museum | **culture**

Volume 8
Part 1

Goemulgaw Lagal: Natural and Cultural Histories of the Island of Mabuyag, Torres Strait.

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National Library of Australia card number
ISSN 1440-4788

VOLUME 8 IS COMPLETE IN 2 PARTS

COVER

Image on book cover: People tending to a ground oven (*umai*) at Nayedh, Bau village, Mabuyag, 1921.
Photographed by Frank Hurley (National Library of Australia: pic-vn3314129-v).

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A Queensland Government Project
Design and Layout: Tanya Edbrooke, Queensland Museum
Printed by Watson, Ferguson & Company

The vegetation and flora of Mabuyag, Torres Strait, Queensland

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Fell, D.G. & Stanton, D.J. 2015: The vegetation and flora of Mabuyag, Torres Strait, Queensland. *Memoirs of the Queensland Museum – Culture* 8(1):1-33. Brisbane. ISSN 1440-4788.

Mabuyag (Mabuiag Island) is the smallest permanently occupied island in the Central Western Islands of Torres Strait. The island is formed on acid volcanic basement rocks and the landscape is rugged with low, shrubby windswept vegetation occupying numerous hills and knolls. Vegetation mapping and biodiversity planning was carried out by the authors between 2007 and 2012 for the Land and Sea Management Unit of the Torres Strait Regional Authority. A total of 21 vegetation communities, within 11 broad vegetation groups and 31 regional ecosystems occur on the island. These represent 17% of regional ecosystems recorded across the broader Torres Strait Island landscape. There are currently 434 flora species recorded on the island comprising 364 (94%) native species and 70 (16%) introduced species. Three plant species are significant at either federal or state level. A further 16 are considered to have significance at the regional and local level. A number of management issues affecting the integrity of the island's biodiversity values such as fire and invasive plant and animal species are described for each of the habitats identified.

□ *Mabuyag, Mabuiag Island, Torres Strait, vegetation, flora, ecology*

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INTRODUCTION

This paper documents the vegetation and flora of Mabuyag (Mabuiag Island), situated in the Central Western group of Torres Strait Islands, in light of recent detailed fieldwork. Although only a small island, Mabuyag supports a diverse range of vegetation communities, and over 400 plant species are found there. Together with the rich marine environment, the island's vegetation and flora have underpinned the lifeway of the Goemulgal for millennia, and have in turn been transformed by their activities, such as firing and gardening. Many plant species continue to be used by, or have other cultural significance to, contemporary Goemulgal. For the most part, the vegetation and flora is in good condition, although in recent decades altered fire regimes, and pest plant and animal species, pose threats to local biodiversity. Appropriate recommendations for the management of the island's habitats by Goemulgal, with support from outside specialists and agencies, are therefore identified.

LOCATION AND ENVIRONMENT

Mabuyag Island, along with the larger islands of Mua and Badu, is part of the Central Western group of Torres Strait Islands which are formed on continental igneous rocks. The island is located 67 km north of Thursday Island at 142° 10' E, 9° 57' S and has an area of 744 ha. It is mostly rocky and undulating with a topographic high point of 146 m. The mean annual rainfall is 1,753 mm (BOM, 2008a) which compares to 1,983 mm on Badu Island (BOM, 2008b), the wettest recording station in the Torres Strait Islands and Dauan, the driest at 1,082 mm (BOM, 2008c). There are no permanently flowing streams on the island although a number of groundwater springs are present which discharge on a seasonal basis.

The Mabuyag landscape is formed by the acid welded tuff and rhyolite of the Torres Strait Volcanic group. Soil development over much of the island is skeletal and surface exposures form hard rock pavements, rock piles, boulders, and associated boulder

slopes. The formation of deeper soil profiles is largely restricted to the northern part of the island, where weathering of a more mafic (iron rich) volcanic lithology has allowed development of relatively fertile red-brown soils. Coarse-grained alluvial soils are restricted to confined pockets associated with seasonal streams and gully lines. Sand dunes, which occur sporadically on the coastal fringe, often form a single parallel ridge of coral rubble and grit, pushed into place by tidal action. These are young features of late Holocene age (< 5,000 years BP) that are formed in response to present day sea levels. No remnants of older Pleistocene age dune systems, a product of the last Glacial Maximum (15,000 – 22,000 yr BP), are preserved on the island. A well-developed system of beach sand ridges occurs in the vicinity of the settlement, although this dune feature has been largely cleared for development. For a comprehensive overview of Mabuyag's geology see von Gnielinski (2015).

METHODS

Assessment of Mabuyag's vegetation and flora has been compiled from analysis of 3D Environmental survey data (Stanton *et al.*, 2009), Queensland Herbarium specimen data (Queensland Herbarium, 2011), and field surveys with the Mabuyag Land and Sea Rangers. Classification of vegetation includes both nomenclature of individual species and the classification of groups of plants, the latter often forming unique assemblages that can be consistently recognised across islands (e.g. Mabuyag), island groups (Central Western Torres Strait Islands) or bioregions (Cape York Peninsula Bioregion). Flora nomenclature follows Bostock and Holland (2010). Species have been categorised into significance categories based on legislative status, and regional and local significance.

Threatened flora species are as listed on the Commonwealth Environment Protection and Conservation Act 1999 (EPBC Act 1999) (DSEWPC, 2012), and the Queensland Nature Conservation Act 1992 (NC Act 1992). Regionally significant species takes into account factors such as disjunct occurrence, endemism (at the bioregional, bioprovince, and island scales), limits of geographic distribution, local rarity in the landscape, and cultural importance. Information on weed species has been sourced from Stanton *et al.* (2009), Queensland Herbarium specimen data (Queensland Herbarium, 2011), field data of the authors and personal communication with Barbara Waterhouse and Stephen McKenna from the Australian Quarantine Inspection Service (DAFF 2012). Common names as well as scientific names are identified for weed species only.

The hierarchy of vegetation classification used in the Torres Strait Islands is illustrated in Figure 1. At the highest level, the classification of plant assemblages is based on vegetation structure considering the dominant life form (tree or grass), height of the tallest strata and canopy closure or cover. Vegetation structural groupings (i.e. shrubland, woodland, grassland etc.) are used to define Broad Vegetation Groups (BVGs). These provide the highest level of vegetation classification recognised by Stanton *et al.* (2009) in vegetation mapping produced for the Torres Strait Islands. BVGs may be an amalgamation of a number



FIG. 1. Diagrammatic illustration of the hierarchy and relationship between components of the vegetation classification system used in the Torres Strait Island vegetation mapping study.

of more specific plant groupings known as Vegetation Communities (VCs). These are a unit of vegetation that demonstrates similarities in both structure and floristic composition and are useful to describe fine scale variation in floristic composition that may occur due to the consistent dominance of a particular plant species or suite of plant species. Regional ecosystems (REs) comprise a group of vegetation communities (Neldner *et al.*, 2012), although unlike BVGs, they consider regional distribution and geology. Whilst REs must be considered due to their legislative implications, BVGs provide a more readily usable habitat management grouping and have been used to define habitat management units.

VEGETATION TYPES

The island's vegetation is described here within BVGs, also referred to as habitats, as derived from Stanton *et al.* (2009). Management issues for each vegetation type are also outlined. The spatial extent and relative contribution of these groupings is provided in Table 1, while descriptions of component vegetation communities and associated regional ecosystems are provided in Table 2.

EVERGREEN/SEMI-EVERGREEN VINE FOREST AND VINE THICKET

Vine forest vegetation in Torres Strait occupies a total area of 2,731 ha and represents 3.3% of the region's land area. On Mabuyag

Table 1. Broad vegetation groups of Mabuyag and relative contributions to island vegetation

Broad Vegetation Group/ Habitat	Component Vegetation Communities	Area (ha)	Contribution (%)
Evergreen/Semi-evergreen vine forest and vine thickets	1d, 1h	8	1
Deciduous/Semi-deciduous vine forest and vine thickets	2f, 2u, 2x	8	1
<i>Welchiodendron</i> dominant closed to open forests and woodlands	4a, 4b, 4c	238	32.1
<i>Melaleuca</i> dominant open forests	7b	2	0.3
<i>Pandanus</i> dominant woodland and shrubland	11b	4	0.5
<i>Melaleuca</i> dominant shrublands and woodlands	13a	11	1.5
Shrublands and shrubland complexes	14a, 14c, 14d, 14j	123	17
Coastal dune complexes	16k	<0.01	<0.05
Grasslands and grassland complexes	17c, 17d	97	13
Rock pavement and pavement complexes	18a, 18b	123	17
Mangrove forest, woodland and shrubland complexes	24a	61	8.2
Regrowth	RE	3	0.3
Exotics (exotic species dominated)	Ex, Bamboo	1.8	0.2
Cleared areas	CI	65	8.7
Total (ha)		744	100

it is limited to 16 ha and 0.02% of the island's total land area. Evergreen and semi-evergreen vine forest and thicket mapped within vegetation communities 1d and 1h represents the maximum development of vine forest on the island. It is restricted to upper hilltops and steep gully lines which are protected from wind exposure, typically in the central and elevated eastern portion of the island (Figure 2). The habitat is represented by two variations. Vine forest is dominated by *Endiandra glauca*, *Acacia polystachya*, *Syzygium bungadinnia*, *Canarium australianum* and *Dysoxylum oppositifolium*. Notophyll vine thicket is dominated by *Buchanania arborescens* amongst other evergreen species such as *Drypetes deplanchei*, *Elaeodendron*

melanocarpum, *Endiandra glauca*, *Elaeocarpus arnhemicus* and *Chionanthus ramiflorus* (Figure 3).



FIG. 2. Semi-evergreen vine forest (type 1d) with *Syzygium bungadinnia*.



FIG. 3. Evergreen vine thicket (type 1h) on high peak of Mabuyag.

Table 2. Descriptions of component vegetation communities and association with regional ecosystems currently recognised on Mabuyag (from Stanton *et al.*, 2009)

Vegetation Community	Description	Geological Association	Regional Ecosystem	VMS*	BDS**
1d	Mesophyll/notophyll vine forest + <i>Endiandra glauca</i> + <i>Acacia polystachya</i> + <i>Syzygium bungadinnia</i> + <i>Canarium australianum</i> + <i>Dysoxylum oppositifolium</i> .	Steep hillslopes on rhyolite.	3.12.4d	OC	OC
1h	Evergreen notophyll vine thicket with <i>Buchanania arborescens</i> + <i>Drypetes deplanchei</i> + <i>Elaeodendron melanocarpum</i> + <i>Endiandra glauca</i> + <i>Elaeocarpus arnhemicus</i> + <i>Chionanthus ramiflorus</i> .	Upper slopes on rhyolite talus.	3.12.36b	OC	OC
2f	Semi-deciduous vine thicket + <i>Canarium australianum</i> + <i>Manilkara kauki</i> + <i>Dalbergia densa</i> var. <i>australis</i> + <i>Buchanania arborescens</i> + <i>Sterculia</i> sp. (Annan River L.J. Brass 20319) + <i>Cochlospermum gillivraei</i> .	Exposed coastal headlands on rhyolite.	3.12.21a	LC	NCAP
2u	Semi-deciduous vine forest + <i>Manilkara kauki</i> + <i>Terminalia</i> spp. + <i>Sterculia quadrifida</i> + <i>Premna serratifolia</i> + <i>Acacia crassicarpa</i> + <i>Drypetes deplanchei</i> + <i>Millettia pinnata</i> .	Beach ridges.	3.2.2b	LC	OC
2x	Deciduous vine thicket + <i>Cochlospermum gillivraei</i> + <i>Bombax ceiba</i> var. <i>leiocarpum</i> + <i>Terminalia subacroptera</i> + <i>Sterculia quadrifida</i> + <i>Psydrax reticulata</i> + <i>Drypetes deplanchei</i> .	Pavement on rhyolite.	3.12.21a	LC	NCAP
4a	<i>Welchiodendron longivalve</i> + <i>Acacia polystachya</i> +/- <i>Terminalia subacroptera</i> +/- <i>Canarium australianum</i> +/- <i>Bombax ceiba</i> var. <i>leiocarpum</i> open to closed forest.	Rocky hillslopes on acid volcanic rocks.	3.12.4a	OC	OC
4b	<i>Welchiodendron longivalve</i> low woodland, low open woodland and tall open shrubland.	Rocky hillslopes on acid volcanic rocks.	3.12.4a	OC	OC
4c	Low <i>Welchiodendron longivalve</i> + <i>Melaleuca dealbata</i> open forest.	Rocky hillslopes on diorite.	3.12.4a	OC	OC
7b	<i>Melaleuca saligna</i> open forest.	Coastal dune swales.	3.2.4d	OC	OC
11b	<i>Pandanus</i> sp. +/- <i>Melaleuca viridiflora</i> open forest, woodland and shrubland.	Alluvial plains.	3.3.42a / 3.2.15	LC	NCAP

Vegetation Community	Description	Geological Association	Regional Ecosystem	VMS*	BDS**
14a	Dwarf <i>Welchiodendron longivalve</i> + <i>Alyxia spicata</i> +/- <i>Melaleuca viridiflora</i> +/- <i>Acacia</i> spp. +/- <i>Asteromyrtus brassii</i> shrubland.	Exposed hillslopes on acid volcanic rocks.	3.12.31x1a	OC	OC
14c	<i>Welchiodendron longivalve</i> shrubland.	Rocky granite hillslopes and knolls.	3.12.20	OC	OC
14d	<i>Cochlospermum gillivraei</i> +/- <i>Canarium australianum</i> +/- <i>Welchiodendron longivalve</i> deciduous shrubland.	Rhyolite and granodiorite hillslopes.	3.12.20	OC	OC
14j	<i>Acacia brassii</i> +/- <i>Welchiodendron longivalve</i> closed shrubland.	Rhyolite pavements.	3.12.23	OC	OC
16k	Coastal foredune grassland, herbland, woodland and vine thicket complex (17j/17d/10b/2aa – 50/20/20/10).	Coastal foredunes.	3.2.24/ 3.2.6a/ 3.2.2a	OC	OC
17c	Open to closed tussock grassland with emergent shrubs.	Rocky headlands.	3.12.29	OC	OC
17d	Medium to tall <i>Mnesithea rottboellioides</i> + <i>Heteropogon triticeus</i> + <i>Cymbopogon</i> spp. +/- <i>Imperata cylindrica</i> +/- <i>Themeda triandra</i> grassland.	Coastal dunes and foredunes.	3.2.24	OC	OC
18a	Deciduous shrubland / Rock pavement complex.	Rocky granite slopes and knolls.	3.12.34c	OC	OC
18b	Low <i>Acacia brassii</i> +/- <i>Welchiodendron longivalve</i> +/- <i>Cochlospermum gillivraei</i> shrubland/ rock pavement complex (18a/14j -50/50).	Rhyolite and granodiorite hillslopes.	3.12.34c	OC	OC
24a	Mangrove closed and open forest, woodland and shrubland complexes (24d/24c – 80/20).	Estuarine muds (periodically inundated).	3.1.1/ 3.1.2	LC	O C s u b - dom.

+ indicates the taxon is always present, +/- indicates taxon may be present or absent from the community.

*According to the Queensland Vegetation Management Act 1999, VMS = Vegetation Management Status, OC = Of Concern Regional Ecosystem, LC = Least Concern Regional Ecosystem, NCAP = regional ecosystem with a biodiversity status that is considered to be 'No Concern at Present'.

** BDS = Biodiversity Status is a non-statutory indicator of a regional ecosystems susceptibility to elements of degradation assigned to REs by Queensland Environment Heritage and Protection (EHP).

These vegetation communities are endemic to Torres Strait and are restricted to the Central Western Islands group. Vegetation community 1d is restricted to Mabuyag with minor occurrences also found on Mulgrave Peak (on Badu Island) and possibly an unsampled example on Gebar Island and other small uninhabited continental islands such as Widul and Ulu (Saddle). Vegetation community 1h is unique to Mabuyag where it occurs on rocky talus slopes in the vicinity of Kuyaman Thoera, a high point on Mabuyag, the resting place of Mabuyag's legendary warrior culture-hero, Kuyam. Significant species include *Psydrax reticulata* which is listed as vulnerable in the Nature Conservation (Wildlife) regulation and the regionally significant *Haplostichanthus fruticosus*, *Miliusa traceyi*, *Uvaria rufa*, *Actephila venusta* and *Triflorensia australis*.

Due to its geographic distribution on steep, rugged topography and its general tendency to be enclosed within a broad buffer of non-flammable vegetation, this habitat has been largely unaffected by human occupation. The vegetation margins are stable, constrained by both topography and local soils with no evidence of recent anthropogenic alteration, invasion by exotic species or incursion by fire.

DECIDUOUS / SEMI DECIDUOUS VINE FOREST AND THICKET

This habitat exists as restricted pockets amongst the more extensive *Welchiodendron longivalve* dominant forests and woodlands, typically occurring on the pavements of upper rocky slopes and exposed coastal headlands (Figure 4). Vine thickets on coastal headlands (VC2f) are typically low (3-6 m), windswept, and formed by a mix of evergreen and deciduous species that vary dependant on site conditions. Species typically include *Buchanania arborescens*, *Millettia pinnata*, *Sterculia* sp. (Annan River L.J. Brass 20319),



FIG. 4. Fully deciduous vine thicket (VC2x) on top of Kuyam's Hill, Mabuyag.



FIG. 5. Low windswept vine thicket on an exposed coastal headland, east coast of Mabuyag.

Terminalia subacroptera, *Cochlospermum gillivraei* and *Sersalisia sericea*. Purely deciduous forms of vine forest comprising *Bombax ceiba* var. *leiocarpum*, *Terminalia subacroptera*, *Cochlospermum gillivraei* and *Sterculia quadrifida* develop on pavements in less exposed locations, typically on the leeward side of hillslopes and coastal headlands (Figure 4, Figure 5). In all examples, the understory is poorly developed because of the low stature and rocky substrate, although annual herbs and vines are likely to be prevalent during the wet season. Restricted occurrences of poorly developed vine thicket are also associated with beach ridges developed

in narrow embayments. The vegetation communities (2f, 2u and 2x) are relatively widely distributed on islands of the Central Western and Inner Island groups. They are best developed on Mabuyag in the vicinity of Kuyaman Thoera at the highest point on Mabuyag on bare pavement and talus. Significant species include the Vulnerable listed *Psydrax reticulata*, the Torres Strait endemic *Croton waterhousaea* and disjunct occurrences of *Haplostichanthus fruticosus*, *Miliusa traceyi*, *Uvaria rufa*, *Actephila venusta* and *Triflorensia australis*.

Vine forest and vine thicket habitats are stable, controlled by the steep rocky slopes and pavements on which they occur. In more exposed areas particularly those associated with coastal headlands near the village, they are increasingly affected by edge effects from fire and weed incursion. Mint weed (*Mesosphaerum suaveolens*) is becoming increasingly widespread on vine thicket margins on coastal headlands with scattered occurrences of red Natal grass (*Melinis repens*). Butterfly pea (*Clitoria ternatea*) is widespread in disturbed areas and is beginning to invade vine thicket margins at more accessible locations near the coast. Siratro (*Macroptilium atropurpureum*), Indian calapo (*Calopogonium mucunoides*) and kudzu (*Peuraria montana* var. *lobata*) are other robust leguminous vines which are a future threat to this habitat, together with the invasive herb praxelis (*Praxelis clematidea*). Lantana (*Lantana camara*), bellyache bush (*Jatropha gossypifolia*) and leucaena (*Leucaena leucocephala*) are currently not present on Mabuyag however they occur on other islands in the region and should be considered a potential threat. Evidence from Mer, Erub and Iama (Stanton & Fell, pers. obs.), the Northern Territory (NT), (Smith, 2003; Franklin *et al.*, 2010) and Pacific Islands (Space & Flynn, 2002) suggest that poinciana (*Delonix regia*) is a potential threat given its ability to invade vine thickets.



FIG. 6. Well developed closed forest of *Welchiodendron longivalve* on steep slopes of Kuyam's Hill.

WELCHIODENDRON DOMINANT CLOSED TO OPEN FORESTS AND WOODLANDS

Mapped as vegetation community 4c, this is the most extensive habitat on Mabuyag occurring from footslopes to hilltops, gully lines and other sheltered locations throughout the island (Figure 6). Canopy heights range from 10-18 m with *Welchiodendron longivalve* being the dominant species, although mixing with vine forest species including *Terminalia subacroptera*, *Acacia polystachya* and *Canarium australianum*. The habitat merges with semi-evergreen vine forest (1d) in sheltered locations and is typically associated with boulder slopes where the rocky substrate prevents the incursion of fire into the forest margins. Sparse grassy ground cover is evident in some localities which provides some evidence that *Welchiodendron* is tolerant of low-intensity fire. High species diversity occurs where a vine thicket understorey is well developed.

This habitat is the most species rich on the island with some 143 species recorded, the majority of which also occur in vine forests and thicket habitats. Significant species include the Vulnerable listed *Psydrax reticulata* and *Diospyros* sp. (Bamaga B.P. Hyland 2517). A number of species are considered regionally

significant namely *Haplostichanthus fruticosus*, *Actephila venusta*, *Syzygium bungadinnia*, *Gunnesia pepo* and *Crotalaria* sp. (Torres Strait J.R. Clarkson 2044).

Exotic species are limited to scattered occurrences of mint weed and stinking passionflower (*Passiflora foetida*), with red Natal grass, butterfly pea and siratro occurring on disturbed margins. Decreased cultural burning on the island will almost certainly result in an expansion of this habitat at the expense of grassland and shrubland habitats.

MELALEUCA DOMINANT OPEN FORESTS

This habitat occurs within a broad dune swale in the vicinity of the Mabuyag township, where it forms a low closed forest dominated by *Melaleuca saligna* (VC7b) (Figure 7). The extent of the habitat has been significantly impacted by development activities, reducing its occurrence by over 40%. It now exists as fragmented remnants behind dunes and along drainage lines.

Geographically, the occurrence of *Melaleuca saligna* on Mabuyag is significant, being the northern limit of its Australian distribution. It is not known to occur in Papua New



FIG. 7. Fragmented occurrence of *Melaleuca saligna* open forest on a dune swale behind Mabuyag community.

Guinea. The major occurrence of this habitat overlaps with a significant cultural area, which includes an old village site (*Maidth*), a relict mound-and-ditch agricultural system (*guwa*) and an old grave, marked by a cement headstone (Neal, 1989).

In the vicinity of the township and access roads, the community is congested with a range of shrubs and vines, typically with a dense sprawling cover of native vines such as *Flagellaria indica*. Habitats associated with drainage lines on the eastern portion of the island are in better condition, although their extent is extremely limited. Due to broad scale clearing and utilisation of the land adjacent to this habitat near the Mabuyag settlement, the habitat margins are choked with a range of exotic weed species including siratro, streaked rattlepod (*Crotalaria pallida*), mint weed, butterfly pea, secca stylo (*Stylosanthes hamata*) and tridax daisy (*Tridax procumbens*). These weeds are likely to contribute to continued habitat degradation.

PANDANUS DOMINANT SHRUBLANDS AND WOODLANDS

The best development of this habitat occurs on the island's north-facing coastline, coincident with a broad area of alluvial outwash. A degraded example is also located on a dune swale behind the island township. The provenance of these woodlands is unclear although they are intimately associated with broader grassland and *Melaleuca* dominant shrubland habitats which occur in the near vicinity. Observations suggest that *Pandanus* occupies the lower portion of the landscape on swampier locations which are seasonally moist and occasionally waterlogged. The *Pandanus* seems particularly tolerant of hot fire and it appears seed germination events are at least partially stimulated by fire.

On the northern side of the island, the habitat is in excellent condition with well-

developed grassy ground cover comprising native species (Figure 8). Weeds are limited to minor occurrences of leguminous creepers such as siratro, butterfly pea, and secca stylo on disturbed margins. There is, however, some indication of major changes to the composition of the ground cover in some areas, particularly in moister locations where broad leaf paperbark (*Melaleuca viridiflora*) seedlings are establishing in the grassy groundcover. This is perhaps an indication of an early stage of shrubland invasion that may significantly change the structure and ecological function of the habitat. Such habitat change, most notably occurring as a dramatic thickening of shrub layers will possibly lead to the long term loss of this habitat from Mabuyag and an overall loss of island habitat diversity. In the vicinity of Mabuyag township, observations suggest that the ground cover of *Pandanus* woodland is being increasingly modified by weeds such as siratro.

The major occurrence of this habitat on the northern side of the island coincides with an old occupational and associated garden site at Wagadagam. The grassy nature of the habitat is the product of long-term anthropogenic fire practice associated with



FIG. 8. *Pandanus* dominant woodland with well developed grassy cover on an alluvial outwash plain, north-facing coast of Mabuyag.

gardening. It is likely that these grassy shrubland and woodland areas have been in a relatively stable state for extended periods, possibly the length of human occupancy, which on Mabuyag exceeds 7,000 yrs (Wright *et al.*, 2013).

MELALEUCA DOMINANT SHRUBLANDS AND WOODLANDS

This habitat is located on the island's north-western coast where it occurs on acid-intermediate volcanic rocks, merging with floristically and structurally similar habitats on alluvial substrates. *Melaleuca viridiflora* is the dominant species, mixing with *Pandanus* sp. and *Welchiodendron longivalve* on footslope and upper slope areas (Figure 9). Ground cover is dominated by native grasses including *Heteropogon triticeus*, *Themeda triandra*, *Imperata cylindrica* and *Mnesithea rottboellioides*. The habitat is indicative of a period where burning pressure was periodically released in a former grassland habitat, being either total fire abstinence, or more likely an absence of hot fire events. The even size distribution of *Melaleuca viridiflora* shrubs is indicative of a single episode of mass shrub regeneration. Evidence from habitats on Cape York Peninsula and southern Papua



FIG. 9. *Melaleuca viridiflora* dominant woodland on acid/intermediate dominant footslope, north facing coast of Mabuyag.

New Guinea suggests that such shrubby invasion generally occurs very rapidly and once established, is difficult to reverse (e.g. Bartolo *et al.*, 2002; Stronach, 2000).

The process of succession (shrubland encroachment) responsible for the development of this habitat is indicative of the considerable potential for more widespread invasion of grassland habitats across the island, particularly if traditional burning practice is interrupted. Whilst little would be gained from any measure to return this habitat to grassland, it is critical from the perspective of habitat diversity that the natural grass cover is maintained and that shrubland encroachment does not proceed to the point that the habitat can no longer carry fire. Landscape function will be maintained only through a regime of appropriate fire management.

SHRUBLANDS AND SHRUBLAND COMPLEXES

Shrubland distribution on Mabuyag is controlled largely by exposure to salt-laden trade winds and skeletal (shallow) soil development on the predominantly acid volcanic lithology (rhyolite). These communities are generally located on south-east facing headlands which are exposed to the prevailing south-easterly trade winds. Occurrences are also associated with exposed hilltops away from the immediate coast (Figure 10). The habitat forms complexes, which range from pyrophytic (fire tolerant) to pyrophobic (vegetation that is fire intolerant) dependant on species composition. Pyrophytic habitats are represented by shrubland to dwarf open shrubland with canopy heights ranging from 0.5 m to 1.5 m (VC14a). The dominant shrub species include *Melaleuca viridiflora*, *Welchiodendron longivalve*, *Asteromyrtus brassii*, *Lithomyrtus retusa*, *Psydrax reticulata*, *Alyxia spicata* and *Acacia brassii*. Groundcover is dominated by stunted shrubs with a minor contribution to



FIG. 10. Dwarf shrubland community 14a on exposed east facing headland of Mabuyag.

cover from *Dianella* sp., *Schoenus* sp., *Themeda triandra* and *Cassytha filiformis* amongst other species.

Shrubrier pyrophobic thickets are typically dominated by *Welchiodendron longivalve* (VC14c), particularly on steeper hillslope positions, and distribution ranges from footslopes extending well upslope to exposed ridge crests and peaks. Whilst *Welchiodendron longivalve* is generally the dominant species, it also occurs mixed with *Acacia polystachya*, *Cochlospermum gillivraei*, *Melaleuca stenostachya*, *Alyxia spicata*, *Terminalia subacroptera* and *Psydrax reticulata*, forming VC14d with increasing dominance of deciduous shrub species. On the more exposed upper slopes, *Welchiodendron longivalve* mixes with *Acacia brassii*, the latter species becoming predominant on the rockier pavements where it forms dense scrubby thickets.

Field surveys within the habitat have recorded 75 species including the Vulnerable listed *Cycas badensis* and *Psydrax reticulata*, the bioregional endemic *Croton waterousaea*, and the regionally significant *Miliusa traceyi* and *Erythroxylum* sp. (Mosquito Point J.R. Clarkson+ 9991). Further surveys in the wet and post-wet season will likely increase species diversity particularly for herbs and graminoids.

The majority of shrublands are unaffected by human influence, other than anthropogenic burning regimes, and are in natural condition. Some areas in the vicinity of the township and airstrip have been impacted by frequent hot fires burnt upslope, which has noticeably reduced the diversity and complexity of the shrub layers. These fire-scarred areas are occupied by scattered shrubs such as *Planchonia careya* and *Welchiodendron longivalve* over a simple cover of native grasses and sedges. Mint weed is increasingly evident on rock pavements and rocky slopes.

The habitat is naturally stable with current distribution of the shrublands controlled by the harsh edaphic conditions they occupy (i.e. steep exposed sites with rock outcrops and shallow skeletal soils) and the burning regime. Numerous stone arrangements have been recorded in this zone but are not threatened by burning. On occasion however other cultural materials including bone and shell fragments are found in association with these features.

COASTAL DUNE COMPLEXES

Coastal dune habitats occur as a number of extremely minor occurrences, generally on the landward fringe of mangrove forests forming a mix of vine thicket, grassland and shrubland. The community occupies late Holocene dune features prone to redistribution during extreme tidal or storm events. For this reason, the habitat is poorly developed and lacks floristic and structural diversity. It has not been adequately field surveyed and the complexity of floristic representation requires further assessment. A limited occurrence of this community on nearby Pulu Islet, in the form of herblands and grasslands (Fell, 2009), is considered typical where an open grassland and forbland complex is dominated by *Cenchrus brevisetosus*, *Heteropogon triticeus*

and *Ipomoea pes-capre* subsp. *brasiliensis*, with associated occurrences of *Anisomeles malabarica*, *Cayratia trifolia*, *Cleome viscosa*, *Crinum uniflorum*, *Vigna marina*, *Sesuvium portulacastrum*, *Tridax procumbens* and *Themeda arguens*. Scattered shrubs include *Clerodendrum inerme*, *Colubrina asiatica* and *Premna serratifolia*.

It is expected that frequent hot fires would have a destabilising effect on habitat ecology (Figure 11). Hot fires also have the potential to degrade cultural sites such as shell middens, conch shells and dugong bones (Hitchcock *et al.*, 2009) which are known to occur within this habitat. For this reason, cultural heritage surveys of this habitat are recommended as a priority management action together with fuel reduction burning, particularly if any culturally sensitive sites are identified, as well as surveys for exotic plant species invasion. Burning in and around the margins of these sites should occur at the earliest possible point where fire will carry with the aim to reduce fuel loads and therefore limit the likelihood of severe late season fires. Back burning to prevent severe wildfire incursion should be undertaken wherever the habitat adjoins fire-promoting vegetation (e.g. grasslands).



FIG. 11. A poorly formed chenier sand ridge which has been severely impacted to the point of being de-vegetated by frequent burning events.

GRASSLAND AND GRASSLAND COMPLEXES

Grassland communities are most extensive on the island's northern coast. The reasons for this distribution are unclear although it is undoubtedly related to traditional occupation (settlements and agriculture) and associated burning practice as well as edaphic conditions. The best-developed grasslands are those formed on andesitic lithologies, where deeper soil development allows the spread of fire without the impediment of bare rock pavements. In these locations, the habitat is represented by a range of grasses most notably *Imperata cylindrica*, *Themeda triandra*, *Mnesithea rottboellioides*, *Ischaemum* spp. and *Heteropogon triticeus* (Figure 12). The species composition is similar for grasslands occurring on rocky hillslopes although low stunted shrubs are characteristic around rocky outcrops. Fifty-nine species are recorded for the habitat. Significant species are limited to the Vulnerable listed Torres Strait island endemic *Cycas badensis* which occurs in association with grassy pandanus woodland on the western side of the island.

Neldner *et al.* (1997) recognise the bioregional conservation value of native grassland habitats in Cape York Peninsula on account of their limited distribution and impacts from changed fire regimes, shrubby thickening and weed invasions. It should, however, be acknowledged that the majority of these habitats in the Torres Strait context are products of cultural burning practices that have probably been ongoing since earliest island occupation, "a period of at least 9,000 years (David *et al.*, 2004; Rowe, 2006). Removal of anthropogenic burning from these habitats will undoubtedly lead to rapid recruitment of shrubs preceding encroachment of more advanced shrubland and woodland ecosystems. This landscape process is likely to be rapid with an eruption of shrubs across the broader habitat extent rather than gradual encroachment advancing



FIG. 12. A large area of grassland at Wagadagam on andesite

from adjacent habitat margins (Russell-Smith *et al.*, 2003; Russell-Smith *et al.*, 2004). There is strong evidence that this process is already affecting some habitats on the island.

On Mabuyag the best-developed grasslands are coincident with past settlement and/or gardening areas. The important cultural component of the landscape that these habitats represent should be acknowledged in cultural and landscape management planning. This includes managing for the maintenance of bamboo groves and other significant cultural places.

There is considerable threat from the introduction of exotic grass species which may change the ecology of these habitats. Fifteen species of introduced grass are currently known from Mabuyag. These include more vigorous species such as annual mission grass (*Cenchrus pedicellatus* subsp. *unispiculu*), Rhodes grasses (*Chloris gayana* and *C. virgata*), itch grass (*Rottboellia cochinchinensis*) and sabi grass (*Urochloa mosambicensis*), all of which are known to invade native ecosystems to varying extents. The invasion of annual mission grass is listed as a Key Threatening Processes under the EPBC Act 1999. It threatens biodiversity in northern savannas by competing with native

annual grass species and rapidly occupying disturbed areas. It has the ability to remain green until the late dry season providing fuel for fires which occur later and that are hotter than normal seasonal fires (Threatened Species Scientific Committee, 2009). Tropical legumes such as siratro, butterfly pea, Townsville stylo and streaked rattlepod also pose a threat to grasslands with the most likely avenue for establishment and invasion being dispersal by vehicles and machinery along access tracks and following any mechanical disturbance.

ROCK PAVEMENT COMMUNITIES

This habitat is extensive on Mabuyag on upper to lower slope positions on acid volcanic rocks. It comprises a complex of bare rock interspersed with shrubland, the latter typically occupying cracks and crevices where sufficient moisture and nutrient is provided to allow shrubland development. The shrubland component typically comprises deciduous vine thicket species ranging in height from 1.5-6 m dominated by species such as *Cochlospermum gillivraei*, *Canarium australianum*, *Terminalia subacroptera*, *Psydrax banksii* and *Psydrax reticulata* (VC18a) (Figure 13). Extensive areas are dominated by *Acacia brassii* (Figure 14). Rock pavements provide habitat for the Vulnerable listed *Dendrobium x superbiens* and *Psydrax reticulata* and disjunct populations of the bioregional endemic *Erythroxylum* sp. (Mosquito Point J.R. Clarkson + 9991).

The majority of rock pavements are in good condition due to their inherent infertility and exposure. Some areas in the vicinity of the township and on coastal headlands have been impacted by exotic weeds such as mint weed and red Natal grass. These species are wind dispersed and typically occur in crevices and gaps between rock outcrops. The extent to which these species have displaced native species is not known.



FIG. 13. Deciduous shrubland habitat (VC18a) with dominant *Cochlospermum gillivraei* forming within a broader expanse of *Welchiodendron longivalve* dominant shrubland.



FIG. 14. Bare pavement mixing with *Acacia brassii* dominant shrubland (VC18b).

A large number of stone arrangements, including cairns and animal effigies, are recorded on rocky areas across the island, most abundantly on island high points which have a specific view or aspect. These rock piles are culturally and archaeologically significant and indicate the cultural importance of this habitat.

MANGROVE FOREST, WOODLAND AND SHRUBLAND COMPLEXES

Narrow belts of mangrove closed forest (*thag*) are found on broad embayments and sheltered enclaves around a large part of the

island, including narrow tidal inlets near the island settlement (Figure 15). The habitat lacks detailed surveys with further exploration likely to increase floristic diversity.

Mangrove communities provide an important cultural resource for the Mabuyag people, both as hunting grounds and material resources such as timber for firewood and construction. A number of species are still used for purposes such as firewood and fencing, and the making of dyes and glues. The pods of a species called *biu*, thought to be the large leaved mangrove (*Bruguiera gymnorhiza*), were used in the past to make an edible paste in times of food scarcity (Haddon, 1904: 73). *Githalay* (Mud Crabs, *Scylla serrata*) are obtained from mangroves, as well as various species of shellfish for food and bait.

This habitat is in good condition although some limited harvesting of mangrove species for firewood is occurring in accessible locations. Mangroves occupying the small tidal inlets (creek mouths) in the vicinity of the township are disturbed on their margins due to timber collection and alteration of natural tidal and drainage flows as a result of roads and associated drainage. Mangrove shrublands on the margins of the refuse tip have been impacted by clearing and



FIG. 15. Mangrove forest fringing the coastline on the north coast of Mabuyag Island.

windblown debris such as plastic bags. The presence of introduced rats, cats and dogs around the community is likely to have impacted on mangrove fauna.

CLEARED/DEGRADED AREAS

Areas where native habitat has been disturbed through development for housing and infrastructure purposes are restricted to the eastern parts of Mabuyag and account for nine hectares of the island's area. Cleared and degraded areas support a number of processes with significant potential to degrade natural ecosystems. The proliferation of exotic weed species presents by far the most serious threat to the integrity of natural habitats across the island. Of the 92 plant species recorded in cleared and disturbed areas of Mabuyag, 70 are exotic species. Whilst the majority are widespread species not considered a significant threat to natural habitats, others are highly invasive as observed and documented from nearby islands and throughout the region. The legume species butterfly pea, siratro, Indian calopo and beggar weed (*Desmodium tortuosum*) are prolific throughout disturbed areas and are becoming increasingly evident on margins to native habitats. Occurrences of praxelis and blue top known from the town area pose a threat to rock pavement habitats. Grasses such as annual mission grass are problematic given its invasive potential and the limited knowledge of its local distribution. The recent discovery of a number of rubber vine plants in a house yard is an example of how highly invasive weeds which are planted as ornamentals may become established.

Fires that are routinely ignited within and on the margins of the community to clean up rubbish and growth of long grass are instrumental in the protection of life and property. However, there is evidence that adjoining habitats which occur close to the community (e.g. shrublands and

Pandanus woodlands) are being simplified in structure and species composition due to regular fire incursion.

FLORA

The known flora of 434 species is a preliminary figure based upon existing data and will likely increase with additional systematic surveys and after finalisation of identifications of specimens collected in recent surveys. The flora comprises 364 (94%) native taxa, with 70 (16%) naturalised. This represents approximately 32% of the known flora for the Torres Strait Islands. The 16% of introduced species listed excludes plants of town gardens; however, it incorporates many species which occur within the disturbed community area and which may occur on the disturbed margins of native vegetation. This figure compares to 5.8% for Badu, 6.7% for Iama, 30% for Boigu and 15% for the Torres Strait Islands overall (Stanton *et al.*, 2009), 7.4% for Cape York Peninsula (Neldner & Clarkson, 1995) and 15.6% for Queensland (Bostock & Holland, 2010). One hundred and three families are represented by 257 genera. Native plant families with high species numbers are Fabaceae (29 species), Apocynaceae (21 species), Rubiaceae (19 species) and Myrtaceae (16 species).

PLANT SPECIES WITH BIODIVERSITY SIGNIFICANCE

Mabuyag supports one species listed on the EPBC Act 1999, three species on the schedules of Queensland's NC Act 1992, and 17 regionally significant species. These species account for 5% of the island's flora. The summaries provided below review the distribution, and the local and regional threats that are affecting each species.

NATIONAL SIGNIFICANCE (EPBC ACT 1999)

Dendrobium x superbiens (Vulnerable)

A natural hybrid between the Cooktown orchid (*Dendrobium bigibbum*) and the golden orchid (*D. discolor*). This orchid occurs from Torres Strait to Portland Roads on north eastern Cape York Peninsula (Jones, 2006; Lavarack & Gray, 1992). One parent species *D. bigibbum* is largely restricted to Cape York Peninsula whereas *D. discolor* occurs along the Queensland coast as far south as Gladstone (Landsberg & Clarkson, 2004). Most known populations are vulnerable to settlement pressures (clearing, exotic animals, weeds, changed fire regimes) and over-harvesting (Landsberg & Clarkson, 2004). On Mabuyag it is restricted to exposed rock pavement shrublands and is locally rare, with further surveys required to determine its local distribution.

STATE SIGNIFICANCE (NC ACT 1992)

Cycas badensis (Cycadaceae)

Two populations of Cycad were recorded on Mabuyag in November 2010 in grassland habitat. Two individuals were located on the eastern side of the island, and another of between 50-100 plants was recorded on the western coast (Figure 16). Prior to the Mabuyag record, *Cycas* in Torres Strait was restricted to Mua (also known as Moa) and Badu islands (*Cycas badensis*), and a disjunct population of the New Guinea species *Cycas scratchlyana* on Mer and Naghir (Forster, 2005). *Cycas badensis* is endemic to the Torres Strait and listed as Vulnerable under both Federal and State legislation. Haddon (1912a) noted dietary use of cycads in Torres Strait: 'I have heard that in some western islands an inferior kind of sago was made occasionally from the pith of a local cycad'. Traditional use of Cycads as a food



FIG. 16. Population of *Cycas badensis* on the western side of the island.

resource is documented from other northern Australian regions (Bradley, 2006) and in Papua New Guinea (Harris, 1977; May, 1984; Powell, 1976).

Dendrobium x superbiens (Vulnerable)

See description above.

Psydrax reticulata (Vulnerable)

A shrub or small tree to 6 m common to vine thickets, shrublands and acid volcanic rock pavements on the majority of continental islands of Torres Strait and near the tip of Cape York Peninsula. It is a bioregional endemic reaching its northern limits of distribution on Torres Strait continental islands with survey records from Mua, Badu, Dauan, Zuna, Warral, Prince of Wales, Wednesday and Naghir. On Mabuyag it is an occasional component of the vine thickets and shrublands of exposed rhyolite and granite hills. The habitat on steep rocky slopes is mostly protected from fire impacts and the habitat is presently free of any major weeds. Herbaceous weeds with wind dispersed seeds, such as praxelis, are a potential threat to the habitat in the longer term. Despite the need for a reassessment of its conservation status toward delisting, it

should be considered a regionally significant taxon given it is endemic to the bioregion and at the limit of its geographical range

Diospyros sp. (Bamaga B.P. Hyland 2517)
(Vulnerable)

A low shrub 1-3 m restricted to evergreen and semi-deciduous vine forests and thickets. It is a bioregional endemic reaching its northern limits of distribution on Torres Strait continental islands. Its occurrence on Mua, Badu, Dauan, Prince of Wales and Naghir is limited to restricted pockets of suitable habitat where the plant may be locally common. As for *Psydrax reticulata*, despite a need for a reassessment of its conservation status, it should be considered a regionally significant taxon given it is endemic to the bioregion and at the limit of its geographical range.

REGIONAL SIGNIFICANCE

The classification of regionally significant species takes into account factors such as disjunct occurrence, endemism (at the bioregional, bioprovince and island scales), limits of geographic distribution and local rarity in the landscape. It is supported by field knowledge of the flora gained through surveys and analysis of available data sets and literature. The 17 species recognised are summarised below in Table 3. They include a record of *Croton waterhousaea*. This shrub to small tree inhabits deciduous vine thickets and shrublands often on the margins of rock pavements. It is previously known only from the type collection on Gebar Island (Forster, 2003), and is one of only three plants endemic to the Torres Strait region (Stanton *et al.*, 2009).

Table 3. Regionally significant flora species of Mabuyag.

Regionally Significant Species	Comments
<i>Actephila venusta</i> (Phyllanthaceae)	A low understorey shrub 1-3 m. A northern Australian endemic known from NT and Cape York Peninsula. Disjunct occurrences on a number of Torres Strait continental islands i.e. Mabuyag, Badu, Mua, Prince of Wales and Dauan represent the northern limit of distribution.
<i>Aristolochia chalmersii</i> (Aristolochiaceae)	A slender twiner endemic to the Cape York Bioregion. The record from Mabuyag in coastal vine thicket is disjunct and represents the northern limit of distribution. It is a host for the larvae of the Cairns birdwing butterfly (<i>Triodes euphorion</i>), the red swallowtail (<i>Atrophaneura polyorus queenslandicus</i>) and the big greasy (<i>Cressida cressida</i>) (Ross & Halford, 2007).
<i>Crotalaria</i> sp. (Torres Strait J.R.Clarkson+ 2044) (Fabaceae)	A highly disjunct species only known from a few islands in Torres Strait and the northern Barrier Reef continental islands. It is only known on Mabuyag from a single Herbarium specimen collected in 1911 with limited details regarding habitat and abundance.
<i>Croton waterhouseae</i> (Euphorbiaceae)	A shrub to small tree endemic to the Torres Strait and previously known only from the type locality on Gebar Island. Occurs in and on the margins of deciduous vine thickets and shrublands often on the margins of rock pavements.
<i>Erythroxylum</i> sp. (Mosquito Creek J.R. Clarkson + 9991) (Erythroxylaceae)	This shrub growing to 2-5 m in height is nowhere common, being found on Mabuyag within shrublands and rock pavements on rhyolite hills. It is endemic to northern Queensland reaching its northern limit of distribution on Mabuyag. Other disjunct occurrences in Torres Strait include Pulu, Badu, Prince of Wales, Hammond and Friday Islands. Further detailed floristic surveys will likely increase the known range and distribution of the species on the island.
<i>Garcinia jensenii</i> (Clusiaceae)	A shrub 2-4 m. Uncommon in the understorey of better developed examples of vine forest. The Badu population is restricted to vine forest on Mt Mulgrave. In the Torres Strait it is also known from Mua, Dauan, Mabuyag, Ulu and Widul. The occurrence is highly disjunct and represents the most northern limit of distribution of a north Queensland endemic.
<i>Gunnessia pepo</i> (Apocynaceae)	A monotypic genus endemic to northern Queensland. An uncommon slender understorey vine with opposite leaves. Its occurrence in <i>Welchiodendron</i> open forests of rhyolite foothills on Mabuyag is disjunct and represents the northern-most limit of its distribution. It is known from northern Cape York Peninsula in seasonally dry forests and vine thickets. It has also been recorded on Badu Island (Fell, pers. obs. 2010) with suitable habitat on Mua.
<i>Haplostichanthus fruticosus</i> (Annonaceae)	A shrub to 2 m found in the understorey of vine thicket and forest, and <i>Welchiodendron</i> forests on rhyolite slopes. The species is endemic to the Cape York Bioregion with a distribution from the McIlwraith Range in the south to Mabuyag in the north. The Mabuyag occurrence is disjunct representing part of its northern-most limit of distribution. In Torres Strait it is also known from Mua (Jessup, 2007); however, it also occurs on Badu and Dauan (Stanton <i>et al.</i> , 2009). It is a food plant for the larval stages of the green spotted triangle butterfly (Sankowsky, 1991).

Table 3. Regionally significant flora species of Mabuyag. cont.

Regionally Significant Species	Comments
<i>Maniltoa lenticellata</i> var. <i>lenticellata</i> (Caesalpinaceae)	This tree with compound alternate leaves occurs north from the Nesbit River in north-east Cape York Peninsula to Papua New Guinea. Disjunct occurrences are known from well-developed evergreen and semi-deciduous vine forest on rhyolite and granite substrates on Badu, Mua, Dauan, Prince of Wales and Mabuyag. On Mabuyag, it is rare and only known from vine forest understorey of closed forest dominated by mango.
<i>Melaleuca saligna</i> (Myrtaceae)	A small paperbark tree with pendulous narrow leaves. The occurrence on Mabuyag is disjunct, representing the northern-most limit of distribution.
<i>Miliusa traceyi</i> (Annonaceae)	A shrub to tree to 8 m. Endemic to northern Australia where it is known from seasonal vine thickets and forests in the NT and Cape York. This species is a common component of <i>Welchiodendron</i> forests and vine thickets on the majority of Mabuyag and the continental islands of Torres Strait. These occurrences are disjunct and in combination represent the species' northern limits of distribution. Food plant for the larval stages of the fivebar swordtail, fourbar swordtail, green spotted triangle, pale green triangle and the green triangle butterflies (Edwards <i>et al.</i> , 2001).
<i>Rhodamnia australis</i> (Myrtaceae)	An understorey shrub to small tree 3-6 m. The occurrence on Badu in the understorey of <i>Welchiodendron</i> forests (4a) is disjunct and represents part of its northern limit of geographical range. In Torres Strait it also occurs on Mabuyag (1d, 2x), and Mua (3a) and Iama. A northern Australian endemic known from Cape York Peninsula and the Northern Territory.
<i>Lycianthes shanesii</i> (Solanaceae)	A shrub to small tree in the understory of vine forest and thicket. A Queensland endemic known from Cape York Peninsula, north eastern Queensland and southwards as far as coastal central Queensland. Recorded on Pulu and Mabuyag in vine forest and vine thicket. These records are disjunct and represent the northern limit of distribution.
<i>Syzygium bungadinmia</i> (Myrtaceae)	A tree to 20 m restricted on Mabuyag to evergreen notophyll vine forest on sheltered gullies and slopes. An endemic to the Cape York bioregion occurring from Iron Range in the south to the Torres Strait Islands, although possibly occurring in PNG. The Mabuyag occurrence is part of a number of highly disjunct populations, which currently represent the northern limits of distribution. Known also from Mabuyag, Mua, Mer and Dauan.
<i>Triflorensia australis</i> (Rubiaceae)	An understorey shrub 2-4 m found on Mabuyag in evergreen notophyll vine forest on sheltered gullies and slopes. Known also from Badu, Mua, Mer, Dauan and Prince of Wales Islands. The Mabuyag occurrence is part of a number of highly disjunct populations, which represent the northern limit of distribution. A northern Australian endemic which also occurs in the Northern Territory.
<i>Uvaria rufa</i> (Annonaceae)	A scrambling shrub or liana known from vine forest and thicket habitats between Coen and Thailand. Occurrences on Mabuyag as well as Badu, Mua, Prince of Wales and Iama are disjunct and restricted.

INTRODUCED PLANTS (WEEDS)

The majority of the 70 exotic species which occur on the island are associated with heavily disturbed areas within and surrounding the Mabuyag township. Species listed as declared on the *Land Protection (Pest and Stock Route Management) Act 2002* are yellow bells (*Tecoma stans* var. *stans*), a Class 3 shrub. Rubber vine (*Cryptostegia madagascariensis*) is a Class 3 weed which was located in a house yard near the Mabuyag airfield during field work in November 2010. The plants, which were planted as garden ornamentals, were robust and healthy and in full flower. Rangers have since destroyed the plants. Sicklepod (*Senna obtusifolia*) is a Class 2 weed that was recorded in 2012 and is apparently locally eradicated (S. McKenna pers., comm., 2014).

Species such as mint weed, red Natal grass and secca stylo are becoming established on exposed rock pavements particularly on the eastern shore line near the community. These rocky pavement habitats appear to be vulnerable to invasion of weeds with wind-dispersed seeds. Praxelis is a highly invasive erect, branched, unpleasant-smelling herb first observed at the far southern end of the Mabuyag settlement in 2004 by Barbara Waterhouse (pers., comm., 2011). This species is known to invade rock pavements in the Mareeba and Mount Molloy districts and therefore is considered a threat to similar habitats on Mabuyag. Robust regeneration of mint weed seedlings was observed at a number of sites. Other common leguminous weeds include alyce clover (*Alysicarpus vaginalis*), phasey bean (*Macroptilium lathyroides*), beggar weed, velvet bean (*Mucuna pruriens* subsp. *pruriens* var. *utilis*), centro (*Centrosema molle*), streaked rattlepod (*Crotalaria pallida* var. *obovata*), sensitive weed (*Mimosa pudica* var. *unijuga*), coffee bush (*Senna occidentalis*) and ringworm shrub (*Senna alata*).

Escaped garden plants such as coral vine (*Antigonon leptopus*), cupid's flower (*Ipomoea quamoclit*) and scarlet flower (*I. hederifolia*), quisqualis (*Quisqualis indica*) and yellow bells have become established in isolated patches on the edge of the community. Yellow bells is widespread in these areas and is in the initial stages of invading rock pavement margins as are the Ipomoea vines which can quickly invade disturbed land following fire. Other species such as tridax daisy (*Tridax procumbens*), sida (*Sida acuta*) and snake weed (*Stachytarpheta jamaicensis*) are widespread and, in combination with the aforementioned, are rapid colonizers of disturbed areas.

Grassy weeds are widespread throughout the disturbed areas of the island and pose a significant threat to grasslands and grassy woodland habitats. Of foremost concern is annual mission grass (*Cenchrus pedicellatus* subsp. *unispiculus*), which is an aggressive species capable of inducing habitat change through altering fire behaviour. Other introduced grasses recorded from the island are Indian couch (*Bothriochloa pertusa*), Mossman river grass (*Cenchrus echinatus*), Rhodes grass (*Chloris gayana*), purpletop Rhodes grass (*C. virgata*), couch (*Cynodon dactylon*), crowsfoot (*Eleusine indica*), red Natal grass, button grass (*Dactyloctenium aegyptium*), sabi grass (*Urochloa mosambicensis*) and itchgrass (*Rottboellia cochinchinensis*). Giant reed (*Arundo donax*) and bamboo (*Bambusa* sp.) are robust graminoids known to be used for cultural purposes. They are limited in occurrence with distribution closely aligned with cultural sites.

Additional information on those weeds considered as the highest threat to biodiversity on the island are summarised in Tables 4 and 5.

Table 4. Summary of major environmental weeds of Mabuyag.

Species	Comments
Praxelis (<i>Praxelis clematidea</i>)	A highly invasive erect, branched, unpleasant-smelling herb with hairy stems and foliage. Collection notes of Waterhouse (in Queensland Herbarium, 2011) refer to a small infestation of several square metres at a house at the far southern end of Mabuyag settlement being the first record on the island. This species is known to invade rock pavements in the Mareeba and Mount Molloy districts and therefore is considered a threat to similar habitats on Mabuyag. Known also from Badu, Mua and Erub.
Butterfly pea (<i>Clitoria ternatea</i>)	This vigorous sprawling vine is one of a number of leguminous vines and herbs which occur throughout the disturbed parts of the island. Butterfly pea is a tropical perennial legume adapted to a range of soils and climates and naturalized in northern (tropical and subtropical) Australia. Current infestations are restricted to disturbed areas; however, evidence from Mabuyag suggests its potential to invade native vegetation. Seeds are likely to be dispersed by vectors such as machinery, water and grazing horses.
Siratro (<i>Macroptilium atropurpureum</i>)	Siratro is widespread on Mabuyag occurring throughout the township area and on the margins of tracks and roads. It is a vigorous sprawling leguminous climber that establishes rapidly and is considered capable of invading the groundcover of shrublands and woodlands.
Indian calopo (<i>Calopogonium mucunioides</i>)	A vigorous short-lived creeper introduced to northern Australia as a pasture legume. It establishes from seed, and rapidly forms dense mats of foliage 30-50 cm high, often climbing and smothering adjoining vegetation. It is less common than siratro and butterfly pea; however, existing infestations within the Mabuyag community have the potential to spread into adjoining vegetation.
Annual mission grass (<i>Cenchrus pedicellatus subsp. unispiculus</i>)	A robust annual grass known from the community area, although the level of infestation is not known at this time. The invasion of annual mission grass is listed as a Key Threatening Process under the EPBC Act. It threatens biodiversity in northern savannas by competing with native annual grass species and rapidly occupying disturbed areas with the ability to remain green until the late dry season providing fuel for fires which occur later and are hotter than normal seasonal fires (DEWHA, 2011). Burning is known to promote further mission grass establishment.
Mint weed (<i>Mesosphaerum suaveolens</i>)	A robust annual herb forming a multi-stemmed shrub to 2 m. Native of tropical America and naturalised throughout Western Australia, Northern Territory, Cape York Peninsula, north-east Queensland and southwards as far as south-eastern Queensland. On Mabuyag it is widespread in and around the community and is becoming prominent on rock pavement shrublands. Seeds are dispersed by wind and water.
Cupids flower (<i>Ipomoea quamoclit</i>)	A slender vine originally from India and now naturalised across northern Australia and on the east coast south to northern New South Wales. Prolific on margins of Mabuyag community forming dense infestations. Strong regeneration observed after fire.

Table 4. Summary of major environmental weeds of Mabuyag. cont.

Species	Comments
Scarlet flower (<i>Ipomoea hederifolia</i>)	A slender vine originally from tropical America, now naturalized in Cape York Peninsula, north-east Queensland and southwards to north-eastern New South Wales. Recorded on disturbed margins of the community invading swampy woodlands and vine thicket.
Coral vine (<i>Antigonon leptopus</i>)	A sprawling vine with attractive pink flowers native to Mexico. An infestation on rock pavement on the edge of the Mabuyag community indicates that this weed may be a future problem. It has tuberous rhizomes.

Table 5. Major weed threats - Mabuyag.

Species	Comments
Leucaena (<i>Leucaena leucocephala</i>)	Leucaena is a small tree up to about 6 m tall with fine bipinnate leaflets. The weed is present on Boigu, Saibai, Mua, Erub, Mer, Dauan, Thursday Island and Horn Island with dense infestations on Boigu posing a significant threat to cultural and natural values.
Lantana (<i>Lantana camara</i>)	Lantana is a Class 3 Declared Weed and listed as a Weed of National Significance (WONS). It is currently widespread on Mer, Erub and Ugar, and poses a potential threat to Mabuyag. Ongoing monitoring and prompt control of any infestations is recommended.
Gamba Grass (<i>Andropogon gayanus</i>)	Gamba is a Class 2 Declared Weed that has not yet been recorded in Torres Strait; however, it is considered a serious potential threat. Together with annual mission grass it is listed as a Key Threatening Process under the EPBC Act. It is widespread in the Bamaga district of northern Cape York Peninsula (Fell <i>et al.</i> , 2009). The grass is an aggressive colonist which develops a standing biomass of 5-7 times that of native species resulting in extremely intense fires (Rossiter <i>et al.</i> , 2003).

PLANTS WITH CULTURAL SIGNIFICANCE

The information on the plants used by Mabuyag people has been sourced from local Goemulgal through the Mabuygiw Rangers and from a review of the available literature including Haddon (1912a, 1912b). The information should be viewed as preliminary in nature. More detailed ethnobotanical studies are required to complement the existing list of useful plants, their uses and local language names. This includes information on seasonality, habitat, distribution, abundance, phenology, and the relationships to story and culture. Preliminary investigations recognise 51 species with known uses (Appendix A). This represents 11% of the island flora. Of these, 19 have documented language names. Nine species (18%) are naturalised some of which [e.g. stinking passionflower, bamboo (*Bambusa vulgaris*) and mango (*Mangifera indica*)] often occur within remnant vegetation, the latter two often in the vicinity of old settlement and garden sites. Others such as cassava (*Manihot esculenta*), tree cashew (*Anacardium occidentale*), sisal hemp (*Agave vivipara* var. *vivipara*), ringworm shrub, giant reed and tridax daisy are abundant in community areas and disturbed margins. Uzu (*Syzygium branderhorstii*) is a favoured fruit tree often planted in gardens. In Torres Strait it occurs naturally in remnant vine forest on Erub, Mer, Dauan and Mua (Fell, pers. obs.).

The majority of the species (64%) are used as a food resource. The fruits of 21 shrubs and trees and an additional three vines (*Ampelocissus acetosa*, *Cassytha filiformis*, *Passiflora foetida*) are eaten. Four species (*Terminalia catappa*, *Cycas badensis*, *Sterculia quadrifida* and *Pandanus* sp.) have nut like seeds, which are either eaten raw or processed before consumption. A further five species produce tubers which are edible although may require processing (*Crinum*

uniflorum, *Dioscorea transversa*, *D. esculenta*, *Mucuna pruriens* subsp. *pruriens* var. *utilis* and *Tacca leontopetaloides*).

Material uses such as for products made from timber (e.g. *Acacia polystachya*, *Manilkara kauki*, *Tabernaemontana orientalis*), decoration (e.g. seeds of *Abrus precatorius*, *Erythrina insularis* and *E. variegata*, *Entada phaseoloides*), rope or binding (e.g. *Hibiscus tiliaceus*, *Flagellaria indica*) account for 34% of the utilised plants, with a small proportion of these (6%) used both for food and materials. The small proportion of plants used for medicinal purposes (6%) and cultural uses (2%) is a reflection of the limitations of the information compiled to date.

CONCLUSION

Detailed investigation of Mabuyag island's vegetation and flora has documented the composition, habitat diversity and species assemblages of the island. This information provides a foundation towards recognition and better understanding of the high biodiversity values at local and regional scales. Importantly, it identifies management requirements necessary for the maintenance of biodiversity and ecological health. The role of fire management is essential to maintain grassy and woodland ecosystems on the island and to protect more sensitive rainforest and vine thicket habitats. This entails a re-engagement with traditional ecological knowledge and fire management practices, and the monitoring of those landscapes threatened by changing burning regimes. An ongoing focus on weed management, particularly within and on the community margins, is required in order to limit the potential invasion of problematic weeds, many of which have the potential to severely impact natural systems. Further work is also required on documenting and recording Goemulgaw traditional ecological

knowledge and ethnotaxonomy. Continued ecological investigation of species and species populations which are significant to local, regional and national biodiversity values is also required. These initiatives must be undertaken in a collaborative research approach with the Goemulgal under established research and cultural protocols and in collaboration with the Goemulgaw Prescribed Body Corporate and the TSRA Mabuygiw Land and Sea Ranger program.

ACKNOWLEDGEMENTS

The information necessary for the preparation of this paper has been collected under funding provided through the Land and Sea Management Unit of the Torres Strait Regional Authority. The authors wish to acknowledge all Goemulgal and thank the Goemulgaw (Torres Strait Islander) Registered Native Title Body Corporate for access to their land. Much appreciation also to the Mabuygiw Rangers Terrence Whap, Charlie Hankin, the David Amber, and TSRA Ranger Mentor Matt Anderson, for assistance in the field.

Field assistance and helpful comments on this paper were provided by Garrick Hitchcock, and staff of the Queensland Herbarium assisted with identification of plant specimens and advice on significant species. Barbara Waterhouse and Stephen McKenna of the Australian Quarantine Inspection Service provided valuable information on the occurrence and distribution of weeds and other flora. All photographs are by David Stanton except Figure 15 which was provided by Garrick Hitchcock.

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APPENDIX A. PRELIMINARY LIST OF USEFUL WILD PLANTS FOR MABUYAG ISLAND

Language Name	Common Name	Scientific Name	Life Form	Broad Use	Part Used	Broad Habitat
<i>abau</i>	Noni Plum or Rotten Cheesefruit	<i>Morinda citrifolia</i>	Shrub	Medicinal	Edible fruit	Vine forest & thickets, paperbark open forests, community areas.
<i>biuu</i>	Large leaved mangrove	<i>Bruguiera gymnorhiza</i>	Tree	Food	Pod was eaten after processing (no longer consumed).	Mangroves
<i>bomer</i>	Pandanus	<i>Pandanus spirilis</i>	Palm	Food	Material Kernel of individual fruit segments hammered out when dry and eaten. Leaves used for baskets etc.	<i>Pandanus</i> grasslands.
<i>dua</i>	Tar Tree or Marking Nut Tree	<i>Semecarpus australiensis</i>	Tree	Food	Part of fruit is eaten. Part of fruit together with leaves and sap are highly toxic causing inflammation.	Vine forest & disturbed areas.
<i>duduam</i>	Water Lilly	<i>Nymphaea sp.</i>	Aquatic	Food	Ovaries of flower eaten.	Wetlands
<i>kaway</i>	Red Bush Apple or Lady Apple	<i>Syzygium suborbiculare</i>	Tree	Food	Fleshy red fruit eaten when ripe. A good shade tree.	Open forests & woodlands.
<i>kuman</i>	Native Grape	<i>Ampelocissus acetosa</i>	Vine	Food	Small black grape like fruits are eaten when ripe.	Vine forest & thickets, <i>Welchiodendron</i> forests, woodlands & shrublands.
<i>kuper</i>	White Apple	<i>Syzygium forte</i> subsp. <i>forte</i>	Tree	Food	Fleshy white fruit are eaten when ripe.	Vine forests.
<i>meke</i>	Sea Almond	<i>Terminalia catappa</i>	Tree	Food	Outer skin of fruit eaten when ripe. Inner nut eaten when dry.	Community areas.

Language Name	Common Name	Scientific Name	Life Form	Broad Use	Part Used	Broad Habitat
<i>mergey</i>	Black Currant Bush	<i>Antidesma parviflora</i>	Shrub	Food	Small purplish-black fruit eaten (stains hands and mouth).	Vine forest & thickets, <i>Welchiodendron</i> forests, woodlands & shrublands.
<i>mipa</i>	No Common Name	<i>Terminalia subacroptera</i>	Shrub or small tree	Food	Fleshy skin of small purplish-black fruit eaten when ripe.	Vine forest & thickets, <i>Welchiodendron</i> forests, woodlands & shrublands.
<i>mumu</i>	Finger Cherry	<i>Rhodomyrtus macrocarpa</i>	Shrub	Food	Edible fruit	Vine forest & thickets
TBD	Sandpaper Fig	<i>Ficus opposita</i>	Shrub	Food	Material	<i>Welchiodendron</i> forests, woodlands & shrublands.
TBD	Ground Lily	<i>Crinum uniflorum</i>	Tuber	Food	The tuber is dug and is scraped tin preparation of a paste. Used like gasi.	Vine forests, <i>Welchiodendron</i> forests, coastal grasslands.
TBD	Dodder Laurel or Devils twine	<i>Cassytha filiformis</i>	Vine	Food	Small fruit eaten as a snack when ripe.	Vine forest & thickets, <i>Welchiodendron</i> forests, woodlands & shrublands.
TBD	Wild Passion fruit	<i>Passiflora foetida</i> *	Vine	Food	Small fruit eaten as a snack when ripe.	<i>Welchiodendron</i> forests, woodlands & shrublands, grasslands, Paperbark open forests, vine thickets, shrublands.
TBD	White Currant	<i>Flueggeia virosa</i> subsp. <i>melathesoides</i>	Shrub	Food	Small white fruit eaten as a snack when ripe.	Vine forest & thickets, <i>Welchiodendron</i> forests, woodlands & shrublands, grasslands.

Appendix A. Preliminary List of Useful Wild Plants for Mabuyag Island. cont.

Language Name	Common Name	Scientific Name	Life Form	Broad Use	Part Used	Broad Habitat
<i>kurath</i>	Cedar Bay Cherry	<i>Eugenia reinwardtiana</i>	Shrub	Food	Small black fruit eaten as a snack when ripe.	<i>Welchiodendron</i> forests, woodlands & shrublands, vine thickets.
TBD	Gidee Gidee	<i>Abrus precatorius</i>	Vine	Material	Black and red seeds used for decorative purposes i.e. necklaces and bracelets.	<i>Welchiodendron</i> forests, woodlands & shrublands, vine thickets.
TBD	Little Gooseberry Tree	<i>Buchanania arborescens</i>	Tree	Food	Small black fruits eaten as a snack when ripe.	Vine forests & thickets.
<i>natwai</i>	Coral Tree	<i>Erythrina variegata</i>	Tree	Material	Glossy red seeds used for decorative purposes i.e. necklaces and bracelets.	Vine forests and thickets.
TBD	Coral Tree	<i>Erythrina insularis</i>	Tree	Material	Glossy red seeds used for decorative purposes i.e. necklaces and bracelets.	Vine forests and thickets.
<i>kalup</i>	Matchbox Bean	<i>Entada phaseioides</i>	Vine	Material	Large flat glossy brown seeds used for dancing decorations and instruments in music.	Vine forests & thickets, mangroves edges.
TBD	Cottonwood Hibiscus	<i>Hibiscus tiliaceus</i>	Tree	Material	Fibrous bark used for fibre in tying and making of bags etc.	Coastal grasslands & mangrove edges.
TBD	Whip Vine	<i>Flagellaria indica</i>	Vine	Material	Cane like stems used for tying, binding and carrying fish.	<i>Welchiodendron</i> forests, woodlands & shrublands, vine forests & thickets, paperbark open forests.

Language Name	Common Name	Scientific Name	Life Form	Broad Use	Part Used	Broad Habitat
TBD	Sisal hemp	<i>Agave vivipara</i> var. <i>vivipara</i> *	Succulent shrub	Material	Leaves dried and processed for fibre used for decorative skirts.	Disturbed areas.
TBD	No common name	<i>Sesuvium portulacastrum</i>	Succulent herb	Feed (fattening pigs)	Fleshy leaves used for feeding pigs.	Coastal grasslands.
TBD	Cashew	<i>Anacardium occidentale</i> *	Shrub	Food	Fruit eaten.	Disturbed areas.
TBD	No common name	<i>Tabernaemontana orientalis</i>	Shrub	Material (making shanghai)	Forks of small branches used for shanghai (slingshot) construction.	Vine forests & thickets.
<i>mukamai</i>	Sea Trumpet	<i>Cordia subcordata</i>	Shrub/Tree	Material	Timber	Vine thickets (dunes), Coastal grasslands, edge of mangroves.
TBD	Ringworm shrub	<i>Senna alata</i> *	Shrub	Medicinal	Decoction from leaves used for treatment of ringworms.	Disturbed areas.
<i>busamargh</i>	Cycad	<i>Cycas badensis</i>	Shrub	Food	Seeds once used for food after processing.	Grasslands.
TBD	Yam	<i>Dioscorea esculenta</i>	Vine	Food	Tuber used for food.	<i>Welchiodendron</i> forests, woodlands & shrublands, vine thickets.
TBD	Yam	<i>Dioscorea transversa</i>	Vine	Food	Tuber used for food.	<i>Welchiodendron</i> forests, woodlands & shrublands, vine thickets.
TBD	Cassava	<i>Manihot esculenta</i> *	Shrub	Food	Tuber used for food.	Disturbed areas.
<i>dell</i>	Sea Cabbage	<i>Scaevola taccada</i>	Shrub	Spiritual	Leaves broken off plant causes wind to blow strongly.	Coastal grasslands (seashore).

Appendix A. Preliminary List of Useful Wild Plants for Mabuyag Island, cont.

Language Name	Common Name	Scientific Name	Life Form	Broad Use	Part Used	Broad Habitat
TBD	Broad leaved Ballart	<i>Exocarpos latifolius</i>	Shrub	Food	Small fruit eaten when ripe.	<i>Welchiodendron</i> forests, woodlands & shrublands, vine thickets.
TBD	Pemphis	<i>Pemphis acidula</i>	Shrub	Material	Timber used for firewood.	Mangrove margins.
TBD	Bamboo	<i>Bambusa vulgaris*</i>	Bamboo	Material	Stems used for construction and various purposes.	Disturbed areas.
TBD	Giant reed	<i>Arundo donax*</i>	Tall grass	Material	Stems used for small spears.	Disturbed areas.
TBD	Tridax	<i>Tridax procumbens*</i>	Annual herb	Medicinal	Decoction of leaves used for treating cuts and sores.	Disturbed areas.
TBD	Pacific Rosewood	<i>Thespesia populneoides</i>	Shrub/Tree	Material	Round fruit used for toys.	Mangrove margins.
TBD	Pacific Rosewood	<i>Thespesia populnea</i>	Shrub/Tree	Material	Round fruit used for toys.	Mangrove margins.
<i>thuul</i>	Hickory Wattle	<i>Acacia polystachya</i>	Tree	Material	Timber flavored for the making of dugong spears (whaps), building timber and firewood.	<i>Welchiodendron</i> forests, woodlands & shrublands.
<i>ubar</i>	Wongai	<i>Mamilkara kauki</i>	Tree	Food	Fruit are eaten. Strong timber favored for carving. Seeds used for necklaces.	Vine forests & thickets.
<i>urgi</i>	Yellow Plum	<i>Ximemia americana</i>	Shrub	Food	Fruit with yellowish flesh is eaten.	Edge of Mangroves.

Language Name	Common Name	Scientific Name	Life Form	Broad Use	Part Used	Broad Habitat
<i>uzu</i>	Lockerbie Satin Ash	<i>Syzygium branderhorstii</i>	Shrub/Tree	Food	Fruit eaten. This plant grows in the wild on Mua, Erub, Dauan however is planted in domestic gardens.	Domestic gardens.
<i>weiba</i>	Nonda Plum	<i>Parinari nonda</i>	Tree	Food	Outer flesh of fruit is eaten when fully ripe.	Open forests & woodlands.
<i>woeywi</i>	Mango	<i>Mangifera indica</i> *	Tree	Food	Fruit eaten.	Disturbed areas.
<i>yarakakur</i>	Peanut Tree	<i>Sterculia quadrifida</i>	Tall shrub to tree	Food	Nut flavored seeds within a woody follicle are eaten.	Vine forests & thickets.
<i>gasi</i>	Arrowroot	<i>Tacca leontopetaloides</i>	Tuber	Food	Tuber	

* denotes introduced species