RECORDS OF THE WESTERN AUSTRALIAN MUSEUM 81 205–244 (2014) DOI: 10.18195/issn.0313-122x.81.2014.205-244
SUPPLEMENT

Flora and vegetation communities of selected islands off the Kimberley coast of Western Australia

M.N. Lyons[1]*, G.J. Keighery[1], L.A. Gibson[2] and T. Handasyde[3]

[1] Department of Parks and Wildlife, Science and Conservation Division, Keiran McNamara Conservation Science Centre, Locked Bag 104, Bentley Delivery Centre, Western Australia 6983, Australia.

[2] Department of Parks and Wildlife, Science and Conservation Division, PO Box 51, Wanneroo, Western Australia 6946, Australia.

[3] Department of Parks and Wildlife, Science and Conservation Division, PO Box 942, Kununurra, Western Australia 6743, Australia.

* Corresponding author: Mike.Lyons@dpaw.wa.gov.au

ABSTRACT – A systematic survey of flora and floristic communities was undertaken on 24 selected inshore islands off the Northern Kimberley (NK) coast between 2007 and 2010. One hundred and thirty seven 50 x 50 m quadrats were sampled for floristics and surface soils, and site attributes recorded. Quadrat sampling was supplemented by general collecting to further document the floristics of major substrates and habitats of each island. We recorded 1005 taxa from the surveyed islands, of which, 403 taxa were new records for the collective islands of the NK bioregion. Based on existing Western Australian Herbarium collections and current survey records, the flora recorded from the islands represents approximately 49 percent of the NK bioregion flora. A total of 57 taxa of conservation significance were recorded from the surveyed islands. Few taxa appear to be restricted to islands. Very few weed species were recorded, except from the islands with a modern history of settlement. Ten floristic groups were defined by the classification of species presence/absence within quadrats. Broad geology coupled with climate and local edaphic parameters appeared to be the main factors influencing the vegetation patterns observed on the islands sampled. Among quadrats on the hard/rocky substrates, there was a compositional gradation from the plant communities of the sandstone geologies to the more fertile volcanic/dolerite substrates, which was reflected in the values of the soil parameters. In terms of the conservation significance of the islands as a whole, the largest and wettest islands were shown to be particularly important as they supported the highest number of NK bioregion endemic plant species. Highest numbers of priority taxa also tended to occur on the largest islands. However, some of the drier islands had unique species assemblages with elements of arid/semi-arid zone flora that were not well represented on other islands. Future management of the islands requires strategies that minimize both the risk of exotic weed introductions, and inappropriate fire that would threaten the persistence of fire-sensitive vegetation.

KEYWORDS: botanical survey, endemism, floristic composition, island conservation, Northern Kimberley, vegetation patterns

INTRODUCTION

The Northern Kimberley (NK) bioregion of Western Australia (Thackway and Cresswell 1995) is widely regarded as one of the world's few remaining tropical areas with largely intact ecosystems where native species and communities are well represented, and the richness of locally endemic species is high (May and McKenzie 2002; McKenzie et al. 2009). As such, this region is recognised as one of Australia's 15 national 'biodiversity hotspots' (SEWPaC 2012). Existing and/or future threats to biodiversity is also considered in the identification of hotspots as, given no threat mitigation, the potential impact on the biodiversity in such areas are likely to be unusually high (Woinarski et al. 2006). In the NK bioregion, an increasing body of research has highlighted ongoing and emerging threats to the region's biodiversity posed by altered fire regimes, invasive weeds, introduced predators and grazing by feral herbivores (McKenzie et al. 1991; McKenzie et al. 2009). The low-nutrient soils of the NK bioregion have historically discouraged pastoral activity in this area. However, localised degradation of habitats such as rainforest and riverine vegetation, along with a landscape-scale simplification of the savanna ecosystems that dominate the region is now evident (McKenzie et al. 2009). Studies of fire regimes at the landscape scale have shown large areas of the NK bioregion are subject to large-scale, frequent and intense fires, often occurring in the late dry season (Fisher et al. 2003; Vigilante and Bowman 2004; Vigilante et al. 2004). These contemporary fire regimes are believed to be the cause of changes in the structure and floristic composition of woody savanna vegetation (Vigilante and Bowman 2004; Russell-Smith et al. 2012). McKenzie and Belbin (1991) documented damage to rainforest patches in the Kimberley from intense fires coupled with damage by cattle. The long-lived and widespread obligate seeder, *Callitris columellaris*, has declined across the region in response to changed fire regimes (Graham 2002). Studies of shorter-lived obligate seeding species elsewhere in northern Australia, also suggest that current fire regimes may locally eliminate taxa through the inability of species to reach maturity and replenish soil seed banks between fire events (Russell-Smith et al. 2002, 2012).

The NK bioregion remains the most weed-free region of the Kimberley, albeit with significant emerging threats from the spread of currently localised infestations and taxa occurring in neighbouring bioregions (McKenzie et al. 2009). The spread of Grader Grass (*Themeda quadrivalvis*) and the potential invasion of Gamba Grass (*Andropogon gayanus*) represent significant threats to NK bioregion plant communities, and will further complicate fire management as has been observed in the tropical savannas of the Northern Territory (Rossiter-Rachor et al. 2008). Additionally, a number of exotic taxa that smother native vegetation including *Cryptostegia madagascariensis*, *Merremia* species, *Clitoria ternata* and *Ipomoea pes-tigridis* may spread from currently isolated occurrences. *Passiflora foetida*, a climber that also smothers vegetation, is already ubiquitous in the region (Carwardine et al. 2011; CCWA 2010). Furthermore, the rocky landscapes of the NK bioregion concentrate the impact of feral and domestic cattle in the productive riparian zones. Here, vegetation trampling, selective removal of palatable species and soil disturbance exacerbate the propensity for weed invasion (McKenzie et al. 2009).

In contrast to the Northern Kimberley mainland, the more than 2500 islands along this coastline have been less-altered by human-associated disturbances. Historically, the remoteness and lack of permanent fresh water on the islands for most of the year discouraged European settlement (Crawford 2001). As a consequence, agricultural activity was limited to a very small number of islands and this activity was not sustained (Crawford 2001). On the other hand, archaeological evidence and accounts from Aboriginal Traditional Owners indicate that Aboriginal people made extensive use of the islands, and this included landscape-burning (Vigilante et al. 2013). However, their movement to mainland settlements in the 1900s resulted in islands that were no longer actively burnt (Vigilante et al. 2013). The influence of Aboriginal burning on the vegetation structure and composition of the Kimberley islands is little understood. Aboriginal occupation of the islands ranged from permanent to seasonal or occasional visits, which was dependent on island size, resource availability and accessibility (Vigilante et al. 2013). Consequently, burning on islands would have varied considerably with differential effects on the vegetation. Batianoff and Dillewaard (1997) similarly suggested that vegetation changes on the Great Barrier Reef continental islands due to Aboriginal burning were confined to larger islands with fresh water and potentially smaller islands with easy access. The movement of Aboriginal people to the mainland, and consequent changed fire frequency, is also likely to have resulted in changes in vegetation patterns on the islands (Bowman 1998; Woinarski et al. 2000).

Isolated from the mainland by rising sea levels up to 10,000 years ago (Nix and Kalma 1972), the Kimberley islands are believed to be microcosms of the vegetation communities widespread on the adjacent NK mainland. Previous surveys and botanical collections from the islands suggest that this is the case. The earliest botanical collections from the Kimberley islands were made by botanist Alan Cunningham who accompanied Lieutenant King on three voyages visiting the Kimberley Coast between 1819 and 1822 (Curry et al. 2002). It was not until the turn of the 20th century that additional island collections were made by W.V. Fitzgerald (Sunday Island – 1906; Fitzgerald 1919). The first published survey of the Kimberley islands focused largely on fauna but included broad vegetation descriptions for 23 islands (Burbidge and McKenzie 1978). Field work was conducted in the dry seasons of 1971–1973, and significant numbers of plant collections were lodged at the Western Australian (WA) Herbarium (PERTH). Beard et al. (1984) give short descriptions of the vegetation of the Osborn islands and Fenelon Island following a brief visit to these islands in the late 1970s. Rainforest patches were also surveyed for plants on eight islands as part of a broader rainforest survey of the Northern Kimberley in 1987-1989 (Kenneally et al. 1991). Koolan Island off the Yampi Peninsula in the Kimberley was surveyed in detail during the wet season of 1993 and a comprehensive species list compiled from survey and WA Herbarium collections yielded a species list of 282 taxa (Keighery et al. 1995). Additionally, a summary of biodiversity publications and unpublished information by island, for those greater than 200 hectares, and a number of smaller islands with known biodiversity values, is provided by the Conservation Commission of Western Australia (CCWA 2010).

The largest existing botanical data source for Kimberley islands is the specimen data for vouchers lodged at the WA Herbarium, which includes approximately 3060 collections of vascular plants from 98 Kimberley islands. Few islands had significant numbers of collections, with only 18 having more than 50 herbarium records. A large number of islands (58) had fewer than 10 records; a reflection of the largely opportunistic nature of the survey effort for the islands of the Kimberley, and the difficulty of accessing this remote area. Collections included vouchers from the previously mentioned surveys and a number of unpublished surveys including the Northern Australia Quarantine Strategy (Australian Quarantine and Inspection Service) surveys, Buccaneer Archipelago Survey 1982 (Western Australian Department of Fisheries and Wildlife), Western Australian Naturalist Club expeditions (e.g. Coate 2011), collections by botanists associated with ecotourism ventures (e.g. Kenneally et al. 1996), and a limited number of surveys undertaken for mining and petroleum development approvals.

Here, we add to this information base and further address the question of islands as microcosms of the NK mainland by examining patterns in floristic composition across 24 of the largest Kimberley islands using systematic quadrat-based sampling. These quadrats will also be important quantitative benchmarks for long-term monitoring of vegetation composition, fire and weeds. This botanical survey forms part of an integrated biological survey carried out between 2007 and 2010, which included sampling for mammals, reptiles, frogs, land snails and birds – the Kimberley Island Biodiversity Survey (KIBS). An overview of the background to the survey, rationale for island selection, design and logistics is provided by Gibson and McKenzie (2012).

METHODS

STUDY AREA

Twenty-four islands were sampled from Sunday Island in the south-west to Adolphus Island in Cambridge Gulf in the east Kimberley (Figure 1).

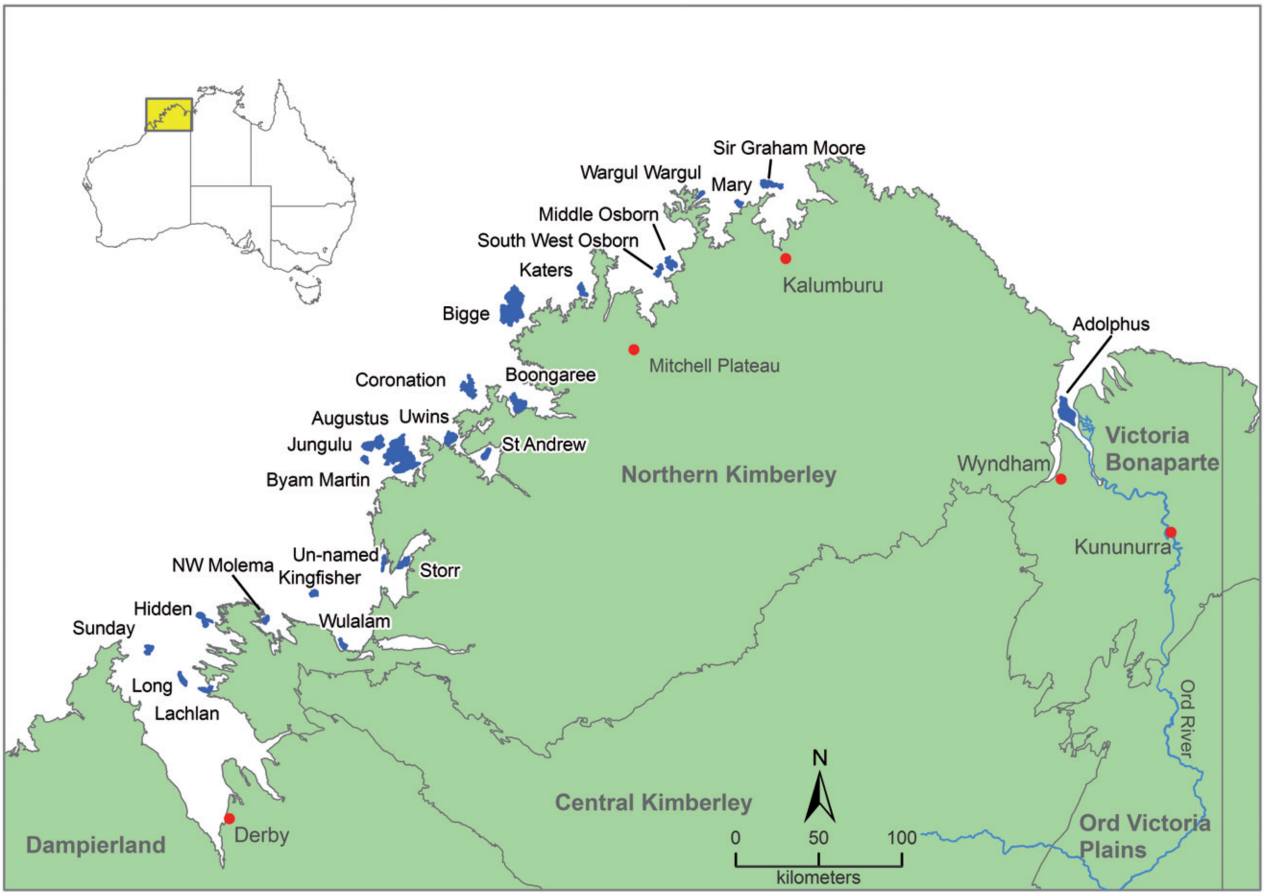

FIGURE 1 Location of Kimberley islands surveyed along the north-west coast of Australia. Biogeographic regions are also shown.

On each island, sampling was centred on campsites positioned to enable access on foot to the maximum number of habitats present. Habitats were identified based on geology and broad structural vegetation types. Two campsites were required on larger islands (Adolphus, Augustus, Bigge, Coronation, Jungulu/Darcy, Middle Osborn and Sir Graham Moore) to better access the environmental variation. Islands were sampled in the dry season (winter) and resampled in the subsequent wet season (summer) with approximately a third of the islands being sampled each year between 2007 and 2010. Two islands, Mary and Wargul Wargul were sampled in the dry season of 2010, but not resampled the following wet season.

The geology of the islands resembles that of the adjacent mainland, although even the largest islands generally, individually included only two or three of the variety of Precambrian rock types present on the mainland (Burbidge and McKenzie 1978; Burbidge et al. 1991). General geological descriptions of the islands are given in Gibson and McKenzie (2012). Briefly, sandstone and volcanic strata structure the island landscapes. The sandstone units tend to give rise to rugged, dissected terrains, while the volcanics usually produce a more rounded and undulating topography. Tertiary duricrusts occur as mesas and dissected tablelands on some islands, capping volcanic or sandstone strata. Quaternary sediments occur in coastal areas.

The Kimberley experiences a tropical monsoon climate with a pronounced dry season extending from around April to October, and a wet season from November to March when almost all rainfall occurs. Cyclonic activity is also a feature of the climate, with an average of two cyclones crossing the northwest Australian coast each cyclone season (http://www.bom.gov.au/cyclone/climatology/wa.shtml). Average annual rainfall ranges from 1500 mm in the northwest to 800 mm in the southeast, and average temperatures range from a daily maximum of 33^{o}C in January to a night time minimum of 15^{o}C in July (http://www.bom.gov.au).

FIELD SAMPLING

At least one 50 x 50 metre quadrat was established within each distinct habitat type, with rectangular transects of the same area (2500 m^2) used to sample linear habitats such as beaches, mangroves and riparian zones. Quadrats were marked with aluminium plates on steel pegs or glued to rocks, and each corner was demarcated with a hand held GPS. Within each quadrat, all vascular plants were recorded and voucher specimens collected. Attributes of the substrate – abundance of coarse fragment and size (i.e. rock), and rock outcrop (or bedrock) were recorded for each quadrat using the coding systems outlined in McDonald et al. (1998). Rock abundance and size was summed to give another measure of rockiness (rock total). Broad surficial geology for each quadrat was noted based on field observations and confirmed by 1:250,000 geological maps (Geological Survey of Western Australia 2010). Quadrat location, values of substrate attributes and geological codes are provided in Appendix 1. Additionally, soil samples from the top 10 cm of the profile were taken at 10 spaced points across each quadrat and combined as a site sample (10 x 100 g). Particle size and soil chemical analyses were performed on the samples by the Chemistry Centre of Western Australia. Parameters analysed included pH, electrical conductivity, organic carbon, phosphorous, nitrogen, potassium, calcium, magnesium, sodium, and percent silt, clay and sand (Appendix 2).

Extensive plant collections were made outside formal quadrats in both the dry and wet seasons to supplement species lists for each campsite/island. Particular focus was placed on small scale habitats not encompassed by quadrats, for example, the ephemeral species of 'minor' wetlands only evident in the wet season. Habitats of particular interest which were difficult to access due to distance or rugged terrain were opportunistically sampled using a helicopter (e.g. the sandstone plateau of South West Osborn Island).

To provide a perspective on the flora of the NK bioregion islands, a list of the known flora of the entire NK bioregion was compiled from collections held in the WA Herbarium. To determine taxa endemic to the NK bioregion, broader distributions were determined by querying Australia's Virtual Herbarium (AVH) (www.anbg.gov.au/avh/).

DATA ANALYSIS

PATTERNS IN SPECIES COMPOSITION

The program PATN (v3.12) (Belbin 1995) was used to classify quadrats according to similarities in their species composition, based on presence/absence data, using the Bray–Curtis measure of dissimilarity, followed by the flexible UPGMA (unweighted pair-group mean average) clustering algorithm and beta value set to -0.1 (Belbin 1995; Sneath and Sokal 1973). To simplify interpretation of the data matrix, singleton taxa (i.e. species recorded from only one quadrat) were excluded from the analysis. The 2STAGE routine in PRIMER 6 (Clarke and Gorley 2006) was used to compare the full and reduced (minus singletons) association matrices using Spearman rank correlation. A 99.8% correlation was found between the two datasets, showing that the singletons added little information to the classification. The resulting association matrix was ordinated using non-metric multi-dimensional scaling (nMDS) in two dimensions (minimum stress of 0.005 and 100 restarts) in PRIMER and displayed as a scatter plot with clusters defined. One quadrat placed in the mangroves (LONG3) contained only five species (*Avicennia marina*, *Bruguiera exaristata*, *Ceriops tagal*, *Rhizophora stylosa* and *Sonneratia alba*), and as an extreme outlier, this quadrat was removed from analyses.

Indicator species characterising each cluster of quadrats identified in the above analysis were determined following Dufrêne and Legendre (1997) using the 'indicspecies' package (De Cáceres and Legendre 2009) in the R statistical computing language (R Development Core Team 2009). The statistical significance of each species as an indicator of a group was tested using 999 permutations.

To explore the relationship between compositional similarity and quadrat attributes, the BEST/BIOENV procedure in PRIMER, where the distances in the association matrix are rank-order matched with the Euclidean distances among each of the site attributes using Spearman's rank correlation, was used. This procedure calculates the Spearman's rank correlation coefficient (rho) using every possible combination of the predictor variables until it finds the combination whose Euclidean distance matrix yields the highest value of rho (Geffen et al. 2004). Two climate attributes were selected to include in the BEST analysis; average annual rainfall and maximum temperature of the warmest period. Both variables were derived using the BIOCLIM module of ANUCLIM (Houlder et al. 2000). For pairs of variables that were highly intercorrelated ($P > 0.9$) a single variable was retained. In this case, exchangeable potassium was retained in preference to total potassium ($P = 0.91$). Rock total was correlated with both abundance and size, but was retained (as it was derived from summing both). Soil chemical attributes with highly skewed distributions were log-transformed and the final variable set was normalized prior to analysis. Quadrats in mangroves, being species poor and compositionally distinct from the terrestrial quadrats, predictably formed an outlier group (ANOSIM routine in PRIMER: r = 0.619, $P < 0.001$) and were removed prior to the BEST analysis. Two additional outliers (quadrats HID6 and WARW4), and two quadrats with no corresponding soil attributes (LACH4 and WUL5) were also removed prior to the BEST analysis.

The degree of spatial structure (or distance decay) in species composition was examined using the Mantel test using the PASSaGE software package (Rosenberg and Anderson 2011). A Euclidian distance matrix was calculated for geographical distance based on the geographical coordinates of the quadrats. The significance of the relationship between species similarity and geographic distance was examined using a Monte-Carlo procedure with 999 permutations.

Species classification (based on quadrat presence/absence) was performed using the two-step algorithm in PATN (Belbin 1980), with clustering following the method employed for quadrats as above. The quadrat and species classifications were combined to generate a sorted two-way table to help interpret the quadrat groups (Electronic Appendix 1).

RICHNESS OF NORTHERN KIMBERLEY BIOREGION ENDEMICS

The richness of plant species endemic to the NK bioregion, tallied from KIBS records for each island, was related to a set of island attributes, and also to sampling effort (i.e. the number of quadrats sampled on each island) (Appendix 3). Attributes selected included island area, closest distance to the mainland, average annual rainfall, maximum elevation of an island and the extent of rock outcrop on each island (referred to as 'boulder'). Island size was defined as the area of land mass (ha) that was unlikely to be inundated (i.e. tidal mudflats and mangroves were excluded), and was determined from digitized 1:100,000 topographic maps. Maximum elevation (m) was also extracted from the 1:100,000 topographic maps. Distance to the mainland (km) was estimated using Google Earth™ imagery. 'Boulder' was determined as: 0 = flat; 1 = rounded, soil-mantled hill slopes and plateaux, narrow scree; 2 = shallow joints, wide ledges, moderate scree; and 3 = massive scree, deep joints and scarp country.

The association between species richness and all possible subsets of the six attributes was modelled using a generalized linear model (GLM), assuming a Poisson distribution. Island size and distance to the mainland was log-transformed prior to analysis. There was no evidence of over dispersion in the global model (i.e. c-hat <1). All models were included in a final candidate set for averaging to estimate parameters based on the second-order Akaike Information Criterion (AIC_c) (Burnham and Anderson 2002). AIC_c weights were calculated and used to weight model coefficients. The relative importance of covariates was examined by summing the AIC_c weights for each covariate across all models in which it occurred (w_+; Burnham and Anderson 2002). Data analyses were run in the R statistical computing language (R Development Core Team 2009) and the 'MuMIn' contributed package. The performance of the averaged-model was evaluated by regressing the fitted values against observed species richness values.

RESULTS

A total of 1005 taxa, from 119 families were recorded from the KIBS islands (Electronic Appendix 2 and 4). The families best represented were Fabaceae (133 taxa, ca. 13% of flora), Poaceae (108, 11%), Cyperaceae (93, 9%) and Malvaceae (63, 6%). A total of 403 genera were recorded, with *Cyperus* (36 taxa), *Fimbristylis* (33), *Acacia* (30) and *Tephrosia* (15) the most speciose. About one quarter of all taxa (230 species) were recorded from only one KIBS quadrat (Electronic Appendix 3). Tallying these singletons for each island showed highest numbers on the relatively large islands of Augustus (31), Sir Graham Moore (29), Coronation (25) and Bigge (23).

Based on specimen records at the WA Herbarium, the currently known flora of the NK bioregion, including islands, consists of 1975 taxa (133 of these are weeds) (Electronic Appendix 2). Prior to the KIBS, 834 taxa were known from the islands. During the KIBS, 403 taxa were recorded that were not previously known to occur on these islands. Combining records from the KIBS and existing herbarium data, 1237 taxa are now known from NK bioregion islands (Electronic Appendix 2). The island flora represents 49% of the known flora of the NK bioregion; a conservative estimate as taxa were amalgamated at the species level to compare the KIBS data with existing herbarium records. Examining these combined records revealed a very small group of taxa that have only been recorded in Western Australia (WA) from islands in the NK bioregion (including some of the KIBS islands). For example, *Commicarpus chinensis* subsp. *chinensis* recorded from Cassini and Corneille islands is also known from Christmas Island in the Indian Ocean and much of coastal South Asia. *Sida pusilla,* recorded from Browse and Leseur islands, grows on coralline sand and occurs on islands of the northern Indian and western Pacific Oceans and northern Australia. *Muellerargia timorensis* occurs in scattered localities across northern Australia and Malesia in rainforest and beach forests. *Salacia chinensis* grows in monsoon vine thickets and rainforests typically close to the sea, and is only known in WA from South West Osborn Island. Its distribution extends through northern Australia, Asia and the South West Pacific. *Dysoxylum acutangulum* has a similar distribution and is only recorded in WA from Berthier and the Maret islands.

Currently, there are also numerous species that occur in the NK bioregion, that are not known to occur in close proximity to the coast (i.e. within 20-30 km), including on islands. For instance, at least 26 of 84 *Acacia* taxa that occur in the NK bioregion have this distribution pattern. Eight of the 14 *Eucalyptus* taxa not recorded on the islands in the NK bioregion have also not been recorded in the coastal region. However, a paucity of survey effort on the mainland Kimberley means that currently understood species distributions may alter with further survey work.

SIGNIFICANT CONSERVATION TAXA

Fifty seven taxa listed as Priority Flora by the Department of Parks and Wildlife (DPaW) due to their conservation significance (http://florabase.dpaw.wa.gov.au/conservationtaxa) were recorded from the surveyed islands (Table 1). An additional nine priority taxa not recorded during the current survey are known from previous collections held in the WA Herbarium (Table 1). Only two islands, Lachlan and Wulalam, have no recorded priority taxa. Thirty three (approx. 51%) of the listed taxa have not been previously recorded from NK bioregion islands. A number of Priority Flora occurred on several islands. *Parsonsia kimberleyensis* was recorded from vine thickets and creeklines on five islands, being previously only known from the northern tip of the Dampier Peninsula in dune swale vine thickets. *Gossypium pilosum*, previously only known from the mainland in the broader Mitchell Plateau area, occurred on five islands associated with basalt and laterite soils. *Solanum cataphractum* was recorded from four islands consistent with a relatively narrow distribution centred on islands and the adjacent mainland in the central NK. In the context of the mainland NK bioregion, the Mitchell Plateau, Prince Regent River and the vicinity of Kalumburu are better known botanically, and a group of Priority Flora has previously been identified in collections from these areas. Many of these taxa were also recorded from the islands during the KIBS. These included *Cyperus sulcinux*, *Fimbristylis* sp. E Kimberley Flora (C.R. Dunlop 5403), *Phyllanthus* sp. D Kimberley Flora (C.R. Dunlop 5302), *Bossiaea* sp. Princess May Range (M.D. Barrett & R.L. Barrett MDB 1326), *Eriocaulon* sp. E Kimberley Flora (A.S. George 12635), *Boronia filicifolia* and *Olearia arguta* var. *lanata* (Table 1).

Despite having extensive distributions outside Western Australia, a number of taxa recorded on the islands are deemed of conservation significance due to the limited number of records within the state's jurisdiction. In the Kimberley, such species are often associated with rainforest and vine thickets, and have distributions that extend across tropical northern Australia. *Diospyros calycantha,* known to occur as a western outlier on the Mitchell Plateau (also recorded from NT, Qld and New Guinea), was recorded from Augustus Island. The ferns *Lygodium flexuosum* (recorded from South West Osborn and Wargul Wargul islands) and *Actinostachys digitata* (Un-named Island) have distributions across tropical northern Australia, with the latter more scattered and extending into Southeast Asia and Sri Lanka. *Croton arnhemicus,*

TABLE 1 Taxa of conservation significance collected from islands during the Kimberley Island Biodiversity Survey (+). Additional records from previous island collections (Western Australian Herbarium) are also shown (++). Priority status follows Smith (2010) with updates sourced from the Department of Parks and Wildlife's FloraBase http://florabase.dec.wa.gov.au/ (accessed on 9 January 2012). No priority taxa were recorded from Lachlan or Wulalam.

	Adolphus	Augustus	Bigge	Boongaree	Byam Martin	Coronation	Jungulu	Hidden	Katers	Kingfisher	Long	Mary	Middle Osborn	NW Molema	Sir Graham Moore	St Andrew	Storr	Sunday	South West Osborn	Un-named	Uwins	Wargul Wargul
Priority 1																						
Acacia sp. Bigge Island (A.A. Mitchell 3436)			+																			
Actinoschoenus sp. C Kimberley Flora (P.G. Wilson s.n. 12/5/72)		+														+					+	
Ailanthus triphysa						+																
Croton arnhemicus	+	+																				
Cyperus sulcinux																			+			
Diospyros calycantha		+																				
Eragrostis rigidiuscula		++																				
Eriachne burkittii						+						+										
Eucalyptus kenneallyi																	++					
Fimbristylis pachyptera						+														+		
Fimbristylis sp. E Kimberley Flora (C.R. Dunlop 5403)			+	+									+						+			+
Fimbristylis sp. I Kimberley Flora (R.J. Hnatiuk 112)						+							+						+			
Fimbristylis subaristata		+											+		+					+		
Goodenia byrnesii	+		+												+							+
Heliotropium nesopelydum															++							+
Hibiscus reflexus																					+	
Marsdenia glandulifera				++																		
Parsonsia kimberleyensis		+				+	+										+				+	
Pentalepis sp. Mt House (E.M. Bennett 1877)			+										+									
Phyllanthus sp. D Kimberley Flora (C.R. Dunlop 5302)									+										+			

	Adolphus	Augustus	Bigge	Boongaree	Byam Martin	Coronation	Jungulu	Hidden	Katers	Kingfisher	Long	Mary	Middle Osborn	NW Molema	Sir Graham Moore	St Andrew	Storr	Sunday	South West Osborn	Un-named	Uwins	Wargul Wargul
Polycarpaea sp. A Kimberley Flora (K.F. Kenneally 8887)																+						
Ptilotus crispus												+										
Sauropus salignus													+									
Scleria levis				++																		
Solanum sp. Boomerang Bay (K.F. Kenneally 10021)			++																			
Sphaeranthus africanus	+																					
Priority 2																						
Actinostachys digitata																				+		
Alysicarpus suffructosus																		++				
Boronia filicifolia			+																			
Bossiaea sp. Princess May Range (M.D. Barrett & R.L. Barrett MDB 1326)			+																			
Cyperus flaccidus						+																
Eriocaulon sp. E Kimberley Flora (A.S. George 12635)																			+		+	
Gossypium pilosum		+											+			+					+	+
Ricinocarpos marginatus			+																			
Trianthema sp. Bachsten Creek (R.L. Barrett & M.D. Barrett RLB 3824)		+																				
Priority 3																						
Acacia kenneallyi			+		+																	
Actinoschoenus sp. D Kimberley Flora (K.F. Kenneally 4789)			+																			
Aponogeton kimberleyensis		+																			++	
Brachychiton incanus	+																					
Brachychiton tridentatus		+													+				+		+	
Croton aridus																				+		
Cupaniopsis anacardioides																			+			

	Adolphus	Augustus	Bigge	Boongaree	Byam Martin	Coronation	Jungulu	Hidden	Katers	Kingfisher	Long	Mary	Middle Osborn	NW Molema	Sir Graham Moore	St Andrew	Storr	Sunday	South West Osborn	Un-named	Uwins	Wargul Wargul
Decaschistia byrnesii subsp. *lavandulacea*			++												+							
Eragrostis spartinoides																	+					
Eriachne sp. Dampier Peninsular (K.F. Kenneally 5946)																		++				
Gardenia gardneri		+																				
Glycine lactovirens													+									
Goodenia purpurascens	+					+																
Helicteres sp. Mertens Falls (K.F. Kenneally 7887)														+		+						
Hibbertia echiifolia		+																				
Ipomoea trichosperma													+						+			
Lygodium flexuosum																			+			+
Olearia arguta var. lanata			+																			
Phragmites karka		++													+							
Phyllanthus aridus		+			+		+	+	+		++				+					+		
Polymeria distigma													+									
Pterocaulon sp. A Kimberley Flora (B.J. Carter 599)															+							
Solanum cataphractum		+	+	+			+														+	
Solanum leopoldense								++														
Spermacoce sp. Berthier Dunes (R.L. Barrett RLB 5753)						+						+			+							
Stylidium perizostera			++																			
Triodia acutispicula																	+				+	
Whiteochloa capillipes	+																					
Priority 4																						
Brachychiton xanthophyllus						+							+									
Haemodorum gracile						+				+												
Total	6	15	14	4	2	10	3	2	2	1	1	3	10	1	9	4	4	2	9	5	9	5

TABLE 2 Introduced taxa recorded from the surveyed Kimberley islands. [1] Indicates cultivated taxa occurring on Sunday Island, but not apparently naturalised there. [2] Jungulu Island record is either *Bidens bipinnata* or *B. pilosa* (exact identification unknown). *Jungulu is also known as Darcy.

	Adolphus	Augustus	Bigge	Boongaree	Byam Martin	Coronation	Jungulu*	Hidden	Katers	Kingfisher	Lachlan	Long	Mary	Middle Osborn	NW Molema	Sir Graham Moore	St Andrew	Storr	Sunday	South West Osborn	Un-named	Uwins	Wargul Wargul	Wulalam
Amaranthaceae																								
Pupalia micrantha						+												+					+	
Apocynaceae																								
Calotropis procera	+																							
Catharanthus roseus[1]																			+					
Plumeria obtusa[1]																			+					
Aracaceae																								
Colocasia esculenta var. *esculenta*																			+					
Asteraceae																								
Bidens bipinnata	+																						+	
Bidens pilosa[2]				+			+			+							+	+						+
Flaveria trinervia	+																							
Sphagneticola trilobata																			+					
Tridax procumbens																			+					
Cucurbitaceae																								
Cucumis melo subsp. *agrestis*	+		+	+													+							
Cyperaceae																								
Cyperus polystachyos																			+					
Euphorbiaceae																								
Euphorbia hirta																							+	
Fabaceae																								
Albizzia lebbeck[1]																			+					
Alysicarpus ovalifolius																+			+					
Clitoria ternatea																			+					
Leucaena leucocephala																			+					
Macroptilium atropurpureum																			+					
Parkinsonia aculeata	+																							
Stylosanthes hamata																			+					
Lamiaceae																								
Hyptis suaveolens																+								
Malvaceae																								
Hibiscus sabdariffa																+								
Melochia pyramidata											+	+												
Sida subcordata						+																		
Meliaceae																								
Melia azedarach[1]																			+					
Musaceae																								
Musa acuminata																			+					
Passifloraceae																								
Passiflora foetida var. *hispida*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

	Adolphus	Augustus	Bigge	Boongaree	Byam Martin	Coronation	Jungulu*	Hidden	Katers	Kingfisher	Lachlan	Long	Mary	Middle Osborn	NW Molema	Sir Graham Moore	St Andrew	Storr	Sunday	South West Osborn	Un-named	Uwins	Wargul Wargul	Wulalam
Poaceae																								
Cenchrus ciliaris																			+					
Cenchrus echinatus																			+					
Chloris barbata																			+					
Cynodon dactylon																			+					
Digitaria ciliaris s.l.					+					+				+					+					
Echinochloa colona	+																							
Portulacaeae																								
Portulaca oleracea											+													
Sapindaceae																								
Cardiospermum halicacabum	+																							
Solanaceae																								
Physalis angulata	+																		+					
Verbenaceae																								
Phyla nodiflora var. *nodiflora*																+			+					
Zygophyllaceae																								
Tribulus terrestris																+								+
Total	9	1	2	3	2	3	2	1	1	3	3	2	1	2	1	6	3	3	22	1	1	1	4	3

recorded from Augustus and Adolphus islands, has a northern Australian distribution that includes vine thickets but also drier woodlands and riparian zones. *Ailanthus triphysa* was recorded from vine thickets on Coronation Island. It has an Australian distribution that extends from Cape York to northern New South Wales with a previously recorded highly disjunct population in the Kimberley (Prince Regent River). *Marsdenia glandulifera* (previously recorded from Boongaree Island) has a scattered largely coastal distribution across northern Australian to northern New South Wales. *Sphaeranthus africanus*, previously only recorded in WA from Wyndham, was recorded from nearby Adolphus Island. Its distribution includes coastal areas of tropical Africa, Asia, Malesia and northern Australia. A new and therefore unclassified record for Western Australia was also found on Adolphus Island, *Allopterigeron filifolius*. This species has previously been well collected in the Northern Territory and Queensland.

PUTATIVE NEW TAXA

A number of collections made during the survey could not be reliably placed within formally described or recognised phrase-named taxa (WA Herbarium). In part, this reflects the current state of taxonomic knowledge for many plant groups across the Kimberley with the result that some of these collections may represent novel taxa. Current taxonomic studies within the genus *Triodia* (Poaceae) confirm two taxa collected during the survey are reliably new (M. Barrett pers. com.). These include *Triodia* sp. Hidden Island (T. Handasyde TH 6109) which was recorded from each of the four rugged, dissected, boulder sandstone areas surveyed on Hidden Island, and *Triodia* sp. Un-named Island (M.N. Lyons 5693) which was recorded from cliff faces on the northern tip of Un-named Island. This taxon is also reported to occur on the adjacent mainland (M. Barrett pers. com.).

WEEDS

Alien taxa represented 3.8% (38 taxa) of the flora (Table 2). The dominant alien families, Fabaceae (7 taxa), Poaceae (6), Asteraceae (5) and Malvaceae (3) reflect their dominance of the total Kimberley island flora, with the exception of Asteraceae.

Passiflora foetida var. *hispidula* was ubiquitous on the islands surveyed, being particularly abundant along drainage lines, vine thicket margins and beach swale thickets. *Bidens pilosa* and *B. bipinnata* were collectively recorded from eight islands, typically near beaches, although on Storr Island, *B. pilosa* occurred well inland at the margin of a dense vine thicket on steep scree. *Hyptis suaveolens*, a major weed of the mainland NK bioregion, was only recorded from Sir Graham Moore Island, near the site of a World War II military radar base and an earlier (1920s) agricultural venture (Crawford 2001). *Hibiscus sabdariffa* (Rosella) was also only recorded on Sir Graham Moore from the margin of a *Melaleuca* swamp in the vicinity of the previous habitations. This species is grown for human consumption and is likely to have been a deliberate introduction.

Twenty-two alien taxa were recorded from Sunday Island, both from a mission settlement (operational between 1889 and 1957), and in the vicinity of a more recent outstation near the south-western tip of the island. They include the only KIBS records of *Cenchrus ciliaris*, *C. echinatus* and *Chloris barbata*. Populations of *Musa acuminata* (Banana) and *Colocasia esculenta* var. *esculenta* (cultivated form) were recorded from the valley floor and drainage lines at the mission site and have naturalized since its closure. Plantings of *Albizia lebbeck*, *Catharanthus roseus* (Madagascar Periwinkle), *Melia azedarach* (Cape Lilac) and *Plumeria obtusa* (Evergreen Frangipani) have persisted variously at the outstation and mission site, but not apparently spread.

Nine alien species were recorded from Adolphus Island at the mouth of the Ord River in the Cambridge Gulf. A number of these taxa are likely to have been transported to the island by major floods (e.g. *Parkinsonia aculeata*).

RICHNESS OF NK BIOREGION ENDEMICS ON ISLANDS

Richness of plant species endemic to the NK bioregion recorded on individual islands during the KIBS ranged from 0–22. Highest numbers occurred on Bigge, South West Osborn and Augustus islands (Appendices 3 and 4). In terms of explaining variation in richness of NK bioregion endemics across all of the islands sampled in the KIBS, the averaged-model performed well (Adjusted R-square = 0.62, P <<0.01). A positive association between endemic species richness and both average annual rainfall and island area were strongly supported (Table 3). There was moderate to weak support for the association of species richness and the remaining variables, which was also reflected by the relatively high standard errors observed (Table 3).

QUADRAT CLASSIFICATION

The 137 quadrats were classified into 10 groups based on their floristic composition (Figure 2). Significant indicator species and their frequency of occurrence within each group are shown in Table 4. Environmental parameters characterising each group are shown in Table 5 and the frequency of geological surfaces sampled within each group in Table 6.

TABLE 3 Model-averaged coefficients and unconditional standard errors for each variable for species richness of endemic plant species on the Kimberley islands (KIBS) sampled. Sum of weights for models containing each coefficient w_+ are also shown.

Key: rain – average annual rainfall (mm); area – area of island (ha); boulder – extent of rocky substrate; quadrats – number of quadrats sampled; distance – distance from mainland (km); elevation – maximum elevation (m).

Variable	Coefficient	Standard Error	w_+
Intercept	-5.431	1.048	
rain	0.004	0.001	1.00
log(area)	0.829	0.255	0.95
boulder	0.190	0.193	0.28
quadrats	0.015	0.071	0.22
log(distance)	-0.099	0.161	0.21
elevation	0.000	0.002	0.18

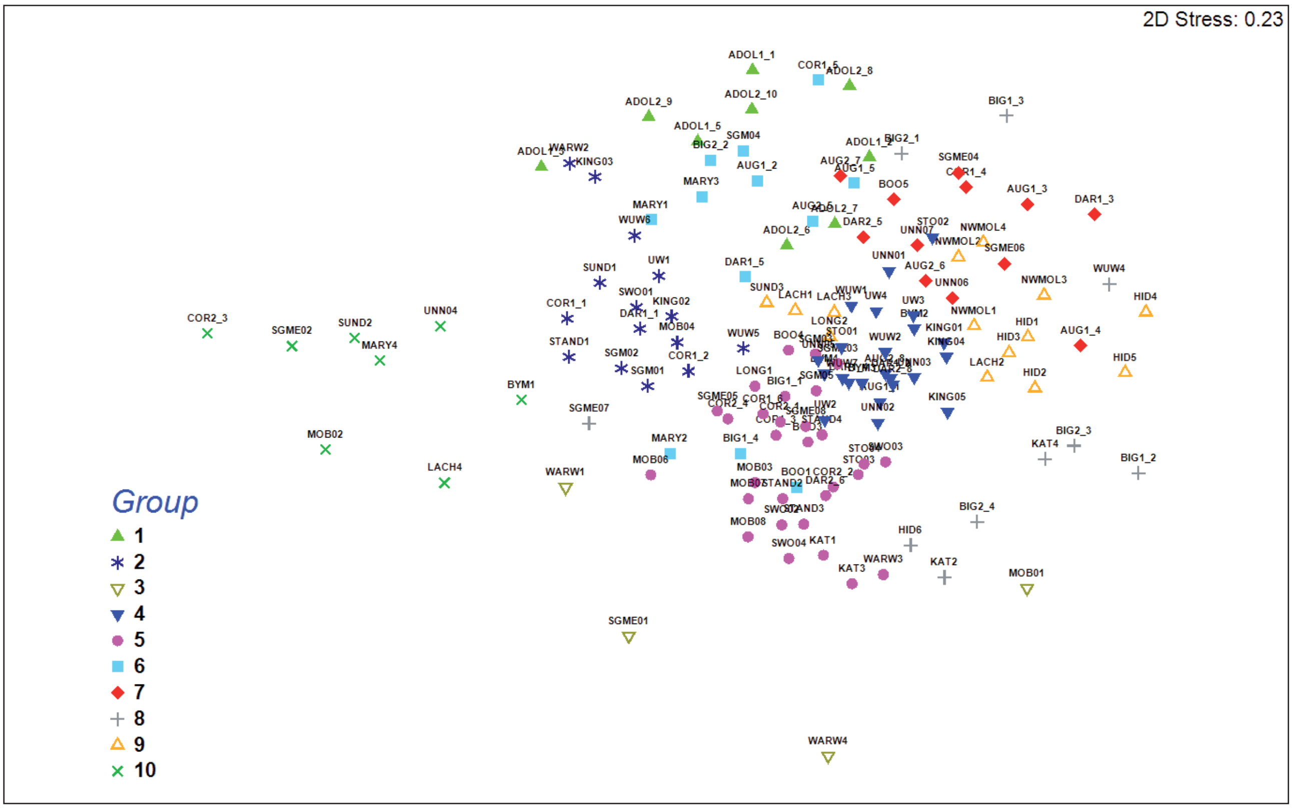

FIGURE 2 Non-metric multi-dimensional scaling ordination showing association among quadrats based on presence or absence of plant species on the Kimberley islands sampled. The 10 floristic groups are indicated. See Appendix 1 for a description of the quadrat codes.

GROUP 1

This group was exclusively composed of the nine quadrats from Adolphus Island, an island geographically distant from all of the other islands sampled, being located on the eastern boundary of the NK bioregion. On average, the quadrats within this group had the lowest estimated mean annual rainfall and highest maximum temperature, and this is reflected by the absence of higher rainfall taxa, and a number of taxa not recorded elsewhere on NK bioregion islands (e.g. *Brachychiton incanus*, *Allopterigeron filifolius* and *Sphaeranthus africanus*). This sandstone island has a relatively subdued topography compared to the other sandstone islands sampled. It is fringed in sections by large areas of alluvial saline flats which account for the low mean surface rockiness values and relatively high Electrical Conductivity (EC) of its soils. Significant indicator species for this group included *Whiteochloa capillipes*, *Eragrostis cumingii*, *Zornia prostrata*, *Melochia corchorifolia* and *Aristida hygrometrica*.

GROUP 2

This group comprised 15 quadrats (from 11 islands) located on beaches and associated dunes on quaternary surfaces with alkaline soils (pH 7.9 ± 1.8) and low rockiness. Quadrats included primary dunes, more consolidated beach dunes and sandy flats with greater species richness. A small number of quadrats (e.g. KING02) were located on beach storm ridges characterised by rock and coralline rubble. Beaches sampled across the full geographic range of the survey classified together in this group. Significant indicator species included *Spinifex longifolius*, *Cleome viscosa*, *Cyperus bulbosus* and *Boerhavia dominii*.

GROUP 3

This group comprised four quadrats (from three islands) which were the most species poor on average (8.5 ± 4.4 taxa per quadrat) and probably explains why they were grouped together. Three of these quadrats occurred on volcanic surfaces. Significant indicator species included *Drypetes deplanchei* and *Lygodium flexuosum*.

GROUP 4

Group 4 consisted of 23 quadrats (from eight islands) with the highest average species richness of all quadrat groups (46.9 ± 12.1 taxa per quadrat). This group occurred on sandstone (Warton, King Leopold and Pentecost) surfaces (and a single quadrat on alluvium below a sandstone escarpment on Un-named Island). The group was characterised by high soil acidity, surface rock abundance and size. Quadrats included mixed woodlands and deciduous vine thickets on landforms associated with rugged sandstone terrain, including dissected massive sandstone blocks, valley slopes and deep gullies. Significant indicator species included *Glycosmis macrophylla, Brachychiton viridiflorus* and *Denhamia obscura.*

GROUP 5

This group comprised 30 quadrats (from 12 islands) largely occurring on fine textured soils (31% silt and clay combined) with relatively high Organic Carbon, total Phosphorus, and exchangeable Calcium, Potassium and Magnesium. More than half the quadrats occurred on Carson Volcanics and Hart Dolerite surfaces. Ten quadrats represented well developed deciduous vine thickets and rainforest patches with remaining quadrats including mixed woodlands with various dominants over *Themeda, Cenchrus* and *Sorghum* grasslands. Significant indicator species included *Corymbia greeniana, Capparis quiniflora* and *Glycosmis trifoliata.* Group 5 shared many ubiquitous rainforest elements with Group 4.

GROUP 6

This group of 12 quadrats (from seven islands) was located in depressions and creeklines on a variety of geological units with low rockiness and little bedrock exposure. The small number of wetlands sampled during the survey (e.g. SGM05) is included in this group, as were quadrats situated in well-developed riparian areas such as the permanent pools of Augustus Island. The three sandy seasonally wet dune swale quadrats sampled on Mary Island all classified with this group. Alluvial communities such as *Melaleuca viridiflora* woodlands and *Pandanus spiralis* patches were a feature of this group. Significant indicator species included *Mnesithea rottboellioides, Pandanus spiralis, Germainia truncatiglumis* and *Calandrinia quadrivalvis.*

GROUP 7

This group comprised 12 quadrats (from six islands) of *Acacia* shrublands over *Triodia bynoei* or *T.* aff. *bitextura* (T. Handasyde TH 6152) hummock grasslands. Quadrats occurred on sandstones with high rock abundance and shallow sandy soils. This relatively species-rich group (29.3 ± 12.9 taxa per quadrat) also had the highest estimated mean annual rainfall (1101 ± 83 mm). Significant indicator species included *Acacia adenogonia,Triodia* aff. *bitextura* (T. Handasyde TH 6152) and *Gompholobium subulatum.*

GROUP 8

This group consisted of nine quadrats (from five islands) of *Acacia* shrublands and *Eucalyptus* woodlands over dense *Triodia* hummock grasslands. Average species richness was the lowest of the sandstone dominated quadrat groups (18.5 ± 7.2 taxa per quadrat). Quadrats were very rocky with the highest combined mean exposed bedrock and total surface rock abundance/size score of all the groups and were characterised by shallow pockets of coarse sandy soils associated with rock pavements. Quadrats from Bigge and Katers islands dominated the group. Significant indicator species included the rock specialists *Solanum petraeum, Terminalia hadleyana, Gardenia pyriformis* and *Monodia stipoides.*

GROUP 9

This group comprised 14 quadrats (from five islands) of *Acacia* shrublands over *Triodia* hummock grasslands on the most acidic soils of the sandstone dominated groups. All quadrats occurred on the sandstone surfaces of five islands in the southern part of the study area (Hidden, Lachlan, Long, NW Molema and Sunday Island), all within the Buccaneer Archipelago (except NW Molema). The average annual rainfall for this quadrat group was among the lowest (830 ± 42 mm). The significant indicator species of this group, such as *Grevillea wickhamii*, *Acacia hippuroides* and *Acacia gracillima*, have southern Kimberley distributions extending into the drier Dampierland subregion (Thackway and Cresswell 1995). *Templetonia hookeri,* another significant indicator species detected in almost all the quadrats of this group, extends into drier areas of the Kimberley with an outlier in the drier Pilbara to the south.

GROUP 10

This relatively species-poor group (11.8 ± 3.2 taxa per quadrat) contained eight mangrove quadrats (from eight islands) and their landward fringes. Predictably the dominant overstorey mangrove taxa *Rhizophora stylosa, Bruguiera exaristata, Ceriops tagal, Avicennia marina, Sonneratia alba, Camptostemon schultzii* and *Osbornia octodonta* were significant indicator species for this group. The soils of this group of mangrove quadrats were characterised by high mean pH and the highest mean EC of all the groups.

TABLE 4 Frequency of occurrence of indicator species and their indicator values (IndVal) within each of the 10 floristic groups (Grp) on sampled Kimberley islands. Only significant taxa are shown (**P* <0.01, ***P* <0.01, ****P* <0.001). Number of quadrats sampled (No. quadrats) within each of the floristic groups is also shown.

Indicator species	Grp	IndVal	Floristic groups									
(No. quadrats)			1 (9)	2 (15)	3 (4)	4 (23)	5 (30)	6 (12)	7 (12)	8 (10)	9 (14)	10 (9)
Whiteochloa capillipes	1	0.88***	7	0	0	0	0	0	0	0	0	0
Eragrostis cumingii	1	0.73***	7	3	0	0	0	2	0	0	0	0
Zornia prostrata	1	0.67***	4	0	0	0	0	0	0	0	0	0
Melochia corchorifolia	1	0.67***	4	0	0	0	0	0	0	0	0	0
Aristida hygrometrica	1	0.67***	4	0	0	0	0	0	0	0	0	0
Adansonia gregorii	1	0.66***	6	1	0	2	1	0	2	0	0	0
Gyrocarpus americanus subsp. *pachyphyllus*	1	0.63**	5	1	0	2	2	0	0	0	0	0
Acacia holosericea	1	0.61***	4	0	0	2	0	0	0	0	0	0
Setaria apiculata	1	0.59**	5	0	0	4	0	1	1	0	0	0
Gomphrena flaccida	1	0.59**	4	0	0	1	0	0	1	0	0	0
Desmodium pycnotrichum	1	0.58***	3	0	0	0	0	0	0	0	0	0
Croton arnhemicus	1	0.58***	3	0	0	0	0	0	0	0	0	0
Crosslandia setifolia	1	0.58***	3	0	0	0	0	0	0	0	0	0
Bidens bipinnata/pilosa	1	0.58***	5	4	0	0	3	0	0	0	0	0
Cucumis melo	1	0.55**	4	0	0	0	1	2	0	0	0	0
Acacia lamprocarpa	1	0.55**	4	0	0	0	3	0	0	1	0	0
Ipomoea polymorpha	1	0.54**	3	0	0	1	0	0	0	0	0	0
Xerochloa imberbis	1	0.50**	3	0	0	0	0	0	0	0	0	1
Triodia aff. *aeria* (T. Handasyde TH 6150)	1	0.47**	2	0	0	0	0	0	0	0	0	0
Tecticornia halocnemoides subsp. *tenuis*	1	0.47**	2	0	0	0	0	0	0	0	0	0
Brachychiton incanus	1	0.47**	2	0	0	0	0	0	0	0	0	0
Physalis angulata	1	0.47*	2	0	0	0	0	0	0	0	0	0
Perotis rara	1	0.47*	2	0	0	0	0	0	0	0	0	0
Mitrasacme hispida	1	0.47*	2	0	0	0	0	0	0	0	0	0
Melaleuca alsophila	1	0.47*	2	0	0	0	0	0	0	0	0	0
Fimbristylis punctata	1	0.47*	2	0	0	0	0	0	0	0	0	0
Cyperus nervulosus	1	0.47*	2	0	0	0	0	0	0	0	0	0
Calotropis procera	1	0.47*	2	0	0	0	0	0	0	0	0	0
Tephrosia laxa var. *angustata*	1	0.46*	3	2	0	0	2	0	0	0	0	0
Owenia vernicosa	1	0.46*	3	0	0	2	0	0	0	1	0	0

Indicator species (No. quadrats)	Grp	IndVal	Floristic groups 1 (9)	2 (15)	3 (4)	4 (23)	5 (30)	6 (12)	7 (12)	8 (10)	9 (14)	10 (9)
Hibiscus meraukensis	1	0.43*	2	0	0	1	0	0	0	0	0	0
Cleome viscosa	2	0.73***	1	14	0	0	1	1	0	0	5	1
Cyperus bulbosus	2	0.60***	0	7	0	0	2	0	0	0	1	0
Boerhavia dominii	2	0.50*	0	5	0	0	1	0	0	0	1	0
Spinifex longifolius	2	0.47*	0	6	0	0	1	1	0	1	0	1
Indigofera linifolia	2	0.46*	0	4	0	0	2	0	0	0	0	0
Chamaecrista absus var. *absus*	2	0.46*	0	4	0	1	1	0	0	0	0	0
Scaevola taccada	2	0.45**	0	3	0	0	0	0	0	0	0	0
Indigofera colutea	2	0.44*	0	4	0	0	1	0	0	0	1	0
Notoleptopus decaisnei var. *decaisnei*	2	0.41*	0	3	0	0	1	0	0	0	0	0
Indigastrum parviflorum	2	0.41*	0	3	0	0	1	0	0	0	0	0
Drypetes deplanchei	3	0.56**	0	2	2	0	5	0	0	0	0	0
Lygodium flexuosum	3	0.47*	0	0	1	0	1	0	0	0	0	0
Gomphrena canescens	3	0.46*	0	0	1	1	0	0	0	0	0	0
Brachychiton xanthophyllus	3	0.44*	0	0	1	0	2	0	0	0	0	0
Galactia tenuiflora	3	0.41*	0	0	1	2	1	0	0	0	0	0
Glycosmis macrophylla	4	0.54**	0	0	0	8	2	0	0	0	0	0
Brachychiton viridiflorus	4	0.54**	0	1	0	8	0	0	0	0	0	0
Denhamia obscura	4	0.52**	0	0	0	8	1	0	0	0	1	0
Corymbia disjuncta	4	0.47*	0	0	0	5	0	0	0	0	0	0
Xanthostemon paradoxus	4	0.42*	0	0	0	4	0	0	0	0	0	0
Corymbia greeniana	5	0.58**	0	0	0	0	12	0	1	0	0	0
Capparis quiniflora	5	0.58**	0	0	0	0	10	0	0	0	0	0
Glycosmis trifoliata	5	0.57***	0	0	0	1	11	0	0	0	0	0
Grewia retusifolia	5	0.45*	0	0	0	0	6	0	0	0	0	0
Melochia umbellata	5	0.41*	0	0	0	0	5	0	0	0	0	0
Mnesithea rottboellioides	6	0.59***	0	0	0	1	1	5	0	0	0	0
Germainia truncatiglumis	6	0.58**	0	0	0	0	0	4	0	0	0	0
Calandrinia quadrivalvis	6	0.58**	0	0	0	0	0	4	0	0	0	0
Pandanus spiralis	6	0.57***	0	0	0	3	4	8	1	2	2	0
Fuirena ciliaris	6	0.53**	0	0	0	3	0	5	0	0	1	0
Cyperus conicus	6	0.53**	0	2	0	1	1	5	0	0	0	0
Eragrostis potamophila	6	0.46*	0	0	0	2	0	4	0	1	0	0

Indicator species (No. quadrats)	Grp	IndVal	Floristic groups 1 (9)	2 (15)	3 (4)	4 (23)	5 (30)	6 (12)	7 (12)	8 (10)	9 (14)	10 (9)
Xyris complanata	6	0.43*	0	0	0	2	0	3	0	0	0	0
Triodia aff. *bitextura* (T. Handasyde TH 6152)	7	0.54**	0	2	0	4	2	0	6	0	0	0
Acacia adenogonia	7	0.54**	0	0	0	1	0	0	4	0	0	0
Gompholobium subulatum	7	0.51**	0	0	0	2	0	0	4	0	0	0
Trachymene didiscoides	7	0.46*	0	0	0	3	0	0	4	0	1	0
Solanum petraeum	8	0.63**	0	0	0	0	0	0	0	4	0	0
Terminalia hadleyana	8	0.57**	0	0	0	2	0	0	0	4	0	0
Gardenia pyriformis subsp. *keartlandii*	8	0.55**	0	0	0	0	0	0	0	2	0	0
Monodia stipoides	8	0.45*	0	0	0	0	0	0	0	2	0	0
Gardenia pyriformis subsp. *pyriformis*	8	0.45*	0	0	0	0	0	0	0	3	0	0
Templetonia hookeri	9	0.79***	0	0	0	5	2	0	2	0	13	0
Grevillea wickhamii	9	0.66**	0	0	0	0	0	0	0	0	6	0
Cassytha candida	9	0.60**	0	0	0	0	0	0	0	0	5	0
Acacia hippuroides	9	0.60**	0	0	0	0	0	0	0	0	5	0
Acacia deltoidea subsp. *deltoidea*	9	0.60**	0	0	0	1	0	1	0	2	8	0
Cassytha aurea	9	0.54**	0	0	0	0	0	0	0	0	4	0
Olax aphylla	9	0.46**	0	0	0	0	0	0	0	0	3	0
Acacia gracillima	9	0.46**	0	0	0	0	0	0	0	0	3	0
Indigofera haplophylla	9	0.39*	0	0	0	0	0	1	0	0	3	0
Rhizophora stylosa	10	1.00***	0	0	0	0	0	0	0	0	0	9
Bruguiera exaristata	10	0.94***	0	0	0	0	0	0	0	0	0	8
Ceriops tagal	10	0.88***	0	0	0	0	0	0	0	0	0	7
Avicennia marina	10	0.83***	1	0	0	0	0	0	0	0	0	7
Aegiceras corniculatum	10	0.82***	0	0	0	0	0	0	0	0	0	6
Sonneratia alba	10	0.75***	0	0	0	0	0	0	0	0	0	5
Xylocarpus granatum/moluccensis	10	0.59**	0	0	0	1	0	0	1	0	0	4
Osbornia octodonta	10	0.58**	0	0	0	0	0	0	0	0	0	3
Fimbristylis cymosa	10	0.56**	0	3	0	0	1	1	0	1	0	5
Sesuvium portulacastrum	10	0.53**	0	1	0	0	0	0	0	0	0	3
Pemphis acidula	10	0.47**	0	0	0	0	0	0	0	0	0	2
Lumnitzera racemosa	10	0.47**	0	1	0	0	0	0	0	1	0	3
Camptostemon schultzii	10	0.47**	0	0	0	0	0	0	0	0	0	2
Amyema mackayensis	10	0.47**	0	0	0	0	0	0	0	0	0	2

TABLE 5 Mean values ± standard error (SE) of the environmental parameters for the 10 floristic groups defined from the quadrats on sampled Kimberley islands. Also shown is the mean species richness (Richness) and number of quadrats (No. quadrats) included in each group (number for the BEST analysis in brackets).

Codes: pH – pH in 0.01M $CaCl_2$ (1:5); EC – Electrical Conductivity (mS/m) (1:5); orgC – Organic Carbon (%); totP – total Phosphorus (mg/kg); exCa – exchangeable Calcium (cmol/kg); exMg – exchangeable Magnesium (cmol/kg); exNa – exchangeable Sodium (cmol/kg); exK – exchangeable Potassium (cmol/kg); Sand – percent sand; Silt – percent silt; Clay – percent clay.; Rain – average annual rainfall (mm); mxTwmP – maximum temperature of the warmest quarter (°C); Rock abundance – coarse fragment abundance (0 – no coarse fragments to 6 – very abundant); Rock size – maximum size of coarse fragments (1 – fine gravely to 7 – large boulders); Rock total – sum of rock abundance and size; Bedrock – (0 – no bedrock exposed to 5 – rockland).

	Floristic Group																			
	1		2		3		4		5		6		7		8		9		10	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
pH	6.3	0.4	7.9	1.8	7.5	1.3	5.3	1.1	6.8	0.8	6.4	1.3	5.6	0.5	6.2	1.7	5.2	1.1	7.8	0.8
EC*	134.8	262.4	33.7	87.0	13.3	10.2	2.6	1.0	13.9	18.1	17.1	42.0	3.2	3.3	17.8	42.3	4.9	5.8	483.8	178.6
orgC*	1.0	0.4	0.8	0.6	3.1	2.3	1.8	0.8	3.4	1.7	1.6	1.4	1.3	0.4	1.9	1.1	2.1	2.1	1.2	0.5
totP*	76.2	15.6	362.4	216.3	474.0	32.1	196.2	207.5	502.8	241.5	154.3	87.5	148.9	78.5	223.4	94.1	177.1	229.6	274.0	184.8
exCa*	2.6	1.8	2.6	2.6	9.6	6.5	3.0	2.1	11.3	5.6	2.6	2.5	1.8	1.0	2.6	2.1	3.8	4.1	2.5	1.1
exMg*	1.5	2.1	0.9	1.5	3.7	3.0	1.2	0.9	4.0	3.7	2.4	3.2	0.8	0.7	1.0	0.7	0.9	1.0	5.4	2.1
exNa*	0.2	0.3	0.5	0.9	0.3	0.3	0.0	0.0	0.4	0.7	0.6	1.1	0.1	0.1	0.2	0.4	0.1	0.1	3.2	2.4
exK*	0.2	0.1	0.1	0.2	0.4	0.4	0.1	0.1	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7	0.5
Sand	92.7	4.6	90.0	14.6	69.2	23.8	89.5	4.8	69.0	18.6	85.1	15.3	88.3	5.3	90.2	3.8	88.7	8.7	86.3	9.8
Silt	4.5	2.8	4.7	7.3	13.8	11.2	5.0	2.8	15.3	10.1	5.8	5.5	5.3	3.0	4.3	1.7	6.0	6.7	5.1	4.0
Clay	2.8	2.2	5.3	7.4	17.0	13.0	5.4	2.5	15.7	9.9	9.2	9.9	6.5	3.6	5.5	2.3	5.3	3.0	8.6	5.8
Rain	827	0	1020	114	992	54	1053	103	1057	84	1086	88	1101	83	1059	72	830	42	979	143
mxTwmP	37.6	0.0	34.5	0.7	34.2	0.5	34.5	0.7	34.8	0.5	34.5	0.4	34.5	0.5	34.8	0.3	33.5	0.3	34.3	0.7
Rock abundance	1.8	2.7	0.4	1.1	3.7	2.5	4.0	1.7	3.6	1.4	1.4	2.1	4.1	1.4	3.7	2.2	3.6	1.9	1.5	0.8
Rock size	2.0	3.0	0.9	1.7	5.0	3.5	5.1	1.4	4.4	1.9	2.2	2.5	3.9	1.6	4.4	3.0	3.7	2.5	1.3	0.7
Rock total	3.8	5.7	1.3	2.6	8.7	5.9	9.1	2.9	8.1	3.0	3.6	4.3	8.0	2.4	8.1	5.0	7.4	4.2	2.8	1.5
Bedrock	1.1	1.7	0.0	0.0	2.7	2.5	1.8	1.8	1.6	2.1	0.3	0.9	2.0	1.9	3.3	2.5	3.3	2.0	0.8	0.6
Richness	25.9	7.2	22.6	11.0	8.5	4.4	46.9	12.1	33.9	9.8	27.3	9.8	29.3	12.9	18.5	7.2	27.1	8.7	11.8	3.2
No. quadrats	9		15(14)		4(3)		23		30		12		12		10(9)		14		8	

*Log-transformation applied prior to analysis

FLORISTIC COMPOSITION AND QUADRAT ATTRIBUTES

The BEST procedure indicated that a combination of six variables [pH, log(totP), log(exMg), log(exNa), clay content and mxTwmP] provided the highest rank correlation with the quadrat dissimilarity matrix (Spearman's rho = 0.38, *P* <0.01). The included soil variables reflect the compositional differences between the major geological surfaces of the quadrats. High pH, associated with the Quaternary sands of the islands' beaches (see Group 2 above), correlates with the major compositional division between these sites and the vegetation of the rocky surfaces of the islands. The soils of all other floristic groups were acidic. The remaining soil variables reflect the compositional 'separation/gradation' from the plant communities of the sandstone geologies (Pentecost, Warton and King Leopold) to the more fertile Hart Dolerite and Carson Volcanics (Table 5). This interpretation is supported by a posthoc ANOSIM test in PRIMER comparing the floristic composition of the major geological units (r = 0.35) [the few Laterite (Tp) quadrats were excluded]. The inclusion of maximum temperature of the warmest period (mxTwmP) was likely to be driven by the compositional differences between the Adolphus Island quadrats in the hotter north-eastern extremity of the study area and the remainder of the islands. Similarity of the plant species between quadrats also decreased significantly with with geographical distance (Mantel r = -0.222, *P* <0.01).

DISCUSSION

The results support the notion of islands as microcosms of the adjacent mainland, with at least 49% of the plant species of the NK bioregion now known on the islands. The completeness of the island lists is limited by the number of quadrats that could be sampled, and while opportunistic sampling (particularly during the wet season) supplemented these lists, undetected species are highly likely. While further botanical exploration of the islands will increase their known flora, the absence of some mainland habitats on islands means they are unlikely to capture some components of the NK bioregion flora. For example, wetlands on the islands are typically small and occur as flooded dune swales and drainage lines occluded by beach dunes. Creeks are mainly seasonal with few permanent pools. Therefore taxa related to larger wetlands, lakes, alluvial floodplains and riparian zones are largely absent from the islands (e.g. *Sesbania erubescens*, *S. formosa* and *S. simpliciuscula*). There are no records of any of the *Myriophyllum* species, *Vallisneria* species or *Najas* species, and few *Utricularia* and *Eriocaulon* species which are all or largely submerged or emergent aquatics found elsewhere in the NK bioregion. Additionally, taxa more typically associated with extensive gently undulating or flat sandy plains on the NK mainland are rare or absent on the islands (e.g. *Eucalyptus tetrodonta*).

There are several elements of the Kimberley flora which are largely absent from the NK bioregion, and which do not form part of the Kimberley islands flora. These are 'dry country' eastern elements, desert and sand dune species. Many taxa which reach their western limits in distribution at the Ord River do not or only marginally extend into the NK bioregion. Since there are few islands east of Kalumburu, and these are mainly small and atypical of the major geological surfaces, such species have rarely been recorded on Kimberley islands. This is unlikely to change, even with more knowledge of this poorly surveyed area.

The biogeographic patterning of the Kimberley mainland and adjacent islands as described by Beard (1990) with subsequent amendments summarized by IBRA7 (http://www.environment.gov.au/parks/nrs/science/pubs/bioregions.pdf) places the surveyed islands within the NK bioregion (Figure 1). For the majority of the quadrat groups we have defined, their distributions span a significant proportion of the study area, but some groups were confined to islands at the southern and eastern extremities. This suggests increased turnover in floristic composition at the margins of the study area corresponding with the boundary of the bioregion. In the south, Hidden, Lachlan, Long, NW Molema and Sunday islands contained floristic elements with distributions that extend into the adjacent Central Kimberley and Dampierland, whereas in the east, Adolphus Island is more representative of elements of the flora of the Victoria Bonaparte bioregion.

RICHNESS OF NK BIOREGION ISLAND ENDEMICS

There are currently only six plant species endemic to the islands in the NK bioregion – *Eucalyptus kenneallyi* from Storr Island, *Polycarpaea* sp.A Kimberley Flora (K.F. Kenneally 8887) from St Patrick Island (not sampled in the KIBS), *Solanum* sp. Boomerang Bay (K.F. Kenneally 10021) from Bigge Island, *Triodia* sp. Hidden Island (T. Handasyde TH 6109), *Tribulopis* sp. Koolan Island (K.F. Kenneally 8278) (not sampled in the KIBS) and *Triumfetta* sp. Adolphus Island (K.F. Kenneally 11898). This paucity of putative island endemics is probably explained by the relatively short time the islands have been separated from the mainland, as well as the close proximity of the islands to the mainland (majority less than 4 km). For many species, gene flow between the islands and the mainland is likely, particularly for species which

TABLE 6 Frequency of geological surfaces sampled within each of the 10 floristic groups on sampled Kimberley islands.

Geology codes: Pkp – Pentecost Sandstone [Buckland Point Member (Pkb); Yampi Member (Pkpy)]; Pkc – Carson Volcanics; Pke – Elgee Siltstone; Pdh – Hart Dolerite; Pkl – King Leopold Sandstone; Pkw – Warton Sandstone; Qa – Alluvium; Qc – Quaternary colluviums; Qs – Quaternary sand; Tp – Tertiary pisolite (laterite)

	Floristic group									
Geology	1	2	3	4	5	6	7	8	9	10
Pkp	4			6						
Pkb							2			
Pkpy				3				1		
Pkc			3		13	1				
Pke									2	
Pdh					3	2	1	2		
Pkl		1		2	3	1	3	5	8	
Pkw				11	4	3	6		2	
Qa				1		2			1	
Qc	5	3							1	7
Qs		11	1		4	3		2		1
Tp					3					
No. quadrats	9	15	4	23	30	12	12	10	14	8

easily disperse. The richness of plant species endemic to the Northern Kimberley at the island-level was strongly associated with average annual rainfall and island area, with larger and higher rainfall islands tending to support more regional endemics. The high rainfall zone of the north-west Kimberley in general is known to support a high number of endemic species (McKenzie et al. 2009). Woinarski et al. (2006) similarly demonstrated that rainfall was a strong predictor of endemic plant species richness in the Northern Territory, with a positive correlation between plant richness and rainfall. Rainfall is likely to determine the soil moisture and productivity in an area (Bowman et al. 2010). Many of the high rainfall Kimberley islands sampled during the KIBS are also topographically complex, with rugged, deeply dissected boulder country a major feature of their landscapes. These rugged landscapes have probably acted as historically stable refugia, protecting species from fire and harsh climates, and thereby promoting the persistence of relictual endemic taxa during the periodic isolation of islands from the mainland, particularly those species with poor dispersal capacity.

The greater sampling effort on the larger islands may have confounded the relationship between endemic richness and island area to some degree, however the number of quadrats sampled on an island explained relatively little of the variation in endemic richness compared to island area. Woinarski et al. (2000) also found that the best predictor of overall plant species richness on selected Northern Territory (NT) islands was island area. Likewise, Heatwole (1991) reported that species richness of plants increased with island area on the Great Barrier Reef islands off the Queensland coast. Authors of both papers suggested that greater niche space due to increased habitat heterogeneity on the larger islands best explains this relationship. This is also likely to be the case for the Kimberley islands, although the lack of vegetation association mapping for the Kimberley islands makes the link between island area, habitat heterogeneity and species richness difficult to quantify.

The influence of distance to the mainland on regional endemic richness of islands was poorly supported. This again is probably due to the close proximity of the islands to the mainland, and the capacity of many plant species to disperse over these short distances to the islands. Along with wind and bird/bat-aided dispersal, strong currents and freshwater plumes extending from river systems along the Kimberley coast are likely to enhance seed dispersal from the mainland to the islands, particularly during the summer monsoon season. Woinarski et al. (2000) also report that island isolation variables explained very little of the variation in plant species richness on the NT islands they sampled. Similarly, Heatwole (1991) found that distance to the mainland only accounted for a small proportion of the variability in richness of plant species on the Great Barrier Reef islands. Heatwole (1991) also suggests that ease of dispersal is likely to explain the lack of importance of isolation.

PATTERNS IN VEGETATION COMPOSITION

Abiotic factors such as soil moisture and fertility have been shown to be primary influences on the vegetation composition of northern Australia, with different geological substrates supporting distinct vegetation communities (Vigilante and Bowman 2004). The density of sampling during the current study does not permit a detailed examination of vegetation patterning across the islands, but does confirm the dominant role of geology coupled with climatic attributes in driving major patterning along the extent of the NK coast.

A broad pattern in vegetation composition based on the island quadrats emerged. The vegetation of the mangrove quadrats was clearly distinct from the other nine defined groups. However, as the KIBS was not focused on mangrove habitats, the small number of quadrats sampled within this vegetation community did not allow for a finer-scale examination of the variation within this group. Similarly, the quadrats on the Quaternary sands of the beaches, sand flats and associated dunes formed a discreet group which, like the mangrove quadrats, was characterised by alkaline soils and low rockiness, but distinct from the acidic soils of the remaining groups. A further group contained quadrats on a variety of geological surfaces, but these were mainly located in alluvial areas including a small number of wetlands and well-developed riparian areas supporting *Melaleuca* woodlands and *Pandanus spiralis* stands. Degree of inundation and associated soil moisture are likely factors influencing the vegetation composition within this group.

The quadrats of all of the other seven classified groups were dominated by hard/rocky substrates. Among these, there was a compositional separation between the plant communities of the sandstone geologies (Pentecost, Warton and King Leopold), the most dominant substrate on most of the islands sampled, and those occurring on Hart Dolerite and Carson Volcanic substrates. This pattern has also been documented on the adjacent mainland (Hnatiuk and Kenneally 1981). The compositional separation was reflected in the soil chemistry and texture parameters measured. Soils derived from the dolerite and volcanic surfaces tended to be more nutrient-rich than those derived from the sandstones, and with three times the silt and clay content on average. The volcanic derived surfaces largely support mixed woodlands with various dominants over *Themeda, Cenchrus* and *Sorghum* grasslands. Taxa of deciduous vine thickets and rainforest patches were also well represented on these surfaces with most of the quadrats within this group occurring on the high-rainfall islands (>1000 mm per year) of the survey region. Notable on the islands was the ubiquity of the rainforest floristic elements across many of the quadrat groups. This is likely to have arisen as a result of the low fire frequency on the islands coupled with their rugged topography providing protection from fire and moisture retention.

Most of the variation in composition between the sandstone dominated communities could be explained in terms of their geographic location (hence differences in responses of species to climate attributes such as rainfall and temperature) and local edaphic factors such as degree of rockiness (hence fire protection and moisture retention). Soil parameters were similar between these sandstone communities, being relatively nutrient-poor. Similarly, Bowman et al. (1990) reported that the sandstone vegetation on the mainland Arnhem Land Plateau was related to topography, rockiness, degree of fire protection and moisture availability. As noted above, the quadrats from Adolphus Island, an island located well to the east of the other islands surveyed formed a discrete floristic group. Primarily it included taxa found in the drier, warmer environments of mainland east Kimberley. Likewise, the quadrat-group situated on the southern-most islands capture elements of the adjacent lower rainfall bioregions such as Dampierland and Central Kimberley. The remaining sandstone dominated groups were largely located on islands that receive greater than 1000 mm annual rainfall on average, and like the volcanic surfaces above, contained many rainforest elements. Degree of rockiness appeared to play a role in separating these sandstone groups with rock specialists more prevalent on the extremely rocky surfaces that support skeletal soils (e.g. Group 8).

CONSERVATION IMPLICATIONS

The largest and wettest islands are particularly important for conservation as they supported the highest number of NK bioregion endemic plant species. Highest numbers of priority species also tended to occur on the largest islands (Pearson pairwise correlation = 0.75; e.g. Augustus, Bigge, Coronation and Middle Osborn). However, despite the regional endemic flora of the drier islands being less species rich, some of these islands had unique species assemblages with elements of arid/semi-arid zone flora that were not well represented on other islands (e.g. Group 1 – Adolphus Island; Group 9 – Hidden, Lachlan, Long, NW Molema and Sunday islands). In terms of representing the diversity of plant communities on the NK bioregion islands, the compositional separation of the communities on sandstone geologies from those occurring on both the dolerite and volcanic surfaces highlights the importance of protecting a suite of islands that capture this geological diversity. Additionally, those islands that have a combination of both sandstone and volcanic/dolerite substrates are more likely to support a higher number of species due to compositional turnover. The distinct plant communities on the Quaternary deposits (i.e. beaches/dunes and mangroves) add to this diversity.

The low number of weed species detected on the sampled islands reflects their near-pristine condition and highlights the importance of quarantine measures to prevent any future incursions, particularly as human activity along the Kimberley coastline is rapidly increasing. No more than three weed species were detected on most islands. However, the 22 weed species recorded on Sunday Island, the only island we sampled with a history of prolonged European settlement, reiterates the importance of biosecurity measures to prevent human-aided introductions onto the islands. Likewise, Keighery et al. (1995) detected 43 weed species on Koolan Island, another Kimberley island with a long history of settlement associated with mining and exploration. Surveys on the Tiwi Islands of Northern Australia revealed that only 10 weed species had become naturalised in native habitat, however, 95 weed species had colonized disturbed habitat around settlements (Fensham and Cowie 1998). Natural colonization of weed species originating from the mainland is more difficult to control. For example, Adolphus Island at the mouth of the Ord River in the Cambridge Gulf had a notable nine weed species, probably as a result of flood events dispersing propogules from the nearby mainland. The ubiquitous weed *Passiflora foetida*, which was detected on all the islands KIBS sampled, is believed to be dispersed by birds (CCWA 2010) and is extremely difficult to control. The potential negative impact of weed species on island flora and fauna makes it vital that the need for vigilance is conveyed to all who propose to visit the islands and that regular surveillance of the islands for weeds occurs.

While fire on the islands in recent years appears to have been infrequent (Vigilante et al. 2013), and mainly due to lightning strike, increasing human activity in the area is likely to lead to fire becoming more of a feature in these island landscapes. An increase in unmanaged fire is likely to pose a threat to fire-sensitive vegetation on the islands, such as monsoonal vine thickets and rainforest patches, and obligate seeder species such as *Callitris columellaris* (Beard et al. 1984; Vigilante and Bowman 2004; Russell-Smith et al. 2012). Many of the highly vagile rainforest/vine thicket taxa were widely distributed on the islands which also suggest infrequent fires. *Callitris columellaris* occurred as both extensive stands (e.g. Un-named and NW Molema islands) and in rocky areas that afforded fire protection (e.g. Augustus and St Andrew islands). Vine thickets and rainforest patches on volcanic-derived substrates are particularly vulnerable to fire as the dominant vegetation surrounding these patches is often highly fire-prone due to a dense understory of perennial grasses (Vigilante and Bowman 2004). Under increased fire frequency, persistence of fire-sensitive vegetation on islands is likely to be dependent on topographical refuges that can offer protection. The deeply dissected boulder country of the sandstone islands is more likely to offer this protection. Fire management on islands is a complex issue that requires a case by case assessment of island size, fire history, fuel loads and seasonal influences (including cyclones), along with a consideration of traditional burning by Aboriginal people. Clearly, future fire management on the islands needs to be carefully considered so that fire-sensitive vegetation and associated fauna is not lost. The development of a fire management plan is a crucial first step towards achieving this goal.

ACKNOWLEDGEMENTS

We particularly thank Tony Start who assisted with the field sampling and Margaret Collins for assistance with the plant identifications. Kelly Shepherd, Bruce Maslin, Rob Davis, Kevin Thiele, Karen Wilson, Matt Barrett, Russell Barrett, Jo Palmer, Ian Cowie, Phil Short, Helmut Tolkein, David Symon, Bill (W.R) Barker, Andrew Mitchell, Tony Start, Allen Lowrie, Bryan Simon, Ailsa Holland, David Halford, Ray Cranfield and Ian Brooker provided much appreciated assistance with the plant identifications. We thank colleagues from the Department of Parks and Wildlife (DPaW), Western Australian Museum, Australian Museum, Kimberley Land Council and Biota Environmental Sciences, the participating Traditional Owners, Aboriginal Rangers and base camp volunteers who contributed to the successful implementation of the field work. We thank the crew of *MV Kimberley Escape*, *MV Odyssey* and pilots from Heliwork and Broome Helicopters for transporting teams safely. We are grateful to the DPaW Kimberley Regional

Manager Daryl Moncrieff and West Kimberley District Manager Alan Byrne and their staff in the Kununurra and Broome Districts for their support and assistance during the project. DPaW staff based at the Mitchell River National Park (particularly Lindsay Baker and John Hayward) provided valuable logistical support. The project was possible through a research agreement with the Kimberley Land Council for the Balanggarra, Bardi-Jawi, Wanjina-Wunggurr Dambimangari, Mayala and Wanjina-Wunggurr Uunguu native title groups. We are grateful to Tom Vigilante, Tim Willing, Kevin Kenneally, Norm McKenzie, Ari Gorring and two anonymous reviewers for valuable comments on the manuscript. Funding was provided by the Natural Heritage Trust and the Western Australian Department of Parks and Wildlife.

REFERENCES

Batianoff, G.N. and Dillewaard, H.A. (1997). Florisitc analysis of the Great Barrier Reef continental islands, Queensland (pp. 300–322). *In*: D. Wachenfeld, J. Oliver and K. Davis (eds), *State of the Great Barrier Reef World Heritage area workshop: proceedings of a technical workshop held in Townsville, Queensland, Australia*. Great Barrier Reef Marine Park Authority: Townsville.

Beard, J.S. (1990). *Plant life of Western Australia*. Kangaroo Press: Kenthurst, New South Wales.

Beard, J.S., Clayton-Greene, K.A. and Kenneally, K.F. (1984). Notes on the vegetation of the Bouganville Peninsula, Osborn and Institut Islands, North Kimberley District, Western Australia. *Vegetatio* **57**: 3–13.

Belbin, L. (1980). *TWOSTEP: a program incorporating asymmetric comparisons that uses two steps to produce a dissimilarity matrix.* CSIRO Division of Land Use Research Technical Memorandum 80/9. CSIRO: Canberra.

Belbin, L. (1995). *Technical reference: PATN pattern analysis package*. Division of Wildlife Ecology CSIRO: Canberra.

Burbidge, A.A. and McKenzie, N.L. (1978). *The islands of the north-west Kimberley: Western Australia*. Wildlife Research Bulletin Western Australia No. 7. Department of Fisheries and Wildlife: Perth.

Burbidge, A.A, McKenzie, N.L. and Kenneally, K. (1991). *Nature conservation reserves in the Kimberley, Western Australia*. Department of Conservation and Land Management: Perth.

Burnham, K.P. and Anderson, D.R. (2002). *Model selection and multimodel inference: a practical information-theoretic approach.* Second edition. Springer: New York.

Bowman, D.M.J.S. (1998). The impact of Aboriginal landscape burning on the Australian biota. *New Phytologist* **140**: 385–410.

Bowman, D.M.J.S., Wilson, B.A. and Fensham, R.J. (1990). Sandstone vegetation pattern in the Jim Jim Falls region, Northern Territory, Australia. *Australian Journal of Ecology* **15**: 163–174.

Bowman, D., Brown, G., Braby, M., Brown, J., Cook, L., Crisp, M., Ford, F., Haberle, S., Hughes, J. and Isagi, Y. (2010). Biogeography of the Australian monsoon tropics. *Journal of Biogeography* **37**: 201–216.

Carwardine, J., O'Connor, T., Legge, S., Mackey, B., Possingham, H. and Martin, T. (2011). *Priority threat management to protect Kimberley wildlife*. CSIRO Ecosystem Sciences, Brisbane.

CCWA (2010). *Status performance assessment: Biodiversity conservation on Western Australian Islands. Phase II – Kimberley Islands.* Unpublished report to the Conservation Commission of Western Australia. The Government of Western Australia: Perth.

Clarke, K.R. and Gorley, R.N. (2006). *PRIMER v6: User Manual/Tutorial.* PRIMER-E Ltd: Plymouth.

Coate, K. (2011). The 1990 expedition to Camden Harbour, north-west Kimberley: Part 1 – background and expedition narrative. *The Western Australian Naturalist* **27**: 193–229.

Crawford, I. (2001). *We won the victory*. Fremantle Arts Centre Press: Fremantle, Western Australia.

Curry, S., Maslin B.R. and Maslin, J.A. (2002). *Allan Cunningham Australian Collecting Localities*. Australian Biological Resources Study: Canberra.

De Cáceres, M. and Legendre, P. (2009). Associations between species and groups of sites: indices and statistical inference. *Ecology* **90**: 3566–3574.

Dufrêne, M. and Legendre, P. (1997). Species assemblages and indicator species: the need for a flexible asymmetrical approach. *Ecological Monographs* **67**: 345–366.

Fensham, R.J. and Cowie, I.D. (1998). Alien plant invasions on the Tiwi Islands. Extent, implications and priorities for control. *Biological Conservation* **83:** 55–68.

Fisher, R.P., Vigilante, T., Yates, C. and Russell-Smith, J. (2003). Patterns of landscape fire and predicted vegetation response in the North Kimberley region of Western Australia. *International Journal of Wildland Fire* **12**: 369–379.

Fitzgerald, W.V. (1919). The botany of the Kimberleys, North-West Australia. *Journal and Proceedings of the Royal Society of Western Australia* **3**: 102–224.

Geffen, E., Anderson, M.J. and Wayne R.K. (2004). Climate and habitat barriers to dispersal in the highly mobile grey wolf. *Molecular Ecology* **13:** 2481–2490.

Geological Survey of Western Australia. (2010). Digital data from GSWA – 1: 250 000 Atlas Mosaic.

Gibson, L.A. and McKenzie, N.L. (2012). Identification of biodiversity assets of selected Kimberley islands: background and implementation. *Records of the Western Australian Museum*, Supplement **81**: 1–14.

Graham, G. (2002). *An assessment of the distribution and status of Arnhem cypress pine* Callistris intratropica *(R.T. Baker and H.G. Sm.) in the Kimberley Region, Western Australia.* Report to the National Reserves System Program, Environment Australia, Canberra. Department of Conservation and Land Management: Perth.

Heatwole, H. (1991). Factors affecting the number of species of plants on islands of the Great Barrier Reef, Australia. *Journal of Biogeography* **18**: 213–221.

Hnatiuk, R.J. and Kenneally, K.F. (1981). A survey of the vegetation and flora of Mitchell Plateau, Kimberley, Western Australia (pp 13–94). In: *Biological survey* *of the Mitchell Plateau and Admiralty Gulf, Kimberley, Western Australia.* Western Australian Museum: Perth.

Houlder, D., Hutchinson, M., Nix, H. and McMahon, J. (2000). *ANUCLIM user guide*. Centre for Resource and Environmental Studies. Australian National University: Canberra.

Keighery, G., Gibson, N., Kenneally, K. and Mitchell, A. (1995). Biological inventory of Koolan Island, Western Australia 1. Flora and vegetation. *Records of the Western Australian Museum* **17**: 237-48.

Kenneally, K.F., Coate, K. and Donaldson, M. (eds) (1996). *Extracts from the Diary of the Kimberley Society Coastal Excursion 1996*. Boab Bulletin, Supplement No. 1: Perth.

Kenneally, K.F., Keighery, G.J. and Hyland B.P.M. (1991). Floristics and phytogeography of Kimberley rainforests, Western Australia (pp 93–121). *In*: McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (eds), *Kimberley rainforests of Australia*. Surrey Beatty and Sons: Chipping Norton, Australia.

May, J.E. and McKenzie, N.L. (eds) (2002). *A biodiversity audit of Western Australia's biogeographical subregions in 2002*. Department of Conservation and Land Management: Perth.

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J and Hopkins, M.S. (1998). *Australian soil and land survey: field handbook*. Second Edition. Australian Collaborative Land Evaluation Program: Canberra, Australia.

McKenzie, N.L. and Belbin, L. (1991). Kimberley rainforest communities: reserve recommendations and management considerations (pp 453–680). *In*: McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (eds), *Kimberley rainforests of Australia*. Surrey Beatty and Sons: Chipping Norton, Australia.

McKenzie, N.L, Johnston, R.B. and Kendrick P.G. (1991). *Kimberley rainforests of Australia*. Surrey Beatty and Sons: Chipping Norton, Australia.

McKenzie, N.L., Start, A.N., Burbidge, A.A., Kenneally, K.F. and Burrows, N.D. (2009). *Protecting the Kimberley: A synthesis of scientific knowledge to support conservation management in the Kimberley region of Western Australia. Part B: Terrestrial environments*. Department of Environment and Conservation: Perth.

Meissner, R., Owen, G. and Bayliss, B. (2009). Flora and vegetation of the banded iron formation of the Yilgarn Craton: Robinson Ranges and Mount Gould. *Conservation Science Western Australia* **7**: 363–376.

Nix, H. and Kalma, J. (1972). Climate as a dominant control in the biogeography of northern Australia and New Guinea (pp. 61–91). *In:* Walker, D. (ed.), *Bridge and barrier: the natural and cultural history of Torres Strait*. Research School of Pacific Studies Publication E6/3. Australian National University Press: Canberra.

R Development Core Team (2009). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna. URL: http://www.R-project.org.

Rosenberg, M.S. and Anderson, C.C. (2011). PASSaGE: pattern analysis, spatial statistics and geographic exegesis. Version 2. *Methods in Ecology and Evolution* **2**: 229–232.

Rossiter-Rachor, N.A., Setterfield, S.A., Douglas, M.M., Hutley, L.B. and Cook, G.D. (2008). *Andropogon gayanus* (gamba grass) invasion increases fire-mediated nitrogen losses in the tropical savannas of Northern Australia. *Ecosystems* **11**: 77–88.

Russell-Smith, J., Ryan, P.G. and Cheal, D. (2002). Fire regimes and the conservation of sandstone heath in monsoonal northern Australia: frequency, interval, patchiness. *Biological Conservation* **104**: 91-106.

Russell-Smith, J., Edwards, A.C. and Price, O.F. (2012). Simplifying the savanna: the trajectory of fire-sensitive vegetation mosaics in northern Australia. *Journal of Biogeography* **39**: 1303–1317.

SEWPaC (2012). Australia's 15 National Biodiversity Hotspots. http://www.environment.gov.au/biodiversity/hotspots/national-hotspots.html. Accessed June 2012.

Smith, M.G. (2010). Declared rare and priority flora list for Western Australia. Accessed 16 September 2010. Department of Environment and Conservation: Perth.

Sneath, P.H.A. and Sokal, R.R. (1973). *Numerical taxonomy: The principles and practice of numerical classification*. W.H. Freeman: San Francisco, U.S.A.

Thackway, R. and Cresswell, I.D. (1995). *An interim biogeographic regionalisation for Australia: a framework for establishing the national system of reserves*. Australian Nature Conservation Agency: Canberra.

Vigilante, T. and Bowman, D.M.J.S. (2004). Effects of fire history on the structure and floristic composition of woody vegetation around Kalumburu, North Kimberley, Australia: a landscape-scale natural experiment. *Australian Journal of Botany* **52**: 381–404.

Vigilante, T., Bowman, D.M.J.S., Fisher, R., Russell-Smith, J. and Yates, C. (2004). Contemporary landscape burning patterns in the far North Kimberley region of north-west Australia: human influences and environmental determinants. *Journal of Biogeography* **31**: 1317–1333.

Vigilante, T., Toohey, J., Gorring, A., Blundell, V., Saunders, T., Mangolamara, S., George, K., Oobagooma, J., Waina, M., Morgan, K. and Doohan, K. (2013). Island country: Aboriginal connections, values and knowledge of the Western Australian Kimberley islands in the context of an island biological survey. *Records of the Western Australian Museum*, Supplement **81**: 145–181.

Woinarski, J.C.Z., Brennan, K., Cowie, I., Fisher, A., Latz, P.K. and Russell-Smith, J. (2000). Vegetation of the Wessel and English Company Islands, North-eastern Arnhem Land, Northern Territory, Australia. *Australian Journal of Botany* **48**: 115–141.

Woinarski, J.C.Z., Hempel, C., Cowie, I., Brennan, K., Kerrigan, R., Leach, G. and Russell-Smith, J. (2006). Distributional pattern of plant species endemic to the Northern Territory, Australia. *Australian Journal of Botany* **54**: 627–640.

MANUSCRIPT RECEIVED AUGUST 2013; ACCEPTED NOVEMBER 2013.

APPENDIX 1

Location and substrate attributes of plant quadrats on each island surveyed during the Kimberley Island Biological Survey, including the quadrat code and geological code (Geolcode) assigned to each quadrat, and the floristic group identified in the cluster analysis. Geological codes were sourced from the Yampi (SE/51-3), Montague Sound (SD/51-12), Cambridge Gulf (SD/52-14), Prince Regent and Camden Sound (SD/51-15,16), and Londonderry (SD/52-5) 1:250,000 geological series map sheets published by the Bureau of Mineral Resources, Geology and Geophysics in conjunction with the Geological Survey of Western Australia.

[a] Substrate codes: Rock abundance – coarse fragment abundance (0 – no coarse fragments to 6 very abundant); Rock size – maximum size of coarse fragments (1 – fine gravely to 7 large boulders); Rock total – sum of rock abundance and size; Bedrock – amount of bedrock (0 – no bedrock exposed to 5 – rockland) (McDonald et al. 1990).

[b] Geology codes: Pkl – King Leopold sandstone; Pdh – Hart dolerite; Pkw – Warton sandstone;
Pkp – Pentecost sandstone [Yampi Member (Pkpy), Buckland Point Member (Pkb)];
Pke – Elgee siltstone; Pkc – Carson volcanics; Tp – Tertiary pisolite; Qc – Quaternary colluviums;
Qs – Quaternary sand; Qa – Alluvium.

Island	Site	Quadrat Code	Latitude (⁰S)	Longitude (⁰E)	Rock abundancea	Rock size[a]	Rock total[a]	Bedrock[a]	Geolcode[b]	Floristic Group
Adolphus	1	ADOL1_1	-15.1069	128.1585	0	0	0	0	Qc	1
		ADOL1_2	-15.1097	128.1552	5	6	11	3	Pkp	1
		ADOL1_3	-15.1042	128.1552	0	0	0	0	Qc	1
		ADOL1_5	-15.1060	128.1582	0	0	0	0	Qc	1
	2	ADOL2_6	-15.0835	128.1409	0	0	0	0	Qc	1
		ADOL2_7	-15.0771	128.1431	6	6	12	4	Pkp	1
		ADOL2_8	-15.0764	128.1408	5	6	11	3	Pkp	1
		ADOL2_9	-15.0794	128.1401	0	0	0	0	Qc	1
		ADOL2_10	-15.0817	128.1406	0	0	0	0	Pkp	1
Augustus	1	AUG1_1	-15.3531	124.5285	6	7	13	4	Pkw	4
		AUG1_2	-15.3506	124.5280	1	5	6	0	Pkw	6
		AUG1_3	-15.3553	124.5313	3	5	8	4	Pkw	7
		AUG1_4	-15.3543	124.5251	3	4	7	1	Pkw	7
		AUG1_5	-15.3530	124.5265	1	5	6	1	Pkw	6
	2	AUG2_5	-15.3908	124.5947	5	6	11	3	Pkw	6
		AUG2_6	-15.3875	124.5961	5	6	11	5	Pkw	7
		AUG2_7	-15.3931	124.5920	1	3	4	0	Pkw	7
		AUG2_8	-15.3881	124.5929	6	6	12	4	Pkw	4
Bigge	1	BIG1_1	-14.5900	125.1839	5	6	11	4	Pdh	5
		BIG1_2	-14.5872	125.1873	5	7	12	5	Pkl	8

Island	Site	Quadrat Code	Latitude (^{0}S)	Longitude (^{0}E)	Rock abundancea	Rock size[a]	Rock total[a]	Bedrock[a]	Geolcode[b]	Floristic Group
		BIG1_3	-14.5911	125.1860	4	2	6	5	Pkl	8
		BIG1_4	-14.5884	125.1851	6	5	11	0	Pdh	6
	2	BIG2_1	-14.5841	125.1019	0	0	0	0	Pdh	8
		BIG2_2	-14.5843	125.1012	0	0	0	0	Pkl	6
		BIG2_3	-14.5853	125.1034	6	7	13	5	Pkl	8
		BIG2_4	-14.5803	125.0975	4	6	10	5	Pkl	8
Boongaree	1	BOO1	-15.0724	125.1834	2	2	4	0	Pdh	6
		BOO3	-15.0711	125.1864	4	6	10	0	Pkw	5
		BOO4	-15.0747	125.1794	3	3	6	0	Pdh	5
		BOO5	-15.0756	125.1783	3	1	4	0	Pdh	7
Byam Martin	1	BYM1	-15.3873	124.3633	5	5	10	5	Qc	10
		BYM2	-15.3844	124.3620	5	5	10	3	Pkw	4
		BYM3	-15.3855	124.3615	2	5	7	0	Pkw	4
		BYM4	-15.3874	124.3627	4	5	9	0	Pkw	4
Coronation	1	COR1_1	-14.9724	124.9180	0	0	0	0	Qs	2
		COR1_2	-14.9728	124.9179	0	0	0	0	Qs	2
		COR1_3	-14.9744	124.9190	4	4	8	0	Pkc	5
		COR1_4	-14.9702	124.9216	4	5	9	4	Pkl	7
		COR1_5	-14.9705	124.9240	2	3	5	0	Pkc	6
		COR1_6	-14.9765	124.9141	4	6	10	2	Pkc	5
	2	COR2_1	-15.0285	124.9527	3	7	10	3	Pkc	5
		COR2_2	-15.0304	124.9543	5	6	11	0	Pkc	5
		COR2_3	-15.0285	124.9517	3	1	4	1	Qs	10
		COR2_4	-15.0292	124.9539	3	1	4	0	Qs	5
Jungulu*	1	DAR1_1	-15.2907	124.3994	0	0	0	0	Qs	2
		DAR1_2	-15.2906	124.4009	6	6	12	3	Pkw	4
		DAR1_3	-15.2897	124.4029	6	6	12	1	Pkw	7
		DAR1_4	-15.2915	124.3978	6	6	12	1	Pkw	4
		DAR1_5	-15.2908	124.4001	0	0	0	0	Qa	6
	2	DAR2_5	-15.2612	124.4422	5	3	8	0	Pkw	7

Island	Site	Quadrat Code	Latitude (^{0}S)	Longitude (^{0}E)	Rock abundancea	Rock size[a]	Rock total[a]	Bedrock[a]	Geolcode[b]	Floristic Group
		DAR2_6	-15.2594	124.4444	4	6	10	0	Pkw	5
		DAR2_8	-15.2616	124.4437	5	6	11	3	Pkw	4
Hidden	1	HID1	-16.2226	123.4527	0	0	0	0	Pkl	9
		HID2	-16.2212	123.4473	4	6	10	5	Qa	9
		HID3	-16.2241	123.4501	5	7	12	4	Pkl	9
		HID4	-16.2204	123.4500	4	6	10	5	Pkl	9
		HID5	-16.2222	123.4506	3	3	6	5	Pkl	9
		HID6	-16.2218	123.4489	0	0	0	1	Qs	8
Katers	1	KAT1	-14.4488	125.5179	4	6	10	0	Pdh	5
		KAT2	-14.4478	125.5190	4	6	10	0	Pdh	8
		KAT3	-14.4484	125.5196	0	0	0	0	Qs	5
		KAT4	-14.4510	125.5193	5	7	12	5	Pkl	8
Kingfisher	1	KING01	-16.0919	124.0909	3	5	8	2	Pkp	4
		KING02	-16.0904	124.0941	4	4	8	0	Qs	2
		KING03	-16.0897	124.0923	1	4	5	0	Qc	2
		KING04	-16.0919	124.0930	3	6	9	0	Pkp	4
		KING05	-16.0904	124.0919	1	4	5	1	Pkp	4
Lachlan	1	LACH1	-16.6230	123.4703	0	0	0	0	Pkl	9
		LACH2	-16.6249	123.4706	6	7	13	5	Pkl	9
		LACH3	-16.6228	123.4711	1	1	2	2	Pkl	9
		LACH4	-16.6238	123.4718	0	0	0	0	Qc	10
Long	1	LONG1	-16.5578	123.3546	2	6	8	0	Pkl	5
		LONG2	-16.5582	123.3548	5	1	6	5	Qc	9
		LONG3	-16.5596	123.3553	0	0	0	0	Qc	10
Mary	1	MARY1	-13.9915	126.3980	0	0	0	0	Qs	6
		MARY2	-13.9905	126.3987	0	0	0	0	Qs	6
		MARY3	-13.9927	126.3983	0	0	0	0	Qs	6
		MARY4	-13.9923	126.4017	0	0	0	0	Qc	10
Middle Osborn	1	MOB01	-14.3102	126.0288	4	7	11	3	Pkc	3
		MOB02	-14.3096	126.0271	0	0	0	0	Qc	10
		MOB03	-14.3100	126.0225	4	7	11	5	Pkc	5

Island	Site	Quadrat Code	Latitude (^{0}S)	Longitude (^{0}E)	Rock abundancea	Rock size[a]	Rock total[a]	Bedrock[a]	Geolcode[b]	Floristic Group
		MOB04	-14.3102	126.0288	0	0	0	0	Qs	2
	2	MOB06	-14.3058	125.9929	3	3	6	0	Pkc	5
		MOB07	-14.3051	125.9934	3	3	6	0	Pkc	5
		MOB08	-14.3039	125.9939	3	3	6	0	Pkc	5
NW Molema	1	NWMOL1	-16.2524	123.8246	4	4	8	0	Pke	9
		NWMOL2	-16.2506	123.8230	5	5	10	3	Pkw	9
		NWMOL3	-16.2513	123.8222	5	5	10	4	Pkw	9
		NWMOL4	-16.2547	123.8244	4	5	9	5	Pke	9
Sir Graham Moore	1	SGM01	-13.8696	126.5128	0	0	0	0	Qs	2
		SGM02	-13.8698	126.5138	0	0	0	0	Qs	2
		SGM03	-13.8724	126.5155	2	2	4	2	Tp	5
		SGM04	-13.8750	126.5139	0	0	0	0	Qa	6
		SGM05	-13.8715	126.5142	1	5	6	1	Qs	5
	2	SGME01	-13.8970	126.5977	1	1	2	0	Qs	3
		SGME02	-13.8994	126.5958	4	4	8	0	Qc	10
		SGME03	-13.8987	126.5995	5	2	7	3	Tp	5
		SGME04	-13.8946	126.6014	5	5	10	3	Pkl	7
		SGME05	-13.8976	126.5975	1	2	3	0	Qs	5
		SGME06	-13.8954	126.6018	5	2	7	3	Pkl	7
		SGME07	-13.8988	126.5960	0	0	0	0	Qs	8
		SGME08	-13.8979	126.5995	3	2	5	3	Tp	5
St Andrew	1	STAND1	-15.3578	124.9959	0	0	0	0	Qc	2
		STAND2	-15.3577	124.9968	4	5	9	0	Pkc	5
		STAND3	-15.3576	124.9969	6	6	12	5	Pkc	5
		STAND4	-15.3582	124.9978	5	6	11	0	Pkw	5
Storr	1	STO01	-15.9493	124.5605	2	4	6	0	Pkl	4
		STO02	-15.9499	124.5598	5	5	10	0	Pkl	4
		STO03	-15.9486	124.5601	6	6	12	0	Pkl	5
		STO04	-15.9491	124.5614	3	3	6	5	Pkl	5
Sunday	1	SUND1	-16.4287	123.1787	0	0	0	0	Qs	2

Island	Site	Quadrat Code	Latitude (^{0}S)	Longitude (^{0}E)	Rock abundancea	Rock size[a]	Rock total[a]	Bedrock[a]	Geolcode[b]	Floristic Group
		SUND2	-16.4283	123.1780	0	0	0	0	Qc	10
		SUND3	-16.4270	123.1764	5	2	7	3	Pkl	9
South West Osborn	1	SWO01	-14.3736	125.9371	0	0	0	0	Qs	2
		SWO02	-14.3744	125.9372	5	6	11	5	Pkc	5
		SWO03	-14.3757	125.9369	5	5	10	5	Pkw	5
		SWO04	-14.3744	125.9383	5	5	10	0	Pkc	5
Un-named	1	UNN01	-15.9112	124.4618	1	2	3	2	Pkp	4
		UNN02	-15.9101	124.4628	5	7	12	5	Pkp	4
		UNN03	-15.9118	124.4621	5	7	12	5	Pkp	4
		UNN04	-15.9104	124.4617	0	0	0	0	Qc	10
		UNN05	-15.9109	124.4615	1	2	3	0	Qa	4
		UNN06	-15.9083	124.4674	4	4	8	3	Pkb	7
		UNN07	-15.9073	124.4656	5	3	8	0	Pkb	7
Uwins	1	UW1	-15.2576	124.7991	0	0	0	0	Qs	2
		UW2	-15.2570	124.8010	4	6	10	3	Pkw	4
		UW3	-15.2590	124.8000	4	4	8	2	Pkw	4
		UW4	-15.2586	124.8003	5	6	11	4	Pkw	4
Wargul Wargul	1	WARW1	-13.9370	126.1756	6	7	13	5	Pkc	3
		WARW2	-13.9360	126.1742	0	0	0	0	Qs	2
		WARW3	-13.9383	126.1737	4	5	9	5	Pkc	5
		WARW4	-13.9394	126.1735	6	3	9	2	Pkc	3
Wulalam	1	WUL1	-16.3707	124.2280	5	5	10	0	Pkpy	4
		WUL2	-16.3734	124.2300	4	3	7	0	Pkpy	4
		WUL4	-16.3702	124.2287	5	5	10	5	Pkpy	8
		WUL5	-16.3709	124.2309	6	4	10	0	Pkl	2
		WUL6	-16.3707	124.2301	1	4	5	0	Qc	2
		WUL7	-16.3731	124.2314	5	5	10	0	Pkpy	4

APPENDIX 2

Soil chemical and climate data for samples collected within each plant quadrat on sampled Kimberley islands. Reported values of <1.0 were treated as 0.001 for multivariate analyses. For details on soil chemical analytical methods see Meissner et al. (2009).

Codes: pH – pH in 0.01M CaCl2 (1:5); EC – Electrical Conductivity (mS/m) (1:5); orgC – Organic Carbon (%); totN – total Nitrogen (%); totP – total Phosphorus (mg/kg); totK – Potassium in 0.5M $NaHCO_3$ (1:100); exCa – exchangeable Calcium (cmol/kg); exMg – exchangeable Magnesium (cmol/kg); exNa – exchangeable Sodium (cmol/kg); exK – exchangeable Potassium (cmol/kg); Sand – percent sand; Silt – percent silt; Clay – percent clay; Rain – average annual rainfall (mm); mxTwmP – maximum temperature of the warmest period of the year (°C).

Island	Site	Quadrat Code	pH	EC	orgC	totN	totP	totK	exCa	exMg	exNa	exK	Sand	Silt	Clay	Rain	mxTwmP
Adolphus	1	ADOL1_1	6.5	540.0	1.50	0.130	98	320	5.70	7.00	0.50	0.53	80.5	11.5	8.0	827	37.6
		ADOL1_2	6.5	3.3	0.90	0.065	86	78	5.50	0.61	0.04	0.12	93.0	4.5	2.5	827	37.6
		ADOL1_3	6.0	6.5	0.88	0.062	57	100	0.67	0.36	0.15	0.17	94.0	3.0	3.0	827	37.6
		ADOL1_5	7.0	3.1	0.47	0.042	63	97	1.60	0.48	0.04	0.15	95.0	3.0	2.0	827	37.6
	2	ADOL2_6	6.0	2.7	1.00	0.069	83	100	2.40	0.86	0.07	0.15	94.5	5.0	0.0	827	37.6
		ADOL2_7	6.0	3.1	1.30	0.084	86	94	1.50	1.10	0.11	0.13	94.0	4.0	2.0	827	37.6
		ADOL2_8	6.5	2.0	1.40	0.093	89	79	3.00	0.65	0.03	0.12	93.5	4.0	2.5	827	37.6
		ADOL2_9	5.5	650.0	0.57	0.036	54	220	1.90	2.40	0.95	0.30	94.0	2.5	3.5	827	37.6
		ADOL2_10	6.5	2.3	0.58	0.047	70	66	1.20	0.45	0.05	0.09	95.5	3.0	1.5	827	37.6
Augustus	1	AUG1_1	6.0	2.0	2.62	0.180	310	78	4.52	2.46	0.05	0.14	88.0	5.0	7.0	1170	34.2
		AUG1_2	5.5	1.0	1.13	0.070	63	22	1.12	0.72	0.03	0.04	95.0	2.0	3.0	1170	34.2
		AUG1_3	5.9	1.0	0.98	0.040	63	20	1.36	0.61	0.02	0.05	93.0	2.5	4.5	1170	34.2
		AUG1_4	5.6	1.0	1.16	0.050	72	20	1.06	0.73	0.02	0.05	93.0	3.5	3.5	1170	34.2
		AUG1_5	5.3	1.0	1.46	0.090	84	19	0.27	0.30	0.05	0.04	91.5	4.0	4.5	1170	34.2
	2	AUG2_5	5.8	2.0	1.15	0.080	97	75	0.78	1.80	0.05	0.11	92.5	3.0	4.5	1170	34.2
		AUG2_6	5.5	1.0	1.41	0.070	68	62	1.68	0.48	0.02	0.05	94.0	3.0	3.0	1170	34.2
		AUG2_7	6.4	3.0	1.21	0.090	180	110	2.83	2.46	0.10	0.18	82.5	7.5	10.0	1170	34.2
		AUG2_8	5.4	2.0	2.25	0.140	190	89	2.48	1.03	0.02	0.09	90.0	4.0	6.0	1170	34.2
Bigge	1	BIG1_1	6.8	9.0	3.98	0.282	464	170	11.24	2.45	0.06	0.31	46.0	27.5	26.5	1103	34.6
		BIG1_2	6.1	3.0	2.66	0.216	319	90	6.10	1.88	0.04	0.17	90.0	4.5	5.5	1103	34.6
		BIG1_3	5.0	1.0	2.20	0.146	180	34	1.28	0.35	0.00	0.06	93.5	3.5	3.0	1103	34.6
		BIG1_4	7.5	8.0	0.99	0.066	304	110	8.95	5.33	0.44	0.18	76.0	8.0	16.0	1103	34.6
	2	BIG2_1	5.8	1.0	0.92	0.060	74	34	1.40	0.54	0.02	0.07	93.5	3.5	3.0	1103	34.6
		BIG2_2	4.7	150.0	4.86	0.265	291	140	1.32	2.53	3.91	0.34	87.0	7.0	6.0	1103	34.6

Island	Site	Quadrat Code	pH	EC	orgC	totN	totP	totK	exCa	exMg	exNa	exK	Sand	Silt	Clay	Rain	mxTwmP
		BIG2_3	4.6	2.0	3.47	0.229	284	89	1.68	0.73	0.05	0.16	89.5	4.5	6.0	1103	34.6
		BIG2_4	8.4	14.0	0.80	0.085	274	32	3.10	0.56	0.20	0.05	92.5	3.5	4.0	1103	34.6
Boongaree	1	BOO1	6.2	4.0	1.45	0.104	149	60	4.62	2.00	0.11	0.14	85.5	4.5	10.0	1138	35.3
		BOO3	6.6	6.0	2.92	0.197	305	200	10.56	2.65	0.07	0.43	83.5	8.0	8.5	1138	35.3
		BOO4	6.6	4.0	1.30	0.102	190	82	4.83	1.09	0.08	0.15	86.0	5.5	8.5	1138	35.3
		BOO5	6.3	13.0	1.11	0.081	202	110	2.92	0.73	0.45	0.20	83.0	6.5	10.5	1138	35.3
Byam Martin	1	BYM1	7.0	480.0	1.44	0.090	190	320	2.34	6.75	2.57	0.51	93.5	3.0	3.5	1144	33.6
		BYM2	5.4	2.0	1.43	0.100	100	37	1.59	0.61	0.05	0.07	93.0	3.0	4.0	1144	33.6
		BYM3	6.4	3.0	2.42	0.160	210	130	5.61	2.51	0.08	0.22	87.5	6.5	6.0	1144	33.6
		BYM4	6.6	4.0	1.91	0.120	200	140	6.22	1.98	0.10	0.27	87.5	6.0	6.5	1144	33.6
Coronation	1	COR1_1	9.4	4.0	0.24	0.010	270	9	0.80	0.11	0.03	0.02	98.0	1.0	1.0	1141	34.8
		COR1_2	9.0	5.0	0.52	0.030	260	13	1.84	0.15	0.00	0.03	96.5	1.5	2.0	1141	34.8
		COR1_3	6.9	14.0	3.40	0.240	350	310	17.86	5.50	0.24	0.56	56.0	19.5	24.5	1141	34.8
		COR1_4	5.4	1.0	1.13	0.080	230	30	0.50	0.25	0.03	0.07	82.5	4.5	13.0	1141	34.8
		COR1_5	6.2	2.0	0.83	0.060	120	23	4.94	11.37	0.22	0.05	42.5	20.5	37.0	1141	34.8
		COR1_6	6.8	5.0	1.85	0.150	260	180	11.16	4.79	0.10	0.25	66.0	14.5	19.5	1141	34.8
	2	COR2_1	6.6	6.0	3.75	0.290	730	190	17.87	2.39	0.10	0.43	44.0	29.0	27.0	1141	34.8
		COR2_2	7.2	19.0	5.78	0.490	1200	460	16.04	3.87	0.05	1.11	47.5	36.0	16.5	1141	34.8
		COR2_3	8.5	840.0	1.20	0.100	530	890	3.57	8.37	4.06	1.59	66.5	13.0	20.5	1141	34.8
		COR2_4	8.5	9.0	1.69	0.150	490	60	6.51	0.67	0.04	0.15	94.5	2.5	3.0	1141	34.8
Jungulu*	1	DAR1_1	9.1	5.0	0.42	0.030	180	52	1.96	0.21	0.96	0.06	97.0	1.0	2.0	1148	33.9
		DAR1_2	6.2	2.0	2.55	0.140	160	120	6.29	3.46	0.05	0.17	89.0	7.0	4.0	1148	33.9
		DAR1_3	5.7	2.0	1.96	0.090	59	71	3.31	0.82	0.02	0.07	95.5	2.5	2.0	1148	33.9
		DAR1_4	6.1	2.0	1.21	0.090	100	89	3.32	0.93	0.03	0.09	94.0	3.0	3.0	1148	33.9
		DAR1_5	6.0	13.0	4.12	0.220	160	180	1.95	2.70	1.31	0.24	84.5	8.0	7.5	1148	33.9
	2	DAR2_5	6.1	3.0	1.70	0.100	150	110	3.16	2.14	0.09	0.18	88.0	4.5	7.5	1148	33.9
		DAR2_6	6.9	7.0	4.21	0.370	340	230	15.47	4.91	0.09	0.36	88.5	7.0	4.5	1148	33.9
		DAR2_8	5.8	3.0	3.31	0.200	140	96	6.22	2.92	0.05	0.14	91.0	4.5	4.5	1148	33.9
Hidden	1	HID1	4.3	2.0	1.03	0.052	52	2	0.41	0.34	0.10	0.03	95.0	1.5	3.5	839	33.2
		HID2	4.0	1.0	0.84	0.051	50	0.01	0.57	0.24	0.04	0.05	94.0	2.5	3.5	839	33.2

Island	Site	Quadrat Code	pH	EC	orgC	totN	totP	totK	exCa	exMg	exNa	exK	Sand	Silt	Clay	Rain	mxTwmP
		HID3	5.5	0.0	0.62	0.038	49	0.01	1.80	0.39	0.02	0.05	94.5	3.0	2.5	839	33.2
		HID4	4.6	1.0	1.45	0.076	72	0.01	2.46	0.56	0.01	0.05	93.5	3.0	3.5	839	33.2
		HID5	5.1	1.0	0.60	0.033	45	0.01	1.12	0.42	0.02	0.03	95.5	2.5	2.0	839	33.2
		HID6	8.1	5.0	0.36	0.030	140	6	1.80	0.19	0.01	0.02	97.5	1.0	1.5	839	33.2
Katers	1	KAT1	7.3	4.0	1.94	0.180	606	110	6.38	1.20	0.01	0.20	50.0	22.5	27.5	1069	35
		KAT2	7.2	6.0	2.18	0.158	320	100	5.88	1.97	0.08	0.20	82.5	7.5	10.0	1069	35
		KAT3	7.4	10.0	3.36	0.293	901	130	8.66	2.55	0.01	0.28	82.5	8.5	9.0	1069	35
		KAT4	4.8	1.0	1.18	0.090	134	33	0.25	0.11	0.01	0.05	91.0	3.0	6.0	1069	35
Kingfisher	1	KING01	8.5	6.0	0.17	0.016	220	7	1.04	0.15	0.03	0.00	98.0	1.0	1.0	943	34
		KING02	4.1	2.0	1.76	0.103	79	1	2.06	0.74	0.04	0.09	89.5	5.0	5.5	943	34
		KING03	4.8	70.0	1.56	0.097	240	50	1.19	2.36	1.69	0.26	73.5	15.0	11.5	943	34
		KING04	4.3	3.0	1.47	0.094	72	1	2.02	0.91	0.04	0.08	85.5	10.0	4.5	943	34
		KING05	4.7	3.0	0.74	0.059	220	4	0.50	1.14	0.13	0.05	88.5	4.5	7.0	943	34
Lachlan	1	LACH1	7.5	7.0	0.78	0.056	270	12	2.09	0.09	0.01	0.01	97.5	1.0	1.5	787	33.9
		LACH2	4.3	2.0	1.53	0.082	89	3	1.06	0.27	0.02	0.04	91.0	4.0	5.0	787	33.9
		LACH3	5.6	8.0	2.86	0.176	160	6	6.22	2.38	0.29	0.14	90.5	4.5	5.0	787	33.9
Long	1	LONG1	7.6	17.0	3.69	0.373	720	20	10.23	2.11	0.07	0.12	90.5	4.0	5.5	768	34
		LONG2	6.5	18.0	8.97	0.593	480	23	15.56	3.40	0.15	0.34	85.5	6.5	8.0	768	34
		LONG3	8.4	300.0	0.60	0.047	140	5	1.42	3.21	1.15	0.44	89.5	3.5	7.0	768	34
Mary	1	MARY1	8.8	5.0	0.25	0.033	280	8	1.20	0.06	0.01	0.01	97.5	1.0	1.5	968	34.5
		MARY2	8.6	7.0	0.45	0.041	110	29	3.00	0.10	0.01	0.08	96.0	1.0	3.0	968	34.5
		MARY3	6.3	2.0	0.70	0.049	74	18	2.50	0.35	0.02	0.04	96.5	1.0	2.5	968	34.5
		MARY4	8.6	470.0	0.75	0.052	120	260	1.80	3.80	1.40	0.37	93.5	1.5	5.0	968	34.5
Middle Osborn	1	MOB01	6.7	9.0	4.42	0.308	437	400	13.71	4.99	0.20	0.87	57.5	21.5	21.0	1051	34.5
		MOB02	7.4	590.0	2.06	0.104	296	950	3.51	7.56	8.42	1.24	81.0	8.0	11.0	1051	34.5
		MOB03	7.4	31.0	2.72	0.234	341	410	13.43	5.29	0.64	0.50	67.0	13.5	19.5	1051	34.5
		MOB04	8.7	7.0	0.99	0.086	520	33	3.70	0.35	0.04	0.05	94.5	2.0	3.5	1051	34.5
	2	MOB06	7.9	100.0	3.94	0.296	551	520	17.41	7.11	3.45	1.06	49.5	23.5	27.0	1051	34.5
		MOB07	6.8	8.0	4.20	0.291	498	630	15.01	7.63	0.24	1.59	40.5	27.0	32.5	1051	34.5
		MOB08	6.7	27.0	3.54	0.256	422	440	14.54	6.99	0.79	1.02	29.5	26.5	44.0	1051	34.5

Island	Site	Quadrat Code	pH	EC	orgC	totN	totP	totK	exCa	exMg	exNa	exK	Sand	Silt	Clay	Rain	mxTwmP
NW Molema	1	NWMOL1	4.7	3.0	2.16	0.094	67	1	4.27	1.17	0.04	0.12	87.0	7.0	6.0	881	33.4
		NWMOL2	4.8	3.0	2.37	0.124	86	1	4.13	1.50	0.06	0.17	64.5	27.5	8.0	881	33.4
		NWMOL3	4.6	3.0	2.40	0.123	70	1	5.40	1.34	0.04	0.09	92.0	3.5	4.5	881	33.4
		NWMOL4	4.0	3.0	1.63	0.110	130	3	0.65	0.29	0.03	0.08	80.0	9.0	11.0	881	33.4
Sir Graham Moore	1	SGM01	9.1	6.0	0.36	0.031	392	20	1.56	0.20	0.01	0.03	98.0	0.0	2.0	979	34.4
		SGM02	8.9	6.0	0.45	0.043	760	12	2.07	0.14	0.03	0.02	94.5	2.0	3.5	979	34.4
		SGM03	6.4	3.0	1.57	0.079	177	47	3.98	1.77	0.06	0.12	88.0	4.0	8.0	979	34.4
		SGM04	5.5	10.0	2.03	0.132	120	57	0.79	1.34	0.60	0.14	76.5	9.0	14.5	979	34.4
		SGM05	7.0	5.0	1.54	0.104	201	86	6.05	1.45	0.04	0.20	91.0	3.5	5.5	979	34.4
	2	SGME01	9.0	6.0	0.43	0.033	495	12	2.18	0.27	0.03	0.02	96.5	1.0	2.5	979	34.4
		SGME02	7.9	480.0	1.17	0.047	263	320	4.02	4.50	2.75	0.51	93.5	2.5	4.0	979	34.4
		SGME03	6.3	11.0	3.43	0.189	613	120	7.79	3.41	0.29	0.27	80.0	10.0	10.0	979	34.4
		SGME04	4.9	4.0	2.04	0.122	88	37	1.02	0.61	0.12	0.06	94.0	3.5	2.5	979	34.4
		SGME05	8.2	10.0	1.99	0.186	755	67	9.66	0.55	2.11	0.39	91.0	4.0	5.0	979	34.4
		SGME06	5.3	4.0	1.28	0.070	185	40	0.63	0.32	0.14	0.09	87.5	3.5	9.0	979	34.4
		SGME07	9.1	130.0	0.49	0.036	296	140	0.98	1.92	1.16	0.25	93.0	2.5	4.5	979	34.4
		SGME08	6.3	14.0	8.75	0.567	650	230	19.53	8.50	0.46	0.59	64.5	19.5	16.0	979	34.4
St Andrew	1	STAND1	6.0	330.0	0.92	0.060	250	730	1.65	5.14	2.92	0.85	85.5	8.0	6.5	1127	35.7
		STAND2	6.8	10.0	5.66	0.430	610	320	23.91	4.77	0.14	0.72	47.5	37.0	15.5	1127	35.7
		STAND3	7.3	14.0	6.12	0.440	640	230	19.98	19.76	0.34	0.42	68.0	17.5	14.5	1127	35.7
		STAND4	6.2	8.0	4.37	0.270	490	150	12.36	3.51	0.10	0.39	61.0	22.0	17.0	1127	35.7
Storr	1	STO01	4.9	2.0	2.17	0.114	180	4	4.18	1.74	0.05	0.11	86.5	6.5	7.0	1007	35.4
		STO02	3.9	2.0	1.21	0.077	210	4	0.18	0.05	0.01	0.02	91.0	2.5	6.5	1007	35.4
		STO03	5.2	4.0	2.28	0.203	300	6	4.92	1.68	0.04	0.10	87.5	5.0	7.5	1007	35.4
		STO04	4.4	34.0	2.25	0.168	200	7	1.53	1.13	0.70	0.14	86.0	4.5	9.5	1007	35.4
Sunday	1	SUND1	8.1	6.0	0.37	0.037	850	57	1.73	0.15	0.03	0.01	96.5	1.5	2.0	778	33.2
		SUND2	8.2	450.0	1.47	0.106	570	23	2.41	6.05	4.15	0.70	80.0	7.5	12.5	778	33.2
		SUND3	7.2	17.0	2.62	0.246	860	41	7.20	0.64	0.07	0.15	81.5	8.5	10.0	778	33.2
South West Osborn	1	SWO01	9.1	5.0	0.28	0.024	282	10	1.17	0.11	0.02	0.01	97.5	0.5	2.0	1041	34.8
		SWO02	7.3	12.0	5.12	0.417	860	360	13.22	2.14	0.08	0.76	62.0	19.0	19.0	1041	34.8

Island	Site	Quadrat Code	pH	EC	orgC	totN	totP	totK	exCa	exMg	exNa	exK	Sand	Silt	Clay	Rain	mxTwmP
		SWO03	6.4	3.0	1.85	0.137	304	120	3.85	2.66	0.06	0.25	78.0	11.5	10.5	1041	34.8
		SWO04	6.7	6.0	2.08	0.174	345	190	5.28	2.96	0.07	0.41	82.5	10.0	7.5	1041	34.8
Un-named	1	UNN01	3.7	2.0	1.22	0.078	64	2	0.29	0.12	0.03	0.02	95.0	2.0	3.0	1000	35.2
		UNN02	4.4	2.0	3.89	0.268	1100	140	2.15	1.56	0.09	0.19	84.5	6.0	9.5	1000	35.2
		UNN03	3.9	2.0	2.24	0.148	230	9	0.43	0.18	0.02	0.06	91.0	2.5	6.5	1000	35.2
		UNN04	6.2	260.0	0.91	0.062	83	3	1.16	3.02	1.17	0.27	93.0	2.0	5.0	1000	35.2
		UNN05	5.1	2.0	1.73	0.118	110	3	4.02	0.90	0.02	0.06	93.5	3.0	3.5	1000	35.2
		UNN06	5.4	3.0	1.08	0.091	300	3	2.44	0.58	0.14	0.17	82.5	10.5	7.0	1000	35.2
		UNN07	5.2	2.0	0.50	0.043	190	3	0.92	0.33	0.04	0.09	84.0	11.0	5.0	1000	35.2
Uwins	1	UW1	8.8	6.0	0.67	0.060	350	23	2.94	0.21	0.04	0.04	96.5	1.5	2.0	1155	34.8
		UW2	5.6	2.0	0.82	0.060	130	39	1.14	0.50	0.03	0.06	92.5	3.5	4.0	1155	34.8
		UW3	5.0	2.0	1.23	0.060	44	58	1.89	0.49	0.02	0.06	96.0	2.5	1.5	1155	34.8
		UW4	5.0	2.0	1.22	0.070	62	60	0.95	0.34	0.06	0.08	94.0	3.5	2.5	1155	34.8
Wargul Wargul	1	WARW1	6.7	25.0	4.32	0.270	490	190	13.00	5.70	0.62	0.45	53.5	19.0	27.5	946	33.7
		WARW2	9.0	7.0	0.45	0.050	410	21	2.10	0.25	0.01	0.05	97.5	0.5	2.0	946	33.7
		WARW3	6.7	7.0	1.71	0.153	570	200	9.20	3.30	0.19	0.45	61.5	15.5	23.0	946	33.7
		WARW4	7.2	4.0	0.78	0.065	650	82	3.00	1.10	0.06	0.18	83.0	8.0	9.0	946	33.7
Wulalam	1	WUL1	5.1	2.0	2.06	0.132	150	3	3.88	1.46	0.04	0.17	80.5	10.0	9.5	901	35.3
		WUL2	5.5	4.0	2.30	0.160	150	4	4.88	1.47	0.03	0.19	83.0	8.5	8.5	901	35.3
		WUL4	4.4	2.0	3.07	0.184	130	3	3.01	1.02	0.04	0.11	86.0	6.5	7.5	901	35.3
		WUL6	6.0	13.0	2.34	0.145	230	16	11.29	2.70	0.70	0.30	45.0	26.0	29.0	901	35.3
		WUL7	5.3	3.0	1.91	0.139	160	4	4.50	0.92	0.03	0.14	79.5	11.0	9.5	901	35.3

APPENDIX 3 Richness of plant species endemic to the Northern Kimberley bioregion recorded on sampled Kimberley islands (KIBS and other records) and the values of the island environmental attributes used in the analysis of species richness.

Key: Richness – plant endemic species richness, Boulder – extent of rock scree (0 = flat; 1 = rounded, soil-mantled hill slopes and plateaux, narrow scree; 2 = shallow joints, wide ledges, moderate scree; 3 = massive scree, deep joints and scarp country), Elevation – maximum elevation (m), Rainfall – average annual rainfall (mm), Distance – distance to the mainland (km), Area – area of island (ha), Quadrats – number of quadrats sampled.

Island	Richness	Boulder	Elevation	Rainfall	Distance	Area	Quadrats
Adolphus	1	2	244	827	1.96	4134	8
Augustus	14	3	181	1170	1.79	18,929	9
Bigge	22	3	138	1103	2.97	17,108	8
Boongaree	9	3	235	1138	0.14	4164	4
Byam Martin	4	3	69	1144	13.28	816	3
Coronation	8	2	153	1141	6.07	3791	9
Jungulu	7	3	95	1148	18.91	4803	8
Hidden	2	3	127	839	1.48	1871	5
Katers	6	3	101	1069	1.4	1713	4
Kingfisher	1	1	82	943	15.47	300	5
Lachlan	1	2	93	787	0.17	1150	3
Long	0	2	65	768	9.36	1125	2
Mary	2	0	11	968	0.68	847	3
Middle Osborn	8	2	240	1051	2.34	2378	6
NW Molema	1	2	154	881	1.06	592	4
Sir Graham Moore	7	1	61	979	2.84	2812	12
St Andrew	5	2	284	1127	2.23	1465	3
Storr	6	3	165	1007	0.26	1883	4
Sunday	0	2	59	778	8.06	1186	2
South West Osborn	15	3	134	1041	3.07	1340	4
Un-named	2	2	83	1000	0.69	897	6
Uwins	10	3	134	1155	0.23	3219	4
Wargul Wargul	4	1	87	946	0.25	626	3
Wulalam	0	1	77	901	0.86	415	6

APPENDIX 4 Plant species endemic to the Northern Kimberley bioregion and recorded on the sampled Kimberley islands.

Island	Family	Genus
Adolphus	Malvaceae	*Triumfetta* sp. Adolphus Island (K.F. Kenneally 11898)
Augustus	Amaranthaceae	*Ptilotus decalvatus*
	Aponogetonaceae	*Aponogeton kimberleyensis*
	Cyperaceae	*Actinoschoenus* sp. C Kimberley Flora (P.G. Wilson s.n. 12/5/72)
	Droseraceae	*Drosera caduca*
	Fabaceae	*Plagiocarpus dispermus*
	Goodeniaceae	*Goodenia arachnoidea*
	Loranthaceae	*Amyema pyriformis*
	Malvaceae	*Gossypium costulatum*
	Malvaceae	*Gossypium pilosum*
	Malvaceae	*Decaschistia occidentalis*
	Nymphaeaceae	*Nymphaea ondinea*
	Rubiaceae	*Gardenia gardneri*
	Solanaceae	*Solanum cataphractum*
	Solanaceae	*Solanum heteropodium*
Bigge	Annonaceae	*Polyalthia australis*
	Cleomaceae	*Cleome* sp. Bonaparte Archipelago (A.A. Mitchell 4774)
	Cleomaceae	*Cleome arenitensis*
	Cyperaceae	*Actinoschoenus* sp. D Kimberley Flora (K.F. Kenneally 4789)
	Cyperaceae	*Fimbristylis* sp. E Kimberley Flora (C.R. Dunlop 5403)
	Euphorbiaceae	*Ricinocarpos marginatus*
	Fabaceae	*Acacia gardneri*
	Fabaceae	*Acacia kenneallyi*
	Fabaceae	*Acacia* sp. Bigge Island (A.A. Mitchell 3436)
	Fabaceae	*Bossiaea* sp. Princess May Range (M.D. Barrett & R.L. Barrett MDB 1326)
	Goodeniaceae	*Goodenia arachnoidea*
	Loranthaceae	*Amyema pyriformis*
	Lythraceae	*Lagerstroemia archeriana* var. *divaricatiflora*
	Malvaceae	*Corchorus leptocarpus*
	Malvaceae	*Triumfetta bradshawii*
	Malvaceae	*Decaschistia byrnesii* subsp. *lavandulacea*
	Malvaceae	*Corchorus puberulus*
	Nymphaeaceae	*Nymphaea ondinea*
	Poaceae	*Monodia stipoides*
	Solanaceae	*Solanum cataphractum*
	Solanaceae	*Solanum* sp. Boomerang Bay (K.F. Kenneally 10021)
	Stylidiaceae	*Stylidium perizostera*
Boongaree	Annonaceae	*Miliusa* sp. Monsoon Forest (K.F. Kenneally 10193 & B.P.M. Hyland)
	Cyperaceae	*Fimbristylis* sp. E Kimberley Flora (C.R. Dunlop 5403)
	Fabaceae	*Plagiocarpus dispermus*
	Lythraceae	*Lagerstroemia archeriana* var. *divaricatiflora*
	Portulacaceae	*Portulaca cyclophylla*
	Rubiaceae	*Spermacoce oxytheca*

Island	Family	Genus
	Sapindaceae	*Lepisanthes rubiginosa*
	Solanaceae	*Solanum cataphractum*
	Solanaceae	*Solanum heteropodium*
Byam Martin	Amaranthaceae	*Ptilotus decalvatus*
	Fabaceae	*Acacia kenneallyi*
	Rubiaceae	*Spermacoce hippocrepica*
	Solanaceae	*Solanum heteropodium*
Coronation	Annonaceae	*Polyalthia australis*
	Cyperaceae	*Fimbristylis* sp. F Kimberley Flora (A.S. George 13789)
	Fabaceae	*Acacia dissimilis*
	Malvaceae	*Gossypium costulatum*
	Malvaceae	*Hibiscus peralbus*
	Polygalaceae	*Polygala* sp. A Kimberley Flora (K.F. Kenneally 7752)
	Rubiaceae	*Spermacoce* sp. Berthier Dunes (R.L. Barrett RLB 5753)
	Solanaceae	*Solanum cataphractum*
Jungulu	Cycadaceae	*Cycas basaltica*
	Cyperaceae	*Actinoschoenus* sp. B Kimberley Flora (G.J. Keighery 2649)
	Fabaceae	*Plagiocarpus dispermus*
	Goodeniaceae	*Goodenia arachnoidea*
	Malvaceae	*Decaschistia occidentalis*
	Solanaceae	*Solanum cataphractum*
	Solanaceae	*Solanum heteropodium*
Hidden	Cyperaceae	*Actinoschoenus* sp. B Kimberley Flora (G.J. Keighery 2649)
	Malvaceae	*Corchorus leptocarpus*
Katers	Annonaceae	*Polyalthia australis*
	Goodeniaceae	*Goodenia arachnoidea*
	Loranthaceae	*Amyema pyriformis*
	Malvaceae	*Corchorus leptocarpus*
	Malvaceae	*Corchorus puberulus*
	Poaceae	*Monodia stipoides*
Kingfisher	Haemodoraceae	*Haemodorum* sp. A Kimberley Flora (K.F. Kenneally 8639)
Lachlan	Fabaceae	*Acacia* sp. Trent River (K.F. Kenneally 11701)
Mary	Amaranthaceae	*Ptilotus crispus*
	Rubiaceae	*Spermacoce* sp. Berthier Dunes (R.L. Barrett RLB 5753)
Middle Osborn	Amaranthaceae	*Ptilotus decalvatus*
	Convolvulaceae	*Ipomoea trichosperma*
	Cyperaceae	*Fimbristylis* sp. E Kimberley Flora (C.R. Dunlop 5403)
	Fabaceae	*Glycine lactovirens*
	Malvaceae	*Corchorus leptocarpus*
	Malvaceae	*Gossypium pilosum*
	Malvaceae	*Hibiscus peralbus*
	Portulacaceae	*Portulaca clavigera*
NW Molema	Malvaceae	*Helicteres* sp. Mertens Falls (K.F. Kenneally 7887)
Sir Graham Moore	Fabaceae	*Jacksonia argentea*
	Goodeniaceae	*Goodenia arachnoidea*
	Goodeniaceae	*Scaevola* sp. Sir Graham Moore Island (P.G. Wilson 11204)
	Malvaceae	*Gossypium costulatum*
	Malvaceae	*Decaschistia byrnesii* subsp. *lavandulacea*

Island	Family	Genus
	Malvaceae	*Gossypium exiguum*
	Rubiaceae	*Spermacoce* sp. Berthier Dunes (R.L. Barrett RLB 5753)
St Andrew	Cyperaceae	*Actinoschoenus* sp. C Kimberley Flora (P.G. Wilson s.n. 12/5/72)
	Fabaceae	*Plagiocarpus dispermus*
	Malvaceae	*Gossypium pilosum*
	Malvaceae	*Helicteres* sp. Mertens Falls (K.F. Kenneally 7887)
	Portulacaceae	*Portulaca clavigera*
Storr	Annonaceae	*Polyalthia australis*
	Cyperaceae	*Actinoschoenus* sp. B Kimberley Flora (G.J. Keighery 2649)
	Droseraceae	*Drosera caduca*
	Goodeniaceae	*Goodenia arachnoidea*
	Myrtaceae	*Eucalyptus kenneallyi*
	Solanaceae	*Solanum heteropodium*
South West Osborn	Annonaceae	*Miliusa* sp. Monsoon Forest (K.F. Kenneally 10193 & B.P.M. Hyland)
	Convolvulaceae	*Ipomoea trichosperma*
	Cyperaceae	*Fimbristylis* sp. E Kimberley Flora (C.R. Dunlop 5403)
	Eriocaulaceae	*Eriocaulon* sp. E Kimberley Flora (A.S. George 12635)
	Fabaceae	*Acacia dissimilis*
	Goodeniaceae	*Goodenia arachnoidea*
	Lentibulariaceae	*Utricularia georgei*
	Loganiaceae	*Mitrasacme kenneallyi*
	Lythraceae	*Lagerstroemia archeriana* var. *divaricatiflora*
	Malvaceae	*Corchorus leptocarpus*
	Malvaceae	*Hibiscus peralbus*
	Malvaceae	*Hibiscus kenneallyi*
	Meliaceae	*Dysoxylum latifolium*
	Phyllanthaceae	*Sauropus salignus*
	Rubiaceae	*Spermacoce oxytheca*
Un-named	Cyperaceae	*Actinoschoenus* sp. B Kimberley Flora (G.J. Keighery 2649)
	Goodeniaceae	*Goodenia arachnoidea*
Uwins	Aponogetonaceae	*Aponogeton kimberleyensis*
	Cyperaceae	*Actinoschoenus* sp. C Kimberley Flora (P.G. Wilson s.n. 12/5/72)
	Eriocaulaceae	*Eriocaulon* sp. E Kimberley Flora (A.S. George 12635)
	Fabaceae	*Plagiocarpus dispermus*
	Goodeniaceae	*Goodenia arachnoidea*
	Malvaceae	*Gossypium costulatum*
	Malvaceae	*Gossypium pilosum*
	Malvaceae	*Hibiscus reflexus*
	Nymphaeaceae	*Nymphaea ondinea*
	Solanaceae	*Solanum cataphractum*
Wargul Wargul	Boraginaceae	*Heliotropium nesopelydum*
	Cyperaceae	*Fimbristylis* sp. E Kimberley Flora (C.R. Dunlop 5403)
	Malvaceae	*Gossypium pilosum*
	Portulacaceae	*Portulaca clavigera*

Electronic Appendix 1	Quadrat by plant species data matrix, reordered according to their quadrat and species classifications, recorded from the 24 sampled Kimberley islands. The ten floristic (quadrat) groups are indicated, as well as the analysis code assigned to each taxon. See Appendix 1 for quadrat code descriptions. Taxa recorded from one quadrat are excluded (see Electronic Appendix 3).
Electronic Appendix 2	List of taxa recorded from the Northern Kimberley bioregion, and their Department of Parks and Wildlife (DPaW, formerly Department of Environment and Conservation) conservation priority codes based on vouchers at the Western Australian Herbarium (PERTH). Species recorded during the current Kimberley Island Biodiversity Survey (KIBS) on the 24 islands sampled are shown, as are previous island records held in the Western Australian Herbarium (Islands). Analysis codes are those used as taxon identifiers for multivariate analyses. Where specimens could not be determined to existing subspecific taxa, and more than one occurs within the broader study area, the specific level taxon is also listed. Some taxa were analysed at the specific level where subspecific determination was not possible. * indicates an exotic species.
Electronic Appendix 3	List of plant taxa recorded from one quadrat only on the 24 sampled Kimberley islands. See Appendix 1 for quadrat code descriptions.
Electronic Appendix 4	List of taxa recorded outside formal quadrats during the Kimberley Island Biodiversity Survey from the 24 sampled islands.

See CD inside the back cover, or visit:
http://www.museum.wa.gov.au/research/records-supplements/attachments