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PISONIA ISLANDS OF THE GREAT BARRIER REEF

PART I. THE DISTRIBUTION, ABUNDANCE AND DISPERSAL BY SEABIRDS OF PISONIA GRANDIS

BY T. A. WALKER

PISONIA ISLANDS OF THE GREAT BARRIER REEF

PART II. THE VASCULAR FLORAS OF BUSHY AND REDBILL ISLANDS

BY T. A. WALKER, M. Y. CHALOUPKA, AND B. R. KING.

PISONIA ISLANDS OF THE GREAT BARRIER REEF

PART III. CHANGES IN THE VASCULAR FLORA OF LADY MUSGRAVE ISLAND

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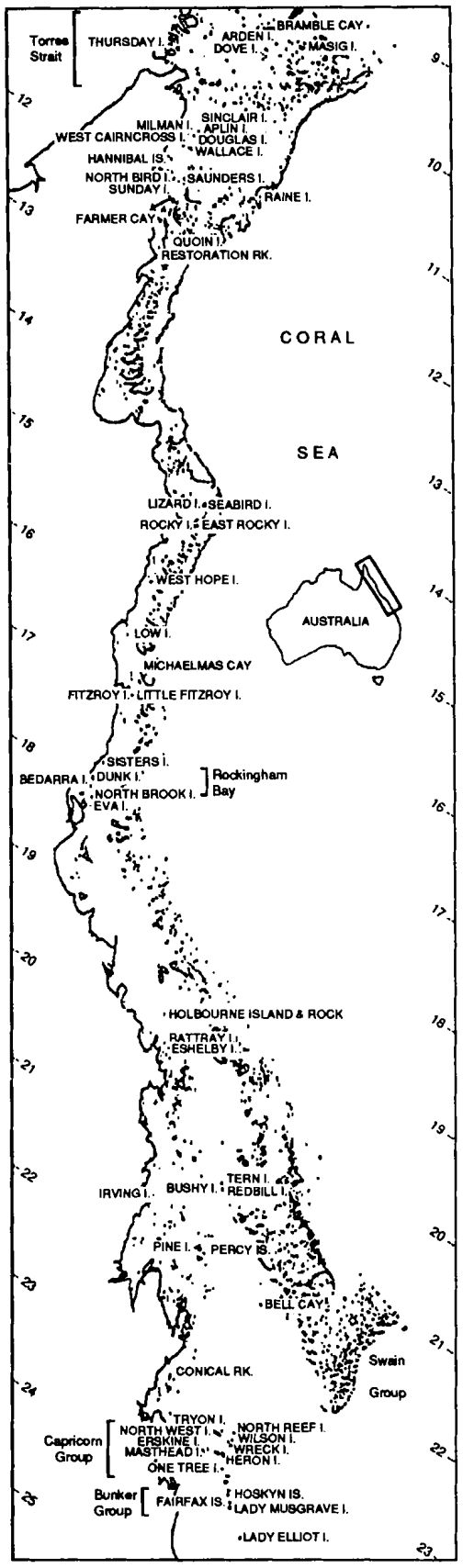

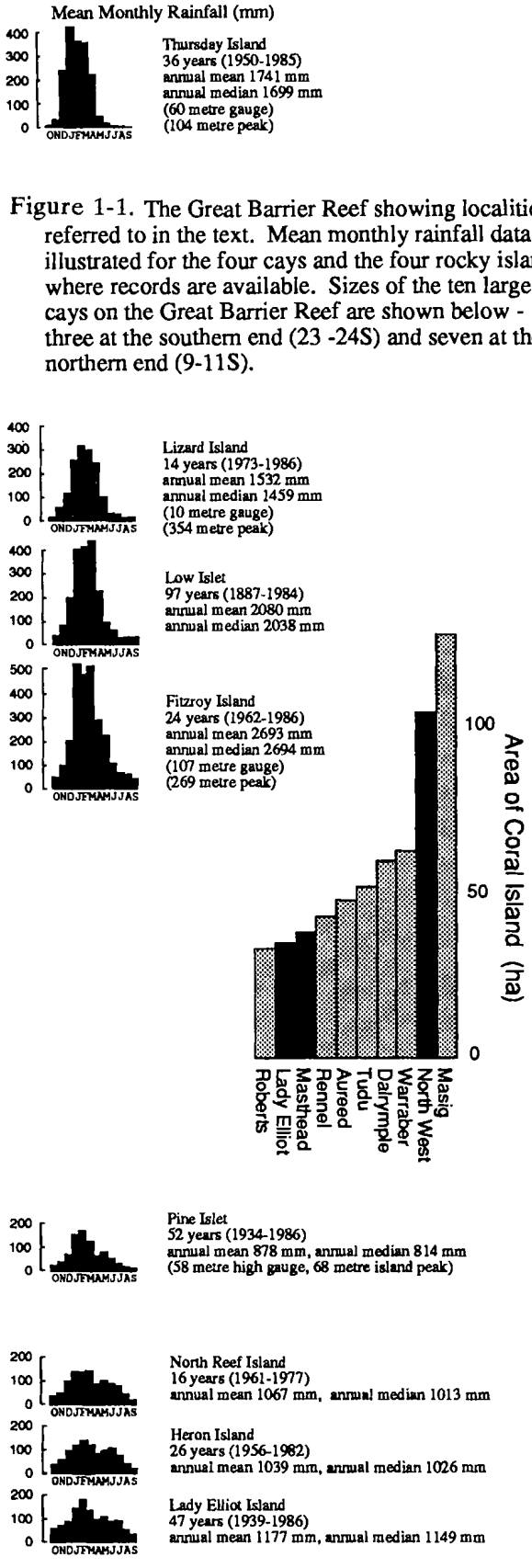

Figure 1-1. The Great Barrier Reef showing localities referred to in the text. Mean monthly rainfall data is illustrated for the four cays and the four rocky islands where records are available. Sizes of the ten largest cays on the Great Barrier Reef are shown below - three at the southern end (23 -24S) and seven at the northern end (9-11S).

PISONIA ISLANDS OF THE GREAT BARRIER REEF

PART II. THE VASCULAR FLORAS OF BUSHY AND REDBILL ISLANDS

BY

T. A. WALKER, M. Y. CHALOUPKA, AND B. R. KING.

ABSTRACT

Vegetation species lists are compared over a sixteen year period at a coral cay and continental island off the east coast of Queensland. A total of thirty-seven species were recorded. These twin islands are of considerable geomorphological and biogeographical importance. Bushy Island supports one of Australia's few forests of *Pisonia grandis* and is floristically identical with the Capricorn-Bunker Islands at the southern end of the Great Barrier Reef.

INTRODUCTION

Coral islands are rare on fringing reefs and with the exception of Redbill Reef (20°58'S; 150°05'S) are restricted to the northern third of the Great Barrier Reef. Such reefs are sometimes considered to be platform reefs incorporating an outcrop of continental rock (Hopley 1982). Redbill Reef (Fig. 2-1) is also unique in that it supports the only wooded coral cay, Bushy Island, on the southern Great Barrier Reef (from 17° to 23°S). Between Bushy Island and Green Island 630 km to the north there are only one or two unstable sandbanks that emerge sufficiently in some years to support herbs. Between Bushy Island and North Reef Island 310 km to the south there are only nine emergent cays supporting a few species of herbs and grasses. The isolation of Bushy Island is remarkable in view of its size and mature forest. Redbill Island is also notable in being the furthest offshore continental island to the east of the Australian coast.

The vegetation of Bushy Island is of considerable interest because it is dominated by *Pisonia grandis* forest (Steers 1938, Wallace and Lovell 1977, Hopley 1982, Walker 1987). *Pisonia grandis* is not known to occur on the Australian mainland and *Pisonia* forest is almost unknown in Australia outside of the Capricorn-Bunker Islands at the southern end of the Great Barrier Reef (Part I).

SPECIES RECORDS

Plants were identified or collected for identification as follows: 26 December 1972 to 4 January 1973, both islands, Wallace and Lovell (1977); 24-25 January 1984, both islands, B. King, A. Taplin and T. Walker; September 1986, Bushy Island, M. Chaloupka; 10 November 1986, Redbill Island, T. Walker; 12 December 1987 (drought conditions), both islands, T. Walker; 30-31 August 1989 (wet conditions), both islands, T. Walker. The results of the floristic surveys are listed in Table 2-1. An additional beach vine, *Canavalia*, was reported in a figure caption to Bushy Island (Hopley 1982, p. 332) but requires confirmation.

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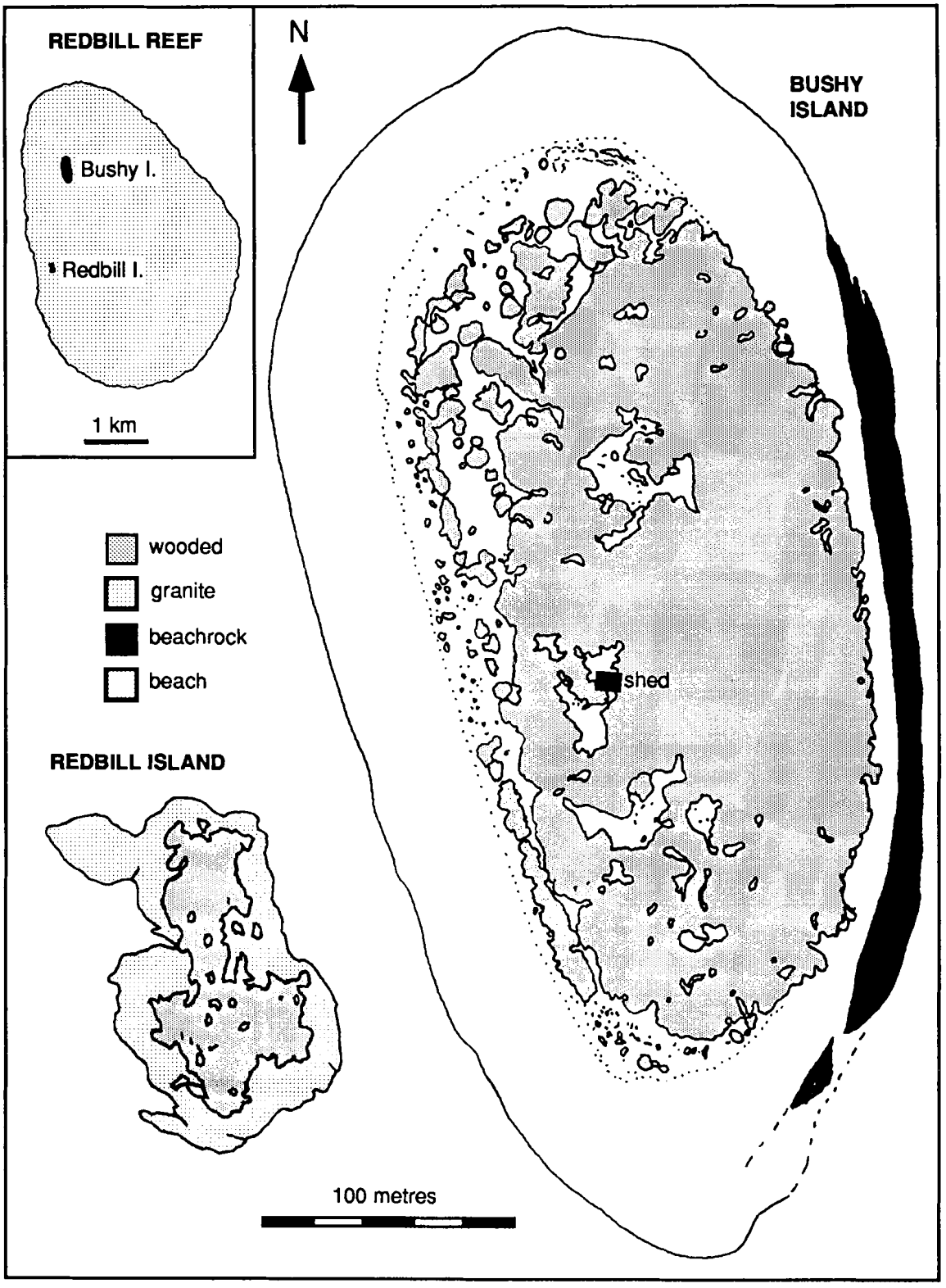

Fig. 2-1. Redbill Reef, Bushy Island and Redbill Island (from 1987 aerial photography by T. Walker). Scales are not precise.

Table 2-1. Floral species lists in different years from Bushy Island and Redbill Island excluding two cultivated species (1973 data from Wallace and Lovell 1977). The number of Capricorn and Bunker Islands (out of a total of 15 including Lady Elliot Island) where each species has been recorded is shown for comparison (Heatwole 1984, Chaloupka and Domm 1985, Cribb 1986, Walker and Ogilvie 1987, Walker unpublished).

Species	Bushy Island					Redbill Island					Capricorn & Bunker Islands
	1973	1984	1986	1987	1989	1973	1984	1986	1987	1989	
Abutilon asiaticum	+	+	+	+	+			+	+	+	14
Cassytha filiformis	+	+	+	+	+						8
Casuarina equisetifolia	+	+	+	+	+						15
Cordia subcordata	+	+	+	+	+						5
Ipomea pes caprae	+	+	+	+	+						11
Pandanus tectorius	+	+	+	+	+						13
Pisonia grandis	+	+	+	+	+		+	+	+	+	15
Salsola kali	+	+	+	+	+						7
Scaevola sericea	+	+	+	+	+						12
Thuarea involuta	+	+	+	+	+	+	+				14
Tournefortia argentea	+	+	+	+	+						15
Tridax procumbens	+	+	+	+	+						1
Triumfetta repens	+	+	+		+						2
Myoporum acuminatum	+							+	+	+	1
Sesuvium portulacastrum	+					+					3
Sophora tomentosa	+										6
Sporobolus virginicus	+										10
Vitex trifolia	+										1
Boerhavia repens		+	+	+	+			+	+	+	15
Euphorbia tannensis		+	+	+	+			+		+	13
Ipomea macrantha		+	+	+	+						11
Lepturus repens		+	+	+	+			+	+	+	15
Portulaca oleracea		+	+	+	+		+	+	+	+	10
Cakile edentula		+	+		+						13
Tribulus cistoides		+	+		+			+	+	+	10
Rhynchelytrum repens			+	+	+						1
Plumbago zeylanica				+	+		+[1]	+	+	+	8
Commelina sp.				+							0
Achyranthes aspera					+			+	+	+	15
Passiflora foetida					+			+		+	0
Solanum americanum					+						13
Sonchus oleraceus					+						10
Wollastonia biflora					+						11
Calophyllum inophyllum					+						1
indeterminate weed					+						
Ficus obliqua						+[2]	+	+	+	+	3
Digitaria brownii								+[1]	+[1]	+	0
Total species (37)	18	20	21	20	29	3	5	13	11	13	
Native species (30)	16	17	17	18	22	3	5	12	11	12	
Sea-dispersed species (19)	14	13	13	11	16	2	1	3	3	3	

1. Identification uncertain.
2. Reported as *Ficus opposita* by Wallace and Lovell (1977).

ISLAND FLORAS

Bushy Island has an area of 4.5 ha (above high tide) and rises 2-3 m above high tide and 6-7 m above the reef flat (Fig.2-1). The reef has an area of about 900 ha. The first records of vegetation were reported by Steers (1938) who produced a compass traverse map in 1936. Steers noted that the cay "resembles the sand islands of the Bunkers and Capricorns very closely" and has "fairly close vegetation, including *Pisonia, Tournefortia,* and *Pandanus.* Creeping plants - eg., *Ipomoae* - were also present, as well as *Abutilon.*" The species diversity has increased since the first systematic floristic collection was made in 1972-73 and although five species have disappeared a total of fifteen new species have been recorded (Table 2-1).

In August 1989 there was an infestation of locusts at Bushy Island but the vegetation was lush and not yet seriously affected by the pest. Most plant species were abundant. The main exceptions were *Cordia subcordata* (four specimens on the eastern edge), *Tribulus cistoides* (eight small specimens on the western strand), *Rhynchelytrum repens* (restricted to a small clearing at the northern edge of the cay), *Sonchus oleraceus* (a few specimens beside the hut), *Solanum americanum* (three specimens in two separate clearings), *Passiflora foetida* (one small specimen on the north-western strand), *Wollastonia biflora* (one small vine in front of the south-western *Casuarina* grove), *Calophyllum inophyllum* (one 50 cm sapling in the *Casuarina* grove) and an indeterminate weed (possibly *Raphanus* sp., a few immature specimens beside the hut). In addition *Achyranthes aspera, Boerhavia repens, Portulaca oleracea, Salsola kali, Triumfetta repens* and *Ipomea pes-caprae* were not abundant, the latter three being restricted to the western strand. In 1987 the island was very dry and foliage was greatly reduced. Seeds of *Cakile, Triumfetta* and *Tribulus* were presumably present in 1987 although plants were not observed.

The periphery of Bushy Island is continually changing in response to alterations in the direction and strength of prevailing seas. Erosion on one side of the cay is normally accompanied by sand accretion on the other side. In 1936 the underlying beach rock along the western shore was uncovered by erosional processes (map of Steers 1938) while in 1973 this rock was reburied and beach rock on the eastern side of the cay was exposed (map of Wallace and Lovell 1977). In the following year beach rock was uncovered on both the eastern and western sides of the southern part of the cay (Hopley 1981). In 1987 over twice as much beach rock was visible along the eastern beach as in 1973 (Fig. 2-1) and a 1-2 metre high sand cliff separated high tide from forest trees which have been toppling onto the beach during the 1980s. This erosion was most extensive in 1989 with many fallen *Pisonia, Tournefortia* and *Pandanus.* Conversely on the western side of the cay sand has accumulated since 1974 to form a wide strand zone. Plant colonisation of this zone has been rapid despite trampling and uprooting by nesting green turtles in summer. In January 1984 hundreds of 40-250 cm high seedlings of *Casuarina equisetifolia* were present in a narrow supra-tidal strip along the southern part of the western strand. Within twenty-two months this strip had grown to a dense 7 m high wall of trees and in 1989 it was fronted by a lower barrier of *Tournefortia* and *Scaevola.*

The centre of Bushy Island is more stable than the margin but has also experienced disturbance in recent decades. Large clearings with fallen *Pisonia* logs have been present since at least 1973 but were not noted in 1936. The clearings appear too discrete to have resulted from indiscriminate cyclone damage but this cannot be ruled out. The forest is devoid of undergrowth or other species except in clearings. Phosphate rock is present with a few pockets of peat-like *Pisonia* humus. A prominent feature within the forest is the presence of incubation mounds and diggings of the Orange-footed Scrubfowl, *Megapodius reinwardt.* The sand mounds are up to three metres high

and the forest floor is a mosaic of pits and tangled *Pisonia* roots uncovered by megapode digging. The continual scratching and digging may inhibit establishment of other plant species in the forest.

Redbill Island lies to the south of Bushy Island with an area of about 1 ha and an elevation of 23 m. The upper slopes are covered with a dense 0.4 ha stunted thicket of *Ficus obliqua* incorporating roughly twenty low *Pisonia grandis* specimens particularly at the edges (Fig. 2-1). The thicket is mainly 1-3 m high. The rock and pockets of humus beneath the thicket are bare of undergrowth except for *Plumbago zeylanica*. The lower slopes of the island are mainly bare granite with pockets or specimens of grasses or herbs. The eastern gully is relatively protected and supports the highest diversity of species including two, *Myoporum acuminatum* and *Passiflora foetida*, not present elsewhere on the rock. In 1989 *Tribulus cistoides* and *Passiflora foetida* were represented by one small specimen and two vines respectively while *Euphorbia tannensis* and *Boerhavia repens* were also rare. There has been an apparent increase from three to thirteen plant species at Redbill Island and only one of the thirteen species present in 1986 was recorded in 1973 (Table 2-1). This change is too great to be an error from incomplete survey results in 1973. The exposed lower rock slopes may undergo episodic defoliation and recolonisation following storms or drought.

PLANT DISPERSAL AND COLONISATION

More than half of the plant species at Bushy Island are dispersed by the sea. The same is true at Redbill Island despite the absence of a beach suitable for colonisation by strand species. Seeds of the species not capable of arrival by sea can all be dispersed by birds. Three or four species have alternative dispersal mechanisms by wind but in view of the distance from mainland (90 km), the rarity of offshore winds and the properties of the seeds of these species this mode of colonisation seems less likely. The potential for introduction of plants by human activities is discussed in the following section.

Few species of birds are resident at the islands however the dominant plant species, *Pisonia grandis* at Bushy Island and *Ficus obliqua* at Redbill Island, are both dispersed by birds. The first seeds of *Pisonia grandis* were undoubtedly transported to the islands attached to the feathers of seabirds. Black Noddies *Anous minutus* and Bridled Terns *Sterna anaethetus* are the principal dispersal agents of *Pisonia* along the Great Barrier Reef (Part I). Black Noddies have a nocturnal roosting population of many thousands on Bushy Island and Bridled Terns have a summer nesting colony of approximately 200 on Redbill Island (Walker 1987, 1989). The *Pisonia* forest appears to propagate vegetatively but in 1989 a group of seventeen *Pisonia* seedlings to 30 cm high were present behind the south-western *Casuarina* grove.

It is notable that the two islands are only 1.3 km apart but *Ficus obliqua* has not colonized Bushy Island. The absence of fig-eating birds or indeed of any resident land birds from Redbill Island apparently precludes dispersal of *Ficus obliqua* which grows to 12 m high on Capricorn-Bunker cays and can germinate upon and "strangle" *Pisonia* trees. Such growth on a *Pisonia* tree was observed near Bushy Island at Tern Island.

HUMAN INFLUENCES ON FLORA

Redbill Island is an inhospitable rock rarely climbed by visitors whereas Bushy Island has long been popular with tourists and campers. A tour vessel operating from 1984 to 1986 brought over 3,000 people ashore per annum. In the mid 1960s a shelter hut was constructed for tourist day-visitors and this was intermittently occupied by a caretaker until 1988. The forest clearings on

Bushy Island may have been cut by beche-de-mer collectors who used the island as a base for boiling their catch in past years. Another possibility is that the clearings are a result of limited phosphate mining. The latter is suspected by local fishermen but there are no records of a mining lease and no apparent indications of digging in the clearings.

Excluding several coconut (*Cocos nucifera*) trees and pawpaw (*Carica papaya*) planted beside the hut there are six or seven non-native species recorded at Bushy Island (17- 20% of all species). *Cakile edentula* and *Triumfetta repens* are supra-tidal herbs that colonise from floating seeds. The grass *Rhynchelytrum repens* and the weed *Sonchus oleraceus* follow human inhabitation of tropical islands and are accidental introductions by visitors to Bushy Island. *Tridax procumbens* is dispersed widely on islands by wind, people or birds. All species at Redbill Island are native to Australia except *Passiflora foetida* which is dispersed by fruit-eating birds.

COMPARISON WITH OTHER ISLANDS

The only species recorded from Bushy Island that have not been reported on Capricorn-Bunker cays are the vine *Passiflora foetida* and the scrambling herb *Commelina*. *Passiflora foetida* and species of *Commelina* are widespread on cays and rocky islands elsewhere throughout the Great Barrier Reef region(as are all the species inTable 2-1with theexception of*Cakile edentula*and possibly *Plumbago zeylanica, Sonchus oleraceus* and *Rhynchelytrum repens*). The *Calophyllum inophyllum* seedling is probably temporary as the species is an unlikely coloniser at Bushy Island. *Calophyllum inophyllum* seeds wash ashore on Capricorn-Bunker cays but do not successfully germinate or do not survive beyond seedling stage (Cribb 1975). The species composition of Bushy Island is virtually identical to that of the Capricorn-Bunker cays (Table 1) and the species diversity is the same as that of the two Capricorn-Bunker cays of the same size (Table 2). The vegetation structure is also identical consisting of a dominant *Pisonia grandis* forest (up to 13 m high) fringed with pantropical strand species.

The floras of Bushy Island and the Capricorn-Bunker Islands differ substantially from those at other Great Barrier Reef islands (Part I). A wide variety of trees, shrubs, vines and herbs not present on the southern cays occurs elsewhere on cays and continental islands. The only other cay with a mature *Pisonia* forest is Douglas Island (east of Cape York Peninsula) which has major differences in the composition of the supporting vegetation.

Table 2-2. Comparison of floristic diversity of Bushy Island with that of the Capricorn-Bunker Islands of equivalent size. Cultivated species and survey data prior to 1968 are excluded. One Tree Island and Fairfax Island data are from Heatwole (1984) and Cribb (1986).

	Bushy	West Fairfax	One Tree
Island area (ha)	4.5	5	4
Range of species numbers in surveys	18-28	21-32	(21)
Total number of species recorded	34	34	30
Range of native species in surveys	16-22	17-21	(19)
Total native species recorded	28	22	22
Sea-dispersed species in surveys	11-15	12-15	(15)

The closest islands to Redbill Reef are Tern Island 6 km to the north-west and Penrith Island 17 km to the south-west. The flora of Tern Island was only partly recorded but at least half of the species in Table 2-1 occur there. Tern Island is a steep rock like Redbill Island but is roughly three times larger with three small detached vegetated rocks. At its northern summit there is a small *Ficus obliqua* thicket containing a few *Pisonia grandis* but the isle is mainly vegetated with grasses, herbs, and low shrubs with higher shrub thickets along the top of the ridge. Several species occur that are not present at Bushy or Redbill Islands. One of these is *Sesuvium portulacastrum* which became extinct at Bushy and Redbill Islands but which is present on all four of the Tern Islets (it is the only plant species present on the smallest southern rock).

Penrith Island is 248 ha in area with at least 162 vascular plant species in up to seven identifiable communities including grassland, *Eucalyptus* woodland and mangroves (Batianoff 1987). All species in Table 2-1 were reported at Penrith Island except *Triumfetta repens, Rhynchelytrum repens, Solanum americanum, Cakile edentula, Portulaca oleracea, Pisonia grandis* and *Plumbago zeylanica*. The exceptionally sticky fruits of the latter two species are dispersed throughout Bushy, Redbill and Tern Islands by seabird populations which are absent from Penrith Island.

REFERENCES

Batianoff, G. N. (1987). Botanical inventory of Penrith Island: Cumberland Islands, Mackay (Qld). Botany Branch, Queensland Department of Primary Industries, Brisbane.

Chaloupka , M. Y. and Domm, S. B. (1985). Comprehensive regional survey of the terrestrial flora on coral cays in the Capricornia Section of the Great Barrier Reef Marine Park. Proc. R. Soc. Qd. 96: 75-80.

Cribb, A. B. (1975). Terrestrial vegetation of Masthead Island. Qd. Nat. 21: 74-78.

Cribb , A. B. (1986). The terrestrial vegetation of Fairfax Islands, Great Barrier Reef. Qd. Nat. 26: 119-126.

Heatwole , H. (1984). Terrestrial vegetation of the coral cays, Capricornia Section, Great Barrier Reef Marine Park. In: The Capricornia Section of the Great Barrier Reef: Past, Present and Future. (W. T. Ward and P. Saenger, eds.) Roy. Soc. Qd. and Aust. Coral Reef Soc., Brisbane. pp 87-139.

Hopley, D. (1981). Sediment movement around a coral cay, Great Barrier Reef, Australia. Pacific Geol. 15: 17-36.

Hopley, D. (1982). The Geomorphology of the Great Barrier Reef. Wiley-Interscience, New York.

Steers, J. A.(1938). Detailed notes on the islands surveyed and examined by the geographical expedition to the Great Barrier Reef in 1936. Reports of the Great Barrier Reef Committee Vol 4, Part 3, No 7: 51-96.

Wallace, C. C. and Lovell, E. R. (1977). Topography and coral distribution of Bushy and Redbill Islands and surrounding reef, Great Barrier Reef, Queensland. Atoll Res. Bull. No. 194.

Walker, T. A. (1987). Birds of Bushy Island (with a summary of the nesting status of bird species on southern Great Barrier Reef cays). Sunbird 17: 52-58.

Walker, T. A. (1989). Seabird Island No. 198: Redbill Island, Great Barrier Reef, Queensland. Corella 13: 110-111.

Walker, T. A. and Ogilvie, P. (1988). The vegetation of North Reef Island. Qd. Nat. 28: 37-41.