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The flora and fauna of Legendre Island

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ABSTRACT

This paper presents the current knowledge of the vertebrate fauna and vascular flora of Legendre Island off the Pilbara coast of Western Australia. It reports on a biological survey performed by the Department of Environment and Conservation (DEC; formerly the Department of Conservation and Land Management, CALM) in July 2000 and collates historical biological data from the island. The survey added 21 new species of vascular flora to the island's species list. One-hundred and seventy plant species, including six weed species, are now known from the island. None of the native taxa are declared rare flora or priority species. The survey added one new species of vertebrate (the python, *Liasis stimsoni*) to the island's records. The confirmed terrestrial vertebrate fauna of Legendre Island consists of one species of mammal (*Rattus tunneyi*), 20 species of reptiles and 50 species of birds.

We suggest that differences between the species identified in 2000 and in previous surveys are the result of seasonality and patchiness of distribution. We believe that more plant and animal species remain unrecorded from the island and recommend a survey program that allows for sampling seasonal variation and variation between wet and dry summers. Such a strategy may also detect those fauna not recently recorded.

We argue that because Legendre Island is the only large limestone island in the Dampier Archipelago and is an important breeding location for three species of marine turtle, it should be included in the conservation estate as part of the proposed Dampier Archipelago National Park.

Introduction

The Dampier Archipelago comprises 42 islands, islets and rocks, lying close to the town of Dampier on the north west coast of Western Australia (Figure 1). The islands are variously composed of Precambrian volcanic and granitic rocks, Pleistocene limestones, and Holocene sand deposits (Kriewaldt, 1964). Twenty-seven of the islands are currently reserved for conservation or for conservation and recreation (CALM, 1990). The other islands are either unallocated Crown land or are under temporary reservation for industrial purposes.

The Dampier Archipelago attained its present form between 7000 and 8000 years ago, following inundation of surrounding lands by the sea (Semeniuk *et al.*, 1982). Legendre Island is the most northerly island of the archipelago and, at approximately 1300 hectares, is the fifth largest. It is not, however, one of the nature reserves of the Dampier Archipelago despite being the only large limestone island found there.

The biological values of Legendre Island have not been previously assessed with any rigour. The known fauna and flora of the island were presented in the Dampier Archipelago Nature Reserves Management Plan (CALM, 1990) which summarised all observations and biological collections known from the island at that time. However, to our knowledge, no pitfall trapping had ever been undertaken. Considering the size of the island and its limestone substrate, a more detailed assessment of the biological values of the island was warranted.

This paper presents the results from a biological survey undertaken on Legendre Island in July 2000, as well as all historical fauna and flora records for the island. We include notes on the history and vesting of the island.

Background

Legendre Island lies between latitudes of 20°21'8"S to 20°25'18"S, and longitudes of 116°49'39"E to 116°57'3"E. It covers an area of 1344 hectares above high water mark, and is approximately 15.5 km long and 1.5 km wide at the widest point. The highest point is 33 m above sea level. On the southern side there are extensive shallow sandy flats, extending as far as adjacent islands. To the north, the water depth descends rapidly to 20 metres and more. A working lighthouse is present on its western end.

The island is composed of Pleistocene dune limestone, with areas of fringing Holocene sands. Extensive areas of sandplain, containing pink-brown limestone-derived sands, have a well-developed hard pan at about 0.3 metres depth. Adjacent Hauy and Keast Islands, and the slightly more distant Delambre Island also contain some limestone areas, but are largely composed of Holocene sand deposits (Kriewaldt, 1964, Ryan, 1966, Biggs, 1976a, 1976b). Legendre Island is the largest limestone island in the Dampier Archipelago. The only limestone island off the Pilbara coast to exceed Legendre in size is Barrow Island.

The island was visited by the French Expedition under the command of Nicholas Baudin on 29 March 1803. It

is believed to have been named in honour of the French mathematician Adrien Marie Legendre (pers. comm., WA Department of Land Information).

Climate

The climate of the Dampier Archipelago is semi-arid tropical with two seasons, a hot summer extending from October to April and a mild winter between May and September. Mean summer temperature ranges from 24°C (minimum) to 35°C (maximum), while mean winter temperatures range from 17°C to 29°C (CALM, 1990). Rainfall is seasonal but unreliable, with an annual average of 276 mm. Evaporation is approximately 2500 mm per year, exceeding rainfall by a factor of 9 (CALM, 1990). The islands may receive more rainfall than the mainland and early morning dews can occur in both summer and winter.

Land status

The majority (1137.5 ha) of Legendre Island is vested in the Minister for State Development, for Future Industrial Purposes. Legendre Island was once part of a proposal to develop a deepwater port to support the iron ore industry, in which it was planned to run a service corridor along the Burrup Peninsula and Dolphin Island to a proposed port area at Legendre Island. This plan was deleted from the Burrup Land Use Plan and Management Strategy in 1996. However, the vesting of the island remains with the Minister for State Development.

Limestone resources have been identified on numerous islands in the Dampier Archipelago, with Legendre assessed to hold 264 million tonnes of limestone at a mean grade of 83.51% (Landvision, 2001). Lime is an important resource for use in cement making and steel production. While Hamersley Iron operated an iron ore pelletising plant at Dampier between 1968 and 1980, no extraction of lime resources was undertaken from Legendre. There are no current leases over Legendre Island, and previously issued exploration licences were surrendered in 2001 (pers. comm., Department of Industry and Resources, September 2004).

In its report to the Environmental Protection Authority (EPA, 1974), the Conservation Through Reserves Committee recommended that part of Legendre Island be left in its natural state, although some of the island was being investigated for deep water port infrastructure. Based on these recommendations and public submissions, the EPA (1975) recommended that the entire Dampier Archipelago be declared a Class A reserve for conservation of flora and fauna. This was later amended, with Legendre and Dolphin Islands proposed to be Class B reserves. However, since this recommendation and following amendments to the Land Administration Act 1997, Class B reserves no longer exist. Thus Legendre Island was never incorporated into the conservation estate.

Previous surveys

Prior to the establishment of the Dampier Archipelago conservation reserves between 1977 and 1987, there were three significant visits by naturalists to the Archipelago. The earliest of these, a WA Museum (WAM) expedition by D. Bathgate, G. W. Kendrick and B. Wilson in 1961, did not visit Legendre Island. However, in the following year (1962), a larger WAM expedition visited many islands of the archipelago, including Legendre, and made extensive collections of vertebrates and flora. Lastly, a joint WAM and WA Department of Fisheries and Wildlife expedition to the archipelago in July 1970 (Burbidge and Prince, 1972), visited islands that were most likely to be affected by proposed industrial developments in the area. Legendre Island was included, but while this expedition surveyed vertebrate fauna and flora, no pitfall trapping was undertaken.

Various other data have been collected since the establishment of the reserves. In 1978, Ian Abbott surveyed birds on Legendre and the surrounding islands (Abbott 1979, 1982) and Ron Johnstone (WA Museum) included mangrove stands on Legendre Island in his 1973–1982 survey of mangrove birds of Western Australia (Johnstone, 1990). Keith Morris (DEC, Woodvale) collated his personal bird records for the island in the Dampier Archipelago Nature Reserves Management Plan (CALM, 1990). Long (1996) performed a flora survey of the southern part of the island for Woodside Petroleum in June 1996 and also made some incidental records of fauna.

No widespread pitfall trapping was undertaken in the archipelago until Connell (1983) studied biogeography and community structure of the reptiles on selected small islands in 1983. Legendre Island was not included here, and no pitfall trapping was done there until a CALM survey in 1998 (unpublished data).

In 1998, it was decided that a fauna survey using pitfall traps should be undertaken, because of the possibility that small, cryptic mammals and reptiles may have been missed during the earlier surveys. In particular, it was thought possible that *Ningaui*, *Planigale* and some small rodents (eg *Pseudomys delicatulus*) might be present on the island, but undetected. That survey established pitfall traps in three different vegetation communities on the western end of the island (see below) and opened these traps from 21 to 23 April 1998.

The island vegetation was classified by Beard (1971a) as t_1Hi: Grass Steppe Spinifex (*Triodia pungens*) no trees or shrubs. The vegetation was classified from an aerial traverse north of the island (Beard, 1971b).

Flora records for Legendre Island come from several sources. Herbarium vouchers were lodged at Perth by the WAM survey in 1962 (99 vouchers of 76 species) and by BG Thomson (2 vouchers of 2 species), while species lists were compiled on two separate occasions: Burbidge and Prince (1972) listed 72 species and Long (1996), surveying a proposed southern corridor, recorded 75 species.

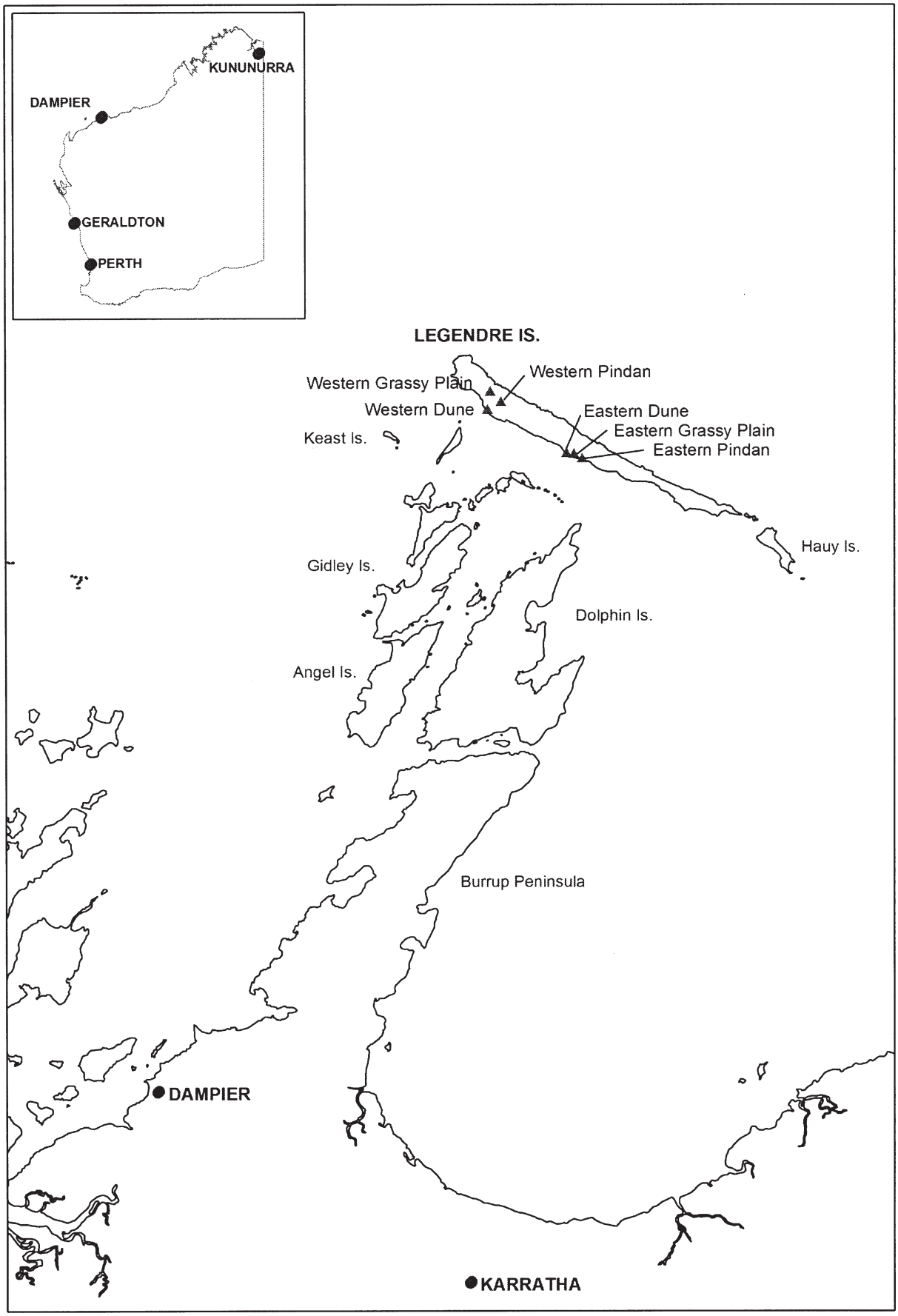

Figure 1. *The Dampier Archipelago showing Legendre Island and the location of the study sites.*

METHODS

Sampling Sites

In the 1998 CALM survey, pitfall trap lines were established in a sand dune, a grassy-plain and a pindan community on the western side of the island. These were again used in the 2000 survey and are designated as Units 1, 2 and 3 respectively. Also in 2000, pitfalls were established in analogous vegetation communities on the eastern end of the island (Units 4, 5 and 6). These sites are termed western and eastern respectively (Figure 1). Only the western sites were sampled in 1998; these data are also presented in the results.

As limestone hills are the dominant feature of the island several units were located here. Unit 7 was established on a limestone hill site about 200 metres north of the eastern dune unit (Unit 4). Unit 8 is an ecotonal region between a limestone hill (Unit 7) and the pindan (Unit 6). Unit 9 is a coastal limestone shelf. Unit 10 is a limestone hill above the campsite (south-east of the eastern units). Unit 11 is an unspecified limestone hill on the western end of the island.

Flora

Vegetation was sampled within 50 x 50 m quadrats within Units 1–10. Unit 11 was not sampled using a quadrat but was sampled by fortuitous collections across a limestone hill.

At least one specimen of each plant species was collected for identification in Karratha.

Fauna

Fauna was sampled by varying techniques depending on location. Vegetation Units 1 to 6 were each sampled the same way: 20 Elliott traps (baited with oats and peanut paste) and pitfall traps. In each unit, Elliott traps were opened for the same period as the pitfall traps. The pit lines consisted of two 20-litre buckets with approximately five metres of fence between them and two metres of fence either side. Units 1, 2 and 3 (the western sites) had four pit lines that were open from the 11th to the 15th of July 2000. The eastern sites (Units 4, 5 and 6) had three pit lines and were open from the 11th to the 17th of July.

The other areas sampled for fauna were on limestone hills where pitfall traps could not be installed. Unit 7 was one of these sites. Unit 7 was sampled by 20 Elliot traps (using the same bait as above) opened from the 11th and 17th of July.

Two other areas were also trapped for mammals. On the northern side of the island a distinctive rocky outcrop was located and 25 Elliot traps, using the same bait as above, were set for four consecutive nights. The mangrove community on the southern side of the island was trapped for Water Rats (*Hydromys chrysogaster*). Four cage traps were set behind the mangroves (two baited with oats and peanut paste, the other two with sardines) for four consecutive nights from the 11th to 14th April.

Each of the designated units was also actively searched for reptiles. Where appropriate this involved digging up rat burrows, tearing off bark, spotlighting, rolling rocks and logs, as well as the more passive sit-and-watch technique, used amongst trees and rocks. All captures were identified in the field or camp as appropriate and released on-site. At least one specimen of each species (except for the Stimson's python) was lodged with the WA Museum. For purposes of comparison, numbers of animals caught in each vegetation unit are presented, but, as there was no marking of animals, these may include recaptures.

Bird records were taken *ad hoc* from sightings around the island. Consequently, these data are not related to any vegetation unit.

Results and Discussion

Vegetation communities

Five main vegetation units can be identified on Legendre Island:

Mangal

Mangals on Legendre Island are found on the southern side of the island and are dominated by the white mangrove, *Avicennia marina*, interspersed with occasional specimens of *Bruguiera exaristata*, *Ceriops tagal* and *Aegialitis annulata*. There were many *A. marina* seedlings particularly on the landward side of the mangal in both 1998 and 2000.

Sand Dune

Sand (white Holocene) dunes are present behind the beaches on the western end and southern side of the island. This habitat is dominated by the low shrub *Acacia bivenosa*, with an herbaceous understorey including *Swainsona formosus*, *Ptilotis exaltatus*, *Tephrosia eriocarpa*, and *Canavalia rosea.*

Grassy Plains

This habitat type is dominated by grasses, including *Enneapogon polyphyllus*, *Themeda triandra*, *Triraphis mollis*, *Eragrostis setifolia*, and *Panicum decompositum*, interspersed with herbaceous annuals, such as *Ptilotus exaltatus*, and the creeper *Rhynchosia minima*. The soil is generally orange sand.

Pindan

This habitat type is somewhat similar to the grassy plain in both vegetation structure and soil colour however, the substrate is much harder and the vegetation community noticeably different. The vegetation is dominated by grass species including *Enneapogon polyphyllus* and *Triodia* sp., with numerous herbaceous annuals such as *Amaranthus pallidiflorus*, *Ptilotus*

exaltatus, *Euphorbia australis* and *Flaveria australasica* and other small plants such as *Boerhavia schomburgkiana*, *Alysicarpus rugosus*, *Indigofera linnaei* and *Melhania oblongifolia*, together with the creeper, *Rhynchosia minima*.

Limestone Hill

Outcroppings of limestone exist in a number of locations on Legendre Island. These range from low areas to hillocks to steep hills. The vegetation on these limestone areas was dominated by grasses and herbaceous plants such as *Sorghum plumosum*, *Triodia wiseana*, *Abutilon lepidum* and *Trichodesma zeylanicum*, with creepers such as *Mukia maderaspatana* and *Rhynchosia minima*. There were also scattered clumps of *Ficus brachypoda* and *Pittosporum phylliraeoides.*

Flora

One-hundred and seventy vascular plant species from 42 families and 105 genera are known from the island; none are declared rare flora (DRF) or priority listed (Appendix 1). Eighty-three species were collected in the 2000 survey, 21 of which new records for the island. Significantly, eighty-seven species previously recorded from the island were not collected in the 2000. This is assumed to be due to seasonal and sampling effects, as the uncollected taxa include both perennial and annual species. Changes in vegetation structure in some vegetation units were noted between the 1998 and 2000 surveys and these could be responsible for some of these differences. In the two years between CALM surveys, there was considerable change in the vegetation structure with substantial grass growth in Pindan and Grassy Plain units on both the eastern and western ends of the island. During the 1998 survey these units were largely bare of grass however in 2000, there was thick growth to one metre high in the eastern Grassy Plain, and spinifex growing through and over the pit fences in the western Pindan. Furthermore, the 1998 survey was done at the end of summer all vegetation was very dry and there were no plants in flower. In stark contrast, during the 2000 winter survey there were a large number of plants in flower and the vegetation was generally green and lush. This followed very high summer rains earlier that same year.

Six island plant species are introduced or naturalised (*Aerva javanica*, *Malvastrum americanum*, *Passiflora foetida*, *Setaria verticillata*, *Amaranthus viridis*, and *Salsola tragus*). Keighery and Longman (2004) consider the first four species environmental weeds, i.e. those that reproduce in reasonably intact bushland. *Aerva javanica* (kapok) was introduced to Australia as a fodder plant. It readily invades disturbed areas and is now widespread on the Pilbara mainland and is recorded from a number of other Pilbara coastal islands, including many islands of the Montebello group (pers. obs., Jeff Richardson). It has not been recorded on the island previously. *Malvastrum americanum* is a native of America and a common weed of arid zone and other habitats, from the Nullarbor to the Pilbara and Kimberley (Hussey *et al.*, 1997). It was not recorded on the island prior to 2000 and then only in the grassy plain on the western end of the island. *Passiflora foetida* (stinking passion flower), native to South America (Hussey *et al.*, 1997), is a common weed of disturbed areas on creek and river banks from Carnarvon to the Kimberley. It also was not collected before 2000 and was only found in the western pindan. *Setaria verticillata* (whorled pigeon grass) is a common and widespread weed of disturbed land and shrublands in the Pilbara and Kimberley (Hussey *et al.*, 1997). Although it was not collected in 2000 it was recorded by Burbidge and Prince (1972). *Amaranthus viridis* is an annual herb that is native to tropical America (Hussey *et al.*, 1997). It was not found in 2000, or recorded by Burbidge and Prince (1972), but was vouchered at the Perth herbarium in 1962. *Salsola tragus* is widespread in WA and also on Legendre Island.

Mammals

Five species of mammal have been recorded on Legendre Island. These records are from vouchered specimens, oral records and evidence such as skeletal remains and scats. The 2000 survey attempted to resolve as many unsubstantiated records as possible.

Vouchers of *Rattus tunneyi* were lodged in the Western Australian museum in 1962 (the WAM visit) and 1970 (Burbidge and Prince, 1972). We found this species in all vegetation units and in high numbers (367 captures for all sites combined; Table 1). *Rattus tunneyi* is not listed on the Western Australian or Commonwealth threatened species lists and is considered secure in the Rodent Action Plan (Lee, 1995). However, it has suffered a significant decline since European settlement (Braithwaite and Baverstock, 1995). It formerly occurred along the west coast and throughout the Pilbara, Gascoyne and Kimberley regions of Western Australia, but has now disappeared from more than 50% of its original area of occupancy in this State and the Northern Territory, and is extinct in South Australia (Morris, 2000). Morris (2000) recommends it should be regarded as lower risk (near threatened) under the IUCN categories of threat (IUCN, 2004), and that it should be monitored and could be added to the CALM Priority Fauna list.

Foxes have been recorded on the island from as early as 1962 (WAM), and Burbidge and Prince (1972) found evidence (scats and tracks) of their presence in 1970. A baiting program was subsequently initiated in 1996 (pers. comm., K. Morris, DEC, Woodvale). There has been no recent evidence of foxes (in this and the 1998 survey) implying that the baiting program has been effective in eradicating this introduced species.

The presence of two other island mammal species has been inferred from skeletal material. Burbidge and Prince (1972) found the skull of a Rock Rat (*Zyzomys argurus*) and a skull of *Pseudomys hermannsburgensis* was found in an owl pellet by P. Kendrick (DEC, Karratha) during the 1998 survey. Neither of these species were found on Legendre during the 2000 CALM

Table 1

Terrestrial vertebrate species recorded from Legendre Island, their distribution across the vegetation units surveyed in 2000 (numbers represent total captures in each unit) and the provenance of previous records. See text for unit descriptions and comments on these species. W=record from the museum collected 1962; B= Burbidge and Prince (1972); C1998=CALM survey (unpublished) in 1998; D= Dampier Archipelago Nature Reserves Management Plan, (CALM, 1990).

GROUP	SPECIES	Vegetation Unit Number							Other Units	Previous Collectors
		1	2	3	4	5	6	7		
MAMMALS	*Rattus tunneyi*	47	43	43	68	67	42	46	11	W, B, C1998
	Vulpes vulpes[1]									W, B
	Tachyglossus aculeatus[2]									L
AGAMIDS	*Ctenophorus caudicinctus*								2	B, L
	Ctenophorus isolepis	1			1				1	W, B, C1998
	Lophognathus gilberti gilberti									W, L
GECKOS	*Gehyra pilbara*[3]							4		B
	Gehyra punctata[4]							11	1	A
	Gehyra variegata							4	1	W, C1998
	Diplodactylus conspicillatus									B
	Diplodactylus elderi[5]									D
	Diplodactylus stenodactylus									B
	Heteronotia binoei							1	2	W, B, C1998
SKINKS	*Ctenotus saxatilis*	16	4	2	4	3	5		1	W, B, C1998
	Ctenotus serventyi	1								W, C1998
	Glaphyromorphus isolepis	5	2		2	1	2	3	2	W, B, C1998
	Lerista bipes	6	3						2	C1998
	Lerista muelleri	3	1	4	1		2	1		W
	Morethia ruficauda	2		1		2	1	3		W
VARANIDS	*Varanus acanthurus*							3[6]		W, B, C1998
	Varanus panoptes					1				C1998
TYPHLOPIDAE	*Ramphotyphlops diversus ammodytes*									B
SNAKES	*Liasis stimsoni*							2		
Total number of species per Unit		8	5	4	5	4	6	9	9	

[1] No foxes seen on the island since the 1996 baiting program initiated.

[2] Scats consistent with the echidna recorded by Long (1996).

[3] Recorded as *G. australis* in Burbidge and Prince (1970), re-identified since (pers. com. L. Smith WA Museum)

[4] Ian Abbott collected 2 species (R60443-44) while on the island surveying for birds in 1978.

[5] The provenance of the record for this species is unknown, it was reported in CALM (1990)

[6] These records come from 3 tails found in a tree. It is assumed that they were dropped there by a raptor, these have not been included in the species count for the unit.

survey despite substantial effort being put into trapping around rock piles to find *Z. argurus*. Both these species live on nearby islands (CALM, 1990) and it is assumed from the results of this survey that the skulls came from animals predated elsewhere, probably by a Barn Owl.

Long (1996) found scats consistent with Echidnas in her southern study sites. There have been no records of this species from previous or the 2000 survey. Although this species is cryptic, it's feeding sign is conspicuous, indicating that Echidna are probably uncommon on Legendre.

Water Rats (*Hydromys chrysogaster*) are thought to live on nearby Dolphin Island, where their tracks are regularly seen near mangroves (pers. obs., Geoff Kregor, Peter Kendrick). We found no tracks, nor evidence of feeding sites, nor did we catch any individuals in the cage traps set behind the mangroves.

Reptiles

Twenty species of reptile are known from museum records from Legendre Island (Table 1). Some have not been recorded since the surveys of 1962 and 1970. For instance, no Diplodactyline geckos were found during this or the CALM 1998 survey, although three species of this group (*Diplodactylus conspicillatus*, *D. stenodactylus* and *D. elderi*) are recorded in CALM (1990) and Burbidge and Prince (1972) vouchered the two former species in the WAM. It is assumed the *D. elderi* record in CALM (1990) comes from an unpublished source.

All gecko species recorded in the current survey were found on the limestone hill (Unit 7) amongst a small area of split and movable rocks (Table 1). In this same rock pile a pair of Stimson's pythons (*Liasis stimsoni*)

were found. These constitute a new record for the island.

Three species of agamids (dragons) are known from the island, but only two species were recorded in the 2000 survey. The Ring-tailed Dragon (*Ctenophorus caudicinctus*) was observed on rocky areas near the shore on both the northern and southern sides of the island. Neither of these was within a sampled vegetation unit. This species was collected in 1970 but no specimens were lodged during the WAM survey in 1962 nor was the species recorded in 1998. Long (1996) observed the species frequently. The second agamid found in the 2000 survey (*C. isolepis*) was recorded from areas with a sandy substrate: one in each of the Dune units (both in pitfalls) and one was seen near the campsite. *Lophognathus gilberti* was lodged in the WA museum in 1962 and was recorded as frequent on the southern part of the island by Long (1996), however it has not been recorded during any other surveys on the island.

All the skink species previously recorded on Legendre were recorded during the 2000 survey. *Ctenotus saxatilis* (*C. leseurii* in Burbidge and Prince, 1972) was the most common, being found in all units except the Limestone Hill. Our record of *Ctenotus serventyi* was a single capture in a sand dune unit (Unit 1) the same site where an individual was caught in 1998. This species was not recorded in CALM (1990), but is on WAM records (1962). This similarity of this species and *C. saxatilis* can lead to *C. serventyi* being reported as the more common *C. saxatilis*. The one record here of *C. serventyi* implies that this species is uncommon on Legendre Island and probably elsewhere: Connell (1983), for instance, found none of this species on the 10 nearby islands he studied, although it is known from the nearby Burrup Peninsula.

No blind snakes (Family Typhlopidae) were recorded in this survey. Two specimens of *Ramphotyphlops diversus ammodytes* were collected in 1970 (Burbidge and Prince, 1972) but this species has not been recorded before then or since.

Two varanids have been recorded from Legendre Island. A single *Varanus panoptes* was found on the grassy plain (Site 5) in 2000 and the same location in 1998 (the first record for the species on Legendre). The other varanid recorded in 2000 (*V. acanthurus*) was from traces of the species: three tails were found in trees on the Limestone Hill, presumably dropped there by a raptor. The WA Museum has a record of this species from 1962, Burbidge and Prince (1972) mention its presence and an individual was caught in an Elliott trap on Unit 1 during the 1998 CALM survey.

Large numbers of turtle tracks observed on beaches suggest that Legendre Island is one of the most important turtle nesting islands in the Dampier Archipelago (pers. comm., Keith Morris, DEC, Woodvale). Green turtles (*Chelonia mydas*) have been recorded nesting on the beaches on the northern side of the island (pers. comm., Keith Morris), and it is likely that Hawksbill turtles (*Eretmochelys imbricata*) and Flatback turtles (*Natator depressus*), which commonly nest on other islands of the archipelago, would also nest here. Green turtles have also been observed aggregating in the waters just off the eastern end of Legendre Island (pers. obs., Fran Stanley). More research needs to be conducted into the species of marine turtle that use the beaches and waters surrounding Legendre Island to determine its overall significance for these species.

Birds

Fifty-three bird species from twenty-eight families have been recorded on Legendre Island (Table 2). Over half of these are terrestrial species, the rest are waders or waterbirds. Five species have been recorded breeding on the island: Wedge-tailed Shearwater, Osprey, White-bellied Sea-Eagle, Bar-shouldered Dove and the Barn Owl. There are at least two resident groups of Barn Owls on the island. One group, consisting of five individuals, was seen on the cliffs to the east of the mangroves on the southern side of the island. A pair (probably not included in the above count) was seen in a cave behind the mangroves, where a nest was found with a single egg. Nesting Barn Owls were also recorded in the 1998 CALM survey. Other breeding records from 2000 were two Osprey nests, each with three eggs in them. The earliest known Osprey breeding record is from 1978 (from the CALM Seabird Breeding Island Database; Abbott, 1982).

General Discussion

The present survey has added substantially to our knowledge of the vascular plant and vertebrate species of Legendre Island, which remains, nevertheless, far from complete. Comparing our survey results with previous surveys highlights some glaring knowledge inadequacies. For instance, the recording of 21 new plant species from the island, but the failure to recollect 87 previously recorded species underlie this. Similarly, Long's (1996) record of *L. g. gilberti* was the first since 1962.

Part of the reason for this disparity would be seasonality and also variation between high rainfall and low rainfall years. Other variations may be explained by sampling location: our 2000 record of Stimson's python and all four gecko species are from a single small rock pile that could have easily been overlooked. Likewise, sampling method is also important. There are no bat records from the island, though Microchiropterans were seen feeding on insects in the camp lights.

We recommend a comprehensive survey program that incorporates all the above considerations. Furthermore, to contextualise the biodiversity values of Legendre Island we also recommend that a similar program of biological survey be performed amongst all islands in the group. As a basis for stratifying future sampling we have identified five vegetation communities on the island.

Legendre Island is the only large limestone island in the Dampier Archipelago, and one of only a few large limestone islands off the Pilbara coast, and efforts should be made to include it in the conservation estate. This is

Table 2

Bird species recorded from Legendre Island. Order and nomenclature from draft working list of birds of Australia and Australian Territories, June 2003 (Birds Australia Website). The seabird and wader records of Abbott (1979, 1982) and Burbidge and Prince (1972) not specified as being on Legendre Island are not included. A[1]=Abbott (1979); A[2]=Abbott (1982); B= Burbidge and Prince (1972); J= Johnstone (1990); C1998 and C2000 CALM officers (unpublished) during the 1998 or 2000 surveys respectively; D=CALM (1990); W1962=record from the museum collected 1962; (b)=breeding record.

FAMILY	COMMON NAME	SOURCE
Phasianidae	Brown Quail[1]	B, C2000
Procellariidae	Wedge-tailed Shearwater	D (b)
Phalacrocoracidae	Pied Cormorant	D
Fregatidae	Lesser Frigatebird	C1998
Ardeidae	White-faced Heron	C1998
Ardeidae	Eastern Reef Egret	D, C1998 (white and dark morphs)
Ardeidae	Great Egret	C2000
Accipitridae	Osprey	A[2] (b), D (b), B, C1998 (b), C2000 (b)
Accipitridae	Black-shouldered Kite	D, B, C1998, C2000
Accipitridae	Whistling Kite	D, B
Accipitridae	Brahminy Kite	D, A[2],C1998, C2000
Accipitridae	White-bellied Sea-Eagle	D (b), B, C1998, C2000
Accipitridae	Spotted Harrier	D, A[2],B, C1998, C2000
Falconidae	Nankeen Kestrel	D, B, C1998, C2000
Scolopacidae	Godwit[2]	C1998
Scolopacidae	Whimbrel	D, C1998
Scolopacidae	Common Greenshank	C1998
Scolopacidae	Grey-tailed Tattler	D, C1998
Scolopacidae	Ruddy Turnstone	C1998
Scolopacidae	Sanderling	C1998
Burhinidae	Beach Stone-curlew[3]	C1998, C2000
Haematopodidae	Pied Oystercatcher	D, A[2],C1998, C2000
Haematopodidae	Sooty Oystercatcher	D, C1998, C2000
Charadriidae	Red-capped Plover	C1998
Charadriidae	Lesser Sand Plover	C1998
Laridae	Silver Gull	D, C1998, C2000
Laridae	Caspian Tern	C1998, C2000
Laridae	Crested Tern	D, A[1]
Laridae	Roseate Tern	C1998
Laridae	Bridled Tern	C1998
Columbidae	Bar-shouldered Dove	D (b), C1998, C2000, J
Cacatuidae	Little Corella	D, B, C2000
Psittacidae	Budgerigar	D, A[2]
Tytonidae	Barn Owl	C1998, C2000 (b)
Halcyonidae	Sacred Kingfisher	D, W1962, B, C1998
Pardalotidae	Dusky Gerygone[4]	D, J
Pardalotidae	Large-billed Gerygone[5]	B
Meliphagidae	Yellow-throated Miner	C2000
Meliphagidae	Singing Honeyeater	D, A[2],B, C1998
Petroicidae	Mangrove Robin	D, W1962, B, J
Pachycephalidae	White-breasted Whistler	D, W1962, B, J
Dicruridae	Grey Fantail	B, C1998
Dicruridae	Mangrove Grey Fantail	D, J
Dicruridae	Willie Wagtail	D, B, C1998, C2000
Campephagidae	Black-faced Cuckoo-Shrike	D, B, C1998, C2000
Campephagidae	White-winged Triller	D
Artamidae	White-breasted Woodswallow	D, A[2],B, C1998,C2000,J
Artamidae	Pied Butcherbird	C2000
Corvidae	Corvid sp. [6]	B, C1998, C2000, D
Motacilidae	Richard's Pipit	D, A[2],B, C2000
Hirundinidae	Welcome Swallow	D, A[2],B, C1998, C2000
Hirundinidae	Tree Martin	C2000
Zosteropidae	Yellow White-eye[7]	D, B, J

[1] Called Quail (?brown) in Burbidge and Prince (1972);
[2] Species not identified;
[3] Bush Stone Curlew reported in CALM (1990) assumed incorrect;
[4] Called Dusky Flycatcher in Johnstone (1990);
[5] Called Large-billed Warbler in Burbidge and Prince (1972) this record appears to be out of its known distribution;
[6] Identified as Torresian Crow in CALM (1990);
[7] Called Yellow Silvereye in Burbidge and Prince (1972).

in line with the EPA's 1975 recommendation that Legendre be included in a Class A reserve. While the island contains relatively large deposits of limestone, the Wittenoom dolomites are a more suitable and more accessible source for lime (Landvision, 2001). In addition, the proposal to construct a deep water port at Legendre Island was dismissed by the EPA and not included in the Burrup Land Use Management Strategy (1996). Inclusion of Legendre Island would ensure the addition of large areas of limestone island habitat in the Pilbara near shore island conservation reserves.

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REFERENCES

Abbott, I. (1979) The distribution and abundance of seabirds at sea and on islands near the mid- and north-western coasts of Australia. *Corella* **3**(5): 93–101.

Abbott, I. (1982) Birds recorded on 22 tropical islands of Western Australia. *Corella* **6**(5):119–122.

Beard, J.S. (1971a) *Pilbara Vegetation 1:1000000 Map Series Sheet 5.* Perth, University of Western Australia Press.

Beard, J.S. (1971b) *The vegetation of the Pilbara area. Explanatory notes to Map sheet 5.* Perth, University of Western Australia Press.

Biggs, E.R. (1976a) *Dampier-Eaglehawk Island – Rosemary Urban Geology, 1:50 000 scale Urban Geology Series.* Western Australia Geological Survey Map 2256IV, 2156I, 2257III.

Biggs, E.R. (1976b) *Nickol Bay – Legendre Urban Geology, 1:50 000 scale Urban Geology Series.* Western Australia Geological Survey Map 2256I – 2257II.

Burbidge, A.A. and Prince, R. (1972) The fauna, flora and planned use of the Dampier Archipelago. *Report No. 11*, Department of Fisheries and Fauna, Western Australia, Perth.

Braithwaite, R.W. and Baverstock, P.R. (1995) Pale field rat, *Rattus tunneyi*. In: *The Complete Book of Australian Mammals.* (Ed. R. Strahan) pp662–664. Reed Books, Sydney.

Burrup Peninsula Management Advisory Board (1996) Burrup Peninsula Land Use Plan and Management Strategy. Unpublished report for the Department of Resource Development, Perth.

CALM (1990) *Dampier Archipelago Nature Reserves Management Plan. CALM Management Plan No. 18.* Dept. of CALM, Perth.

Connell, G. W. (1983) *Biogeography and community structure of insular herpetofaunas.* Unpublished Honours Thesis, Department of Zoology, University of WA.

EPA (1974) *Conservation Reserves in Western Australia.* Report of the Conservation Through Reserves Committee to the Environmental Protection Authority. Perth, Western Australia.

EPA (1975) *A report to the Hon. Minister for Conservation and Environment on Conservation Reserves for Western Australia as recommended by the Environmental Protection Authority system 4, 8, 9, 10, 11 and 12.* EPA, Perth.

Hussey, B.M.J., Keighery, G.J., Cousens, R.D., Dodd, J. and Lloyd, S.G. (1997) *Western Weeds. A guide to the weeds of Western Australia.* The Plant Protection Society of Western Australia, Perth.

IUCN 2004. *2004 IUCN Red List of Threatened Species.* <www.redlist.org>.

Johnstone, R.E. (1990) *Mangroves and Mangrove Birds of Western Australia.* Western Australian Museum, Perth.

Keighery, G. and Longman, V. (2004) The naturalised vascular plants of Western Australia 1: Checklist, environmental weeds and distribution in IBRA regions. *Plant Protection Quarterly* **19**(1):12–32.

Kriewaldt, M. (1964) *Dampier and Barrow Island, Western Australia. 1:250 000 Geological Series.* Western Australia Geological Survey, Explanatory Notes, SF/50-2 and SF/50-1.

Landvision (2001) *Draft State Lime Supply Strategy.* Landvision Consultants, Perth WA.

Lee, A.K. (1995) *The Action Plan for Australian Rodents.* Australian Nature Conservation Agency, Canberra.

Long, V. (1996) *Woodside Offshore Petroleum Pty Ltd. Proposed Second Trunkline, flora survey of Legendre Island.* Astron Environmental, Karratha.

Morris, K.D. (2000) The status and conservation of native rodents in Western Australia. *Wildl. Res.* **27**(4): 405–419.

Paczkowska, G. and Chapman, A.R. (2000) *The Western Australian Flora: a Descriptive Catalogue.* Wildflower Society of Western Australia, Perth.

Ryan, G.R. (1966) *Roebourne, Western Australia. 1:250 000 Geological Series.* Western Australia Geological Survey, Explanatory Notes, SF/50-3.

Semeniuk, V., Chalmer, P.N. and Le Provost, I. (1982) The marine environments of the Dampier Archipelago. *J. Roy. Soc. W.A.* 65(3):97–114.

Appendix 1

The vascular plants of Legendre Island, their occurrence in sampling units and previous collections made from the island. Order and nomenclature follows Paczkowska and Chapman (2000). Vegetation Unit locations and descriptions are outlined in the text. OTHER are those species recorded or collected from the island by: * lodged in the State Herbarium in 1962; # recorded in Burbidge & Prince, (1972); L recorded in Long (1996).

		Vegetation Unit Number											
FAMILY	**SPECIES**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**OTHER**
Poaceae	*Aristida contorta*												#
Poaceae	*Chloris pumilio*												#
Poaceae	*Chrysopogon fallax*												*
Poaceae	*Cymbopogon ambiguus*												*,#,L
Poaceae	*Cymbopogon bombycinus*								+				
Poaceae	*Dactyloctenium radulans*												#
Poaceae	*Digitaria ctenantha*												L
Poaceae	*Enneapogon caerulescens*						+	+	+				L
Poaceae	*Enneapogon oblongus*												*
Poaceae	*Enneapogon pallidus*												#
Poaceae	*Enneapogon polyphyllus*		+	+		+			+				*,L
Poaceae	*Eragrostis dielsii*												L
Poaceae	*Eragrostis eriopoda*												#,L
Poaceae	*Eragrostis falcata*												*
Poaceae	*Eragrostis setifolia*				+	+							
Poaceae	*Eragrostis xerophila*												*
Poaceae	*Eriachne mucronata*									+			
Poaceae	*Eriachne obtusa*												#,L
Poaceae	*Eulalia aurea*	+			+					+			*,#,L
Poaceae	*Panicum decompositum*				+	+	+		+		+		*,L
Poaceae	*Paspalidium sp.*	+											
Poaceae	*Paspalidium tabulatum*												#,L
Poaceae	*Setaria dielsii*			+							+		
Poaceae	*Setaria verticillata*[1]												#
Poaceae	*Sorghum plumosum*							+	+				#,L
Poaceae	*Sorghum timorense*												*
Poaceae	*Spinifex longifolius*	+			+					+			#,L
Poaceae	*Sporobolus virginicus*												*,#,L
Poaceae	*Themeda triandra*		+	+					+				*,#,L
Poaceae	*Triodia angusta*												*
Poaceae	*Triodia epactia*	+											
Poaceae	*Triodia longiceps*												L
Poaceae	*Triodia pungens*												*,#,L
Poaceae	*Triodia sp.*			+									
Poaceae	*Triodia wiseana*					+	+	+	+		+		
Poaceae	*Triraphis mollis*		+										L
Poaceae	*Whiteochloa cymbiformis*												#
Cyperaceae	*Cyperus cunninghamii subsp. cunninghamii*												*
Cyperaceae	*Fimbristylis schultzii*												#
Moraceae	*Ficus brachypoda*							+	+			+	*,#,L
Moraceae	*Ficus opposita var. aculeata*											+	*
Moraceae	*Ficus virens var. virens*												*
Chenopodiaceae	*Atriplex isatidea*												*,#
Chenopodiaceae	*Enchylaena tomentosa*												*,#
Chenopodiaceae	*Neobassia astrocarpa*												*
Chenopodiaceae	*Rhagodia eremaea*			+				+					*,L
Chenopodiaceae	*Rhagodia preissii subsp. obovata*	+			+								*,#
Chenopodiaceae	*Salsola tragus*[1]	+	+	+	+		+	+	+		+		#,L
Chenopodiaceae	*Sclerolaena diacantha*		+	+						+			L
Chenopodiaceae	*Sclerolaena uniflora*												*
Chenopodiaceae	*Threlkeldia diffusa*	+			+					+			#,L
Amaranthaceae	*Achyranthes aspera*							+				+	*,L
Amaranthaceae	*Aerva javanica*[1]							+	+				
Amaranthaceae	*Amaranthus interruptus*												*
Amaranthaceae	*Amaranthus pallidiflorus*	+		+	+	+				+	+		#,L
Amaranthaceae	*Amaranthus viridis*[1]												*
Amaranthaceae	*Gomphrena canescens*											+	#
Amaranthaceae	*Gomphrena sordida*												L
Amaranthaceae	*Gomphrena tenella*												#
Amaranthaceae	*Ptilotus exaltatus var. exaltatus*		+	+	+	+	+		+	+	+		*,#,L
Amaranthaceae	*Ptilotus fusiformis*												#
Amaranthaceae	*Ptilotus obovatus var. obovatus*				+		+	+	+				*,L
Amaranthaceae	*Ptilotus villosiflorus*	+			+								L
Nyctaginaceae	*Boerhavia burbidgeana*	+					+						*
Nyctaginaceae	*Boerhavia schomburgkiana*			+	+				+				#,L
Nyctaginaceae	*Commicarpus australis*												L

FAMILY	SPECIES	Vegetation Unit Number										OTHER
		1	2	3	4	5	6	7	8	9	10	11	
Aizoaceae	*Sesuvium portulacastrum*									+			*
Aizoaceae	*Trianthema triquetra*												*
Aizoaceae	*Trianthema turgidifolia*		+			+	+			+	+		#,L
Molluginaceae	*Mollugo molluginis*												#
Portulacaceae	*Portulaca intraterranea*												L
Portulacaceae	*Portulaca oleracea*								+				
Portulacaceae	*Portulaca pilosa*												#,L
Menispermaceae	*Tinospora smilacina*												*
Capparaceae	*Capparis spinosa var. nummularia*								+				*,#,L
Capparaceae	*Cleome viscosa*												*,#,L
Pittosporaceae	*Pittosporum phylliraeoides*							+					*,#
Surianaceae	*Stylobasium spathulatum*												#,L
Mimosaceae	*Acacia arida*												*
Mimosaceae	*Acacia bivenosa*	+			+	+				+			*,L
Mimosaceae	*Acacia coriacea*												#
Mimosaceae	*Acacia inaequilatera*												*
Mimosaceae	*Acacia orthocarpa*								+			+	*
Mimosaceae	*Neptunia dimorphantha*												#
Caesalpiniaceae	*Senna glutinosa subsp. x luerssenii*												*
Papilionaceae	*Alysicarpus rugosus*		+	+		+	+		+				L
Papilionaceae	*Canavalia rosea*				+			+	+				*,#,L
Papilionaceae	*Crotalaria novae-hollandiae subsp. novae-hollandiae*												*,#
Papilionaceae	*Cullen badocanum*												*
Papilionaceae	*Indigofera colutea*												#
Papilionaceae	*Indigofera linifolia*			+		+	+		+	+	+		L
Papilionaceae	*Indigofera linnaei*		+	+		+	+		+		+		#
Papilionaceae	*Indigofera monophylla*				+				+	+	+		*,#,L
Papilionaceae	*Indigofera trita*								+				L
Papilionaceae	*Rhynchosia minima*		+	+	+	+	+	+	+	+	+		*,#,L
Papilionaceae	*Swainsona formosa*		+		+					+			*,#
Papilionaceae	*Swainsona pterostylis*	+				+	+			+			#,L
Papilionaceae	*Tephrosia bidwillii*												#
Papilionaceae	*Tephrosia rosea*												L
Papilionaceae	*Tephrosia sp.*			+					+				#
Zygophyllaceae	*Tribulus occidentalis*												*,#,L
Euphorbiaceae	*Adriana tomentosa*											+	
Euphorbiaceae	*Euphorbia alsiniflora*												*
Euphorbiaceae	*Euphorbia australis*	+	+	+	+	+	+			+			L
Euphorbiaceae	*Euphorbia boophthona*	+	+	+	+					+	+		
Euphorbiaceae	*Euphorbia coghlanii*	+				+	+						L
Euphorbiaceae	*Euphorbia drummondii*			+			+						*,L
Euphorbiaceae	*Euphorbia myrtoides*				+				+	+			*
Euphorbiaceae	*Euphorbia tannensis subsp. eremophila*												*,#,L
Euphorbiaceae	*Phyllanthus maderaspatensis*												L
Euphorbiaceae	*Phyllanthus reticulatus*												#
Sapindaceae	*Alectryon oleifolius*		+										#
Sapindaceae	*Diplopeltis eriocarpa*												L
Tiliaceae	*Corchorus parviflorus*												L
Tiliaceae	*Corchorus sp.Burrup(G.Craig 235)*							+	+				
Tiliaceae	*Corchorus walcottii*												#
Malvaceae	*Abutilon cunninghamii*												#
Malvaceae	*Abutilon indicum var. australiense*							+	+				L
Malvaceae	*Abutilon lepidum*							+			+	+	
Malvaceae	*Abutilon sp.*												#
Malvaceae	*Gossypium australe*		+			+	+						
Malvaceae	*Malvastrum americanum*[1]		+										
Malvaceae	*Sida fibulifera*					+	+	+					L
Malvaceae	*Sida sp.*					+	+			+	+		
Sterculiaceae	*Melhania oblongifolia*		+	+		+	+			+			*,L
Violaceae	*Hybanthus aurantiacus*												*
Violaceae	*Hybanthus enneaspermus*												#
Passifloraceae	*Passiflora foetida*[1]			+									
Rhizophoraceae	*Bruguiera exaristata*												#
Rhizophoraceae	*Ceriops tagal*												#
Apiaceae	*Trachymene oleracea subsp. oleracea*												#
Plumbaginaceae	*Aegialitis annulata*												*
Plumbaginaceae	*Plumbago zeylanica*												*
Oleaceae	*Jasminum didymum subsp. lineare*												*,L
Asclepiadaceae	*Cynanchum floribundum*		+						+	+			*,#,L
Asclepiadaceae	*Sarcostemma viminale subsp. australe*	+		+	+		+	+	+				*,#,L
Convolvulaceae	*Convolvulus clementii*												*

FAMILY	SPECIES	Vegetation Unit Number 1	2	3	4	5	6	7	8	9	10	11	OTHER
Convolvulaceae	*Evolvulus alsinoides*					+							*,#,L
Convolvulaceae	*Ipomoea lonchophylla*		+	+							+		
Convolvulaceae	*Ipomoea pes-caprae*												#
Convolvulaceae	*Operculina ?aequisepala*												L
Cuscutaceae	*Cuscuta victoriana*												L
Boraginaceae	*Heliotropium cunninghamii*												*
Boraginaceae	*Heliotropium pachyphyllum*												*
Boraginaceae	*Heliotropium tenuifolium*												L
Boraginaceae	*Trichodesma zeylanicum*				+			+					#,L
Verbenaceae	*Clerodendrum tomentosum*												#
Avicenniaceae	*Avicennia marina*												*,#
Solanaceae	*Nicotiana benthamiana*												#
Solanaceae	*Solanum cleistogamum*												*
Solanaceae	*Solanum diversiflorum*												*
Solanaceae	*Solanum ellipticum*												#
Solanaceae	*Solanum esuriale*												L
Solanaceae	*Solanum phlomoides*												L
Solanaceae	*Solanum sp.Boomerang Bay (K.F.Kenneally 10021)*			+									
Scrophulariaceae	*Stemodia grossa*									+			#,L
Scrophulariaceae	*Striga curviflora*							+					*,#
Myoporaceae	*Eremophila longifolia*		+										
Rubiaceae	*Oldenlandia crouchiana*												*
Rubiaceae	*Synaptantha tillaeacea*	+			+								*,L
Cucurbitaceae	*Mukia maderaspatana*							+	+				*,#,L
Cucurbitaceae	*Trichosanthes cucumerina*												#
Goodeniaceae	*Goodenia forrestii*												#
Goodeniaceae	*Goodenia microptera*				+		+					+	*,L
Goodeniaceae	*Scaevola crassifolia*		+			+	+						#,L
Goodeniaceae	*Scaevola cunninghamii*	+								+			*,L
Goodeniaceae	*Scaevola spinescens*									+		+	*,L
Stylidiaceae	*Stylidium spathulatum*											+	
Asteraceae	*Flaveria australasica*		+	+		+	+	+	+	+	+		L
Asteraceae	*Pentalepis trichodesmoides*							+				+	*
Asteraceae	*Pluchea rubelliflora*												*
Asteraceae	*Pterocaulon sphacelatum*				+	+		+	+	+			L
Asteraceae	*Pterocaulon sphaeranthoides*						+		+				*
Asteraceae	*Streptoglossa adscendens*			+			+					+	
Asteraceae	*Streptoglossa liatroides*												*