Biota of the Mandora System, Western Australia: – Mammals

A N Start[1,3], P Kendrick[2] & N L McKenzie[1]

[1] Department of Environment and Conservation,
PO Box 51, Wanneroo, WA 6946.
[2] Department of Environment and Conservation,
PO Box 835, Karratha, WA 6714
[3] Correspondence: 29 Valley View Road,
Roleystone, WA 6111
✉ tonys@wn.com.au

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Abstract

The Mandora System is an internationally important wetland situated on the boundary of two bioregions belonging to different biological provinces. Its biota was poorly known before a survey of selected taxa in 1999. The recorded mammal fauna is not particularly diverse (16 native species comprising eight marsupials, four bats and four rodents). It included species from both provinces but the Eremaean was better represented than the Torresian. Highly saline surfaces had fewer species than either loamy or sandy surfaces. Other notable features included the presence of some species at or close to the known limits of their distributions and the presence of two 'critical weight range' (CWR) species within the study area. Two more CWR species are reported from nearby in habitats that are widespread in the study area.

Keywords: Mammals, Eremaean and Torresian bioregions, saline soils, loams, desert dunefields.

Introduction

The Mandora Paleo-river is a now-occluded system that once drained the south-east Kimberley and adjacent parts of the Northern Territory across the Great Sandy Desert to the Indian Ocean at the (present-day) Eighty-mile Beach (van de Graaff *et al*. 1977; Wyrwoll *et al*. 1986). Its mouth was associated with a marine embayment which has been cut off from the sea by the formation of coastal dunes (K-H Wyrwoll pers. com.). Today, inland of the coastal dunes, saline sediments and loamy soils are flanked by red, aeolian dune fields. They extend to about 80 km east of the present coastline. Biogeographically, the red dune fields belong to the (Eremaean province) Great Sandy Desert bioregion (GSD) and the coastal dunes support a narrow strip of the (Torresian province) Dampierland bioregion (DL) that parallels the coast along most of the Eighty-mile Beach. The saline sediments comprise an intrusion of DL the into the GSD (Fig. 2).

The area is part of the Ramsar-registered Eighty Mile Beach Wetland of International Importance (Anon 1999; DCLM 2003). Its outstanding features include inland occurrences of the mangrove tree *Avicennia marina* (Avicenniaceae) and mangrove fern *Acrostichum speciosum* (Pteridaceae). Fresh-water mound springs occur in the midst of saline landscapes. They support forests of *Melaleuca leucadendron* (Myrtaceae), and/or swampy areas containing beds of A. *speciosum,* the 'bulrush' *Typha domingensis* (Typhaceae), and the small wetland/riparian tree *Sesbania formosa* (Fabaceae). Ephemeral lakes sometimes support up to 500,000 waterbirds and many species breed there when conditions are suitable (Halse *et al*. 2005). Cattle, *Bos taurus* and to a lesser extent camels, *Camelus dromedarius* and donkeys, *Equus asinus* are affecting conservation values, particularly biota associated with the mound springs. Current tenure is pastoral lease (Anna Plains Station) but conversion to a conservation reserve is proposed (G. Graham pers. com.).

Given the area's location at the boundary of the Eremaean and Torresian provinces and the significance of its natural features, remarkably little is known of its biota except water birds. In 1983 NMcK collected bats and some terrestrial vertebrates. In 1999, a multi-disciplinary team including ANS and PK investigated the flora, vertebrate fauna and some aquatic invertebrate groups and documented the results in Graham (1999) but they are not formally published or readily available. In 2001, PK obtained some additional mammal records. This paper presents the information on mammals obtained on those three occasions. Anticipating publication of results for other groups in a similar format, we provide site data in some detail.

Methods

Study Area

The study area is at about 19° 45' S, 121° 25' E, some 40 km inland of the Eighty Mile Beach, Western Australia (WA) Fig. 1. It experiences a semi-arid monsoonal climate with hot summers and warm winters. Rainfall is erratic but predominantly occurs in summer (January to March) and the area is affected by frequent cyclones (typically, several per decade). Median annual rainfall is 326 mm at Mandora Station and 360 mm at Anna Plains Station (about 60 km west and north of the study area

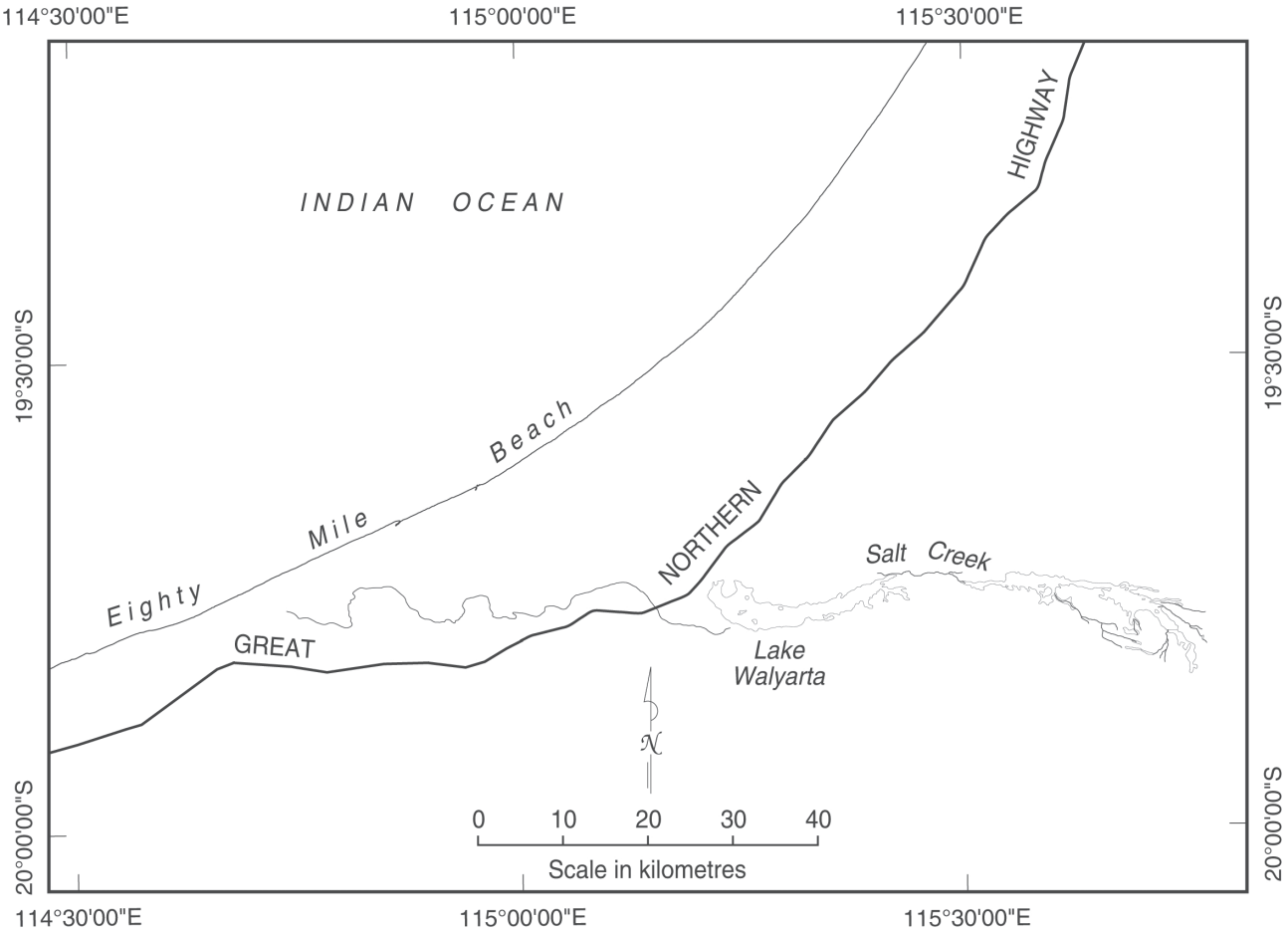

Figure 1. General location of the study area.

respectively). Mean monthly maximum temperatures range from ~30°C in July to ~39°C in January. Wyrwoll *et al.* (1986, 1992) described the Holocene climates and their role in the hydrological and geomorphological development of the system.

A large ephemeral lake, Lake Walyarta, near the western end of the former marine embayment is linked eastward (*i.e.* inland) with a series of smaller ephemeral lakes by Salt Creek, a blind channel that holds permanent salt water, and is fringed by *Avicennia marina* trees. The valley floor comprises saline clays and loams underlain by secondary calcretes that are evident in the bed of Salt Creek and outcrop as small ridges in some low-lying areas. Soils become progressively less saline, more loamy and then sandier as the valley sides rise towards the flanking, red dune fields.

The study area is situated to the south of Salt Creek. A typical north-south section runs from bare saline clays, through halophytic 'samphire' communities (predominantly, *Halosarcia* spp., Chenopodiaceae), then swards of *Sporobolus virginicus* (Poaceae) on saline clays. Above them, less saline clays support sparse shrublands over perennial and annual grasses including *Aristida* sp., *[1] *Cenchrus ciliaris* and *Eragrostis* sp. Hummock grass (*Triodia* sp.) occurs on raised areas including calcrete outcrops. In places, thickets of *Acacia ampliceps* (Mimosaceae) and several *Melaleuca* spp. (Myrtaceae) add a structurally important tall shrub layer to the vegetation. Higher on the valley sides, hummock grasses become more prominent and the shrub flora becomes more diverse. The boundary with red sandy dunes and swales of the GSD is usually well defined and corresponds with significant changes in vegetation structure and floristic composition but some integration occurs where shallow sands partly cover marginal DL surfaces.

In addition to Salt Creek, *Avicennia marina* occurs in some low-lying areas that are subject to inundation as well as some linear depressions in areas dominated by swards of *S. virginicus*. Mound springs and associated swamps of fresh to brackish water occur throughout the system. Those supporting *Melaleuca leucadendron* forests tend to have thickets of A. *ampliceps* near their margins and areas of open water but sparse, if any, understoreys (*e.g.* Eil Eil Spring). Others have dense beds of *Typha domingensis* or A. *speciosum* in a 'moat' of fresh water and emergent *S. formosa* over dense thickets of A. *ampliceps* on peaty soils of a central mound (*e.g.* Fern Spring).

Sampling

Sample site characteristics are shown in Table 1. Most sites were located on DL surfaces associated with the

[1] * is used throughout to indicate exotic taxa.

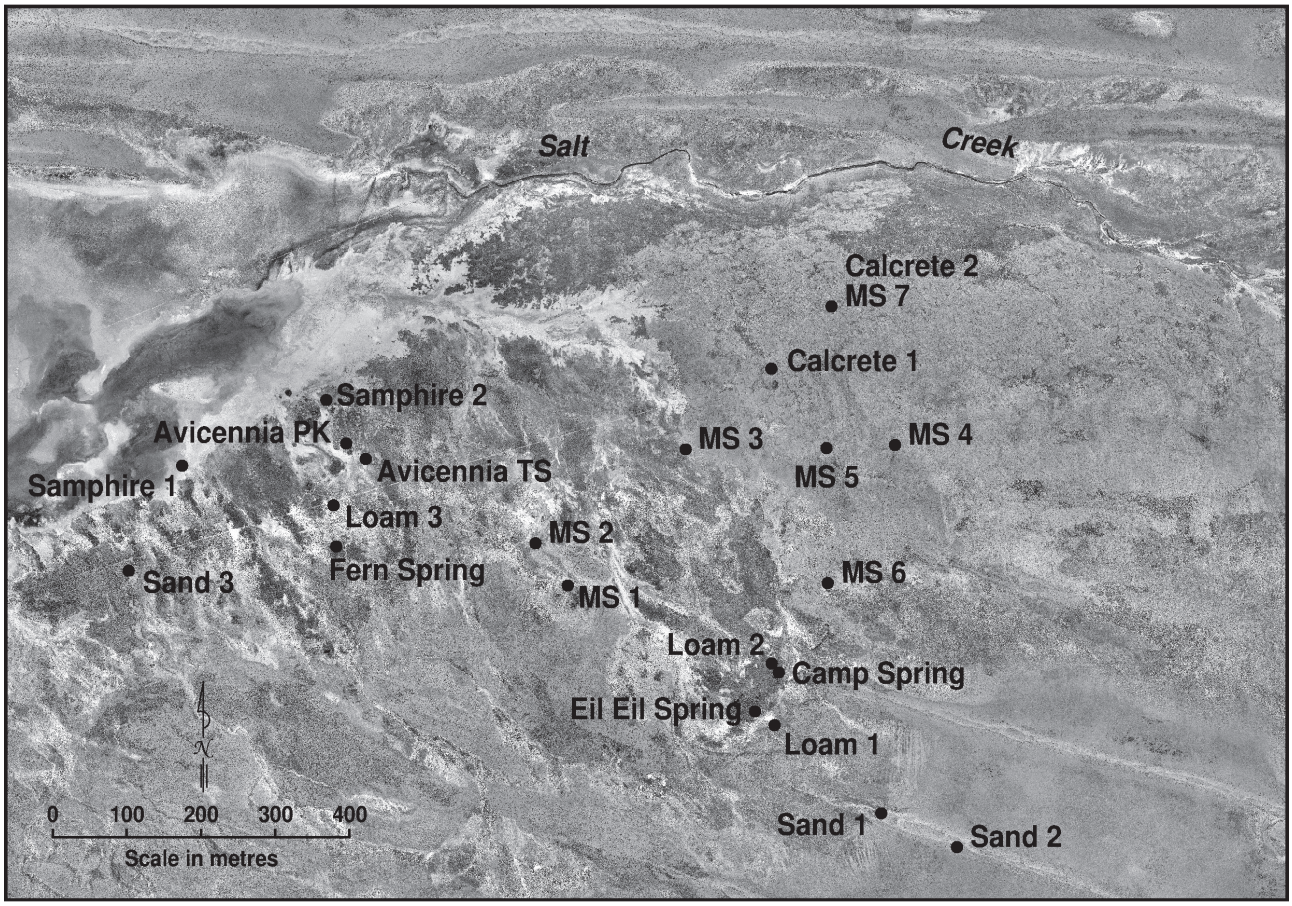

Figure 2. Sample site locations superimposed on a satellite image of the study area to show the juxtaposition of Great Sandy Desert and Dampierland bioregional systems. The former is typified by linear dune systems clearly visible to the north and southeast of the area and the latter by the complex array of surfaces through the centre of the image.

former marine embayment but red sand surfaces of the GSD were also sampled.

From 12–17 August 1983, NMcK sampled bats by spotlight-shooting and mist-netting and terrestrial mammals with pit traps and modified metal break-back rat-traps (Table 2). From 12–21 October 1999, vertebrate fauna and flora were sampled systematically in ten quadrats positioned along the altitudinal catena from sometimes-inundated samphires on the saline lake margin to red dunes. Both pit traps and medium-sized Elliott traps were used. Where shallow water tables prevented the use of pit traps, additional sites were trapped less rigorously (informally) with Elliott traps, to provide some sampling of major habitat types not represented in quadrats (Table 2). In both years, pit traps were made from 60 cm lengths of 125 mm diameter white PVC tubing seated on aluminium flywire floors. In 1983, they were set in lines of (usually) six pits along 50 m drift fences made from 30 cm wide strips of flywire. In 1999, five randomly-placed pairs were set in each quadrat. Five-metre drift fences were erected between and to each side of each pair. Besides site-based trapping, incidental sightings, tracks and scats, were recorded where they added to knowledge of the occurrence or distribution of mammals in the area. Nomenclature follows How *et al.* 2001. Distributional information refers only to Western Australia. All specimens have been deposited in the Western Australian Museum.

Results

Sixteen native mammals were recorded as extant in the study area (Tables 3 and 4): eight marsupials (four dasyurids, three macropods and a bandicoot), four bats and four rodents. There were also seven introduced species (three carnivores, including the dingo, *Canis lupus dingo*, three large herbivores and a rodent). Numbers of each taxon trapped at sample sites were too low for quantitative site comparisons. Therefore, results are presented for the three distinctive substrate types, highly saline soils and loams of DL and red sands of GSD (Table 4). Although numbers are still too low for meaningful quantitative analysis, the results are indicative and consistent with previously recorded habitat preferences (*e.g.* van Dyck & Strahan 2008).

Native mammals were least diverse (3 species) and, amongst species amenable to trapping, least abundant (4 animals) on highly saline substrates. They were a dasyurid, a large macropod and a rodent. All three individuals of the dasyurid, *S. macroura*, were taken in halophytic low shrublands (samphire); the macropod, *M. rufus*, was present in all major habitats and is capable of moving between them at will within the study area. However only one of five P. *desertor* trapped in the study area was from this surface-type. It was trapped in a sward of the halophytic grass, *S. virginicus*; the others were taken on red sands (3) and a loamy surface (1). In

Table 1

Location and summary of geo-physical and vegetation attributes of trapped sites listed from high to low landscape settings. Sites prefixed 'MS' were sampled in 1983 and the remainder in 1999. GSD = Great Sandy Desert bioregion, DL = Dampierland bioregion.

Site name and type	Co-ordinates	Landscape position	Landscape setting and soil	Bioregion and Vegetation
MS 06 Informal	19°46'54" 121°27'20"	High.	Dune. Red sand. "A" horizon weak to absent. Humus and charcoal visible <10 cm.	GSD. Diverse shrubs over hummock grass.
Sand 1 Quadrat	19°48'35" 121°27'44"	High.	Dune and adjacent swale margin. Red sand. "A" horizon weak to absent. Humus visible at surface but fading < 10 cm.	GSD. Diverse shrubs over hummock grass.
Sand 2 Quadrat	19°48'50" 121°28'19"	High.	Dune and adjacent swale margin. Red sand. "A" horizon weak to absent. Humus and charcoal visible <10 cm.	GSD. Diverse shrubs over hummock grass.
MS 07 Informal	19°44'53" 121°27'23"	High.	Swale. Red sand. "A" horizon weak to absent. Humus and charcoal visible >10 cm.	GSD. Sparse, low trees and diverse shrubs over hummock grass. Regenerating after fire
MS 08 Informal	19°42'06" 121°28'25"	High.	Swale. Red sand. "A" horizon weak to absent. Humus and charcoal visible >10 cm.	GSD. Sparse, low trees and diverse shrubs over hummock grass.
Loam 1 Quadrat	19°47'56" 121°26'55"	High/ Moderate	Red sand, in places overlying loamy sand. Latter uniform to 60 cm. No obvious "A" horizon.	DL/GSD interface. Low acacia thickets and diverse shrubs with hummock grass.
MS 03 Informal	19°45'55" 121°26'15"	High/ Moderate	Near interface of aeolian red sand and loamy soils. Medium to fine brown sand <30 cm over clay-loams. "A" horizon weak to absent.	DL (near GSD interface). Sparse, low trees and sparse shrubs over hummock grass.
Sand 3 Quadrat	19°46'46" 121°21'57"	High/ Moderate	Isolated dune overlying loamy soils. Red sand (dune) and paler sandy clay (remaining surface). "A" horizon weak to absent on both. Humus/charcoal not noted.	GSD/DL interface. Sparse, low trees and diverse shrubs over hummock grass (on dune) or tussock grasses (heavily trampled by cattle) on remainder.
Loam 2 Quadrat	19°47'29" 121°26'54"	Moderate.	Pallid pink-grey, somewhat saline sandy-loam or loam, Damp below 30 cm.	DL. Scattered thickets of *Acacia ampliceps* and *Melaleuca* sp. shrubs over annual and perennial grasses.
Camp Spring Informal	19° 47' 33" 121° 26'57"	Moderate	Outer margin of mound spring 'moat'. Grey, somewhat saline loam or clay-loam. "A" horizon not noted.	DL. Mid-dense thicket of *A. ampliceps* with sparse understory. Rushes at water's edge.
Eil Eil Spring Informal	19°47'50" 121°26'46"	Moderate	Margin of mound spring. Grey, somewhat saline loam or clay-loam ("A" horizon not noted) adjacent to litter over deep peaty soil.	DL. Thicket of *Melaleuca* sp and *A. ampliceps* adjacent to forest of *M. leucadendron* with little/no understory
MS 02 Informal	19°46'54" 121°25'05"	Moderate/ Low	Evaporite on saline, greyish sandy silt and clay. "A" horizon not noted.	DL. *Acacia ampliceps* over halophytic shrubs, sub-shrubs and grass.
MS 04 Informal	19°45'54" 121°27'52"	Moderate/ Low.	Shallow, fine silty sand and clay over calcrete. "A" horizon not noted.	DL. Halophytic low shrubs and tussock grasses.
MS 01 Informal	19°40'53" 121°25'20"	Low	Evaporite on saline, greyish sandy silt and clay. "A" horizon not noted.	DL. Halophytic shrubs, sub-shrubs and grass.
Calcrete 1 Quadrat	19°44'53" 121°27'23"	Low.	Cracking evaporite crust over pallid grey loam. Calcrete pan (<50 cm) over crustose red sand and calcrete nodules (> 50cm). "A" horizon not noted.	DL. Halophytic low shrubs and tussock grasses
Calcrete 2 Quadrat	19°45'20" 121°26'55"	Low	Shallow soils between calcrete ridges. Cracking evaporite crust over pallid grey loam. Calcrete pan (<50 cm) over crustose red sand and calcrete nodules (> 50cm). "A" horizon not noted.	DL. Halophytic low shrubs and tussock grasses.
MS 05 Informal	19°45'55" 121°27'20"	Low	Shallow soils between calcrete ridges. Shallow, saline clay, grey silt and fine sand. "A" horizon not noted.	DL. Halophytic low shrubs and tussock grasses.
Fern Spring Informal	19°46'36" 121°23' 33"	Low/ Very low	Mound spring with freshwater 'moat'. Centre with thick litter grading into peat. Surrounded by saline clays with no observed "A" horizon.	DL. Central thicket of *Sesbania formosa/A. ampliceps*. Dense beds of *Typha domingensis/Acrostichum speciosum* in wetted perimeter and sward of *Sporobolus virginicus* beyond.

Table 1 (cont.)

Site name and type	Co-ordinates	Landscape position	Landscape setting and soil	Bioregion and Vegetation
Loam 3 Quadrat	19°46'18" 121°23'32"	Low/ Very low	Saline evaporite crust breaking to powdery surface over grey sandy-loam to10 cm, over pallid damp clay. "A" horizon not noted.	DL. Sward of the halophytic grass, *S. virginicus*
Avicennia TS Informal	19°45'58" 121°23'47"	Low/ Very low	Blind channel incised into deep, saline clay. No observed "A" horizon.	DL. Low forest to thicket of *Avicennia marina* on channel margins and sward of *S. virginicus* on adjacent plane.
Avicennia PK Informal	19°45'51" 121°23'38"	Low/ Very low	Blind channel incised into deep, saline clay. No observed "A" horizon.	DL. Low forest to thicket of A. *marina* on channel margins and sward of *S. virginicus* on adjacent plane.
Samphire 1 Quadrat	19°46'00" 121°22'22"	Very low.	Lake margin. Ridged, saline evaporite crust over damp, dark clay <5 cm over pallid clay. Releasing free water at 50 cm. No observed "A" horizon.	DL. Samphire at margin of lakebed. Indications of inundation in recent months.
Samphire 2 Quadrat	19°45'32" 121°23'29"	Very low.	Lake margin. Ridged saline evaporite crust over damp sandy clay. Hardpan at 30 cm over pale brown-grey clay to 40cm, over pallid clay releasing free water at 60 cm. No observed "A" horizon.	DL. Samphire at margin of lakebed. Inundated in recent months (dried algae draped over drowned samphire stems).

Table 2

Summary of trap effort. Numbers in parenthesis show the number of traps used and number of nights trapping respectively. BB = Modified break-back trap.

Site Name	Site Type	Dates	Elliott Trap Nights	Pit Trap Nights	BB Trap Nights
Sand 1	Quadrat	1999 October	225 (25x9)	90 (10x9)	0
Sand 2	Quadrat	1999 October	225 (25x9)	90 (10x9)	0
Sand 3	Quadrat	1999 October	175 (25x7)	70 (10x7)	0
Loam 1	Quadrat	1999 October	225 (25x9)	90 (10x9)	0
Loam 2	Quadrat	1999 October	225 (25x9)	90 (10x9)	0
Loam 3	Quadrat	1999 October	200 (25x8)	80 (10x8)	0
Calcrete 1	Quadrat	1999 October	225 (25x5)	90 (10x9)	0
Calcrete 2	Quadrat	1999 October	200 (25x8)	80 (10x8)	0
Samphire 1 (E)	Quadrat	1999 October	200 (25x8)	80 (10x8)	0
Samphire 2 (W)	Quadrat	1999 October	175 (25x7)	70 (10x8)	0
Fern Spring	Informal	1999 October	200 (50x4)	0	0
Avicennia TS	Informal	1999 October	100 (25x4)	0	0
Avicennia PK	Informal	1999 October	100 (25x4)	0	0
Camp Spring	Informal	1999 October	100 (25x4)	0	0
Eil Eil Spring	Informal	1999 October	100 (25x4)	0	0
Total 1999			**2675**	**830**	**0**
MS 01	Informal	1983 August	0	30 (6x5)	10 (2x5)
MS 02	Informal	1983 August	0	30 (6x5)	10 (2x5)
MS 03	Informal	1983 August	0	35 (7x5)	20 (4x5)
MS 04	Informal	1983 August	0	0	60 (12x5)
MS 05	Informal	1983 August	0	0	60 (12x5)
MS 06	Informal	1983 August	0	30 (6x5)	20 (4x5)
MS 07	Informal	1983 August	0	30 (6x5)	20 (4x5)
MS 08	Informal	1983 August	0	30 (6x5)	20 (4x5)
Total 1983			**0**	**185**	**220**

Table 3

Mammals recorded from the study area. Numbers handled are shown in square brackets and voucher collection numbers in round brackets (those prefixed F&W are (former) Department of Fisheries and Wildlife field numbers and those prefixed M are Western Australian Museum registration numbers).

Family	Species	Notes
Dasyuridae	*Planigale maculata* Long-tailed Planigale.	**Oct. 1999:** Fern Spring [1] (M51586). Identification confirmed genetically (Cooper *et al.* 2001).
	Planigale sp. Undescribed Planigale	**Oct. 1999:** Loam 2 [1] (M51581). Female with developed pouch. Identification confirmed genetically (Cooper *et al.* 2001). A widespread species in the Pilbara.
	Sminthopsis macroura Stripe-faced Dunnart	**Aug. 1983:** MS 02 [1] (FW2027). Male. **Oct. 1999:** Samphire 2 [2] (M51580, -99). Female with developed pouch and a male.
	Sminthopsis youngsoni Lesser Hairy-footed Dunnart	**Aug. 1983:** MS 03 [2] (FW2029, -33). Females with pouch young. **Oct. 1999:** Sand 3 [1] (M51567). Juvenile.
Peremelidae	*Macrotis lagotis* Bilby	**Oct. 1999:** Sand 1. Several recent burrows and fresh tracks.
Macropodidae	*Macropus agilis* Agile Wallaby	**Oct. 1999:** Eil Eil and Little Eil Eil Springs. Sight records. **Sep. 2001:** Loam 2, Calcrete 2, Eil Eil Spring, Little Eil Eil Spring, Grant's Spring (near Sand 3), Fern Spring. Sight records.
	Macropus robustus Euro	**Sep. 2001:** Eil Eil Spring and Salt Creek. Sight records. Apparently not common.
	Macropus rufus Red Kangaroo	**Aug. 1983:** MS 04; fresh tracks presumed to be this species. **Oct. 1999:** Sand 2, Sand 3, Loam 2, Fern Spring, Stockyard Spring, PK Avicennia. Sight records. Tracks and droppings of large macropods (probably this species) were ubiquitous but not abundant. **Sep. 2001:** Fern Spring, Grants Spring, Lake Walyarta. Sight records, including animals grazing at night on the margins of Lake Walyarta.
Pteropodidae	*Pteropus* sp. Flying Fox	**Oct. 1999:** Eil Eil Spring. Sight record. Overhead at dusk.
Emballonuridae	*Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat	**Aug. 1983:** Eil Eil Spring [1] (M51581). Found dead under paper bark tree (*M. leucadendron*) with hollow spout. Another seen flying over paperbarks at same site on the same date.
Molossidae	*Chaerephon jobensis* Northern Freetail-bat.	**Aug. 1983:** Eil Eil Spring. Recorded flying over paperbarks (*M. leucadendron*).
Vespertilionidae	*Nyctophilus geoffroyi* Lesser Long-eared Bat.	**Oct. 1999:** Eil Eil Spring [1] (M51562). Mist-netted over water.
Muridae	**Mus domesticus* House Mouse.	**Oct. 1999:** Eil Eil Spring [4] (M51555, -61, -78, -79), Fern Spring [25] (M51559, -63, -64, -68, -71,-84, -85, -87, -89, -95), Loam 1 [1] (no voucher), PK Avicennia [11] (M51556, -57, -75, -77, -90, -93,-97), Samphire 2 [1] (M51560), 'TS Avicennia' [6] (M51565, -72, -74, -94, -96). Common in swamps and halophytic vegetation, particularly dense swards of *S. virginicus*. More released from these sites without being recorded. Adults in all reproductive phases and juveniles.
	Notomys alexis Spinifex Hopping-mouse.	**Oct. 1999:** Sand 1 [3] (M51558), Sand 3 [1]. Two pregnant females. **Sep. 2001:** Sand 2 [1]. Apparently not common at the time.
	Pseudomys desertor Desert Mouse.	**Oct. 1999:** Sand 1 [1] (M51583), Sand 2 [2] (M51601, -02), Loam 2 [1] (M51604), TS Avicennia [1] (M51566).
	Pseudomys hermannsburgensis Sandy Inland Mouse.	**Aug. 1983:** MS 07 [2] (FW2031, -32), MS 08 [1] (FW2035). **Oct. 1999:** Calcrete 1 [4] (M51600).
	Pseudomys nanus Western Chestnut Mouse	**Oct. 1999:** Sand 1 [1] (M51582), Loam 2 [1] (M51603).
Canidae	**Canis lupus dingo* Dingo	**Aug. 1983** Salt Creek, dunes north of Salt Creek, calcrete area south of Salt Creek. Tracks. **Sep. 2001:** Calcrete 2, Grant Spring. Tracks. (The population may include domestic dog hybrids.)
	**Vulpes vulpes* European Red Fox	**Oct. 1999:** Sand 1, Sand 2 and Loam 1. Tracks. **Sep. 2001:** Calcrete 2 and Eil Eil Spring. Tracks.
Felidae	**Felis catus* Feral Cat	**Aug. 1983**: Tracks on a red sand dune. **Oct. 1999:** Sand 1, Sand 3, Calcrete 2, Loam 1, Grant Spring, north of Salt Creek. Tracks, scats, one sight record and one old skull. A scat contained arthropods and an agamid lizard.

Table 3 (cont.)

Family	Species	Notes
Bovidae	**Bos taurus* Cattle	**Oct. 1999: A**ll sites except Sand 1 and Sand 2. Tracks and two sight records. Tracks were most abundant on loam surfaces and around springs. Large numbers watered daily at Stockyard Spring.
Camelidae	**Camelus dromedarius* Camel.	**Oct. 1999:** Throughout the survey area. Tracks.
Equidae	**Equus asinus* Donkey.	**Oct. 1999:** Loam 2 and Eil Eil Spring. Old tracks preserved in dried mud.

contrast to the native taxa, the introduced rodent, *M. domesticus*, was abundant on highly saline surfaces, particularly in sites dominated by or close to extensive areas of *S. virginicus*.

Mus domesticus was much less abundant on loamy surfaces and was not detected on red sands. However assemblages of native taxa were considerably more diverse on them than on highly saline ones. Although we recorded approximately equal numbers of species (8 and 7 respectively) on them, and there was some commonality (*e.g.* P. *hermannsburgensis*, P. *nanus* and *M. rufus*), their compositions differed. Thus three taxa (two *Planigale* sp. and *M. agilis*) were only detected on loamy surfaces and three taxa (*S. youngsoni*, *N. alexis* and *M. lagotis*) on red sands.

Discussion

The only rocky surfaces in the study area are low, calcrete exposures but the area is otherwise geomorphologically and hydrologically diverse and straddles a sharply defined boundary between two bioregions (DL and GSD) of different biological provinces (Torresian and Eremaean). However, diversity of the native mammal fauna was relatively low (*cf.* McKenzie 1981; McKenzie & Youngson 1983), as were population densities in 1999 when five individuals represented four dasyurid species (0.6% trap success in pit traps, dasyurids are not commonly taken in Elliott traps) and 15 individuals represented four native rodent species (0.43% trap success in all traps). Most of those animals were taken in dryer habitats. However, **Mus domesticus* was abundant in saline (*S. virginicus*) grasslands and some adjacent swamps. *E.g.* trap success rates of 12.5% at Fern Spring and (collectively) 8.5% in the two Avicennia sites where others were released without being recorded.

Low numbers may have been a consequence of edaphic conditions. The general condition of the country in 1983 is not known but 88% of the total trap effort for terrestrial species was applied in 1999 (Table 2) when the condition of vegetation indicated there had been no significant rain over the study area for many months and usually-common, arid-zone passerine birds were rare (*e.g.* Singing Honeyeaters, *Lichenostomus virescens*, Black-faced Woodswallows, *Artamus cinereus* and Crimson Chats, *Epthianura tricolor*) although species associated with groundwater-dependent vegetation of mound springs were common (*e.g.* White-plumed Honeyeaters, *Lichenostomus penicillatus*) (Hassell 1999).

For two reasons, it is likely that the recent (post European settlement) mammalian fauna of the area has been, and probably still is, more diverse than shown by

Table 4

Numbers of terrestrial native species (N=12) and **M. domesticus* trapped in each of the three most widespread habitats (Table 1). 'Presence' is noted for taxa that were not trapped. Highly saline habitats were those supporting strongly halophytic vegetation (*Halosarcia* sp., *Sporobolus virginicus* and/or *Avicenna marina*). Fern Spring is treated as highly saline because the vegetation associated with the mound spring occupies a small area within a highly saline landscape and the sampling quadrat incorporated both. Total trap effort was 1845, 885 and 1025 trap nights respectively for saline, loam and sand surfaces.

Family	Taxon	Highly Saline	Other Loams	Red Sands
Dasyuridae	*Planigale maculata*	*	1 (100%)	*
	Planigale spp.	*	1 (100%)	*
	Sminthopsis macroura	3 (100%)	*	*
	Sminthopsis youngsoni	*	*	3 (100%)
Peramelidae	*Macrotis lagotis*	*	*	Present
Macropodidae	*Macropus agilis*	*	Present	*
	Macropus robustus	*	Present	*
	Macropus rufus	Present	Present	Present
Muridae	*Notomys alexis*	*	*	5 (100%)
	Pseudomys desertor	1 (20%)	1 (20%)	3 (60%)
	Pseudomys hermannsburgensis	*	4 (57%)	3 (43%)
	Pseudomys nanus	*	1 (50%)	1 (50%)
	**Mus domesticus*	43 (90%)	5 (10%)	*
Native taxa		3 species	8 species	7 species
Trapped individuals of native taxa		4 animals	13 animals	15 animals

our results. First, some extant species may not have been detected. In particular, the bat fauna may be under represented. Second, many CWR species (Burbidge & McKenzie 1989) have declined throughout much of arid mainland Australia and some are now presumed extinct (*e.g.* McKenzie & Burbidge 2006). The study area is within the former distribution limits of several of them (*e.g.* van Dyck & Strahan 2008; Menkhorst 2001). Nevertheless, two CWR species, *Macrotis lagotis* and *P. nanus* (which, at 35 g, is at the lower end of the CWR; Burbidge & McKenzie 1989) were present and there are recent records of two others from the vicinity. *Lagorchestes conspicillatus,* (Macropodidae) is known from a 2002 record about 90 km northeast of the study area (WA Museum Reg. No. M 54161) and there are two sight records of *Trichosurus vulpecula* (Phalangeridae) on the Great Northern Highway about 50 and 120 km north of the study area respectively (K. Miller, Wildlife Officer, Department of Conservation & Land Management, Broome – pers. comm. to ANS). Habitats similar to those in which both species were recorded occur within the study area and more broadly within the Mandora System.

Table 5 indicates the affinities of all species with Torresian and Eremaean provinces. Representatives of both faunas are present but Eremaean elements predominate. *Macropus agilis*, was the only exclusively (in WA) Torresian species. Three more, a dasyurid, a rodent and a megachiropteran bat are characteristically Torresian but also occur in Eremaean bioregions. In contrast *Planigale* sp., *S. youngsoni* and P. *hermannsburgensis* are more or less exclusively Eremaean. As expected, *S. youngsoni,* and many of the P. *hermannsburgensis* were recorded on red sandy surfaces of the GSD while the Planigale was taken on heavier soil of DL (*cf.* McKenzie & Youngson 1983). Five other species, a dasyurid, a bandicoot, a macropod and two rodents, are characteristically Eremaean but extend into more arid Torresian areas (McKenzie 1981). The remaining species, a macropod, and the three microchiropteran bats are widespread in both provinces.

Besides the admixture of Eremaean and Torresian elements, interesting features of the mammal fauna include the occurrence of the un-named Pilbara *Planigale* so far north, the persistence of small populations of the CWR species *M. lagotis* and *P. nanus* (the most southerly mainland population known to be extant) and the occurrence of *M. agilis*. We are not aware of previously published records of *M. agilis* from so far south but in May 2003, it was reported "in plague numbers" at least 80 km further south-west in coastal (DL) country on Wallal Downs Station (19° 47' S, 120° 39' E; Kingsley Miller personal communication to ANS). Also in May 2003, after heavy overnight rain, many were seen on the side of the Great Northern Highway from the edge of the Mandora paleo-system at 19° 46' S 121° 09' E (near Sandfire Roadhouse) to the edge of Roebuck Plains at 18° 00' S, 122° 36' E (ANS personal observation) and so the species probably occurs continuously in coastal habitats of the Dampierland bioregion from the southwest Kimberley to at least Wallal Downs.

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Table 5

Biogeographic affinities (in WA) of the native mammals recorded in the Mandora study area. *** = essentially endemic, ** = present but not widespread, * = widespread.

Family	Species	Torresian	Eremaean
Dasyuridae	*Planigale maculata*	*	**
	Planigale spp.		***
	Sminthopsis macroura	**	*
	Sminthopsis youngsoni		***
Peramelidae	*Macrotis lagotis*	*	*
Macropodidae	*Macropus agilis*	***	
	Macropus robustus	*	*
	Macropus rufus	**	*
Muridae	*Notomys alexis*	**	*
	Pseudomys desertor	**	*
	Pseudomys hermannsburgensis		***
	Pseudomys nanus	*	**
Pteropodidae	*Pteropus sp.*	*	**
Emballonuridae	*Saccolaimus flaviventris*	*	*
Molossidae	*Chaerephon jobensis*	*	*
Vespertilionidae	*Nyctophilus geoffroyi*	*	*

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