# The mammals of Shark Bay, Western Australia

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**Abstract**

Seven marine mammal species have been recorded from Shark Bay, and 37 native terrestrial mammal species have been recorded from the islands, peninsulas and mainland around the Bay. The islands are all landbridge islands cut off from the mainland by rising sea level since the last glacial. The numbers of native species recorded from islands is as follows: Dirk Hartog Island: 7 marsupials, 5 rodents and 2 bats; Dorre Island: 4 marsupials, 1 rodent and 1 bat; Bernier Island: 4 marsupials, 3 rodents and 2 bats. Although Shark Bay marks the northern range limit of south-western mammal species, the distributions of only five of these reach the Bay. The majority of the native land mammal fauna is composed of species that were originally widespread in both the south-west and arid zone. Shark Bay is thus not as biogeographically significant for mammals as it is for plants.

**Résumé**

Sept espèces de mammifères marins ont été recensées dans la Baie des Chiens Marins, et 37 espèces de mammifères terrestres indigènes ont été recensées sur les iles, les péninsules et le continent autour de la Baie. Toutes les iles sont un chapelet d'iles continentales séparées du continent par la montée du niveau de la mer depuis la dernière glaciation. Les nombres d'espèces indigènes recensés sur les iles sont les suivants: Ile Dirk Hartog: 7 marsupiaux, 5 rongeurs et 2 chauves-souris; Ile Dorre: 4 marsupiaux, 1 rongeur et 1 chauve-souris; Ile Bernier: 4 marsupiaux, 3 rongeurs et 2 chauves-souris. Bien que la Baie des Chiens Marins marque la limite septentrionale des répartitions des mammifères du sud-ouest, seulement cinq d'entre eux atteignent la Baie. La majorité de la faune mammifère terrestre indigène est composée d'espèces qui étaient originellement répandues à la fois dans la zone du sud-ouest et la région aride. La Baie des Chiens Marins n'est donc pas aussi biogéographiquement importante pour les mammifères qu'elle ne l'est pour les plantes.

## Introduction

Shark Bay is a significant area from the biogeographic point of view. It has been known since the mid 19th century that it marks the northern limit of the South-west Botanical Province, through the work of von Mueller and Diels, with later refinements by Gardner and Beard (Beard 1980).

The pattern of land mammal distribution has been less clearly understood. Some of the mammals that occur on the islands were amongst the earliest Australian species known to Europeans, following the publications of the scientists and illustrators accompanying the French explorers, but few mammals were collected on the mainland. Shortridge (1910) noted that by the beginning of the 20th century many mammal species had become very rare on the mainland,

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but considered that the faunas of the Shark Bay islands held the key to the original mainland distributions of the species occurring on them, and regarded the island faunas as corresponding with that of the sand plain habitats of south-western Australia.

The situation described by Shortridge for south-western Australia is part of an Australia-wide pattern of devastating local or general extinction which many native mammal species have suffered since the arrival of European man (Ride 1968). For some decades it has no longer been possible to make meaningful studies of mammal zoogeography by collecting from living populations in most of mainland Australia. It is one of the main reasons for the ignorance of mainland mammals in the Shark Bay area. Fortunately this problem can be largely overcome by making use of mammal remains from the surface of deposits in small caves and rock shelters, which are quite common around Shark Bay. A substantial proportion of the data presented in the faunal tables in this paper is derived from such surface deposits. Full details of sources and materials will be published elsewhere (Baynes and Smith in prep.). The majority of such deposits are the remains of pellets cast by Barn Owls (*Tyto alba*); consequently, small mammals tend to have been sampled more completely than medium to large-sized species.

The climate at Shark Bay (Beard 1976) varies from dry warm Mediterranean on the western peninsula (Edel Land) and the western islands, to hot semi-desert Mediterranean on the Peron Peninsula and the mainland on the eastern side. Mean annual rainfall exceeds 300 mm on the west coast and decreases rapidly to less than 200 mm on the eastern side. The limestone cliffs of the west coast probably cause an orographic effect which locally increases the quantity of rainfall from the reliable winter westerly wind systems, and thereby create a rain-shadow which exaggerates the gradient to the east, where rainfall is much more variable and includes a substantial summer component. The eastern side of Shark Bay marks the western edge of the arid zone (Slatyer and Perry 1969).

## Mammal faunas

The nomenclature used for the mammal species follows that of Walton (1988), except for bats of the genus *Eptesicus* which follows Kitchener, Jones and Caputi (1987), and the Shark Bay Mouse which is discussed in some detail below.

The mammal faunas of Shark Bay are given in Tables 1 and 2. The extents of the original ranges of the terrestrial species in south-western Australia and the arid zone are also indicated, based upon Strahan (1983), Baynes (1984, 1987a) and a substantial body of unpublished data from cave surface mammal remains collected in 1985 and 1986.

Faure Island has not been included as a separate entity, even though one skull of *Bettongia penicillata* (W.A. Museum M9544) has been found there. The Island appears to have been part of Peron Peninsula in the geologically very

**Table 1:** Terrestrial mammals recorded from the islands and peninsulas of Shark Bay **BI** = Bernier Island; **DI** = Dorre Island; **DHI** = Dirk Hartog Island; **EL** = Edel Land peninsula; **PP** = Peron Peninsula; **ME** = mainland to the east. ✓ = recorded and still present: (✓) = recorded but locally extinct; [(✓ )] = recorded but totally extinct except for island populations; [[✓ ]] = recorded but totally extinct; .. = not recorded. X = extensive original range or x = restricted original range in south-west (**SW**) and/or arid zone (**AZ**).

| | SW | EL | DHI | DI | BI | PP | ME | AZ |
|---|---|---|---|---|---|---|---|---|
| Kultarr | | | | | | | | |
| *Antechinomys laniger* | x | .. | .. | .. | .. | .. | (✓) | X |
| Mulgara | | | | | | | | |
| *Dasycercus cristicauda* | x | (✓) | (✓) | .. | .. | (✓) | (✓) | X |
| Western Quoll | | | | | | | | |
| *Dasyurus geoffroii* | X | (✓) | (✓) | .. | .. | (✓) | (✓) | X |
| Dibbler | | | | | | | | |
| *Parantechinus apicalis* | X | (✓) | (✓) | .. | .. | .. | .. | .. |
| Red-tailed Phascogale | | | | | | | | |
| *Phascogale calura* | X | (✓) | .. | .. | .. | (✓) | (✓) | X |
| [Dunnart with no common name] | | | | | | | | |
| *Sminthopsis dolichura* | X | ✓ | ✓ | .. | .. | ✓ | ✓ | X |
| Stripe-faced Dunnart | | | | | | | | |
| *Sminthopsis macroura* | .. | .. | .. | .. | .. | .. | (✓) | X |
| Pig-footed Bandicoot | | | | | | | | |
| *Chaeropus ecaudatus* | x | .. | .. | .. | .. | .. | [[✓]] | X |
| Golden Bandicoot | | | | | | | | |
| *Isoodon auratus* | .. | .. | .. | .. | .. | .. | (✓) | X |
| Southern Brown Bandicoot | | | | | | | | |
| *Isoodon obesulus* | X | (✓) | .. | .. | .. | .. | .. | .. |
| Western Barred Bandicoot | | | | | | | | |
| *Perameles bougainville* | X | [(✓)] | [(✓)] | ✓ | ✓ | [(✓)] | [(✓)] | x |
| Bilby | | | | | | | | |
| *Macrotis lagotis* | X | .. | .. | .. | .. | .. | (✓) | X |
| Burrowing Bettong | | | | | | | | |
| *Bettongia lesueur* | X | .. | [(✓)] | ✓ | ✓ | .. | [(✓)] | X |
| Brush-tailed Bettong | | | | | | | | |
| *Bettongia penicillata* | X | .. | (✓) | .. | .. | (✓) | .. | x |
| Rufous Hare-wallaby | | | | | | | | |
| *Lagorchestes hirsutus* | x | .. | .. | ✓ | ✓ | (✓) | .. | X |
| Banded Hare-wallaby | | | | | | | | |
| *Lagostrophus fasciatus* | X | .. | [(?)] | ✓ | ✓ | [(✓)] | .. | .. |
| Common Wallaroo | | | | | | | | |
| *Macropus robustus* | X | ✓ | .. | .. | .. | ✓ | ✓ | X |
| Red Kangaroo | | | | | | | | |
| *Macropus rufus* | .. | .. | .. | .. | .. | .. | ✓ | X |
| Crescent Nailtail Wallaby | | | | | | | | |
| *Onychogalea lunata* | X | .. | .. | .. | .. | [[✓]] | .. | X |

**Table 1 (continued)**

| | SW | EL | DHI | DI | BI | PP | ME | AZ |
|---|---|---|---|---|---|---|---|---|
| Black Flying fox *Pteropus alecto* | .. | .. | .. | .. | .. | .. | ✓ | X |
| Little Red Flying-fox *Pteropus scapulatus* | .. | ✓ | .. | .. | .. | .. | .. | X |
| [Eptesicus with no common name] *Eptesicus finalysoni* | .. | ✓ | ✓ | .. | ✓ | .. | .. | X |
| Lesser Long-eared Bat *Nyctophilus geoffroyi* | X | ✓ | ✓ | ✓ | ✓ | .. | .. | X |
| Greater Long-eared Bat *Nyctophilus timoriensis* | X | .. | .. | .. | .. | ✓ | .. | X |
| White-striped Mastiff-bat *Nyctinomus australis* | X | .. | .. | .. | .. | ✓ | .. | X |
| Lesser Stick-nest Rat *Leporillus apicalis* | x | [[✓]] | .. | .. | .. | [[✓]] | [[✓]] | X |
| Greater Stick-nest Rat *Leporillus conditor* | x | [(✓)] | [(✓)] | .. | .. | [(✓)] | [(✓)] | X |
| Spinifex Hopping-mouse *Notomys alexis* | x | (✓) | .. | .. | .. | ✓ | ✓ | X |
| Long-tailed Hopping-mouse *Notomys longicaudatus* | x | .. | .. | .. | .. | .. | [[✓]] | X |
| Ash-grey Mouse *Pseudomys albocinereus* | X | ✓ | ✓ | ✓ | ✓ | .. | .. | .. |
| Desert Mouse *Pseudomys desertor* | .. | (✓) | .. | .. | (✓) | .. | .. | X |
| Shark Bay Mouse/Alice Springs Mouse *Pseudomys fieldi* | x | [(✓)] | [(✓)] | .. | ✓ | [(✓)] | [(✓)] | X |
| Sandy Inland Mouse *Pseudomys hermannsburgensis* | x | ✓ | ✓ | .. | .. | ✓ | ✓ | X |
| Western Chestnut Mouse *Pseudomys nanus* | x | (✓) | .. | .. | .. | .. | (✓) | X |
| Heath Rat *Pseudomys shortridgei* | X | (✓) | (✓) | .. | .. | .. | .. | .. |
| Pale field-rat *Rattus tunneyi* | x | ✓ | .. | .. | .. | (✓) | (✓) | X |
| House Mouse *Mus musculus* | X | ✓ | ✓ | .. | ? | ✓ | ✓ | X |
| Rabbit *Oryctolagus cuniculus* | X | ✓ | .. | .. | .. | ✓ | ✓ | X |
| Dingo *Canis familiaris* | X | .. | .. | .. | .. | .. | ✓ | X |
| Fox *Canis (Vulpes) vulpes* | X | ✓ | .. | .. | .. | ✓ | ✓ | X |
| Cat *Felis catus* | X | ✓ | ✓ | .. | .. | ✓ | ✓ | X |
| Total No. native species | | 21 | 14 | 5 | 7 | 18 | 23 | |

| PP | ME | AZ |
|---|---|---|
| .. | ✓ | X |
| .. | .. | X |
| .. | .. | X |
| .. | .. | X |
| ✓ | .. | X |
| ✓ | .. | X |
| [[✓]] | [[✓]] | X |
| [(✓)] | [(✓)] | X |
| ✓ | ✓ | X |
| .. | [[✓]] | X |
| .. | .. | .. |
| .. | .. | X |
| [(✓)] | [(✓)] | X |
| ✓ | ✓ | X |
| .. | (✓) | X |
| .. | .. | .. |
| (✓) | (✓) | X |
| ✓ | ✓ | X |
| ✓ | ✓ | X |
| .. | ✓ | X |
| ✓ | ✓ | X |
| ✓ | ✓ | X |
| 18 | 23 | |

recent past. *B. penicillata* originally occurred on Peron Peninsula, and it is quite possible that the specimen predates island formation rather than representing an island population. No other native mammal species has been recorded from Faure Island.

Ride and Tyndale-Biscoe (1962) noted that *Mus musculus* was recorded from Bernier Island by Shortridge, although they did not find any at the time of their visit in 1959. The absence of this species from the surface remains in the site on Bernier Island is consistent with a 20th century introduction.

The short list of marine mammals recorded from Shark Bay (Table 2) is probably incomplete. The most commonly observed are the Bottle-nose Dolphins (*Tursiops truncatus*), which have become well known as a result of their interactions with humans at the Monkey Mia beach (Connor and Smolker 1985). The Humpback Whales (*Megaptera novaeangliae*) were exploited intermittently between 1912 and 1963 by shore-based hunting operations from Point Cloates and Carnarvon (Chittleborough 1965). The record of *Orcinus orca* derives from the reports of Anderson and Prince (1985). The Dugong is the subject of ongoing research (Prince *et al.* 1981, and Anderson 1986).

**Table 2** Marine mammals recorded in Shark Bay.

| |
|---|
| **Cetacea** |
| Unidentified Beaked Whale, (Ziphiidae indet.) |
| Pygmy Sperm Whale (*Kogia breviceps*) |
| Unidentified Pilot Whale (*Globicephala* sp.) |
| Killer Whale (*Orcinus orca*) |
| Bottle-nose Dolphin (*Tursiops truncatus*) |
| Humpback Whale (*Megaptera novaeangliae*) |
| **Sirenia** |
| Dugong (*Dugong dugon*) |

**Systematics of the Shark Bay Mouse**

For much of this century the Shark Bay Mouse was thought to be restricted to Shark Bay. However, recognition of its remains in cave deposits all along the west coast south of Shark Bay (Archer and Baynes 1973, Baynes 1982), not only showed a much wider original distribution but also raised questions on its specific status.

In 1910, Oldfield Thomas described *Pseudomys praeconis* on the basis of a specimen from Peron Peninsula, and also referred to the same species a skull collected on Bernier Island by G.C. Shortridge in 1906 (Thomas 1910). Shortridge (1936) himself listed the skull under *"Mus gouldi"*, although he seems to have been a little confused because he mentioned "...original type-specimen (from the Peron Peninsula, Shark's Bay)...". (The lectotype of *Pseudomys gouldii* originated in New South Wales.) This suggests that Oldfield Thomas originally

identified the Shark Bay specimens as *P. gouldii*, and that in naming *P. praeconis* as a separate species Thomas was splitting his former concept of *P. gouldii*. Mahoney (1969) identified as *P. gouldii* some mice collected in 1843 from the Victoria Plains near New Norcia. Specimens from this area which I examined in the British Museum (Natural History) showed that these fell within my definition of *P. praeconis*. Pursuing the investigation led me to suggest (Baynes 1980) that *Pseudomys fieldi* (Waite, 1896), long known from only a single specimen from near Alice Springs, in the Northern Territory, was closely related to or conspecific with *P. praeconis*, and that both were related to *P. gouldii* from New South Wales.

Later work extended the original distribution of *P. praeconis* inland into the arid zone (Baynes 1984). Material collected in 1985 and 1986 has now shown that the original distribution of *P. praeconis* extended across the upper Gascoyne, northern goldfields and Gibson Desert (unpublished data). With the recent discovery of remains of *P. fieldi* at Uluru (Baynes 1987b), it seems very likely that "*P. praeconis*" and *P. fieldi* were continuous and were one and the same species. Specimens show no significant morphological differences between east and west (unpublished observations), or between Alice Springs and the Nullarbor (Baynes 1987a). For these reasons the scientific name used here for the Shark Bay Mouse is *Pseudomys fieldi*.

## Discussion

Before discussing patterns in the distribution of the species it is necessary to consider how well the recorded assemblages represent the original faunas.

Examination of Table 1 shows that a number of species are not recorded from the original faunas of areas where they would be expected to have occurred. Thus, *Lagostrophus fasiatus* and *Bettongia lesueur* have not yet been recorded from Edel Land, even though both were originally widespread in south-western Australia and were on all or most of the major islands, and *Lagostrophus* is recorded from Peron Peninsula. Both species were probably members of the original fauna of Edel Land: the current lack of records reflecting the fact that the deposits which have so far been found on this peninsula are mainly owl pellet accumulations. The same may apply to *Lagorchestes hirsutus*, but it was less widespread in the south-west and may represent an arid zone element at Shark Bay. *Sminthopsis dolichura, Lagorchestes hirsutus, Onychogalea lunata* and *Pseudomys desertor* have not yet been recorded from surface deposits on the eastern, mainland, side of Shark Bay. There is a modern specimen of *S. dolichura* from the area, and the species occurred in the arid zone nearby (Kitchener *et al.* 1984). The two wallabies were widespread in the arid zone. In the case of *L. hirsutus* and *Pseudomys desertor* absence may be true and reflect lack of suitable habitat.

The species richness of the recorded bat fauna is relatively low. This probably reflects the absence of trees in the region, but may be a partly false picture

resulting from the lack of biological survey in the area. The *Pteropus scapulatus* record probably represents a vagrant individual. The colony of *Pteropus alecto* around Carnarvon is probably dependent upon fruit from the plantations and street trees, and so may be regarded as commensal.

These considerations suggest that there are species still to be added to the original faunas of all areas except the smaller islands. Knowledge of the faunas appears sufficient to permit the general patterns to be elucidated, but the data are probably still not robust enough to investigate parameters as subtle as possible peninsula effects.

**Island and peninsula effects**

As expected, the figures of original total native mammal species (Table 1) show that the islands have smaller faunas than the peninsulas and eastern mainland. The original figures for the islands are close to the theoretical saturation figures for islands of those sizes (Kitchener *et al.* 1980). The faunas of the peninsulas would also be expected to be smaller than that of the adjacent mainland (the peninsula effect) but this is not clear from the figures.

**Which macropods originally occurred on Dirk Hartog Island?**

All authors of papers on the mammals of Dirk Hartog Island in the 20th century have assumed that *Lagostrophus fasciatus* occurred on the island, and some have also included *Lagorchestes hirsutus* in the fauna (see Burbidge and George 1978). I can find no evidence that *Lagorchestes hirsutus* originally occurred on the Island and I consider that there are good grounds for doubting that *Lagostrophus fasciatus* originally occurred there either. Péron, who with Lesueur named *L. fasicatus*, stated that it occurred in large numbers on Bernier, Dorre and Dirk Hartog Islands (Ride and Tyndale-Biscoe 1962); yet the party from the *Geographe*, in which Péron sailed, only visited Bernier and Dorre Islands (see Horner 1987). During Baudin's expedition it was a party from the *Naturaliste*, under the command of Hamelin, that visited Dirk Hartog Island. The *Naturaliste* zoologist Levillain was less than enthusiastic about Dirk Hartog Island and appears to have made only a poor collection of natural history specimens (Horner 1987). The source locality of the original material of *L. fasciatus* was Bernier Island (Calaby and Richardson 1988). During Freycinet's second visit to Shark Bay, in the *Uranie*, Quoy and Gaimard visited Dirk Hartog Island, and found skulls of the animal they named *Hypsiprymnus (= Bettongia) lesueur* along with debris of birds, reptiles and fish beneath an Osprey's nest (see Ride and Tyndale-Biscoe 1962). A bird of prey capable of taking a *B. lesueur* would be able to catch young *L. fasciatus* or *L. hirsutus* fresh out of the pouch. If either had been present on the Island it would be surprising if their remains were not included in the Osprey midden, and if so were not collected and remarked upon by Quoy and Gaimard. F.M. Rayner also collected skulls of *B. lesueur* on Dirk Hartog Island, during the Herald expedition in 1858 (see Thomas 1888, p.114), but

apparently found skulls of neither *L. fasciatus* nor *L. hirsutus*. No remains of either species have been found in cave deposits or sand dune blowouts on Dirk Hartog Island, which have yielded several more *B. lesueur* specimens and remains of 10 other species (see Burbidge and George 1978).

It may have been a little premature to attempt to re-introduce, or more probably introduce, *Lagostrophus fasciatus* to Dirk Hartog Island (see Burbidge and George 1978). It is to be hoped that skeletal remains from the introduced animals will not confuse future attempts to establish whether *L. fasciatus* was originally present on the Island.

**Patterns of mammal distribution**

As Table 3 shows, at least half of the non-volant native land mammals recorded from the Shark Bay area are wider-ranging species for which the Bay does not represent a geographic limit. For several arid zone species Shark Bay is a point on the western limit of their ranges. For only five south-western species is it their northern range limit.

**Table 3:** Numbers of non-volant native terrestrial mammal species following various biogeographic patterns across Shark Bay: **SW to SB** = south-western species for which Shark Bay marks the northern range limit; **WIDE** = species widespread in both the south-west and arid zone; **AZ to SB** = arid zone species for which Shark Bay marks the south-west limit.

| | SW to SB | WIDE | AZ to SB |
|---|---|---|---|
| Number of species | 5 | 15 | 8 |
| Percent | *17.9* | *53.5* | *28.6* |

*Species pairs*

Three or four out of these five south-western species at their northern limits are members of pairs of ecological vicar species in which both members are recorded in the original mammal fauna of Shark Bay (Table 4). In most cases the members of the pairs are closely related and have very similar morphology, particularly in size and form of teeth. *Lagorchestes* is included as the arid zone vicar of *Lagostrophus* with less certainty (indicated by parantheses) because the two species are less closely related and are rather less similar morphologically than the members of the other pairs.

**Table 4:** The south-western mammal species which reach their northern range limit at Shark Bay, and the ecological vicar species which replaces each across Shark Bay and in the arid zone.

| South-western | Arid zone vicars | Sympatric? |
|---|---|---|
| *Parantechinus apicalis* | *??* | — |
| *Isoodon obesulus* | *Isoodon auratus* | No |
| *Lagostrophus fasciatus* | *(Lagorchestes hirsutus)* | Yes |
| *Pseudomys albocinereus* | *P. hermannsburgensis* | Yes |
| *Pseudomys shortridgei* | *Pseudomys desertor* | Yes |

The direct, vicarious, replacement of *Pseudomys shortridgei* in the arid zone is probably *P. desertor.* In south-western Australia, *Pseudomys shortridgei* forms a mutually exclusive pair with *P. nanus. P. shortridgei* is restricted to the heaths of the Swan Coastal Plain and southern Yilgarn Block, and *P. nanus* is restricted to different habitats on the more northerly Yilgarn Block. This pattern continues into the Shark Bay area. On Edel Land, and Dirk Hartog Island its geomorphological continuation, *P. shortridgei* appears to have been restricted to the western coastal edge and absent from the eastern coasts, where, at least at the southern limit of the peninsula, it was replaced by *P. nanus* (Baynes and Smith in prep.). *P. nanus* is also a member of the mainland fauna, but has not been recorded from Peron Peninsula.

It would be very interesting to investigate the fine details of the sympatry of the members of species pairs which are recorded from the same areas. Ecological separation by primary habitat would be expected. For example, *Pseudomys albocinereus* and *P. hermannsburgensis* are the small mice of the sand substrate habitats of respectively the south-west and the arid zone. *P. albocinereus* is adapted to the reliable winter rainfall of the south-west, whereas *P. hermannsburgensis* is adapted to the very variable but occasionally heavy rain experienced in the arid zone. Their distributions intermingle on the western side of Shark Bay. It seems likely that *P. hermannsburgensis* would be found to occur on the red sand dunes, whereas *P. albocinereus* is probably restricted to the white sands bearing south-western plant species. Both species still occur on Dirk Hartog Island where they are stated by Burbidge and George (1978) to occur in the same habitat.

**Zoogeography**

Shortridge (1910, p. 819) made three crucial points about the faunas of the islands off the coasts of Western Australia. Following a discussion of the extent and causes of post-European extinction of much of the native mammal fauna, he stated that "... the abundance of native mammals on the small islands off the coast, ... is very marked, and forms a key to the original distribution of many of them." "Insular forms of South-Western mammals extend as far north as the Shark Bay Islands in the West;" and "The mammals on the islands off Shark Bay correspond with the originally widely spread "sand-plain fauna" of the South-West."

Ride and Tyndale-Biscoe (1962) reviewed the then known mainland records of the species recorded from Bernier and Dorre Islands and concluded that: "The distributions of the various species thus indicate that the island fauna is not a South-western fauna which is, as a result of being "stranded" on an island, out of place in relation to its latitudinal position along the Western Australian coast."

The new information on the mammal faunas of Shark Bay presented in this paper supports Shortridge's generalizations. The idea of a "stranded" fauna

appears to be reading a meaning into Shortridge's words which is not justified. All seven of the mammal species recorded from Bernier and Dorre Islands were indeed members of the original faunas of the Shark Bay peninsulas and/or mainland. Four of these, *Perameles bougainville, Lagorchestes hirsutus, Lagostrophus fasciatus* and *Pseudomys albocinereus* originally occurred in the sand plains of south-western Australia; and four (the remaining three plus *Lagorchestes hirsutus* again) were originally widespread in the arid zone, at least two in sandy habitats. One of the arid zone group (*Pseudomys desertor*) was unknown to Shortridge. The exact compositions of the island faunas are probably best explained in terms of the theory of island biogeography (Kitchener *et al.* 1980). However, all three major islands are principally composed of sand substrate habitats and so it is not surprising that their original faunas are largely composed of sandy habitat species of both south-western and arid zone affinities. Four of the five south-western species which reach their northern limits at Shark Bay (Table 4), are recorded from one or more of the islands. The four constitute all of the sand plain species in that group.

## Conclusions

The change from south-western to arid zone mammal fauna across Shark Bay is not as dramatic as the floristic change between the South-west and Eremean Botanical Provinces. Although the Bay marks the northern limit of south-western elements in the mammal fauna, not many south-western species' original range limits reached as far north along the coast as Shark Bay.

For mammals, Shark Bay is thus just one point on the South-west Province/arid zone boundary, but it is an important one for the understanding of mammal zoogeography because the original fauna is relatively well known, and there is a sharp climatic gradient across the Bay. Bernier and Dorre Islands preserve their original faunas, and the geology of the region is suitable for the formation of many small coastal caves which contain remains of the original mammal fauna. In this respect it is comparable with the eastern end of the South-west Botanic Province, where the caves of the southern Nullarbor and adjacent regions provide a good record of the original occurrence of south-western elements at that limit of the Province (Baynes 1987a). As can be seen in Table 5, all the south-western mammals which originally reached their northern limits at Shark Bay, reached their eastern limit in western Australia at the Bight. The Bight fauna includes a further four species. *Tarsipes rostratus* has not been detected at Shark Bay, but might have originally occurred there also: it is more difficult to detect in cave surface remains than the other species because its tooth-bearing structures are vanishingly small and fragile, and its identification depends upon postcranial elements. The other three additional species reaching their limits at the Bight generally had a more southerly distribution within the south-west (none has been recorded from north of 29°S latitude). The original ranges of

most south-western mammals appear to have been limited by rainfall, but at least one of the three (*Pseudomys occidentalis*) appears to have been limited by temperature — probably summer maxima.

Because both Shark Bay and the western Bight lie across the boundary, and there is an intermingling of south-western and arid zone elements, the levels of mammal species richness, at an assemblage level, are exceptionally high in both areas (Morton and Baynes 1985, Baynes 1987a).

The original mammal faunas of the Shark Bay islands relate directly to those of the peninsulas and mainland, and are not "stranded" examples of a fauna from higher latitudes.

**Table 5:** The south-western mammal species which reach the northern limit of the South-west Botanic Province at Shark Bay, compared with those that reach the eastern limit of the Province on the Great Australian Bight.

| Shark Bay | Bight |
|---|---|
| *Parantechinus apicalis* | *Parantechinus apicalis* |
| *Isoodon obesulus* | *Isoodon obesulus* |
| | *Tarsipes rostratus* |
| | *Potorous platyops* |
| *Lagostrophus fasciatus* | *Lagostrophus fasciatus* |
| *Pseudomys albocinereus* | *Pseudomys albocinereus* |
| | *Pseudomys occidentalis* |
| *Pseudomys shortridgei* | *Pseudomys shortridgei* |
| | *Rattus fuscipes* |

## Future work

As the discussions above show, more data are badly needed in several categories: particularly the original mammal faunas of Edel Land and the mainland to the east, which are inadequately known; the original mammal fauna of the mainland to the south, which is not known at all; and on the vexed question of the original occurrence of *Lagostrophus fasciatus* on Dirk Hartog Island.

Skeletal remains from the surfaces of cave deposits represent the only possible source of many of the data required. Most of such material is accumulated by predators. Owls, particularly the Barn Owl *Tyto alba*, produce large accumulations of remains which can provide a rich source of information on most or all of the small mammals which occur in an area. Remains of medium to large-sized mammals are accumulated mainly by mammalian predators, whose lairs tend to contain remains of far fewer individuals. The discovery of one or two large owl pellet accumulations in critical localities will provide many of the missing data on small mammals, but the question about original presence of species of wallabies in various faunas will require substantially more time-consuming searches. Especially large samples are needed convincingly to demonstrate absence from a fauna (see Baynes 1987a). Any *Lagostrophus fasciatus*

remains found on Dirk Hartog Island will need to be radiocarbon dated to distinguish original from introduced material.

A survey of the present day mammal fauna of Shark Bay is clearly needed; and indeed a survey of the Carnarvon Basin is high on the list of priorities of the biological survey group at the Western Australian Wildlife Research Centre (N.L. McKenzie pers. comm.).

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