

Biogeography of the vertebrates of the Cape Range peninsula, Western Australia

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Abstract

Thirty mammals, 84 reptiles, five amphibians and about 200 birds are known from the Cape Range peninsula. Biogeographic patterns of the extant terrestrial vertebrate fauna of the peninsula, particularly among the herpetofauna and avifauna, are significantly related to landform units present on the peninsula.

The mammal fauna of the Cape Range peninsula has suffered numerous recent extinctions, but is not yet completely known (particularly for bats). With the exception of *Petrogale lateralis*, the 11 ground dwelling native mammals are common elsewhere in the arid and semi-arid north west of Western Australia. Most of the bats are northern species, but two southern species are present (*Tadarida australia* and *Chalinolobus gouldii*). Introduced mammals are well established in the area, including goats and foxes.

In addition to ubiquitous species, the bird and reptile faunas are typical of the semi-arid and arid north west and interior, although some south western species are also present. Many species are represented on Cape Range peninsula by populations isolated from the main part of their conspecific distribution. Despite this, levels of endemism on the peninsula are low. Only two species, *Lerista allochira* (a skink confined to the limestone of the Cape Range) and the Grey Shrike-thrush (*Colluricincla harmonica rufiventris*) show specific and sub-specific endemism respectively within the Cape Range peninsula area.

Inter-tidal coastal flats and mangrove habitats are significant to many bird species occurring on the peninsula, although many of these are migratory. The rocky gorges of the Cape Range provide refuge for the Black Footed Rock Wallaby (*Petrogale lateralis*) and the frog *Pseudophryne douglasi*, both species which occupy scattered relictual ranges within the north west (*P. lateralis* also occurs in the south west of Western Australia). However, among the reptiles, aeolian units on the peninsula are much more significant biogeographically. Southern species at their northern limits on the peninsula are found on the white beach dunes of the western coast, while isolated populations of northern and central arid and semi-arid zone reptiles occur on the small areas of orange sand ridges found on the peninsula.

The Cape Range peninsula presents a unique combination of environments for the north west coast. Precambrian units are absent, and the dissected limestone of the Cape Range is isolated from other rocky country by lowland sand plains, dune fields and heavier alluvial units. While the Cape Range peninsula is strongly connected southward to the sand ridge and sand plain units of the Gascoyne, the Giralia anticline effectively isolates the peninsula sand units from those to the north and east. This combination of different sandy habitats, the dissected limestone range, extensive inter-tidal habitats and a coastally ameliorated climate suitable to some southern and northern mesic zone species combine to maintain a diverse and concentrated suite of vertebrates.

Introduction

Patterns of biogeography arise through interactions between organisms and their environment. The mobility, physiology and other requirements of species, as well as inter-specific interactions, evolve within a physical environment, shaped by the evolution of

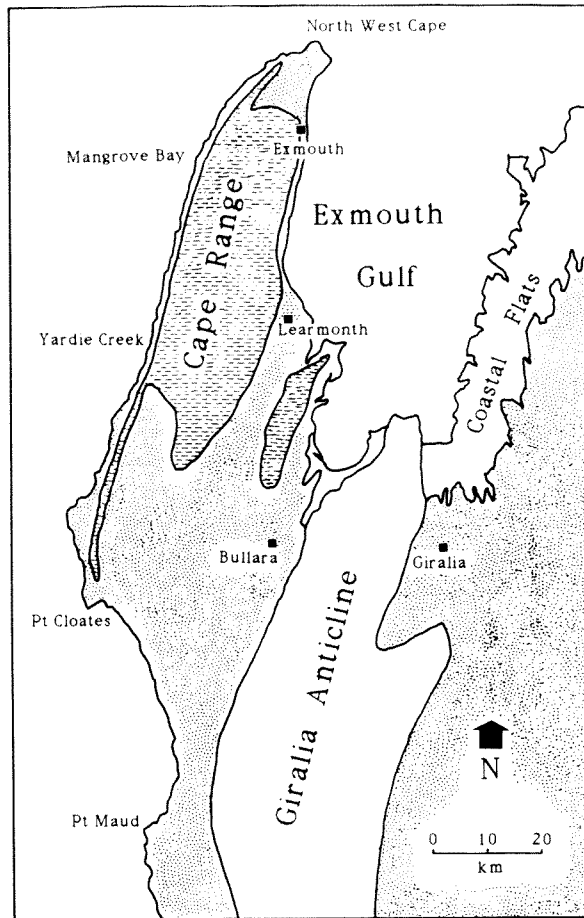


Figure 1. Map of the Cape Range peninsula area, showing the distribution of sand ridge or sand plain land units (stippled), and the extent of the Cape Range and Giralia anticline features which interrupt them. Both the Bullara and Giralia sand units extend southward, but the Bullara sands have stronger connections to the coastal sandy units of the Shark Bay area. The Cape Range peninsula dunefields are isolated from other sand units.

landform units. This interaction between species and their environment occurs over ecological and geological time.

Biogeographic patterns of different groups of organisms correlate with patterns of landforms to different degrees; generally, the distribution of less mobile groups follow land unit boundaries more closely. For groups like birds, biogeographic patterns are apparent on a large geographic scale, while lizard distributions often correlate with land unit boundaries at fine geographic scales (Pianka 1972). This is indicated by the relative sizes of individual species' geographic ranges (compare, for example, Pizzey and Doyle [1982] for birds and Wilson and Knowles [1988] for reptiles). Different groups of the fauna within a region will thus show different biogeographic patterns.

Such a pattern is apparent in the vertebrate fauna of the Cape Range peninsula. Although there are exceptions, the geographic ranges of reptile species correlate closely with distribution of landform substrate units, while bird species often range across landform units. Partly

because they show large scale patterns, bird distributions appear to be influenced more directly by climate, although clearly vegetation associations and landforms are also significant. The relative vagility of faunal groups is clearly a major factor in determining these patterns of distribution. Distribution patterns also correlate with habit; fossorial skinks and pygopodids are clearly more influenced by substrate type than, for example, surface dwelling varanids. Patterns of distribution are thus determined by a variety of features of the environment and organisms.

This paper describes patterns of distribution of the extant vertebrate fauna of the Cape Range peninsula. Marine species are not considered.

Landforms, geology and climate

Cape Range peninsula lies within the Carnarvon Phytogeographic district, the western-most district of the Eremean Botanical Province (Beard 1980). This phytogeographic district extends from the Exmouth Gulf area southward to Shark Bay. The Cape Range peninsula is thus located in the far north of the district, adjacent to both the Ashburton and Fortescue districts. Thus, while the Exmouth Gulf area shows strong botanical affinities toward the south, it lies close to the two major botanical districts of the semi-arid Pilbara block.

Storr and Hanlon (1980) recognised four landform zones; the West Coast, Cape Range, Western Lowlands and Eastern Lowlands. These units are described below and placed in a regional geographic context.

The West Coast zone is comprised of a narrow strip of white calcareous sand, with a cooler and wetter climate than other parts of the area due to its close proximity to the ocean (Payne *et al.* 1987). Vegetation includes *Spinifex longifolius*, *Acacia coriacea*, *Heterodendron oleaefolium*, *Scaevola tomentosa* and *Acanthocarpus preissii*. These coastal sand units form an almost continuous connection to the Shark Bay area (including the Shark Bay islands), and in some areas lie adjacent to inland orange and red sand-plains and dune fields.

The heavily dissected limestone ranges of the Cape Range form the bulk of the Cape Range peninsula, rising to about 300 metres above sea level. The gorges are often lightly wooded, but the slopes and crest of the range are sparsely vegetated with *Triodia* and shrubs. It is the only elevated limestone range on the north west coast of Western Australia, and is isolated from other rocky range areas by extensive alluvial and aeolian flats and low-lands to the south, south east and east.

The Western Lowlands (Storr and Hanlon 1980) lie immediately inland from the West Coast unit, to the south of the Cape Range limestone block. Coastal sandfire flats give way to shallow red clays and sands supporting *Acacia* scrub and *Triodia*. These sand plains and dune fields extend more or less continuously to the Shark Bay area on the coast, and to south of the Gascoyne River further inland.

The Eastern Lowlands extend from the bottom of Exmouth Gulf southward and eastward, and join up with the extensive dune fields around Onslow. These sand habitats connect by often narrow corridors along the north west coast to the Great Sandy Desert. However, the Cape Range peninsula is now isolated from these sand plains and dune fields by the Giralia anticline, a low range feature running southward from the bottom of Exmouth Gulf (Payne *et al.* 1988).

The land unit mapping of Payne *et al.* (1987, 1988) provides more detail than this, but essentially confirms the pattern described above. Figure 1 shows the position of the limestone and sand substrate land units of the Cape Range peninsula district.

Sand plains and sand ridge land units are geographically significant landforms in areas to the south and east of Cape Range peninsula Payne *et al.* (1987, 1988). However, sandy units are not well represented on the peninsula itself. The two most significant aeolian units on the peninsula are the white dunes of the west coastal strip and the red sand ridge fields at the southern and northern ends of the Cape Range limestone block. Both of these white and red sand units are biogeographically significant, particularly for reptiles.

Biogeographic patterns of vertebrate groups

Mammals

Thirty mammals are known to occur in the Cape Range peninsula area, of which eight were introduced by Europeans (Table 1). Baynes and Jones (1993) treat the mammal fauna more comprehensively and discuss the fauna extant prior to the advent of European settlement in Australia.

Table 1. Extant mammal fauna of the Cape Range peninsula, as determined by W.A. Museum collection records, collections of N. McKenzie (indicated by *) and observations of Cape Range National Park management staff. Species introduced by Europeans are indicated by¹; S = southern, N = northern.

Tachyglossidae	<i>Tachyglossus aculeata</i>	Continental
Dasyuridae	<i>Dasykaluta rosamondae</i>	Semi-arid Pilbara
	<i>Ninguai timealeyi</i>	Semi-arid Pilbara
	<i>Pseudantechinus macdonnellensis</i>	Central arid zone
	<i>Sminthopsis macroura youngsoni</i>	Semi-arid, arid zone
Macropodidae	<i>Macropus robustus</i>	Semi-arid, arid zone
	<i>Macropus rufus</i>	Semi-arid, arid zone
	<i>Petrogale lateralis</i>	Scattered, relictual
Pteropidae	<i>Pteropus scapulatus</i>	N sub-humid
	<i>Pteropus alecto</i> *	N sub-humid
Emballonuridae	<i>Taphozous georgianus</i>	N mesic to arid
Molossidae	<i>Tadarida australis</i>	S arid to mesic
	<i>Chaerophon jobensis</i> *	N mesic, semi-arid
	<i>Mormopterus loriae</i> *	N mesic
Vespertilionidae	<i>Chalinolobus gouldii</i>	S mesic, semi-arid
	<i>Eptesicus finlaysoni</i>	Semi-arid, arid zone
	<i>Eptesicus pumilis</i>	N mesic to arid
	<i>Nyctophilus arnhemensis</i> *	N mesic
Muridae	<i>Nyctophilus geoffroyi</i> *	Continental
	<i>Mus musculus</i> ¹	Continental
	<i>Notomys alexis</i>	Central arid zone
	<i>Pseudomys hermannsburgensis</i>	Central arid zone
Leporidae	<i>Oryctolagus cuniculus</i> ¹	S continental
Canidae	<i>Canis familiaris</i>	Continental
	<i>Vulpes vulpes</i> ¹	S continental
Felidae	<i>Felis catus</i> ¹	Continental
Equidae	<i>Equus caballus</i> ¹	N semi-arid
Bovidae	<i>Capra hircus</i> ¹	Scattered semi-arid
	<i>Ovis aries</i> ¹	Domestic stock
Camelidae	<i>Camelus dromedarius</i> ¹	Semi-arid, arid zone

With the exception of *Petrogale lateralis*, the native terrestrial mammals still extant on the peninsula are all widespread and fairly common in the north west of Western Australia. All are found primarily in the arid and semi-arid interior of the continent, including the Pilbara (Table 1). *Petrogale lateralis* was once widespread in Western Australia, but is now restricted to isolated populations scattered through the south west, north west coast, Pilbara and southern Kimberley regions. This species has suffered severe decline in the presence of foxes, and several island populations were either destroyed or greatly reduced after foxes gained access to them (Kinnear *et al.* 1988). The Cape Range peninsula supports a secure population of *P. lateralis* in the western gorges of the Cape Range.

Eleven species of bat are known from the peninsula area. Of these, only *Tadarida australis* and *Chalinolobus gouldii* have mainly southern ranges, while *Nyctophilus geoffroyi* occurs throughout the continent. All of the others have distributions extending northward, usually into the tropical sub-humid zone. *Taphozous geogeanus*, an obligate cave-roosting species, is favoured in the limestone country of the Cape Range. Many species forage within the mangrove ecosystems around the coast of the peninsula. However, collections from the Cape Range peninsula area are not comprehensive (N. McKenzie, pers. comm.) and it is possible that other species may be present (for example *Taphozous flaviventris*, *Nycticeius greyii* and *N. balstoni*).

Mammals have not been intensively or systematically surveyed on the Cape Range peninsula. It is possible that populations of species now thought to be locally or regionally extinct may be located on the peninsula. Such a view is supported by the recent discovery of mainland populations of *Macrotis lagotis*, *Lagorchestes conspicillatus*, *Trichosurus arnhemensis* and *Sminthopsis longicaudata* in the Ashburton region or further north in the Pilbara.

Eight mammal species present on the peninsula were introduced by Europeans, while the dingo became established with pre-European human populations. The dingo was exterminated (or nearly so) from the Cape Range peninsula by the pastoral industry in quite recent times, with the advent of aerial baiting. Wild dogs are still occasionally present in the Cape Range National Park, probably originating from the settlements of Exmouth and Learmonth. Sheep, goats, horses and cattle were introduced as domestic stock, but only sheep are maintained under free range pastoral management. Goats have established viable feral populations in the Cape Range, where they have reached high population levels due to their competence in rough country and independence from husbandry. Goats (*Capra hircus*) are now subject to intensive control operations throughout the pastoral regions. House mice (*Mus musculus*) probably reached the area with early European settlement, although the rabbit (*Oryctolagus cuniculus*) and fox (*Vulpes vulpes*) appear to have dispersed to the north west of Western Australia without the deliberate assistance of people (Morton 1990). Foxes are still common in the area and are subject to control by 1080 baiting in areas adjacent to *Petrogale lateralis* colonies and sea turtle nesting beaches. Rabbits are present in small numbers at a few localities on the peninsula, and recently, a feral camel (*Camelus dromedarius*) has been observed on the peninsula, having apparently escaped from captivity.

Birds

The avifauna of the Cape Range peninsula reflects the range of habitats on the Cape, with its narrow coastal plains, dissected limestone uplands, sand plains and sand ridges, extensive inter-tidal flats and large areas of mangrove. The bird fauna is generally representative of the semi-arid north west coasts and hinterlands.

Table 2. Summary table of southern species which are present on Cape Range peninsula at the northern limits of their range (S), northern species present at the southern limits of their range (N), and species for which populations on the Cape Range peninsula are geographically isolated from other conspecific populations (I).

Species	S	N	I
Striated Field Wren (<i>Calamanthus fuliginosus</i>)	*		
Grey-breasted White Eye (<i>Zosterops lateralis gouldi</i>)	*		
Beach Stone Curlew (<i>Burhinus neglectus</i>)		*	
Bar Shouldered Dove (<i>Geopelia humeralis</i>)		*	
Rufous-crowned Emu Wren (<i>Stipiturus ruficeps</i>)		*	*
Grey Headed Honeyeater (<i>Lichenostomus keartlandi</i>)		*	*
Painted Firetail Finch (<i>Emblema picta</i>)		*	*
Spotted Bowerbird (<i>Chlamydera maculata</i>)		*	*
Spinifex Pigeon (<i>Petrophassa plumifera</i>)			*
Little Woodswallow (<i>Artamus minor</i>)			*
Grey Shrike-thrush (<i>Colluricincla harmonica rufiventris</i>)		*	

A checklist of birds recently observed within the Cape Range National Park (Department of Conservation and Land Management pamphlet) lists 154 species. This list is incomplete, and contains many obvious omissions; for example, Little Pied Cormorant (*Phalacrocorax sulcirostris*), Sharp-tailed Sandpiper (*Calidris acuminata*), Whiskered Tern (*Chlidonias hybrida*), Owlet Nightjar (*Aegotheles cristatus*), Horsefield's Bushlark (*Mirafra javanica*), Welcome Swallow (*Hirundo neoxena*), Fairy Martin (*Cecropis ariel*), Black-faced Cuckoo-shrike (*Coracina novaehollandiae*) etc. Storr (1984) and Johnstone (1990) provide more comprehensive treatment of the regional avifauna, while Pizzey and Doyle (1982) and Slater *et al.* (1986) give a more general coverage of bird distributions within the region.

Three broad biogeographic patterns are apparent in the Cape Range peninsula avifauna; species ubiquitous throughout and beyond the area, species endemic or locally restricted to the area, and species which reach the limits of their natural distributions on the peninsula. This last category are either southern species which extend as far north as the peninsula, or northern or inland species which extend as far south as the peninsula. Some of these latter species extend further south than the peninsula in the inland parts of their range further to the east. Species in these latter two categories are listed in Table 2, as well as those species for which peninsula populations are geographically isolated from adjacent conspecific populations.

According to Storr (1984), few southern species currently attain their northern limits on Cape Range peninsula; these include Striated Field Wren (*Calamanthus fuliginosus*) and Grey-breasted White Eye (*Zosterops lateralis gouldi*), the latter as a 'rare visitor'. Thomas Carter observed or collected examples of a number of additional south western species from the vicinity of Cardabia (at the base of Cape Range peninsula) between 1899 and 1902 (Storr 1984), including Little Shearwater (*Puffinus assimilis*), White Faced Storm Petrel (*Pelagodroma marina*), Australasian Gannet (*Morus serrator*), Freckled Duck (*Stictonetta naevosa*), Musk Duck (*Biziura lobata*), White Fronted Chat (*Ephthianura albifrons*) and Elegant Parrot (*Neophema elegans*). While these species have not been observed on the Cape Range peninsula for many years, some may be occasional vagrants to the area. If Carter's observations describe the bird fauna as it was nearly 100 years ago, changes apparent since

that time beg explanation. Local disappearance of these species may be attributable to the effects of European settlement, although disappearances may have been caused by natural processes.

Species whose southern-most (western coastal) limits fall on Cape Range peninsula include Beach Stone Curlew (*Burhinus neglectus*), Bar Shouldered Dove (*Geopelia humeralis*), Rufous-crowned Emu Wren (*Stipiturus ruficeps*), Grey Headed Honeyeater (*Lichenostomus keartlandi*), Painted Firetail Finch (*Emblema picta*) and Spotted Bowerbird (*Chlamydera maculata*), and vagrants such as the Redshank (*Tringa totanus*, rarely recorded as far south as Peel Inlet). Some of these species occur further south in inland areas, but not along the coast. In addition, Storr (1984) notes two species that appear to have disappeared from the Exmouth Gulf area since Carter observed them there; the Plumed Whistling Duck (*Dendrocygna eytoni*, which Carter saw in huge numbers at Point Cloates), and Chestnut Teal (*Anas castanea*, once resident at Mangrove Bay).

Storr (1984) notes seven species for which populations on Cape Range peninsula are isolated from conspecific populations in adjacent regions (Table 2). These species all have northern or arid zone distributions, although some extend south of the Ashburton River. They include the Spinifex Pigeon (*Petrophassa plumifera*), Rufous-crowned Emu Wren (*Stipiturus ruficeps*), Grey Headed Honeyeater (*Lichenostomus keartlandi*), Painted Firetail Finch (*Emblema picta*), Little Woodswallow (*Artamus minor*) and Spotted Bowerbird (*Chlamydera maculata*). Isolation of the Cape Range peninsula population of the Grey Shrike-thrush (*Colluricincla harmonica rufiventris*) from both Pilbara and southern interior populations is accompanied by a difference in size (Cape Range birds are smaller, Storr 1984). Similarly, Spinifex Pigeon (*Petrophassa plumifera*) from the Cape Range are morphologically distinct from Pilbara populations, although Johnstone (1981) did not consider sub-specific recognition appropriate.

These breaks in distribution probably relate to the distinct landforms and vegetation of the Cape. The Cape Range, with its sheltered woodland habitats in the valleys and gorges, gives way to country with uniform low relief to the south and east. Mountainous land units with topography equivalent to the Cape Range are not encountered until one reaches the Barlee and Hamersley Ranges, over two hundred kilometres to the east. The hundreds of kilometres of low-relief aeolian and alluvial country stretching to the north, east and south of the peninsula represents unsuitable habitat for some bird species (eg. the Spinifex Pigeon; Johnstone 1981).

Due to the extensive observations and collections of Thomas Carter at the turn of the century, we have some evidence of local environmental change having occurred on the Cape Range peninsula. Johnstone's (1990) survey of Western Australian mangrove bird communities shows that, while three species collected by Carter are now absent from the Mangrove Bay mangal (Mangrove Kingfisher, *Halcyon chloris*; Mangrove Golden Whistler, *Pachycephala melanura*; Mangrove Robin, *Eopsaltria pulverulenta*), three other species not recorded by Carter are now both common and conspicuous (Bar Shouldered Dove, *Geopelia humeralis*; White Breasted Woodswallow, *Artamus leucorhynchus*; White Breasted Whistler, *Pachycephala lanioides*). The former species are restricted to mangal with well developed *Rhizophora* or large *Avicennia* forest, now absent from Mangrove Bay. The sub-fossil remains of extensive *Rhizophora* stands are still apparent at Mangrove Bay; this change is an example of natural habitat evolution occurring over historical time.

Changes in bird community composition correlating with habitat modification are well

known. Throughout the arid zone, provision of artificial aquatic habitats or free water has benefited many species which would otherwise occur only as vagrants, or not at all (Storr 1984). Similarly, modification of habitat through European occupation (particularly through the effects of pastoralism) has led to local extinction (eg. the Night Parrot, *Pezoporus occidentalis*; Serventy and Whittell 1976) but also large extensions of range for some species (eg. the Galah, *Cacatua roseicapilla* and Emu, *Dromaius novaehollandiae*; Serventy and Whittell 1976). While the advent of pastoral land use may have led to such changes in the area, the avifauna of the peninsula area is typical of that of the north west coasts and adjacent semi-arid and arid hinterlands.

Reptiles and amphibians

Acquisition of systematic herpetofauna collections from the Cape Range peninsula did not begin until the 1960's, and intensive collections were not attempted until the late 1970's (Storr and Hanlon 1980). In 1978, Glen Storr and coauthors began to assess the regional herpetofaunas of the north west coast of Western Australia (Storr and Harold 1978, 1980, 1984, 1985; Storr and Hanlon 1980). Although significant additions to our knowledge of these faunas have been collected since, these works provide a valuable basis upon which to assess the biogeographic patterns of the Cape Range peninsula herpetofauna. Recent additions to these faunas were identified from the collections of the Western Australian Museum.

While Storr and Hanlon (1980) listed 114 species of reptile and amphibian (13 families, 49 genera) occurring in the general Exmouth area (including country to the east and south), the W.A. Museum collections now hold 125 species (13 families, 53 genera). However, if only terrestrial species (excluding the Chelonidae, Cheluidae and Hydrophidae) known to occur on the Cape Range peninsula (north of Point Cloates on the western coast, and Gales Bay in Exmouth Gulf) are considered, the total falls to 89 species (10 families, 40 genera; Tables 3 and 4). There are no recorded extinctions from the herpetofauna of the peninsula.

As with the birds, the Cape Range peninsula herpetofauna is made up of distinct components; ubiquitous species, elements of adjacent regional faunas which extend into the area, and local endemics. Many of the species present on the peninsula have very wide distributions, and the reader is referred to Wilson and Knowles (1988), Cogger (1983), or the excellent series of Western Australian Museum handbooks (Storr *et al.* 1981, 1983, 1986, 1990; Tyler *et al.* 1984) for further information on distributions.

The amphibian fauna of the Cape Range peninsula is small and composed largely of species with northern or central desert distributions (Table 3). *Cyclorana maini* and *Neobatrachus sutor* have ranges centred on the central deserts or semi-arid interior, while *Litoria rubella* is

Table 3. Listing of amphibian species occurring on the Cape Range peninsula, based upon specimens held in the collections of the W.A. Museum.

Species	Range
Leptodactylidae	
<i>Neobatrachus fulvus</i>	Semi-arid western coasts, WA
<i>Neobatrachus sutor</i>	Semi-arid southern interior, WA
<i>Pseudophryne douglasi</i>	Relictual, west Pilbara and Ashburton
Hylidae	
<i>Cyclorana maini</i>	North west and central arid zone, WA/NT
<i>Litoria rubella</i>	Monsoonal, arid and southern semi-arid, Australia wide

found across monsoonal, arid and southern semi-arid Australia. *Neobatrachus fulvus* occurs in coastal country between the Cape Range peninsula and Carnarvon, although the eastern limits of its range are unknown (J. D. Roberts, pers. comm.). *Pseudophryne douglasi* however occupies a scattered and probably relictual range across the southern Pilbara and Ashburton.

While the other frog species breed opportunistically following heavy rains (usually occurring in summer), *P. douglasi* appears to be a winter breeder. Main (1964) described breeding records for *P. douglasi* from the Chichester Range (west Pilbara), Barlee Range (Ashburton) and Cape Range, all following winter rains. The known localities and habitats from which the species is known (sheltered permanent wetlands in deep gorges or canyons) indicates a relictual distribution, and its breeding biology suggests southern affinities. On the Cape Range, *P. douglasi* is known from Shothole Canyon. The nearest known conspecific population are those from the Barlee Range, over 200 kilometres south east. This is a poorly known species which has not been recently collected.

Among the 84 species of terrestrial reptile recorded from the area, the Cape Range peninsula is the northern geographic limit of seven southern species: *Diplodactylus ornatus*, *Tympanocryptis parviceps*, *Ctenotus fallens*, *Lerista lineopunctulata*, *L. praepedita*, *Morethia lineocellata* and *Vermicella littoralis*. All of these species occur on the western coastal dunes and are largely restricted to the coastal corridor. Without exception, these species are endemic to southern Western Australia and are restricted to sandy coastal habitats along the western coast.

Many northern or inland reptiles extend onto the Cape Range peninsula and are found on the red sand ridges near Vlaming Head. Five of these (*Ctenotus grandis titan*, *Eremiascincus fasciolatus*, *Lerista bipes*, *Ctenophorus isolepis isolepis* and *Diporiphora winneckeii*) are primarily of the central and northern coastal sandy deserts. *Diplodactylus conspicillatus* and *Varanus brevicauda* are found throughout the Pilbara and the sandy deserts of the interior, while *Gehyra pilbara* favours the protected environments of termitaria throughout the Pilbara. Only one species, *Gemmatophora gilberti*, has a mainly northern distribution, extending southward along the north western coast from the monsoonal environments of the Kimberley and Northern Territory.

Five species occurring on the Cape Range peninsula are separated from other populations of conspecifics, which generally lie to the east and north. *Diplodactylus elderi* and *D. mitchelli* are both found in the Pilbara region, although the range of *D. elderi* extends over much of the southern and central interior of the continent. *Diplodactylus ciliaris aberrans* from Cape Range peninsula are isolated from populations in the Pilbara, Kimberley and central deserts. *Ctenophorus clayi* from Exmouth Gulf are distantly isolated from the larger part of this species range, in sand ridge habitats in southern central Australia. Finally, an isolated population of an undescribed species of *Acanthophis* occurs on the Cape Range peninsula. This species, otherwise found in the Pilbara region, has a disjunct distribution with *A. pyrrhus* from the Giralia area occurring between the two populations (K. Aplin, pers. comm.).

As Storr and Hanlon (1980) point out, the route by which these species reached the red dunes and sand plains at the northern end of the peninsula is unknown; they may have moved along the eastern side of the peninsula from the south, or through country now submerged beneath Exmouth Gulf.

Finally, five reptile species are endemic, or nearly so, to the Cape Range peninsula. *Aprasia fusca*, *Ctenotus rufescens* and *C. iapetus* occur mainly on the peninsula but are also found a short distance eastward in the dune and sand plain country of Bullara and Giralia Stations.

Table 4. Listing of reptile species occurring on the Cape Range peninsula, based upon specimens held in the collections of the W.A. Museum. Geographic ranges are summarised by the following abbreviations: E, endemic or local to the Exmouth Gulf area; N/M, northern monsoonal distribution; C/A, central arid zone (may include Pilbara as well as the central sandy deserts); P, Pilbara only (excludes sandy deserts); SW, western coastal and southern distribution. (I) indicates populations that are locally isolated on the Cape Range peninsula.

Reptile species, by families	Geographic ranges				SW
	E	N/M	C/A	P	
Gekkonidae					
<i>Crenadactylus ocellatus horni</i>		*	*	*	*
<i>Diplodactylus ciliaris aberrans</i> (I)	*	*	*	*	
<i>Diplodactylus conspicillatus</i>		*	*	*	
<i>Diplodactylus elderi</i> (I)	*		*	*	
<i>Diplodactylus jeanae</i>			*	*	
<i>Diplodactylus mitchelli</i> (I)	*			*	
<i>Diplodactylus ornatus</i>	*			*	
<i>Diplodactylus rankini</i>	*				
<i>Diplodactylus stenodactylus</i>		*	*	*	
<i>Diplodactylus strophurus</i>			*	*	
<i>Gehyra pilbara</i>	*		*		
<i>Gehyra punctata</i>			*		
<i>Gehyra variegata</i>		*	*	*	
<i>Heteronotia binoei</i>	*	*	*	*	
<i>Nephrurus levis occidentalis</i>				*	*
Pygopodidae					
<i>Aprasia fusca</i>	*				
<i>Delma nasuta</i>		*	*		
<i>Delma pax</i>			*		
<i>Delma tinctoria</i>	*	*	*		
<i>Lialis burtonis</i>	*	*	*	*	
<i>Pygopus nigriceps</i>	*	*	*	*	
Agamidae					
<i>Ctenophorus clayi</i> (I)	*		*		
<i>Ctenophorus femoralis</i>	*				
<i>Ctenophorus inermis</i>		*	*		
<i>Ctenophorus isolepis isolepis</i>			*	*	
<i>Ctenophorus maculatus badius</i>					*
<i>Ctenophorus reticulatus</i>					*
<i>Diporiphora winneckeii</i>	*		*	*	
<i>Gemmatophora gilberti gilberti</i>		*		*	
<i>Gemmatophora longirostris</i>			*	*	
<i>Moloch horridus</i>		*		*	
<i>Pogona minor minor</i>		*	*	*	
<i>Tympanocryptis parviceps</i>	*				
Scincidae					
<i>Carlia munda</i>	*		*		
<i>Cryptoblepharus carnabyi</i>		*		*	*
<i>Cryptoblepharus plagiocephalus</i>		*	*	*	*
<i>Ctenotus duricola</i>			*		
<i>Ctenotus fallens</i>				*	
<i>Ctenotus grandis titan</i>			*	*	
<i>Ctenotus iapetus</i>	*				

Table 4 (cont.)

Reptile species, by families	Geographic ranges				
	E	N/M	C/A	P	SW
<i>Ctenotus pantherinus ocellifer</i>		*	*	*	*
<i>Ctenotus rufescens</i>	*				
<i>Ctenotus saxatilis</i>	*	*	*		
<i>Cyclodomorphus melanops</i>			*	*	*
<i>Eremiascincus fasciolatus</i>			*	*	
<i>Eremiascincus richardsonii</i>			*	*	*
<i>Lerista allochira</i>	*				
<i>Lerista bipes</i>		*	*		
<i>Lerista elegans</i>				*	
<i>Lerista lineopunctulata</i>					*
<i>Lerista macropisthopus fusciceps</i>			*		*
<i>Lerista muelleri</i>		*	*	*	
<i>Lerista planiventralis planiventralis</i>					*
<i>Lerista praepedita</i>				*	
<i>Lerista uniduo</i>				*	
<i>Menetia greyii</i>	*	*	*	*	
<i>Menetia surda</i>			*	*	
<i>Morethia lineoocellata</i>					*
<i>Morethia ruficauda exquisita</i>				*	
<i>Morethia ruficauda ruficauda</i>		*	*		
<i>Notoscincus ornatus</i>	*	*	*		
<i>Tiliqua multifasciata</i>	*	*	*		
Varanidae					
<i>Varanus acanthurus</i>	*	*	*		
<i>Varanus brevicauda</i>	*	*	*		
<i>Varanus eremius</i>	*	*	*		
<i>Varanus giganteus</i>		*	*	*	
<i>Varanus gouldii</i>	*	*	*	*	
<i>Varanus tristis tristis</i>	*	*	*	*	
Typhlopidae					
<i>Ramphotyphlops diversus ammodytes</i>				*	
<i>Ramphotyphlops grypus</i>			*	*	
Boidae					
<i>Aspidites melanocephalus</i>		*		*	
<i>Morelia stimsoni stimsoni</i>		*	*	*	*
<i>Morelia perthensis</i>			*		
Elapidae					
<i>Acanthophis</i> sp. (I)	*			*	
<i>Demansia calodera</i>	*				*
<i>Demansia psammophis cupreiceps</i>		*		*	
<i>Denisonia fasciata</i>		*	*	*	
<i>Furina ornata</i>	*	*	*	*	
<i>Pseudechis australis</i>	*	*	*	*	
<i>Pseudonaja modesta</i>	*	*	*	*	
<i>Pseudonaja nuchalis</i>	*	*	*	*	
<i>Vermicella bertholdi</i>		*		*	
<i>Vermicella littoralis</i>				*	
<i>Vermicella semifasciata</i>			*		*

Diplodactylus rankini occurs in the white coastal dunes of the west coast of the Cape Range peninsula, and extends for a short distance to the south. The only true endemic vertebrate of the Cape Range is *Lerista allochira*, which is restricted to the dissected limestone country of the Cape Range block (Kendrick 1989). It exists in sympatry with the similar but widely distributed *L. muelleri* (which appears to be a composite taxon: K. Aplin, pers. comm.).

Discussion

The Cape Range peninsula supports a rich vertebrate fauna, due to the range of habitats available (from mangrove and inter-tidal marine to sand ridges, alluvial plains and rocky ranges) and the occurrence of species at the limits of their geographic range or as geographically isolated populations (one mammal, one frog, 11 birds, 21 reptiles). The extant vertebrate fauna of the peninsula shows a pattern typical of much of arid or semi-arid Australia; mammals were severely disrupted following European settlement, with numerous feral species established, while the bird and reptile faunas are apparently largely or completely intact (Morton 1990).

The ruggedly dissected limestone of the Cape Range offers habitats not found in the surrounding lowlands. These are clearly important to a range of species requiring rocky habitats, including *Taphozous georgianus* (an obligate cave-roosting bat), *Petrogale lateralis*, *Lerista allochira*, *Pseudophryne douglasi*, Rufous-crowned Emu Wren (*Stipiturus ruficeps*), Grey Headed Honeyeater (*Lichenostomus keartlandi*), Painted Firetail Finch (*Emblema picta*), and Spotted Bowerbird (*Chlamydera maculata*).

Of the 13 reptiles restricted to the Cape Range peninsula area, only *Lerista allochira* appears to be dependant upon the elevated limestone of the Cape Range. The other twelve species (Table 4) are found on sandy habitats of the peninsula (the white western coastal dunes or the red dunes at the base of the peninsula or near North West Cape). While the limestone of the Cape Range supports the only true endemic reptile of the peninsula, the sandy habitats support isolated populations of both southern and northern/central species. The origins of these populations are obscure, but it is likely that they were once connected to conspecific populations by areas of suitable habitat. These aeolian units may now be inundated by marine transgression, or dissipated by erosional processes.

A similar pattern is apparent among the frogs. *Pseudophryne douglasi*, probably a species of southern origin now occupying a precarious and relictual habitat, is found in the eastern gorges of the Cape Range. However, the other frog species are more competent in arid environments, and excepting the opportunistically distributed *Litoria rubella*, are widespread on the sandy or loamy substrates adjacent to the limestone uplands of the Cape Range.

Cape Range peninsula is not an intense centre of endemism for vertebrates. Two birds (Spinifex Pigeon, *Petrophassa plumifera* and Grey Shrike-thrush, *Colluricincla harmonica rufiventris*) show distinct variation in locally isolated populations on the peninsula, and one lizard (*Lerista allochira*) is restricted to the Cape Range. This general absence of high levels of endemism or local sub-specific distinctiveness, despite the occurrence of isolated populations of both birds and reptiles, indicates that isolation has been relatively recent. The elapsed time has been insufficient for sub-specific differentiation to develop within the isolated populations.

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