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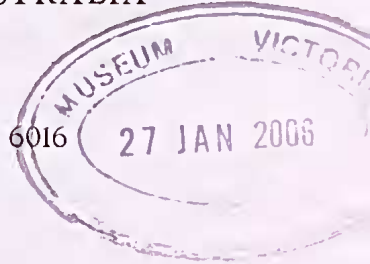
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A HERPETOFAUNA HOTSPOT, THE CENTRAL WEST COAST OF WESTERN AUSTRALIA

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ABSTRACT

The herpetofauna of the Geraldton region was first described in detail by Storr *et al.* (1983) in one of several papers dealing with the herpetofauna of the west coast of Western Australia. Twenty years on, additional information shows the coastal and hinterland areas of the central west coast of Western Australia south of the Kalbarri National Park to Leeman (an area of only *ca.*1620 km²) supports an incredibly rich herpetofauna comprising 115 terrestrial and marine species and subspecies of frogs, turtles, lizards and snakes. This represents the highest herpetofaunal diversity than that recorded from other areas on the west coast between Shark Bay and Onslow. Aspects of regional composition, biogeography and conservation are discussed in the context of new species recorded and discovered for the area. These recent discoveries underline how much more work is required before a complete understanding of biodiversity and distribution is attained. Attention is drawn to the biogeographical significance of Kalbarri National Park and the necessity to conduct a systematic biological survey of the area.

INTRODUCTION AND BACKGROUND

The coastal areas of the south-west of Western Australia have been subject to increasing

pressures since European settlement and, similar to other areas, the central west coast in recent times has become the focus of major developments for

agriculture, mining and tourism (How *et al.* 1987). This economic importance and continual environmental pressures exacerbates the fragmentation of the unique landforms and biota of the region. Thus a revised evaluation of this 'herpetological hotspot' is warranted in light of this anthropogenic disturbance as the only detailed assessment of the herpetofauna of the region was done over 20 years ago (Storr *et al.* 1983). Taxonomic revisions

of certain species and an increased level of opportunistic sampling by field herpetologists has also highlighted the need for an inventory that reinforces the true richness of the central west coast.

The region's diversity of 109 terrestrial and six marine species (Table 1) is exceptional when comparisons are made with detailed inventories and literature from other regions. The diverse herpetofauna of the

Table 1. Herpetofauna species list for the Central West Coast. Those species that are unlikely to occur naturally in the area are marked with * (see section on Herpetofaunal Introductions and Dubious Records for further comments).

Myobatrachidae – Ground Frogs

Crinia pseudinsignifera
Heleioporus albopunctatus
Heleioporus eyrei
Heleioporus psammophilus
Limnodynastes dorsalis
Myobatrachus gouldii
Neobatrachus kunapalari
Neobatrachus pelobatoides
Neobatrachus sutor
Neobatrachus wilsmorei
Pseudophryne guentheri

Hylidae – Tree Frogs

Litoria adelaidensis
Litoria moorei
Litoria rubella *

Cheloniidae – Sea Turtles

Caretta caretta
Chelonia mydas
Eretmochelys imbricata bissa

Cheluidae – Freshwater Turtles

Chelodina oblonga *
Chelodina steindachneri

Gekkonidae – Geckos

Christinus marmoratus

Crenadactylus ocellatus ocellatus
Diplodactylus alboguttatus
Diplodactylus granariensis granariensis
Diplodactylus ornatus
Diplodactylus polyophthalmus
Diplodactylus pulcher
Diplodactylus squarrosus
Gehyra punctata *
Gehyra variegata
Heteronotia binoei
Nephurus levis occidentalis
Strophurus michaelsoni
Strophurus spinigerus spinigerus
Strophurus strophurus
Underwoodisaurus milii

Pygopodidae – Legless Lizards

Aprasia sp. nov. aff. '*fusca*'
Aprasia repens
Delma australis
Delma butleri
Delma concinna concinna
Delma fraseri
Delma grayii
Delma tincta
Lialis burtonis
Pletholax gracilis gracilis
Pygopus lepidopodus
Pygopus nigriceps

Table 1. (cont.)

Agamidae – Dragons	<i>Morethia obscura</i>
<i>Ctenophorus maculatus maculatus</i>	<i>Tiliqua occipitalis</i>
<i>Ctenophorus nuchalis</i>	<i>Tiliqua rugosa rugosa</i>
<i>Ctenophorus reticulatus</i>	
<i>Lophognathus longirostris</i>	Varanidae – Monitors
<i>Moloch horridus</i>	<i>Varanus breviceuda</i> *
<i>Pogona minor minima</i>	<i>Varanus caudolineatus</i>
<i>Pogona minor minor</i>	<i>Varanus eremius</i>
<i>Rankinia adelaidensis adelaidensis</i>	<i>Varanus giganteus</i>
<i>Rankinia parviceps butleri</i>	<i>Varanus gouldii</i>
<i>Tympanocryptis cephalus</i> *	<i>Varanus panoptes rubidus</i> *
	<i>Varanus tristis tristis</i>
Scincidae – Skinks	
<i>Cryptoblepharus carnabyi</i>	Typhlopidae – Blind Snakes
<i>Cryptoblepharus plagiocephalus</i>	<i>Ramphotyphlops australis</i>
<i>Ctenotus alleni</i>	<i>Ramphotyphlops hamatus</i>
<i>Ctenotus australis</i>	<i>Ramphotyphlops leptosoma</i>
<i>Ctenotus fallens</i>	<i>Ramphotyphlops waitii</i>
<i>Ctenotus impar</i>	
<i>Ctenotus mimetes</i>	Boidae – Pythons
<i>Ctenotus pantherinus pantherinus</i>	<i>Antaresia stimsoni stimsoni</i>
<i>Ctenotus schomburgkii</i>	<i>Aspidites ramsayi</i>
<i>Ctenotus severus</i>	<i>Morelia spilota imbricata</i>
<i>Ctenotus uber uber</i>	
<i>Cyclodomorphus branchialis</i>	Elapidae – Front Fanged Snakes
<i>Cyclodomorphus celatus</i>	(Terrestrial Forms)
<i>Egernia kingii</i>	<i>Acanthophis antarcticus</i> *
<i>Egernia multiscutata</i>	<i>Brachyurophis fasciolata fasciolata</i>
<i>Egernia stokesii badia</i>	<i>Brachyurophis semifasciata</i>
<i>Egernia stokesii stokesii</i>	<i>Demansia psammophis reticulata</i>
<i>Eremiascincus richardsonii</i>	<i>Echiopsis curta</i>
<i>Hemiergis quadrilineata</i>	<i>Elapognathus coronatus</i> *
<i>Lerista axillaris</i>	<i>Neelaps bimaculatus</i>
<i>Lerista christinae</i>	<i>Neelaps calonotos</i>
<i>Lerista distinguenda</i>	<i>Parasuta gouldii</i>
<i>Lerista elegans</i>	<i>Parasuta monachus</i>
<i>Lerista gerrardii</i>	<i>Pseudechis australis</i>
<i>Lerista kendricki</i>	<i>Pseudonaja modesta</i>
<i>Lerista lineopunctulata</i>	<i>Pseudonaja nuchalis</i>
<i>Lerista macropisthopus galea</i>	<i>Simoselaps bertholdi</i>
<i>Lerista muelleri</i>	<i>Simoselaps littoralis</i>
<i>Lerista planiventralis decora</i>	<i>Suta fasciata</i>
<i>Lerista praepectata</i>	
<i>Lerista yuna</i>	Elapidae – Front Fanged Snakes
<i>Menetia greyii</i>	(Marine Forms)
<i>Menetia surda cresswelli</i>	<i>Disteira major</i>
<i>Morethia butleri</i>	<i>Hydrophis elegans</i>
<i>Morethia lineoocellata</i>	<i>Pelamis platura</i>

Perth region (Bush *et al.* 1995) is significant by Australian standards with 86 species. Further south, and reflecting the more southerly location with cooler temperatures, only 59 are recorded from coastal areas between Busselton and Albany (How *et al.* 1987).

The first detailed inventories of the west coast of Western Australia (including the area discussed here) were carried out between 1976 and 1983 in which the biogeographical relationships and habitat preferences of the herpetofauna were documented. These inventories detailed 103 species from Shark Bay (Storr and Harold 1978, 1990); 83 from Zuytdorp coast and hinterland (Storr and Harold 1980); 89 from Exmouth (Storr and Hanlon 1980; Kendrick 1993); 98 from Lake MacLeod (Storr and Harold 1984) and 81 from Onslow (Storr and Harold 1985). To emphasise the high diversity of the current project area, the more recent systematic survey of a much bigger area, the southern Carnarvon Basin recorded 133 terrestrial species from a 75 000 km² study area (McKenzie *et al.* 2000).

The only detailed systematic surveys conducted in areas on the central west coast to date consist of the Cockleshell Gully Reserve (Dell and Chapman 1977) and Wandana, East Yuna and Bindoo Hill Nature Reserves near Yuna (Burbidge *et al.* 1978; Dell *et al.* 1981). To the immediate north-west of these lies the regionally

significant Kalbarri National Park. Apart from unpublished studies by Bannister *et al.* (1969), this area is yet to be systematically surveyed (Table 2). As highlighted by Storr *et al.* (1983) much of the published information on the herpetofauna of the central west coast covered only the Houtman Abrolhos. Herpetological fieldwork on these islands has been limited and of an opportunistic nature without any systematic surveys. However the species compositions of some island groups (Table 3) have been slightly changed with more recent visits (How *et al.* 2004).

During the past twenty years our knowledge and understanding of the regional herpetofauna has been greatly improved by the many naturalists exploring the sandplain, wetlands, coastal dunes and other habitats on the central west coast. In particular, the efforts of long-term Geraldton residents, S. Heriot and A. Desmond, have contributed substantially in this area by conducting pit trapping programs at Spalding Park and Wicherina, and collecting many additional specimens that have included significant distributional records and even unnamed taxa awaiting formal description. Taxonomic revisions have also enhanced the richness of the central west coast with recent descriptions of the following species: *Cyclodomorphus branchialis* (Shea and Miller 1995), *Lerista axillaris*, *L. kendricki*, *L. yuna*

Table 2. Herpetofauna species list for the Kalbarri National Park (including Kalbarri townsite) based on Western Australian Museum records *, field observations by naturalists + and unpublished studies by Bannister *et al.* (1969) #.

<i>Arenophryne rotunda</i> * +	<i>C. plagiocephalus</i> * + #
<i>Crinia pseudinsignifera</i> *	<i>Ctenotus australis</i> * #
<i>Heleioporus albopunctatus</i> * +	<i>C. fallens</i> * + #
<i>H. psammophilus</i> *	<i>C. p. pantherinus</i> *
<i>Limnodynastes dorsalis</i> *	<i>C. schomburgkii</i> * #
<i>Myobatrachus gouldii</i> *	<i>C. severus</i> #
<i>Neobatrachus kunapalari</i> * +	<i>Cyclodomorphus celatus</i> *
<i>N. pelobatoides</i> * +	<i>Eremiascincus richardsonii</i> * #
<i>N. wilsmorei</i> +	<i>Lerista connivens</i> * + #
<i>Pseudophryne guentheri</i> * +	<i>L. elegans</i> * + #
<i>Litoria moorei</i> *	<i>L. kendricki</i> *
<i>Chelodina steindachneri</i> * #	<i>L. lineopunctulata</i> * + #
<i>Crenadactylus ocellatus</i> subsp. * +	<i>L. macropisthopus galea</i> * #
<i>Diplodactylus alboguttatus</i> * + #	<i>L. muelleri</i> * #
<i>D. ornatus</i> + #	<i>L. planiventralis decora</i> * #
<i>Gehyra variegata</i> * + #	<i>L. praepedita</i> * +
<i>Heteronotia binoei</i> * + #	<i>Menetia greyii</i> * + #
<i>Nephrurus levis occidentalis</i> * + #	<i>M. surda cresswelli</i> *
<i>Strophurus s. spinigerus</i> * + #	<i>Morethia butleri</i> * #
<i>Underwoodisaurus milii</i> * #	<i>M. lineoozellata</i> * + #
<i>Aprasia</i> aff. 'fusca' *	<i>Tiliqua occipitalis</i> * + #
<i>A. smithi</i> *	<i>T. r. rugosa</i> * + #
<i>Delma fraseri</i> #	<i>Varanus eremius</i> #
<i>D. grayii</i> *	<i>V. gouldii</i> * + #
<i>Lialis burtonis</i> * + #	<i>V. t. tristis</i> * #
<i>Pletholax gracilis edelensis</i> *	<i>Ramphotyphlops leptosoma</i> * + #
<i>Pygopus lepidopodus</i> * + #	<i>Antaresia s. stimsoni</i> * #
<i>P. nigriceps</i> *	<i>Brachyurophis f. fasciolata</i> *
<i>Ctenophorus m. maculatus</i> * + #	<i>B. semifasciata</i> * +
<i>C. nuchalis</i> * + #	<i>Demansia psammophis reticulata</i> * + #
<i>C. reticulatus</i> * + #	<i>Echiopsis curta</i> *
<i>C. scutulatus</i> * + #	<i>Parasuta gouldii</i> *
<i>Lophognathus longirostris</i> * + #	<i>P. monachus</i> * #
<i>Moloch horridus</i> * + #	<i>Pseudechis australis</i> * #
<i>Pogona m. minor</i> * + #	<i>Pseudonaja modesta</i> * #
<i>Rankinia a. adelaidensis</i> * #	<i>Pseudonaja nuchalis</i> * + #
<i>Cryptoblepharus carnabyi</i> * +	<i>Simoselaps littoralis</i> * + #

(Storr 1991a,b) and *Menetia surda cresswelli* (Aplin and Adams 1998).

STUDY AREA

The study area (ca 1620 km²) is

located on the west coast of Western Australia approximately between latitudes 28° and 30° south and extends inland to about Galena, Ajana, Yuna, Mullewa, Three Springs and

Table 3. Distribution of the reptiles on the Houtman Abrolhos by island groups.

SPECIES	NORTH	WALLABI	EASTER	PELSAERT
<i>Chelonia mydas</i>	X	X		
<i>Christinus marmoratus</i>	X	X	X	X
<i>Crenadactylus o. ocellatus</i>		X	X	X
<i>Diplodactylus ornatus</i>		X		
<i>Gehyra variegata</i>		X		X
<i>Heteronotia binoei</i>	X	X		
<i>Strophurus s. spinigerus</i>		X		
<i>Underwoodisaurus milii</i>		X		X
<i>Delma australis</i>			X	X
<i>D. grayii</i>		X		
<i>Lialis burtonis</i>		X		
<i>Pogona minor minima</i>	X	X		
<i>Cryptoblepharus carnabyi</i>		X	X	X
<i>Ctenotus fallens</i>	X	X	X	X
<i>Egernia kingii</i>	X	X		X
<i>E. s. stokesii</i>		X	X	X
<i>Lerista distinguenda</i>			X	
<i>L. elegans</i>	X	X		X
<i>L. lineopunctulata</i>	X	X		X
<i>L. praepedita</i>	X	X		X
<i>Menetia greyii</i>	X	X	X	X
<i>Morethia lineoocellata</i>	X	X		
<i>M. obscura</i>				X
<i>Ramphorhynchops australis</i>		X		
<i>Morelia spilota imbricata</i>		X		
<i>Simoselaps littoralis</i>		X		
TOTAL	11	23	8	14

Coorow, and includes the Houtman Abrolhos islands (Figure 1). The study area is located in the northern Geraldton Sandplains Bioregion that extends from Shark Bay south to the vicinity of Jurien and Badgingarra (Beard 1990). Beard (1976) has reviewed the physiography, soils and vegetation of this area and Storr *et al.* (1983) also provide a summary description of the environment.

HERPETOFAUNAL COMPOSITION

The 57 genera and 115 species and subspecies of naturally occurring amphibians and reptiles are distributed in 12 families (Table 1). Of the 115 species and subspecies of frogs and reptiles known to occur on the central west coast, 30 (26%) are endemic to southwestern Australia. Complementing this comparatively high proportion of



Figure 1. Map of the central west coast of Western Australia, showing the study area outlined with a continuous line.

endemics are a large number of species that reach their distributional limits, and combined, these highlight the biogeographical significance of the study area. The zoogeographic relationships of the species are briefly discussed in family sequence.

MYOBATRACHIDAE

Myobatrachid frogs are quite diverse on the central west coast with 10 species. One genus, *Myobatrachus* and six species are endemic to southwestern Australia attaining their northern limit of known distribution in the study area, viz.:

Crinia pseudinsignifera, *Heleioporus albopunctatus*, *H. eyrei*, *H. psammophilus*, *Limnodynastes dorsalis*, *Myobatrachus gouldii* and *Pseudophryne guentheri*. *Neobatrachus* has four species of which *N. pelobatoides* is endemic to southwestern Australia while *N. kunapalari*, *N. sutor* and *N. wilsmorei* are widespread throughout the semiarid and arid regions of Western Australia.

HYLIDAE

The two species recorded on the central west coast, *Litoria adelaidensis* and *L. moorei*, are endemic to southwestern Australia attaining their northern

limit of known distribution in the study area. This family is poorly represented in southwestern Australia, a pattern that may be attributed to the drier conditions, as they are more diverse in Australia's tropical and eastern regions (Cogger 2000).

CHELONIIDAE

The monotypic genera *Caretta*, *Chelonia* and *Eretmochelys* are all more or less confined to tropical and warm temperate seas. Although they do occur naturally in waters off the central west coast they are not often seen. Contrary to the anecdotal report of *Chelonia mydas* nesting on North Island in the Houtman Abrolhos (Storr 1960), nesting always occurs on tropical to subtropical beaches (Wilson and Swan 2003) to the north of the study area.

CHELUIDAE

Chelodina steindachneri is endemic to Western Australia and is a widespread arid-adapted species occurring in watercourses between the De Grey and Irwin Rivers. The southern limit of its known distribution is on the central west coast.

GEKKONIDAE

Geckos are prominent on the central west coast with 15 species. Three of these species are endemic to southwestern Australia: *Diplodactylus polyopthalmus*, *Strophurus michaelsoni* and *S. spinigerus* (2 subspecies). *Diplodactylus*

polyopthalmus attains its northern limit of known distribution in the study area, while *D. pulcher*, *D. squarrosus*, *Nephrurus levis* and *Strophurus strophurus* attain their southern distributional limit here. Those species with primarily west coastal distributions are *Diplodactylus alboguttatus*, *D. ornatus* and *S. michaelsoni* (restricted to semiarid west coast and hinterland). *Diplodactylus granariensis* (2 subspecies), *D. pulcher*, *D. squarrosus*, *N. levis* (3 subspecies) and *S. strophurus* are widespread throughout semiarid and arid regions of Western Australia. *Crenadactylus ocellatus* (4 subspecies) comprises several disjunct populations in Western Australia. *Christinus marmoratus* and *Underwoodisaurus milii* are widespread across southern Australia. *Gehyra variegata* and *Heteronotia binocoi* are both widespread throughout most of temperate and arid Australia.

PYGOPODIDAE

Pygopodids are exceptionally rich on the central west coast with 11 species occurring here. One genus, *Pletholax*, and four species, *Aprasia repens*, *Delma concinna* (2 subspecies), *Delma grayii* and *Pletholax gracilis* (2 subspecies), are endemic to southwestern Australia. *Aprasia repens* and *D. grayii* attain their northern limit of known distribution in the study area, while *Delma butleri*, *D. tinctoria* and *Pygopus nigriceps* attain their southern distributional limit

here. *Aprasia repens* is a southwestern representative of a widespread genus, though mainly in southern Australia, while the northern representative species, *Aprasia fusca*, has affinities with a currently undescribed taxon on the central west coast. *Delma grayii* has a relatively restricted west coast distribution. The remaining species are widespread in southwestern Australia and throughout arid and tropical Australia, viz.: *Delma australis*, *D. butleri*, *D. fraseri* and *D. tincta*. *Lialis burtonis* is widespread throughout the greater part of Australia. *Pygopus lepidopodus* and *P. nigriceps* have widespread southern and northern distributions respectively that overlap on the central west coast.

AGAMIDAE

Agamids are represented on the central west coast by 9 species with none endemic to southwestern Australia. *Rankinia adalaidensis* (2 subspecies) attains its northern limit of known distribution in the study area, while *Ctenophorus nuchalis*, *C. reticulatus*, *Lophognathus longirostris*, *Moloch horridus* and *Rankinia parviceps* (2 subspecies) attain their southern distributional limit here. Both *Rankinia* species share primarily west and south coastal distributions. *Ctenophorus maculatus* (4 subspecies), *C. nuchalis*, *C. reticulatus*, *L. longirostris*, *M. horridus* and *Pogona minor* (3 subspecies) are widespread outside

the central west coast, throughout the temperate, semiarid and arid regions of Western Australia.

SCINCIDAE

Skinks are the most diverse group on the central west coast with 37 species. Twelve species are endemic to southwestern Australia: *Ctenotus alleni*, *C. australis*, *C. impar*, *Cyclodomorphus branchialis*, *Egernia kingii*, *Hemiergis quadrilineata*, *Lerista axillaris*, *L. christinae*, *L. distinguenda*, *L. gerrardii*, *L. kendricki* and *L. yuna*. From these, *C. branchialis* (almost so), *L. axillaris* and *L. yuna* are endemic to the central west coast. *C. impar*, *L. christinae* and *L. distinguenda* attain their northern limit of known distribution in the study area, while *Cryptoblepharus carnabyi*, *Ctenotus alleni*, *C. mimetes*, *C. schomburgkii*, *C. severus*, *Lerista gerrardii*, *L. kendricki*, *L. muelleri* and *Morethia butleri* attain their southern distributional limit here.

A number of skink species have extensive west coastal distributions, viz.: *Ctenotus australis*, *C. fallens*, *Cyclodomorphus celatus*, *H. quadrilineata* (restricted mostly to Swan Coastal Plain), *Lerista elegans*, *L. lineopunctulata*, *L. planiventralis* (3 subspecies), *L. praepedita* and *Morethia lineocellata*. *Egernia stokesii* (3 subspecies) is comprised of fragmented populations on Western Australia's west coast (mostly islands), semiarid regions and eastern interior of Australia. The remaining species have

wider distributions in Western Australia or are widespread throughout the greater part of Australia.

VARANIDAE

Varanids are represented on the central west coast by 3 species with none endemic to southwestern Australia. *Varanus caudolineatus* is endemic to Western Australia and is widespread throughout the semiarid and arid regions. The southern limit of its known distribution is on the central west coast. *Varanus gouldii* and *V. tristis* are widespread throughout temperate, arid and tropical Australia.

TYPHLOPIDAE

Blind snakes are represented on the central west coast by 4 species with none endemic to southwestern Australia. *Ramphotyphlops hamatus* and *R. leptosoma* (restricted to midwest coast) attain their southern limit of known distribution in the study area. *Ramphotyphlops australis*, *R. hamatus* and *R. waitii* are widespread throughout the temperate, semiarid and arid regions of Western Australia.

BOIDAE

Pythons are represented on the central west coast by 3 species with none endemic to southwestern Australia. *Aspidites ramsayi* is widely distributed in arid Australia, however the populations in Western Australia appear disjunct (Maryan 2002).

Morelia spilota (7 subspecies) is widespread throughout temperate and tropical Australia, and *Antaresia stimsoni* (2 subspecies) is widespread throughout the greater part of Australia.

ELAPIDAE (Terrestrial Forms)

The terrestrial elapid fauna of the central west coast is diverse with 14 species. Two species are endemic to southwestern Australia: *Neelaps calonotos* and *Parasuta gouldii*. *Suta fasciata* is endemic to the semiarid and arid regions of Western Australia. *Brachyuropis semifasciata*, *Echiopsis curta*, *N. calonotos* and *P. gouldii* attain their northern limit of known distribution in the study area, while *Parasuta monachus*, *Pseudonaja modesta* and *S. fasciata* attain their southern distributional limit here. The small fossorial snakes are well represented with *Brachyuropis*, *Neelaps* and *Simoselaps* each having two species. *Neelaps calonotos* is restricted mostly to the Swan Coastal Plain and has only been recently recorded on the central west coast. Endemic to WA, *Simoselaps littoralis* has an extensive west coastal distribution. *Brachyuropis fasciolata* (2 subspecies), *B. semifasciata*, *Neelaps bimaculatus* and *Simoselaps bertholdi* are widespread throughout the temperate and arid regions of Western Australia. *Echiopsis curta* is essentially coastal in distribution with disjunct populations across southern Australia. The remaining species, *Demansia psammophis* (3

subspecies), *Pseudechis australis*, *Pseudonaja modesta* and *P. nuchalis* are widespread throughout the greater part of Australia.

ELAPIDAE (Marine Forms)

The marine elapids are all more or less confined to tropical and warm temperate seas. Due to the southerly location of the central west coast they are not often seen and are more encountered on beaches after winter storms (Storr *et al.* 2002). The exception is *Pelamis platura*, the most widespread and pelagic of the marine elapids and a true inhabitant of central west coast waters.

HERPETOFAUNAL INTRODUCTIONS AND DUBIOUS RECORDS

Those species with the symbol * in the species list (Table 1) are omitted from the herpetofaunal composition as they almost certainly represent a human-induced introduction or have uncertain locality information. All registered specimens cited in this paper are lodged in the Western Australian Museum (R suffix omitted from registration numbers in brackets).

Chelodina oblonga appears to be established in both the Greenough and Chapman Rivers from turtles originally caught by a farmer in the 1940's from Perth lakes (S. Heriot pers. comm.). During his residence in Geraldton, Mr Heriot often received calls when the

Chapman River flooded, from worried residents living along the Champion Bay foreshore, alerting him to the presence of 'weary long-necked turtles' crawling up the beach. A specimen of *C. oblonga* (127472) is lodged at the WA Museum from Bluff Point in Geraldton. The northern limit of their natural distribution is the Hill River, immediately south of the study area.

Small species of frogs and lizards are commonly transported inadvertently in produce, firewood, sandalwood and nursery plants (Bush 1987). The two abundant northern WA species, *Litoria rubella* (131741) and *Gehyra punctata* (113646) definitely qualify for inadvertent 'stow-away' species to the study area.

The remaining species, *Tympanocryptis cephalus* (13476), *Varanus brevicauda* (12159), *V. panoptes rubidus* (14891), *Acanthophis antarcticus* (12368) and *Elapognathus coronatus* (12355-56, 15071) are omitted on account of their distant natural distributions to the study area and that no further specimens have been collected in recent times to verify the authenticity of earlier records. These could also qualify for introductions, however it is more likely a case of 'human error' on the collector's part or they represent incorrect entries on the WA Museum database. As the most southerly record for *V. brevicauda* on the west coast is 16km S of Hamelin Homestead (pers. obs.) at Shark Bay and no

further specimens have been collected in the wider vicinity, its distribution as stated by Storr *et al.* (1983) extending south to Mullewa requires confirmation. Regarding the two snakes, *A. antarcticus* and *E. coronatus*, I concede that the anecdotal reports of 'adder-like' snakes in grasslands east of Geraldton (S. Heriot pers. comm.) raises the possibility for *A. antarcticus* (or another taxa) being present in the study area. There is more than a single record for the other species, however two of these specimens have been discarded and cannot be checked to confirm identification (Storr *et al.* 2002). Also in this category, an old record of *Lerista greeri* (188) from the Houtman Abrolhos (listed by Storr *et al.* 1983), is not included in the species list as it naturally occurs in the Kimberley region. In addition to this, Storr *et al.* (1983) did not mention the Houtman Abrolhos records of *Limnodynates dorsalis*, *Myobatrachus gouldii* and *Eremiascincus richardsonii* documented by Alexander (1922).

HERPETOFAUNA OF ADJACENT LOCATIONS

A number of species recorded from localities just outside the study area have been included in species list to highlight geographic proximity and their potential presence with future field work. In this category are: *Neobatrachus wilsmorei* recorded from Kalbarri National Park and

East Yuna Nature Reserve (pers. obs.), *Ctenotus uber uber* from Gutha (141884-85) and Pintharuka (141941), *Varanus eremius* from 29 km N of Ajana (33597) and *V. giganteus* from 2 km N of Galena (Thompson *et al.* 2005). Despite the close proximity of *N. wilsmorei* to the study area and reported occurring south to the Irwin River (Tyler *et al.* 2000), there are no confirmed records in the WA Museum collection. However, it is likely the species occurs in the area and searching after rain may reveal its presence. In addition to this, several species are recorded to the immediate north (Kalbarri townsite and National Park) and immediate east (Bindoo Hill, Wandana Hill and East Yuna Nature Reserves) but appear absent from the study area, viz. *Arenophryne rotunda*, *Rhynchoedura ornata*, *Aprasia smithi*, *Ctenophorus scutulatus*, *Egernia inornata* and *Lerista connivens* based on Western Australian Museum records, Burbidge *et al.* (1978) and Dell *et al.* (1981).

Further to the Storr *et al.* (1983) listing of species likely to be recorded in the study area, the following are now confirmed as present: *Amphibolurus parviceps* = *Rankinia parviceps butleri*, *Ctenotus severus*, *Lerista muelleri* and *L. 'nicholli'* = *L. kendricki/yuna*. Storr *et al.* 1983 lists another species, *Lerista humphriesi* as a possible addition to the study area. This species is morphologically similar to *L. praepedita* and has not been

recorded south of the Kalbarri National Park, the most southerly regional specimens being from near Murchison House Homestead (64441-42, 64346-47). It now appears to be entirely endemic to the Zuytdorp coast and hinterland (Storr and Harold 1980).

KALBARRI NATIONAL PARK

Kalbarri National Park lies immediately north of the study area and comprises a large area (183 004 ha) of predominantly sandplain gazetted for the conservation of flora and fauna. It is well known for its scenic sandstone gorges along the Murchison River and wildflowers that in turn generates much tourism and public interest. Furthermore, the largest and richest remnant of the original kwongan of the Northern Sandplains is preserved in the Kalbarri National Park (Beard 1990). Despite its regional conservation importance this extensive area is yet to be systematically surveyed and there is no published herpetological information (Table 2). The number of interesting distributional records and species reaching their apparent northern limits (ie. *H. psammophilus*, *E. curta* and *P. gouldii*) that have only been recorded in recent times by opportunistic collecting indicates this national park has substantial biogeographical significance. For instance, as recently as July 2003

Myobatrachus gouldii was recorded for the first time from the Kalbarri National Park. This national park requires a systematic biological survey to improve our knowledge and understanding of its faunal composition resulting in a better appreciation of its value as a conservation reserve.

HOUTMAN ABROLHOS

The gecko, *Diplodactylus ornatus*, and the blind snake, *Ramphotyphlops australis* represent the only additions since the list presented by Storr *et al.* (1983) for reptiles recorded from the Houtman Abrolhos archipelago (Table 3). They also provided some comments on species zoogeography. Brief visits in recent times have changed species composition on some islands highlighting the need to conduct a more systematic biological sampling regime using pitfall trapping techniques as there is considerable information still to be gathered on the reptile fauna of this remote archipelago (How *et al.* 2004).

A visit by S. Heriot and B. Maryan to North Island in March 1996 added *L. elegans*, *L. lineopunctulata* and *M. greyii*. As recently as April 2003 the species composition on several islands in the Pelsaert Group was changed by adding *L. lineopunctulata* and *M. greyii* on Gun Island, *C. o. ocellatus*, *C. carnabyi*, *L. elegans* and *M. obscura* on Murray Island and *D. australis* and *M. obscura* on Middle Island

(How *et al.* 2004). From this brief survey *D. australis*, *L. elegans*, *L. lineopunctulata* and *M. greyii* represented entirely new records for the Pelsaert Group. For large islands such as East and West Wallabi with diverse habitats it usually takes some time too fully determine their herpetofaunal assemblages.

Generally the herpetofauna of the Houtman Abrolhos islands could be considered to be impoverished, however it compares favourably with the 20 reptile and one frog species recorded from the Archipelago of the Recherche (Smith and Johnstone 1996). Contrary to Storr's (1983) assertion that the archipelago's herpetofauna differs considerably from that of the adjacent mainland, it is comprised of primarily coastal-inhabiting species, except for the absence of occasional species on the adjacent mainland. However, these scenarios are no less different than occurs with disjunct distributions or species compositions on other island groups.

Lerista distinguenda is only known from Rat Island in the Easter Group and appears to be patchily distributed on the adjacent mainland. *D. australis* and *M. greyii* have been recorded for the first time from some islands (How *et al.* 2004) and are probably more widespread throughout the archipelago than the few records indicate. Apart from the Houtman Abrolhos endemic *Pogona m. minima*, the following

species, *Christinus marmoratus*, *Cryptoblepharus carnabyi* (terrestrial spotted form) and *Egernia s. stokesii*, occur on the islands but are absent from the adjacent mainland. These three species reappear on the mainland much further north, mainly in the Shark Bay area (albeit *C. marmoratus* is only known from a single record). The presence of *Morelia spilota imbricata* on islands in the Wallabi group is comparable to populations on Garden Island and the Archipelago of the Recherche. However in recent times it has been observed that densities of *M. s. imbricata* on the islands are comparatively different. They appear to be common on West Wallabi Island, scarce on East Wallabi Island with only two recent confirmed sightings in October 2003 and November 2005, and highly unlikely that Seagull Island supports a viable population (D. Pearson pers. comm.) with no records.

In essence, the peculiarities of some reptile distributions on the west coast of Western Australia represent evolutionary conundrums in terms of speciation and apparent extinctions as highlighted by Storr *et al.* (1983) in reference to the reptiles of the Wallabi Islands. It is interesting to speculate on a possible biogeographical connection between the Houtman Abrolhos islands and the southern peninsula and islands at Shark Bay in regards to the absence of *Christinus marmoratus*,

Cryptoblepharus carnabyi and *Egernia s. stokesii* on the mainland in the study area. Recent biochemical studies of the nominate form *E. s. stokesii* from these populations have demonstrated a close relationship (Hamilton 2003).

REGIONAL BIOGEOGRAPHY

The gecko, *Crenadactylus o. ocellatus* and the pygopod, *Delma australis* are now recorded from the mainland in the study area, though they appear to be patchily distributed. In the case of *C. o. ocellatus* its geographic proximity to the striped subspecies 'horni' is close, and in the Kalbarri region their respective distributions appear to meet. *C. o. 'horni'* is also recorded from the Wandana and East Yuna Nature Reserves near Yuna. *D. australis* was previously only known from Rat Island in the Houtman Abrolhos (Storr *et al.* 1983) but is now known to occur on the adjacent mainland.

Similar to *Crenadactylus ocellatus*, the boundaries of the two morphological forms of *Lerista lineopunctulata*, those with 2 toes in the south and 1 toe in the north (Storr *et al.* 1999), appear to meet in the Kalbarri region (pers. obs.). *Aprasia repens* was previously recorded as occurring north to Kalbarri (Storr *et al.* 1990). However, this record is based on a single specimen (86892) that is more closely allied to *Aprasia 'fusca'* (Aplin and Smith 2001). It is not clear

whether this specimen is the same as the *Aprasia* sp. nov. aff. 'fusca' from Wicherina (121129, 121132, 146587) and 10 km SSE of Dongara (127527) or if it represents another undescribed species. The most northerly confirmed record of *A. repens* is from just north of Geraldton at Oakajee River (144049).

The inclusion of *Hemiergis quadrilineata* to the species list is based on a single record (85016) from Leeman that cannot be located for verification. According to Storr *et al.* 1999, the Leeman record is apparently disjunct from populations further south. This seems to be validated by Dell and Chapman (1977) who did not record this species at Cockleshell Gully. The addition of this species could be considered arbitrary, however its presence at Jurien does support the possibility of it occurring further north. The mention by Storr *et al.* (1983) of *Notechis scutatus* extending north to the Hill River is based on a 1974 record (45550) from near Jurien that cannot be located for verification. There have been no recent records from the area and considering its large size and foraging habits, it is unlikely to be a species that can be overlooked through observation or as a roadkill. Currently this species is acceptably recorded only north to the Gingin area.

For many Australian species of frogs and reptiles their distributions still remain uncertain and with ongoing fieldwork,

range extensions are a common occurrence. This is highlighted by the very recent detection of *Neelaps calonotos* in the study area. As a result of this reappraisal, the number of southwestern species and subspecies of frogs and reptiles attaining their northern limit of known distribution in the study area requires amendment from Storr *et al.* (1983) whose statements are indicated in bold, viz.:

- Crinia pseudinsignifera* (to the Murchison River)
- Heleioporus albopunctatus* (to the Murchison River)
- H. eyrei* (to Geraldton)
- H. psammophilus* (to Kalbarri National Park)
- Limnodynastes dorsalis* (to the Murchison River)
- Myobatrachus gouldii* (to Kalbarri National Park)
- Litoria adelaidensis* (to Port Gregory) *
- L. moorei* (to the Murchison River)
- Crenadactylus o. ocellatus* (to near Kalbarri on the mainland; to East Wallabi Island in the Houtman Abrolhos)
- Diplodactylus g. granariensis* (to the Hutt River)
- D. polyophthalmus* (to Eneabba)
- Aprasia repens* (to Geraldton)
- Delma c. concinna* (to Coolimba)
- D. grayii* (to Kalbarri)
- Pletholax g. gracilis* (to Wicherina)
- Rankinia a. adelaidensis* (to Kalbarri)
- Ctenotus impar* (to Burma Road Nature Reserve)
- Lerista christinae* (to Eneabba)

L. distinguenda (to the Greenough River on the mainland; to Rat Island in the Houtman Abrolhos)

Morelia spilota imbricata (to Geraldton on the mainland; to East Wallabi Island in the Houtman Abrolhos)

Brachyurophis semifasciata (to Kalbarri)

Echiopsis curta (to Kalbarri National Park)

Neelaps calonotos (to Port Denison) *

Parasuta gouldii (to Kalbarri National Park)

(*These two species represent northern outliers in the study area).

Other species that could be added to this list all share disjunct populations in the Shark Bay region. One of these is *Christinus marmoratus*, which occurs north to Cockleshell Gully on the mainland but is only known from the Houtman Abrolhos islands in the study area, and reappears further north on Edel Land (False Entrance Well). *Ramphotyphlops australis* is currently known to extend north to near Kalbarri with apparently isolated populations on Edel Land, Bernier and Dorre Islands.

Both *Egernia kingii* and *E. multiscutata* share similar broken distributions. The former extends to the lower Hutt River on the mainland and many Houtman Abrolhos islands, but reappears further north on Three Bays Island; while the latter

occurs only north to Eneabba on the mainland and much further north on Bernier Island.

A list of typically semi-arid to arid zone reptiles that reach their southern limit (at least on the central west coast) of known distribution also requires amendment from Storr *et al.* (1983) whose statements are indicated in bold, *viz.*:

- Chelodina steindachneri* (to the Murchison and Irwin Rivers)
- Diplodactylus pulcher* (to Ajana and possibly Eradu)
- D. squarrosus* (to Binnu)
- Nephrurus levis occidentalis* (to the hinterland of Geraldton)
- Strophurus strophurus* (to Binnu)
- Delma butleri* (to Northampton)
- D. tincta* (to Mingenev)
- Pygopus nigriceps* (to the lower Irwin River)
- Ctenophorus nuchalis* (to Lake Arrowsmith)
- C. reticulatus* (to Geraldton)
- Moloch horridus* (to near Geraldton and Marchagee Track)
- Rankinia parviceps butleri* (to Kalbarri) *
- Cryptoblepharus carnabyi* (to Ajana and Mullewa on the mainland; to the Houtman Abrolhos islands)
- Ctenotus alleni* (to Yuna)
- C. mimetes* (to Yarra Yarra Nature Reserve)
- C. schomburgkii* (to Eneabba)
- C. severus* (to Ajana)
- Lerista gerrardii* (to the Greenough River)
- L. kendricki* (to Kalbarri)

- L. macropisthopus galea* (to Binnu)
 - L. muelleri* (to Strawberry)
 - Menetia surda cresswelli* (to Yuna)
 - Morethia butleri* (to the Hutt River)
 - Varanus caudolineatus* (to Ajana)
 - Ramphotyphlops hamatus* (to the Greenough River)
 - R. leptosoma* (to the Greenough River)
 - Parasuta monachus* (to Wicherina)
 - Pseudonaja modesta* (to the Greenough River)
 - Suta fasciata* (to Binnu)
- (*Possibly represents a southern outlier population of a subspecies currently known only from Edel Land and Dirk Hartog Island at Shark Bay).
- The number of species with apparent discontinuous distributions is high on the central west coast. Storr *et al.* (1983) remarked on the extent of these gaps for several species and stated that it is 'difficult to distinguish between complete absence and very low density'. For those species that are very cryptic *i.e.* fossorial snakes, it often requires a considerable length of time to reveal their presence, and this is only achieved by conducting trapping programs (How and Shine 1999). However, based on personal observations when conditions are optimal, it is possible to reveal reasonable numbers of these small elusive reptiles by raking. Indeed, the two records of *Neelaps calonotos* from near Port Denison were collected this way.

Further fieldwork in the study area has reduced the disjunction in some species and probably strengthened it for *Christinus marmoratus*, *Egernia kingii* and *E. multiscutata*. The same could be applied to *Delma c. concinna* whose disjunction remains the same between Coolimba and the Shark Bay subspecies *D. c. major*. In the case of *Pletholax*, the disjunction between the nominate form and *edelensis* has been substantially reduced from Wicherina to Kalbarri National Park (ca 240 km distance). Closer examination of *Rankinia parviceps butleri* (Aplin and Smith 2001) has revealed another small disjunction between Kalbarri and Tamala Station (ca 125 km distance). The implied disjunctions by Storr *et al.* (1983) for *Lerista elegans* and *Morethia lineoocellata* are less apparent now due to further collecting in suitable habitats, for instance on coastal dunes where both species are common (pers. obs.). Further fieldwork in the study area has also created additional disjunctions for *Litoria adelaidensis* (Roberts and Majors 1993) from Port Gregory to the Moore River (ca 320 km distance); and *Neelaps calonotos* from Cooljarloo to Port Denison (ca 165 km distance).

ENDEMIC TAXA

Since 1983, the taxonomic revision of certain species also necessitates an assessment of the endemic taxa in the study area. Although not described, the

clearly distinct *Aprasia* sp. nov. aff. '*fusca*' is considered endemic to the study area until further specimens are collected outside the study area. This is based on four specimens collected from widely separated localities (just south of Port Denison and from Wicherina). The recent discovery of this small, fossorial pygopod underlines the value in conducting trapping programs.

Pogona minor minima is the only reptile considered endemic to the Houtman Abrolhos, and occurs on North, East and West Wallabi Islands in the Wallabi group. However the subspecific divergence of this population closely resembles morphologically *Pogona* on the adjacent mainland (Witten 1994). Considering that these islands are only ca 11500 years old (Main 1961) it would be interesting to examine this subspecific divergence with genetic analysis. Similarly, major morphological differences are noted for *C. fallens* and *E. stokesii* from the Abrolhos Islands (J. Hill pers. comm. and Hamilton 2003).

Based on current collection records, *Cyclodomorphus branchialis* is almost entirely endemic to the study area between the Murchison and Irwin Rivers. The extent of its inland distribution is uncertain at this stage where very few records are known. Currently, it has been recorded east to the vicinity of Yalgoo (Storr *et al.* 1999) based on a single record (89448) taken from the gut of a snake and

recently from 2 km E Mount Magnet (156771-72).

The long held belief that *Egernia stokesii stokesii* is endemic to the Houtman Abrolhos islands is challenged by the recent collection of similar looking skinks on Edel Land at Shark Bay. The Baudin Island subspecies *E. s. aethiops* is also now considered to be an insular population of the nominate form (Aplin and Smith 2001). The recent evaluation of this species intraspecific relationships using genetic and morphological analysis supports this view (Hamilton 2003).

Lerista axillaris is considered endemic to the study area, despite being only known from a single locality in mostly cleared farming country just south of Kalbarri. Recent attempts to enlarge on this distribution have been unsuccessful and it is geographically proximate to *L. macropisthopus galea* that is confined to an area along and a little south of the lower Murchison River. Interestingly enough, its taxonomic identity is challenged by the collection of *L. m. galea* at Binnu with similar morphological characters to *L. axillaris* (Gaikhorst 2002). *Lerista yuna* is only known to occur in the vicinity of Yuna on nature reserves and uncleared bushland and similarly the minor differences between it and *L. kendricki* suggest further taxonomic investigation is required.

CONSERVATION

All species of marine turtles inhabiting Western Australian waters are listed as Schedule 1 fauna. The recent detection of *N. calonotos* in the study area represents a significant advancement in the conservation status of this species. Formerly believed to only occur between Mandurah and Lancelin on the Swan Coastal Plain (Storr *et al.* 1986), and considered endangered by (Cogger *et al.* 1993), it currently receives no priority listing by Western Australian authorities. The records (127530, 141838) from near Port Denison possibly suggest that *N. calonotos* is patchily distributed along the west coast north of Lancelin, however this is yet to be proven. Considering the endorsements made by Cogger *et al.* (1993) and statements by How and Shine (1999) regarding the conservation and ecology of this species, it is probably time for a re-evaluation of its status.

Considering its apparent low density in an area heavily cleared for agriculture the conservation status of *Cyclodomorphus branchialis* is a concern as highlighted by Shea and Miller (1995). In the study area, *C. branchialis* occurs patchily in the interior on red heavy soils with *Acacia*, often in association with rocky areas. Some recent records are from Ajana, Galena, Warribano Chimney and Ellendale Pool (pers. obs.). However, the recent collection of this species from near Mount

Magnet represents a significant range extension that indicates a broader inland distribution outside the study area.

The conservation and endemism status of *Pogona minor minima* from the Houtman Abrolhos islands would be determined with an investigation of its taxonomy. Currently it and *Egernia s. stokesii* are classed as Priority Taxa (P4) under the CALM priority ranking of species.

On the mainland, only one species in the study area, *Egernia stokesii badia* is considered Schedule 1 fauna 'that is rare or likely to become extinct'. *Aspidites ramsayi* and *Morelia spilota imbricata* are deemed 'in need of special protection' and listed as Schedule 4 fauna (WA Government Gazette, 9 April 2002). This listing for *E. s. badia* is considered appropriate for a subspecies that has suffered a marked decline due to land clearing (How *et al.* 2003). This species also displays long-term social and genetic monogamy (Chapple 2003) that further exacerbates its vulnerability to anthropogenic disturbance.

The conservation status of the southwestern wheatbelt population of *Aspidites ramsayi* is critically endangered (Smith 1981; Barker and Barker 1994; Cogger *et al.* 1993; Pearson 1993; Bush *et al.* 1995 and Maryan 2002). Despite this it is not appropriately recognised by WA authorities as was done by Cogger *et al.* (1993) and Environment Australia who

include this population on the Australian and New Zealand Environment and Conservation Council (ANZECC) list of endangered vertebrate fauna. In the study area there have been no confirmed records since 1967 and considering the paucity of published information and the lack of feedback from residents of the area despite a public appeal, the widely accepted view that this population is 'close to extinction' is probably correct. It is therefore disappointing that a recovery plan has not been developed despite it being listed under Schedule 4 as 'fauna in need of special protection'.

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