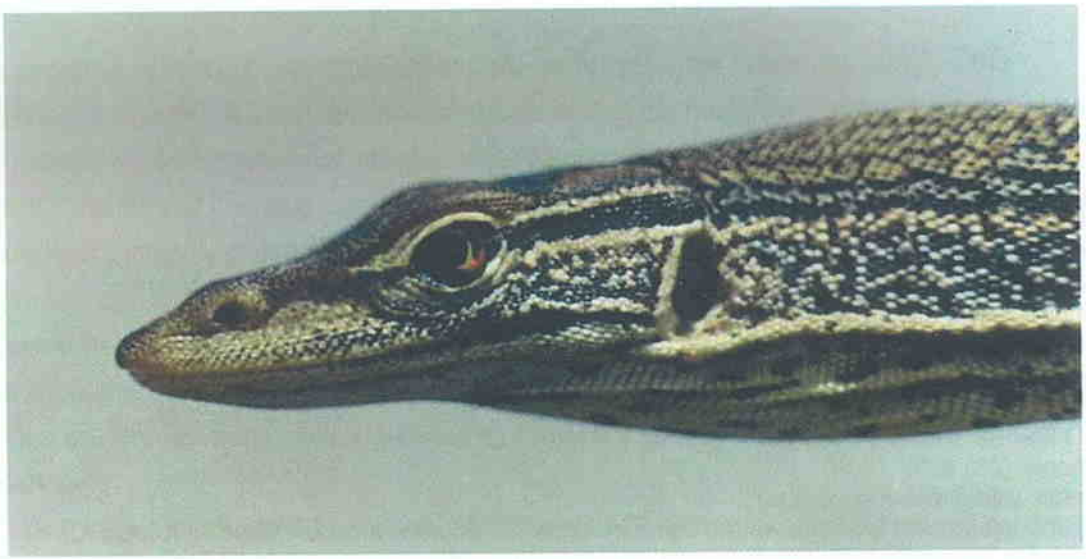
FAUNA MONITORING OF THE CHAPMAN RIVER WILDLIFE CORRIDOR, GERALDTON



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Executive Summary

The Chapman River Wildlife Corridor project is fortunate to have available a significant body of knowledge of the fauna inhabiting the area. The majority of this data is the result of an extensive pit trapping program run by the authors in the main area of remnant bushland, the previous proposed Chapman River Regional Park.

The results of this study, along with other details resulting from the authors extensive knowledge of the fauna of the Midwest, are presented here.

The study found that 10 species of native mammals, 39 species of reptile and six species of frogs occur within the Chapman Regional Wildlife Corridor area, and discusses a number of other species that may occur in the area.

The value of the Chapman River Wildlife Corridor is shown here to be unparalleled for an urban environment. The CRWC is at least as important as the well-known Bold Park in Perth, which has a significant budget provided by the State Government to ensure maintenance of its conservation and recreation values. The conservation values of the CRWC as a large area of remnant vegetation in a highly cleared catchment, with a documented diverse flora and fauna, are very significant to the people of the Midwest and the State as a whole.

In addition a number of recommendations are made for further monitoring efforts in the CRWC. It is presumed in these recommendations that the main focus of future efforts will be to monitor the effectiveness of activities undertaken in the corridor to maintain its value as wildlife habitat and breeding area and to ascertain stability in species population densities and biodiversity integrity and to improve the condition of interconnecting corridors.

Recommendation 1

An integrated approach to data collation, including a central information gathering point. There are already many groups undertaking comprehensive data collection and monitoring such as:

- Water and River's Commission's, Ribbons of Blue's regular river monitoring program, annual macro invertebrate snapshot day and fish monitoring projects
- Birds Australia's ongoing bird monitoring program
- WA Museum database and surveys
- WA Wildflower Society/ Regional Herbarium's data collection
- Keen amateur observations (Friends group)

All this information needs to be gathered and stored in a central registrar that is easily accessible to all groups. The Community Access to Local Catchment Information project may be the appropriate holding body until a Regional Information Center is available.

This data needs to be presented to the community in a form that is appealing and understandable, with maximum community awareness and involvement.

Recommendation 2

Future ongoing monitoring in a way that is both easily accessible to the general public, but also upholds its scientific integrity.

A number of monitoring methods are discussed at length in this report, which have been undertaken in the past and can be implemented into the future, with variations that can substantiate previous monitoring projects. Some methods need the assistance of trained personell to impliment, but most can be undertaken by interested groups and individuals with minimum training. These are discussed at length, with mention to their opportunities and constraints.

In conjunction with this study, there was a small amount of invertebrate monitoring and collection undertaken which is currently being processed. This is an area that is virtually overlooked by many monitoring and evaluation processes and needs to be incorporated into any future baseline data projects.

In the future the collection and study of invertebrates within the CRWC is an area that needs much work and expansion. The future monitoring can be undertaken with little volunteer training and can be very time effective with the use of in-situ invertebrate traps that can be checked and cleared on a periodic basis. Following the collection phase if necessary the specimens collected can be stored for a significant time before full identification occurs without loss of valuable data.

This report is one of a series of reports that have been conducted in the CRWC. Previous reports have detailed a number of recommended management actions. Current implementation of these recommendations will need to be ongoing to maintain and enhance the significant conservation values of the Chapman River Wildlife Corridor.

INTRODUCTION

The Chapman River Wildlife Corridor (CRWC) is an area of approximately 664 ha, running from the mouth of the Chapman River east to Cutubury Nature Reserve, a distance of approximately 17 km. At the western end of the CRWC is the proposed Chapman River Regional Park (CRRP). The CRRP is an area of 364 hectares of land located approximately five kilometres north east of the centre of the city of Geraldton (Fig. 1)(28° 47' S, 114 °37' E). Within the (CRWC) a wide variety of land uses exist, with areas set aside for recreational pursuits such as golf, football and picnics, and areas of significant remnant vegetation. In preparation for the declaration of the original CRRP the authors conducted a survey of the non-volant mammals and herpetofauna of the remnant vegetation areas.

Prior to the study reported here very little data was available on the fauna of the Midwest region of Western Australia. The nearest published major studies were in the Zuytdorp district 130 km to the north (Storr and Harold, 1980, Burbidge et al. 2000), the East Yuna reserve 70 km to the north-east (Dell et al, 1978), the Wandana Reserve 85 km to the north-east (Burbidge *et. al*, 1978), the Wilroy Nature Reserve 100km to the east (Dell *et. al*, 1979) and the Stockyard Gully area 130 km to the south (Dell and Chapman, 1977). This is reflected in the records of the Western Australian Museum for the area at the time this study commenced showing only 32 species of reptiles and five species of frog for the immediate vicinity of Geraldton (Aplin, pers. comm.). Storr et. al, (1983) recorded 94 species of terrestrial reptiles and frogs occurring in the Geraldton region, an area they referred to as ranging from Greenhead 115° E, 30° S to Kalbarri 114° 10' E, 27° 28' S and east to Eradu 115° 05' E, 28 ° 40' S.

The Perth metropolitan region contains the closest studies of remnant urban bushland to our site. These remnants can be considered to be generally similar as they both occur on the Swan Coastal Plain, however there are differences in vegetation, soil and fauna aseemblages. Major published studies conducted in the metropolitan region have been carried out in Bold Park, (How & Dell, 1990; How 1998), reserves in South Perth (Turpin, 1990, 1991a, 1991b), the general southern suburbs (Maryan, 1990), and reserves in Caversham (Cooper et al, 1999). The status of Perth's ground vertebrate fauna and the effect of urbanisation is discussed by How and Dell (2000). All these studies found that even very small areas of remnant bushland had conservation value for reptiles and frogs in particular. Areas as small as 1 hectare contained reptile assemblages but required active management to ensure the survival of the species present (How and Dell, 2000).

The importance of remnant bushland reserves in the rural environment in Western Australia was studied in a series of surveys throughout the Wheatbelt by the Western Australian Museum and the Fisheries and Wildlife Department during the 1970's and 1980's. The effect of size and structure of rural reserves on the conservation of lizards was discussed by Kitchener et. al, (1980). Broadly this study showed that for reserves in the Wheatbelt the number of vegetation and soil types was significantly related to the number of lizard species they contained. Wheatbelt reserves as small as 30 ha were found to be valuable for lizard conservation.

This study surveyed the area of the CRRP intensively with pit-trapping and other collecting techniques and surveyed the remainder of the CRWC less intensively with hand collecting and spotlighting techniques.

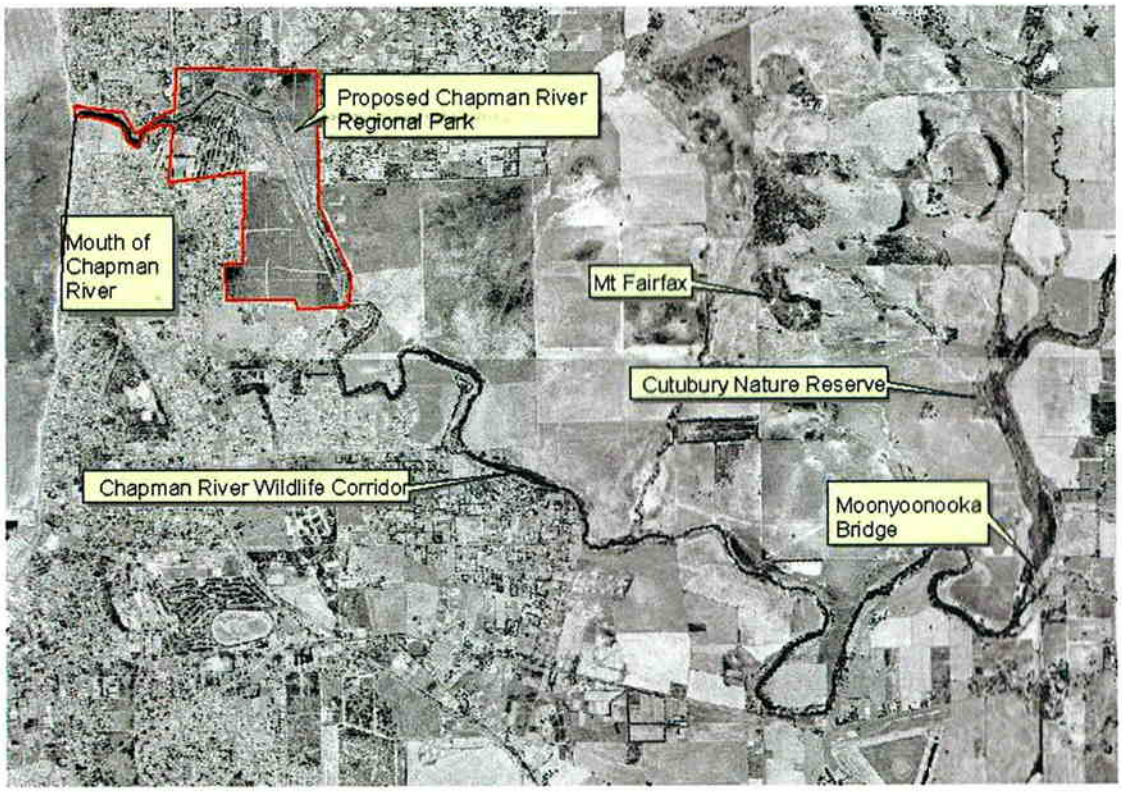

Figure 1. Chapman River Wildlife Corridor running from the mouth of the Chapman River along the river corridor to Cutubury Nature Reserve.

STUDY AREA

The CRWC runs from the mouth of the Chapman River to 4500 m upstream, terminating at Cutubury Nature Reserve and varies in width from less than 100 m to approximately 1500 m. At the western most part of the CRWC, it contacts the coast and incorporates a small area of beach, sandune and salt marsh. At its eastern most point the Cutubury Nature Reserve consists of a mix of riparian *Eucalyptus camaldulensis* vegetation and vegetation types such as Jam (*Acacia acuminata*) and Hakea open woodland.

The Chapman River Catchment encompasses three major geomorphological regions. These are the Victoria Plateau at its headwaters, the Chapman region and the Swan Coastal Plain where it empties into Champion Bay. Within the area of the Chapman Wildlife Corridor the coastal plain comprises undulating shoreline deposits of the Quindanup Dune System, underlain by the more ancient Pleistocene consolidated dune system of Tamala Limestone. More recently, with the action of the Chapman River through these systems, there are more recent alluvial deposits and incisions of up to fifteen metres into the surrounding coastal plain Mitchell McCotter (1993).

The soil types of the study area have been comprehensively classified by Mitchell McCotter's (1993), *Park Management Plan* and Landform Research's (1999), *Park Management Strategy*. These soil types ultimately impact on vegetation type and determine specific microhabitats that many of the fossorial reptiles depend upon for survival.

Beard and Burns (1976) classified the area as the Greenough vegetation system, a near-coastal botanically rich area of plant communities growing over limestone and other rock types. Occurring in the overlap zone between heathlands of the Jurien - Eneabba area and the shrublands and heathlands of the Northampton - Kalbarri area, floral diversity is high (Aplin et al., 1993). Including previous studies, Mitchell McCotter recorded 227 taxa of flora occurring in eleven major vegetation communities.

Gutteridge, Haskins & Davey (2001) in their Vegetation Quality Assessment and Analysis report, identified four major vegetation communities within the study area of the CRWC.

- Limestone Associations
- Riparian Zone communities
- Vegetation growing on sandy loam over gravel/clay
- Sandplain community over laterite

The climate of the study area is considered to be Mediterranean with hot dry summers and mild wet winters. A Meteorological station records constant data at the Geraldton Airport two kilometres south of the study site. Geraldton receives an average annual rainfall of 472 mm, most of which falls between the months of May and September. There are occasional summer cyclonic events that result in flooding of the river. This has some major significance in some species successful breeding cycles.

Figure Two. The Carpet Python is known to inhabit areas of remnant vegetation in close proximity to the Chapman River Wildlife Corridor.

METHODS

The non-volant mammal and herpetofauna of CRWC has been surveyed since September 1992, using fenced pit traps and hand collecting methods. Surveying was initially carried out continuously between September 1992 and June 1993 and then periodically until 1999, with the effort subsequently being concentrated in early winter and spring. Over 10, 000 trap nights have been conducted in the area to date.

The pit lines consisted of 6 to 11 lengths of PVC tubing (diameter 150 mm, length 500 mm) in lines 30 m to 55 m long. Flywire drift fences of 300mm height were erected on all lines. Sampling using pitlines was conducted at seven sites within the study area. These sites were recognized by on ground inspection identifying various dominant vegetation types and conducted in September 1992 in conjunction with Ken Aplin (Curator of Vertebrate Fauna, Western Australian Museum), Neville Marchant (Curator Western Australian Herbarium), and Greg Wallace (Ex Curator, Geraldton Region Museum) These sites were located in: *Banksia prionotes - Acacia rostellifera* shrubland, *Verticordia chrysantha - Conospermum stoechadis* low heath, *Acacia rostellifera* thickets and *Acacia spathulata* limestone heath. These were the predominant vegetation types at the sites inspected with minor vegetation types being sampled by manual searching methods. A number of the field sites have since undergone minor vegetation changes due to fire incidences and weed infiltration.

Site One consisted of six traps running in a north - south direction. The site was located in an *Acacia rostellifera* thicket in grey loamy sands. Site coordinates 50J 0269741, 6818976 (GDA).

Site Two consisted of six traps running in a north – south direction. The site was located in an *Acacia spathulata* Limestone heath. Site coordinates 50J 0269732, 6818946 (GDA).

Site Three consisted of six traps running in a north – south direction. The site was located in a *Grevillea, Acacia* woodland with an understory of Conostylis spp in yellow sands. Site coordinates 50J 02669410, 6817886 (GDA).

Site Four consisted of six traps running in a north – south direction. The site was located in a *Banksia prionotes, Banksia attenuata, Acacia* woodland over Conostylis spp. On pale yellow sands.Site coordinates 50J 0269613, 6818158 (GDA).

Site Five consisted of six traps running in a north – south direction. The site was located in a low heath of *Conospermum, Verticordia* and *Melaleuca megacephala* over pale yellow / brown sands. Site coordinates 50J 0269904, 6819160 (GDA).

Site Six consisted of six traps running in an east – south direction. The site was located in a low heath of *Conospermum, Verticordia* and *Melaleuca megacephala* over pale yellow / brown sands. Site coordinates 50J 0269872, 6819157 (GDA).

Site Seven consisted of six traps running in a north – south direction. The site was located in a *Grevillea, Acacia* woodland with an understory of *Conostylis* spp in yellow sands with some emergent *Banksia prionotes.* Site coordinates 50J 0269478, 6818127 (GDA). Site Seven was relocated from the position of Site Three in a structurally similar area to reduce the amount of travel required to complete the entire trapping run.

Manual searching involved active searching by day and spotlighting by night. Hand held spotlights and head torches were used at night to collect nocturnal geckoes, snakes and frogs. Active searching involved raking leaflitter, searching under bark, in rotten logs and under piles of debris. Burrows were excavated and other signs such as scats and diggings were also recorded.

Voucher specimens for all species of herpetofauna were lodged with the Western Australian Museum. The remainder of specimens were measured to determine total length and snout vent length where appropriate, and toe-clipped or scale-tagged as appropriate prior to release at the capture site.

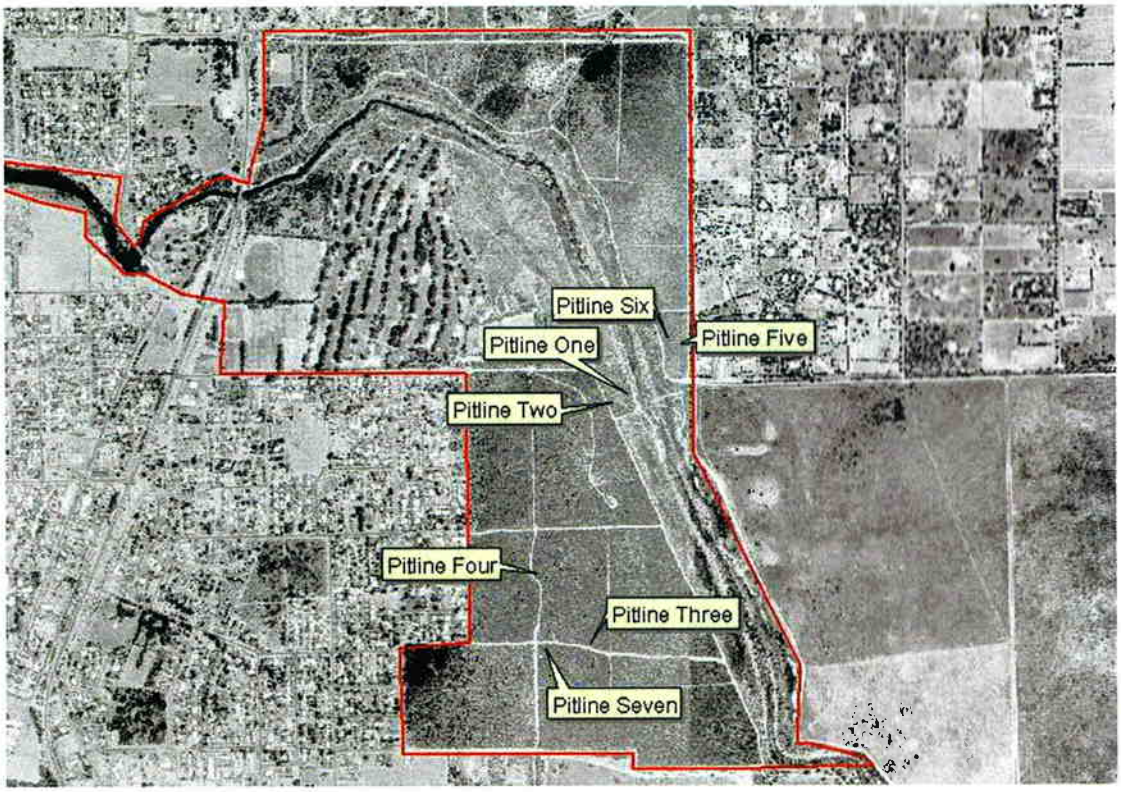

Figure Three. Location of pitlines within the Chapman River Wildlife Corridor.

Figure Four. Trapline One. This area has been burnt since trapping commenced in this area, changing the vegetation structure.

Figure Five. Trapline Two. Illustrates the thick Acacia heath.

Figure Six. Trapline Three. Much of the overstory in this area has become senescent since trapping begun.

Figure Seven. Trapline Four. Dominated by *Banksia prionotes and Banksia attenuata.*

Figure Eight. Trapline Five. This area was burnt during the study and consequently has a changed vegetation structure.

Figure Nine. Trapline Six. This area was burnt during the study and consequently has a changed vegetation structure.

Figure Ten. Trapline Seven. This area is structurally similar to Trapline Three.

RESULTS

39 species of reptiles, six species of frogs from two families and 11 mammals are recorded for the area.

Species recorded for the CRWC.

REPTILES

AGAMIDAE

Ctenophorous reticulatus

(Western Netted Ground Dragon)

One specimen collected in *Verticordia* heath in first warm weather of Spring. Storr (1983) lists as being found nearly to the mouth of the Chapman River. This species is more typically found in "sandplain" environments in the Midwest (such as the *Verticordia* heath) rather than coastal environments.

Moloch horridus

(Thorny Devil)

Several specimens have been observed recently, 2000, in the riparian zone within the study area. None have been captured by field survey techniques.

Pogona minor minor

(Western Bearded Dragon)

The most common dragon species of the study area, found in all areas. Seen laying eggs in study area in soft sand under *Acacia rostellifera* leaf litter.

Rankinia adelaidensis

(Western Heath Dragon)

Only known from one specimen caught in the disturbed northern section of the study area (H. Butler, pers. comm.).

Figure 11. Western bearded dragon. The most common dragon found in the CRWC.

GEKKONIDAE

Crenadactylus ocellatus ocellatus

(Clawless Gecko)

Not commonly observed, but occurs throughout the study area. Generally found associated with domestic litter and fallen bushes.

Strophurus spinigerus spinigerus

(South-western Spiny Tailed Gecko)

Few specimens of this gecko have been observed in the CRWC. The few specimens that have been collected were found in the *Verticordia* heath. Common in areas of Acacia rostellifera in coastal environments in the Geraldton region.

Gehyra variegata

(Variegated Dtella)

The most commonly observed gecko in the study area with specimens being found throughout the study area. Frequently found under domestic rubbish, peeling bark and other similar hiding spots. Gravid females containing one egg were captured in December and January.

Heteronotia binoei

(Binoe's Gecko)

This is the second most commonly observed gecko in the study area, being found in suitable habitats throughout the study area. Habitat is essentially the same as that of *G. variegata.* Specimens collected from an *Acacia* shrubland burnt approximately two months earlier had heavy infestations of an orange mite.

Nephurus levis occidentalis

(Western Knob-tailed Gecko)

A single adult specimen was located beneath a rotting *Acacia* log on the northern boundary of CRWC at Waggrakine. This represents the southern limit of this arid tolerant species.

Figure 12. South-western Spiny Tailed Gecko. This species is highly charismatic due to its size, brightly coloured eyes and patterning. It is also able to exude a sticky smelly fluid from tubercules (spines) on its tail.

PYGOPODIDAE

Delma fraseri

(Fraser's Legless Lizard)

Recorded from the *Banksia* woodland and other litter such as tree branches and leaf litter. Oddly this species finds something favourable about discarded cardboard and is found with ease under this manmade microhabitat.

Delma grayii

(Side Barred Delma)

Although not captured in this study, a specimen is registered with the WA Museum (115749) that was captured in Geraldton, presumably the CRWC, in February 1993.

Delma tincta

(Excitable Delma)

Infrequently observed, with only one specimen being captured within the CRWC during this study in October 1992.

Pygopus lepidopodus

(Common Scaly-foot)

This species appears to be common for brief periods, found largely in early spring basking in sunny areas, with two males and two females being found within one hour in heathland in September 1992. Found in a variety of habitats, ranging from *Banksia* woodlands to heaths.

Lialis burtonis

(Burton's Legless Lizard)

Infrequently observed, found to occur in the *Banksia* woodland and sand plain heath, though probably occurs elsewhere. Several colour forms were recorded from the area.

Figure 13. Burton's Legless Lizard, a common species specialising in a diet of skinks.

VARANIDAE

Varanus gouldii

(Gould's Monitor)

Found throughout the study area, this species though rarely trapped as adults is conspicuous because of its size and habits. Tracks and burrows presumably of this species have been observed throughout the study area. In January 1993 five juveniles, up to 298mm total length, were captured in the sand plain heath within a 50 m radius. Often seen as road casualties on roads on the eastern side of the study area.

Varanus tristis

(Black-tailed Monitor)

This monitors preference for arboreal habitat is possibly one reason for not finding many specimens in the study area by conventional fauna monitoring techniques. A number of individuals have been observed however on the periphery of the study site. One specimen was found occupying a bridge just east of the study site at Moonyoonooka on a tributary creek, East Chapman River, and another captured in a residential house south and adjacent to the study area in July.

Figure 14. The Black-tailed Monitor shown above is seen much less frequently than the Gould's monitor.

SCINCIDAE

Cryptoblepharus plagiocephalus

(Fence Skink)

Found throughout the study area, this species shelters largely under loosened bark on fallen tree trunks and branches. Often seen sunning itself on tree trunks and other similar surfaces.

Ctenotus fallens

(West-coast Laterite Ctenotus)

This skink appears to be relatively widespread throughout the study area, utilizing many of the vegetation types surveyed.

Lerista elegans

(Elegant Slider)

Common throughout the study area in large numbers. Mainly found amongst leaf litter. Gravid females were captured in January with very small juveniles being captured in February and March.

Lerista lineopunctulata

(Dotted-line Slider)

Common throughout the study area in sandy soils with leaf litter covering. Two morphologically distinct forms of this species appear to be present in the park (Aplin pers. comm.).

Lerista praepedita

(Blunt-tailed Westcoast Slider)

Found throughout the study area, largely in loose sands. Specimens from the *Verticordia* heath appear to have colouration different from those in the *Acacia* and *Banksia* shrublands.

Menetia greyii

(Common Dwarf Skink)

Found throughout the study area, usually in dense leaf litter. A common species.

Morethia lineoocellata

(Westcoast Morethia Skink)

Found in small numbers in *A. rostellifera*, *Banksia* woodland and *V. chrysantha* low heath. Males in breeding colours observed in November and December.

Tiliqua occipitalis

(Western Bluetongue Lizard)

Found throughout the study area, this species appears more secretive and less common than *Tiliqua rugosa*.

Tiliqua rugosa

(Bobtail Lizard)

Found in all areas of the study area, this is the most commonly observed reptile due to its large size and habits. Frequently found in nearby backyards and dead on roads surrounding the area.

Figure 15. The West-coast Laterite Ctenotus is a moderate sized skink found throughout the CRWC.

TYPHLOPIDAE

Ramphotyphlops australis

(Southern Blind Snake)

One male specimen recorded, captured after rain in *Acacia rostellifera* thicket.

Ramphotyphlops leptosoma

(Murchison Blind Snake)

One female specimen recorded, captured in *Verticordia chrysantha* heath.

Ramphotyphlops waitii

(Beaked Blind Snake)

A search of the WA Museum records, reveals a single individual being recorded from the CRWC in November 1992. Habitat unknown.

Figure 16. The Southern Blind Snake is rarely seen due to its fossorial nature.

BOIDAE

Antaresia stimsoni

(Large-blotched Python)

Regionally this python is quite common and has been observed in and around houses and human habitation on the northern boundary of the study area in Waggrakine, and the eastern area in Moonyoonooka. Preferring the laterite breakaway country that the Moresby Ranges offer, this snake would, in all probability, be utilizing the corridor for migration and feeding purposes.

Morelia spilotes imbricata

(Southwest Carpet Python)

A specimen of the Southwestern Carpet Python was located on a tributary creek to the north of the study area at the foothills of the Moresby Ranges in November 98. This species is currently gazetted as threatened, although there are locally healthy populations of this snake both north and south of Geraldton. This is another important species (listed under the Wildlife Conservation Act 1954 as being in need of special protection) that would be utilizing the wildlife corridor to move between relictual populations.

ELAPIDAE

Brachyurophis semifasciata

(Southern Shovel-nosed Snake)

One specimen located burrowing at night near the surface of the soil on a sand track in *Acacia* thicket. This species feeds on reptile eggs (How and Shine, 1999).

Demansia psammophis reticulata

(Yellow-faced Whipsnake)

Common throughout the area, the second most common snake recorded in and around the study area within a range of vegetation types.

Neelaps bimaculatus

(Black-naped Burrowing Snake)

Specimens located in sandy habitats throughout the area. This species feeds on non-fossorial skinks (How and Shine, 1999).

Parasuta monachus

(Monk Snake)

Recorded from a single specimen from within the study area in July 1993 at trapsite three. These animals are relatively common throughout the region and seem to be quite cold tolerant as many specimens have been observed to be moving around at night during the colder winter months.

Pseudechis australis

(Mulga Snake)

Although a relatively common species on the sandplain plateau 10 km inland from Geraldton, relatively few specimens have been seen throughout the study area. Two specimens have been recorded, both as road kills adjacent to remnant vegetation associated with the CRWC. One specimen was found adjacent to Geraldton Airport where the river meanders quite close to the road. This individual was one of the largest seen by the authors and would have been a very old individual > 10 yrs. The other specimen was observed adjacent to Cutubury Nature Reserve as a road kill.

Pseudonaja nuchalis

(Gwardar or Western Brown Snake)

Commonly located under rubbish throughout the corridor, and in the surrounding suburban and rural areas. Most common snake recorded in and around the study area. The Gwardar occurs in a large number of colour morphs most of which have been recorded in the CRWC. Large numbers of juveniles located in nearby suburban areas in February through to May. This is possibly one of the few animals within the study area that has benefited from human intervention, preferring the open grasslands created by land clearance and benefiting from an increased food supply in the form of introduced field mice *Mus musculus*.

Simoselaps bertholdi

(Southern Desert Banded Snake)

Recorded as being captured within study area in October 93. This species, although present in the study area, is not as common as *Simoselaps littoralis*, which is found in most sandy leaf litter. This species feeds on non-fossorial skinks (How and Shine, 1999).

Simoselaps littoralis

(West-coast Banded Snake)

The most common burrowing species found in the study area. Found in most suitable sandy habitats in a variety of vegetation types.

Figure 17. The West-coast Banded Snake is the most commonly seen species of the four burrowing snakes found in the CRWC.

CHELUIDAE

Chelodina oblonga
(Oblong Snake-necked Tortoise)

Specimens only located at the mouth of the river or leaving the area in July 1996 and March 2000 after heavy rains. Common further upstream in pools. May have been introduced to the Chapman River.

Figure 18. The oblong turtle may be an introduced species to the CRWC.

Frogs

MYOBATRACHIDAE (Ground Frogs)

Heleioporus albopunctatus

(Western Spotted Frog)

The most commonly observed and trapped frog species, found throughout the area in large numbers from March through to December. The first frog species to be captured and commence calling after Autumn rains. Breeding in burrows in river bed. This frog is very comfortable moving large distances during damp and wet weather and has been observed 10 km away from the nearest water.

Figure 19. A Western Spotted Frog encountering a pit fence line.

Limnodynastes dorsalis

(Western Bullfrog)

The second most commonly recorded frog species, found throughout the area from April through to December, when it is also heard calling.

Myobatrachus gouldii

(Turtle Frog)

Common after heavy winter rains where it is seen moving throughout a variety of vegetation types but most commonly associated with deep yellow sands.

Figure 20. The turtle frog is highly unusual in that it has no free swimming tadpole stage, an adaptation that allows it to breed without the presence of surface water.

Neobatrachus pelobatoides

(Humming Frog)

Found throughout study area in variety of vegetation types. Often associated with permenant water where it is seen at night calling from the edges.

Pseudophryne guentheri

(Gunther's Toadlet)

Found in small numbers in Winter in *Verticordia* heath. Recorded breeding in small burrows located in roadside areas near area of *Verticordia* heath.

HYLIDAE (Tree Fogs)

Litoria moorei

(Motorbike Frog)

Heard calling in Winter, Spring and early Summer months in river bed. Only one specimen captured in field surveys, in *Verticordia* heath. Found in backyard swimming pools near river mouth (Robinson pers comm.). This species is found throughout the river system at any time of the year in association with permanent water pools. There are a number of these pools within the study site and all require a substantially healthy riparian zone to shade the pools from summer sun and provide habitat for frogs until the river runs from heavy enough rainfall events. This frog is triggered into breeding at any time of the year by substantial rainfall, either in winter or early summer. Its lack of captures in survey traps suggest that this species does not move very far from the safety of the riparian zone.

MAMMALS

TACHYGLOSSIDAE

Tachyglossus aculeatus

(Short-beaked Echidna)

Common throughout the corridor and greater Midwest region and also extending into urbanised areas adjacent to CRWC. Has been observed in a number of vegetation types within the study area.

DASYURIDAE

Sminthopsis crassicaudata

(Fat-tailed Dunnart)

This species of dunnart is probably the most tolerant to altered vegetation and has been observed on a number of occasions in farmland adjacent to the southern edge of the wildlife corridor.

Sminthopsis dolichura

(Little Long-tailed Dunnart)

Common throughout the wildlife corridor and have been captured within a range of vegetation types mainly associated with dense understorey.

TARSIPEDIDAE

Tarsipes rostratus

(Honey Possum)

Although this species has not been captured in the present trapping project an individual was observed after having been preyed upon by a domestic cat adjacent to the northern area of the CRWC. This area is rich in sandplain heath vegetation that Honey possums require for habitat, so it is not unlikely that a relict population exists within the park, albeit in small numbers. This is a species that requires a much more intensive field data program as its specific habitat is represented within the CRWC.

Figure 20. The CRWC is potentially important habitat for the Honey Possum.

PHALANGERIDAE

Trichosurus vulpecula

(Common Brushtail Possum)

Common throughout the study area, preferring riparian zone with large riverside trees such as *Eucalyptus camaldulensis, Casuarina obesa, Melaleuca raphyophila*. Found right to the river mouth and occasionally occurring in suburbs near the CRWC as nuisance species. This species has undergone a significant reduction in distribution in the State and the Midwest in particular (How and Hillcox, 2000).

MACROPODIDAE

Macropus fuliginosus
(Western Grey Kangaroo)

Common throughout the study area. Recent observations suggest that this species is breeding within the park and population densities have possibly increased since the beginning of this survey project. It is unclear whether this population increase is due to an increase in numbers from a relict population or individuals are moving from eastern regions utilizing the corridor.

Macropus robustus erubescens
(Common Wallaroo or Euro)

Although this species generally prefers the lateritic breakaways and upland slopes of the Moresby Ranges, an individual was observed in March 2001 utilizing the old Moonyoonooka bridge, crossing from the south bank to the north and proceeding west along the riparian corridor.

MOLOSSIDAE

Nyctinomus australis
(White-striped Freetail-bat)

This species is one of the few that have a call that can be heard by humans, sounding like a faint metallic chime. It is common throughout the region and is often heard calling in the CRWC.

VESPERTILIONIDAE

Nyctophilus geoffroyi
(Lesser Long-eared Bat)

Has been collected two km east of study area on the Chapman River and has been observed flying amongst *Eucalyptus camaldulensis* canopy within the CRWC.

PTEROPIDAE

Pteropus scapulatus
(Little Red Flying Fox)

Vagrants occasionally recorded in the Geraldton area.

LEPORIDAE

Oryctolagus cuniculus * introduced

(European Rabbit)

The rabbit is common in most areas of the Chapman River Wildlife Corridor. Rabbits prefer areas of sandy soils with remnant vegetation for shelter. The CRWC is ideal for this species and tracks, dung piles, burrows and animals are regularly seen.

CANIDAE

Vulpes vulpes* introduced

(European Red Fox)

Foxes are very adaptable predators and are at home in rural, semi-urban and urban environments. All environments within the CRWC are likely to contain this species.

Caninis familiaris* introduced

(Dog)

Dogs are frequently observed in the CRWC without an owner or without being on a leash. These animals can be significant predators of skinks such as the Bobtail and larger species such as Kangaroos. Even in circumstances where they do not kill the animal they may cause injury and the stress may reduce the animals health and ability to effectively breed.

FELIDAE

Felis cattus* introduced

(Feral Cat)

Cats are prevalent throughout the CRWC, both feral and domesticated.

SUIDAE

Sus scrofa* introduced

(Pig)

Pigs use the CRWC as a corridor to travel along and inhabit much of the area of riparian vegetation though only on a temporary basis. Pigs can cause a large amount of damage to vegetation and soils structure whilst foraging in addition to being predators to a number of species of fauna, particularly frogs.

MURIDAE

Mus musculus* introduced

(House Mouse)

Ubiquitous throughout the CRWC and found in high numbers in some areas. The effect this introduced predator is having on native rodents is not clear.

Pseudomys albocinereus

(Ashy-grey Mouse)

Not recorded from this survey though it is likely they occur in the CRWC. Elliot traps may assist in capturing this species. This species is superficially very similar to *Mus musculus*.

Rattus rattus* introduced

(Black Rat)

Rarely captured but known to occur in the CRWC in unknown numbers. Particularly favours habitat of African Boxthorn thickets.

BOVIDAE

Capra hircus* introduced

(Goat)

Seen on occasions throughout the reserve. Has the potential to destroy large amounts of remnant vegetation due to its indiscriminant browsing and high reach, although populations are unlikely to persist for any length of time due to human hunting pressure. Three individuals captured within CRWC in August 1994.

DISCUSSION

Previous studies of isolated tracts of bushland in urban Western Australia have largely been confined to the Perth metropolitan area (Cooper et al., 1999; How, 1998; How & Dell, 1990; How & Dell, 2000; Turpin 1990; Maryan, 1990). These studies have shown that a surprising number of terrestrial vertebrates are able to survive in relatively small, isolated pockets of remnant bushland. The largest single area of bushland surveyed was Bold Park (338 ha) (How & Dell, 1990; How & Dell, 2000), and supported six species of frogs, and 29 species of reptiles. The recorded presence of six species of frogs, 39 species of reptiles and 11 species of native mammals in the CRWC remnant bushland makes this a diverse and important conservation site.

The reptile fauna is somewhat depauperate in several groups, particularly in the dragons, with only three species recorded from the study area, and two of these being from single specimens only. The single specimen of *Rankinia adelaidensis* was found in a degraded area in the north west section of the study area which has not been thoroughly surveyed. This area has been used for a variety of purposes and consequently has many weed species and numerous areas of open, bare yellow and white sands. This appears to fit the preferred habitat for *R. adelaidensis*, and may explain its occurrence in this limited area (Bamford, 1995). This area is now largely the site of a highway bypass and further attempts to locate specimens of this species are required. A search of Western Australian Museum records shows the nearest specimen in their collection to be approximately 40 km south east of the study area.

Although not recorded from the study area, the dragon *Ctenophorous maculatus* is known to occur in similar habitat, primarily *A. rostellifera* thickets, within 7 kilometres. There is anecdotal evidence to suggest that another agamid, *Moloch horridus,* was plentiful in the study area and has been recently observed as single individuals basking alongside pathways within CRWC. The reduction of this species may be linked to several factors, however increased predation, destruction of habitat and increased fire prevalence are likely explanations. Predation by cats, both domestic and feral, foxes, dogs and humans may have contributed to the apparent decline within the study area. There are large numbers of cats frequenting the wildlife corridor, and there is also a significant number of dogs which are allowed to run free or are simply strays found in the study area. Both of these are quite capable and likely to kill any slow moving prey such as *M. horridus* or *Tiliqua* species that they encounter.

As well as threats from predation, the remaining area of significant bushland is only 280ha in size and is linked to other areas of remnant bushland by the valley of the Chapman River, a tenuous and distant link at best. This is likely to have a severe impact on recruitment. The role that a changed fire regime may have had is unclear, however a slow moving species such as *M. horridus* would have to rely on its burrowing abilities to escape fire, and increased destruction of habitat through fire would further limit the habitat area available. Our observations suggest that *M. horridus* inhabiting remnant bushland that is burnt during a fire

frequently migrate, often falling victim to vehicles. The reduction of this species from the study area is not however entirely unexpected, as there is anecdotal evidence to suggest that there has been a decline in the number of *M. horridus* throughout the Midwest area.

By contrast with the dragons, the skinks are prevalent, with nine species recorded. This appears to represent the majority of species that may be expected to occur in the area, with several range extensions being recorded. However, the genus *Ctenotus* appears to be underrepresented in the study area. This genus of skinks has approximately three species likely to occur in the area, however, only one species has been recorded and that from only one specimen. However, the habitat requirements of at least one of these *Ctenotus* are probably significantly different from the habitats found in the study area.

Three species of Sand Swimmers or *Lerista's* are recorded which represents most species of this genus that occur within the vegetation types present within the CRWC. This group is one that future monitoring, targeting different vegetation types, may improve the number of species. Two species that may occur in small number or unmonitored vegetation tpes are *Lerista planiventralis,* which is found only 10 km north on white coastal dunes under *Spinifex longifolius*, and *Lerista gerrardii*, which has been located at Moonyoonooka but tends to prefer red loamy soils.

Eight species of elapid snakes are recorded, with *Pseudonaja nuchalis* being the most frequently observed. This is to be expected as it is the largest and most conspicuous elapid in its habits. *P. nuchalis* is also prevalent in the more urbanised areas, and is the most common of the nuisance snakes. Four species of burrowing snakes, *Neelaps bimaculata, Simoselaps littoralis, Simoselaps bertholdi* and *Brachyurophis semifasciata* are present in the CRWC. The diversity of this genus in the CRWC is probably the result of the diversity of skinks, their food items, to be found in the area and the subsequent ability to allow diversification into particular feeding niches.

The Blind Snakes, *Typhlopidae* are represented by three species, *Ramphotyphlops australis, Ramphotyphlops leptosoma* and *Ramphotyphlops waitii.* Museum records indicate that at least one other species, *Ramphotyphlops hamatus* is likely to occur in the area, having being found in similar habitat types nearby. Due to their cryptic fossorial (burrowing) lifestyle, further monitoring is required to develop a better understanding of this strange family of reptiles.

Although two species of python, *Morelia spilota imbricata* and *Antaresia stimsoni* are known to occur within five kilometres of the study area in similar vegetation types, no specimens have been recorded specifically from within the study area. This is probably a result of the urbanised nature of the area. *A. stimsoni* have been regularly recorded within the lateritic breakaways of the Moresby Ranges and in agricultural habitat with little remnant vegetation, however the surrounding areas were not urbanised. Significant populations, including breeding specimens, of *Morelia spilota imbricata* are also known from the region within very small areas of remnant vegetation along seasonal rivers and surrounding buildings. The Woma Python, *Aspidites ramsayi,* is likely to have occurred in the study area, and a data search of Museum records reveals a number of specimens recorded close by, all prior to 1967. They include a specimen captured between Geraldton and Northampton on 15th March 1935, and an individual at Newmarracarra in 1936. A general declining trend in python populations in Western Australia has been recorded (Smith, 1981; Pearson, 1993)

The pygopods are represented in the reserve by four species. One specimen of *Pygopus lepidopodus is* currently being closely examined to determine its taxonomic status due to the presence of aberrant hemipenes and colouration . *Delma grayii* could reasonably be expected to occur here. *Aprasia repens* is likely to be present in the study area, having being found by us in similar areas within ten kms however this species is rarely seen due to its fossorial habits.

The monitors are represented by two species, Gould's monitor, *Varanus gouldii* and the Black tailed monitor *Varanus tristis* . Gould's monitor is largely terrestrial, searching for food on the ground and constructing burrows in sandy soil, and the Black Tailed monitor tends to more arboreal. This creates a bias in the results towards more Gould's Monitor tracks, sightings and captures compared to *V. tristis. V. gouldii* has been found in many areas of urban remnant bush, and appears to be well adapted to this environment (Storr, 1980; Thompson, 1992, 1995)

The geckos are relatively poorly represented with only five species being recorded. Other species recorded from Museum records or by us in similar habitat nearby are *Underwoodisaurus milii*, *Diplodactylus alboguttatus* and *Diplodactylus ornatus.*

Six species of frog have been recorded to occur in the survey area. Only one member of the Hylidae has been recorded, *Litoria moorei.* This species is dependent on permanent fresh water. The continued availability of fresh water pools upstream may be required to ensure the continued recruitment to the lower reaches. The presence of *Gambusia affinis and Tilapia mossambicus*, two species of introduced predatory fish implicated in the predation of tadpoles and frog eggs, may make the lower reaches unsuitable for successful breeding. Investigations into the ability of frog species successfully breeding in the lower reaches of the Chapman River should be investigated.

Five species of the Myobatrachidae are recorded from the area. All of these species are able to survive without the presence of surface water. All species appear to be showing a decline in numbers throughout the Wheatbelt (Aplin pers comm.). *Neobatrachus pelobatoides* was moderately common, and found in all sections of the study area. This species is generally not found this close to the coast. The Turtle Frog, *Myobatrachus gouldii*, was found in limited numbers after rain in winter on deep sand plain areas mainly in the eastern section of the survey area. Again, this species is generally found further inland. Gunther's toadlet, *Pseudophryne guentheri*, was also found only in small numbers on the sand plain areas. *Heleioporus eyrei* has been recorded occurring on the Greenough River, the next river immediately to the south of the Chapman River. At their closest points the two rivers come within less than 10 kilometres from each other. This distance is not significant for a species as mobile as *H. eyrei* and it is possible that *H. eyrei* may be found on sandy sites in the Chapman River valley. *Crinia pseudinsignifera* has also been recorded just 5 km upstream of Cutubury Nature Reserve, breeding within the Chapman River and with further monitoring could be expected to be found within the study area.

The mammal fauna of the CRWC has undoubtedly suffered a decline in the animals in the Critical Weight Range. This decline is common throughout continental Australia but is particularly marked in areas such as the Midwest. The presence of species such as the Grey Kangaroo and Echidna give the area an interest but due to their widespread distribution and relatively high numbers does not give the CRWC any particular significance for conservation.

The presence of the marsupial Dunnarts *Sminthopsis dolichura* and *Sminthopsis crassicaudata* is of significance.The capture of seven *Sminthopsis dolichura* in the study area throughout this survey is of considerable significance. This species is usually dependant on reasonably healthy areas of remnant vegetation, and its regular capture throughout the wildlife corridor, usually associated with a dense understorey, can be construed as a reasonably positive indicator of a healthy ecology within the large area of remnant vegetation that comprises the bulk of CRWC.

The capture of *Sminthopsis crassicaudata* from farming land around the reserve is less significant, although still important, in that this small marsupial is as at home in a changed farming environment as in remnant vegetation. Both marsupials represent an ideal opportunity to introduce the community to the unique fauna of the CRWC. Both these animals have the "cute and cuddly" appeal and would represent very "usable" icons to portray the reserves native fauna.

Gaps in the studies undertaken to date

Whilst this study is one of the more intensive studies undertaken in Western Australian remnant vegetation a number of areas could be improved on. Whilst the major vegetation types of the CRWC have been surveyed there are a number of important vegetation types that were not surveyed. For instance the riparian vegetation of *Eucalyptus camaldulensis* and *Casuarina obesa* have not undergone any pit trapping. If possible it would be worthwhile expanding the pit trapping surveys to vegetation types not previously surveyed however the limitations of pit trappin in inundated areas must be considered.

No Elliot trapping or cage trapping was undertaken during the study described here. Elliot traps are small folding aluminium traps that utilize bait and are designed for catching small mammals and reptiles. While the capture rate for Elliot traps is very low and they are expensive to purchase, they do allow for the capture of small native rodents and marsupials that may not be captured in pit traps such as were used in this study.

An example of a species that has been recorded within 20 kms of the CRWC that is only very rarely caught in pit traps is the Spinifex Hopping mouse, *Notomys alexis*. This species is able to jump very well and so can escape from pit traps. Records of the Hopping mouse have come from Wicherina Water Reserve, East Yuna Nature Reserve, and Kalbarri National Park. It is possible that this species may occur within the CRWC however its preferred habitat of tussock grass and sandy substrates is not prevalent within the CRWC and therefore it is less likely.

The Ashy Grey Mouse, *Pseudomys albocinereus,* is well within range here being recorded at Wicherina (35 km East) and Narngulu (5 km South). This is another species that appears to be able to jump out of most pit traps and is reasonably likely to enter Elliot Traps and likely to occur within the CRWC.

Any further pit trapping exercises would be made more valuable and possibly more effective by the inclusion of Elliot traps if these are available.

The only mammal species that is likely to be captured in cage traps is the Western brushtailed possum. Cage traps are particularly efficient at catching species that are within the Criticlal Weight Range (CWR). CWR mammals are largely regionally extinct in the Midwest (and frequently on the Australian mainland) due to predation by introduced foxes and cats. It is highly unlikely that any CWR native mammal is found in the CRWC and therefore the use of cage traps to catch additional species is unlikely to prove beneficial. Studies on the Western brushtailed possum may find the use of cage traps worthwhile however it could not be generally recommended due to the low return of species and specimens per trap night that would be expected.

Other methods would be very effective for monitoring Possum numbers. One method is to closely monitor possum highways, the scratches that possums leave on trees as they move up and down recognized habitat and food trees. Possum scat, or droppings, are also easily recognizable and can be a useful tool to monitor movement and population densities.

Future monitoring

Surveys of terrestrial fauna are frequently used as a monitoring tool in areas of native vegetation to provide:

- The regular collection and analysis of information to assist in timely decision making
- Ensure accountability and provide the basis for evaluation and learning
- An inventory of the species present
- Data that will assist with the development of works to reconstruct or enhance habitat
- Data to enable the success of works to reconstruct or enhance habitat to be determined.

The study described here has provided an immensely valuable inventory of the species present in the CRWC. To capitalise on the value of the work done thus far, a number of techniques are available to determine the success of works to date in enhancing or protecting the habitat in the last ten years and the future success of reconstruction, protection and enhancement activities. A number of suitable techniques are listed below with details of the opportunities and constraints for each.

Technique One: Re-establish the pitlines that were used in this study and undertake comprehensive surveying.

Opportunities:

1. Makes maximum use of the data gained
2. Enables direct comparison over time and treatments undertaken in the CRWC
3. Can improve skills in the community if undertaken by a skilled trainer
4. Can provide a highly satisfactory experience for community members

Constraints:

1. Requires skilled personnel to undertake the trapping
2. Requires licensing by Department of Conservation and Land Management
3. Is highly resource intensive

Technique Two: Re-establish the pitlines that were used in this study and undertake selected season surveying.

Opportunities:

1. Reduces the resources required to continue the surveying
2. Makes efficient use of the data gained
3. Enables direct comparison over time and treatments undertaken in the CRWC
4. Can improve skills in the community if undertaken by a skilled trainer
5. Can provide a highly satisfactory experience for community members

Constraints:

1. Requires skilled personnel to undertake the trapping
2. Requires licensing by Department of Conservation and Land Management
3. Is moderately resource intensive

Technique Three: Re-establish selected pitlines that were used in this study and undertake comprehensive or selected season surveying.

Opportunities:

1. Reduces the resources required to continue the surveying
2. Makes efficient use of the data gained
3. Enables direct comparison over time and treatments undertaken in the CRWC
4. Can be targeted to priority vegetation types that contain priority species
5. Can improve skills in the community if undertaken by a skilled trainer
6. Can provide a highly satisfactory experience for community members

Constraints:

1. Pitlines not surveyed will result in some vegetation types being omitted from the survey
2. Requires skilled personnel to undertake the trapping
3. Requires licensing by Department of Conservation and Land Management
4. Is moderately resource intensive

Technique Four: Establish new pitlines in areas that were not surveyed in this study and undertake comprehensive surveying.

Opportunities:

1. Enables gaps in the previous study to be comprehensively surveyed
2. Allows the possibility of adding previously undescribed fauna to the data base
3. Develops a better overall understanding of fauna species and interdependence between different vegetation and soil types

Constraints:

1. Requires skilled personnel to undertake the trapping and interpret information
2. Requires licensing by Department of Conservation and Land Management
3. Is highly resource intensive

Technique Five: Determine a species that appears to have specific habitat condition requirements and target surveys to determine its presence or absence. Further interrogation of the data would be required to determine a species that may be suitable.

Opportunities:

1. Reduces the resources required to continue the surveying
2. Makes efficient use of the data gained
3. Enables direct comparison over time and treatments undertaken in the CRWC
4. Can be targeted to priority vegetation types that contain priority species
5. Can improve skills in the community if undertaken by a skilled trainer
6. Can provide a highly satisfactory experience for community members

Constraints:

1. Requires skilled personnel to undertake the trapping and interpret information
2. Requires licensing by Department of Conservation and Land Management
3. Is highly resource intensive

Other possible monitoring techniques:

If it is decided that fauna monitoring techniques as described above are not suitable due to the need for qualified personnel etc, then a number of other techniques are available to monitor the progress of the CRWC. These can be divided into those techniques which focus on taxa already surveyed (e.g. herpetofauna and non-volant mammals) and techniques focussing on other taxa.

Description of a number of techniques and their opportunities and constraints is provided below.

Undertake less intensive means of surveying reptiles and small mammals. A number of techniques that do not require skills in handling fauna

Technique One: Use hair tubes for sampling of small mammals

Opportunities:

1. The chance of identifying new or "trap-shy" mammals from within the study area
2. The in-field installation can be undertaken by minimally trained volunteers
3. Reduces the resources required to continue the surveying
4. Enables direct comparison over time and treatments undertaken in the CRWC
5. Can be targeted to priority vegetation types that contain priority species
6. Can improve skills in the community if undertaken by a skilled trainer
7. Can provide a highly satisfactory experience for community members

Constraints:

1. Very few mammals of the Critical Weight Range most suitable for sampling using hair tubes are present in the CRWC or likely to reappear due to activities undertaken in this projects lifespan.
2. Specialised skills are required for identifying mammal hair samples
3. Requires licensing by Department of Conservation and Land Management

Technique Two: Survey invertebrates (a number of methods available)

Opportunities:

1. Surveying invertebrates is relatively inexpensive
2. Once survey installed can be collected quickly and easily on a periodic basis
3. Provides information on taxa that have not been surveyed previously
4. Invertebrates are widely used as indicator species in other monitoring studies which allows for comparisons between this area and others
5. Can improve the skills of community if initially workshopped by a skilled trainer
6. provides a highly satisfactory experience for community members

Constraints:

1. At present, not generally considered as interesting by community members.
2. Specialised skills are required for identifying invertebrates below the level of Order.
3. Requires licensing by Department of Conservation and Land Management.

Technique Three: Survey birds (a number of methods available)

Opportunities:

1. Surveying birds is relatively inexpensive
2. A number of tested techniques are available
3. Using techniques developed by Birds Australia would allow data to be also used for projects such as the Bird Atlas
4. Birds are attractive to many members of the public heightening the appeal of surveying
5. Does not require licensing by Department of Conservation and Land Management unless specimens are taken

Constraints:

1. Requires some skills and misidentification can be a concern
2. If it is decided not to use Birds Australia as the "vetting" body for records created then someone with skills will be required to complete the task.
3. Requires seasonal monitoring

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3. Requires seasonal monitoring

Technique Four: Tracks, Scats and other Traces

Opportunities

1. Can improve the skills of community if initially workshopped by a skilled trainer
2. Provides a highly satisfactory experience for community members
3. No licensing requirements
4. Opportunistic observations can be utilized

Constraints

1. Requires skilled personnel to interpret information
2. Not a very accurate measure of data collection

Monitoring bats

Bats are a key predator in an area of remnant vegetation like the Chapman River Wildlife Corridor. This study reports on three species known from the area, however Microbats have been observed on many occasions flying and hunting within the tree canopy. Positive identification could extend the number of species by four. Relatively little is known about the West Australian bat fauna and techniques for study are limited. Generally only three study techniques are likely to be of use; recording of echolocation calls, harp traps and mist nets. These techniques are discussed below.

All techniques have value in engaging members of the public due to the mystique of bats. All species likely to be encountered in the park belong to the Microchiroptera, the insectivorous species. The Megachiroptera are the fruit bats or flying foxes largely found in tropical regions. A small number of vagrants are blown off their course every year and have been recorded as far south as the Midwest.

Technique One: Record sound of echolocation calls for identification

Opportunities:

1. Able to gain knowledge of species without handling them
2. Relatively limited resources required
3. Provides information on taxa that have not been surveyed previously

Constraints:

1. Specialised expensive equipment required to effectively record bat calls
2. Specialised skills are required for identifying bat calls
3. Requires licensing by Department of Conservation and Land Management

Technique Two: Use of harp trap to capture bats

Opportunities:

1. Provides information on taxa that have not been surveyed previously
2. Allows members of survey team to see bats close up

Constraints:

1. Specialised expensive equipment required (harp trap)
2. Specialised skills are required for capture, identification and handling of bats
3. Requires licensing by Department of Conservation and Land Management and Bird and Bat Banding Scheme
4. Potential (though small) of lyssavirus

Technique Three: Use of mist nets to capture bats

Opportunities:

1. Provides information on taxa that have not been surveyed previously
2. Allows members of survey team to see bats close up

Constraints:

1. Specialised expensive equipment required (mist nets)
2. Specialised skills are required for capture, identification and handling of bats
3. Requires licensing by Department of Conservation and Land Management and Bird and Bat Banding Scheme
4. Potential (though small) of lyssavirus

As can be seen the majority of the techniques described here require, at least initially, the involvement of personnel with skills in the relevant technique. There are a number of people in the local community that may be able to provide these skills, however it is likely that a consultant may be required. These people can be used to build the capacity of the community to undertake monitoring of fauna.

In addition a number of references have been provided that give more in depth information on the design and conduct of fauna monitoring surveys. These are vital resources for any group planning to undertake fauna monitoring.

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