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Mammal and Reptile Planning Project

Review of Potential Mammal and Reptile Indicators for Monitoring Habitat Rehabilitation

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Cover Photo: Tiger Snake *Notechis scutatus* from the Mud Islands Game Reserve. AC Robinson NPWSA.

Summary

This review of potential mammal and reptile indicators for monitoring habitat rehabilitation in the Coorong, Lower Lakes and Murray Mouth (CLLMM) project area provides a brief overview of standard biological survey techniques as outlined in Owens (2000). It then details which of these methods are most applicable to detecting the three mammal and seven reptile species identified as being of interest at CLLMM sites by Eichler *et al.* (2011). A review was undertaken to determine the suitability of the species identified by CLLMM for monitoring habitat rehabilitation. No extra mammal species were identified as being good candidates for monitoring in the project area, however, a number of potential reptile species are discussed. Standard monitoring methods, sampling protocols and the data types are listed for each species of interest. The relative merits of different methods in relation to each species of interest are then discussed. While the 11 floristic communities as described in Eichler *et al.* (2011) were considered, no priority was given to any particular community or communities as this will have to be determined by what types are being rehabilitated. A methodological framework for developing a monitoring program is presented.

Table of Contents

Background

SRC was contracted to provide the following advice to the CLLMM Project regarding fauna monitoring:

1. Document the standard biological survey method requirements for undertaking mammal and reptile surveys.
2. Review the proposed CLLMM list of mammals and reptiles that have been identified as species of interest and which may provide an opportunity for the development of indicator species.
3. Suggest other potential species of interest.
4. Suggest modifications of the standard methods to account for any habitat preferences or behaviour characteristics of the proposed CLLMM list of mammals and reptiles.
5. Suggest the number of vegetation communities or habitat types that should be sampled in the CLLMM region to be representative.
6. Document techniques and methods that would need to be incorporated into a survey in order to assess change of species composition or habitat use over time.

Introduction

This report provides an outline of standard biological survey methods used for terrestrial fauna in South Australia. The objective is to discuss potential methods for monitoring the response of a range of target fauna species that can potentially be linked to CLLMM rehabilitation work in the Coorong and Lower Lakes region, as defined by Eichler *et al.* (2011).

Three mammals and seven reptile species have been identified as having the potential to be useful indicators of the success of rehabilitation efforts.

The information provided to SRC indicates that the available data for all species is deficient, so the first step of any program should be establishment of a baseline for each species to improve understanding of which habitats they currently use. This step is critical in postulating realistic hypotheses about what sort of species recovery represents successful rehabilitation.

For each species a number of potential methods have been discussed with respect to sampling techniques, field protocols and the minimum data that should be recorded (excluding date, site location and observers which should be recorded for each technique used). A brief discussion follows about the relative merits of different methods in terms of being able to efficiently meet monitoring goals focused on the presence/absence of a species in an area or its relative abundance.

As a general guide, it is initially most resource efficient to focus on presence/absence as it is less prone to high variation in estimates. Subsequently, lessons learned by monitoring officers and the success of the initial program should inform whether more resource intensive abundance measures are practical and/or necessary.

Without knowledge of the number, location, size and ecological characteristics of each rehabilitated site it is not possible to design a detailed sampling protocol for each species for each site. However, we recommend that a sufficient number of sites are sampled to represent the key ecological components of the system that the project aims to restore. Results from these areas should provide a baseline assessment of how detectable each species is in the target area. It will also enable the usefulness of the chosen indicator species to be evaluated over the envisaged timeframes.

In the longer term, sampling should include both remnant and restored sites that allow comparisons to be made of how fauna responds to rehabilitation of particular habitat types. In reality, this is likely to involve sampling a gradient that includes remnant areas in different states through to restored habitats. The

development of state-and-transition models early in the project would be useful to inform the design of a long-term monitoring program.

Once an initial, pilot phase of the project is completed for fauna, further work could be supported by SRC to develop sampling designs that have sufficient statistical power to achieve reliable results.

The structure of the report follows the sequence outlined in the Background section.

1. Standard biological survey method for mammals and reptiles

Standard biological surveys for mammals and reptiles are based on sampling terrestrial environments and they are usually done at sites that have been or are concurrently being surveyed for vegetation composition, cover and structure . A standard fauna site in the SA agricultural zone comprises one pitfall trapline (6 x 150mm diameter x 390mm deep pits approximately 10m apart and connected by 50m x 33cm flywire drift fence) and one standard sized Elliott trapping line of 15 traps at 5m to 10m intervals and 2 strategically placed larger cage traps (usual dimensions ~ 30cm x 30cm x 80cm) (Owens 2000).

The pit lines are most suitable for detecting small ground dwelling reptiles and dasyurid mammals, whilst the Elliott traps are good for small to medium sized rodents. Elliotts also sample medium to large skinks and larger snakes, particularly when they have the scent of previously captured rodents. Cage traps mostly capture Sleepy Lizards (*Tiliqua rugosa*) and larger possums in places where they are active on the ground. Cage traps have also been successfully deployed to catch Water Rats (*Hydromys chrysogaster*).

The review in part 2 highlights the lack of information on all of the identified species of interest. For this reason a standard baseline survey would be warranted across the variety of habitats occurring in the region, particularly those areas not surveyed as part of the Murray Mouth Reserves project (Brandle 2002). A baseline survey should aim to target a minimum of 3-5 sites in each geographically distinct occurrence of each of the 11 flora associations highlighted by Eichler *et al.* (2011).

This level of sampling is required to develop coarse estimates of the likelihood of occurrence of species within particular habitat types, particularly important if attempting to use rare species for monitoring success. The benefit of such an approach is that it will identify detection rates for other more common species which may serve as additional faunal indicators of rehabilitation success. Thus it would be advantageous to include appropriate methods for monitoring the species of interest identified in Eichler *et al.* (2011) in any baseline surveys where those species are likely to occur (see Section 5 – Priority habitat types to sample).

The sampling design could then be refined to ensure that the right fauna species are being targeted and the sampling effort is suitable to obtain reliable results.

2. Review of the proposed CLLMM list of mammals and reptiles

Mammals

Three mammal and seven reptile species were identified as being of interest in the "Coorong Lower Lakes and Murray Mouth Restoration Prioritisation Report Stage 1- Supporting Documentation" (Eichler *et al.* 2011).

Two of the mammals, the Water Rat *Hydromys chrysogaster* and Swamp Rat *Rattus lutreolus* lend themselves to monitoring wetland rehabilitation work as they both prefer dense cover in wet swampy areas, which is a focus of the CLMM project. In contrast, the Common Brushtail Possum is mostly linked to

availability of arboreal shelter hollows. Moreover, its catholic diet allows it to inhabit a wide variety of vegetation types, and where it can gain sufficient food without the need for extended ground foraging it is usually present. It is also more likely to respond to fox control in areas where it needs to feed for extended periods on the ground than rehabilitation work and should only be considered a candidate for monitoring at sites which have a mature Eucalypt cover with many large hollows.

The Water Rat is largely aquatic during active periods and rarely ventures far from shore during foraging so the only resources which it uses on land are shelter from potential predators . This means any type of dense shrub cover would be useful. Provided that aquatic food resources occur along the edge of the rehabilitation site it is probable this species will be encountered. As a result their occasional presence may not be a reliable indicator of rehabilitation progress. In contrast, sustained presence of Swamp Rat with its smaller home range and reliance on local vegetative resources (food and shelter) is likely to be a better indicator of rehabilitation success.

No other mammals were considered to be suitable candidates for monitoring.

Reptiles

The reasoning behind the choice of these six reptiles as biodiversity target species is worth reconsidering. Three have state conservation ratings and two others are considered vulnerable within the AMLR. Obviously a variety of threats to these species have been recognised. The first issue to consider is that the fact that these species tend to be rare is likely to reduce the rate at which they can be easily detected.

While it may be desirable that the occurrence of these species should increase with improved land management, there may be other unknown environmental factors influencing their overall distribution and existence at specific locations. It may even be that they were not present in the past, prior to the influence of recent threatening factors.

Overall, establishing monitoring specifically for these species may not be the best way to evaluate the effectiveness of improved vegetation rehabilitation. It may be more useful to establish a broader monitoring program for a wide variety of species and observe changes and improvements over time. If the target species are recorded, then closer monitoring of them could be considered valid.

Both species of tortoise are highly aquatic and subsequently harder to observe than terrestrial species, rarely leaving the water, or at least not in a regular easily monitored manner. As such, any changes in their numbers or distribution is more likely to reflect water quality and the state of the aquatic environment than improved land management in the immediate area.

We provide an overview of monitoring methods for a range of reptile species for CLLMM to consider but suggest options are discussed further with SRC prior to designing the monitoring project.

3. Other species of interest

No mammals were considered to be likely candidates for monitoring improvements in the habitats outlined in Eichler *et al.* 2011. As indicated in the previous sections, there has been a lack of systematic surveys for reptiles in the region and target habitat types, baseline surveys of intact remnants would be the most effective way to identify other candidate reptile species.

Two large snake species which feed on semi-aquatic species such as frogs have potential to be used as indicators of recovery – Tiger Snake *Notechis scutatus* and Red-bellied Black Snake *Pseudechis porphyriacus*.

4. Potential monitoring methods for mammals and reptiles

For each candidate species a table of potential methods, a protocol and what data to collect is shown. A short discussion on the relative merits of each for different circumstances is provided. Ultimately, which approach is the most effective will need to be determined after some initial monitoring is undertaken.

Mammals

***Trichosurus vulpecula* – Common Brushtail Possum**

Possible Monitoring Methods	**Protocol**	**Data to collect**
Traces:		
Claw marks on larger smooth barked tree trunks	30 mins search per location	Location of search path (log with GPS and waypoint trees searched), # trees checked + pres/abs
Scats at base of trees and below larger branches, particularly if large hollow present	30 mins search per location	As above
Spotlighting:		
Handheld spotlight during 1st 3 hours after nightfall	Search all branches in available trees 30 mins per location	As above + pres/abs of moon & phase, weather conditions during sample. Time observation started and time finished
Motion activated cameras:		
Set camera in likely locations i.e. main trunk and thick branches, rub peanut butter on tree in target area	Initial trial for 5 nights in known location with a number of cameras on different trees, daily check to determine trap rate – and assess if technique worth pursuing	Camera locations (GPS) and nights deployed, # nights with presence
Trapping:		
Set 2 cage traps near base of 2 likely possum trees for up to 4 nights or until a possum is trapped	baited with green apples + peanut buttered bread	Trap location (GPS), # nights, # captures per trap night, moon phase and weather conditions during sample

Of the methods suggested above, traces and spotlighting are the most resource efficient for producing reliable results. Checking for traces would likely involve 30 minutes spent at each location during the set-up phase. This should be the standard method used, with spotlighting, camera's or trapping considered if there are uncertainties around what the trace represents (see below) or if monitoring relative abundance is required.

Scratch marks on trees can also be made by cats so it is important to also locate scats to increase detection certainty. If uncertainty exists because of potential for other possum species to be present spotlighting is recommended. For example, Ring-tailed Possums could potentially occur near areas of stringy bark forest at the edge of the Mt Lofty ranges.

Hydromys chrysogaster – Water Rat

Possible Monitoring Methods	Protocol	Data to collect
Traces:		
Tracks in mud/sand at water's edge	30 mins search per location	Metres of suitable substrate checked + proportion with tracks
Search for burrow entrances under dense vegetation on mud banks and associated tracks and scats	30 mins search per location	Metres of suitable substrate checked + # burrows + presence of tracks/scats
Spotlighting:		
Handheld spotlight during 1st 4 hours from sunset	Search water's edge and open water at regular intervals from a quiet location on the bank or from a quiet boat. Search for 30 mins per location	Whether on bank or boat, # individual animals observed pres/abs of moon & phase, weather conditions during sample. Time observations started and finished
Motion activated cameras:		
Set camera in likely locations i.e. on bank with traces if present. Bait target area with oily sardine/pilchard.	Initial trial for 5 days in known location with a number of cameras on different trees, daily check to determine trap rate – and assess if technique worth pursuing	# cameras and nights deployed, # nights with presence
Trapping:		
Cage/Large Elliott traps - set a minimum of 4 traps above waterline at edge of water and if possible amongst dense cover	baited with sardine/pilchard in oil	# traps, # nights, # captures per trap night
Aquatic traps – get info		

The reliability of Water Rat traces as a monitoring method will be determined by the characteristics of the location, i.e. if it has muddy/sandy beaches that are accessible along the water's edge. As site rehabilitation progresses this method may become less useful i.e. too many sedges/reeds. In these situations, spotlighting and motion sensitive cameras may prove the most effective methods for determining use of the site. Trapping is less reliable as many Water Rats appear to be trap-shy.

Rattus lutreolus – Swamp Rat

Possible Monitoring Methods	Protocol	Data to collect
Traces:		
Rat sized runways, though dense ground vegetation	30 mins search per location – use to determine best placement for an Elliott trapline	Area searched and proportion with obvious rat runways and burrow
burrows and diggings with rat scats	As above	As above with proportion and number of dug areas + pres/abs scats
Trapping:		

Set a line of standard Elliott traps (minimum 15 traps) along area of densest cover in moist locations	baited with peanut past and rolled oats set until species detected – maximum 4 nights	# traps, # nights, # captures per trap night

Swamp rats are usually conspicuous by their tunnelling and runways, however, site characteristics may affect ability to detect traces. Also, other similar sized native and introduced *Rattus* spp. can leave similar traces. Trapping to confirm species is therefore recommended.

Elliott traps come in boxes of 15, 20 or 25. Set a minimum of 25 traps (or 2 boxes worth) at each location and check morning and afternoon until target species is detected for up to 4 nights. Bait with rolled oats and peanut paste. Traps should be set in a line at 3-5m intervals between traps and preferably well sheltered under dense vegetation (each trap in a line needs to be set in numbered order and flagged, so that traps are not missed during checking). Trap lines can be set in one long line or in a loop back toward the start depending on site characteristics such as the distribution of the most suitable dense vegetation or obvious sign.

Camera trapping and spotlighting is not recommended as rat species can be difficult to determine unless captured.

Reptiles

Chelodina longicollis – Common Long-necked Tortoise

Possible Monitoring Methods	**Protocol**	**Data to collect**
Traces:	N/A	N/A
Spotlighting:	N/A	N/A
Motion activated cameras:	N/A	N/A
Trapping:		
Cage trapping (using specialist mesh or netting tortoise traps) in shallows along shoreline using fish or meat baits, ensuring traps are unable to become entirely submerged	Ten traps at 20m intervals parallel to shoreline	Species and trap success rate
Physical searching & observation:	?	?

Other aquatic predators such as fish species and Water Rat may be captured using this trapping method. Transect searching of shorelines for basking tortoises may be used (as described for *E. heatwolei* below), but would be a secondary choice to trapping, as it is reliant on difficult to quantify observational skills, variable between observers, during short periods.

Emydura macquarii – Macquarie Tortoise

Possible Monitoring Methods	**Protocol**	**Data to collect**
Traces:	N/A	N/A
Spotlighting:	N/A	N/A
Motion activated cameras:	N/A	N/A
Trapping:		
Cage trapping (using specialist mesh or netting tortoise traps) in shallows along shoreline using fish or meat baits, ensuring traps are unable to become entirely submerged	Fixed number of traps at intervals parallel to shoreline. Inspected daily for fixed number of days	Species, sex and size (measurement) and trap success rate. Consider permanent marking to

	Trial 5 traps at 20m intervals for 4 days	monitor recapture rate
Physical searching & observation:	?	?

Other aquatic predators such as fish species and Water Rat may be captured using this trapping method. Transect searching of shoreline for basking tortoises may be used, but would be a secondary choice to trapping, due to possible variation between observers.

Eulamprus heatwolei – Yellow-bellied Water Skink

Possible Monitoring Methods	**Protocol**	**Data to collect**
Traces:	N/A	N/A
Spotlighting:	N/A	N/A
Motion activated cameras:	N/A	N/A
Trapping:		
Elliot trapping	Set Elliot traps at short intervals (2-5 meters) along shoreline, targeting areas where prominent basking options are most frequent	Number of traps set, what bait used (if any), time of year, weather conditions. GPS location of start and finish of trap line. GPS location and description of any capture sites
Physical searching & observation:	Searching of fixed length of the shoreline either on foot, or from a kayak moving parallel to the waters edge, for basking individuals, preferably in warm sunny weather	GPS location of start and finish points of shoreline search; temperature and other weather conditions. Substrate on which lizards observed. Time taken to travel fixed transect distance

Although *E. heatwolei* has been recorded in moist locations away from permanent water sources it tends to be infrequent. It is more usually observed basking along the waters edge. Trapping will be more likely to achieve results during the spring months when reptiles are most active and mobile.

Bait in Elliot traps for *E. heatwolei* may not be necessary, as the traps may be seen as dark refuge areas rather than a source of food. Initially, standard peanut paste and oats bait should be used in half the traps. If some level of consistency in captures is found, e.g. rodents are frequently caught in baited traps but not unbaited tarps, and *E. heatwolei* is caught in unbaited traps, then the bait can be eliminated.

Varanus rosenbergi - Heath Goanna

Possible Monitoring Methods	**Protocol**	**Data to collect**
Traces:		
Characteristic diggings created whilst searching for prey (not possible to differentiate from closely related *V. gouldii*)	Dependant on area to be searched. If detailed assessment required, then an area can be searched in a 5 – 10 meter grid pattern, or if time is	Number, type and estimated age of traces observed. GPS location of start and finish of transect

	restricted a linear transect through the most likely habitat and substrate	
Tracks (not possible to differentiate from closely related *V. gouldii*)		
Spotlighting:	N/A	N/A
Motion activated cameras:	?	?
Trapping:	?	?
Physical searching & observation:	?	?

As a top predator the Heath Goanna would not be expected to be encountered with any frequency, unless relatively large areas of suitable habitat are available to provide sufficient prey. Its presence may also be dependent on the level at which introduced predators/competitors such as the Red Fox are controlled. Motion activated cameras and/or cage trapping using carrion as attractant/bait may be useful in assisting with differentiating tracks and traces of the two possible *Varanus* spp., but are also likely to attract foxes, feral cats or possibly birds of prey.

Delma inornata – Olive Snake-lizard

Possible Monitoring Methods	**Protocol**	**Data to collect**
Traces:	N/A	N/A
Spotlighting:	N/A	N/A
Motion activated cameras:	N/A	N/A
Trapping:		
Pitfall and Funnel trapping	Establish standard 50-60m (6 pitfalls @ 10 metre intervals) trap lines in areas of appropriate grassland habitat and install 4 Funnel traps (2 either side) along and hard against drift net fence	Number of trap days; number of individuals of all species trapped; weather conditions
Physical searching & observation:		
	30 minute search of areas of grassland habitat, concentrating in and under larger tussocks where *D. inornata* is most likely to shelter	Location of area searched; micro habitat where any records made; weather conditions, time of year

Trapping will be more likely to achieve results during the spring months when reptiles are most mobile. Although traces of *D. inornata* are difficult to locate, sloughed skins of *Delma* spp. are sometimes located. These may be found when searching grass tussocks or under fallen timber or other ground debris.

Tympanocryptis lineata – Five-lined Earless Dragon

Possible Monitoring Methods	**Protocol**	**Data to collect**
Traces:	N/A	N/A
Spotlighting:	N/A	N/A
Motion activated cameras:	N/A	N/A

Trapping:		
Pitfall trapping	Establish standard 50-60m (6 pitfalls @ 10 metre intervals) trap lines in areas of appropriate grassland habitat	Number of trap days; number of individuals of all species trapped; weather conditions
Physical searching & observation:	N/A	N/A

The Five-lined Earless Dragon is a relatively small lizard, which is well camouflaged in its preferred grassland habitat. Its presence is difficult to establish through direct observation or searching, as it is cryptic and usually remains motionless when threatened. However, it has been known to occur in relatively small sections of appropriate habitat, even corridors of roadside vegetation. Trapping will be more likely to achieve results during the spring months when reptiles are most mobile.

5. Priority habitat types to sample

Eichler *et al.* (2011) identified 11 flora communities (reproduced in Table 1). These equate reasonably well with fauna habitat. Which of these are of priority to sample depends on which of these are being rehabilitated, and which ones are likely to support the nominated species.

The species discussed for monitoring in this document have been aligned to potential habitats to indicate which species to monitor (Table 1).

If a baseline survey is undertaken as suggested, a number of extra species that may be considered are likely to be identified.

Table 1. Potential Links between Fauna Indicator Species and Flora Communities Identified by Eichler *et al.* (2012).

Scientific name	SA	AUS	Species to monitor
Allocasuarina verticillata (Drooping Sheoak) grassy woodland	V		*Delma inornata, Tympanocryptis lineata*
Diverse reed beds			*Hydromys chrysogaster, Rattus lutreolus, Chelodina longicolis, Emydura maquarii*
Eucalyptus camaldulensis var. *camaldulensis* (River Red Gum) woodland on seasonally inundated flats	E		*Trichosurus vulpecula,*
Eucalyptus fasciculosa (Pink Gum) grassy woodland	V		*Delma inornata,Tympanocryptis lineata*
Fleurieu Swamps		CE	*Eulamprus heatwolei*
Freshwater herblands (eg *Triglochin*)	E		
Gahnia filum (Cutting Grass) sedgeland in drainage lines and depressions	E		*Rattus lutreolus*
Lomandra effusa (Iron-grass) tussock grassland	E	E	*Delma inornata,Tympanocryptis lineata*
Melaleuca halmaturorum (Swamp paperbark) woodland			*Rattus lutreolus, Hydromys chrysogaster*
Muehlenbeckia florulenta (Lignum) shrubland			*Rattus lutreolus, Hydromys chrysogaster*
Samphire sp. Chenopod shrubland			*Rattus lutreolus, Hydromys chrysogaster*

6. A methodology framework for assessing change

The following framework is suggested as a guide for setting up a fauna monitoring program:

1. Determine which habitats undergoing rehabilitation are to be monitored for fauna response.
2. Undertake a baseline survey to select species that are associated with particular habitat types and have detection rates in functionally intact habitat of greater than 60% (consider how isolated the area being rehabilitated is from other areas supporting target species and the dispersal ability of those species).
3. Develop conceptual models of rehabilitation focussing on how it provides critical resources for the target species and how that target species might recolonise the monitored area in response to increasing resource availability over time.
4. Decide on the most appropriate methodologies for target species within particular habitat types and across the sampling area. Monitoring at rehabilitation sites should be coupled with monitoring at similar, and preferably adjacent, intact habitats. It may also be worth selecting monitoring sites at suitable locations along potential dispersal routes if this functional trait is identified as an important determinant of fauna survival (from the conceptual models for individual species).
5. Identify the most useful sampling seasons based on target species' activity periods.
6. Develop a sampling protocol that most efficiently targets desired species.
7. Decide on a measure of success for on-ground works in relation to a species' usage of sites. Also consider the time frame for achieving targets as it relates to the progress of other rehabilitation indicators (e.g. vegetation cover and structure).
8. Establish a review protocol. Review the sampling program in the early part of the project and at suitable intervals thereafter , and adjust the methodology as necessary to meet revised targets.

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