

“Conservation planning for mangrove forests and their terrestrial vertebrate fauna”

Final report Paddy Pallin 2017 – StefanieRog.wordpress.com, Monash University

Project background

As with most forest systems around the world mangrove forests are under threat (World Wildlife Fund 2014). Mangroves provide a wide range of ecosystem services, including: (i) coastal protection from storm damage, (ii) carbon sequestration, (iii) provision of nursery grounds for fisheries, and (iv) habitat for many threatened and endemic species (Macintosh 2002). Despite widespread recognition of their importance, mangrove forests have declined in extent by 35% over recent decades (Valiela et al. 2001). Mangrove forests receive less research attention and are relatively poorly understood when compared with terrestrial tropical forests (Kier et al. 2005; Valiela et al. 2001). Even less attention has been paid to the vertebrates that utilize mangrove forests. Those few studies that have been conducted typically focus on fish and birds (Cawkell 1964; Faunce & Serafy 2006; Ford 1982), whereas very little attention has been directed towards mammals, reptiles and amphibians. As a consequence, we have a poor understanding of how terrestrial vertebrates utilize mangroves, where mangrove forests could become refuges for animals whose primary habitats are fragmented or lost by human disturbance (Nowak 2013), and which roles these animals play in benefitting mangrove health. There is the potential that mangroves and their inhabitants are especially vulnerable to degradation given these forests are situated at the border between terrestrial and marine habitats (e.g. coastlines) and between saline and freshwater habitats (e.g. estuaries). The treatment of mangroves as either terrestrial or aquatic systems (Macintosh 2002), has led to inconsistent management priorities (Spalding et al. 2010) and potential confusion as to who is responsible for management (Government of Western Australia Department of Fisheries 2012). **It is likely that our poor understanding of mangroves and their inhabitants impacts on our ability to effectively conserve and manage mangrove forests.**

Project significance and aims

This project seeks to rigorously assess the adequacy of current management actions and plans for mangroves as they relate to occupation and use by terrestrial vertebrates. The project will also assess the efficiency of the tools at our disposal to document terrestrial vertebrate biodiversity in what is a challenging field environment. The project will provide management recommendations that will seek to maximize biodiversity conservation. For the scientific community my research will summarise current knowledge gaps and provide guidance on timelines to address these. To do this I will address the following research questions: **question 3** is the focus of the fieldwork for which funding from Paddy Pallin is used.

1. **What is the current state of knowledge on terrestrial vertebrates within mangroves and what are the implications for mangrove conservation?**
2. **How are mangrove communities managed in Australia and what are the implications of existing governance structures for the effective management of mangroves?**
3. **How well does the knowledge that protected area managers have on the use of mangroves by terrestrial vertebrates reflect the *in situ* situation?**
4. **How does knowledge on species occurrences and ecology derived from different data sources change management objectives for mangroves?**

Field surveys

Field surveys are an extensive part of my PhD which would not have been possible to carry out to such a large extent without the help from Paddy Pallin.

Placement in the field and field locations

Because mangroves grow across the intertidal zone from the landward side all the way down to the low water mark my design using a total of seven techniques to detect mammals, reptiles and amphibians was interspersed in this whole area (Fig 1).

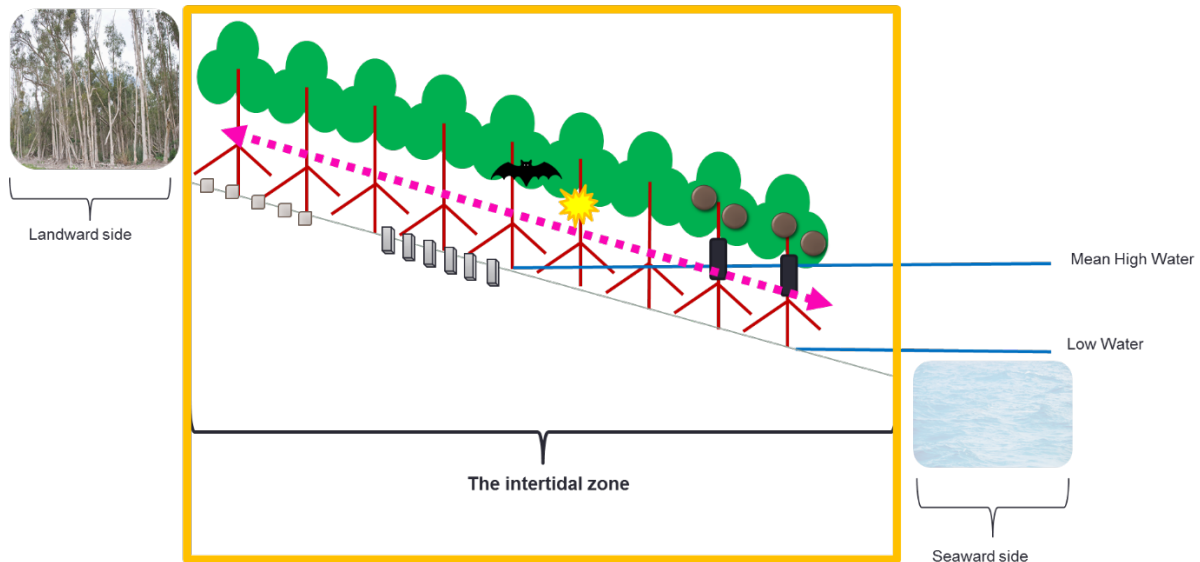


Fig 1. Placement of different trapping techniques as part of the novel survey design in mangrove forests to detect mammals, reptiles and amphibians. In the flooded tidal area 24 hair traps (grey circles) and 20 foam covers (black cylinders) were placed, just on the high tide line the 4 camera traps (star) and bat detector (bat) and above the tide line the 40 Elliot traps (grey boxes) and 40 ground covers (grey squares). In addition four 100m night transects (pink line) were walked parallel through the whole mangrove area.

With this design (Fig 1) I surveyed a total of ten mangrove locations all along the East coast gradient of Australia (Fig 2), capturing temperate, subtropical and topical mangroves. This gradient is interesting not only to investigate patterns in animal species richness and whether this might be related to patterns in mangrove plant species richness, but also to determine how well the design and separate techniques performed in detecting unique species and the three taxa groups in each climate zone.

Break-down of conducted field surveys over three years

- *Year 1 (April 2014- April 2015)*
First field survey on temperate location Victoria- Feb 2015. See interim report on findings from this survey and how field experiences from this location improved the design for the following field survey locations.
- *Year 2 (April 2015 – April 2016)*
Field surveys on two temperate and four subtropical locations in New South Wales and Southern Queensland - Oct/Nov 2015
- *Year 3 (April 2016 – April 2017)*
Field surveys on two tropical locations in North Queensland- Oct 2016
Last field survey on one temperate location in Victoria– Dec 2016

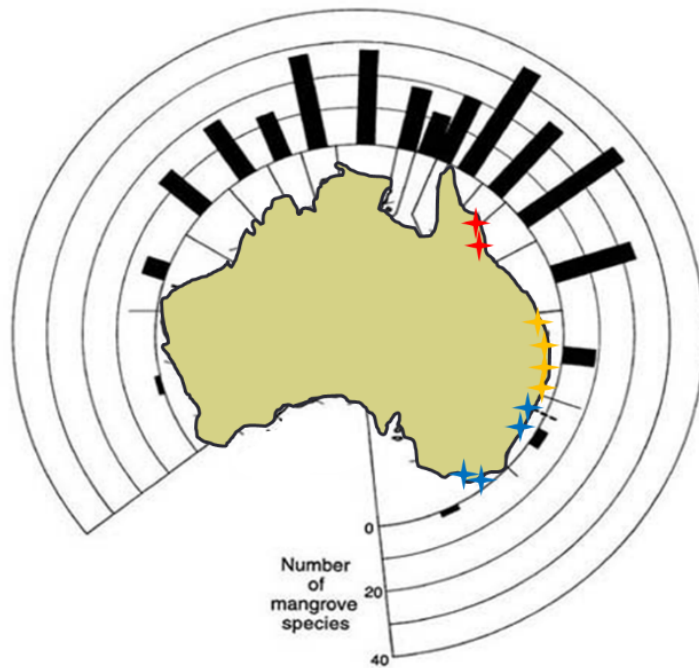
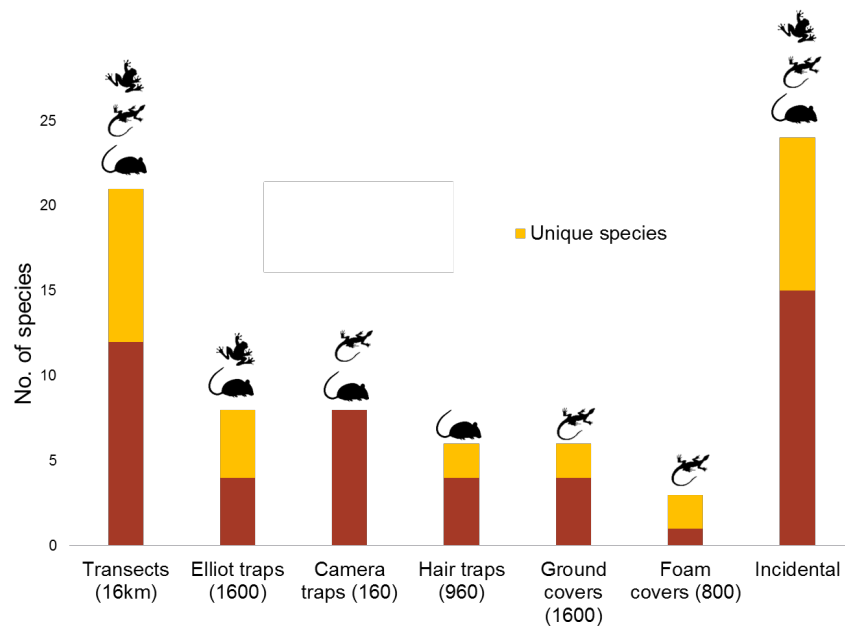


Figure 1. Ten mangrove survey locations along the east coast gradient of Australia. Blue stars indicate the four temperate locations, yellow stars the four sub-tropical locations and red stars the two tropical locations. The graph represents the mangrove plant species across Australia, showing higher plant species richness towards the tropics.

Preliminary outcomes of field surveys

When we look at the performance of each technique pooled over all the ten mangrove locations the technique from the design that detected the highest species richness was night transects (Fig 3). However, you see that a higher species richness was detected incidentally -while exploring the mangrove locations and setting up the design. This could mean that transects walked during the day is a good addition to the design. Nevertheless, the design held the maximum number of traps and transects to be checked with two people within a 24h period, and a third person needs to be added to ensure safe sleep patterns are obtained. The techniques that detected very few species (e.g. foam covers) did detect unique species which can be critical information to management as well as they could include threatened or invasive species, meaning they should be kept in the design. All three taxa groups were detected with night transects and incidental sightings while some techniques worked specifically well for reptiles or mammals alone (Fig 3). I also found that the pattern of animal species richness does follow the same patterns as that of mangrove plant species richness. I am currently working on chapter three that will go into more detail about the methods and their detection success in mangroves, and on chapter four that will discuss the ecology of species detected in mangroves, possible explanations apart from mangrove plant diversity and the applications for management.



No. traps (varied) * Sites (10) * Nights (4)

Fig 3. Detection of species richness, unique species and taxa in mangroves with different techniques of the design. Results are pooled over the ten surveyed locations. Bars represent total species numbers of which the yellow part represents the number of unique species and red bar the species shared/detected with other techniques. Bat detector results are not included as calls still await analysis. Hair trap results shown for seven out of ten locations, the last three locations will be analysed later in 2017.

Other outcomes and achievements from PhD research

Papers

1. Chapter one: My literature review “More than marine: revealing the critical importance of mangrove ecosystems for terrestrial” is published in Diversity and Distributions Volume 23, Issue 2, pages 221–230, February 2017
2. Chapter two: “Strengthening governance for intertidal ecosystems requires a consistent definition of boundaries between land and sea”, is submitted to Journal of Environmental Management in February 2017. This chapter evaluates the complex intertidal legislation and implications on intertidal ecosystem management, by exploring inconsistent land sea boundary definitions and the characterization of vegetated intertidal ecosystems (e.g. mangroves as case study) as marine or terrestrial.
3. Chapter three: draft prepared of: “An effective novel survey design to rapidly assess terrestrial vertebrate richness in challenging tidal/inundated forests along the temperate to tropical cline”, plan to submit to “Methods in Ecology and Evolution” by late March 2017. This paper discusses the novel field approach (using a range of field techniques that were purchased with help from Paddy Pallin) on its success in detecting mammals, reptiles and amphibians in mangroves.
4. Chapter four: draft in preparation of “Knowledge derived from different data sources change management objectives for mangroves”, plan to submit to “Animal conservation” by June 2017. This paper discussed the ecology of the species detected with the field design and links this knowledge to current mangrove management.

Conference communications and public lecture

- I have attended the Australian Mangrove and Saltmarsh Conference in Wollongong in February 2015 to discuss mangrove protection and management and the ESA conference in Perth in December 2016 where I presented my field survey design to overcome tidal challenges in mangrove forests.
- I made a short video of my fieldwork findings which was shown at the Australian Mangrove and Saltmarsh conference in 2016 in Darwin and was sent to Paddy Pallin for placement on their website.
- Feature article in Wild Melbourne “Marvelous Mangroves” linking to the video that includes acknowledgement of Paddy Pallin: <http://wildmelbourne.org/articles/marvelous-mangroves>
- I was invited to provide a one hour public lecture about my field methods and findings at the Field Naturalist Club meeting in Victoria in February 2017.

Not for online publication:

Milestone

Mid candidature in April 2016, panel and supervisors satisfied with progress and planning coming year. Delays with permit applications, traditional owner approval discussions and safety requirements in relation to crocodile risk in tropical mangrove regions made that an extension was required to make sure all chapters could be completed with sufficient quality. The new thesis submission date is therefore 30th of September 2017.

Planning last six months of PhD candidature

- Submit chapter 2, 3 and 4 to high impact journals in conservation biology.
- Attend the international ICCB conference in June in Colombia to present my work and share findings and the importance of the terrestrial side of mangroves with the largest international conservation biology community in the world.
- Write general thesis introduction and discussion and submit September 2017.

Spending of last \$500

The final payment of \$500 will go towards the hair analyses from the last three surveyed locations in 2016 of which the results will be used for analyses in Chapter 3 and 4.