Department of Biodiversity, Conservation and Attractions

GOVERNMENT OF WESTERN AUSTRALIA

Biodiversity and Conservation Science

Two species, one island: Retrospective analysis of animal translocations with divergent outcomes

Doole Island in the Exmouth Gulf of Western Australia

Kelly Rayner, **Cheryl Lohr**, Peter Speldewinde, Sean Garretson and Keith Morris

Thank you.

Today I'll be speaking about the use of population viability modelling in the planning stages of translocations.

Specifically I'll be referring to two translocations of threatened fauna to Doole Island, in Western Australia – one which succeeded and one which failed – and how population viability modelling could have allowed us to predict that outcome before we invested in the translocations.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Translocations

Translocations are a tool that are used commonly worldwide in an effort to improve species conservation.
But translocation attempts also commonly fail. In Australia between the 1970s and 2009, 35000 animals that we know of were translocated. But only 32% of translocation attempts during this period were known to be successful. Failures are rarely reported which is a shame, as these situations are where we stand to learn the most about how we can do things better.

Islands are a great option translocations. They are closed systems, so introduced predators can be eradicated rather than continually managed, translocated animals stay within the release area and there is some protection from human interference as these locations are often harder to access than mainland sites.

In Western Australia these advantages have been reflected in outcomes with 78% of translocations as of 2015 being successful.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Doole Island

- Nature reserve
- 258 hectares
- No introduced predators
- Easily accessible

One island in WA that was identified as a good option for the translocation of two mammal species was this one – Doole Island, in the Exmouth gulf.
This island fell within the historic range of both of these species, but there was no evidence that either had previously existed on this island.

It was deemed a suitable release site because
- Nature reserve with no recreational access
- it was thought to be large enough and similar enough to source population habitats to support populations of these species,
- no introduced predators
- No native competing species present
- relatively easily accessible.

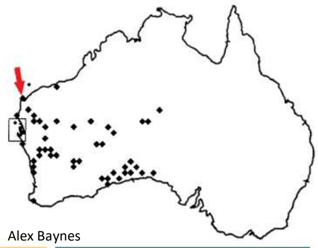
Importantly, the criteria used to deem this site suitable were the same for both of the species translocated here.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

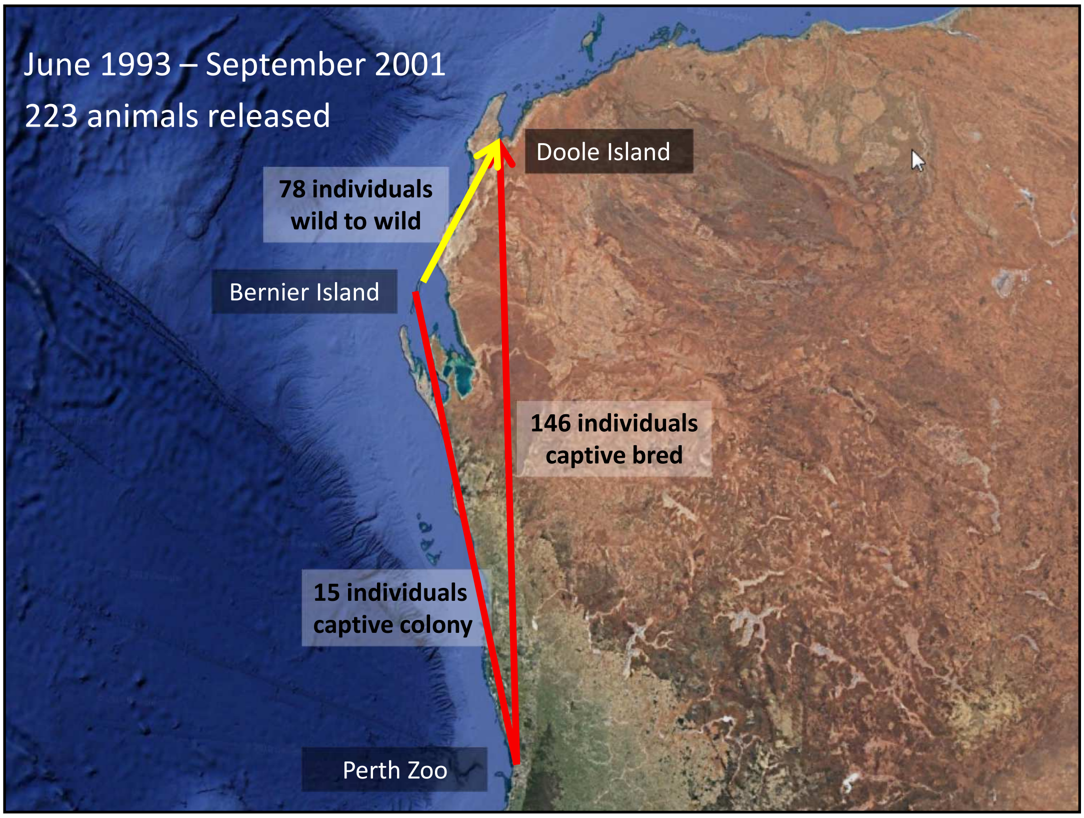
Shark Bay Mouse (*Pseudomys fieldi)*

- Vulnerable
- One natural population remains
- Translocation to Doole was a recovery action
- 1993-2001



The first species translocated to Doole island was the Shark Bay Mouse.
This is a threatened species, which suffered a massive decline following colonisation. We have records of this species having occurred from the southwest corner of WA, right through the arid zone. But now, there is only one natural population left on Bernier Island off of Shark Bay, hence the name. Bernier Island is here in the box.

A Recovery plan was written in 1991 and one of the recovery actions was to establish another island population of Shark Bay mice, for which Doole island was selected as the release site.
In June 1993 the first 27 mice were translocated to the island.



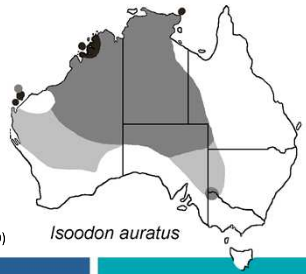
Between 1993 and 2001, there were seven release events of shark bay mice on Doole island. The first of these were direct, wild to wild translocations, while the later releases consisted of animals bred in captivity at Perth zoo.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

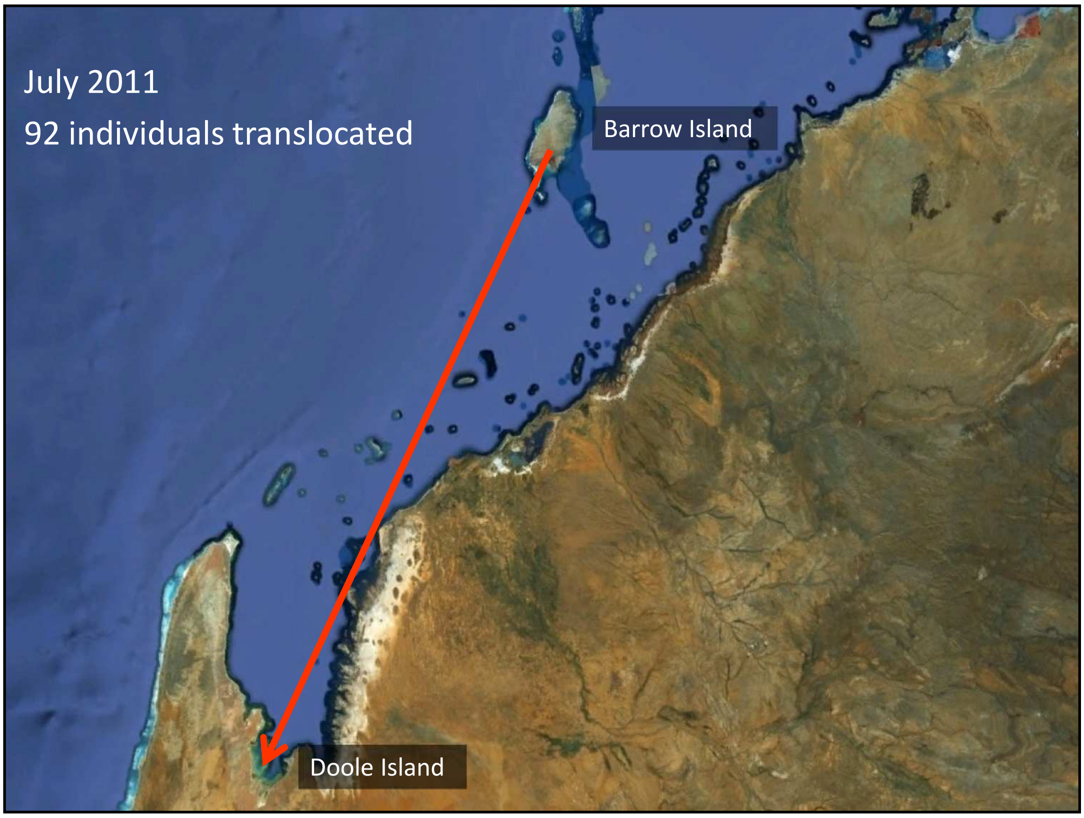
Golden bandicoot (*Isoodon auratus)*

- Vulnerable
- Only found in 1% of former range
- Translocation offset for industrial works

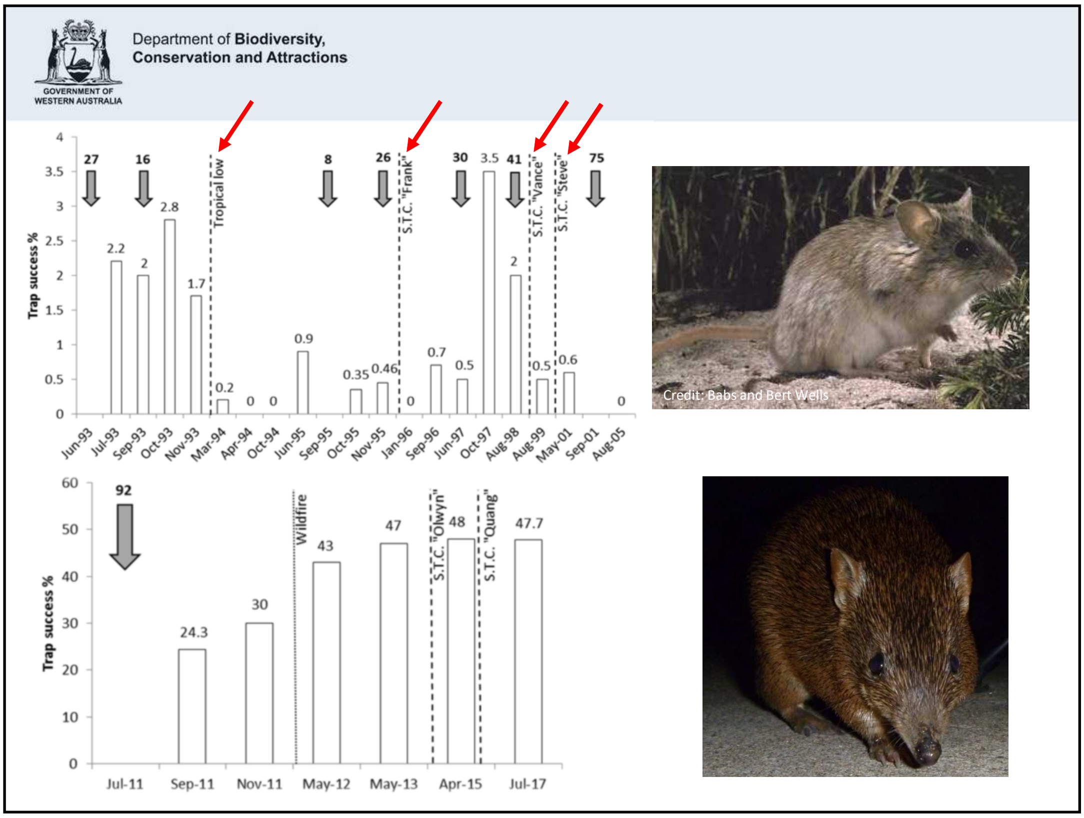


McKenzie et al. (2000)

The second species translocated to Doole island was the golden bandicoot. It is also a threatened species and has also suffered a massive decline since colonisation.
The pilbara subspecies that we translocated is extinct on the mainland and only found naturally on two offshore islands.
One of these islands is now the site of a major gas plant, and the translocation of this species was undertaken to ameliorate potential impacts of these industrial works.



There was only one release event of golden bandicoots on Doole Island, with 92 animals translocated directly from Barrow Island in 2011.



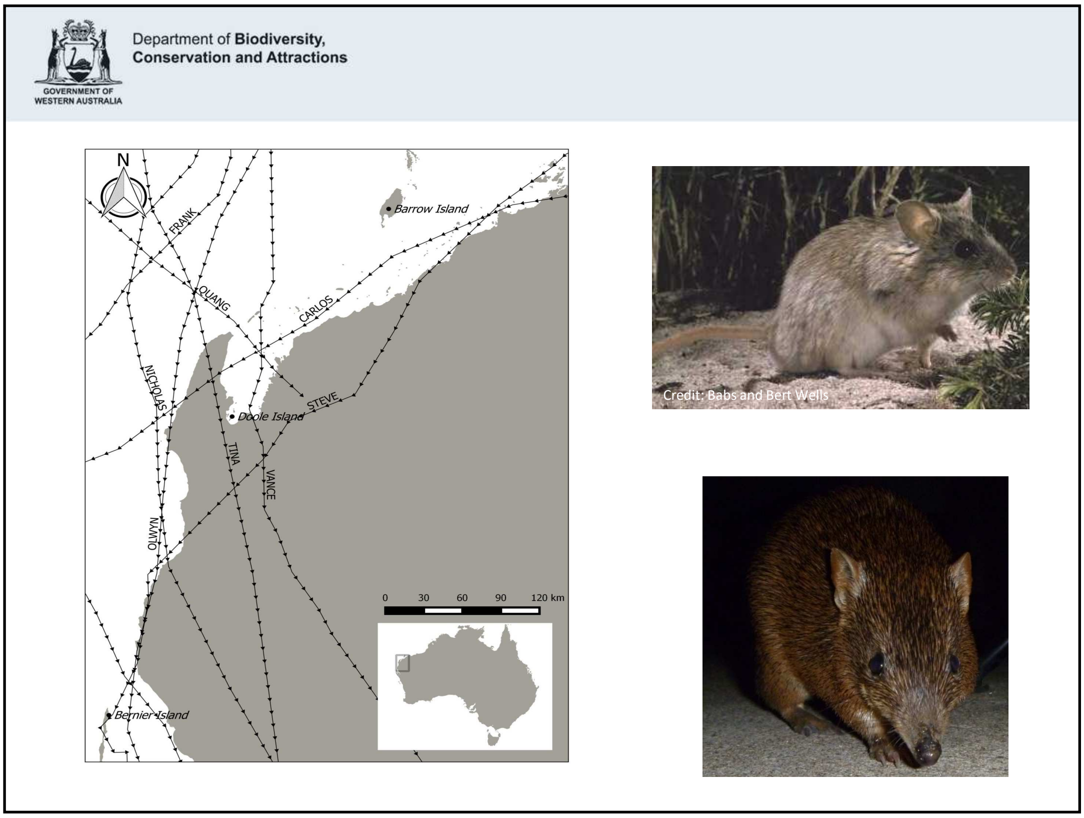
Here we have shark bay mice above and golden bandicoots below, the arrows indicate release events and the bars along the x -axis show trap success rates for each monitoring session.
We also have the instances of severe tropical cyclones indicated by the broken lines, which will be become more relevant shortly.

Shark Bay mice failed to establish on Doole island despite multiple release events.
The golden bandicoots have persisted on the island after just one release event.

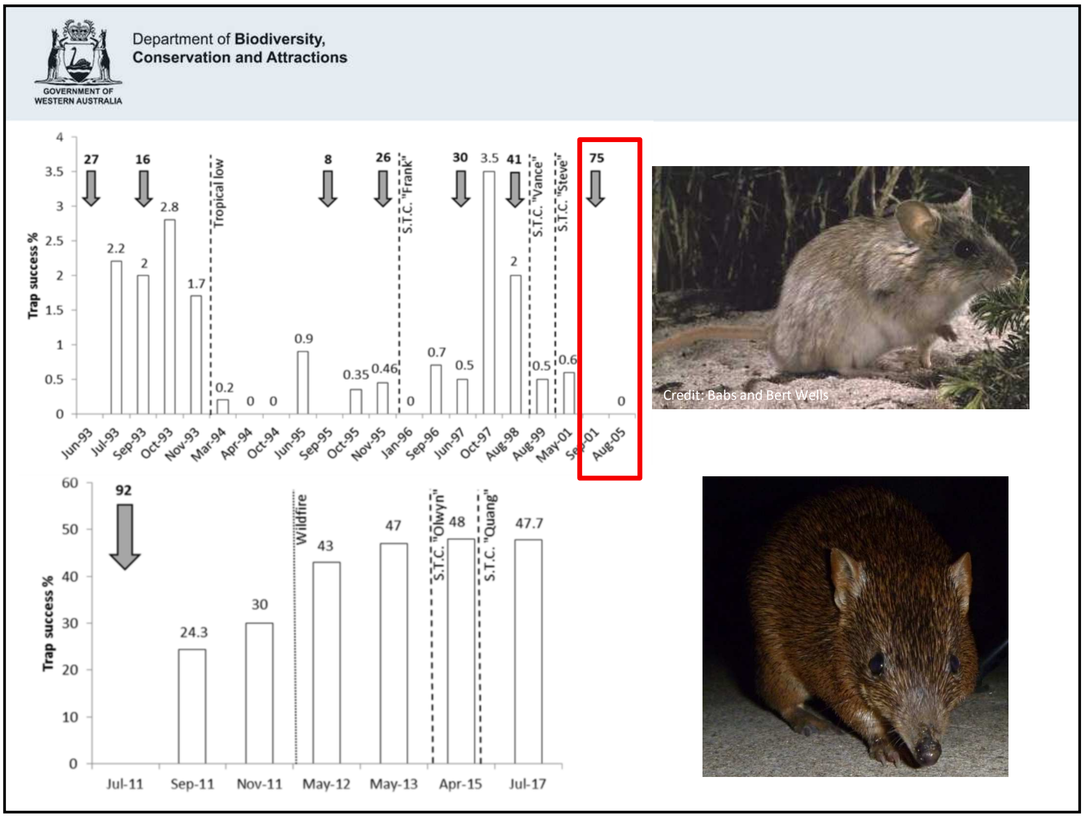
Criteria for success were defined for both of these translocations to help determine the outcomes of the work.
Shark bay mice failed to meet any of these criteria.
But the criteria weren't particularly helpful in helping us figure out what went wrong because they were broad statements like – species persisted for 2 years.

We needed to identify the reasons why shark bay mice failed to establish.

Looking at this graph, we first thought it must be the cyclones.



Looking at this graph you can see why. On average there is a cyclone that passes within 100km of Doole Island every 3 years. Since Doole Island is at the bottom of the Exmouth Gulf it gets extremely high storm surges as water is pushed in and trapped by the storm.



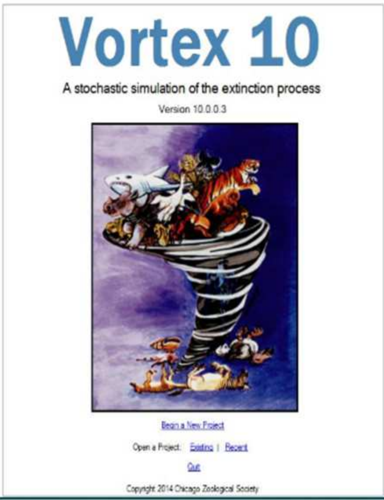
But if it was cyclones then shouldn't our final introduction of 75 mice in 2001 have established a population??

We turned to population viability modelling with the aim of developing a model that would predict the outcomes we did see and then allow us to explore demographic parameters that may have played into these two translocations on the same island having divergent outcomes.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Population viability analysis (PVA)



Predicts the long-term persistence of a population using stochastic simulation

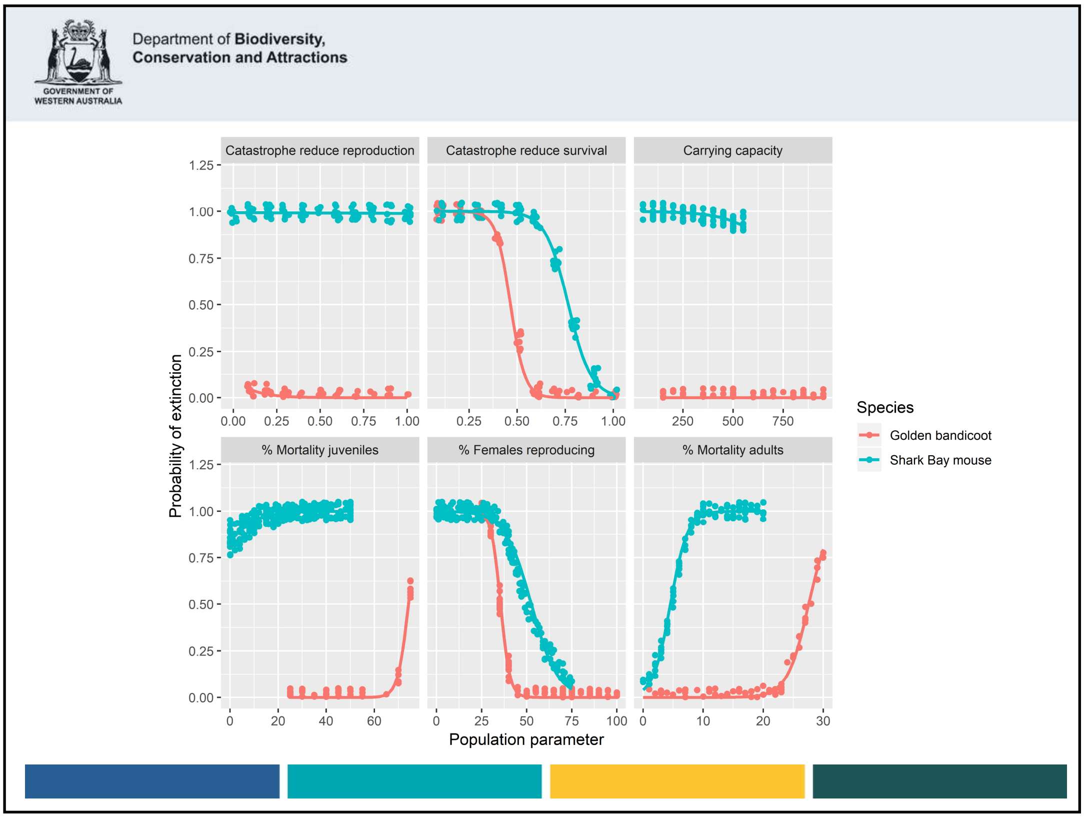
Contention about accuracy and role of PVA for data deficient species

Sensitivity analysis overlooked

Most of you will have heard of population viability analysis – It can be used to predict the long-term persistence of a population using stochastic simulation.

There is some contention about the viability of this tool for use with threatened species especially data deficient species. This concern is valid. As with any model, garbage in – garbage out.
So we started by building and iteratively refining a model with species experts and published data – until our model predicted the persistent population of species in their source locations, and their predicted success or failure on Doole Island. Model validation is an important part of the process.

Rather than then focusing on the models predictions of extinction risk – we know that shark bay mice failed and golden bandicoots succeeded – we used sensitivity analysis of the demographics of each species to elucidate why we got the outcomes we did.



The sensitivity function in VORTEX allows you to iteratively change the inputs for any of the demographic parameters. You put in the range of values you want to test, and the interval between each change and the program automatically runs all the necessary models, which in our case was 2328 parameter combinations. We then used logistic regression to plot the variation in probability of extinction against variation in the inputs.

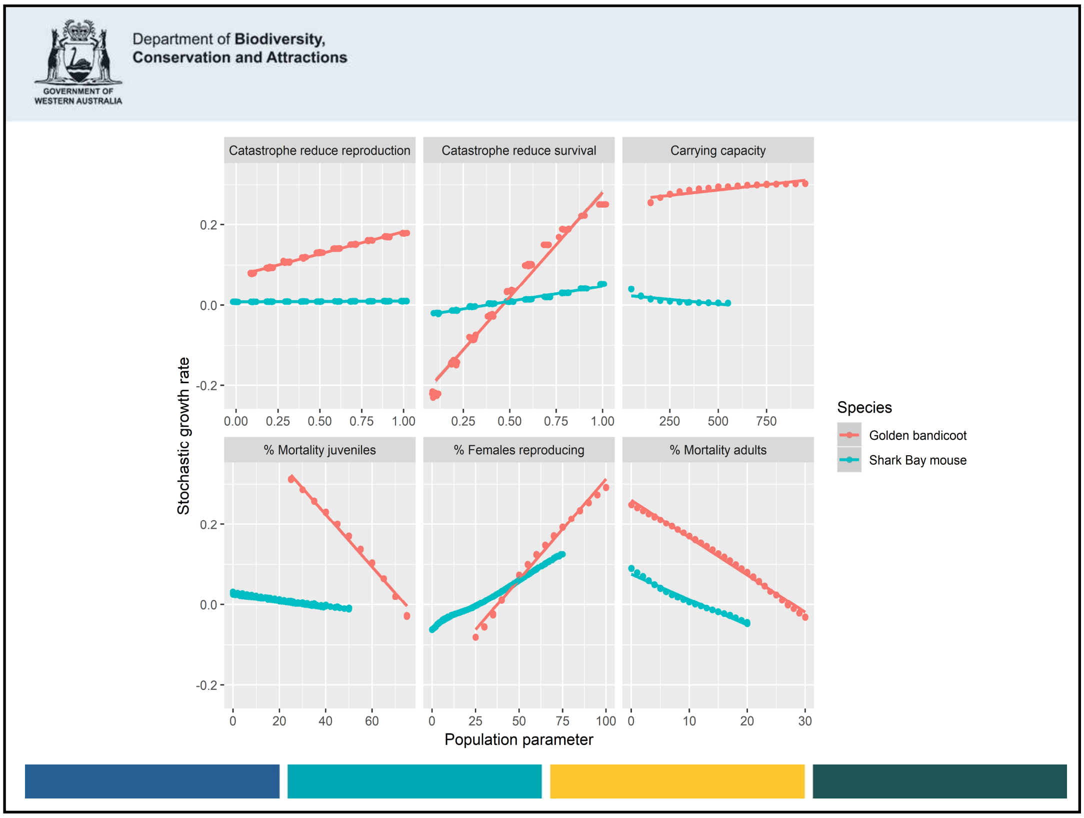
GB data red lines
SBM data blue lines

PE = 1 is guaranteed extinction – you want it to curve down.
You can immediately see that SBM far greater risk than GB.

You can see from this graph that half of our demographic parameters appear to have a non-significant relationship with PE.
Most notably, carrying capacity did not influence PE. We had hypothesised that the island was too small it is only 258ha after all. We pushed K up to 550 individuals for SBM and down to 150 for GB. These results do not tell us that K is unimportant – but that other demographic variables are more important in predicting PE.

Looking at adult mortality and catastrophe reduced survival you can see a lot of movement in the graph.
SBM will go extinct if 10% of more of the adult population dies per timestep. GB on the other hand far more robust withstanding 25% adult mortality.
Reduction in survival due to a catastrophe is additive mortality. When equal to one then

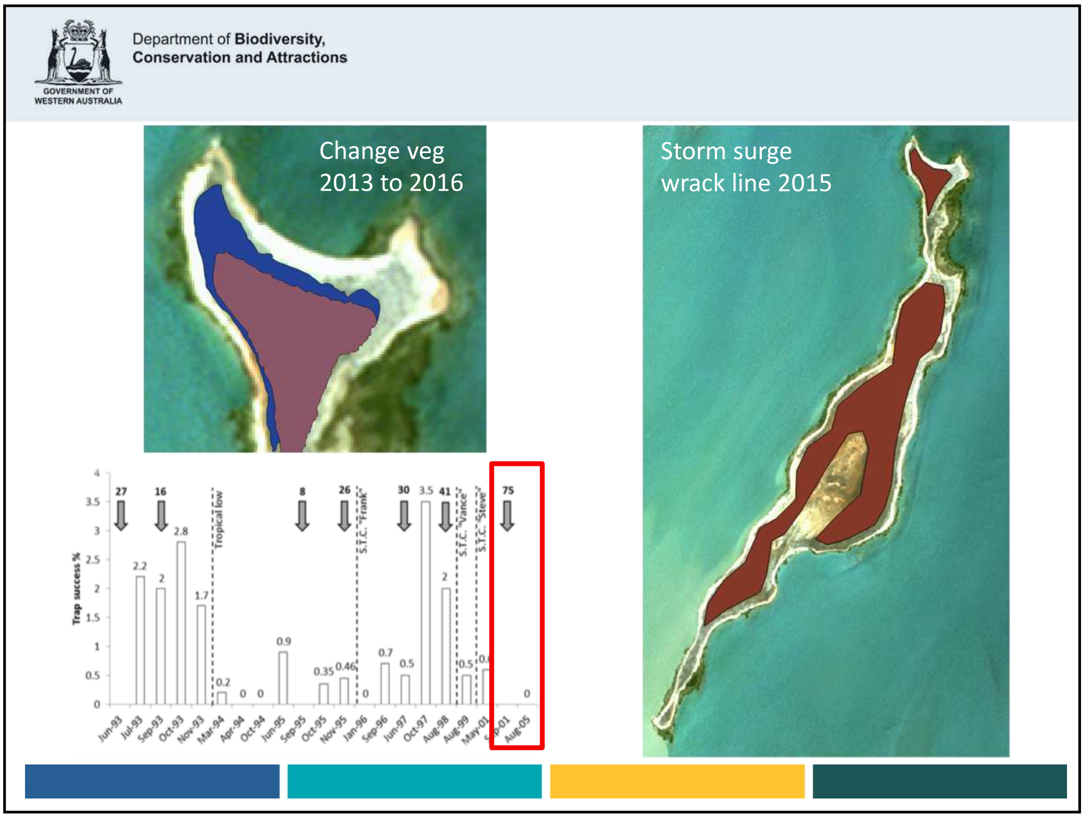
catastrophe does not exacerbate normal adult mortality – catastrophe has no effect.
In SBM is catastrophe has ANY effect on adult mortality then go extinct.
GB more robust species and normal adult mortality can be increased by 50% before risk of extinction become 50% or more.
We see the same pattern with % females reproducing: if less than 75% of SBM females reproduce the species starts heading towards extinction whereas GB as few as 40% could reproduce within a timestep before the species is at risk.



If we compare the stochastic growth rate of SBM and GB to variation in demographic parameters we see similar patterns. When stochastic growth is above zero a species will increase in abundance, and when it is below zero declines towards extinction.
GB are typically above zero. Only when adult mortality above 25%, fewer than 40% females reproducing or catastrophe is exacerbating mortality by another 50% does the stochastic growth rate drop below zero. They are a robust species.

SBM on the other hand always hovering around zero. They are a very sensitive species.

Only when more than 25% females are reproducing in a timestep do they start to increase in abundance.
If cyclonic storm surge takes SBM mortality from 10% to 15% (50% increase) they risk extinction. That is factoring in that there is only a 7% chance of a cyclone passing through the area.

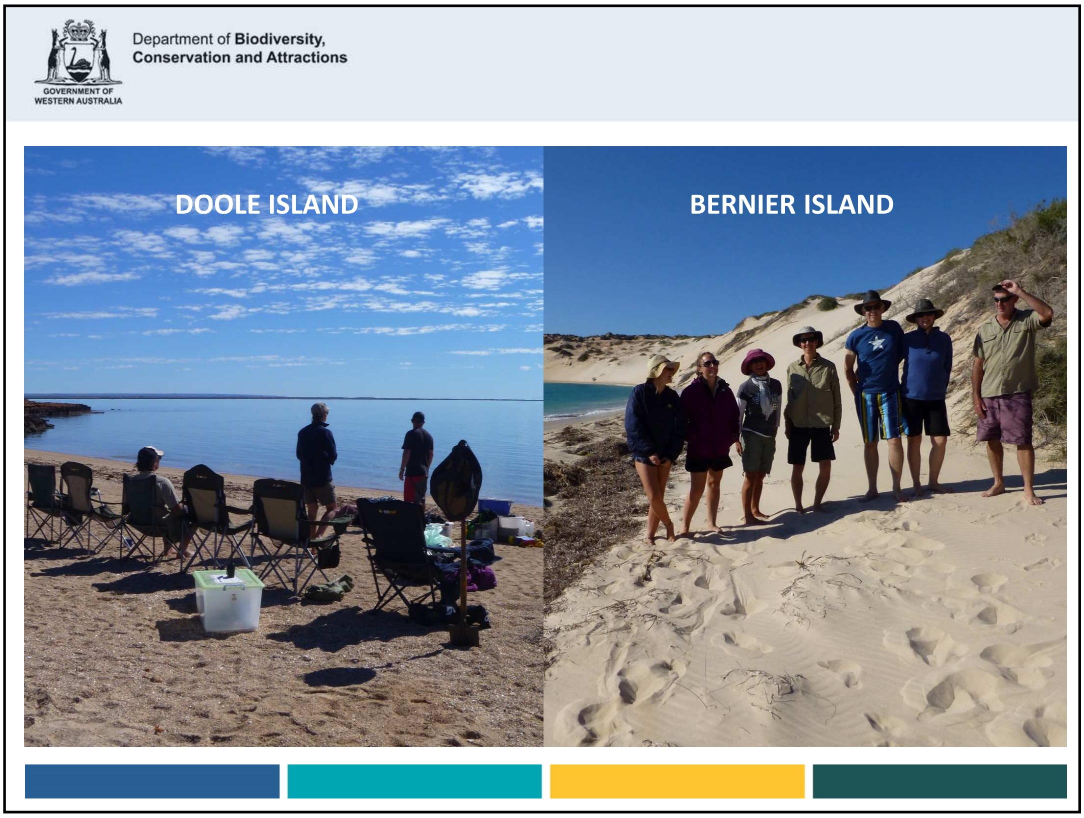


The PE associated with lack of females reproducing might explain why our final introduction of 75 SBM did not establish a population despite the lack of cyclone.

Doole island is very low lying. Highest point only 12.55m above mean sea level. Plotted storm wrack in 2015 was 5.1m above mean sea level. Only half the island remains above water.
Looking at aerial imagery between 2013 and 2016 we could see that cyclones had removed sizeable portion of coastal vegetation.

We know from the source population on Bernier Island that SBM favour dense patches of spinifex longifolius – a species commonly found along coastal margins.

If the cyclones Vance and Steve in 1999 and 2000 had also ripped out large portions of the spinifex longifolius then there would be minimal habitat for the SBM we released in 2001 to shelter or breed in. Lagged impact of cyclonic storm surge that meant new animals could not establish a population.



In conclusion:

The real value in PVA prior to translocation is the information on species plasticity – robust or sensitive species. How careful do you need to be about your site selection.

There are many benefits to islands, but selection of sites must be species specific.

Need to account for risk of catastrophes occurring and the potential local impact of a catastrophe. Look at the slope in the beach sand and sand dunes on Doole Island compared to Bernier Island. The storm surge on one island is going to be far more devastating than the other, especially if you like to live in borrows in coastal vegetation.

Need basic biological studies of threatened species including habitat requirements! The potential cost of a failed translocation should be carefully considered.

We need publications on why translocations have failed. We learn the most from our mistakes.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Acknowledgements

Kelly Rayner, Peter Speldewinde, Sean Garretson and Keith Morris

Natural Heritage Trust
Department of Fisheries
Bunbury Aero Club
Chevron Australia
Bullara Station
Volunteers

Perth Zoo Native Species Breeding Program

Animal science, Exmouth District and Barrow Island DBCA staff