Monitoring Source Populations of Fauna for the Dirk Hartog Island National Park Ecological Restoration Project – 2021

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GOVERNMENT OF WESTERN AUSTRALIA

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Contents

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Summary

Monitoring of source populations of six mammal and one bird species was undertaken by the Department of Biodiversity Conservation and Attractions' (DBCA), Biodiversity and Conservation Science in 2021 to obtain information on the distribution, abundance and health of the wild source populations for translocations occurring as part of the Dirk Hartog Island National Park Ecological Restoration Project (DHINPERP).

Monitoring of these source populations in 2021, also fulfilled the requirements of Corporate Guideline 36 (Sections 1.2 and 5.2.9), to monitor the status of Shark Bay bandicoots on Bernier Island post-harvesting in 2020, and of dibblers on Escape Island post-harvest of animals in February and October 2019, and December 2020. Monitoring of Shark Bay mice on Bernier Island and Northwest Island, and of greater stick-nest rats on Salutation Island was also undertaken to inform proposed harvesting activity in autumn 2021 and 2022. Monitoring of all species on Bernier Island occurred in late March 2021.

Heath mice surveys occurred in December 2021 but failed to capture any individuals at these historical locations.

In addition, ongoing preliminary monitoring and capture work of western grasswrens has been undertaken at two locations in Shark Bay since July 2019: Hamelin Station Reserve (owned by Bush Heritage Australia) and Peron Peninsula (including Francois Peron National Park and adjacent Unallocated Crown Land). Data collected from this work will be used as part of a doctoral study by A. Gibson Vega on the genetics and behaviour of this taxon, which will inform the proposed translocation to Dirk Hartog Island.

1 Introduction

This report documents the monitoring activities undertaken in 2021 on Bernier and Salutation Islands in Shark Bay, Northwest Island in the Montebello Islands and Boullanger, Whitlock and Escape Islands off Jurien Bay. Species targeted for monitoring were Shark Bay bandicoot (*Perameles bougainville*), boodie (*Bettongia lesueur*), Shark Bay mouse (*Pseudomys gouldii*), greater stick-nest rat (*Leporillus conditor*) and dibbler (*Parantechinus apicalis*).

We also present the results of monitoring of western grasswrens (*Amytornis textilis*) at Hamelin Station Reserve and on Peron Peninsula, both in the Shark Bay area, and surveys for heath mice (*Pseudomys shortridgei*) in the Ravensthorpe area on the South Coast of WA. All seven species covered by this report have already been translocated or are planned for future translocation to Dirk Hartog Island National Park (DHI).

2 Methods

2.1 Surveys

2.1.1 Bernier Island

Monitoring of Bernier Island in Shark Bay (Midwest Region) was undertaken between 25 and 31 March 2021. One permanent trapping grid of 64 trap points has been established on the plateau at Red Cliff Bay, Bernier Island and this grid was open for four nights, targeting all mammals, especially boodies, bandicoots and rodents. The total trapping effort was 256 cage and 256 Elliott trap nights.

Another smaller permanent grid of 21 trap points, located in consolidated sand dune habitat near Red Cliff Bay on Bernier Island, was also operated together with the larger grid, to specifically target Shark Bay mice (SBM). This grid has medium Elliott traps (placed inside pipes to protect them from boodie disturbance) and was also opened for four trap nights concurrently with the larger grid. A full description of permanent trap grid design, locations and methodology are described in previous reports (Sims *et al.* 2020).

In 2021, an additional grid of 21 trap points was also located in semi-mobile dunes east of, and concurrently with the first. This grid was targeted at trapping more rodents and used a wire mesh ‘cage’ to discourage disturbance from larger, non-target mammals (boodies and bandicoots) rather than pipes.

The total trap effort for the 2 smaller grids was 168 Elliott trap nights. A small number of extra Elliott traps were set on the beach area of Red Cliff Bay providing an additional 30 Elliott trap nights

All Shark Bay bandicoots (SBB) captured on Bernier Island were examined for possible symptoms of active infection with Bandicoot Papillomatosis Carcinomatosis Virus One (BPCV1). Bandicoots were carefully examined for abnormalities of the hair and skin, and any suspicious lesions were to be photographed and then sampled,

along with other potential viral shedding sites on the bandicoots (eyelids, lips, feet and flanks) using sterile saline swabs (Woolford 2017). Swabs would then be frozen and sent for PCR assay for detection of BPCV1 (Woolford *et al.* 2007). See previous reports (e.g. Sims *et al.* (2020)) and the Disease Risk Analysis (Vaughan-Higgins *et al.* 2018) for further information on this disease.

2.1.2 Northwest Island

Monitoring of Shark Bay mice on Northwest Island in the Montebello Islands (Pilbara Region) took place between 15 and 18 April 2022, prior to the planned translocation to DHI. Two trapping grids were used consisting of seven lines of three with one Elliott trap at each point, mirroring the 21 trap points per grid used on Bernier Island. This included the 'original' grid that has been used to monitor Shark Bay mice at this site since 2014 and the 'new' grid established and first run in 2019. Combined trapping effort was 168 trap nights across both grids.

2.1.3 Salutation Island

Monitoring of greater stick-nest rats on Salutation Island prior to the proposed harvesting and translocation, was scheduled for 4 nights trapping (by Gascoyne District Parks and Wildlife Service (PWS) personnel and one DHINPERP staff member). This monitoring occurred on the permanent 10 x 10 grid using medium Elliott traps that has been in place since the original establishment of this population in 1990. However, weather conditions disrupted the program and only one night of trapping was completed (trap effort of 100 trap nights) on 18 May. However, data collected in that one night was sufficient (in conjunction with the data from the 2020 monitoring) to inform the planned translocation.

2.1.4 Dibbler

Trapping for dibblers on Boullanger, Escape and Whitlock Islands in Jurien Bay (Midwest Region) involved medium Elliott traps placed on permanent monitoring transects. Methods used were as per previous reports (e.g. Sims *et al.* (2021)).

Monitoring on Boullanger and Whitlock Islands took place between 25 and 28 May and 26 and 29 October 2021. Unfortunately, adverse sea conditions during both sessions meant that surveys had to be curtailed, resulting in three nights' trapping in May and two nights' trapping in October, compared with the usual four. Monitoring on Escape Island was originally planned for January 2022 but was postponed due to forecast high temperatures and the survey took place between 9 and 12 March 2022. As in 2020, the trapping team camped overnight on Escape Island, in part so that traps could be opened as late as possible in the afternoon to reduce the number of captures of King's skink (*Egernia kingii*), which are abundant on the island.

Trapping effort across all three sites was:

- Boullanger (375 May 2021; 250 October 2021)
- Whitlock (120 May 2021; 80 October 2021)
- Escape (400 March 2022)

2.1.5 Western grasswren

Western grasswren monitoring took place between 20 July and 28 September 2021 at Hamelin Station Reserve. Monitoring consisted of searching for colour-banded individuals from previous years and recording evidence and quantifying breeding attempts. Groups which were successfully reproducing were captured via mist nets. Mist nests were strategically placed close to shrubs and grasswrens were lured into the net with playback and herding. Upon capture, weight, morphological and blood samples were measured and obtained for this species. Individuals were marked with three colour leg bands and one metal leg band (two bands on each tarsus).

2.1.6 Heath Mouse

The heath mouse formerly had a wide distribution in Western Australia, from Shark Bay to Israelite Bay, but was thought to have become extinct in the state prior to 1987 when it was rediscovered in the Fitzgerald River National Park (FRNP) on the south coast of WA. Recent records have been confined to the mallee-heath between Lake Magenta and Ravensthorpe, including FRNP (Figure 1). However, there have been few records since 2011 with two individuals captured near Ravensthorpe in 2019 and another at Digger Rocks near Frank Hann National Park (100km NNE of Ravensthorpe), also in 2019. The latter site was impacted by a bushfire not long after the survey.

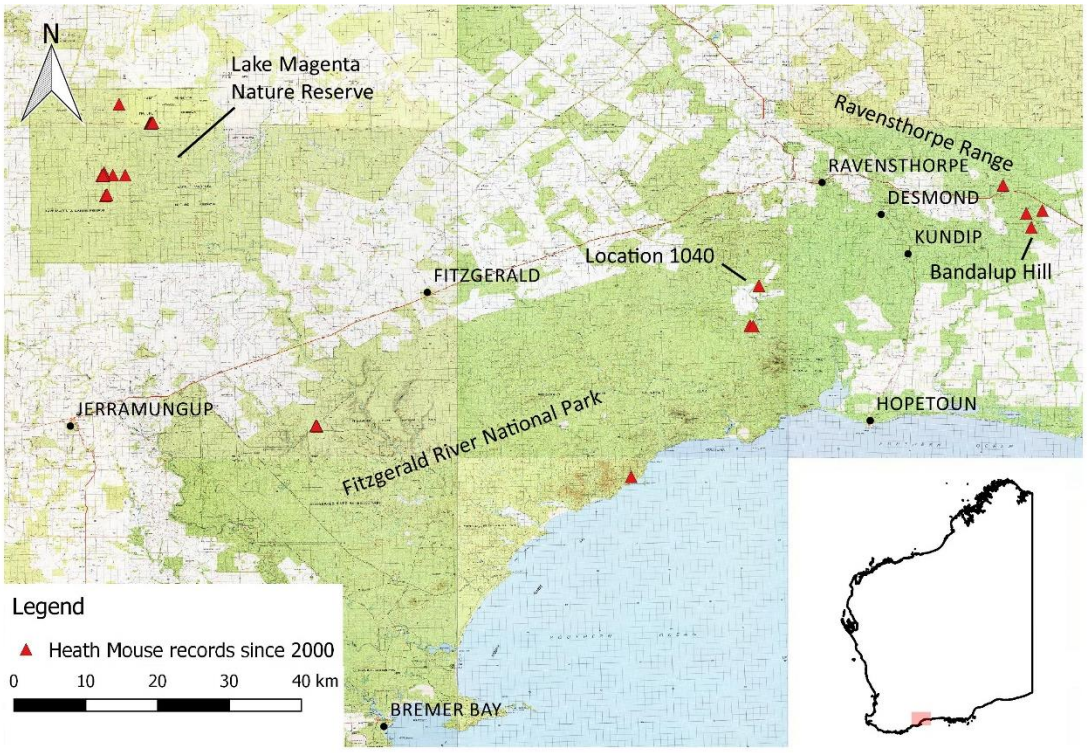

Figure 1. Map of heath mouse records since 2000 in the South Coast and southern Wheatbelt Regions. Note the 2019 record from Digger Rocks (100km NNE of Ravensthorpe) is not shown.

Heath mouse surveys were carried out between 30 November and 5 December 2021 in the Ravensthorpe area. Medium Elliott traps with universal bait were placed along transects at ~10-20m intervals (depending on habitat) in or near historical records in the Ravensthorpe Range and FRNP (‘Location 1040’).

2.2 Data analysis

Trapping data from Bernier and Northwest Islands were analysed using the Spatially Explicit Capture Recapture (SECR) package (secr 4.5.3) in ‘R’ version 3.6.3 (R Core Team 2020) to provide density and abundance estimates.

3 Results

3.1 Shark Bay bandicoot

3.1.1 Bernier Island

A total of 8 captures of 5 individuals were recorded on the Bernier Island main grid in March 2021, from 512 trap nights. An additional one individual was captured in the ad hoc Red Cliff Bay Elliott traps. The sex ratio of all individuals was 3M:3F and four were new individuals. Two out of three (67%) females had pouch young (PY). SECR analysis provided a population estimate of 1,150 (409-3,232), the lowest estimate for this population in the period 2017-2021 (Figure 2).

No bandicoots with suspicious lesions (i.e. symptomatic for BPCV1) were captured and no swabs were taken for analysis.

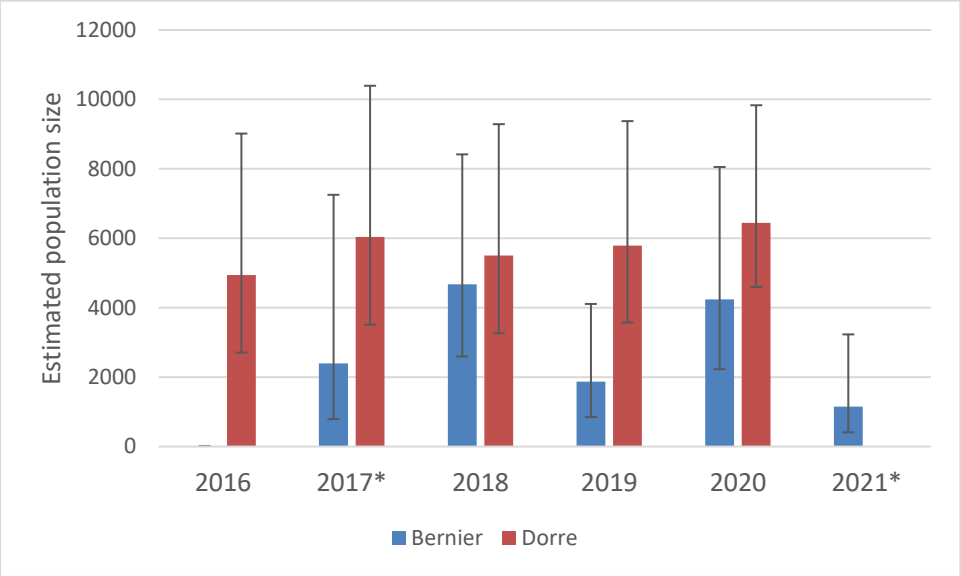

Figure 2. Population estimates for Shark Bay bandicoots on Bernier and Dorre Islands between 2016 and 2021, derived from SECR analysis on trapping data (denotes poor model fit). NB. Bernier was not surveyed in 2016 and Dorre was not surveyed in 2021.*

3.2 Boodie

3.2.1 Bernier Island

A total of 51 captures of 21 individuals were recorded on Bernier Island in March 2021, from 256 trap nights. The sex ratio of individuals was 12M:8F and nine were new individuals. Six out of eight females (75%) had PY, with another one reproductively active. SECR analysis provided a population estimate of 3,967 (2,340-6,589), representing an increase since 2020 and the largest population estimate between 2016 and 2021 (Figure 3).

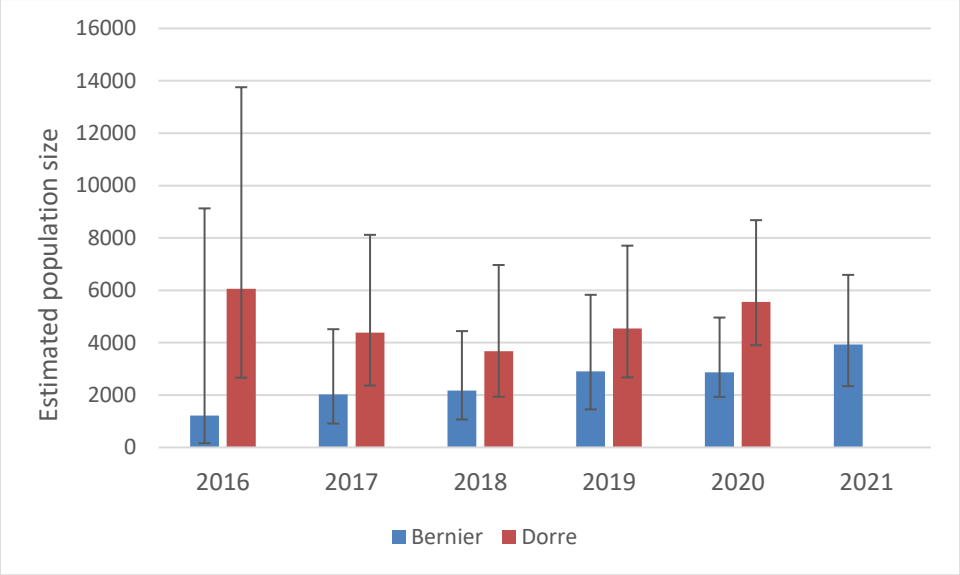

Figure 3. Population estimates for boodies on Bernier and Dorre Islands between 2016 and 2021, derived from SECR analysis on trapping data. NB. Dorre was not surveyed in 2021.

3.3 Shark Bay mouse

3.3.1 Bernier Island

Just one new (young male) SBM was captured on Bernier Island in March 2021, along with just one ash-grey mouse (*Pseudomys albocinereus*). As a consequence, no population modelling was possible. Although this was the lowest capture success for both species since 2016, there were numerous tracks of both mice species around the grids and traps, and in the sandy dune systems.

3.3.2 Northwest Island

A total of 106 captures of 98 individuals were recorded on Northwest Island in April 2021. The sex ratio of individuals was 67M:31F, or nearly 2M:1F. On the 'main' grid there were 52 captures of 46 individuals, in a sex ratio of 32M:14F. These capture data were used in a SECR analysis to provide a population estimate of 3,878 (1,525-9,860), representing an increase since 2019 (Figure 4), although the capture success was similar in both years.

Based on these results, 80 individuals (32M:48F) were translocated to Dirk Hartog Island between 20 and 22 April 2021.

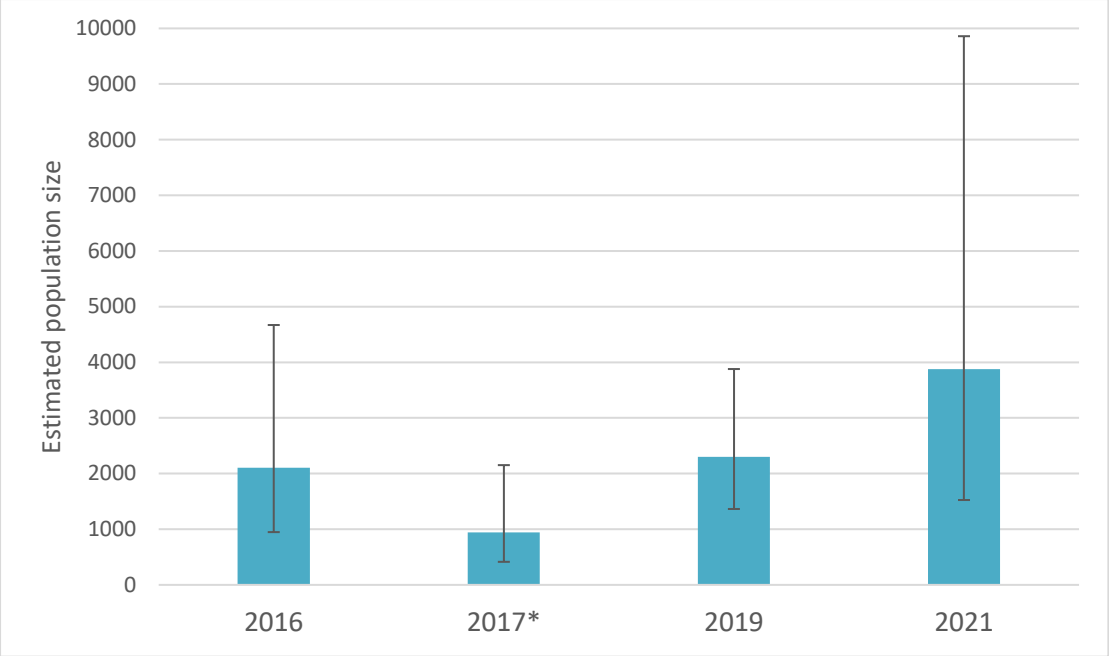

Figure 4. Population estimates from SECR analysis for Shark Bay mice on Northwest Island between 2016 and 2021 (denotes poor model fit).*

3.4 Greater stick-nest rat

The one night of trapping for stick-nest rats on Salutation Island (100 trap nights) resulted in the capture of 67 individuals (17M:50F) with four new individuals and 19/50 or 38% of females reproductive. This represents a trap rate of 67 individuals per 100 trap nights and was greater than the first day trap rates (45 per 100, and 55 per 100) recorded in May and October 2020 respectively. May 2020 trap results, (when analysed using SECR) translated to an abundance estimate of 2,760 animals (2,230-3,438), suggesting that the 2021 abundance was likely higher than this again. The trap rate of 67 per 100, was the highest recorded for this population in the 30 years since its establishment (Figure 5)

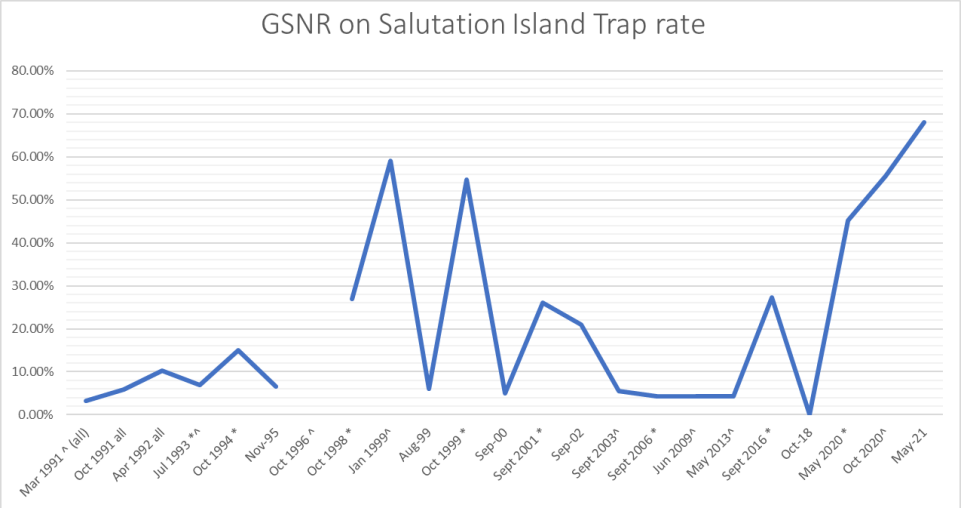

Figure 5. Relative stick-nest rat trap rates on Salutation Island since 1991.

3.5 Dibbler

3.5.1 Boullanger and Whitlock Islands

A total of 10 individuals (2M:8F) were captured on Boullanger Island in May 2021 over 375 trap nights (Figure 6). Capture success was 2.7 individuals per 100 trap nights. Two new individuals (both females) were captured, and seven females (88%) were carrying PY: three with eight PY, three with seven PY and one with two PY. This result represents a small increase in capture success rate over the last three years since 2018.

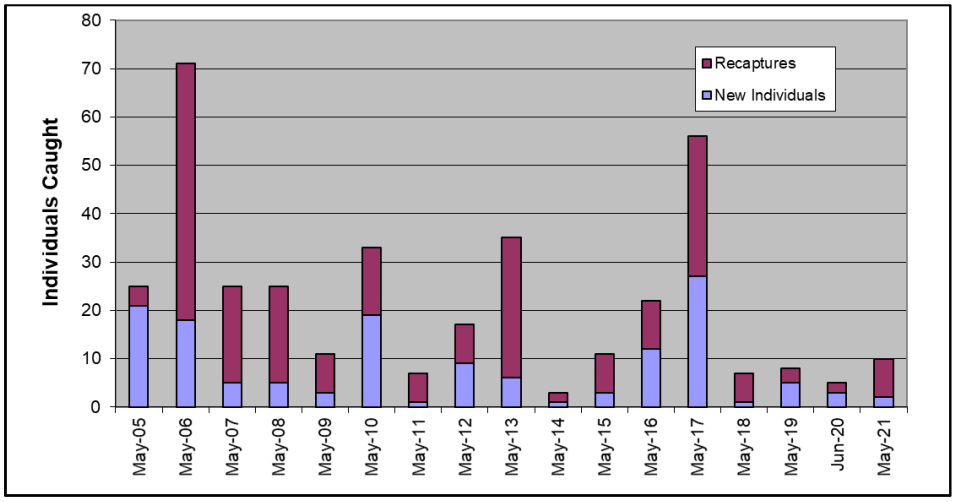

Figure 6. Individual dibblers captured on Boullanger Island in autumn between 2005 and 2021. NB. Surveys in 2009 (3 nights), 2020 (2 nights) and 2021 (3 nights) were curtailed due to sea conditions.

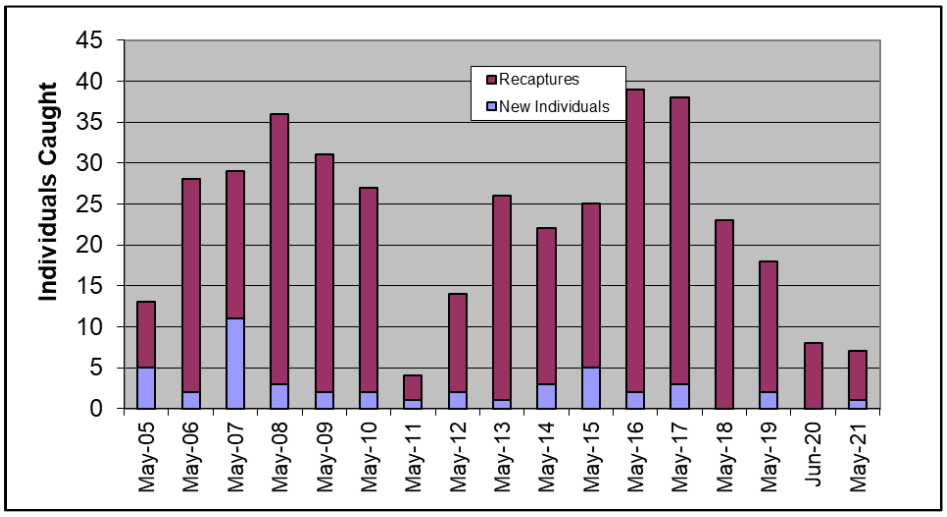

Figure 7. Individual dibblers captured on Whitlock Island in autumn between 2005 and 2021. NB. Surveys in 2009 (3 nights), 2020 (2 nights) and 2021 (3 nights) were curtailed due to sea conditions.

On Whitlock in May 2021, a total of seven individuals (4M:3F) were captured over 120 trap nights (Figure 7). Capture success was 5.8 individuals per 100 trap nights. One

new individual (a female) was captured. One female had seven PY, one had four PY and the third was released before its pouch could be checked.

In October 2021, trapping on Boullanger Island resulted in the capture of 19 individuals (9M:10F), including 13 new animals, over 250 trap nights (Figure 8). Capture success was 7.6 individuals per 100 trap nights, a strong increase from rates below 3 per 100 trapnights seen over the last two years. All five recaptured females showed signs of having bred in 2021.

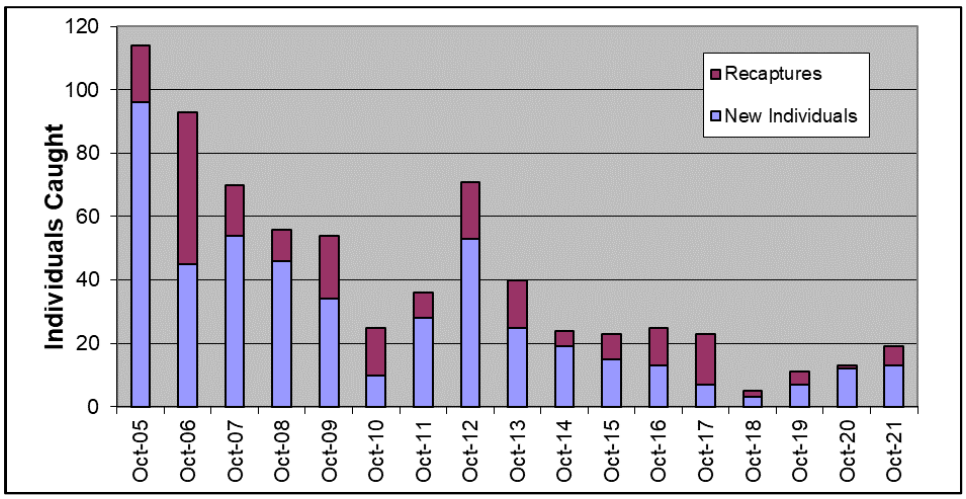

Figure 8. Individual dibblers captured on Boullanger Island in spring between 2005 and 2021. NB. Survey in 2021 (2 nights) was curtailed due to sea conditions.

Spring trapping on Whitlock Island in October 2021 resulted in the capture of 11 individuals (3M:8F), including eight new individuals (all subadult), over 80 trap nights (Figure 9). Capture success was 13.8 individuals per 100 trap nights. All three recaptured females showed signs of breeding in 2021.

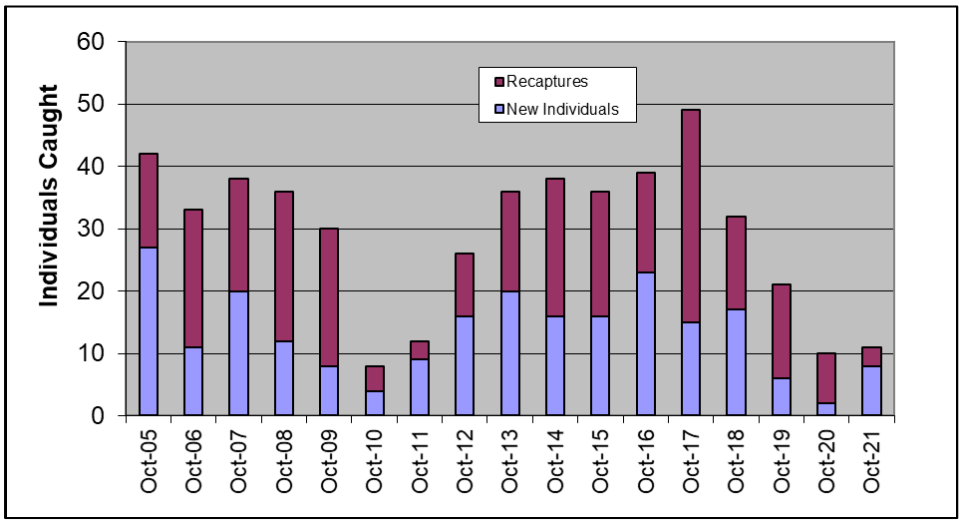

Figure 9. Individual dibblers captured on Whitlock Island in spring between 2005 and 2021. NB. Survey in 2021 (2 nights) was curtailed due to sea conditions.

3.5.2 Escape Island

Trapping on Escape Island in March 2022 resulted in the capture of 93 individuals (29M:64F), of which 49 were new, over 400 trap nights (Figure 10). Of these new animals, 18 (5M:13F) were adults and when added to the animals captured in December 2020 gives an overall 'known to be alive' (KTBA) statistic of 91. Capture success in 2022 was 23.3 individuals per 100 trap nights. Unfortunately, one (recaptured) female was found dead in a trap on the first morning, likely due to thermal stress as the trap had been set on the sunny side of a shrub.

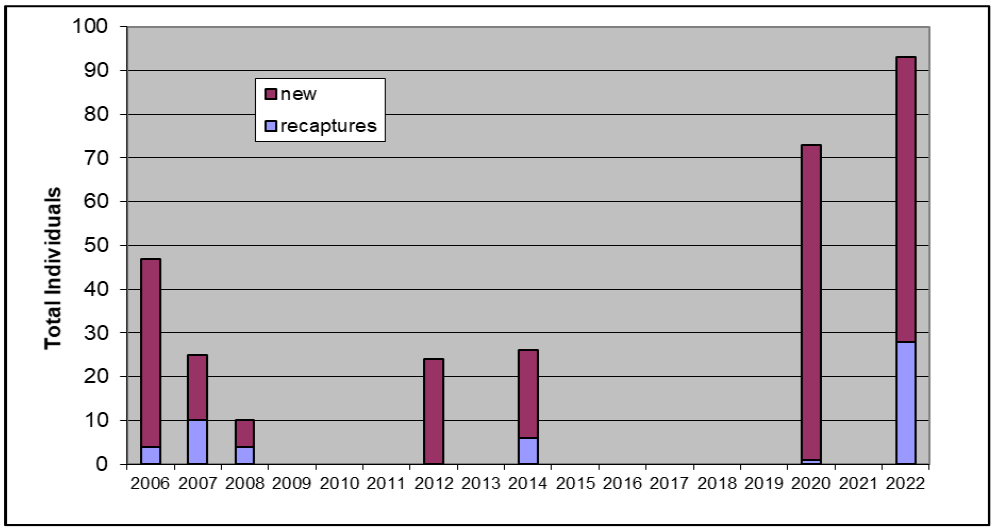

Figure 10. Individual dibblers captured on Escape Island during standard monitoring sessions between 2006 and 2022.

One interesting result from the March 2022 trapping on Escape was the strongly biased sex ratio, with a greater than 2:1 ratio of females to males. This difference was also reflected in the timing of captures, with relatively few males captured on the first night of trapping, compared to the following three nights (Figure 11). This likely reflects differences in behaviour between the sexes, possibly relating to the onset of the breeding season (compared with trapping sessions in December or January when even sex ratios have been recorded).

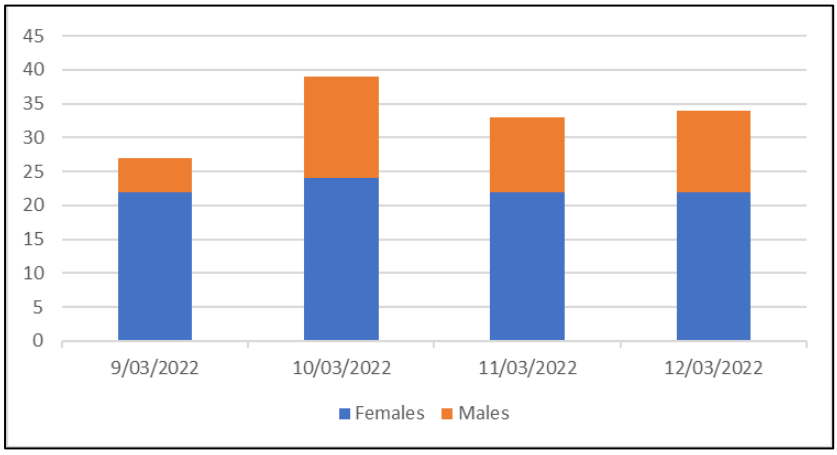

Figure 11. Numbers of male and female dibblers captured on each night of trapping on Escape Island. Repeat captures of dibblers during the session are included.

3.6 Western grasswren

Monitoring attempts for western grasswrens could only be done in areas of Hamelin which logistically allowed for multiple visits as quantifying reproductive success is a slow process (Figure 12). As such, areas such as the north-east corner of Hamelin were ignored for this season due to long travel times to that area. The west boundary of Hamelin has been identified as a new area that contains an abundance of grasswren habitat and strong evidence of occupancy by grasswren individuals in 2021 (Figure 12). Trapping efforts for this season resulted in 49 new captures, with 26 of those captures being adults.

Previous population estimates for the western grasswren in Shark Bay have varied considerably, from 40,000 (Brooker 1998) to 21,500 (Garnett and Crowley 2000). As part of the ongoing PhD study by A. Gibson Vega, an estimate of 'effective population size' (*Ne*; essentially an estimate of the number of reproductive individuals in a population that are passing on their genes) has been derived using genetic data. This estimate has then been used to extrapolate a conservative population estimate, as *Ne* is typically assumed to be 10% of the census population. This resulted in an estimate of 2,500-12,680 birds at Peron and 990-1,790 at Hamelin, with a combined estimate of 3,540-14,470.

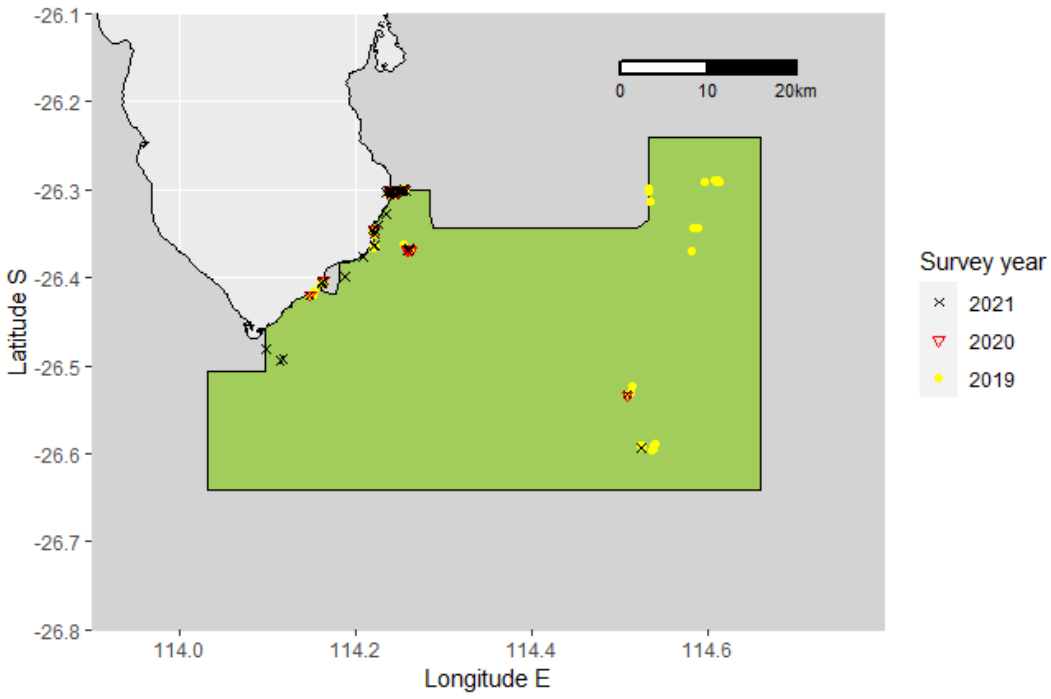

Figure 12. Western grasswren areas which were monitored and captured or grasswrens were opportunistically seen over 2019, 2020 and 2021 at Hamelin Station Reserve (green). Note that much of the middle of Hamelin was not able to be checked for the presence of grasswrens due to time constraints.

3.7 Heath mouse

Despite a total of 1,250 trap nights across sites in the Ravensthorpe Range and ‘Location 1040’, no heath mice were recorded. Small numbers of other native rodents were captured, with 18 bush rats (*Rattus fuscipes*), five western mice (*Pseudomys occidentalis*) and two ash-grey mice. House mouse was the most abundant mammal but only 33 individuals were captured.

3.8 Rainfall at monitoring sites in 2021

3.8.1 Shark Bay

Remote weather stations have been established by DBCA on Bernier, Dorre and DHI. Bernier Island received 204mm of rain in 2021, Dorre received 521mm and DHI received 323mm. Carnarvon Airport received 420mm (annual average 223mm and Shark Bay Airport received 285mm (annual average 209mm) (Bureau of Meteorology, 2022). Overall, rainfall in Shark Bay in 2021 was above average, with Dorre Island receiving some particularly heavy falls (e.g. 229mm on 5 February and 104mm on 29 May).

3.8.2 Pilbara islands

The nearest weather station to the Montebello Islands is on Barrow Island (~50km from Northwest Island). Annual rainfall at Barrow in 2021 was 386mm, compared to 146mm in 2020 and a mean of 271mm (Bureau of Meteorology, 2022).

3.8.3 Jurien Bay

Complete annual rainfall totals were unavailable for the Jurien Bay weather station in 2021. However, Nambung Station (35km away) recorded 703mm in 2021, which was above the annual mean, and Lancelin (Defence) (62km away) recorded 771mm (Bureau of Meteorology, 2022).

3.8.4 Central South Coast

Annual rainfall for Ravensthorpe (Carlingup) in 2021 was 416mm, compared to 296mm in 2020 and the mean of 408.3mm. Rainfall at Jacup (near Jerramungup) in 2021 was 600mm, compared to 430mm in 2020 and the mean of 441mm (Bureau of Meteorology, 2022).

4 Discussion

4.1 Shark Bay bandicoots

4.1.1 Population estimates and dynamics

Only the Bernier Island population of SBB was monitored in 2021 and abundance estimates for this population have been quite variable since 2017 (Figure 2). The population estimate for 2021 was substantially lower than for 2020, but unfortunately the low capture numbers resulted in a poorly fitted SECR model and the confidence intervals for this estimate were quite broad. As for other species of mammals that occur on Bernier and Dorre Island, abundance appears to be strongly linked to rainfall (Chapman *et al.* 2015). Bernier only received 128mm in 2019 and 116mm of rain in 2020 (Sims *et al.* 2020, Sims *et al.* 2021), compared to 204mm in 2021. In addition, numbers of boodies were comparatively high in 2021, and this species' 'trap happy' behaviour may have contributed to lower capture success for other species such as SBB and SBM.

Relatively low rainfall and interference by boodies are likely to be the main reasons why the population estimate for SBB on Bernier declined in 2021. The last cohort of SBB to be harvested from Bernier were 27 individuals translocated to DHI in September 2020 and this survey was the first after this took place. At the time, this cohort represented just ~1% of the lower confidence limit of the population estimate for Bernier. Therefore, it is very unlikely that a harvest of this size would have had a measurable impact on the Bernier population, particularly as there was a marked increase in the population estimate after the 2019 translocation of 20 individuals to DHI. It is postulated that the return to relatively average rainfall on Bernier Is in 2021 will precipitate an improvement in the population size and capture rate of Shark Bay bandicoots in the April 2022 monitoring.

4.1.2 Disease

No signs of BPCV1 or other pathogens were observed in any captured SBB in 2021 on Bernier Island. However, the number of animals caught was relatively low compared with some previous years (e.g. 14 in 2020), so consequently the sample size was quite small. Historically, higher prevalence of BPCV1 lesions has been associated with higher population numbers and is likely linked to higher stress levels when population density and intraspecific competition is also high. Future surveys will continue to monitor for symptoms of potential pathogens, including BPCV1.

4.2 Boodies

The population estimate for boodies on Bernier was the highest recorded in the period 2016-2021 and there has been a clear trend of steadily increasing numbers over this time. Boodie populations on both Bernier and Dorre Islands tend to fluctuate with natural variations in rainfall (Short and Turner 1999, Chapman *et al.* 2015) but the trend observed on Bernier in recent years appears to be relatively stable. Rainfall on Bernier in 2021 was relatively high, so we may expect this trend to continue or at least

remain steady. However, the summer of 2021-22 was dry (0mm during December to February) so if the population was relatively large coming into this period, it may have exceeded its carrying capacity and be at risk of crashing. Nevertheless, this is speculation and monitoring planned for April 2022 will confirm if the boodie population on Bernier has remained stable or not.

4.3 Shark Bay mice

The SBM population on Bernier was unable to be monitored adequately in 2021, with just one capture. Consequently, no population estimate could be derived but it appears that numbers were low. This is the second year in a row that low capture success has resulted in no population estimate for this population.

Trends in SBM abundance are similar to other mammal species on Bernier and Dorre Islands, in that they tend to correlate with rainfall. For example, in 2006 and 2009 when boodie capture success was relatively high, SBM capture success was also high (Chapman *et al.* 2015). However, boodies may also confound trapping effort for other species, due to interference with traps, so high numbers may result in lower capture success for SBM. Nevertheless, it is most likely that two lower than average rainfall years in a row (Sims *et al.* 2020, Sims *et al.* 2021) have resulted in low numbers of SBM on Bernier. If this trend continues, harvesting sufficient founders to reinforce the 2021 translocation of SBM from Northwest Island to DHI may be difficult and potentially unsustainable. However, 2021 was a higher rainfall year on Bernier and it is hoped that the vegetation and the SBM population will have recovered sufficiently to permit a harvest of at least 20, and up to 50 individuals.

The trend on Northwest Island, where rainfall was also low in 2020, was quite different with an abundance estimate indicating that the population of SBM was stable at a minimum of 1,500 individuals and could comfortably sustain the proposed harvest of 80 individuals for translocation to DHI which represented only 5% of the lower confidence level for this population. SBM on Northwest Island have no mammalian competitors and this may have played a role in their resilience during a relatively poor rainfall year. Post-translocation monitoring is planned for October 2022 to coincide with the monitoring of other translocated fauna in the Montebello Islands.

4.4 Greater stick-nest rats

The trap success and abundance of greater stick-nest rats on Salutation Island appeared to continue to increase during 2020 and likely reached a peak population in early 2021. The high trap success from the single night of trapping in mid-May 2021 provided confidence to proceed with the harvest of 56 individuals for translocation to DHI. The high trap rate and relatively poor body condition of animals in May 2021 during the monitoring and harvest suggest that the population on Salutation Island was likely reaching its peak density (i.e. approaching carrying capacity) and potentially facing another crash, which this population appears to experience periodically (Short *et al.* 2019). It is possible that the removal of 56 individuals at this time may have alleviated some competitive pressure on the population and assisted survival of remaining individuals. The irruptive cycle of this population is exemplified by the zero-

capture rate in 2018 which has been followed by a steady increase over the subsequent three years to 67 per 100 in 2021. Plans for Gascoyne District staff to carry out follow up monitoring in October 2021 was disrupted by poor weather and logistical issues, but post-translocation monitoring is planned for May 2022.

4.5 Dibblers

The capture rates of dibblers on Boullanger and Whitlock in 2021 suggest that the series of declines in these populations may have halted. Despite curtailed trapping sessions in both autumn and winter, trap success on these islands was higher than in recent years. The relatively high numbers of subadults captured in October may have been a result of above average winter rainfall, but the increase on Boullanger in May (despite only three nights' trapping) is unlikely to relate to this. Hopefully these results are indicative of a recovering population trend and indicates that the small numbers taken from these populations into the captive breeding program at Perth Zoo between 2018 and 2019 (three from Boullanger, 11 from Whitlock) have not had a measurable impact in the longer term. Monitoring planned for May 2022 will confirm if new subadults trapped in October have survived to reproduce.

The population on Escape Island appears to be stable with very similar KTBA values for December 2020 and March 2022. Based on the number of new individuals captured in March, there was a high level of recruitment in 2021 and this may also be related to the above average rainfall. Although monitoring on Escape was planned for January 2022, it was postponed until March and this may not be the ideal time to survey dibblers, based on the strong sex bias observed in the captured animals. Future surveys should be timed for December or January, but with some flexibility to allow for avoidance of periods of high temperatures as was experienced in January 2022.

4.6 Western grasswrens

Over the past three years, ad-hoc surveys for western grasswrens at Hamelin Station Reserve and Peron Peninsula have provided an insight into how widespread and abundant this species is in Shark Bay. In 2021, new locations were identified on Hamelin where grasswrens were present and they appear to occur discontinuously across both areas. During these surveys, grasswren territory occupation appeared to be highly conserved, but are not necessarily occupied by the same birds between breeding seasons.

Previously the population size for this species has been estimated at between 21,500 and 40,000 mature individuals (Brooker 1998, Garnett and Crowley 2000). We used effective population size to extrapolate a census population estimate of 3,540-14,470 (95% confidence intervals), which is substantially smaller. While we acknowledge this is quite a broad estimate, it provides a useful baseline for planning the harvest of grasswrens for translocation to DHI in 2022. Based on these estimates, harvesting ≤5% of the adult population from both Hamelin and Peron would permit at least 50 individuals to be translocated from each site. It is anticipated that such a harvest would not have a measurable impact on either population. However, work done to map

grasswren territories at both Peron and Hamelin can be used as method of monitoring a) what the status of the population is prior to translocation and b) what the impact will be of removal post-translocation. Rates of occupancy of previously occupied territories will be used as a metric of population status and if ≤50% of previously occupied territories are vacant, the translocation may be delayed to allow the population to recover. Pre-harvest monitoring is planned for late August 2022 to coincide with the breeding season, which will also help inform the logistics of the translocation (i.e. when will offspring be mature enough to be translocated).

4.7 Heath Mice

No heath mice were captured during surveys in historical habitat in the Ravensthorpe area, including 'Location 1040' where two individuals were captured in 2019. More surveys for this species are planned for 2022 at other sites where the species occurred historically, e.g. Fitzgerald River National Park and Lake Magenta Nature Reserve. However, the ongoing difficulties in locating any population, let alone one that could sustain a harvest to establish a captive population, indicate that the likelihood of a translocation of this species to DHI within the scope of DHINPERP is low.

4.8 Future monitoring plans

Table 1 shows the currently programmed source population monitoring surveys to be undertaken 2022. It should be noted that these plans may be forced to change to mitigate risks around the transmission of COVID-19, including anthropozoonotic transmission (i.e. human to animal).

Monitoring of the SBM population on Bernier Island is planned for early April 2022 (prior to proposed harvest for translocation in late April/early May). Monitoring of SBM on Northwest Island (post- harvest) is planned for October 2022 to coincide with the monitoring of translocated fauna on other islands in the Montebello Archipelago.

Monitoring (post-harvest) of the Salutation Island population of greater stick-nest rats will be carried out by Gascoyne District PWS staff in May 2022. Pre-harvest monitoring of the populations of greater stick-nest rats on East and West Franklin Islands (SA) will occur immediately prior to proposed translocation from this source in late May 2022.

Further surveys for heath mice are planned for April and May 2022 at sites in and around Fitzgerald River National Park and at Lake Magenta Nature Reserve.

Pre-harvest monitoring for western grasswrens is planned for late August at Hamelin Station Reserve and Peron Peninsula to confirm if the population can sustain a harvest and that juveniles will be likely to be energetically independent of their parents at the time of the planned translocation to DHI in early October.

Surveys for dibblers in October and December may also entail additional harvesting of breeding stock for the Perth Zoo captive colony, but only if the breeding program is planned to continue beyond 2022 and survey results indicate the populations can sustain a harvest.

Table 1. Source population monitoring planned for 2022 calendar year (SBB, Shark Bay bandicoot; SBM, Shark Bay mouse; GSNR, greater stick-nest rat).

Species	Location	Timing
SBB/SBM/Boodie	Bernier Island	April
Heath Mouse	South Coast/Wheatbelt regions	April/May
GSNR	Salutation Island (Gascoyne PWS)	May
GSNR	Franklin Islands	May
Dibbler	Boullanger/Whitlock Islands	May
Western Grasswren	Hamelin Reserve/Peron Peninsula	August
SBM	Northwest Island	October
Dibbler	Boullanger/Whitlock Islands	October
Dibbler	Escape Island	Dec/Jan

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Appendices

Appendix 1 Density and abundance estimates for from trapping data at Dorre (2016-2020) and Bernier Island (2016-2021)

SBB, Shark Bay bandicoot; BB, boodie (burrowing bettong), SBM, Shark Bay mouse

(* Denotes poor model fit (** worse); red text indicates unreliable or no estimate obtained)

1a. 5134ha Dorre Island (habitat area used for calculating abundance ~ 4815ha)

Species	Year	N	Density/ha	SE	LCL density	UCL density	Mean popn	LCL popn	UCL popn
SBB	2016	16	1.03	0.32	0.56	1.87	4939	**2705**	9018
SBB	2017	16	1.25	0.35	0.73	2.16	6041	**3511**	10394
SBB	2018	16	1.14	0.31	0.68	1.93	5503	**3261**	9288
SBB	2019	19	1.20	0.30	0.74	1.95	5788	**3573**	9376
SBB	2020	24	1.34	0.27	0.95	2.04	6445	**4598**	9833
BB	*2016	12	1.26	0.55	0.55	2.86	6053	**2664**	13755
BB	2017	12	0.91	0.29	0.49	1.69	4382	**2365**	8118
BB	2018	14	0.76	0.26	0.40	1.45	3672	**1935**	6966
BB	2019	16	0.94	0.26	0.56	1.60	4539	**2674**	7705
BB	2020	24	1.15	0.24	0.81	1.80	5559	**3904**	8679

1b. 4267ha Bernier Island (habitat area used for calculating abundance ~ 3750ha)

Species	Year	N	Density/ha	SE	LCL density	UCL density	Mean popn	LCL popn	UCL popn
SBB	**2017	8	0.64	0.39	0.21	1.93	2397	**792**	7253
SBB	2018	15	1.25	0.38	0.69	2.24	4675	**2596**	8418
SBB	*2019	7	0.50	0.21	0.23	1.10	1868	**849**	4109
SBB	2020	14	1.13	0.38	0.59	2.15	4244	**2228**	8054
SBB	**2021	8	0.31	0.17	0.11	0.86	1150	**409**	3232

Species	Year	N	Density/ha	SE	LCL density	UCL density	Mean popn	LCL popn	UCL popn
BB	**2016	5	0.32	0.44	0.04	2.43	1213	**161**	9128
BB	*2017	7	0.54	0.23	0.24	1.20	2029	**912**	4515
BB	2018	8	0.58	0.22	0.28	1.18	2177	**1067**	4443
BB	2019	10	0.78	0.28	0.39	1.55	2910	**1453**	5828
BB	2020	14	0.77	0.19	0.51	1.32	2869	**1931**	4960
BB	2021	21	1.06	0.28	0.62	1.76	3967	**2340**	6589
SBM	**2016	7	1.55	2.28	0.19	12.72	5458	704	47692
SBM	*2018	8	0.33	0.23	0.10	1.13	1251	**369**	4238
SBM	*2019	11	1.42	0.84	0.49	4.16	5335	**1823**	15614
SBM	2020	3	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a
SBM	2021	1	n/a	n/a	n/a	n/a	n/a	**n/a**	n/a