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A Six-Month Progress Report for

PROJECT PHELSUMA

Supporting the long-term survival of the Critically Endangered *Phelsuma antanosy* in Sainte Luce, southeast Madagascar

October 2024

1 Summary

1.1 Context

Sainte Luce is the largest remaining stronghold for the *Phelsuma antanosy*, a Critically Endangered species of day-gecko, endemic to southeast Madagascar (Jenkins, Randrianantoandro, & Ramanamanjato, 2011). The littoral forests of Sainte Luce host three of the four remaining subpopulations of *P. antanosy*, with the fourth subpopulation located in the forests of Ambatotsirongorongo, 50km southwest of Sainte Luce. Sainte Luce consists of just under 1,600 hectares of isolated forest fragments. Presently, the largest subpopulation of *P. antanosy*, around 3,500 individuals, exists within the Sainte Luce littoral forest (SLLF) fragment known as S7, from which, resource extraction is permitted due to its designation as a Community Resource Use zone. In contrast, very few individuals inhabit the protected SLLF fragments of S8 and S9.

The decline of *P. antanosy* populations has previously been attributed to deforestation and habitat fragmentation, however, the population in Sainte Luce is also threatened by proposed mining operations. S7 is situated within a prospective ilmenite mining zone, as such, the forest fragment and much of the surrounding landscape could be cleared as early as 2027. This would likely result in the loss of 80% of the global population of *P. antanosy*, highlighting a critical need for intervention. Considering *P. antanosy's* highly restricted distribution, ecological specialisation, and the threat of habitat loss, urgent conservation action is required to ensure the species' long-term survival.

1.2 Project Overview

Since January 2024, three months prior to the project's official inception in April 2024, Project Phelsuma conducted comprehensive ecological research of *P. antanosy*, building on SEED Madagascar's (SEED's) previous research on the species (Pointer et al., 2024). Project Phelsuma involves the development and dissemination of scientific research articles, and an IUCN Red List[1] re-assessment aiming to raise international awareness of *P. antanosy*. A trial translocation study will be conducted in Sainte Luce in early 2025, with a small number of *P. antanosy* individuals being moved from the unprotected forest fragment of S7 to the protected forest fragment of S9 (IUCN Cat. V) (Figure 1). A robust translocation protocol will be developed for *P. antanosy*, including a methodology developed from international best practice and local knowledge, and refined by learnings from this study. As *P. antanosy* are encountered predominantly on *Pandanus longistylus* in Sainte Luce (Pointer et al., 2024), a pilot transplantation of the screw pine *Pandanus longistylus, P. antanosy*'s host plant, will take place in S9 to increase habitat availability at the release site. These research activities will inform future conservation ambitions for at-risk *P. antanosy* subpopulations.

[1] IUCN Red List: **International Union for the Conservation of Nature** (IUCN) **Red List of Threatened Species** is an inventory of the global conservation status and extinction risk of biological species.

Figure 1: Map showing all remaining habitat of P. antanosy *and presence/absence within forest fragments on the southeast coast of Madagascar. Bemanasa hosts the only* P. antanosy *subpopulation on the Ambatotsirongorongo massif, while roughly 50km northeast in Sainte Luce, fragments S7, S8, and S9 host three subpopulations.*

1.3 Report Overview

This report covers progress made during the first six months of Project Phelsuma, from April 2024 to September 2024. Additionally, it incorporates relevant data collected during the three months leading up to the project's official inception. Over this period, SEED has made significant progress towards Outcome 1, enhancing scientific understanding of the *P. antanosy* species, and begun working towards Outcome 2 to develop a five-year *P. antanosy* translocation strategy.

In order to study the density and territorial behaviours of *P. antanosy*, the locations of 181 individual geckos (both Phelsuma antanosy and other Phelsuma species) have been mapped during ecological surveys. A cross-visit was conducted to the only other known population of *P. antanosy* outside of Sainte Luce, the Ambatotsirongorongo massif, where population and density estimates for this forest were made and differences in host-plant preferences by sub-population were identified. Capacity of the team to facilitate the translocation has been strengthened via local knowledge exchanges and online meetings with international experts. A pilot transplantation of *P. longistylus* has been conducted to expand available habitat for *P. antanosy* within S9. Intensive research into appropriate translocation methodologies has begun, with information on stress-minimising practices, the quality of release sites, and post-translocation monitoring, informing Project Phelsuma's proposed translocation methodology. Lastly, during this reporting period a novel computer-aided monitoring software has been trialled to assist with the identification of individual geckos.

2 Activity Detail

2.1 Background

Since 2017, data has been collected on all reptile and amphibian species found in Sainte Luce as part of the SEED Herpetofauna Long-Term Monitoring programme. As part of SEED's Conservation Research Programme (SCRP), the team have collected non-invasive data via distance sampling along 16 established transects in four littoral forests fragments in Sainte Luce (S7, S8, S9, and S17). As of September 2024, 639 transect surveys were conducted with a total of 387 observations of *P. antanosy* since 2017. These data have provided *P. antanosy* population estimates for each of the forest fragments. The current estimate for the species total population is 4,150 animals, with 80% of these located in S7 (population estimate for S7 is 3,453). A current population for S9 not possible to estimate due to insufficient observations for population modelling, however, data from the period 2018-2019, suggest a S9 population of 128 individuals at a density of 0.37 animals per Ha.

2.2 OUTCOME 1: Scientific understanding of the *P. antanosy* species is enhanced.

2.2.1 Ecological Research

Figure 2: Male and female Phelsuma antanosy *in S7.*

Since January, under Project Phelsuma, SCRP have been studying the species, identifying 181 geckos through two types of ecological survey conducted in Sainte Luce Forest fragments S7 and S9. During both the behavioural and spatial density surveys, age, sex, GPS location, height of *P. antanosy* in a plant, and height and species of the plant, are collected and recorded.

Behavioural surveys are carried out by observing the *P. antanosy* over a 20-minute interval with notes being made on any behaviours seen, such as foraging, basking, and any inter- or intra-species interactions. Results from behavioural surveys found that *P. antanosy* were on *Pandanus* plants 90.6% of the time, on *P. longistylus* 65.6% of the time, on *Pandus dauphinensis* 21.9% and the remaining time on unidentified *Pandanus* species. The main

behaviours observed were similar for male and female *P. antanosy*. The most frequent behaviours observed in males were *travelling* (28.0%), *resting* (12.3%) and *grooming/licking* (4.1%). For females this differed with *resting* (30.0%), *travelling* (24.9%) and *vigilance* (7.0%) the most common behaviours observed. There have been nine observations of *P. antanosy* feeding with prey items including ants (Hymenoptera) and flies (Diptera).

The mean distance travelled in total during a 20-minute survey was 2.05m for males and 1.97m for females. This indicates minimal short-term spatial movement and supports SEED's and other researchers' previous findings suggesting that *P. antanosy* are particularly host-plant-specific with small individual ranges (Pointer et al, 2024; Lehtinen, 2002).

Spatial density data is collected by measuring the distance between *P. antanosy* observed on the same day. It is also collected by measuring the distance that an individual *P. antanosy* has moved, if observed on separate days (re-identified through photograph comparisons). Distances were recorded between different combinations of age and sex categories, both on different and the same *Pandanus* individuals. The mean height of male *P. antanosy* observed in *Pandus* was 1.78m and the median distance from another *P. antanosy* was 5.15m. The closest recorded males were 0.45m apart. Female *P. antanosy* were found in *Pandus* at a mean height of 1.27m and a median of 3.40m from the nearest male.

On some occasions, multiple adult females were found on the same *Pandanus* as one adult male. When multiple *P. antanosy* were observed on the same *Pandanus*, the mean number of adult males and females was three, however, the most common sex ratio of adults on a single *Pandanus* was 1:1.

Mean distances from the nearest adult *P. antanosy* to other *Phelsuma* species were also measured. The greatest mean distance between geckos was to *Phelsuma parva* (10.33m), followed by *Phelsuma modesta* (2.43m), and the shortest mean distance was between *P. antanosy* and *Phelsuma lineata* (1.81m).

Both behavioural and spatial density surveys of *P. antanosy* will continue until the end of the Project, in March 2025. Findings will be shared with local stakeholders, and will be used to inform regional, national, and international audiences about the ecology of *P. antanosy*.

2.2.2 Conservation Status Reassessment

In September 2024, a four-day cross-visit to Ambatotsirongorongo massif, 50km southwest of Sainte Luce (Figure 1), was conducted as this is the second, and only other, remnant habitat for *P. antanosy.* Two forest fragments within this habitat, *Grand Lavasoa* and *Bemanasa*, were surveyed for *P. antanosy*. Spatial density and behavioural surveys identified 45 *P. antanosy* individuals in *Bermanasa* with no *P. antanosy* found in *Grand Lavasoa*. These data will be used to supplement the spatial density and behavioural data that have been collected in Sainte Luce to date.

Following the cross-visit, population and density estimates were calculated. It was estimated that within the 33Ha forest fragment of *Bemanasa*, there were 360 *P. antanosy*, with individuals found at an estimated density of 11.14 *P. antanosy*/Ha. Data from both Sainte Luce and *Bemanasa* in the Ambatotsirongorongo massif will be collated into an updated census for the species and used in a reassessment of *P. antanosy's* IUCN Red List threat category.

2.3 OUTCOME 2: A five-year *P. antanosy* translocation strategy is developed.

2.3.1 Capacity Building

Meetings have been held with herpetologists experienced with reptile translocations for discussions regarding mate selection, habitat quality, and translocation transport vessels.

Mate selection should not be underestimated as male and female from other gecko species, and other lizard species, put substantial effort into mate selection. Artificially establishing/merging pairs is likely to be detrimental to breeding success due to existing selection commitment. In artificially established pairings, individuals are also more likely to disperse as they may be searching for other mates. Collecting and releasing a reproductive unit of one male and two females allows for greatest chance of reproductive success.

Another key recommendation for successful translocation is to maximise the habitat quality at the release sites. This could include creating artificial refugia with cover objects on the *Pandanus*, in addition to ensuring that there are receptacles for collecting fresh rainwater.

Translocation transport vessels may consist of 10-20 cm bamboo tubes, which can be attached to the *Pandanus* stem at the release site allowing the geckos to emerge at their own rate. Each individual should be moved in a separate vessel, following standard practice in the translocations of large invertebrates and iguanas (*Cyclura lewisi*) (Dave Laux, pers comm.). Supplementary feeding, such as papaya fruit pulp, is also highly recommended (Avery Tilley, pers comm.).

The management body of the Ambatotsirongorongo reserve is the Tropical Biodiversity Social Enterprise (TBSE) who collaborate with QIT Madagascar Minerals (QMM) for ecological monitoring and consultation. Both parties agree that the *Phelsuma antanosy* needs to be conserved and recognise the species as a key conservation priority. Both parties have expressed interest in collaborating with SEED so that research and efforts are complementary.

2.3.2 *P. longistylus* Transplantation

A pilot transplantation of *P. antanosy's* host plant, *P. longistylus,* has been conducted to expand available habitat for *P. antanosy* within S9. If the transplantation is successful, translocated *P. antanosy* will be moved to newly established *P. longistylus* groves inside the protected area. Transplantation of *P. longistylus* began prior to the project's April start date, in January 2024. To date, 45 plants have been moved from the unprotected fragment of S7 to the protected fragment of S9. Regular monitoring of the *P. longistylus* has been carried out since their transplantation during which, a condition score from 1-4 is given to each *Pandanus* (Table 1) and a photo is taken to document the condition.

Table 1: Condition score description for monitoring Pandanus

Code	Description
4 – Good	In good condition. Can have brown leaves at the base of the head. Fewer than 5% brown leaves within the head. Black mould not completely covering the base of heads
3 – Fair	Black mould is covering most of the base of the heads. Fewer than 30% brown leaves within the head. (A score of 3.5 can be recorded if it is only marginally below a 4)
2 – Poor	Any heads have fallen off. Majority of leaves on each head are brown. Black mould is fully covering base of heads and parts of stem or leaves. Not able to support itself upright. (A score of 2.5 can be recorded if the plant is only marginally below a 3)
1 – Dead	Dead

Monitoring of the transplanted *P. longistylus* in September indicated that on average, the plants had a 'Fair' condition (mean = 3.15). One *P. longistylus* planted in May had died by September. With only one of the 45 transplanted *P. longistylus* dying post-transplantation, the transplantation effort had a survival rate of 97.8%.

Figure 3: Transplanted P. longistylus *with red label in forest fragment S9.*

2.3.3 *P. antanosy* Translocation

A review of research conducted on day-gecko species in Mauritius (Choeur, Clémencet, Le Corre, Roesch & Sanchez 2023) and Reunion (Buckland et al., 2014) highlights the importance of pre-translocation microhabitat studies of the target species to gain a thorough understanding of their specific microhabitat requirements. This allows for correct choice of translocation site, or, in the case of Project Phelsuma, allows for educated planning for the creation of habitat through transplantation of *P. longistylus*. SEED Madagascar affiliates with recently published results on *Phelsuma antanosy* habitat use (Pointer et al., 2024).

Translocation-induced stress responses are a threat to the success of any translocation. Stresses can come from a variety of sources during the process including capture, captivity, transportation, release procedure, and novelty of the new site (Dickens, Delehanty, & Romero, 2010). Attempts can be made to reduce the number and intensity of stress factors on geckos. These include limiting the length of time spent trying to capture the animal, reducing handling time for biometric measurements and placing the animal in its transport container, and reducing the length of time the gecko has to spend within its transport container to get to the new site. Through communications with herpetologists in New Zealand (Dave Laux pers comm.), it has been advised to use 30-40cm long bamboo tubes to transport the geckos, which can then be attached to the *Pandanus* and left in-situ with one end open. The geckos can choose to leave the shelter at their own pace, which can reduce acute stress from handling and transport. Post-release monitoring through visual encounter surveys are non-invasive methods of monitoring.

Published articles regarding gecko translocations in New Zealand describe the positive effect of soft release (via penning or provision of supplementary shelter and/or food) on geckos to encourage short-term site retention and allow for site habituation (Richardson, 2021). The most commonly reported cause for translocation failure was migration of individuals away from the translocation site due to the insufficient quality of the release habitat (Germano & Bishop, 2009). Although, high activity levels and potential dispersal does not necessarily indicate

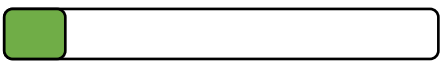
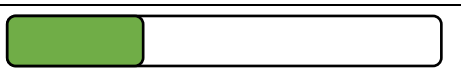
insufficient quality of the release site as it could also be due to geckos searching for familiar environmental cues or exploring their new habitat (Van Winkel, 2008).

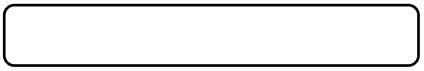
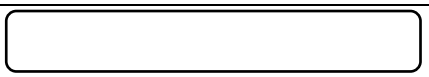
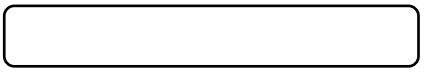
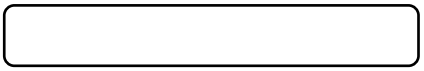
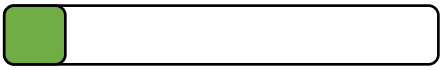
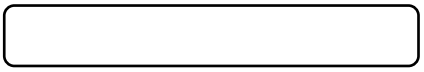
There are a variety of sampling techniques available for post-translocation monitoring of herpetofauna. Care must be taken to select the most appropriate method for the study species and to ensure the specific aims and objectives of the monitoring programme are upheld (Van Winkel, 2008). Sampling techniques include pitfall traps, funnel traps, artificial cover objects (ACOs), drift-fences, and visual searching (Lettnick, & Monks, 2012). In recent years, tracking tunnels (originally used for pest monitoring) have been added to the array of sampling techniques for herpetofauna (Jarvie & Monks, 2014). These are useful for cryptic geckos as they are non-invasive in the habitat and provide refuge and food rewards (such as banana) to the geckos (Van Winkel, 2008). Due to the tendency of *P. antanosy* to live in *P. longistylus* or other *Pandanus* species, most of these techniques are not applicable, with visual searching being the most appropriate. In the instance of *P. antanosy* dispersing from the translocation site, tracking tunnels can provide an opportunity to survey whether the geckos are still within the vicinity. This would require a visual understanding of the differences between footprints of the four day-gecko species that can be found within the SLLF.

With this research considered, Project Phelsuma is developing a translocation strategy to move a small number of geckos from S7 to S9 in March of 2025.

3 Progress of Activities

Complete or in progress and on track	In progress with slight challenges	In progress with serious challenges

Activity 1.1.1 Conduct microhabitat surveys of *P. longistylus* to determine *P. antanosy* habitat availability.	
Activity 1.1.2 Conduct research of *P. antanosy* behaviour and life history.	
Activity 1.1.3 Develop a scientific research paper for submission to publication.	
Activity 1.2.1 Map the *P. antanosy* population distribution in Sainte Luce.	
Activity 1.2.2 Conduct demographic analysis to assess *P. antanosy* population abundance in Sainte Luce.	
Activity 1.2.3 Review current species threats and conservation efforts.	
Activity 1.2.4 Complete a cross visit and collaborate with stakeholders in Ambatotsirongorongo forest.	
Activity 2.1.1 Conduct meetings with local and national stakeholders to share knowledge of translocation best practice and inform project activities.	
Activity 2.1.2 Conduct research of international best practice for conservation translocation.	

Activity 2.2.1 Identify *P. antanosy* release sites in S9.	
Activity 2.2.2 Conduct *P. longistylus* transplantation trials.	
Activity 2.2.3 Supplement *P. antanosy* habitat at release sites.	
Activity 2.3.1 Secure a 6-month herpetological translocation permit.	
Activity 2.3.2 Complete a translocation feasibility and risk assessment.	
Activity 2.3.3 SRCC review pilot translocation methodology.	
Activity 2.3.4 Conduct a pilot translocation study of P. *antanosy* individuals from S7 into S9.	
Activity 2.3.5 Conduct post-release monitoring of translocated individuals.	
Activity 2.3.6 Develop a translocation protocol and release strategy.	
Activity 2.3.7 Complete a technical and ethical review of the translocation protocol by external conservation researchers and bodies.	
Activity 2.3.8 Develop a scientific research paper for submission to publication.	

4 Monitoring, Evaluation, and Learning

Novel use of computer-aided photograph identification software (Interactive Individual Identification System - I3S) has been trialled for use in Project Phelsuma. Each survey area was visited two to three times throughout one week and when a gecko was located, photographs of the gecko's dorsal area (back) where taken for use in I3S. Selection of *P. antanosy's* dorsal area stems from their unique red marking on their back surface which are easily seen in photographs and act as a great tracking marker to be utilised by I3S. Over the course of several revisits, photos of the same geckos were taken when possible. To trial the software, photos from the first record were uploaded to build the software database, and afterwards, any photos taken on subsequent days were run through the programme to test whether the software could identify the 'unknown' gecko. The programme compares the markings on each *P. antanosy*, within a designated 'zone of identification', and ranks the likelihood of the unknown gecko existing within the database. While final decision of matching relies on the user, this software provides a rapid method of re-identifying individuals post-translocation, during follow-up monitoring. Overall, it will enable monitoring to be conducted more efficiently. This would be particularly helpful, if many individuals were to require monitoring, as the software allows for comparisons of hundreds of images.

Post-translocation monitoring will assess the trial translocations success and gain an understanding of the acclimatisation rates of *P. antanosy* post-translocation. Researchers and local guides will return to the release site(s) and conduct presence and absence monitoring to confirm the continued survival of translocated *P. antanosy*. With the individual being translocated on day 0, monitoring will occur on days: 1, 2, 4-5, 8-10, 15-16, and 25. Following this, monitoring will occur quarterly, up to and including, the next breeding season during the austral summer.

5 Next Steps

During the next six months of Project Phelsuma (October 2024 – March 2025), SEED will continue to work towards achieving the two project outcomes of enhancing the scientific understanding of the *P. antanosy* species and developing a five-year *P. antanosy* translocation strategy. The next steps include ongoing data collection and consolidation to inform the translocation methodology, followed by a review and approval by the SRCC. Monitoring of the transplanted *P. longistylus* will continue to ensure the established grove forms a release habitat of suitable size and quality for translocated *P. antanosy.* Prior to the translocation, up to 20 individual *P. antanosy* will be identified as suitable for translocation in terms of age, sex, and health condition. Post-translocation, all *P. antanosy* moved from S7 to S9 will be regularly monitored for survival, dispersal, health, and reproduction using both visual observation and I3S computer-aided photograph identification software. Population and density data collected in Ambatotsirongorongo massif will be combined with data from Sainte Luce, and will feed into a robust species status review, and will be submitted to the IUCN as part of a Red List re-assessment. A paper regarding the population and conservation status of *P. antanosy* will be submitted to an academic journal for publication.

Considering all data currently available, it is becoming apparent the most suitable time to translocate *P. antanosy* is following their breeding season (November – March). As such, Project Phelsuma has provisionally scheduled the trial translocation to occur at the end of March 2025. This date will allow the project to collect a full year of ecological data on *P. antanosy* before deciding to conduct the translocation. Therefore, it will ensure as much information is known about the species life cycle, feeding, breeding, and dispersal as possible, so the translocation methodology can be adapted to promote the highest chances of success. Given this timeline, it is likely Project Phelsuma will extend beyond its initial one-year timeframe, to ensure adequate post-translocation monitoring of *P. antanosy* in the release habitat.

6 Conclusion

Project Phelsuma is on track to achieve its primary objectives. Ecological research has been conducted in the form of behavioural and spatial density surveys to enhance scientific understanding of the species. A cross-visit has been conducted to the Ambatotsirongorongo sub-population, providing population and density estimates and a better understanding of host-plant relationships. This data will be feed into a species IUCN Red List reassessment, where a census of *P. antanosy's* population will be detailed to improve international knowledge of the species. Capacity of the project team to conduct a translocation has been developed via local learning exchanges and meetings with international conservation experts. To date, 45 *P. longistylus* have been transplanted from S7 into S9 to increase habitat availability for *P. antanosy* at the release site, with a 97.8 % survival rate of transplanted *P. longistylus* to date. Research into international best practice of translocation is informing the development of the *P. antanosy* translocation methodology, which, will continue to be refined by primary data findings and secondary literature reviews throughout the remainder of the project. I3S, a computer-aided identification software, has been trialled to increase the efficiency and accuracy of pre- and post-translocation monitoring efforts. So far, the software is proving highly reliable at identifying individual geckos. While a project extension is likely to improve the validity of post-translocation monitoring data and ultimately determine if the translocation has been successful, the project as per the original outcomes, is set to be completed within the initial project timeframe.

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