

Mitigating habitat loss by artificial egg laying sites for Reunion day gecko *Phelsuma borbonica*, Sainte Rose, Reunion Island

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SUMMARY

During the construction of a water storage tank for a hydroelectric plant, areas of natural habitat of the Reunion day gecko were destroyed by embankments of deposited excavated material. To offset this impact and encourage the gecko's return, 40 artificial egg laying site (AELS) were established in the area between September 2009 and July 2010. An AELS provides the gecko with a site for oviposition, shelter and basking. Since their installation, the number of AELS used for reproduction increased from 11.8 % (4/34) in June 2010 to 20% (8/40) in September 2011. Also, the number of eggs has progressively increased: 10 in June 2010, 23 in September 2010, 36 in March 2011 and 41 in September 2011.

BACKGROUND

The endangered Reunion day gecko *Phelsuma borbonica* is endemic to the South West Indian Ocean, with one subspecies that is endemic to Agalega Islands (*P. b. agalegae*) and two others that are endemic to Reunion Island (*P. b. mater* and *P. b. borbonica*). *P. borbonica* is considered an Endangered species by the IUCN in Reunion Island (IUCN France & MNHN 2010), based on the size of the area of occupancy (< 500 km²), the severely fragmented distribution and the continuing decline in the extent and quality of the habitat.

On this island, hydroelectricity represents 25 % of total energy consumption. Several hydroelectric generating stations are operating; one of them is the Sainte Rose, located in the south-east, in the middle of a well preserved tropical rainforest which supports a *P. borbonica* population. This hydroelectric plant was supplied by three water storage tanks (diameter 46 m; height 18.42 m). To adapt the generation output to meet increased daily energy demands, a fourth tank has been built

with the same dimension as the others; construction beginning in 2008. Ground preparations to accommodate this fourth tank required the excavation of about 50 000 m³ rock. Material from the excavation was deposited on degraded pioneer vegetation, where excavated material had previously been deposited between 1978 and 1980 from the construction of the three first tanks. An area of about 9,000 m² was impacted by the new embankments of deposited material which was used to create six terraces. To offset biodiversity losses, two measures have been adopted by the plant operator on the impacted area. The first was to restore natural habitat by planting 22,000 native plants from 50 species. The second was to install artificial egg laying site (AELS) for *P. borbonica*, to encourage its return. A monitoring programme was established for the AELS with two main objectives: firstly to test the effectiveness and the attractiveness of AELS for gecko reproduction, and secondly to assess whether AELS can lead to re-colonization of the



Figure 1. *P. borbonica* AELS installed on a terrace and (inset) details of the top. (Photo: M. Sanchez)

restored area by the gecko. This case study describes the establishment of AELS and the first year's monitoring results.

ACTION

Study site: The hydroelectric plant is located 4 km from Sainte Rose city, in the heart of the National Park, at about 800 m elevation. Tropical rainforest vegetation dominates the area with three identified natural habitat types (Lavergne 2009): windward sub-montane rainforest, Pandanus sub-montane wet thicket and pioneer grassland dominated by herbaceous species.

Species study: *P. borbonica* is a diurnal, arboreal gecko, which mainly lives in native forest. Breeding occurs throughout the year. Females lay one or two calcareous eggs (9-13 mm x 10-14 mm) which are glued on the nesting site (Probst 2002). Communal oviposition sites are common and can contain more than hundred eggs stuck together (Probst & Deso 2001, Probst 2002). In natural habitat, eggs are laid in trees or in rock crevices. Eggs can also be glued on wooden structures such as huts, picnic tables, electric poles, boxes and postboxes, or metallic tubes and pluviometers. Along roads, metal poles supporting road signs or advertisements are frequently used as gecko

shelters and egg laying sites (Probst 1995). Several clutches can be glued to one pole.

Artificial egg laying site provision and placement: Between September 2009 and July 2010, 40 AELS were placed across the whole of the embankment area: on six terraces and on the forest edge (the minimal distance between two poles is around 3 m).

AELS are rectangular galvanized metal poles (height 250 cm; cross section 4 x 8 cm) commonly used to support road signs (Fig. 1). The AELS top is closed by a plastic plug into which two round holes are drilled to allow geckos entry and prevent forest birds from being trapped inside. The plugs are removable for monitoring. The poles are driven into the ground to 50 cm deep. Each AELS costs around US \$70.

Artificial egg laying site monitoring: A first survey was conducted on the 18th of June 2010, when 34 AELS were installed. After installing all the AELS, monitoring was undertaken on the 21st of September 2010, the 15th of March 2011 and the 30th of September 2011. Each AELS was checked with a lamp to determine the presence of geckos or eggs. Clutches were photographed in order to distinguish eggs dating from the previous survey (even hatched, fragment of yellowish calcareous shell remain) and recent eggs (white pure color). Unfortunately, the design of the AELS does not permit the easy recording of eggs; as observation is from the top, eggs towards the bottom may not be seen and therefore hatch status cannot be recorded

Information recorded on the Gecko's found on or in the AELS was: position on the AELS (outside or hidden inside), sex (where possible), and age class estimated by total length measurements: juvenile < 6 cm; sub-adult: 6 – 12 cm; and mature adult: 12 – 20 cm.

CONSEQUENCES

Oviposition in artificial egg laying site: Monitoring in June 2010, indicated at least four AELS (11.8 %) were used by *P. borbonica* as oviposition sites (Table 1); in September 2011, eight AELS were used (20 %). Most of those used are located near the forest edge (1, 2, 3, 6, 7, and 14) (Fig. 2). Only



Figure 2. Sainte Rose hydroelectric plant showing position of tanks, forest habitat, AELS location (square), AELS used by *P. borbonica* in September 2011 (square with cross).

two are on spoil terraces (12 and 30), respectively 12 m and 5 m from the forest's edge. Eggs are deposited deep in AELS, mostly more than 1.20 m from the top (Fig. 3). The number of eggs recorded increased at each monitoring: 10 eggs in June 2010, 23 in September 2010, 36 in March 2011 and 41 in September 2011. Since AELS installation a total of 110 eggs have been recorded. In addition, AELS were found to be re-used by geckos between the monitoring periods: 75% between June and September 2010, 66.6% between September 2010 and March 2011, and 80% between March 2011 and September 2011. Because visual monitoring of eggs is restricted, hatching success cannot be precisely recorded.

However, photographic comparison between two surveys shows that approximately one quarter of the eggs are hatched. In natural oviposition sites, hatching success and neonate sex-ratio are unknown.

AELS occupation by Reunion day gecko: Geckos not only used AELS for oviposition but also for shelter (inside) and thermoregulation by basking (outside) (Fig. 4). Between 1 and 4 AELS were occupied by the species during monitoring (Tab. 2). Usually, these AELS contain eggs, but one adult gecko was recorded inside the AELS without eggs (AELS n°8). Adults mostly occupied AELS;

Table 1. AELS used by *P. borbonica* during monitoring, number of recent eggs, sum of eggs deposited, number of AELS used (sum and %) and AELS reused (%) between two survey.

AELS number	June 2010	Sept. 2010	March 2011	Sept. 2011	Total
1	2	7	15	22	46
2	0	0	0	2	2
3	4	10	12	1	27
6	0	1	0	3	4
7	2	0	7	4	13
12	2	2	0	0	4
14	0	1	1	9	11
30	–	2	1	0	3
Recent eggs	10	23	36	41	110
AELS used	4 (11.76%)	6 (15%)	5 (12.5%)	6 (15%)	8 (20%)
AELS reused	–	3 (75%)	4 (66.6%)	4 (80%)	–

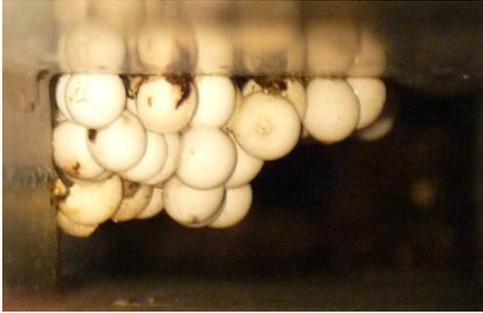


Figure 3. Communal clutches in AELS n°1 in March 2011.



Figure 4. Adult Reunion day gecko emerging from an AELS

no juvenile were observed. Some of the adults present in the AELS were confirmed as females, but because not all individuals were sexed it was not possible to make any comparison between sexes.

Discussion: AELS were rapidly colonized by *P. borbonica*, which used them for oviposition, shelter and basking. AELS were frequently reused by the geckos to deposit more eggs after the first oviposition. Presently, the AELS most frequently used are at the forest edge. In order to monitor hatching success, future AELS design must be modified to allow better access to eggs. AELS can encourage re-colonization by geckos of the restored habitat. However, as *P. borbonica* is an arboreal species, it appears that re-colonisation is enhanced where the AELS is close to native vegetation. Based on this case study, it is considered that AELS could be developed for others *Phelsuma* “egg gluer species”, such as the critically endangered Manapany day gecko, *P. inexpectata*.

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Table 2. Number of Reunion day geckos observed on the outside or inside AELS (A=adult; SA=sub-adult; F=female; M=male).

AELS number	June 2010	Sept. 2010	March 2011	Sept. 2011
1	0	2 (1 SA on, 1 F inside)	1 (A inside)	3 (1 F on, 2 A inside)
3	1 (A inside)	1 (F inside)	0	0
6	0	1 (F inside)	0	1 (F on)
7	0	0	0	3 (1 M, 1 F, 1 A on)
8	0	0	0	1 (A inside)
30	0	1 (A inside)	0	0
Total	1	5	1	8

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